

# RECLAMATION

*Managing Water in the West*

## **2009 Review of Operating Principles and Project Operations**

**Trinidad Lake Project, Colorado  
Great Plains Region  
Eastern Colorado Area Office**

**Draft for Review**



# EXECUTIVE SUMMARY

This 10-Year Review of the Trinidad Project (Project) summarizes activity related to the Operating Principles and Criteria for the period 1995-2004 and responds to specific issues raised by interested parties. Previous Reviews were concluded in 1988 and 1996. Open issues from the 1996 review include: storage of winter water in the irrigation capacity, development of a real-time irrigation requirement, and development of a substitute water supply plan to implement conditions (d) and (e) of H.D. No. 325.

The Operating Principles were amended six times in the period 1995-2004. Three of these were temporary amendments allowing stock watering at rates greater than five cfs during the non-irrigation seasons of 1998-1999, 2001-2002, 2002-2003; the last two of these also included provisions for verifying that the acreage irrigated was less than 19,717 acres. The 1996 permanent addressed an increase in the allocated capacity of Trinidad Reservoir to 125,967 acre-feet, and assignment of the increased capacity to the permanent fishery pool. The 1997 Amendment addressed change of use to municipal and industrial (M&I), and removal of land classification requirements. The 2004 amendment addressed several items, including a permanent seasonal stock watering limitation of 1,200 acre-feet with no flow rate requirement, alteration, a 'clean up' of the water rights, acreages, acreage verification system (AVS), and water rights changes from the Model Land & Irrigation Company to Colorado State Parks.

A mass balance analysis of the Trinidad and Thatcher gages (above and below the project) shows no negative impact from the project. The project may have a slight positive impact on downstream users, as compared to pre-project conditions.

Conclusions and Recommendations of this review are:

- While the Trinidad and Thatcher gages are sufficient to analyze downstream impacts of the Project, an additional gage would be very helpful. Two locations have been suggested, one just below the Hoehne diversion, and another near the Highway 350 bridge.
- The standardized AVS should be used to improve acreage reporting and increase confidence of other parties in the District's operations.
- Use of the AVS, improved canal gages, the U.S. Geological Survey loss study, and improved irrigation practices should result in a usable real-time irrigation requirement.
- The model made available as part of this review needs further development to extend the period of record and document data needs.
- Damaging flows may occur lower than previously thought. Results of an ongoing channel capacity study will need inclusion in the Operating Principles.
- The Operating Criteria use two terms that need definition, "transportation efficiencies" and "improved facilities."

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# INTRODUCTION

The Trinidad Project (Project) was authorized for construction by the Corps of Engineers (Corps) under Public Law 85-500 (85<sup>th</sup> congress S-3910 July 3, 1958, as described in H. Doc. 325 84<sup>th</sup> Congress, 2d session, January 1956) as a multipurpose project including flood control, irrigation, fish and wildlife preservation, and recreation. The Project includes an irrigation purpose for which the Bureau of Reclamation has a contract with the Purgatoire River Water Conservancy District (District) for repayment of the reimbursable cost allocated to the irrigation purpose.

The irrigation portion of the Project was constructed to provide a more reliable source of water for lands within the project area that had been irrigated since the 1860s. The Project lands included areas served by eleven different ditches and extend about 25 miles downstream of the City of Trinidad on either side of the Purgatoire River. The District was organized to provide overall management of the Project water supply and for the purpose of contracting with Reclamation.

Reclamation developed operating principles as part of its irrigation report with an objective to operate the Project in such a manner as to secure the greatest benefits from the available water supply consistent with the laws and policies of Colorado and the United States, including the Arkansas River Compact between Colorado and Kansas. The Operating Principles include a requirement for a periodic review of the operating Principles and Project operations.

Article VI. of the Operating Principles, Trinidad Dam and Reservoir Project, provides that the “Operating Principles may be subject to review and amendment not more than once a year at the request of any of the parties’ signatory; provided, that at least one review shall be accomplished within the first 10 years following completion of the Trinidad Dam and at least one review be accomplished every 10 years thereafter. The primary object of such reviews will be obtaining optimum beneficial use of water as conditions change, operating experience is gained, and more technical data become available.”

Condition No. 4 of Kansas’ Five Conditions requires “That 5 years after beginning operation of the Trinidad reservoir for irrigation purposes, the Operating Principles be reviewed to determine the effect, if any, the operation has had on other Colorado and Kansas water users and the principles amended as necessary. Each 10 years thereafter reviews should be provided with amendments as needed.”

Signatories to the Operating Principles include; the Purgatoire River Water Conservancy District, the State of Kansas, the Arkansas River Compact Administration (ARCA), the Army Corps of Engineers (Corps), and Reclamation.

## PURPOSE OF THIS REPORT

The purpose of this report is to:

1. Document status of the operating principles, including activities that have occurred during the 10-year period related to the operating principles, and
2. Document the results of the November 1, 1994, thru October 31, 2004, 10-year review of the operating principles and project operations.

## PREVIOUS 10 YEAR REVIEWS AND RECOMMENDATIONS

Reclamation has conducted two previous reviews for the Project. The first review covered the period of 1979 through 1984 and was documented in a 1988 report. A 10-year review was requested by the District in 1994, covered 1985 through 1994 and was documented in a December 1996 report. Conclusions and recommendations from the 1988 review were addressed in the 1996 report and are not restated in this report. A summary of recommendations from the 1996 review which are pertinent to this review are presented below. Responses to the recommendations are given in italics following the recommendations.

## SUMMARY OF 1996 REPORT RECOMMENDATIONS AND ACTIONS TAKEN

- A. Operating Principles do not need to be amended to recognize the practice of transfer of water remaining in storage in the Model right to the joint use pool.

Action Taken: *No action required*

- B. Storage of winter water under the direct flow rights in the irrigation capacity is allowed by the Operating Principles and they should be amended to clarify this.

Action Taken: *The recommendation has not been acted upon by the Parties but it is anticipated that the re-creation of the operational model in this review will allow analysis and resolution of this issue in the future.*

- C. The Operating Principles should be amended to incorporate the enlargement, initial filling, and maintenance of the permanent fishery pool.

*Action Taken: The recommendation was addressed in the 1996 amendment to the Operating Principles.*

- D. The Operating Principles should be amended to allow a rate of release up to the rate of inflow to Trinidad Reservoir for stock water release and the volume limit should be reduced to 1,200 acre-feet.

*Action Taken: The recommendation was addressed in temporary stock water amendments and permanently in the 2004 Amended Operating Principles.*

- E. The Operating Principles should be amended to reduce the total irrigable acreage from 19,717 to 19,499 acres. Land classifications requirements should be deleted and irrigable lands should be identified. District should develop a procedure to verify that no more than 19,499 acres are receiving an allocation of water and/or actually being irrigated in any year.

*Action Taken: The recommendation was addressed in the 2004, 1996, and 2004 amended Operating Principles, respectively.*

- F. The District should develop a methodology for developing a current real time irrigation requirement.

*Action Taken: The recommendation was partially addressed by an investigation into improved irrigation practices by the Natural Resources Conservation Service and Spanish Peaks Soil Conservation District, 1996-2001.*

- G. The District should determine transportation losses.

*Action Taken: The recommendation was partially addressed by the Reclamation and District funded agreement with the U. S. Geological Survey (Survey) for the Canal Loss Study.*

- H. The Operating Principles should be amended to allow City of Trinidad to change Project water to municipal and industrial (M&I) use.

*Action Taken: The recommendation was addressed in 1997 and 2004 amended Operating Principles.*

- I. The Operating Principles should be amended to allow the District to implement conditions (d) and (e) of H.D. No. 325 with development and approval of a substitute water supply plan pursuant to Colorado water law.

