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THE "FILL MEAD FIRST" PROPOSAL

POTENTIAL LEGAL ISSUES UNDER THE LAW OF THE RIVER

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INTRODUCTION

The Glen Canyon Institute (GCI) — a non-profit founded in 1996 to protect and restore Glen Canyon — has proposed dramatic changes to operations at the Glen Canyon and Hoover Dams on the Colorado River. *See* www.glencanyon.org/. While certainly deserving of consideration on its own merits, analysis of the legal backdrop to the proposal also offers an opportunity to examine the legal flexibility of the "Law of the River" — i.e., the extensive and ever-evolving body of law pertaining to Colorado River water management which includes: federal and state statutes; interstate compacts; contracts with federal government; an international treaty; operating criteria; administrative decisions; and court decisions and decrees. *See also* Gheleta, *Litigation on the Colorado River: Conflicts in Search of Solutions — TWR* #67).

Entitled "Fill Mead First" (FMF), the GCI initiative proposes that the declining water supply from the Upper Colorado River Basin be stored primarily in Lake Mead (Hoover Dam), with the balance of the water held in Lake Powell (Glen Canyon Dam). At present, water is maintained at approximately equal levels in the two reservoirs. Under current conditions the effect is that both reservoirs are about half full. GCI argues it makes better sense to keep Mead full so that less of the Glen Canyon area is under water. It also asserts there would be a savings of water because less would be lost to bank storage. GCI believes a more natural flow of water through Glen Canyon Dam would benefit the Grand Canyon. For a full discussion of the merits of FMF, *see* Michael Kellett, *Fill Mead First: A Plan for Saving Colorado River Water* (Glen Canyon Institute, 2013).

The recently completed Colorado River Basin Water Supply and Demand Study by the US Bureau of Reclamation (Reclamation) verified the critical problems facing the Basin states, signaling the need for action. As the states, the federal government, and other interested parties contemplate next steps, FMF warrants serious consideration. This article considers whether there are legal impediments to adopting a FMF strategy and, if so, how they might be addressed.

In particular, the article considers the following three questions:

1. Is the FMF proposal possible under the Colorado River Compact and various federal and state laws? If there are barriers, what are they?
2. Is FMF possible under existing Colorado River administrative regulations, guidelines, and agreements? If there are barriers, what are they?
3. Are there plausible steps to overcome legal, regulatory, or administrative barriers? If so, what are they?

Colorado River Basin Storage

Compact

75/10 Requirement

Mexico Treaty

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The article begins with a brief overview of key pieces of the Law of the River. It then turns to a discussion of potential legal issues raised by the FMF proposal. Finally, it concludes that US Department of the Interior guidance would have to be changed, requiring agreement among the Basin states, but that no existing laws absolutely bar adoption of the FMF proposal.

RELEVANT PIECES OF THE LAW OF THE RIVER

The Colorado River Compact (1922 Compact)

The purpose of the 1922 Compact was to divide the consumptive use of the water available in the Colorado River Basin between users in the Upper Division States of Arizona, Colorado, New Mexico, Utah, and Wyoming and users in the Lower Division States of Arizona, California, Nevada, New Mexico, and Utah. Article III (a) apportioned the consumptive use of 7.5 **m**illion **a**cre-**f**eet (maf) to a hydrologically-defined Upper Basin and an equal amount to the Lower Basin. Article III (b) authorized consumptive use of an additional one maf in the Lower Basin.

The key relevant provision of the 1922 Compact for the purposes of this article is Article III (d). Article III (d) provides:

> "The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series beginning with the first day of October next succeeding the ratification of this compact."

Under this provision, flows at Lee Ferry are measured to ensure that at least 75 maf pass this point (the dividing line between the two basins) over consecutive 10-year periods (75/10 requirement). While the Compact does not require a fixed amount each year — only that there be at least 75 maf for each preceding ten-year period — the operating procedure for managing releases from Glen Canyon Dam (discussed below) has ensured that at least 8.25 maf of water (including 750,000 acre-feet for the Mexico Treaty obligation) passes Lee Ferry annually.

The Boulder Canyon Project Act (BCPA)

The BCPA, authorizing construction and operation of Hoover Dam, contemplated storage of all available flows from upstream in the Basin for use under contract in the Lower Basin. It allowed ratification of the 1922 Treaty by only six states (Arizona had refused to sign) so long as California agreed to limit its consumptive use to 4.4 maf/year. It also authorized the Secretary of the Interior to enter into contracts for the use of water and power to help repay the costs of project construction. 43 U.S.C. §§ 617-617v.

The 1944 Treaty with Mexico (1944 Treaty)

The 1944 Treaty is concerned with deliveries of water from the Colorado River for use in Mexico. The US has interpreted Article III (c) of the Colorado River Compact to require the Upper Basin to make available at Lee Ferry 750,000 acre-feet annually to meet the treaty obligation to deliver 1.5 maf/year to Mexico.

Specifically Article III (c) provides:

> "If, as a matter of international comity, the United States of America shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado River System, such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin, and whenever necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d)."

The obligation to deliver 1.5 maf/year to Mexico is included in Section 602 (b)(1) of the Colorado River Basin Project Act and in the Long Range Operating Criteria implementing this provision.

The 1948 Upper Colorado River Compact (1948 Compact)

The 1948 Compact is concerned primarily with allocating the Upper Basin's share of Basin water established under Article III (a) of the 1922 Compact among the Upper Division states. It also addresses the means by which the Upper Division states will reduce existing uses if necessary to meet the 10-year flow obligation at Lee Ferry (i.e., the 75/10 requirement).

Colorado River Basin Storage

The Colorado River Storage Project Act (1956 Storage Act)

The 1956 Storage Act, among other things, authorized construction, operation, and maintenance of Glen Canyon Dam (and three other Project dams in the Upper Basin) for the purposes of "regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes,… ."

Adapted from: Colorado River Basin Supply & Demand Study, Interim Report #1, USBR, June 2011

Colorado River Basin Storage

Arizona v. California

***Arizona v. California*, 373 U.S. 546 (1963)**

Perhaps the most relevant aspect of this important decision for this paper was the Court's decision to award 7.5 maf of annual consumptive use of mainstream Colorado River water to Arizona (2.8 maf), California (4.4 maf), and Nevada (0.3 maf), based on an interpretation of the Boulder Canyon Project Act. (*See* MacDonnell, "*Arizona v. California* Revisited," 52 Nat. Res. J. 332 (2012) for more discussion of this case. The 1964 Decree empowered the Secretary to determine whether there was sufficient water available for release from Hoover Dam and other dams on the Colorado River in the Lower Basin to permit consumptive use of 7.5 maf in Arizona, California, and Nevada.

Section II. B of the Decree provides:

(1) If sufficient mainstream water is available for release, as determined by the Secretary of the Interior, to satisfy 7,500,000 acre-feet of annual consumptive use in the aforesaid three states, then of such 7,500,000 acre feet of consumptive use, there shall be apportioned 2,800,000 acre-feet for use in Arizona, 4,400,000 acre-feet for use in California, and 300,000 acre-feet for use in Nevada;

(2) If sufficient mainstream water is available for release, as determined by the Secretary of Interior to satisfy annual consumptive use in the aforesaid states in excess of 7,500,000 acre feet, such excess consumptive use is surplus, and 50% thereof shall be apportioned for use in Arizona and 50% for use in California; provided, however, that if the United States so contracts with Nevada, then 46% of such surplus shall be apportioned for use in Arizona and 4% for use in Nevada;

Surplus Water

(3) If insufficient mainstream water is available for release, as determined by the Secretary of the Interior, to satisfy annual consumptive use of 7,500,000 acre feet in the aforesaid three states, then the Secretary of the Interior, after providing for satisfaction of present perfected rights in the order of their priority dates without regard to state lines and after consultation with the parties to major delivery contracts and such representatives as the respective states may designate, may apportion the amount remaining available for consumptive use in such manner as is consistent with the Boulder Canyon Project Act as interpreted by the opinion of this Court herein, and with other applicable federal statutes, but in no event shall more that 4,400,000 acre feet be apportioned for use in California including all present perfected rights;… .

California Limit

Arizona v. California, 376 U.S. 340, 342 (1964).

The Colorado River Basin Project Act (1968 Project Act)

Central Arizona Project

The primary purpose of the 1968 Project Act was to authorize construction of the Central Arizona Project. Public Law 90-537. It also authorized construction of several small Reclamation projects in the Upper Basin. Section 602 (b) of this Act directed the Secretary of the Interior to propose criteria for the "coordinated long-range operation of the reservoirs constructed and operated under the authority of the Colorado River Storage Project Act, the Boulder Canyon Project Act, and the Boulder Canyon Project Adjustment Act."

This provision continues:

The criteria shall make provision for the storage of water in storage units of the Colorado River storage project and releases of water from Lake Powell in the following listed order of priority:

(1) releases to supply one-half the deficiency described in article III (c) of the Colorado River Compact, if any such deficiency exists and is chargeable to the States of the Upper Division, but in any event such releases, if any, shall not be required in any year that the Secretary makes the determination and issues the proclamation specified in section 202 of this Act;

(2) releases to comply with article III (d) of the Colorado River Compact, less such quantities of water delivered into the Colorado River below Lee Ferry to the credit of the States of the Upper Division from other sources; and

(3) storage of water not required for the releases specified in clauses (1) and (2) of this subsection to the extent that the Secretary, after consultation with the Upper Colorado River Commission and representatives of the three Lower Division States and taking into consideration all relevant factors (including, but not limited to, historic stream-flows, the most critical period of record, and probabilities of water supply), shall find this to be reasonably necessary to assure deliveries under clauses (1) and (2) without impairment of annual consumptive uses in the upper basin pursuant to the Colorado River Compact: Provided, That water not so required to be stored shall be released from Lake Powell: (i) to the extent it can be reasonably applied in the States of the Lower Division to the uses specified in article III (e) of the Colorado River Compact, but no such releases shall be made when the active storage in Lake Powell is less than the active storage in Lake Mead, (ii) to maintain, as nearly as practicable, active storage in Lake Mead equal to the active storage in Lake Powell, and (iii) to avoid anticipated spills from Lake Powell.

Water Storage

Colorado River Basin Storage

Thus this provision identifies purposes for which water is to be released from Lake Powell and the priority of such releases that the Secretary is to include in the operating criteria. After review and comment by the Basin state governors and other entities, the Secretary is to adopt criteria and publish them in the Federal Register.

Operating Criteria

Long-Range Operating Criteria (LROC)

Adopted in 1970, LROC first addresses the Upper Basin reservoirs authorized under the 1956 Storage Act. In an annual plan of operations to be made available on January 1st of each year, the Secretary of the Interior is to determine the quantity of water that is to be in storage in these reservoirs on September 30th to satisfy the requirements of Section 602 (a) of the 1968 Project Act (the amount reasonably necessary to assure deliveries under clauses (1) and (2) of Section 602 (a) without impairment of annual consumptive uses in the Upper Basin). If that amount is projected to be less than the amount required under Section 602 (a) or if projected storage in Powell on September 30th will be less than projected storage in Mead, releases from Glen Canyon are to be no more than the "minimum" objective of 8.23 maf during that water year.

Release Requirements

If Upper Basin reservoir storage is projected to be more on September 30th than the amount considered necessary by the Secretary under Section 602 (a), then releases may be greater than 8.23 maf for the year. There must be uses for this water in the Lower Basin, and such releases cannot be made if storage amounts in Powell are less than in Mead. Another objective for releases more than 8.23 maf annually is to maintain storage in Mead approximately equal to that in Powell.

Grand Canyon Protection

Grand Canyon Protection Act of 1992 (Protection Act)

The Protection Act directed the Secretary of the Interior to operate Glen Canyon Dam to "protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use." TITLE XVIII, RECLAMATION PROJECTS AUTHORIZATION AND ADJUSTMENT ACT OF 1992, Pub. L. 102-575, Oct. 30, 1992, 106 Stat. 4669, at Section 1802. The Secretary was to adopt operating criteria for Glen Canyon, developed using the National Environmental Policy Act (NEPA) environmental impact statement process. *Id*. at Section 1804. These criteria govern daily operations of the dam and operate consistently with the LROC.

Storage Level Trigger

Interim Guidelines for the Operation of Lake Powell and Lake Mead (Interim Guidelines)

In 2007, the Secretary of the Interior adopted these Interim Guidelines primarily to govern Lake Mead operations when storage levels drop below elevation 1,075 feet — triggering a shortage condition under which there would not be enough water available to enable annual consumptive use of 7.5 maf in the Lower Basin. If the Lake Mead elevation drops below 1,075 feet, the Secretary of the Interior automatically implements the shortage guidelines and reduces the allocation of Colorado River water to Arizona and Nevada. *See* complete Interim Guidelines at: www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf.

"Coordinated" Operations

In addition, in section 6 the guidelines govern "coordinated" operations of Powell and Mead. Reclamation conducts what is called the 24-month computerized study to project water elevations in both reservoirs. If the projected January 1 elevation levels in Powell are above so-called "equalization" levels set out in a table ((beginning at 3,636 feet in 2008 and gradually increasing to 3,666 feet in 2026), then Reclamation will make releases from Powell in excess of 8.23 maf until the storage levels of the two reservoirs equalize or certain elevation levels are reached (the "equalization tier"). *See* Record of Decision, Guidelines at 51. If the projected January 1 level is below the table value but the storage elevation in Powell is above 3,575 feet (9.52 maf of active storage), then there are several operational options that could involve releases from Powell of from 7.0 to 9.0 maf ("upper elevation balancing tier"). If the projected storage elevation in Powell on January 1st is below 3,575 feet, then releases are either 7.48 maf or 8.23 maf dependent upon the projected elevation of Lake Mead ("mid-elevation balancing tier"). If Powell's January elevation is projected to be less than 3,525 feet (5.93 maf of active storage), then Reclamation is to make releases of between 7.0 and 9.5 maf to "balance" the amounts in the two reservoirs ("low-elevation balancing tier").

Powell & Mead Elevations

The guidelines state: "Coordinated operation of Lake Powell and Lake Mead as described herein will be presumed to be consistent with the Section 602(a) storage requirement contained in the Colorado River Basin Project Act."

Colorado River Basin Storage

POTENTIAL LEGAL ISSUES FOR FMF

Introduction

Under the FMF approach, water coming from the Upper Basin would be passed through Glen Canyon Dam so long as there is storage space available in Lake Mead. Flows passing Lee Ferry would be measured to ensure that the 75 maf requirement over consecutive ten-year periods is met (75/10 requirement). Releases from Lake Mead would be managed to meet the Mexican Treaty delivery obligation and to make available sufficient water to enable consumptive use of 7.5 maf in Arizona, California, and Nevada when feasible. It would be necessary to change the operating rules for Lake Mead to account for the higher levels of storage than would otherwise exist. There would be less ability to operate the hydroelectric power facilities at Glen Canyon to meet peaking power demands and perhaps even to effectively generate electricity in some periods.