Action Taken: *No action taken to date*

## **STATUS OF OPERATING PRINCIPLES**

Several amendments to the Operating Principles have been adopted since the 1996 Review. Even prior to the conclusion of the 1996 Review, parties to the Operating Principles were working on amendments. Due to the ongoing litigation in *Kansas v. Colorado*, the State of Kansas had declined to approve proposed amendments to the Operating Principles in the late 1980s and early to mid 1990s. An amendment to the Operating Principles to recognize the enlargement of the permanent fishery pool and the total allocated capacity of Trinidad Reservoir was signed by all the parties by May 1996. This was the last amendment adopted prior to the publishing of the 1996 Review but a revised version of the Operating Principles including this amendment was not produced until the 1997 amended Operating Principles. The major points of this and subsequent amendments and the actions leading up to the amendments are discussed below. Copies of all the amendments are provided in Appendix A.

### **1996 AMENDMENT**

This amendment recognized the enlargement of the permanent fishery pool from 4,500 acre-feet to 15,967 acre-feet and the total allocated capacity of Trinidad Reservoir to 125,967 acre-feet. The amendment also clarified the filling and replacement of evaporation for the permanent fishery pool. The amendment was approved by ARCA and the other parties at a special telephonic meeting in January 1996 and signed by all the parties by May 30, 1996. This amendment addressed the 1996 10-Year Review recommendation C.

### **1997 AMENDMENT**

In 1997 an amendment to the Operating Principles was approved adopting several changes that had been discussed for numerous years previously. The amendment addresses the City of Trinidad change of use to M&I and removal of land classification requirements. This amendment partially addressed the 1996 10-Year Review recommendations E and H.

The City of Trinidad, the District, the State of Colorado and Reclamation had sought amendments to the Operating Principles allowing the City to change the use of its water rights to M&I purposes. The need to amend the Operating Principles to allow the M&I use of the City of Trinidad's water rights was also recognized in recommendation H of the 1996 Review.

The original Operating Principles limited irrigation of the District lands to those classified as Class 1, 2, and 3 irrigable acres under Reclamation law. Reclamation wrote to the District on April 19, 1996, clarifying that under the 1982 Reclamation Reform Act, the Project was exempt from Reclamation land classification requirements since the Project had been constructed by the U.S. Army Corps of Engineers. While a previous modification of the contract between the Reclamation and the District deleted this requirement, the Operating Principles had not been amended to recognize the change. Recommendation E. of the 1996 Review recommended that the classification requirement be removed by amendment of the Operating Principles.

The 1997 Amended Operating Principles were approved at the December 1997 ARCA meeting and signed by all the parties by April 22, 1998. The 1997 Amended Operating Principles allowed the City of Trinidad to use its water rights for M&I purposes, clarified the use of the City's water rights, and removed the acreage classification requirements.

In response to the 1996 Review recommendations Reclamation continued in 1998 to pursue additional amendments of the Operating Principles with the Parties including acreage adjustments, adjustments to stock watering practice and a general 'clean up' of the language and format of the Principles. A technical meeting was held amongst the parties on February 18, 1998, to discuss the recommendations of the 1996 Review and potential amendments to the Operating Principles to address the recommendations. Reclamation sent a letter on October 15, 1998, to the parties summarizing the February 18<sup>th</sup> meeting and providing status on the issues. Reclamation noted that Kansas had provided language for a proposed stock water amendment, that the District had provided information explaining acreage verification procedures, that Reclamation was working with the District to address the ideal head gate requirement, that Colorado would provide a letter describing flood flow storage and release criteria, and that Kansas had committed to provide general criteria for modeling of storage of winter direct flows in the Joint Use Pool.

Direct flow water rights had not been acquired by the District at its formation thus reducing the lands eligible for Project water. Recommendation E in the 1996 Review also recommended that the Operating Principles be amended accordingly to reduce the lands served to not exceed 19,499 acres. The District had worked with a Soil Conservation Service (SCS) employee to conduct a survey of irrigated acres and submitted the survey results to Reclamation. In mid-1996 Reclamation analyzed Operating Principle irrigated acres versus those submitted by the District and worked with the District to come to resolution on the amounts. Resolution of these amounts was not accomplished in time to have appropriate amendments included in the 1997 amended Operating Principles. The modification of the list of water rights and irrigable acreage was not permanently adopted until the 2004 amended Operating Principles.

On December 1, 1998, prior to the upcoming ARCA meeting, Reclamation sent out a 'cleaned up' version of the Operating Principles that were proposed in November 1997 including amendments adopted in 1997 and those that were not adopted in 1997. The District had indicated that they wished to have amendments to allow the storage of winter direct flows outside the Model right. However, Reclamation responded by letter of December 4, 1998, that they were not prepared to support such an amendment at the time. Reclamation set up a technical meeting in Lamar on December 7, 1998, prior to the ARCA committee meetings with the parties to discuss the proposed amendments. Reclamation provided a revised version of the 'cleaned up' Principles for consideration.

## **1998 TEMPORARY AMENDMENT**

The parties were not able to support adoption of the full amended 'cleaned up' version of the Principles at the 1998 ARCA meeting. However, at the request of the District, a temporary stock watering amendment was approved for the 1998-99 non-irrigation season only to allow the District to make releases for stock watering at a rate greater than 5 cfs. The language for the amendment removed the prior limitation of 5 cfs release rate or its volumetric equivalent and replaced it with a seasonal volumetric limitation of 1,200 acre-feet. The seasonal volumetric limitation of 1,200 acre-feet represented a reduction from the 1,500 acre-feet which was the previous volumetric limitation. The amendment was signed by all the parties by January 1, 1999.

On December 23, 1998, Kansas provided a letter with their criteria on how Reclamation should conduct their modeling for storage of winter direct flows in the Joint Use Pool.

On December 30, 1998, Reclamation provided a list of remaining action items and proposed deadlines pertaining to amendments of the Operating Principles. Substantive issues identified included: providing written comment on the criteria for detention and release of flood flows, providing written comments on permanent stock water language, providing comment on acreage verification information provided by the District, drafting an amendment to address concerns relating to irrigated acreage, and reviewing Kansas' proposed modeling approach.

On December 2, 1998, The State of Colorado provided a letter with criteria on temporary storage and release of flood flows at Trinidad Reservoir. The Corps of Engineers provided a letter on February 10, 1999, clarifying their criteria for temporary detention and release of flood flows from Trinidad Reservoir. The Corps referred to their 1992 study and subsequent April 16, 1993, letter to Colorado State Division Engineer, Steve Witte, clarifying Corps personnel would make the call on releases above 3,000 cfs. They also suggested language in the Division 2 Engineer's December 2, 1998, letter to Reclamation clarifying that the Corps may direct releases above 3,000 cfs but not exceed 5,000 cfs if channel conditions permit.

The Colorado State Engineer sent a letter on February 23, 1999, expressing concern over Kansas' proposed modeling approach. Colorado questioned whether such a complex model could be constructed given data limitations and whether it should be constructed to the state

line. Reclamation arranged a technical meeting of the parties for July 12, 1999, in Denver, to discuss progress on resolving issues identified in Reclamation's December 30, 1998, letter. The specific focus of the meeting was on issues related to irrigated acreage and approach to addressing concerns over proposed winter direct flow storage.

Prior to the meeting, Reclamation sent out a status of action items and responses by the Parties to the issues. The District had proposed listing contracted acres in the Operating Principles while limiting the overall irrigable acreage to 19,499 acres. Reclamation agreed with this approach and encouraged the District to continue to pursue an acreage verification system. Kansas had yet to respond to proposed irrigated acreage amendments. Reclamation noted that while 'ideal irrigation requirement' was mentioned in the 1988 Review, that term is not in the Operating Principles and it is the responsibility of the District to allocate the District's water supply. Reclamation had offered Field Services program assistance to the District to allow the District to gain a better understanding of diversion and on-farm needs. Reclamation noted that Reclamation and Colorado were concerned that Kansas criteria for a model to study the effects of winter storage of direct delivery flows went too far in proposing to study effects to the state line and that there was insufficient data to construct a model that would satisfy Kansas' requirements. Language for a permanent stock water amendment was still being reviewed by the parties, but Reclamation supported the adoption of the District's proposed language.