Based on these assumptions the potential legal issues are the Lee Ferry flow obligation under the 1922 Compact; the provisions in Section 602 of the 1968 Project Act; the Long-Range Operating Criteria; and the Interim Guidelines.

Potential Issues

Article III (d) of the 1922 Compact

75/10 Requirement

Arguably, there is an increased risk the 75/10 requirement might not be met in some years under the FMF approach. Storage in Lake Powell is used to ensure that at least 8.23 maf passes Lee Ferry each year. It is assumed the Paria River, entering the Colorado just above the Lee Ferry dividing point, contributes the other 20,000 acre-feet annually. Without that storage to even out high and low flow years in the Upper Basin, it is possible during periods of prolonged drought in the Upper Basin the 75/10 requirement will not be met. Under the Compact, the Upper Division states are obligated to reduce consumptive uses as necessary to enable sufficient water to reach Lee Ferry to bring the 10-year total to 75 maf.

Flow Probability

The Colorado River Basin Supply and Demand Study modeled the probability of Lee Ferry flow deficits under several different scenarios. (*See Technical Report G – System Reliability Analysis and Evaluation of Options and Strategies*, at G-19-20, 29). This analysis found the percent of "traces" (i.e. a single simulaton of the study period) with a deficit begins to increase markedly after 2020; by 2060 deficits appear in from 2 to 25 % of the traces. The potential size of the deficits ranges from 500,000 af to 3.5 maf. It is not clear there would be more curtailments under a FMF operating regime than under the existing regime, but there would certainly be great concern about this possibility. If the Basin states agree there would be more benefits under the FMF approach, there may be opportunities to put in place measures that would reduce the likelihood of a 75/10 shortfall such as using an accounting system to smooth out the annual variability of flows and even a relaxation of the requirement under certain circumstances. Presumably, such a relaxation would have to be part of a negotiated agreement containing benefits for the Lower Basin. [Author's Note: "A trace is a single simulation of the study period (2012-2060). To elaborate a bit, there are six demand scenarios, four supply scenarios and two reservoir operational policies for a total of 48 scenarios. However, for each of the supply scenarios, there are many 'realizations' of the next 50 years, thus producing a large number of traces when all scenarios are considered." Personal Communication, Kenneth Nowak, Bureau of Reclamation, April 29, 2013].

Potential Deficits

"Surplus" Conditions

It should be remembered that at the time the Compact was negotiated, the drafters assumed only the existence of Lake Mead. While the potential for a high dam at Glen Canyon was recognized, no one expressed the belief that such a dam was necessary to meet the 75/10 obligation. For most of its existence, Glen Canyon has been operated to ensure the availability of "surplus" conditions in the Lower Basin so the mainstream states could use as much water as there was demand for. As a result, consumptive uses in California reached approximately 5.3 maf, nearly 1 maf more than its basic apportionment. The U.S. Supreme Court in *Arizona v. California* used a strained interpretation of the Boulder Canyon Project Act to decide the three mainstream states held the right to annually consume 7.5 maf from the Colorado River itself, without accounting either for uses from the tributaries or for reservoir evaporation and river losses. Arizona got the Central Arizona Project despite widespread recognition there wasn't enough water in the

Colorado River Basin Storage

Reliable Supply

Lower Basin apportionment for its supply. In short, depletions of water in the Lower Basin expanded well beyond that contemplated under the 1922 Compact and probably beyond the capacity of the Basin water supply to sustain.

To return and keep Basin water uses within the Basin's reliable water supply it may well be necessary to cap existing depletions in the Lower Basin and begin their gradual reduction while also limiting increased consumption in the Upper Basin. For one such proposal, see MacDonnell, *The Disappearing Colorado River*, Western Economics Forum 1-6 (Fall 2010). As part of the negotiations that would be necessary to achieve such a substantial change, the Lee Ferry flow requirement (including water for the Mexico Treaty obligation) is likely to get substantial attention. If, as part of this process, the FMF proposal turns out to have important benefits it seems likely the Lee Ferry requirement can be addressed.

In any event, Article III (d) does not preclude a FMF approach. It is simply one of the considerations that must be taken into account.

Section 602 of the 1968 Project Act

Mexico Obligation

The provisions in this section resulted from lengthy negotiations among representatives from the seven Basin states and the US. A major concession from the Upper Basin was agreement to allow annual releases of 750,000 acre-feet to help meet the Mexico Treaty obligation while reserving the right to contest that the Upper Basin has any such obligation. In turn, the Upper Basin sought to protect sufficient storage in Lake Powell to essentially guarantee meeting its 75/10 year flow obligation at Lee Ferry as consumptive uses in the Upper Basin increased. The Lower Basin got the security that at least 8.25 maf of water would pass into the Lower Basin each year — more when storage in Powell was high. The Lower Basin also obtained the significant benefit of "equalization" — that storage amounts in Lake Mead would be maintained "as nearly as practicable" to the storage amounts in Lake Powell. As clarified in Senate Report 408 (1967), however, equalization was applicable only in times of "excess" water and not when no such excess is available. Senate Report 408 (1967) at p. 64.

"Equalization"

Upper Basin Use

There was much discussion of the Basin's reliable water supply during consideration of authorization of the Central Arizona Project (CAP). The Upper Division states commissioned a study by Tipton and Kalmbach in 1965 that concluded the availability of water for diversion by CAP depended on use of water apportioned to the Upper Basin under the 1922 Compact — that is, sufficient water would only be available if the Upper Basin states did not consumptively use water to which they were entitled. Tipton and Kalmbach, *Water Supplies of the Colorado River*, Prepared for the Upper Colorado River Commission (July 1965). Even Reclamation studies showed a shortfall of water for CAP over time as consumptive uses in the Upper Basin increased.

Missing Improvements

Congressional agreement to authorize CAP resulted in large part from several assumptions about expected improvements to Basin water supply that have not occurred: first, the legislation authorized studies of ways to "augment" the water supply by importing water from other locations; second, it included an apparent commitment by the US to find other water to meet the 1.5 maf annual delivery obligation to Mexico; and third, it included "salvage" provisions that were expected to increase the Basin's usable water supply by 680,000 acre-feet.

Colorado River Basin Storage

Reservoir Operations

FMF Accounting

Minimum Powell Release

Powell Pass Through

Indeed, just as expected, there have not been surplus conditions in the Lower Basin since 2005. To meet the Mexico delivery obligation, cover evaporation and other losses, and still deliver enough water to enable 7.5 maf of annual consumptive use of mainstream water in Arizona, California, and Nevada it has been necessary to draw down both Mead and Powell to record low levels. Reservoir operations are now managed under the Interim Guidelines, a negotiated agreement among the states and the US that dramatically alters the historical manner of operation of these reservoirs.

The terms of Section 602 (a) represent a statement of priorities for uses of Colorado River mainstream water: meeting the Mexico Treaty obligation first, Lee Ferry flows to support consumptive uses from the mainstream in the Lower Basin second, and consumptive uses in the Upper Basin third. The remainder of this provision (those terms following the word "Provided") comes into play only to the extent there is water available beyond that necessary to meet these priorities. Consequently, FMF must be implemented in a manner that follows those priorities and that can also meet the conditions under the proviso when applicable.

Under FMF, it would be necessary to use accounting procedures to track flows at Lee Ferry regarded as helping to meet the Treaty obligation and flows applying to meet the 75/10 requirement. So long as these obligations are satisfied it would seem the requirements of Section 602 (a) also are satisfied. It seems likely that just as interim guidelines include a presumption of consistency with Section 602 (a), a similar statement could be included in an agreement implementing FMF.

Long-Range Operating Criteria (LROC)

A FMF strategy would be inconsistent with the existing LROC, which are predicated on maintaining substantial storage in Lake Powell and using that storage to ensure a "minimum" release of 8.23 maf/annually. Adoption of a FMF approach would require revision of LROC, something that is explicitly within the authority of the Secretary of the Interior. Adoption of a FMF policy would almost certainly depend on agreement among the states and the US. Assuming such agreement could be reached, there would be little difficulty in making the necessary changes in the LROC.

Revised LROC would change operation of Lake Powell to allow a pass through of water to Lake Mead so long as there was sufficient available storage space in Mead. Releases from Mead average about 9.5 to 10 maf/year. Inflows from the Little Colorado and the Virgin River restore some of that water, but most comes from the Upper Basin. Presumably the objective of joint reservoir operation is to keep Mead as full as possible without risk of flood releases while only retaining in Powell water that cannot be safely stored in Mead.

Lake Powell - Glen Canyon National Recreation Area, Utah

Colorado River Basin Storage

Mead Levels (Trigger)

Interim Guidelines

A FMF strategy is inconsistent with the Interim Guidelines, which rely heavily on releases from Powell to keep Mead above levels that would trigger declaration of shortage conditions in the Lower Basin. In a sense, however, the Interim Guidelines help make the case for a FMF approach. Rather than the complexities of managing two reservoirs as if they are a single source of supply with multiple tiers triggering different releases, the FMF approach would emphasize managing storage in a single reservoir — Mead. Storage in Powell would serve primarily as insurance for unexpected events.

The guidelines would need to be changed or eliminated, a matter entirely within the authority of the Secretary of the Interior. Again, any change would depend on agreement of all the Basin states and the US. Assuming such agreement can be reached, there should no legal problems with revising the guidelines.

Power Generation

Water Supply

Other Legal Considerations

No doubt there are legally authorized uses of Glen Canyon Dam and Lake Powell that would be affected by a FMF policy. For example, electricity generation at the Glen Canyon power plant would likely be affected. It may be necessary to find replacement power to offset reductions in power availability. Commercial recreational uses of Lake Powell under contract with the US may also be affected. There may be liability associated with changes in reservoir storage that could not be otherwise offset. While these are issues that would need to be addressed to implement a FMF strategy, they in no way bar such an action. The use of Reclamation facilities for power generation and recreation are always secondary to their use for water supply. Should the decision be made that a FMF approach would improve water supply, these secondary uses would necessarily have to be adjusted.

CONCLUSION

Upper Basin Curtailment

The Fill Mead First Proposal is not precluded by any Federal or State statutes

While there will likely be objections to a FMF approach because of concerns it would increase the possibility that flows at Lee Ferry will not total 75 maf during every consecutive 10-year period, that possibility exists as well under the existing operating approach. *See* Reclamation, Colorado River Basin Water Supply and Demand Study (2012). Because the consequence of total flows not meeting this Compact requirement is that existing consumptive uses in the Upper Basin will have to be reduced, the Upper Division states are understandably concerned that the Lee Ferry flow obligation be met. Studies are needed to model the potential effects of FMF on meeting the 75/10 requirement. Should they indicate more years in which this requirement will not be met as opposed to existing operations, the Upper Division states are likely to oppose FMF unless there are other overriding benefits and ways to mitigate the effects of curtailments are found. So while there may be real issues of potentially increased risk to the Upper Basin associated with the FMF approach, there is no absolute legal barrier to its adoption.

Reclamation Priorities

Similarly, while Section 602 of the 1968 Project Act contemplated using Lake Powell to regulate flows into the Lower Basin there is nothing in the statutory language that absolutely precludes operations contemplated under the FMF approach. Its effect is merely to establish priorities for operation of Reclamation facilities: meet the Mexico Treaty obligation first; supply water to meet Lower Basin uses second; and, meet Upper Basin demands third. So long as these priorities are met, there is compliance with Section 602. The FMF proposal involves no change in these priorities. The provisos in the Section apply only in conditions when there is water availability in the Basin *beyond* that required to meet these priorities, a condition that does not seem likely to exist in the foreseeable future — but that would presumably mean storage levels in Lake Powell will be high enough to allow compliance with the provisos.

Interior's Authority

The Fill Mead First Proposal is inconsistent with the existing LROC and the Interim Guidelines

The FMF proposal is inconsistent with both the existing LROC and the Interim Guidelines. While the Guidelines would go away under FMF, the LROC would need to be substantially revised. Neither is adopted as a formal rule under the Administrative Procedures Act. They apply only to actions of Department of the Interior and can be changed by the Department. LROC are required under Section 602 of the Project Act, but they are subject to review and revision at least every five years. While any such revision requires consultation with the Basin states and other affected interests (the Grand Canyon Protection Act requires consultation with other agencies within the Department of the Interior, tribes, electric power producers, conservation groups, and other interests. Section 1804), their adoption is entirely within the control of the Secretary of the Interior. The same is true of the Interim Guidelines, which are intended to sunset at the end of 2026. The Guidelines in Section 7 B. 1 require the Secretary to consult with the Basin states before making any modifications: "The Secretary shall first consult with all the Basin States before making any substantive modification to these Guidelines." Indeed, adoption of the Interim Guidelines is itself evidence of the ability of the Secretary to make changes in the operation of Powell and Mead.

Colorado River Basin Storage

Uncertainty

Declining Water Supply

The Basin States and the US will have to decide the Fill Mead First Proposal is desirable to enable necessary changes in LROC and the Interim Guidelines

Interest in making a change to a FMF operating regime depends on an ultimate determination by affected interests — particularly those representing major water users in the Basin — of the benefits of such an approach. The Basin Study makes clear the Lower Basin may be facing shortages sooner than previously expected. Would FMF reduce the likelihood of such shortages? Unless and until there is further analysis and discussion enabling full consideration of the benefits and costs, nothing is likely to change.

At present, the Basin states seem uncertain about what to do. They are banking on there being enough water to maintain the status quo (and even increased consumptive use), an unlikely future according to most analyses. Some still hold out hopes for enhanced water supplies from some outside source(s). All are planning on increasing their use of Basin water to meet what they know will be increasing demands from users in their state located within the Basin or within areas to which Basin water currently is exported.

FMF appears to offer some promise for increasing the efficiency with which we manage and use a declining water supply. If, in fact, further analysis demonstrates this is the case, FMF may well become a piece of the answer to how we bring Basin water uses into line with reliable Basin water supplies. The questions about its feasibility are not essentially legal but political. Its political feasibility will depend on whether reservoir operations under a FMF approach enhance the goals of the Basin states.