Reclamation held another technical meeting on the Operating Principles on October 19, 1999, to review and address the action items from the December 30, 1998, letter. There was some progress on language for a stock water amendment. The District agreed that they should develop an acreage verification system and noted that they were still tabulating the irrigable acres. Kansas continued to express concerns about having an acreage verification system in place prior to agreeing to other amendments. There was still lack of agreement on how to address temporary storage and release flood flows and storage of winter water. In November 1999 the District again asked that a permanent stock water amendment be considered and adopted at the December 1999 ARCA meeting. Despite the progress made on language for this amendment, ARCA did not adopt any amendments to the Operating Principles in 1999 or 2000.

In 2000 Reclamation proceeded to work on a pilot acreage verification system (AVS) to present to the District. Reclamation made a presentation of the pilot AVS and the District began developing their own system that would meet Reclamation and Kansas' criteria. The District presented an initial version of their AVS system to Reclamation on July 18, 2001. Reclamation entered into an agreement September 18, 2001, to provide the District with \$13,500.00 over 2 years towards funding the development of an AVS.

## **2001 TEMPORARY AMENDMENT**

In 2000 and 2001, the District made considerable progress on correcting the lists of irrigable acres and direct flow water rights in the Operating Principles. On May 9, 2001, they sent a letter to the ARCA chairman requesting that amendments for stock watering and clean up of the lists be put on the agenda for approval at the 2001 ARCA meeting. Kansas felt it was premature to adopt permanent amendments to the Operating Principles until the AVS had been developed and the lists of acres and rights had been reconciled. Kansas did support, and ARCA adopted, a temporary amendment to the stock watering provision similar to the temporary amendment approved in December 1998 with minor clarifications. As part of the agreement to provide the stock water amendment, a temporary amendment was also approved requiring the District to implement procedures to verify that no more than 19,717 acres would be irrigated in 2002. Both amendments were only for the 2001 and 2002 calendar years.

## **2002 TEMPORARY AMENDMENT**

Resolution was reached on the irrigable acres and water rights listing and in October 2002 the District requested that amendments correcting the lists and providing for permanent stock watering be considered at the ARCA meeting that year. The Model Land & Irrigation Company also submitted amended Operating Principle language providing for the transfer of some of Model's rights to Colorado State Parks. Due to scheduling conflicts with the Kansas vs. Colorado litigation, ARCA was not able to complete its regularly scheduled business at the December 2002 meeting. The parties were, however, able to adopt another temporary one year stock watering and acreage verification amendment similar to the previous temporary amendments. ARCA scheduled a special meeting for May 22-23, 2003, to complete business and consider amendments to adopt the corrected water rights and acreage listings submitted by the District in its letter of May 9, 2001.

## **2004 AMENDMENT**

At the May 22-23, 2003, meeting, ARCA considered amendments to the Operating Principles addressing acreage verification, tabulation of project water rights, tabulation and limitation of irrigated acres, Model Land & Irrigation Co. to State parks water rights changes, and stock watering. Kansas and Colorado both wanted more time to consider two alternatives for the stock watering amendment and to defer voting until the December meeting. The District was not willing to support the adoption of the amendments with Kansas' version of stock watering. ARCA voted to approve all the amendments except the stock water amendment, deferring it to the December 2003 meeting. This amendment addressed the 1996 10-year review recommendations D and E.

In July of 2003, Reclamation, with the Corps of Engineers as a cooperating agency, initiated National Environmental Policy Act (NEPA) review of proposed Operating Principles and Operating Criteria amendments. The proposed changes considered included: providing for the City of Trinidad's use of a portion of the irrigation capacity for M&I purposes, allowing Colorado State Parks to utilize 700 acre-feet of the irrigation capacity, and allowing more effective stock watering practices. The review resulted in an Environmental Assessment (EA) of the proposed changes. The analysis for the EA was concluded in November 2004 and resulted in a Finding of No Significant Impacts (FONSI) associated with adopting the proposed actions.

At the December 2003 meeting, ARCA acknowledged the amendments passed at the previous May meeting and approved an amendment for stock watering. While the language of the amendments was approved by ARCA it was recognized that there was considerable 'clean up' of the formats, order of items and general editing that needed to be done prior to all parties adopting the Operating Principles.

Reclamation completed the 'clean up' of the Operating Principles and sent them along with a copy of the Final EA to the signatory parties on November 12, 2004. The 'cleaned up' version included previously discussed corrections to the lists of water rights, acreages, permanent stock water and acreage verification, and Model Land & Irrigation Co. to State Parks water rights changes. This version of the Operating Principles was relabeled as 'amended 2004.' The 2004 Amended Operating Principles were signed by all the parties prior to the December 14, 2004, ARCA meeting. Signed copies were distributed to the parties on December 22, 2004.

There have been no further amendments to the Operating Principles prior to this writing. Copies of the various Operating Principle versions and amendments can be found in Appendix A of this report. A copy of the current Operating Criteria is also provided in Appendix B.

# REVIEW OF OPERATING PRINCIPLES

## REVIEW PROCESS

Reclamation initiated the 10-Year Review process by sending a letter to the signatories and the State of Colorado on March 3, 2005. Pursuant to the charge in the Operating Principles, the letter stated the objectives of the 10-Year Review as two-fold:

- 1) To help obtain optimum beneficial use of the water supply as conditions change, experience is gained and more technical data becomes available (Operating Principles, Article VI) and
- 2) To determine the effect, if any, that the Project operations have had on other Colorado and Kansas water users pursuant to Kansas Condition 4.

The letter requested recipients submit any issues or comments that their organizations would like to see addressed in the 10-Year Review by April 15, 2005. The State of Kansas and the Colorado State Engineer provided letters by April 15 with issues they would like considered in the Review. On October 5, 2005, Purgatoire River Water Conservancy District submitted a letter with their request for issues to be considered for the 10-Year Review. These letters are presented in Appendix C. Reclamation held an informational and scoping meeting in Trinidad on October 5, 2005, to present the issues identified to concerned parties and to solicit additional comments.

On January 25, 2006, Reclamation held a conference call with Kansas to gain a better understanding of Kansas' request, to set up a technical meeting to review issues to be considered, and the approach to review. Kansas again noted that they would like to see impacts of recent changes analyzed. While Reclamation recognized that this is a concern of Kansas, Reclamation noted that changes such as the stock water and acreage verification are so recent as to have very little operating experience or adequate data to analyze the impacts.

Kansas also expressed concerns that they had not received data on how recent changes to the Operating Principles were being conducted including: accounting, drying up of irrigated land, and stock watering. They reiterated their concern that impacts be modeled with and without the Project. They suggested that this review should make recommendations as to what is needed to conduct this modeling in terms of gages, data and type of model. They also suggested that the review go over what has been accomplished to date on terms of real time data to allow evaluation of the ideal headgate requirement and what next steps might be taken. In response to Kansas' concern about flood operations, Reclamation suggested that that would be more appropriately handled by the Corps of Engineers outside the 10-Year Review process. Kansas also sought clarification of the winter water storage proposal and status of other reservoirs in the

Project area, including Model Reservoir for which a recent change had been filed in water court.

On January 31, 2006, Reclamation held a conference call with the State of Colorado to clarify issues they raised in their letter of April 15, 2005. Colorado acknowledged that it appeared that the Luning Arroyo gage, Von Bremmer Arroyo gage, and Thatcher gage issue was already being dealt with as Reclamation and the Corps agreed to cost share funding these gages. Colorado expressed concern that the review stay focused and that data for an analysis beyond what had been done in 1988 and 1996 was still insufficient.

On February 21, 2006, Reclamation held a conference call with Julianne Woldridge, representing the District, to seek clarification of the District's proposed issues to review.

On February 22, 2006, Reclamation held a technical meeting amongst the parties in Denver to discuss the review process, present a table of proposed issues parties had requested be considered, prioritize data collection, and review potential modeling. Representatives of Colorado, Kansas, the District, the City of Trinidad, the U.S. Army Corps of Engineers, and the Nature Conservancy attended. Seventeen issues identified by the parties were included in the table with identification of similar issues and clarifying comments. Discussions centered on what the parties were really looking for in raising an issue, issue status, and the appropriateness of considering the issue in the Review.

Reclamation revised the table of potential issues based upon written comments and those received at the February 22 meeting and issued a letter on April 27, 2006, with a list of issues that would be considered under this review, Appendix D. David Barfield with the State of Kansas provided comments by email to issues on the list. A copy of this email can be found in Appendix C.

During June 2006, Reclamation had its Technical Service Center (TSC) begin reviewing the 1964 and 1988 model analyses to determine model adequacy and what it would take to re-create the 1964 model using a modern computer software program. A series of technical meetings were held to discuss findings and an approach to updating the models. The first meeting was held on February 6, 2007, at the TSC with Jeris Danielson and TSC staff. A second technical meeting with interested parties was held on February 14, 2007, to review past modeling and a proposed modeling approach. A final meeting to agree on modeling approach was held April 17, 2007, at the TSC. On July 10, 2007, Reclamation held a meeting to discuss progress on water measurement and gaging issues, acreage verification and to present preliminary results of the modeling. Based upon comments at the July 10<sup>th</sup> meeting, further revisions were made to the model and a final meeting to present modeling results occurred on September 19, 2007.

In the April 27, 2006, letter, Reclamation had committed to convening an ad-hoc technical team to examine which gages are needed for the Project. Reclamation began to assemble gage information and members of the team were identified at the July 10, 2007, meeting. Team members included representatives of the District, the States of Colorado and Kansas, the Corps and Reclamation.

## ISSUES ADDRESSED IN THE 2006 10-YEAR REVIEW

Reclamation reviewed the issues submitted by the parties and assembled the Preliminary List of Issues, Appendix D. From this list Reclamation identified issues that were appropriate to address in the 10-Year Review and by letter of April 27, 2006, provided the parties a list of issues that would be considered. The items identified in the April 27 letter and addressed in this review are presented below:

### ***Water Measurement and Gaging***

**U.S. Geological Survey Canal Loss Report:** Recommendation G of the 1996 10-Year Review of Operating Principles stated that the District should determine the losses of each of the individual ditch systems for allocation of the District water supply. In consultation with Colorado Water Conservation Board and Reclamation, the District agreed to have a canal loss study conducted. Reclamation entered into a 3 year cooperative agreement in September 1999 (Agreement No. 99-FC-60-1330, copy in Appendix E) to assist the District with funding the study. During June 2000, the District contracted with the U. S. Geological Survey (Survey) to conduct a study of losses and gains along selected canals included in the District. The Survey originally estimated the cost of the canal loss study to be \$171,000.00. Per the agreement with the District, Reclamation provided a total of \$91,275.00. The Colorado Water Conservation Board also provided \$ 39,000.00 and the Survey provided \$26,000.00 to fund the study.

Survey staff conducted field studies between July 2000 and June 2004. Due to the severe drought of 2002, there was no data collected for that year. Results of the study provided indication of significant losses and gains in specific canal reaches and dependence upon time of canal wetting. The Survey published their findings in a report entitled *Losses and Gains for Eight Unlined Canals Along the Purgatoire River near Trinidad, Colorado, 200-2004* (Scientific Investigations Report 2006-5164, U.S. Department of the Interior, U.S. Geological Survey)

One of the major findings of the Canal Loss Study was that the gages on the various ditch diversion structures were underreporting diversions due to gage configuration, maintenance, or calibration issues. In an effort to improve water management, administration and data collection for future Project reviews, the District, the State of Colorado, and Reclamation worked together to upgrade the diversion gages. The District worked with ditch companies to improve diversions and erect enclosures for new instrumentation. Reclamation provided \$36,000.00 through a Water Conservation Field Services Program grant for the District to purchase six satellite monitoring stations to be able to collect and transmit real time data on ditch diversions. The District provided matching commitment to Reclamation's grant for installation and annual operation and maintenance of the stations. The State of Colorado, Division of Water Resources, provided staff for installation and calibration

of the stations. The stations were installed in the fall of 2007 and were operational and providing data as of November 2007. Real time diversion data is currently available either on the District's web site ([www.prwcd.org](http://www.prwcd.org)) or the State's web site ([www.dwr.state.co.us/SurfaceWater/default.aspx](http://www.dwr.state.co.us/SurfaceWater/default.aspx)) for the following six gages: Chilili (CILDITCO), Enlarged South Side (SOUDITCO), Hohne (HOEDITCO), John Flood (JOHDITCO), Model Ditch (MODCANCO) and Picketwire (PIKDITCO). A copy of Reclamation's grant agreement for Installation, Operation and Maintenance of Satellite Ditch Monitoring Stations is included in Appendix H. With the improved gaging and data on canal losses, the District is improving delivery of the District water supply in accordance with the Operating Principles and recommendations F and G of the 1996 10-Year Review.

**Documentation of Historic Gages for the Project:** One of the concerns that has been expressed in past 10-Year Reviews was the availability of data to be able to model and review Project operations. There was also confusion among signatory parties over which gages exist and are currently in service and which data would allow future modeling and analysis. At the February 14, 2006, general technical meeting, Reclamation agreed to put together a preliminary list for parties to review and to convene an ad-hoc technical team to review and analyze the value of the gages. During the July 10, 2007, 10-Year Review meeting at the TSC, Reclamation presented a preliminary list of gages in the Purgatoire River basin. Representatives of the Parties agreed to participate in the ad-hoc technical team. Entities represented included PRWCD, States of Kansas and Colorado, Army Corps of Engineers, and Reclamation. Reclamation assembled a table of gages, the period of record for each gage, and a location map. An ad-hoc technical team meeting occurred on August 30, 2007, via conference call. Gages on the list were then determined by the team to be important or not important for evaluation of Project operations. The table of gages and a discussion of their importance to evaluation of operations is presented in Appendix F.

**Cost Sharing of Thatcher Gage O&M by COE and Reclamation:** Reclamation has an ongoing Cooperative Stream Gaging Program with the Survey to cover costs of gages related to Reclamation Projects administered by the Great Plains Region. The Program is renewed annually and includes gages related to projects administered by the Eastern Colorado Area Office. For FY 2008, the Thatcher gage was added to the list of gages for which Reclamation provides funding under the agreement. Reclamation committed to fund 50 percent of the gage O&M costs for a total of \$7,250.00 for 2008.

**Gages Needed for the Project:** An ad-hoc team was convened and a list of gages in the Purgatoire River Basin was assembled. Gages were identified in the documentation in Appendix F as pertaining to the Project Operations. It was determined that in order to better administer Project diversions and provide more accurate data for future analyses of Project operations, improvement of the gaging at the ditch diversion structures was necessary. In response to this, the District, the State of Colorado and Reclamation worked to improve these gages as presented in the following section.

Reclamation has also concluded as part of this effort that the Trinidad gage and the Thatcher gage are sufficient to analyze the effect of Project operations on downstream users. The Model transfer decree had provided that three gages would be used to analyze the effect of Project operations on downstream users. The decree erroneously identified three sites, two of which appeared to be the same site, now the site of the Thatcher gage, and the third misidentified Luning Arroyo as Leitensdorfer Arroyo. As a result of investigations and consultations during the 1988 Review, it was decided that existing gages at Thatcher, Luning Arroyo and Van Bremer Arroyo would address the needs of the decree. A more detailed discussion is presented in the 1988 Review at Section IV. I.

The Model transfer decree provides that the State of Colorado shall regulate the storage in Trinidad Reservoir in such a manner that the volume in the Purgatoire River occurring at the site of the Thatcher gage shall remain the same during any ten year consecutive period as it would have been had the Model right not been transferred. The effects of the Project are evaluated by requiring that the flows at the Thatcher gage not be diminished by Project operations. Reclamation conducted a double mass analysis comparing pre- and post-Project flows at the Trinidad gage and the Thatcher gage during the 1996 10-year review. Reclamation found that there was no material depletion in streamflow from the pre-Project period to the November 1984 through October 1994 10-year review period. In fact, there was a return flow benefit by the Project operations.