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Additional Online Information

Colorado River Compact at: www.usbr.gov/lc/region/g1000/pdfiles/crcompct.pdf;
Colorado River Basin Water Supply and Demand Study at: www.usbr.gov/lc/region/programs/crbstudy.html
Boulder Canyon Project Act at www.usbr.gov/lc/region/pao/pdfiles/bcpact.pdf.
1944 Treaty with Mexico at: www.usbr.gov/lc/region/g1000/pdfiles/mextrety.pdf)
1948 Compact at: www.usbr.gov/lc/region/g1000/pdfiles/ucbsnact.pdf
1956 Storage Act at: www.usbr.gov/lc/region/g1000/pdfiles/crspuc.pdf
1968 Project Act at: www.usbr.gov/lc/region/g1000/pdfiles/crbproj.pdf
Long Range Operating Criteria at: www.usbr.gov/lc/region/g1000/pdfiles/opcriter.pdf
Grand Canyon Protection Act of 1992 at: www.usbr.gov/uc/legal/gcpa1992.html
Interim Guidelines for Operation of Lake Powell and Lake Mead at:
www.usbr.gov/lc/region/programs/strategies/RecordofDecision.pdf

Lawrence MacDonnell is an attorney and consultant in Boulder who recently retired as a professor of law at the University of Wyoming College of Law where he taught water law, public land law, and natural resources law. He was the first director of the Natural Resources Law Center at the University of Colorado School of Law, a position he held between 1983 and 1994. Between 1995 and 2009 he worked as an attorney and consultant in Boulder, Colorado. His work focused primarily on water resources and on ways to make natural resource development more environmentally compatible. His publications include numerous books, law review articles, other journal articles, and research reports. He has given over 250 invited presentations. He will be teaching water law at the University of Colorado, Boulder as an adjunct professor in fall 2013.

Climate Change Science

Evidence Strengthened

Severe Weather

Human Activities Dominant

Rate-of-Change Increase

CLIMATE CHANGE SCIENCE UPDATE

"*Our Changing Climate: An Update on the Science*"

A Presentation of Dr. Donald Wuebbles, University of Illinois (Urbana, Illinois)

For a Briefing hosted by the US Senate Committee on Environment and Public Works on February 13, 2013

Editors' Note: The text of the following article has been reprinted verbatim from a presentation made earlier this year to the US Senate Committee on Environment and Public Works. Minimal editing has been done to the graphics and graphics' captions to better match our format.

Thank you for the opportunity to present the latest evidence for our changing climate in the US. Changing trends in severe weather are of special concern.

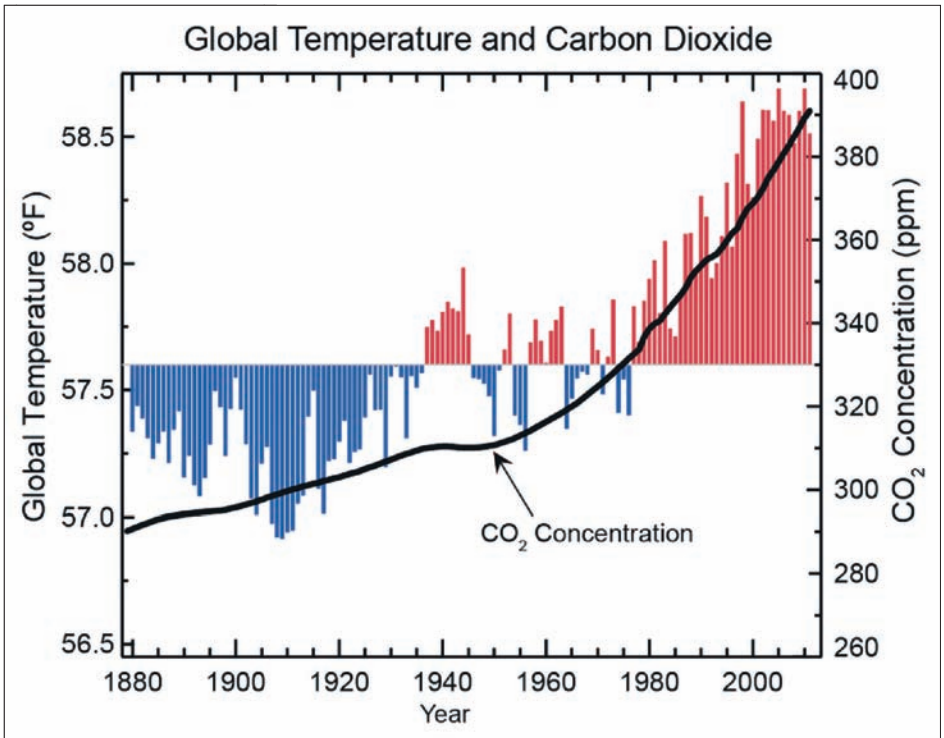
I am a professor and atmospheric scientist in the Department of Atmospheric Sciences at the University of Illinois. I am an expert in atmospheric physics and chemistry, and have authored over 400 scientific articles in peer reviewed journals, books, chapters of books, and in a number of national and international assessments related to concerns about ongoing changes in the Earth's climate and atmospheric chemistry. I co-lead the chapter on climate science for the US National Climate Assessment. The assessment is currently under review by the National Academy of Sciences and the public at ncadac.globalchange.gov. I am also a member of the Executive Secretariat that oversees the assessment process and the Federal Advisory Committee for the assessment. In addition, I am a Coordinating Lead Author on the next major international IPCC [Intergovernmental Panel on Climate Change] assessment of climate change. [Editor's note: as of the date of our publication, this next IPCC iteration was expected to be released by year's end — personnel communication with Dr. Wuebbles.]

As the son of an Illinois farmer, I am well aware of the importance of the climate to farmers and other Americans because of the effects of a changing climate on our economy and on our personal well-being. Our draft of the National Climate Assessment concludes that the evidence for a changing climate has strengthened considerably since the last assessment report written in 2009. Many more impacts of human-caused climate change have now also been observed. Corn producers in Iowa, oyster growers in Washington State, wine producers in California, and maple syrup producers in Vermont have all seen changes in their local climate that are outside of their experience. So too have coastal planners from Florida to Maine, water managers in the arid Southwest and parts of the southeast, and Native Americans on tribal lands across the nation. As we will discuss, there is also strong evidence of an increasing trend over recent decades in some types of severe weather. Scientific analyses suggest an increase in the likelihood of these events as our climate continues to change over this century. In today's testimony, I will focus on five main points about the changing climate in the US.

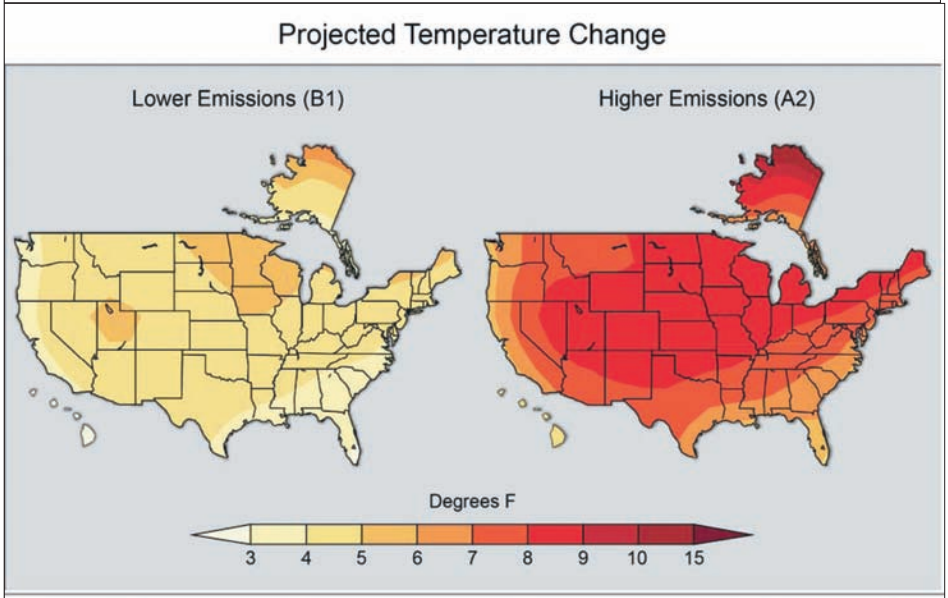
1. The US and the global climate is changing now and this change is apparent across a wide range of observations. The evidence indicates that most of the climate change of the past 50 years is primarily due to human activities.

There is no debate within the science community, based on the peer-reviewed literature, about the large changes occurring in the Earth's climate and the fact that these changes are occurring as a response to human activities, mainly burning fossil fuels (e.g., see the current draft National Climate Assessment for a discussion of the evidence; the figure below shows the trend in global temperatures). Natural factors have always affected our climate in the past and continue to do so today; but now, the dominant influence is human activities. The science is clear and convincing that climate change is happening, happening rapidly, and happening primarily because of human activities.

A wide variety of independent observations give a consistent picture of a warming world. In the US, average temperatures have increased by 1.5°F since 1900 with more than 80% of the increase occurring since 1980. As a result of this warming, the growing season is lengthening, sea levels are rising, and glaciers and arctic sea ice are melting. Such multiple lines of evidence and the consistency of findings among many independent analyses form the basis for the conclusion that the "warming of the climate system is unequivocal."



Caption. Global annual average temperature (as measured over both land and oceans; scale on left) has increased by more than 1.4°F since 1880. Red bars show temperatures above the long-term average, and blue bars indicate temperatures below the long-term average. The black line shows atmospheric carbon dioxide (CO_2) concentration in parts per million (ppm); scale on right. While there is a clear long-term global warming trend, some years do not show a temperature increase relative to the previous year, and some years show greater changes than others. These year-to-year fluctuations in temperature are due to natural processes, such as the effects of El Niños, La Niñas, and the eruption of large volcanoes. (Source: Temperature data from NOAA NCDC 2012, CO_2 data from NOAA ESRL 2012)



Caption: Maps show projected change in average surface air temperature in the later part of this century (2070-2100) relative to the early part of the last century (1901-1960) under a scenario that assumes substantial reductions in heat trapping gases (B1, left) and a higher emissions scenario that assumes continued increases in global emissions (A2, right). Projected changes are averages from 15 global climate models. In the low emissions scenario B1, CO_2 emissions increase by a small amount to 2050 and then decrease by 50% relative to 2010 emissions. In the high emissions scenario A2, which largely assumes continued heavy energy and transportation reliance on fossil fuels, CO_2 emissions increase throughout the century, by almost a factor of 3 in 2100 relative to 2010.

Natural drivers of climate cannot explain the observed warming over the last five decades; the majority of the warming can only be explained by the effects of human influences.

Our confidence in projections of future climate change has increased. Choices made now and in the next few decades will determine the amount of additional future warming (see maps, this page).

Lower levels of heat-trapping gas emissions will lead to noticeably less warming beyond the middle of this century. Higher emissions levels will result in more warming, and thus more severe impacts on many aspects of human society and the natural world. Emissions produced today will continue to affect our climate for decades and even centuries to come.

2. Heavy downpours are increasing in most regions of the US, especially over the last three to five decades. Certain types of other extreme weather events, including heat waves, and floods and droughts in some regions have become more frequent and intense. The trends are projected to continue.

Analyses from the NOAA National Climate Data Center indicate that the last two years, 2011 and 2012, have had some of the most extreme, and most costly, weather events in the history of our country. These two years have had the largest number of billion dollar events. Both years have had over $60 Billion in damages from severe events. The events include: major droughts and heat waves; severe storms; tornadoes; floods; hurricanes; and wildfires.

These recent events are just part of the picture, however. Overall, there has been an increase in some key types of extreme weather events since about 1960. Widespread changes in temperature extremes have been observed over the last 50 years. In particular, the number of heat waves globally has increased, and there have been widespread increases in the numbers of very warm nights. Numbers of very cold days, cold nights, and days with frost have decreased.

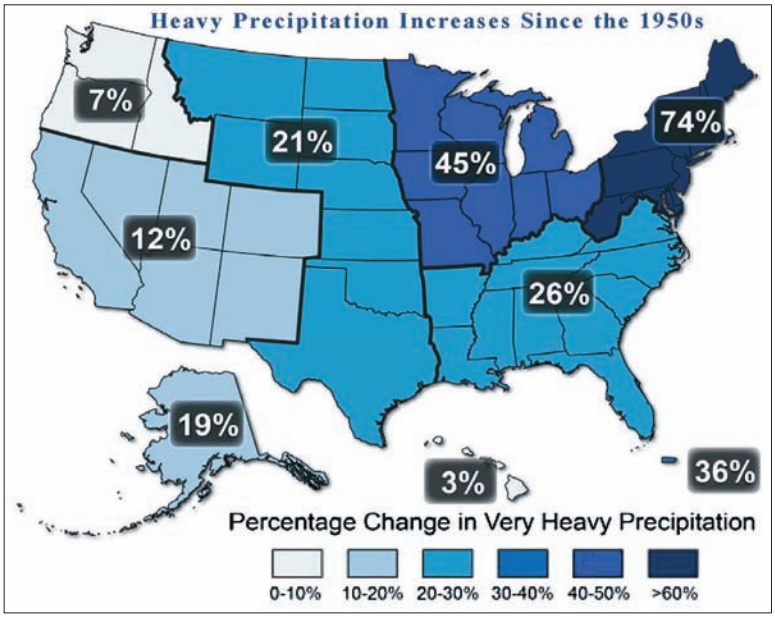
Overall, we're seeing more extreme heat and less extreme cold, as you'd expect in a warming climate. Heat waves have generally become more frequent across the US in recent decades, with western regions (including Alaska) setting records for numbers of these events in the 2000s. Recent prolonged (multi-month) extreme

Climate Change Science

heat has been unprecedented. The 2011 and 2012 events in the central US set records for highest monthly average temperatures, including the highest monthly temperature on record; for the spring and summer months, 2012 had the largest area of record-setting high monthly average daytime high and nighttime low temperatures combined. Corresponding with this increase in extreme heat, the number of cold waves has reached the lowest levels on record.

Intense Rainfall

Since the 1950s, there has been an increase in the amount of rain falling in the heaviest events (the top 1%) across the US (see figure below), with an increase of 45% in the Midwest and 74% in the Northeast. Over the US as a whole, there's been about a 20% increase in the amount of precipitation falling in the heaviest events. More intense rainfall means an increased likelihood of floods. In general, the national tendency for more precipitation coming as larger events is projected to further increase because as the atmosphere warms it holds more moisture.



Wet & Dry Increases

The general pattern of precipitation change is one of increases at higher northern latitudes and decreases in the tropics and subtropics over land. Essentially, the wet areas are getting wetter and the dry areas are getting drier, and this pattern is expected to continue.

For some severe weather events — such as tornadoes, lightning, hail and strong winds — uncertainties in data collection make it difficult to determine statistically significant trends.

3. Scientific analyses are now indicating a strong link between changing trends in severe weather events and the changing climate.

Severe Weather Link

Every weather event that happens nowadays takes place in the context of a changed background climate. Globally, the temperatures are higher, the sea level is higher, and there is more water vapor in the atmosphere, which energizes storms. So nothing is entirely "natural" anymore. The background atmosphere has changed and continues to change due to human activity.