The double mass analysis was extended to cover the November 1994 through October 2004 period covered by this 10-year review. The cumulative flow of the Purgatoire River at the Thatcher gage was 71.36 percent of the cumulative flow of the Purgatoire River at the Trinidad gage during the pre-Project period. The cumulative flow of the Purgatoire River at the Thatcher gage was 71.12 percent of the cumulative flow of the Purgatoire River at the Trinidad gage during the period covered by the November 1994 through October 2004 10-year review period, Table 1.

**Table 1. Streamflow of the Thatcher gage as a percentage of the Trinidad gage, 10-year Periods.**

<i>10-year Period</i>	<i>Cumulative Thatcher flows for period, af</i>	<i>Cumulative Trinidad flows for period, af</i>	<i>Thatcher flows as percent of Trinidad flows.</i>
Nov 1966 – Oct 1976	274,643	384,866	71.36
Nov 1984 – Oct 1994	438,106	589,677	74.29
Nov 1994 – Oct 2004	364,431	512,445	71.12
Nov 1984 – Oct 2004 Water Year Statistics for moving 10-year periods, 11 periods in all.		Average	72.74
		Median	73.85
		Minimum	65.12
		Maximum	76.98
		Standard Deviation	3.84

Further review of the gaging station records for the past twenty years, November 1984 thru October 2004, show that on the average cumulative flow at the Thatcher gage is 72.74 percent of the flow at the Trinidad gage. The minimum percentage is 65.12 and the maximum percentage is 76.98. It is unknown how the flows of the Thatcher gage compared with the Trinidad gage prior to 1967. A detailed double mass analysis is included in Appendix G.

Also included in Appendix G are charts showing the cumulative flows for the Trinidad and Thatcher gages, along with trendlines. The slopes of the trendlines for the 10-year period associated with this review, November 1994 thru October 2004, and for the 20-year period of November 1984 thru October 2004 are greater than the slope of the trendline for the pre-project period, November 1966 thru October 1976. The greater slope indicates that there is relatively more water at the Thatcher gage since development of the Project than during the pre-Project periods, possibly due to more return flows to the river.

The use of the double mass analysis of these two gages was and continues to be sufficient to evaluate the effects of the Project.

The current gages at Luning Arroyo and Van Bremer Arroyo were not used in the 1996 analysis. Most of the Project return flow occurs below the Hoehne diversion and the consensus opinion of the ad hoc committee is that replacing these gages with a single, more accurate, gage on the main stem of the Purgatoire River just below the Hoehne diversion, or perhaps downstream near the Highway 350 bridge, would provide better information from which return flows may be determined. In conjunction with the Thatcher gage, a gaging site just below the Hoehne, or downstream near the Highway 350 Bridge, would allow more complete mass balance calculations of the Project return flows. As previously discussed, it is believed that the Luning Arroyo and Van Bremer Arroyo gages are referenced in the Model transfer decree and hence that any replacement or elimination of these gages may require consent of the objectors in that case. The alternative described above would eliminate the need for these two gages. The State of Colorado, Division 2 Office, has

suggested that they could take the lead in establishing and maintaining a new gage at a location below the Hoehne diversion, or downstream near the Highway 350 Bridge.

### ***Acreage Verification***

**Tracking of Project Acreage:** During the late 1990s, considerable concern was expressed by the State of Kansas that the District was not meeting the 1996 10-Year Review recommendation No. 5. Recommendation No. 5 is for the District to develop a procedure to verify that no more than 19,499 acres are receiving an allocation of water and/or actually being irrigated in any year. Reclamation worked with input from the District and the State of Kansas to define criteria for an acreage verification system (AVS). On August 7, 2000, Reclamation sent a letter to the District providing an agreement, including the criteria, wherein Reclamation would assist with the costs for the District to develop an AVS.

The District contracted for the development of an AVS and on September 20, 2001, entered into a Grant Agreement with Reclamation, Appendix I. Under the agreement Reclamation provided \$7,500.00 in FY 2001 to the District towards funding the development of an AVS that would meet the criteria. The agreement was extended to provide an additional \$6,000.00 in FY 2002 for a total of \$13,500.00 towards the AVS development which the District estimated would cost \$30,000.00.

On August 29, 2002, the District provided a demonstration of their AVS to Reclamation. Reclamation provided a letter to the District on September 24, 2002, with comments on improvement of the AVS but noting that it appeared to meet the criteria set out in the Grant Agreement. The District continued to work on the AVS and provided a demonstration to other parties at the December 2002 ARCA meeting.

In 2004 a permanent amendment to the Operating Principles was adopted to provide for acreage verification which included the AVS criteria. The language of the amendment is contained at article B.2. of the Operating Principles and reads:

“The **District** shall provide notice each year, prior to June 1, to the State of Kansas, the Bureau of Reclamation and other parties making a written request, of lands expected to be irrigated. Such notice shall include a map and a tabulation of said lands, both showing tracts, their acreage and location. Any interested party may conduct field inspections related to the **District irrigable area**, and the **District** shall cooperate with the party in the conduct of such inspections.

The **District** shall implements substantive procedures to verify each year that not more than the **District Irrigable Area**, less lands **removed from irrigation**, are irrigated in that year. The **District** shall prepare a report each year including a tabulation showing tracts, acreage and location of lands irrigated in that year. The **District** shall provide the report to the State of Kansas, the Bureau of Reclamation and other parties making a written request, by February of the following year.”

The District has been operating under this amendment since 2004.

**Procedural Improvements to Ensure Compliance Operating Principles:**

Beginning in 2005, the District began providing reports of projected acreage and final acreage for irrigation years. The District initially had some challenges with the AVS and the report of 2005 projected irrigation was only received on July 11. The report of Final Acreage for 2005 was received on September 9, 2006. Reports of Proposed and Final Irrigated Acreages for 2006 were received on May 31, 2006, and March 23, 2007, respectively. The initial reports for 2005 included a map of all parcels in the District irrigable area and a table of parcels to be irrigated for the year.

Unfortunately, there was no way to cross reference the two documents. The District was asked to provide cross reference by numbering the parcels consistent with the tabulation in future submittals. In 2006, the District's tabulation of irrigated acres provided cross reference by parcel number to the map. Reclamation and Kansas also asked the District to provide maps with local geographic features on them, such as roads, to ease field checking the parcels and to provide the GIS shape files for the mapping. The District provided those files in 2007.

The timeliness of submittal of AVS reports needs to be improved. Sufficient data and detail in base maps and acreage tabulations also needs to be provided to allow outside entities to conduct their own field checking of the reported acreages.

**Standardization of the District's Geographic Information System data:**

The State of Colorado is currently involved in developing procedures and data to monitor irrigated acreage on the mainstem of the Arkansas River Basin to meet modeling [HI Model input data] and reporting requirements pursuant to the Kansas vs. Colorado Arkansas River Compact litigation. This effort will result in some standardization of the District's GIS information with the State's. At the February 26, 2006 technical meeting on the 10-Year Review, Colorado Water Conservation Board (CWCB) staff indicated that they are interested in having a uniform irrigated acres procedure for the entire Arkansas River Basin. CWCB staff would be assisting the District in developing imagery and base maps that could be used by the District to support the AVS. CWCB also suggested that they would be willing to assist with funding an effort to coordinate the mapping needs of the District's AVS with the State's Arkansas River Basin product. CWCB has allocated \$5,000.00 to cover costs of entering the District's irrigated parcels into the State's Hydrobase Information Retrieval System. At the December 9, 2008, ARCA meeting, Bill Tyner reported that this effort has been completed. The intent of inclusion of the District's parcels in the States Hydrobase system is to be able to provide base maps to the District and other interested parties on a consistently verified and updated basis. On-the-ground verification and reporting of annual irrigated acreage is still the responsibility of the District.