It's a fallacy to think that individual events are caused entirely by any one thing, either natural variation or human-induced climate change. Every event is influenced by many factors. Human-induced warming is now a contributing factor in all weather events.

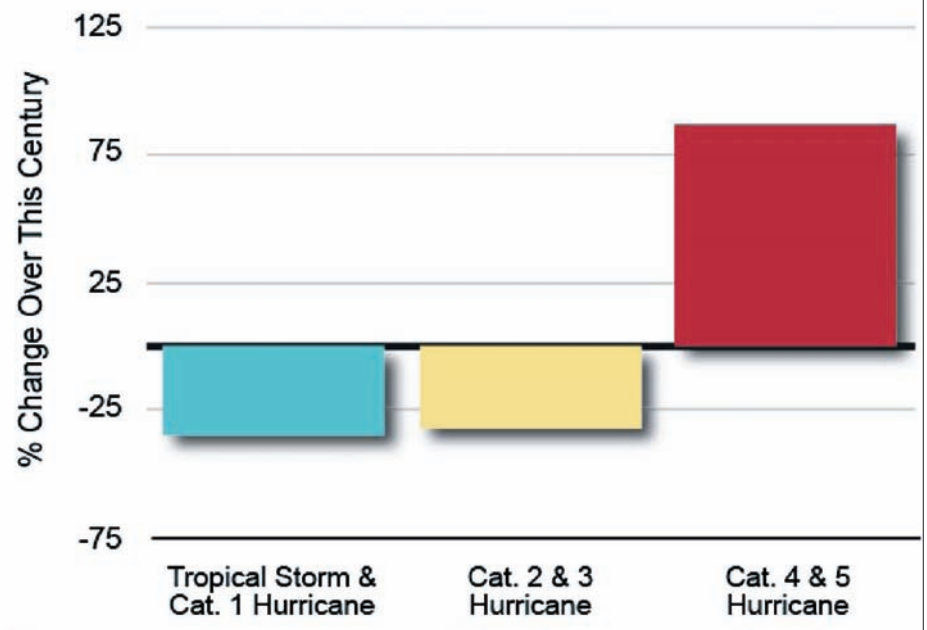
Heat Waves

We're seeing more heat waves and they are hotter and they last longer. And while a particular heat wave may still have occurred in the absence of human-induced warming, it would not have been as hot, or lasted as long, and such events would not occur as frequently. For example, an analysis of the Texas heat wave of 2011 found it was 20 times more likely due to human-induced warming than it would have been otherwise. And in the future, summers that hot will be commonplace, if we continue on our current path of increasing emissions of heat-trapping gases.

Wet/Dry Cycles Intensifying

The changes occurring in precipitation are also consistent with our understanding of our changing climate. For extreme precipitation, we know why more precipitation is falling in very heavy events — warmer air holds more water vapor, and so when any given weather system moves through, all that extra water dumps out in a heavy downpour. And in between these downpours there are longer periods without rain. So you get this cycle of very wet and very dry conditions. And we're seeing this happening now, just as climate studies indicated it would. The same is true for heavy snowfall events.

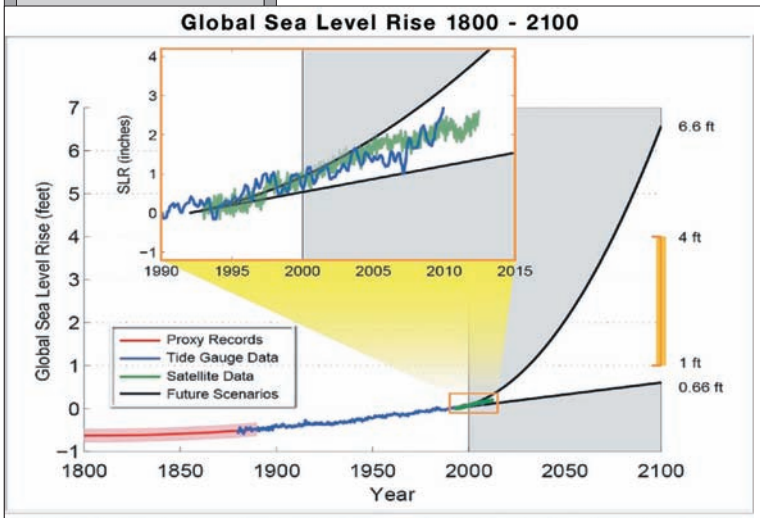
At the same time, droughts like we have been seeing in recent years in the Southwest and Midwest are projected to become stronger and more frequent as climate change continues.



Model projections of percentage changes in Atlantic hurricane and tropical storm frequencies for different storm categories, by the late this century, showing that intensity is likely to increase. Projected changes are for the period 2081-2100 compared with the period 2001-2020.

Climate Change Science

Sea Level Rise



Caption. Estimated, observed and possible amounts of global sea level rise from 1800 to 2100. Proxy estimates (Kemp et al. 2012) (for example, based on sediment records) are shown in red (pink band shows uncertainty), tide gauge data in blue (Church and White 2011), and satellite observations are shown in green (Nerem et al. 2010). Future scenarios range from 0.66 feet to 6.6 feet in 2100 (Parris 2012). Higher or lower amounts of sea level rise are considered implausible, as represented by the grey shading. The orange line shows the currently projected range of sea level rise of 1 to 4 feet by 2100. The large projected range reflects uncertainty about how glaciers and ice sheets will react to the warming ocean, the warming atmosphere and changing winds and currents. As seen in the observations, there are year-to-year variations within the long-term upward trend.

4. There has been an increase in the overall strength of hurricanes and in the number of strong (Category 4 and 5) hurricanes in the North Atlantic since the early 1980s. The intensity of the strongest hurricanes is projected to continue to increase as the oceans continue to warm.

There has been a substantial increase in virtually every measure of hurricane activity in the Atlantic since the 1970s. These increases are linked, in part, to higher sea surface temperatures in the region in which Atlantic hurricanes form in and move through.

Climate models that incorporate the best understanding of all the factors affecting hurricanes project further increases in the frequency and intensity of the strongest Atlantic hurricanes, as well as increased rainfall rates in response to continued warming of the tropical oceans.

Hurricane activity in other ocean basins like the Pacific has not shown such clear increases as those found in the Atlantic, but there is a lack of sufficient historical data in these regions.

5. Global sea level has risen by about eight inches since 1880. It is projected to rise another one to four feet by 2100. Many coastal areas of the US will be increasingly affected.

After at least two thousand years of little change, sea level rose by roughly eight inches over the last century, and satellite data provide evidence that the rate of rise over the past 20 years has roughly doubled. In the US, millions of people and many of the nation's assets related to military readiness, energy, transportation, commerce, and ecosystems are located in areas at risk of coastal flooding because of sea level rise and storm surge.

Sea level is rising because ocean water expands as it heats up and because water is added to the oceans from melting glaciers and ice sheets. Sea level is projected to rise an additional one to four feet in this century. Scientists are unable to narrow this range at present because the processes affecting the loss of ice mass from the large ice sheets are dynamic and still the subject of intense study. Some impact assessments consider sea level rise as high as 6.6 feet by 2100.

Nearly five million people in the US live within four feet of the local high-tide level. In the next several decades, storm surges and high tides could combine with sea level rise and land subsidence to further increase flooding in many of these regions.

Climate Change Science

Choices

Climate Models

Remarkable Accuracy

Consistent Findings

Long-Term Upward Trend

CONCLUSIONS

In conclusion, while we are already seeing the climatic effects of our emissions of heat-trapping gases, it is important to recognize that the future lies largely in our hands. Will we reduce our emissions, and have a future with less warming and less severe impacts, or will we continue to increase our emissions and have a future with more warming and more severe impacts, including more extreme weather events? The choice is ours.

ADDENDUM: Addressing Some of the Commonly Asked Questions About Climate Change

Below I address just a few questions that might be of interest to the members of the Senate. Many other Commonly Asked Questions are addressed in an Appendix of the draft National Climate Assessment (go to http://ncadac.globalchange.gov and select Appendix 1).

Should we trust computer models of the Earth's climate?

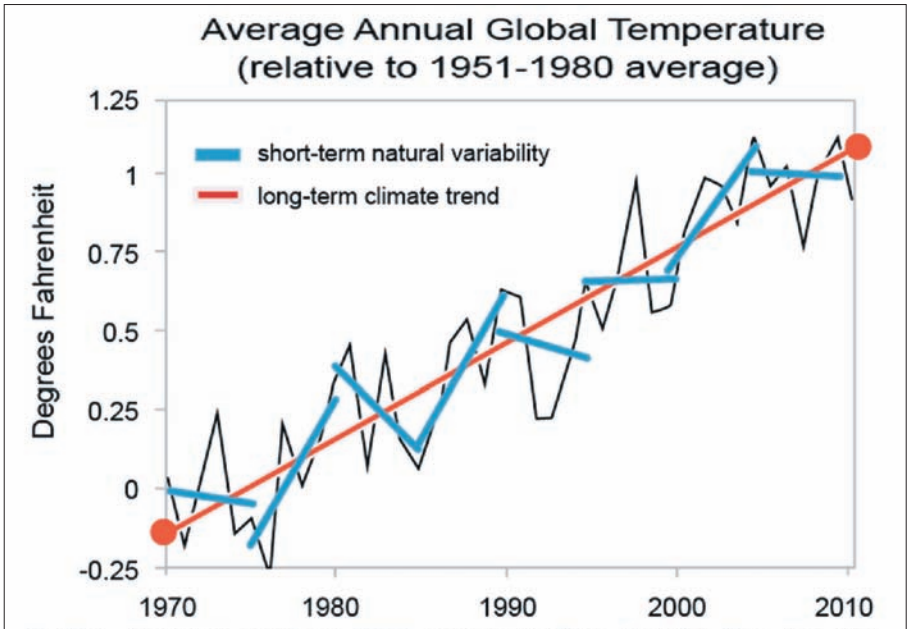
Some people wonder if they should trust computer climate models. While no model is perfect, climate models have proven remarkably accurate in forecasting the climate change we've experienced to date. In a few cases, model projections have been overly conservative, for example, in projecting how quickly Arctic sea ice would decline. It has in fact declined more rapidly than the models forecast.

Today's climate models encapsulate the great expanse of current understanding of the physical processes involved in the climate system, their interactions, and the performance of the climate system as a whole. They are extensively tested relative to observations and are able to reproduce the key features found in the climate of the past century.

Because models differ in their representation of certain processes, we make use of these differences by examining suites of models in climate assessments. However, they all give the same basic story. Also, despite the tremendous improvements in the climate modeling capabilities over my 40 years as a scientist, the basic response of a significant effect on the climate system from human activities continues to be about the same as the models were finding 40 year ago. These models are the only crystal balls we have — and although not perfect, they are very useful tools.

Is the global temperature still increasing? Isn't there recent evidence that it is actually cooling?

Climate change is defined as a change in the average conditions over periods of 30 years or more. On these time scales, global temperature continues to increase. Over shorter time scales, however, natural variability (due to the effects of El Niño and La Niña events in the Pacific Ocean, for example, or volcanic eruptions or changes in energy from the Sun) can reduce the rate of warming or even create a short-term cooling. We do not expect every single year to be warmer than the previous year, because there are still natural variations in climate. The long-term trend is very clearly an upward one, but not in a straight line.

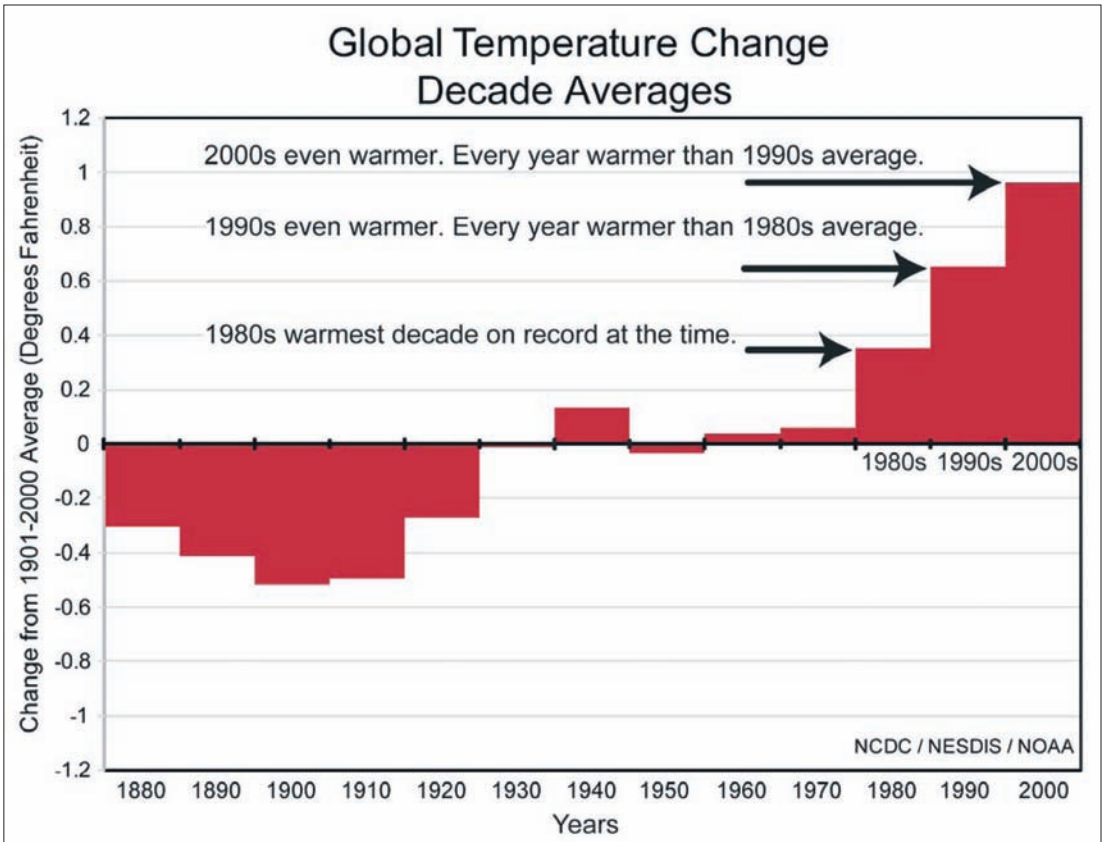


Caption. Short-term trends in global temperature (here, the blue lines that show temperature trends at five-year intervals from 1970 to 2010) can range from negative to sharply positive. The evidence of climate change is based on long-term trends over 20-30 years or more (red line). Measurement data from NASA-GISS.

Climate Change Science

Temperature Increases

As shown below, every decade in the last 50 years has been warmer than the one before it. The decade of the 2000s was the warmest globally.



Caption: The last 5 decades have seen a progressive warming of the Earth. Measurement data from NOAA NCDC.

Climate is always changing. How is recent change different than in the past?

Accelerated Changes

The Earth has experienced large climate changes in the past. However, current changes in climate are unusual for two reasons: first, these changes are occurring faster and second, these changes are primarily the result of human activities.

In the past, climate change was driven exclusively by natural forcings: explosive volcanic eruptions that inject reflective particles into the upper atmosphere and cool climate on short time scales; or periodic variations in the Earth's orbit that change climate on longer timescales.

Unprecedented Warming Rate

Natural factors are still affecting the planet's climate today. The difference is that, since the beginning of the Industrial Revolution, humans have been adding increasing amounts of heat-trapping gases to the atmosphere at a much faster rate than can occur naturally as we dig up billion year old carbon in the form of coal, oil and gas and release that carbon to the atmosphere in the geological blink of an eye. Records from ice cores, tree rings, and other forms of "natural thermometers" reveal three important findings. First, recent climate change is unusually rapid. After a glacial maximum, the Earth typically warms by about 7 to 13°F over thousands of years. The current rate of warming is about eight times faster.

Historic First

Second, global temperatures in the last 100 years are unusually warm when compared to temperatures over the last several thousand years. And third, carbon dioxide levels are currently higher than any time in at least the last 800,000 years. Paleoclimate studies indicate that temperature and carbon dioxide levels have been higher in the distant past, millions of years ago, when the world was very different than it is today. But never before have such rapid, global-scale changes occurred during the history of human civilization.

Our societies have not been built to withstand the changes that are anticipated in the relatively near future, and many are already experiencing the effects of failure to anticipate higher temperatures, sea level rise, and other climate-related impacts.

For Additional Information:
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Don Wuebbles is the Harry E. Preble Professor of Atmospheric Science at the University of Illinois. He is a professor in the Department of Atmospheric Sciences as well as an affiliate professor in the Departments of Civil and Environmental Engineering and in Electrical and Computer Engineering. He was the first Director of the School of Earth, Society, and Environment at Illinois, was the first Director of the Environmental Council at the University, and was Head of the Department of Atmospheric Sciences for many years. Dr. Wuebbles is an expert in numerical modeling of atmospheric physics and chemistry. He has authored over 400 scientific articles, relating mostly to atmospheric chemistry and climate issues. He has been a lead author on a number of national and international assessments related to concerns about climate change. He has also been a lead author on national and international assessments relating to atmospheric chemistry and the effects of human activities on stratospheric and tropospheric ozone. Dr. Wuebbles and colleagues received the 2005 Stratospheric Ozone Protection Award from the US Environmental Protection Agency. He has been honored by being selected a Fellow of three major professional science societies, the American Association for the Advancement of Science, the American Geophysical Union, and the American Meteorological Society. He is the Chair of the Global Environmental Change Focus Group for the American Geophysical Union. He shares in the 2007 Nobel Peace Prize for his work with the international Intergovernmental Panel on Climate Change. He was a member of a federal advisory committee that assessed and in 2009 published a report on the potential impacts of climate change on the United States. Professor Wuebbles is a Coordinating Lead Author for the next major international IPCC assessment of climate change that will be published in 2013 and is a leader in the next US National Climate Assessment, being a member of the Executive Secretariat and the Federal Advisory Committee. Don and his wife, Barbara, have been married for 42 years and have three sons and two grandsons. Don grew up on a farm near Carlyle, Illinois. He has two degrees in Electrical Engineering from the University of Illinois and a PhD in Atmospheric Sciences from the University of California, Davis.

In-Conduit Hydropower

IN-CONDUIT HYDROPOWER

AT THE WATER-ENERGY NEXUS: RENEWABLE ENERGY FROM IN-CONDUIT HYDROPOWER

by Jennifer Allen Newton, Bluehouse Consulting Group, Inc. (Hillsboro, OR)

INTRODUCTION

The water-energy nexus — the interdependency between water and energy — is fast becoming a hot topic of conversation on the world stage. Quite simply, it takes a lot of water to produce energy and it takes a lot of energy to deliver water.

Water for Energy

Cooling Water

Huge amounts of cooling water are used in the daily operation of coal and nuclear power plants. Gas companies compete with farmers for water rights for the hydraulic fracturing of shale gas wells. Production of biofuels requires agricultural water and even the production of photovoltaic solar panels is water-intensive. In its November 2012 World Energy Outlook, the International Energy Agency (IEA) said that "the energy sector already accounts for 15% of the world's total water use" and that "its needs are set to grow, making water an increasingly important criterion for assessing the viability of energy projects."

Energy for Water

Energy for Delivery

Likewise, large amounts of energy are required to pump, move, store, purify, and deliver water. Energy is the number one cost center, or biggest expense, for municipal water utilities. According to the US Environmental Protection Agency (EPA), drinking water and wastewater facilities spend about $4 billion per year on energy to treat water — operating costs that can add up to one-third of a municipality's total energy bill. A 2009 study by The River Network estimated that water-related energy use in the US is at least 521 million **m**ega**w**att **h**ours (Mwh) a year, which is the equivalent of 13% of the nation's electricity consumption. EPA estimates that in California energy expendit ure on water is more than 20%.

Driven by shrinking budgets, rising energy costs, and the need to reduce their carbon footprints, managers of municipal water and wastewater systems have been seeking more cost-effective, renewable sources of energy.

Energy from Water

Renewable Approach

A new renewable energy approach — in-conduit hydropower — provides an opportunity for water agencies to use their own infrastructure to generate low-cost, renewable energy around the clock. Putting hydrodynamic turbines inside of large, gravity-fed water pipelines provides an opportunity to generate predictable, non-weather-dependent electricity from the fast-flowing water under our cities, towns, and agricultural areas — with no environmental impact and no disruption to pipeline operations. Forward-thinking water utilities like Riverside Public Utilities in California, Portland Water Bureau in Oregon, and San Antonio Water System in Texas are already on board with this new, cost-effective renewable energy technology.

IN-CONDUIT HYDROPOWER

In-conduit (also known as in-pipe) hydropower sits at the intersection of water and energy. It enables both water providers and large industrial and agricultural water users to produce carbon-free, baseload electricity from an existing, renewable resource, i.e. the water flowing through their water and effluent pipelines.

In-Conduit Hydropower

In-Pipe Turbine

Portland, Oregon-based Lucid Energy has been developing, testing and perfecting in-conduit hydroelectric technology since 2007. Fueled by a grant from the US Department of Energy and a partnership with Northwest Pipe Company, Lucid Energy has developed the LucidPipe Power System, a patented solution that integrates a spherical turbine inside a large-diameter water pipe along with the power electronics that connect to the grid like a solar system or wind turbine. The lift-based turbines spin as water passes through them, converting potential energy, in the form of water flow and pressure head inside the pipe, into electricity with minimal impact to operations. The LucidPipe Power System turbines have been tested and Certified by the National Sanitary Foundation (NSF International) to NSF/ANSI Standard 61 for use in potable water systems. NSF/ANSI Standard 61 is the national standard for products connected to safe drinking water. Thus, receiving NSF Certification is a significant achievement, as drinking water standards in the US are among the strictest in the world.

Pilot Awarded

Lucid Energy piloted three versions of the system at Riverside Public Utilities (RPU) in California and received its first patent in May 2011 and a second patent in January 2013. The Riverside installation earned RPU a 2011 "Outstanding Energy Management Award" from the California-Nevada section of the American Water Works Association (AWWA). In January 2012, the company installed the first commercial version of the LucidPipe Power System at RPU and announced broader commercial availability in April 2012.

Pressure Reduction

The energy produced with LucidPipe can be used to power equipment behind the meter or fed back into the grid to help offset energy costs or generate new revenue streams through Power Purchase Agreements. In addition to producing electricity, the slight reduction in head pressure confers added advantages for pipeline operations. Most gravity-fed systems utilize a pressure reducing valve system to reduce the amount of pressure in water pipelines before water is delivered. Because the LucidPipe turbines are placed before the valve, they help relieve pressure, which not only reduces wear on valves but also helps reduce water leakage.

For industries such as thermo-electric plants, mining operations, paper mills, and others that use large amounts of water in open-loop cooling systems, the turbines can be placed near the water return outlets to capture otherwise wasted energy and help offset water pumping costs.

How LucidPipe Works

Flow Utilization

The blades (or hydrofoils) of the LucidPipe turbine generate lift as water flows through them, causing the turbine to rotate about its central shaft. As the turbine spins it extracts pressure from the flow of water. The turbine is connected to an electrical generator that is mounted outside of the pipe. The generator, which is the same kind used with wind turbines, is then connected to additional electrical components that regulate electricity flow and ensure compatibility with the local grid. The speed of the turbine is governed by the velocity of the water.

Central Control System

A central control system allows for monitoring, managing, and controlling water velocity to maintain output to the optimal operational efficiency. The pipeline operator can determine optimal operation based on flow conditions and the amount of pressure that needs to be extracted. The control system gives the operator more control over his/her operation. With it, they can manage electricity generation, pressure extraction, or both, based on the needs, preference, and financial benefit to the operator or project owner. Unlike conventional hydropower technologies, the lift-based LucidPipe turbine can operate in a wide range of velocities, so it can be used in pipelines and effluent streams with flows as low as 3 feet per second (FPS). Flows that range from 3 FPS to 12 FPS and pressure of at least 5-7 pounds per square inch (PSI) are ideal for each LucidPipe turbine. When operating, each turbine extracts a small amount of head pressure (1-6 PSI). Each turbine within the system can be operated independently. When turned off, the turbine stops spinning and very little pressure (<1 psi) is extracted as water flows past.

Water Velocity Ranges

The power generated by the LucidPipe is proportional to the water velocity. For example, each 42-inch, single-turbine LucidPipe has a 50 kilowatt (kW) capacity. Multiple turbines can be installed along a pipeline to produce hundreds of kilowatts or megawatts of electricity. The number of turbines that may be integrated at a site is determined by assessing the expected flow rates, the pressure that may be extracted from those flows, and the physical length of pipeline that is available. Generally, each turbine is spaced four diameters apart, i.e. four times the diameter of the pipe from each other. The LucidPipe Power System currently accommodates pipes from 24 inches - 60 inches based on operating conditions. A larger system is planned for early next year.

Cutaway of LucidPipe In-Conduit Generation System showing internal hydrofoils and external generators

The system does not need to be placed in a pressure transient zone or where extreme differential pressures are needed. However, the turbines may be placed upstream from a valve used to control flow rate or pressure. As noted above, when placed upstream from a valve the slight reduction in pressure reduces wear and tear on the valve and also helps reduce water leakage in the pipeline.

In-Conduit Hydropower

Pressure & Generation

Installation

Utilizing Primary Asset

Electricity Output

The rate at which a pipeline leaks increases as its internal pressure (gage pressure) rises. Pressure head inside a gravity-fed pipeline that transmits water over long distances may rise to levels that are higher than necessary, so pressure reduction valves are often used at points where pressure is critically high in order to achieve safer and more cost-effective pressure levels downstream. These valves are effective at reducing pressure, but the potential energy of the excess head pressure is essentially lost in the valve, burned off as heat and noise.

Similar to a valve, LucidPipe systems have the ability to lower the pressure along the entire length of the pipeline, with the excess head pressure converted to electricity by the turbines. Thus, when used in pipelines with lower pressure reduction needs, or in conjunction with valves in higher pressure systems, the system helps reduce the amount of water lost to leakage, helps pipeline operators manage pressure more efficiently, and offers tangible benefits to the water utility or project owner's bottom line.

Installing the System

The LucidPipe Power System is a complete water-to-wire solution comprised of a control system, with multiple energy generating turbine systems in its own pipe section. The system includes a drivetrain, generator, power electronics, and other hardware required to connect the system to the grid or wherever power is required. The system is installed underground in a vault or above-ground for easy access. Each turbine is integrated into a pipe section. The pipe sections are bolted together and then welded or bolted to the new or existing pipeline. The generator and other power system components are the same as those used to connect a wind turbine to the grid. Electricity produced by the system can be used internally or connected to the grid and can be configured to be single phase AC or three-phase depending on requirements.

LucidPipe is assembled locally and delivered to the construction site as a complete system. This keeps installation time to a minimum (usually a day or two).

ECONOMIC BENEFITS TO WATER UTILITIES

As water agencies face shrinking budgets, rising energy costs, and mandates for the use of renewable energy, many are seeking alternatives that reduce the energy intensity and volatility of fossil-fuel-based grid power. Unlike other renewable energy options, LucidPipe uses the primary asset water agencies have at their disposal — water moving through pipelines — to generate a consistent, reliable, carbon-free and cost-effective means of generating their own electricity. The system enables water agencies to improve the efficiency of their pipeline operations while reducing energy costs and developing new revenue streams that help fund growth and modernization of their infrastructure.

Riverside Public Utilities (RPU) in Riverside, California — which was the pilot site for development and testing of the LucidPipe Power System in an operational water system — installed the first commercial system in January 2012. That system is comprised of a single, 42-inch turbine inside of a 60-inch water pipeline that delivers water from the Gage Canal to RPU's residential and business customers. Electricity produced by the system is fed directly to RPU, which uses the electricity to offset operations during the day and to power streetlights at night. To date, more than 45 megawatt hours (MWh) of energy have been produced by the system.

Installation by Riverside Public Utilities

In-Conduit Hydropower

Portland, OR System

San Antonio, TX System

Tax Credit Availability

Energy Sales Agreements

Energy/Water Use Trends

Water Infrastructure Needs

Jennifer Allen Newton, President of Bluehouse Consulting Group, Inc. (www.bluehousecg.com) in Hillsboro, Oregon, is a writer and consultant working with companies and organizations in the environmental, clean technology, and industrial sectors.

A new LucidPipe installation is now in progress in the City of Portland, Oregon. Lucid Energy and the Portland Water Bureau are installing a four-turbine system in a large-diameter (50-inch), water pipeline that provides drinking water to the people of Portland. When completed in summer 2013, the four turbines will occupy approximately a 50-feet length of pipe located upstream of an annex for a recently installed flow control valve. Real-time performance data and measured conditions will be available directly to the municipal **s**upervisory **c**ontrol **a**nd **d**ata **a**cquisition (SCADA) infrastructure to further enhance control and visibility of pipeline operations (SCADA refers to computer control and information systems that monitor and control industrial processes at utilities). Once complete, the system will generate an average of 1,100 MWh of energy per year — enough electricity to power up to 150 homes. The installation of the LucidPipe system is part of Portland's mission to reduce the energy intensity and costs of delivering safe, clean drinking water.