## ***Documentation of Current and Historic Practices***

**Stock Water Releases:** Diversion of river flows during the non-irrigation season for the purpose of stock watering was contemplated in the original planning and analysis of the irrigation portion of the Project. Reclamation's pre-Project analysis acknowledged that the ditches forming the District diverted an average of 1,500 acre-feet annually during the non-irrigation season. Pre-Project flow records indicate that stock water diversions occurred as part of winter irrigation diversions. Stock watering occurred at rates and times when the divertible flow in the Purgatoire River was sufficient to reach fields and stock ponds down the lengths of the canals. With the Project's development, irrigation diversions during the non-irrigation season shifted to storage. The 1,500 acre-feet stock water allowance was addressed in the Operating Principles at IV. D. 2. wherein the District was to ' . . . provide an allowance for stock watering purposes of not more than a daily mean flow of five second feet or its volume equivalent . . .' The 1,500 acre-feet was later reduced to 1,200 acre-feet as a result of the Division 2 Water Court, Case No. 86CW25, where certain of the Hoehne's rights to stock watering were terminated.

The Project began operation in 1979 with irrigation available to all project lands by 1985. During the early years of Project operation, the District apparently released water from the reservoir during the non-irrigation season at sufficient rates to allow for stock water deliveries to make it down the canals and reach the stock ponds while not exceeding the overall seasonal stock water volume allowance. Records of deliveries for water years 1988 through 1991 and 1993 were available and indicate that between one and six stock water deliveries were made during the non-irrigation seasons of those years at overall rates up to approximately 80 cfs. The gross deliveries for those years varied between 387 and 980 acre-feet for the whole non-irrigation season.

In September 1993 the Colorado State Engineer concluded that stock watering was not being conducted in accordance with the 5 cfs limitation in the Operating Principles and directed the District to make future stock water releases at the 5 cfs rate. The 1996 10-Year Review of the Project recommended that the Operating Principles be modified to reduce the seasonal volume for stock watering from 1,500 to 1,200 acre-feet.

The District began pursuing amendment of the Operating Principles to allow for stock water releases in excess of 5 cfs but not exceeding the 1,200 acre-feet per season limitation. A permanent stock water amendment was not adopted until December, 2004 but in 1998, 2001 and 2002 temporary stock water amendments were approved for those non-irrigation seasons.

Concerns were raised by some of the parties to the Operating Principles about potential effects of alternative stock watering practices as compared to the practice of limiting the releases to 5 cfs. Reclamation agreed to analyze, to the degree feasible,

potential effects of alternative stock watering practices as compared to the practice of limiting the stock water releases to 5 cfs. In July 2004 Reclamation produced a report on Modeling of Stock Water Alternatives and circulated it to the parties. The report concluded that there was no significant impact upon downstream water availability by the stock watering practice proposed by the District. Data from that report has been extended to document the District's stock watering practices from the 1995-'96 non-irrigation season through the 2005-'06 non-irrigation season.

Stock watering diversions are presented in Appendix J of this report. Table J-1 provides a summary of the total volumetric diversions and maximum total daily rate of stock water diversions for participating ditches for the review period. Table J-2 provides daily stock water diversions by year.

Stock watering diversions occurred in all of the years of the review period. During the '95-'96, '96-'97 and 03-'04 non-irrigation seasons, stock watering rates exceeded the 5 cfs limitation directed by the Division Engineer. In the '97-'98, '99-'00 and '00-'01 non-irrigation seasons maximum diversion rates did not or did not significantly exceed the 5 cfs limitation. During the remaining years there was either a temporary or a permanent amendment to the Operating Principles allowing stock watering to occur at rates greater than 5 cfs. At no time did the seasonal diversion exceed the 1,200 acre-feet volume allowance.

**Permanent Fishery Pool:** The capacity of Trinidad Reservoir as authorized and noted in the original Operating Principles was 114,500 acre-feet. Of this capacity 4,500 acre-feet was set aside for fish and wildlife purposes. A 1986 re-survey of the reservoir capacity determined that the as-built capacity was actually 125,967 acre-feet or 11,467 acre-feet greater than originally planned. The Corps of Engineers conducted a NEPA analysis on a proposal to assign the additional unallocated space to the Permanent Fishery Pool. Upon completion of the NEPA in September 1994, the Corps assigned the additional capacity to the Permanent Fishery Pool increasing it to a total of 15,967 acre-feet. Since the Permanent Fishery Pool was originally filled by exchange with water brought in from outside the Arkansas River basin by the State of Colorado Division of Wildlife, the downstream concerned parties and signatories to the Operating Principles did not object to this change. During the 1996 10-Year Review process the parties agreed to proceed with an amendment to the Operating Principles to permit storage in the enlarged Permanent Fishery Pool. This amendment was adopted by all the parties by May 1996 and is included in Appendix A of this report. The language of the amendment was made part of the 1997 Amended Operating Principles.

Subsequent to the 1997 amendments, the State of Colorado acquired interests in additional water to use for maintenance of the permanent fishery pool, recreation, and fish and wildlife propagation. Antonio Lopez Ditch water was converted for these purposes in Division 2 Water Court case No. 88CW062. Colorado State Parks acquired interest in some of the Model Land and Irrigation Co. rights and had those rights transferred in case No. 03CW108 to storage in the Trinidad Reservoir for

maintenance of the permanent fish pool and with a requisite dry up of certain of Model Land and Irrigation Co. lands.

Accounting records for the filling of the permanent fishery and recreation pool were provided by the Division 2 Engineer's office and are presented in Appendix K. It appears from the accounting and documentation that the permanent fishery pool has been filled in accordance with the Operating Principles.

**City of Trinidad Use of Municipal and Industrial Water:** The City of Trinidad purchased and sought to change the points of diversion and uses for certain shares of the John Flood and Model Land and Irrigation Company water rights. The changes were sought in water court in December 1988 in case No. 88CW061, Colorado Water Division 2. The court ruled in 1993 that the Operating Principles for the Project must be amended to allow the changed uses of water before the decree could be entered. As described in Section II above, the Operating Principles were amended in 1997 to allow for the changes of use sought by the City. A final decree was entered in June 2001 awarding the changes of use and points of diversion sought by the City.

Reclamation's contract with the District acknowledges that the City of Trinidad owns a portion of the water rights usable by the Model Land and Irrigation. Reclamation, working with the City, determined that the City began using some of their Model water beginning in 2003. Water usage by the City has increased steadily from through 2007 is listed in Table 2.

Table 2. City of Trinidad Usage of Transferred Model Water Rights.

<u>Year</u>	<u>Usage, acre-feet</u>
2003	17.1
2004	35.3
2005	29.69
2006	392.49
2007	484.17

During August 2007, Reclamation issued a contract administration letter to clarify the process for reporting the City of Trinidad's use of water and for billing the District for the City's water use. These changes should facilitate reporting and billing for the City's water use.

## ***Modeling Review and Verification***

**Review 1964 and 1988 models and Data:** In order to respond to modeling concerns presented by the Parties, Reclamation undertook reviewing the previous modeling efforts and recreating the previous models in a modern computer format. A goal of the effort was to create a model consistent with the previous analyses in a transparent format that the Operating Principle signatories and other entities could use to conduct their own analysis. In June 2006 Reclamation had its Technical Service Center (TSC) begin review of the analyses conducted for the 1964 Irrigation Report and 1988 10-Year Review of Operating Principles. TSC reviewed the earlier models to determine their adequacy and to recreate the 1964 analytical process using a Microsoft Excel spreadsheet model.

A series of technical meetings were held beginning in February 2007 and running through September 2007 to review findings and determine an approach to updating the model. A report of the modeling effort, documentation and results is included in Appendix L. An electronic copy of the model and documentation is also included with this report, or may be requested directly from Reclamation.

**Documentation for the 1964 and 1988 models:** The 1964 report included a description of the analysis conducted and a hand calculated spreadsheet. The analysis in the 1988 report reproduced the 1964 hand spreadsheet in a FORTRAN program. Some documentation, but no computer code, was available from the 1988 analysis. As a result, it was necessary to reverse-engineer some of the logic so that the new model would allow replication of the previous modeling efforts.

As the new model was based upon the previous analyses, documentation was provided only for the new model with references to the origins of data and functions in the previous analyses. There are some minor differences from the 1964 and 1988 analyses and the new model developed under this effort. These include differences between recorded historical data and data used in the previous efforts and evaporation data. These differences, how they were handled and complete documentation of the model are provided in Appendix L. The model was accepted by the team as an adequate update of the original model.

**Review of data being collected for future modeling:** The 2007 water accounting computer model requires the following input data:

1. Trinidad Reservoir inflow
2. Late month unusable inflow
3. John Martin Reservoir spills
4. Stock water releases
5. Estimated headgate requirements
6. High inflow bypass
7. Historic Ninemile Canal diversion
8. Historic Highland Canal diversion
9. Reservoir water surface evaporation

All of this input data is either available directly or generally accepted methods of developing the data exist, except for No. 2, late month unusable inflow. This data input represents the amount of water in the river late in the month and cannot be assumed to be useable for diversion, but can be stored in the reservoir. Prior documentation indicates that in prior model analysis, this value was derived from daily flow data, but the criteria for developing the input data could not be identified. A method for developing the data needs to be agreed upon.

The 2007 water accounting computer model was developed based on previous models used for the Project. These previous models include a time period of 1927 through 1957. In order for a technical team, the Operating Principle signatories, or other entities to use the model, the time period needs to be updated from 1958 through the present, or some other representative hydrologic period.

**Impacts from storing direct flow during non-irrigation season:** The model has been provided to the signatories to the Operating Principles, the parties represented on the technical team, and is available to others. A large part of the intent of updating the model and providing the model to the parties was to enable the parties to conduct their own analysis of issues that are of concern to them using a model that is generally available and acceptable. For example, the parties may use the model to analyze the impact of storing direct flows in the irrigation capacity during the non-irrigation season.

### ***Flood Control Operations of Trinidad Dam and Reservoir***

**Flood Control Operations:** Flood operations are to be conducted in accordance with regulations prescribed by the Secretary of the Army and as listed in Article III of the Principles. Flood waters are to be retained to prevent the flows from exceeding, insofar as possible, the non-damaging flow below the dam. The original Operating Principles identified the non-damaging flow as 5,000 cfs. In 1992, the U.S. Army Corps of Engineers (Corps) completed an analysis of the river channel below Trinidad dam and concluded that the existing channel capacity was then 3,000 cfs. On April 16, 1993, the Corps sent a letter to the Colorado Division 2 Engineer presenting the finding and stating that any releases in excess of 3,000 cfs should only be made in consultation with the Corps.

The Division Engineer subsequently modified his criteria for temporary detention of flood flows and subsequent release. A copy of the modified criteria was provided by letter of December 2, 1998, to Reclamation and other interested parties. The Corps acknowledged the modified criteria and suggested a minor change to them in a February 10, 1999, letter to Reclamation with a copy to the State of Colorado. The Colorado State Engineer adopted the Corps' suggestions and reissued the criteria by letter of December 3, 1999, to the signatories of the Operating Principles.

The reduction of the flood release caused concern among downstream Colorado water users and Kansas. The concern was that reduced flood release might result in greater evaporative and channel loss of the waters released over the losses that would have occurred if higher flood releases had been made. While this issue was not directly addressed in the 1996 10-Year Review, it has been an increasing concern during the current review period as there has been significant vegetative encroachment in the river channel in the last 10 years. In 2004, there were two flood water retention and release events at Trinidad Dam. On May 5 a release of 1,051 cfs was recorded and on August 12 a release of 1,260 cfs was recorded. The Division 2 Engineer's office received reports of flood damage concerns at these release rates. As a result, there is currently concern that the non-damaging channel capacity below the dam is less than 3,000 cfs.

During the 2004 events, the Corps noted that the outlet works gage immediately downstream of the dam appeared to become unreliable at flows in excess of 1,000 cfs. As a result, the Corps worked with the Survey in the spring of 2005 to establish a secondary gage site below the outlet works gage. This gage will be used to measure releases in excess of 800 cfs. The Survey frequently monitors both gages to gather measurements to calibrate the secondary gage.

Copies of the following letters from the Corps and the State establishing the non-damaging flows and Operating Criteria for flood retention and release are included in Appendix M:

1. April 16, 1993 – Letter from U.S. Army Corps of Engineers to Steve Witte, Div. 2 Engineer; Indicating existing channel capacity below Trinidad Dam of 3000 cfs.
2. Dec. 2, 1998 – Letter from Steve Witte, Div. 2 Engineer to A. Jack Garner, Reclamation; Providing 'Criteria for Temporary Detention and Subsequent release of Flood Flows stored in the Trinidad Reservoir Conservation Pool'
3. Feb. 10, 1999 – Letter from U.S. Army Corps of Engineers to Jack Garner, Reclamation; Clarifying 'Criteria'
4. Dec. 3, 1999 – Letter from Hal Simpson, Colorado State Engineer to A. Jack Garner, Reclamation & others; Providing revised 'Criteria for Temporary Detention and Subsequent release of Flood Flows stored in the Trinidad Reservoir Conservation Pool'

**Corps of Engineers' Letter Documenting Current Maximum Non-Damaging Flow Capacity:** The Corps has agreed to conduct a channel capacity study beginning in 2007 and has provided \$100,000.00 towards the study. Reclamation also entered into an agreement in September 2007 to provide \$15,000.00 to the Corps to assist in conducting a channel capacity study. The study is ongoing as of this writing. Upon completion of the channel capacity study in FY09, the Corps will designate a revised non-damaging flow for the channel below Trinidad Dam.

## OTHER ISSUES

### ***Documentation of Operating Principles Amendments***

Reclamation also noted in the Preliminary List of Issues for the 2006 Review of Operating Principles at item 13 that it would maintain a record of changes to the Operating Principles and amendments that occur in the future. All versions of the Operating Principles and amendments during this 10-year review period are included in Appendix A of this report.

### ***Development of Current Real Time Irrigation Requirements***

In response to 1996 10-Year Review Recommendation F, Reclamation entered into a grant agreement with Spanish Peaks-Purgatoire River Soil Conservation District (SP-PRSCD) to provide funding of evaluation and demonstration of improved irrigation practices. The initial agreement was through 1998 but was extended through 2001. The program involved demonstrating best management practices on selected farms within PRWCD and promoting public water conservation education. Reclamation made \$120,000.00 available for the total program cost of \$521,975.00. Other contributors included landowners, PRWCD, SP-PRSCD, Colorado State University, Natural Resources Conservation Service, and the Environmental Protection Agency.

Over the initial 5 years, the program provided assistance to 57 individuals (over a third of PRWCD irrigators). The SP-PRSCD also installed a COAGMET weather station that enables farmers to access current weather information and allows them to more effectively apply irrigation water. Other efforts taken under this program in 2000 and 2001 alone included installation of over 21 miles of buried pipe, over eleven miles of gated irrigation pipe, and over 17 acres of land leveling. These efforts, and the ongoing activities of the SP-PRSCD, are allowing the PRWCD to improve their irrigation application efficiency. A copy of Reclamation's initial grant agreement (No. 6-FC-60-08180) and the SP-PRSCD's 2000/2001 report are included in Appendix N.

### ***Definition of Operating Criteria Terms***

Previous iterations of the Operating Criteria have added definitions for several terms. The Colorado State Engineer's Office has raised some concerns about the applicability of the following clause in the Operating Criteria:

11. Any future increase in transportation efficiencies derived from improved facilities shall accrue to the benefit of those responsible for the improvement of facilities to the extent such water will still be used beneficially and in accordance with the **Operating Principles**.