San Antonio Water System (SAWS) in Texas has also announced plans to deploy the LucidPipe Power System in 2013 as part of the Regional Carrizo Water Supply Project that will deliver up to 17,200 acre-feet of water per year from the Carrizo Aquifer to the city of San Antonio. The new 60 kW-rated system will include three turbines inside of a section of 24-inch steel water pipe at SAWS. The energy produced will be used to power equipment onsite at SAWS.

Project economics are compelling. In the US, the LucidPipe Power System qualifies for the Investment Tax Credit (ITC) and Production Tax Credit (PTC) as well as state incentives for renewable energy generation. Municipalities are not eligible to use federal tax incentives, so these incentives are crucial to success in bringing in private investors. In many cases, no out-of-pocket capital is required to install the system. Funding is available through Lucid Energy and its partners, who are some of the best-known Energy Service Companies in the United States, including CH2M Hill, Honeywell, and Siemens, and renewable energy developers who want to finance projects for water agencies.

In municipalities like Portland, net metering regulations allow power generated by the system to be sold back to energy utilities through Power Purchase Agreements (PPA). In large pipelines with heavy flows and excess available pressure, paybacks can be less than seven years for typical projects. Payback with incentives is under seven years, which is particularly important in places like the Pacific Northwest where electricity costs are among the lowest in the country.

CONCLUSION

IN-CONDUIT HYDRO: A GLOBAL OPPORTUNITY

Both energy and water use are increasing at a global scale. According to the International Water Management Institute, water withdrawals are predicted to increase by 50% by 2025 in developing countries and 18% in developed countries. The International Data Base of the US Census Bureau projects that energy use will have increased by nearly 50% in the period from 2007–2035. The IEA predicts that expanding power generation and water-dependent biofuels will result in an 85% increase in the amount of water consumed (water that is not returned to its source after use) through to 2035.

The increasing demand for water is resulting in new pipeline construction around the world. At the same time, existing pipeline infrastructure in many parts of the world, including the U.S. and Europe, is failing and in dire need of upgrade and repair.

Meanwhile, the World Bank estimates that worldwide costs from leaks in water pipelines total $14 billion annually. In the US alone, the EPA estimates that $650 billion in water infrastructure upgrades will be needed to replace aging pipelines and to satisfy new demand over the next 20 years.

This presents a tremendous opportunity for in-conduit hydro projects, which are most cost-efficient when installed during routine pipe maintenance, replacement, or in new pipeline construction. With LucidPipe systems incorporated into the miles of pipeline slated for rehabilitation and new construction, there is potential to generate billions of megawatts of renewable electricity from an otherwise untapped, clean energy resource.

The water-energy nexus is a critically important area of investment, both for private industries that need to improve their economics around water and energy usage as well as for municipalities and irrigation districts who need to find ways to offset the rising cost of energy to deliver water to their customers. For developing and fast-growing nations with thousands of miles of new water infrastructure being built, LucidPipe systems provide an opportunity to turn water pipelines — even in remote locations — into generators of carbon-free, baseload electricity to run pumps and other equipment on-site or provide power to communities along the way.

In-conduit hydropower turns the water-energy nexus into an opportunity to produce clean energy, help implement smart-grid technology, and provide energy security around the world's most precious resource: water.

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WATER QUALITY TRADING

AN UPDATE ON LAWSUITS AND LEGAL CHALLENGES

by Teresa Jacobs and Priscilla Hampton, Perkins Coie (Portland, OR)

[**Editor's Introduction:** Readers will recall that Tom Lindley authored *Lawsuit Challenges All Water Quality Trading*, which appeared in our November 2012 issue, *TWR*# 105. This article provides an update about the litigation described in Tom's November article and additional information about related challenges.]

Water Quality Trading

Credit Generation

TMDL Challenged

CWA Authorization Questioned

Broad Implications

INTRODUCTION

Water quality trading programs typically allow point source dischargers to purchase credits generated from pollution reduction projects implemented at nonpoint sources such as farms. For example, credits may be generated from implementation of projects on farm lands (projects not otherwise required under state law) that reduce nutrient loading upstream to achieve reductions in oxygen demand downstream, such as livestock management or identification of critical area set-asides. Point source dischargers are able to purchase credits and use them to meet their NPDES permit limits. Such restoration projects are beneficial for two reasons. First, they are less expensive than installing conventional "end-of-pipe" wastewater treatment technologies, and second, they provide multiple ecosystem benefits such as improved habitat.

CHALLENGE TO CHESAPEAKE BAY TMDL

Food and Water Watch and Friends of the Earth filed a lawsuit on October 2, 2013, in the U.S. District Court for the District of D.C. to challenge provisions in EPA's total maximum daily load (TMDL) for the Chesapeake Bay. *Food & Water Watch v. Envtl. Prot. Agency*, Case No. 12-cv-01639 (D.D.C.). The challenged TMDL provisions allow water quality trading between point and nonpoint sources of pollution in order to reach pollution reduction goals set forth in NPDES permits regulating point sources discharges.

The environmental groups' position in the *Food and Water Watch* case — that water quality trading is not authorized under the Clean Water Act — is of key national interest. The plaintiffs contend that water quality trading is not authorized because it allows point source dischargers to avoid compliance with technology and water quality standards required under the Act. Specifically, they claim that "[t]rading and offsets allow point sources to violate their NPDES permits by discharging greater amounts of pollutants than their waste load allocations permit," which they argue will lead to "local and downstream non-attainment of water quality standards." Several entities have intervened in the lawsuit, including the National Association of Clean Water Agencies, several state municipal water quality agencies, the National Association of Home Builders, and the American Farm Bureau Federation. The US Environmental Protection Agency (EPA) and intervenors filed motions to dismiss the case based on procedural arguments, including the contention that no alleged violations have yet occurred because trading under the TMDL has not been implemented through any permits. These motions are pending before the court. If the court eventually considers the merits of the plaintiffs' contentions about the legality of water quality trading, the outcome of the case could have broad legal implications regarding EPA's and states' water quality trading policies.

OREGON'S WATER QUALITY TRADING PROGRAM

With respect to Oregon's water quality trading program, Northwest Environmental Advocates (NWEA) recently sent a letter to EPA's Office of Water and Watersheds raising concerns about how water quality trading has been incorporated into the City of Medford, Oregon's NPDES permit. NWEA's letter also included general concerns about Oregon's water quality trading policies and the Oregon Department of Environmental Quality's (ODEQ's) guidance on water quality trading. Specifically, NWEA did not allege that water quality trading is illegal, but instead argued that when ODEQ approved trading under the City of Medford's permit, it "gave no consideration whatsoever to baseline requirements for nonpoint sources involved in creating thermal credits. As a result, Oregon DEQ simply assumed that existing conditions — not TMDL Implementation Plans — are the baseline." At the heart of this issue is the concern that water quality credits are generated by projects that are already required under the TMDL. In other words, NWEA and other environmental groups contend that the credits do not go beyond the baseline requirements set forth in the TMDL to achieve further benefits in addition to those already required under the TMDL.

The Freshwater Trust, which executed a contract with the City of Medford to provide its Regional Water Reclamation Facility with thermal credits generated from riparian restoration projects implemented along the Rogue River, responded to NWEA's letter on April 22, 2013. The Freshwater Trust's position is that the City of Medford's water quality trading program meets NPDES permit obligations because the credit-generating restoration projects feature rigorous accounting, credible mechanics, and verified implementation and efficacy. Further, The Freshwater Trust cited to EPA and ODEQ water quality trading policies as evidence that nonpoint sources may only generate credits from projects that reduce pollution below the TMDL load allocation. We expect that NWEA, The Freshwater Trust, and other state and environmental groups will continue this debate in the coming year.

In its response letter, The Freshwater Trust noted that ODEQ's determination of baseline conditions in the Rogue TMDL was based on the agency's reliance on Oregon's Natural Conditions Criteria (NCC). In

National Roundtable on Water Quality Trading

July 17-18
Cincinnati, Ohio

US Water Alliance Event
While an "invitation-only" event, all seats will be filled.
For registration availability, contact:
lkoss@uswa.us

Water Quality Trading

Natural Thermal Potential

Numeric Criteria

Temperature TMDL Adjustments

Baselines

Congressional Action?

early April, however, the U.S. District Court of Oregon (court) approved a final settlement agreement that set aside Oregon's NCC and remanded it to EPA for review under Clean Water Act (CWA) Section 303(c). This was the second settlement resulting from the court's decision in *Northwest Environmental Advocates v. U.S. Environmental Protection Agency*, in which the court also invalidated ODEQ's use of certain narrative standards applicable to nonpoint sources, with implications for farming, forestry, grazing, and related practices. *See* 855 F. Supp. 2d 1199 (D. Or. 2012).

Oregon's NCC, found in OAR 340-041-0028, states that where DEQ determines that "the natural thermal potential of all or a portion of a water body exceeds the biologically-based [numeric] criteria, the natural thermal potential temperatures supersede the biologically-based [numeric] criteria, and are deemed to be the applicable temperature criteria for that water body." EPA previously approved the NCC because, in some cases, the natural thermal potential for portions of water bodies may have exceeded the numeric criteria for those waters, but nonetheless fish historically thrived in the warmer natural conditions. Siding with NWEA, the court found that "the NCC supplants rather than supplements the numeric criteria by allowing Oregon to replace the numeric criteria (determined to be protective of salmonids) with a new numeric standard during the TMDL process," and that the NCC is "based on the [flawed] assumption that if historical water temperatures protected salmonids then, the same water temperatures would protect salmonids now." According to the court, the improper effect of the NCC is that it "attempts to restore one aspect of Oregon's historical water conditions (higher temperatures in some water bodies) without restoring the other conditions that allowed salmonids to thrive." Under the settlement agreement, the deadline for EPA to review the NCC is August 8, 2013.

Following the NWEA settlements, assumptions underlying the development and implementation of many or all TMDLs in Oregon may be subject to change. Specifically, DEQ may need to modify its temperature TMDLs for water bodies where the total allowable heat loading to the water body was based on the NCC. This could potentially require reductions in the allowable heat loading to these water bodies, which, in turn, could reduce the amount of heat that point and nonpoint sources may discharge to a water body. All of these actions would have significant implications for water quality trading because DEQ's approach to evaluating baseline conditions was based, in part, on its reliance on the NCC as applied to various TMDLs throughout the State. See EPA, Water Quality Trading Policy, 68 Fed. Reg. 1608, 1610 (Jan. 13, 2003) (2003 EPA Trading Policy) ("[W]here a TMDL has been approved or established by EPA, the applicable…nonpoint source load allocation would establish the baselines for generating credits."); Oregon DEQ, Water Quality Trading Internal Management Directive, at 20 (2012) ("Provisions of the TMDL Implementation Plans for designated management agencies [which are meant to achieve load allocations] would be the baseline for nonpoint sources.").

CONCLUSION

The above and similar challenges to water quality trading have prompted Congressional and agency action. Senator Ben Cardin of Maryland and Senator John Boozman of Arkansas held a hearing on May 22, during which witnesses provided testimony regarding EPA's authority under the Clean Water Act to regulate interstate water quality trading. The Senators have not yet authored a water quality trading bill, but such legislation may be forthcoming. A previous attempt to codify a framework for water quality trading failed in 2009. At the same time, EPA is in the process of reviewing its 2003 water quality trading policy. Needless to say, several industry and environmental groups will be watching closely to determine their next steps.

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Priscilla (Polly) Hampton is an associate at Perkins Coie LLP in the firm's Environment, Energy & Resources practice. Polly focuses her practice in the areas of environmental and natural resources law, assisting clients with permitting, compliance and regulatory matters under federal and state laws involving hazardous substance releases, hazardous waste, solid waste, water quality and use, and air quality. She primarily handles matters involving cleanup of contaminated industrial and commercial properties, development of natural resource and industrial projects, defense of environmental enforcement actions and citizen suits, allocation of liability for response costs under CERCLA, and environmental due diligence in real estate and business transactions.

WATER BRIEFS

WALMART PLEADS GUILTY US

CWA, FIFRA, & RCRA VIOLATIONS

Walmart Stores Inc. (Walmart) pleaded guilty on May 28th in cases filed by federal prosecutors in Los Angeles and San Francisco to six counts of violating the Clean Water Act (CWA) by illegally handling and disposing of hazardous materials at its retail stores across the US. The company also pleaded guilty in Kansas City, Missouri, to violating the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) by failing to properly handle pesticides that had been returned by customers at its stores across the country.

As a result of the three criminal cases brought by the US Justice Department, as well as a related civil case filed by EPA, Walmart will pay approximately $81.6 million for its unlawful conduct. Coupled with previous actions brought by California and Missouri for the same conduct, Walmart will pay a combined total of more than $110 million.

According to documents filed in US District Court in San Francisco, from a date unknown until January 2006, Walmart did not have a program in place and failed to train its employees on proper hazardous waste management and disposal practices. As a result, hazardous wastes were either discarded improperly at the store level — including being put into municipal trash bins or, if a liquid, poured into the local sewer system — or they were improperly transported without proper safety documentation.

Walmart owns more than 4,000 stores nationwide that sell thousands of products which are flammable, corrosive, reactive, toxic, or otherwise hazardous under federal law. The products that contain hazardous materials include pesticides, solvents, detergents, paints, aerosols, and cleaners. Once discarded, these products are considered hazardous waste under federal law.

As part of a plea agreement filed in California (six misdemeanor counts of negligently violating the CWA, Walmart was sentenced to pay a $40 million criminal fine and an additional $20 million that will fund various community service projects, including opening a $6 million Retail Compliance Assistance Center that will help retail stores across the nation learn how to properly handle hazardous waste.

In the third criminal case resolved, Walmart pleaded guilty in the Western District of Missouri to violating FIFRA. According to a plea agreement filed in Kansas City, beginning in 2006, Walmart began sending certain damaged household products, including regulated solid and liquid pesticides, from its six return centers to Greenleaf LLC, a recycling facility located in Neosho, Missouri, where the products were processed for reuse and resale. Because Walmart employees failed to provide adequate oversight of the pesticides sent to Greenleaf, regulated pesticides were mixed together and offered for sale to customers without the required registration, ingredients, or use information, which constitutes a violation of FIFRA. Between July 2006 and February 2008, Walmart trucked more than two million pounds of regulated pesticides and additional household products from its various return centers to Greenleaf. In November 2008, Greenleaf was also convicted of a FIFRA violation and paid a criminal penalty of $200,000 in 2009.

Pursuant to the Missouri plea agreement, Walmart is paying a criminal fine of $11 million and pay another $3 million to the Missouri Department of Natural Resources, which will go to that agency's Hazardous Waste Program and used to fund further inspections and education on pesticide regulations for regulators, the regulated community, and the public. Walmart has already spent more than $3.4 million to properly remove and dispose of all hazardous material from Greenleaf's facility.

In conjunction with the guilty pleas in the three criminal cases, Walmart agreed to pay a $7.628 million civil penalty that will resolve civil violations of FIFRA and the Resource Conservation and Recovery Act (RCRA). Walmart is also required to implement a comprehensive, nationwide environmental compliance agreement to manage hazardous waste generated at its stores. The agreement includes requirements to ensure adequate environmental personnel and training at all levels of the company, proper identification and management of hazardous wastes, and the development and implementation of Environmental Management Systems at its stores and return centers. Compliance with this agreement is a condition of probation imposed in the criminal cases.

For info: Additional details at: www.epa.gov/enforcement/waste/cases/walmart.html

COLORADO DIVERSION WEST

RECLAMATION REQUESTS PAYBACK

With drought pushing supplies to the brink, water users from the Colorado River are getting testy, particularly in regard to diversions made in 2010 by the Imperial Valley Irrigation District (IID). IID — the single largest water user on the Colorado (3.1 million acre-feet) — delivered 46,546 acre-feet of Colorado River water to the Salton Sea in 2010. IID's intent was to "consumptively use Colorado River water by temporarily storing it in the Salton Sea for later use to mitigate QSA [Quantification Settlement Agreement] impacts on the Salton Sea that require mitigation in 2011 and the first half of 2012." According to IID, the "Salton Sea mitigation water is used to replace the reduced inflows to the Salton Sea caused by the IID conserved water transfers to SDCWA" (San Diego County Water Authority) to fulfill certain QSA environmental mitigation purposes. *See* IID Letter to Reclamation, Sept. 20, 2010, pp. 1-2, 4.

This "unilateral action by IID" resulted in "concerns throughout the Colorado River water community" and led to a letter from Reclamation to IID reiterating the need to "restore water to the system in a timely manner." Reclamation's letter noted that IID has stated that the district will "*take appropriate actions to reduce future Colorado River diversions to make up for the 2010 advance mitigation deliveries.*" (*See* Reclamation Letter, May 3, 2013, pp. 1-2; Emphasis in original).

Reclamation is pushing IID for "prompt responsive action" regarding the 46,546 acre-foot depletion. "A depletion of this magnitude, without prompt responsive action, has the potential to tip the system into shortage earlier than might otherwise occur, with IID at the focal point of such a destabilizing event," said Terry Fulp, Reclamation's Lower Colorado Regional Director in the May 3rd letter to the irrigation district. *Id.* at 3.

Reclamation noted "IID's desire and willingness to move forward in a constructive manner on this matter" but also firmly concluded with a deadline given the uncertainty and lack of action by IID to date. "We therefore request that IID present to Reclamation by June

WATER BRIEFS

30 of this year a credible set of actions and a definitive timeline to make up for the 2010 advanced mitigation deliveries of 46,546 acre-feet." *Id.*

Marion Champion of IID told *TWR* that the District was still working on its response at the time of publication.
For info: Reclamation and IID letters available upon request from TWR; Rose Davis, Reclamation, 702/ 293-8421; Marion Champion, IID, 760/ 604-4120; IID website on water rights: www.iid.com/index.aspx?page=125

WATER TRANSFERS PUSH CA

GOVERNOR'S ORDER TO STREAMLINE

With near record-low precipitation in California, Governor Brown on May 20 issued an Executive Order to streamline approvals for voluntary water transfers to assist California agricultural. The Executive Order directs the State Water Resources Control Board (SWRCB) and the Department of Water Resources (DWR) to expedite the review and processing of voluntary transfers of water and water rights. DWR will coordinate State Water Project operations to alleviate impacts to San Joaquin Valley agriculture.

SWRCB and DWR share responsibilities for the transfer of water in California. SWRCB reviews and processes water transfer petitions, while DWR has the primary functional responsibility for the actual transfer of water. Water transfers in dry years assist those who potentially have excess supplies by allowing them to sell to those who are short of supplies, providing a valuable economic incentive to both buyer and seller.

DWR's May 2nd snow survey found the Sierra snowpack at 17 percent of normal. State Water Project deliveries this summer will be only 35 percent of requested amounts. The federal Central Valley Project will deliver as little as 20 percent of requested amounts to some customers.
For info: Executive Order at: http://gov.ca.gov/news.php?id=18048

WATER SUPPLY FUND TX

$2 BILLION INVESTMENT

On May 28, Governor Perry signed House Bill 4, which is designed to lay the foundation for meeting Texas' future water needs. HB 4 provides for: full-time governance at the Texas Water Development Board; creates a funding mechanism to support water-supply projects over the next 50 years; and directs local, regional, and state officials to prioritize projects to ensure efficient use of available resources.

According to the Governor's press release, "HB 4 will ensure Texas has a reliable water supply for the next 50 years by promoting conservation and innovative reuse. With voter approval of SJR 1 this fall, this $2 billion investment will fund up to $30 billion in projects over the next 50 years. These measures will help address the increased demand population growth will have on our water needs now and into the future." House Bill 4 becomes law on September 1, 2013, but the $2 billion water fund is contingent on Texans' vote this fall to approve creation of the water fund — via a constitutional amendment to set up the necessary bank accounts for the fund. That large sum of money is scheduled to come from Texas' Rainy Day Fund to pay for water projects, as approved in a separate piece of legislation.

The Texas Water Development Board (TWDB) has posted a web page concerning the "State Water Implementation Fund for Texas" (SWIFT). TWDB cited the three bills that were part of a broad package to provide funding for projects within the State Water Plan: Senate Joint Resolution 1, House Bill 4, and House Bill 1025. "Taken together, these bills propose an amendment to the Texas Constitution creating the State Water Implementation Fund for Texas (or SWIFT), appropriate $2 billion from the economic stabilization fund to the SWIFT, and direct TWDB on how the newly created fund may be used."

TWDB also noted the voter's approval requirement. "Before any funds may be used for State Water Plan projects, however, Texas voters must first consider the proposed amendment to the state's Constitution creating the SWIFT. That amendment will be up for election on November 5th. If the constitutional amendment is approved by Texas voters, then the state can begin implementing the SWIFT. This implementation, based on the deadlines in House Bill 4, may not be complete until March 2015." The TWDB website listed below includes the table and timeline depicting the steps and deadlines prescribed by legislation for SWIFT's implementation.
For info: http://governor.state.tx.us/news/press-release/18577/; Jeremy Mazur at, TWDB, 512-463-5850, jeremy.mazurat@twdb .texas.gov or www.twdb.state.tx.us/newsmedia/swift/index.asp

AG IRRIGATION WEST

COLORADO RIVER CONSERVATION

On May 9, the Pacific Institute released a report entitled *Water to Supply the Land: Irrigated Agriculture in the Colorado River Basin.* New research describes the extent of irrigated agriculture in the Colorado River basin states and two states in Mexico, the types of crops grown, and the amount of water used. The report compares several agricultural management scenarios and their associated water savings and costs. The focus is on conserving water without removing agricultural land from production.

The Colorado River helps irrigate millions of acres of land. Yet demands on the river already exceed the river's average supply, a situation that is projected to get worse in coming years. Irrigated agriculture currently consumes more than 70% of the water supply within the Colorado River basin.

More than 90% of pasture and cropland in the 256,000-square-mile Colorado River Basin requires irrigation, with about 60% of the irrigated acreage devoted to pasture, alfalfa, and other forage crops used to feed cattle and horses. These forage crops consume about five million acre-feet per year — equivalent to a third of the river's annual flow. Employing innovative irrigation techniques more strategically and in more places — techniques that many farmers are already using — can help ensure agriculture in the basin states continues in the face of rising demand and climate change's projected impact on supply.

Modeling a series of water conservation strategies — including regulated deficit irrigation, crop shifting, and advanced irrigation technologies — the report compars potential water savings and costs associated with individual scenarios. The analysis shows considerable water savings are possible. For example, almost a million acre-feet of water may be generated by irrigating alfalfa less often ("regulated deficit irrigation") throughout the basin in the US, at an estimated base cost of approximately $81 per acre-foot. Other scenarios, such as shifting to less water-intensive crops, also yield impressive water savings with relatively low costs without reducing irrigated acreage.

WATER BRIEFS

Replacing about 10% of the basin's irrigated alfalfa acreage with cotton and wheat, for example, could save about 250,000 acre-feet of consumptive water use each year, with estimated base costs of less than $40 per acre-foot. Total reductions in water withdrawals and applied water would be even greater.

An interactive map of Colorado River basin agriculture, showing federal and state agency information on the amount of irrigated and total harvested acreage in the basin by county, and total reported water use as reported by USGS, is available on Pacific Institute's website at: http://pacinst.org/reports/co_river_ag_2013/map/.
For info: Full Report at: www.pacinst.org/reports/co_river_ag_2013/irrigated_ag_crb.pdf

FRACKING DRAFT RULE US
PUBLIC & INDIAN LANDS PROPOSAL

The Interior Department announced the release of an updated draft proposal on May 16 that would establish safety standards for hydraulic fracturing on public and Indian lands. Interior received extensive feedback following release of an initial draft proposal in 2012, including over 177,000 public comments.. Interior stated that new draft: maintains important safety standards; improves integration with existing state and tribal standards; and increases flexibility for oil and gas developers. The updated draft is subject to a new 30-day public comment period.

Approximately 90 percent of wells drilled on Federal and Indian lands use hydraulic fracturing, but the Bureau of Land Management's (BLM's) current hydraulic fracturing regulations are more than 30 years old. The proposed rules modernize BLM's management of such operations, and help establish baseline environmental safeguards.

The new draft proposal maintains the three main components of the initial proposal: requiring operators to disclose the chemicals used in fracturing activities on public lands; improving assurances of well-bore integrity to verify that fluids used during fracturing operations are not contaminating groundwater; and confirming that oil and gas operators have a water management plan in place for handling fluids that flow back to the surface.

The supplemental proposal released revises the array of tools operators may use to show that water is being protected, and provides more guidance on trade secret disclosure, while providing additional flexibility for meeting these objectives.

While the new draft seeks to establish baseline safeguards across all public and Indian lands, it also complements efforts of several states that are regulating hydraulic fracturing, including Colorado, Wyoming, North Dakota, and Texas. The proposal includes a variance process that allows for deferring to states and tribes that already have standards that meet or exceed those proposed.

Although BLM is not proposing a material change in the provision that allows hydraulic fracturing flowback fluids to be stored either in tanks or in lined pits, BLM is seeking comments on the costs and benefits of requiring flowback fluids to only be stored in closed tanks.

Domestic production from more than 92,000 oil and gas wells on public lands accounts for about 13 percent of the nation's natural gas production and five percent of its oil production. BLM administers approximately 700 million acres of onshore mineral estate owned by the Federal government and has trust responsibilities for about 56 million acres of Indian lands.
For info: Jessica Kershaw, Interior, 202/ 208-6416; Bev Winston, BLM, 202/ 912-7239; Draft proposal at: www.blm.gov/pgdata/etc/medialib/blm/wo/Communications_Directorate/public_affairs/hydraulicfracturing.Par.91723.File.tmp/HydFrac_SupProposal.pdf

FRACKING COMMENTS US
EPA COMMENT PERIOD EXTENDED

On April 30, EPA released notice that it is extending its deadline for the public to submit data and scientific literature to inform EPA's research on the potential impacts of hydraulic fracturing on drinking water resources from April 30, 2013 until November 15, 2013.
For info: https://federalregister.gov/a/2013-10154; EPA website: www2.epa.gov/hydraulicfracturing

CULVERT CASE APPEAL WA
TRIBAL FISH PASSAGE

On May 28, Washington Attorney General Bob Ferguson announced that the State of Washington filed a Notice of Appeal in the case of *U.S. v. Washington*, C70-9213 (March 29, 2013) — the "culverts" case. That decision — based on the state's duty to maintain, repair and replace culverts under State-maintained roads that hinder fish passage — was designed to ensure that the Tribes in Washington that retained fishing rights under the 1855 Treaty of Point Elliot actually have fish to catch versus meaningless treaty rights. *See* Moon, *TWR* #110 for additional details regarding the federal court's decision.

"The state remains committed to addressing fish passage barriers and will continue to do so as resources permit. The implications of the case, however, stretch beyond culverts. Issues of this magnitude deserve full and thoughtful appellate review," Ferguson said. Among other possibilities, Attorney General Ferguson is undoubtedly referring to estimates that the State's obligation under the decision could runs into billions of dollars.

The case is being appealed to the Ninth Circuit Court of Appeals, which will soon establish a schedule for the briefing and argument of the case.
For info: Janelle Guthrie, AG's Office, 360/ 586-0725; Decision available at: http://pugetsoundblogs.com/waterways/files/2013/04/Decision.pdf

WATER BANKING CRITERIA CA
CENTRAL VALLEY PROJECT

The US Bureau of Reclamation (Reclamation) released Draft Water Banking Criteria on May 24 for banking Central Valley Project (CVP) water outside of a contractor's contract service area. Reclamation developed these criteria to implement water banking as authorized by the Central Valley Project Improvement Act and as allowed by certain federal contracts.

Reclamation recognizes groundwater banking as an important water management tool in optimizing the use of CVP water while addressing groundwater overdraft in certain areas. These criteria will apply to contractors under contract with Reclamation for water service or repayment, water rights settlement, exchange, or other applicable contracts requesting to bank CVP water outside of their contract service area. These criteria set forth the standards under which Reclamation may approve banking and recovering of CVP water outside of the contractor's contract service area boundary, while protecting the integrity of the CVP.

Written comments on the criteria must be received by the close of business on June 21, 2013. Send

WATER BRIEFS

comments to Sheri Looper, Bureau of Reclamation, 2800 Cottage Way, MP-400, Sacramento, CA 95825, faxed to 916/ 978-5290, or emailed to slooper@usbr.gov.
For info: Pete Lucero, Reclamation, 916/ 978-5100

KLAMATH BIOP OR/CA
OPERATIONS OF KLAMATH PROJECT

The US Bureau of Reclamation (Reclamation) announced June 3 the receipt of a joint, coordinated Biological Opinion (BO) delivered by the National Oceanic and Atmospheric Administration's National Marine Fisheries Service and the US Fish and Wildlife Service (Services). The BO analyzes the effects of the ongoing operations of Reclamation's Klamath Project (Project) through March 31, 2023 on federally listed threatened and endangered species, including but not limited to, the endangered Lost River and shortnose suckers and the threatened coho salmon and their designated critical habitat.

The Services have concluded that the ongoing operation of the Project as described in Reclamation's 2012 Biological Assessment, and as modified during formal consultation, is not likely to jeopardize the continued existence of federally listed species or their critical habitat. As noted in the Services' transmittal letter to Reclamation, however, "the Services expect incidental take of SONCC coho salmon, Lost River sucker, and shortnose sucker, as well as adverse effects to designated critical habitat for SONCC coho salmon, Lost River sucker, and shortnose sucker, as a result of implementation of the proposed action." Services Letter, May 31, 2013.