Definitions of some of the key terms in this clause are not included in the Criteria, and therefore may be subject to some interpretation.

# CONCLUSIONS

## WATER MEASUREMENT AND GAGING

Utilization of the Trinidad and Thatcher gages is sufficient to analyze the effects of the Project operations on downstream users. The administration of the Project and measurement of Project return flows would be better accomplished by replacing the current Luning Arroyo and Van Bremer Arroyo gages with a single gage on the Purgatoire main stem just below the Hoehne diversion, or downstream near the Highway 350 Bridge.

## ACREAGE VERIFICATION

The District has established an acreage verification system. The District is continuing to improve the AVS both in terms of accuracy and timeliness of submission. The District and the State have standardized the District's mapping data into the State's basin wide system.

## STOCK WATERING

The District did significantly exceed the 5 cfs diversion for stock watering in 3 of the eleven years evaluated during this review. During an additional 5 of those 11 years, there were temporary or permanent amendments to the Operating Principles allowing in excess of 5 cfs to be diverted for stock watering. At no time, however, did the stock watering exceed the seasonal volume allowance of 1,200 acre-feet. The Operating Principles were permanently amended in 2004 to allow up to 1,200 acre-feet of stock water releases to be made during the non-irrigation season at a release rate under the discretion of the District. Records since the 2004 amendment indicate that the District is conducting stock watering in accordance with the amended Operating Principles.

## **CITY OF TRINIDAD USE OF MUNICIPAL AND INDUSTRIAL WATER**

The City is using their water rights in accordance with the Operating Principles.

### **MODELING**

Reclamation has updated and documented the original model with the concurrence of interested parties. The model was previously distributed to the parties. The model and model documentation is provided in this 10-Year Review. The model data needs include 'late month unusable inflow,' which does not have clear criteria for development. The model also only covers the period 1927-1957.

### **FLOOD CONTROL**

There is currently uncertainty regarding the non-damaging flow rate below Trinidad dam. The Operating Principles still list the estimated non-damaging flow to be 5,000 cfs. Upon recommendation of the Corps of Engineers, the State of Colorado has established modified release criteria whereby releases may be made by the State up to 3,000 cfs and above 3,000 cfs only in consultation with the Corps. The 5,000 cfs listed in the Operating Principles may not reflect a non-damaging flow given the current condition of the river channel. The Corps, the State of Colorado and Reclamation are currently conducting a study to determine an appropriate non-damaging flow.

### **DETERMINATION OF THE IRRIGATION REQUIREMENT**

Through the demonstration of improved irrigation practices program, the canal loss study and the improvements in flow measurement, the District has acquired better knowledge of the irrigation requirement. Some members of the District have adopted improved practices to a greater degree than others. There is still room for District to improve irrigation efficiency by using a real-time irrigation requirement.

## **DEFINITION OF OPERATING CRITERIA TERMS**

The Operating Criteria uses “transportation efficiencies” and “improved facilities” without defining these terms.

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# RECOMMENDATIONS

## WATER MEASUREMENT AND GAGING

Replace the Luning Arroyo and Van Bremer Arroyo gages with a single main stem gage at a site below the Hoehne ditch diversion, or downstream near the Highway 350 Bridge, as identified by the State of Colorado Division 2 Office.

## ACREAGE VERIFICATION

The District should continue to improve the accuracy and timeliness of data for the AVS system. The District and the State of Colorado should use the standardized AVS to improve the ability of the District to report on irrigated acreage and increase confidence of other signatory parties in the District's operations.

## MODELING

A technical team should be convened to develop and agree upon a method for determining the water accounting model input data for 'late month unusable inflow'. Additionally, the technical team should update the period of study to include a time period of 1958 through the present, or some other representative hydrologic period.

## FLOOD CONTROL

The 5,000 cfs listed in the Operating Principles may not reflect a non-damaging flow given the current condition of the river channel. The parties should continue funding the Channel Capacity study to determine a non-damaging flow rate that reflects the current condition of the channel. Upon determination of the appropriate rate, flood operating Criteria and the Operating Principles should be modified to reflect any adjustment in the rate. Channel maintenance and/or restoration issues should also be addressed.

## DETERMINATION OF THE IRRIGATION REQUIREMENT

The District should use the results provided by the Demonstration of Improved Irrigation Practices with Spanish Peaks SCD, the Survey Canal Loss study, and the improved canal diversion gage data to improve determination of irrigation requirements. The District

should also pursue canal improvements to reduce seepage in high loss segments and continue to analyze their system to improve determination of the irrigation requirement.

## **CLARIFICATION OF OPERATING CRITERIA TERMS**

The Parties to the Operating Criteria should agree on and insert definitions for “transportation efficiencies” and “improved facilities” into Part A of the Operating Criteria.

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## REFERENCES

- A. Trinidad Lake Project, Colorado, Review of Operating Principles and Project Operations, Final Report, December 1996, U.S. Department of the Interior, Bureau of Reclamation
- B. Losses and Gains for Eight Unlined Canals Along the Purgatoire River near Trinidad, Colorado, 2000-2004, Scientific Investigations Report 2006-5164, U.S. Dept. of the Interior, U.S. Geological Survey

## APPENDICES

- A. Operating Principle Versions and Amendments Since 1996
  - 1. *1996 Amendment to the Operating Principles-Enlarging Trinidad Reservoir and Permanent Fish Pool capacities*
  - 2. *1997 Amendment to the Operating Principles- City of Trinidad and Removal of Lands Classification Requirement*
  - 3. *1998 Temporary Amendment to the Operating Principles-Stock Water*
  - 4. *2001 Temporary Amendment to the Operating Principles-Stockwater and Acreage Verification*
  - 5. *2002 Temporary Amendment to the Operating Principles-Stockwater and Acreage Verification*
  - 6. *2004 Amendment to the Operating Principles*
- B. Purgatoire River Water Conservancy District - Operating Criteria – Amended and Restated February 2008
- C. Comment Letters Providing Issues for 10 Year Review
  - 1. *Apr. 14, 2005 - Letter from State of Kansas*
  - 2. *Apr. 15, 2005 - Letter from Colorado State Engineer*
  - 3. *Oct. 5, 2005 - Letter from Purgatoire River Water Conservancy District*
  - 4. *May 31, 2006 - Email from David Barfield, KS to Jaci Gould, USBR*
- D. Table of Preliminary List of Issues to be Addressed in 10-Year Review
- E. Reports of Cooperative Agreement for Canal Seepage Loss Study and Cooperative Agreement for Canal Seepage Loss Study (Agreement No.99-FC-60-1330)
- F. Gaging
- G. Double Mass Hydrologic Analysis
- H. Agreement for Purchase, Installation, Operation and maintenance of Satellite Ditch Monitoring Stations on the Trinidad Project (Agreement No. 06FG602122)
- I. Grant Agreement for Acreage Verification System (Agreement No. 01FO601589)
- J. Stock Water Releases
- K. Permanent Fish Pool
- L. Modeling Report
- M. Flood Control Operations Documents
  - 1. April 16, 1993 – Letter from COE to Steve Witte, Div. 2 Engineer indicating existing channel capacity of 3000 cfs
  - 2. Dec. 2, 1998 – letter from Steve Witte to BOR provided ‘Criteria for Temporary Detention and Subsequent release of Flood Flows stored in the Trinidad Reservoir Conservation Pool’
  - 3. Feb. 10, 1999 – Letter from U.S. Army Corps of Engineers to Jack Garner, Reclamation – clarifying ‘Criteria’
  - 4. Dec. 3, 1999 – Letter from Hal Simpson, Colorado State Engineer to A. Jack Garner, Reclamation & others – providing revised ‘Criteria for Temporary Detention and Subsequent release of Flood Flows stored in the Trinidad Reservoir Conservation Pool’
- N. Demonstration of Improved Irrigation Practices, Spanish Peaks Soil Conservation District (Grant Agreement No. 6-FC-60-08180)