Reclamation and the Services participated in extensive interagency coordination over the last two years for the purpose of collaboratively developing a water management approach that has the flexibility to optimize the benefits of available water for federally listed species while providing irrigation deliveries to the Project. Through this collaboration, Reclamation developed an innovative approach with the key driver and benefit of providing greater certainty, early in the year, on the amount of water that will be available for Upper Klamath Lake (endangered suckers), the Klamath River (threatened coho salmon) and the Project. "A team of Federal resource managers was convened in early 2011 to establish an Agency Coordination Team. The Agency Coordination Team consists of hydrologists, biologists, managers from each agency, and support staff. The team met on over 25 occasions... and created a new paradigm and decision-making process for managing Reclamation's Project in a manner that provides more certainty for Project water users, UKL elevations, and Klamath River flows than in the past." BO at 4.

Implementation of this innovative water management approach will be beneficial during dry hydrologic years like 2013, and throughout the life of the BO, as the approach is expected to more efficiently optimize limited water supplies to benefit listed fish species and Project water users than in the past.

Reclamation's proposed Project operations from 2013 to 2023 consist of three major elements: 1) Store waters of the Klamath and Lost Rivers; 2) Operate the Project, or direct the operation of the Project, for the delivery of water for irrigation purposes, subject to water availability, while maintaining lake and river hydrologic conditions that avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat; and 3) Perform **o**peration and **m**aintenance (O&M) activities necessary to maintain Project facilities to ensure proper long-term function and operation. BO at 10.

Additional information regarding Project operations and anticipated water supplies during 2013 can be found in the 2013 Operations Plan, which is expected to be released in early June.
For info: Kristen Hiatt, Reclamation, 541/ 883-6935 or khiatt@usbr.gov; Website: www.usbr.gov/mp/kbao/

AQUIFER DEPLETION US
USGS STUDY

A new US Geological Survey (USGS) study documents that the Nation's aquifers are being drawn down at an accelerating rate. *Groundwater Depletion in the United States (1900-2008)* comprehensively assesses long-term groundwater depletion in 40 separate US aquifer systems or subareas, and one land use category [Agriculture and Land Drainage].

The cumulative volume of groundwater depletion in the US during the 20th century is large — totaling about 800 cubic kilometers (km3) and increasing by an additional 25 percent during 2001–2008 (to a total volume of approximately 1,000 km3). This total equals more than twice the volume of water found in Lake Erie. US groundwater depletion accelerated in the late 1940s and continued at an almost steady linear rate through the end of the century.

The depletion of groundwater has many negative consequences, including land subsidence, reduced well yields, and diminished spring and stream flows. Groundwater depletion also adversely impacts the long-term sustainability of groundwater supplies to help meet the Nation's water needs. Groundwater depletion also is a small contributor to global sea-level rise, but sufficiently large that it needs to be recognized as a contributing factor and accounted for when explaining long-term global sea-level rise. Groundwater depletion in the US in the years 2000-2008 accounts for more than two percent of the observed global sea-level rise during that period.

While the rate of groundwater depletion across the country has increased markedly since about 1950, the maximum rates have occurred during the most recent period of the study (2000–2008), when the depletion rate averaged almost 25 cubic kilometers per year. For comparison, 9.2 cubic kilometers per year is the historical average calculated over the 1900–2008 timespan of the study.

One of the best known and most investigated aquifers in the US is the High Plains (or Ogallala) aquifer. It underlies more than 170,000 square miles of the Nation's midsection and represents the principal source of water for irrigation and drinking in this major agricultural area. Substantial pumping of the High Plains aquifer for irrigation since the 1940s has resulted in large water-table declines that exceed 160 feet in places. Since 2000, depletion of the High Plains aquifer appears to be continuing at a high rate. The depletion during the last 8 years of record (2001–2008, inclusive) is about 32 percent of the cumulative depletion in this aquifer during the entire 20th century. The annual rate of depletion during this recent period averaged about 10.2 cubic kilometers or roughly two percent of the volume of water in Lake Erie.
For Info: *USGS Groundwater Depletion* Report at: http://pubs.usgs.gov/sir/2013/5079; Report Author Leonard Konikow, USGS, 703/ 648-5878 or lkonikow@usgs.gov

CALENDAR

June 17-18 ID
Summer Water Law & Resource Issues Seminar, Sun Valley. Sun Valley Resort. Presented by Idaho Water Users Ass'n. For info: www.iwua.org

June 17-21 OR
Water Conflict Management Course, Corvallis. Presented by Oregon State University. For info: http://outreach.oregonstate.edu/nrla/

June 18 CA
Stormwater Workshop, Los Angeles. Metorpolitan Water District. Presented by Southern California Water Committee. For info: Kym Belzer, kbelzer@fionahuttonassoc.com or www.SoCalWater.org

June 18 CO
Colorado River Trust 5th Annual RiverBank Fundraiser, Denver. McNichols Civic Ctr. Bldg. For info: www.coloradowatertrust.org/campaigns/riverbank-2013

June 18-21 NV
New MODFLOW Course: Theory & Hands-On Applications, Las Vegas. Presented by Nat'l Ground Water Ass'n. For info: www.ngwa.org/Events-Education/shortcourses/Pages/258jun13.aspx

June 18-21 CA
The Environmental Awareness Bootcamp, San Diego. DoubleTree Downtown. For info: EPA Alliance Training Group, www.epaalliance.com

June 19 AZ
The Colorado River & Yuma State Historic Park - Brownbag Seminar, Tucson. WRRC Sol Resnick Conference Rm., 12-1:30pm. For info: wrrc.arizona.edu/brownbag

June 20 OR
Gresham Wastewater Treatment Plant & Columbia River Slough Regional Stormwater Facility: Field Trip, Gresham. Presented by Environmental & Natural Resources Section (OSB). For info: RSVP LawsonFite@MHGM.com

June 20-21 OR
15th Annual Oregon Wetlands & Aquatic Resources Seminar, Portland. World Trade Ctr. Two. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

June 20-21 WA
2nd Annual Fisheries & Hatcheries Conference: Legal & Regulatory Frameworks, Seattle. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

June 22-21 MN
Tribal Rights, Sovereignty & Economic Development in the Midwest Seminar, Minneapolis. Wells Fargo Center. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

June 24-28 MA
Water Diplomacy Workshop, Boston. By Application. For info: http://waterdiplomacy.org/workshop/

June 24-25 WA
Water Law in Washington Seminar, Seattle. Washington State Convention Ctr. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

June 24-25 CT
2013 AWRA Summer Specialty Conference: Environmental Flows, Hartford. Hilton Hotel. For info: www.awra.org/meetings/EnvironmentalFlows2013/

June 24-26 WY
Western States Water Council Summer (172nd) Council Meeting, Casper. Hilton Garden Inn. For info: www.westernstateswater.org/upcoming-meetings/

June 25-27 NE
2013 Water & Natural Resources Tour: Managing Nebraska's Water Resources, Kearney. Sponsored by Nebraska Water Center. For info: Steve Ress, NWC, sress1@unl.edu or http://watercenter.unl.edu/Archives/2012/2012_ResourcesTour.asp

June 25-27 CO
Grazing Management for Riparian & Wetland Areas Workshop, Gunnison. Gunnison Valley Fairgrounds. Presented by National Riparian Service Team. For info: Jay Thompson, BLM, 303/ 239-3724 or jmthomps@blm.gov

June 27-28 CT
2013 AWRA Summer Specialty Conference: Healthy Forests = Healthy Water, Hartford. Hilton Hotel. For info: www.awra.org/meetings/HealthyForest2013/

June 28-30 UT
Western Governors' Ass'n 2013 Annual Meeting, Park City. Montage Deer Valley. For info: Sarah Olsen, WGA, 720/ 897-4540, solsen@westgov.org or www.westgov.org

July 1-4 Australia
Asia Pacific Water Recycling Conference, Brisbane. For info: www.awa.asn.au/recycling13/

July 9 WA
Celebrate Water Reception, Seattle. Ivar's Salmon House. Presented by Center for Environmental Law & Policy. For info: www.celp.org/

July 9-11 TX
Water Management: Unconventional Oil & Gas Water Management Forum, Grapevine. Gaylord Texan Hotel. Presented by Ground Water Research & Education Foundation. For info: www.gwpc.org/sites/default/files/events/WaterManagementFlier.pdf

July 10-12 CA
Overview of Environmental Statistics Course, Davis. UC Davis, 1137 Lab, Plant &Environmental Sciences. For info: UC Davis Extension, http://extension.ucdavis.edu/

July 12 TX
Texas WateReuse Conference, Austin. Convention Ctr. Presented by Texas Section, WateReuse Ass'n. For info: www.watereuse.org/sections/texas

July 15-16 AZ
Arizona Water Reuse 2013 Conference, Flagstaff. Little America Hotel. Presented by Arizona Water Ass'n. For info: www.watereuse.org/sites/default/files/u8/SaveTheDatePostcardc.pdf

July 15-18 Greece
Annual International Forum on Water, Athens. For info: www.atiner.gr/water.htm

July 16-19 CO
The Environmental Awareness Bootcamp, Colorado Springs. Antlers Hilton. Presented by EPA Alliance. For info: www.epaalliance.com/envbootcampcolsprings13.html

July 17 CA
Modeling Hydromodification Impacts & Interventions: Seminar, Costa Mesa. SCCWRP Office, 3535 Harbor Blvd., Ste. 10. Presented by State Water Resources Control Board. For info: www.waterboards.ca.gov/water_issues/programs/stormwater/hydromodification.shtml

July 17-18 CO
3rd Annual NEPA Compliance Workshop, Colorado Springs. Antlers Hilton. Presented by EPA Alliance. For info: www.epaalliance.com/nepaworkshopJul13.html

July 17-19 CO
38th Annual Colorado Water Workshop, Gunnison. Western State Colorado University. Presented by Colorado Water Workshop. For info: Jeff Sellen, 970/ 943-3162, jsellen@western.edu or www.western.edu/academics/water

July 18 OH
National Roundtable on New Tools for Water Quality: Trading & Beyond, Cincinnati. Hilton Netherland Plaza. Presented by U.S. Water Alliance. For info: Lorraine Koss, 202/ 533-1819, lkoss@uswa.us or www.uswateralliance.org/

July 18-19 NM
Natural Resources Damages Seminar, Santa Fe. Hilton Plaza Hotel. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com or www.lawseminars.com

July 18-20 WA
Rocky Mt. Mineral Law Foundation 59th Annual Institute, Spokane. Red Lion Hotel at the Park. For info: www.rmmlf.org

July 25-26 CO
Water Transfers Conference: Nuts & Bolts, Case Studies & More, Beaver Creek. Beaver Creek Lodge. For info: CLE International, 800/ 873-7130 or www.cle.com/

July 25-26 DC
Oil, Gas & Renewable Energy on Tribal Lands: The New Landscape, Washington. Embassy Row Hotel. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com or www.lawseminars.com

July 26 OR
Habitat & Species Seminar, Portland. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

July 26 WA
GMOs: Agricultural Law & Biotechnology Seminar, Seattle. City University, 521 Wall St. For info: The Seminar Group, 800/ 574-4852, email: info@theseminargroup.net, or website: www.theseminargroup.net

The Water Report
Water Rights, Water Quality & Water Solutions in the West
260 N. Polk Street • Eugene, OR 97402

CALENDAR

(continued from previous page)

July 28-31 OR
Chapman Conference: Seasonal to Interannual Hydroclimate Forecasts & Water Management, Portland. Presented by American Geophysical Union. For info: http://chapman.agu.org/watermanagement/

July 29-30 CA
Environmental Regulation of Fracking Seminar, Santa Monica. DoubleTree Guest Suites. For info: Law Seminars Int'l, 800/ 854-8009, email: registrar@lawseminars.com or www.lawseminars.com

July 29-31 WA
Western Water Seminar, Stevenson. Skamania Lodge. Presented by National Water Resources Ass'n. For info: www.nwra.org/events/2013/7/western-water-seminar-3/

July 29-Aug. 2 IL
5th National Conference on Ecosystem Restoration NCER, Chicago. Renaissance Schaumburg Convention Ctr. Hotel. For info: www.conference.ifas.ufl.edu/NCER2013/

July 31 WA
Tribal Water in the Pacific Northwest, Seattle. Renaissance Seattle Hotel. For info: Law Seminars Int'l, 800/ 854-8009, registrar@lawseminars.com or www.lawseminars.com

August 1-2 WA
Collaborative Negotiations Skills for Environmental Professionals, Seattle. For info: Northwest Environmental Training Center, www.nwetc.org

August 4 NM
Association of Clean Water Administrators Annual Meeting 2013, Santa Fe. Lodge at Santa Fe. For info: www.acwa-us.org/#!meetings

August 8-9 AZ
Arizona Water Law Conference, Phoenix. Arizona Biltmore Resort. For info: CLE Int'l, 800/ 873-7130 or www.cle.com

August 13-15 NM
Symposium on the Settlement of Indian Water Rights Claims, Santa Fe. Hilton Santa Fe at Buffalo Thunder. Presented by Western States Water Council & Native American Rights Fund. For info: WSWC, 801/ 685-2555 or www.westernstateswater.org/upcoming-meetings/

August 14 CA
Habitat Conservation Planning Course, Sacramento. Sutter Square Galleria, 2901 K Street. For info: UC Davis Extension, http://extension.ucdavis.edu/

August 15-16 CO
Clyde Martz Summer Conference: Arizona v. California at 50: The Legacy and Future of Governance, Reserved Rights, and Water Transfers, Boulder. University of Colorado School of Law. Sponsored by the Getches-Wilkinson Center. For info: www.colorado.edu/law/research/gwc/events

August 18-21 MN
2013 International Low Impact Development (LID) Symposium, St. Paul. St. Paul RiverCentre. For info: Nicole Freese, University of Minnesota, 612/ 624-3708, cceconf5@umn.edu or www.cce.umn.edu/2013-International-Low-Impact-Development-Symposium/index.html

August 18-22 SC
StormCon: Stormwater Pollution Prevention Conference, Myrtle Beach. Sheraton Convention Ctr. Hotel. For info: www.stormcon.com/

August 20-22 SC
SPCC & Stormwater Compliance Workshop, Hillton Head Island. The Beach House. Presented by EPA Allicance. For info: www.epaalliance.com/spcc&stormwateraug13.html

August 22-23 NM
Tribal Natural Resources Law Conference, Santa Fe. La Posada de Santa Fe Resort. For info: CLE Int'l, 800/ 873-7130 or www.cle.com