CALFED Science Program Workshop Summary

Science Issues Relating to Delta Conveyance Infrastructure: Through Delta Options

Workshop Summary for September 11, 2007

This workshop focused on through-Delta options as the conveyance mechanism for moving Sacramento River water to the export pumps. A preceding workshop held August 22, 2007, examined issues associated with various isolated facility conveyance options. Considered together these workshops will help identify the issues and questions that need to be raised in evaluating an effective Delta-region conveyance mechanism for water project exports.

Topics and Speakers:

Through-Delta Conveyance Options – Dr. Ron Ott, CALFED Science Program
Conceptual Approaches to Water and Environmental Management – Dr. Denise Reed, University of New Orleans
Hydrodynamics Issues – Dr. Pete Smith, United States Geological Survey
Water Quality Issues - Dr. Robin Stewart, United States Geological Survey
Environmental Issues – Mr. Matt Nobriga, CALFED Science Program
Synthesis - Dr. Bruce Herbold, United States Environmental Protection Agency
Discussion - Dr. Michael Healey, CALFED Science Program

This summary report and the speakers' presentations are posted on the CALFED Science Program website (http://science.calwater.ca.gov). An archived webcast of this workshop is available at http://www.visualwebcaster.com/event.asp?regd=y&id=41794.

Key Messages Across Presentations:

- Clear objectives for through-Delta conveyance are crucial to understand the technical questions involved and to resolve any conflicting outcomes
- Objectives need to be specific enough to guide planning. Specific benchmarks or targets need to be set
- Delta Cross Channel operations have local (e.g. entrainment) and regional (e.g. water quality) effects. Therefore both local and regional analyses are needed to assess operational consequences
- Visions of the future are not implementation plans. A step-by-step staging of actions will be needed to craft any future Delta conveyance infrastructure
- Managers need to continually re-examine assumptions underlying engineered solutions to environmental challenges
- In the San Francisco Estuary (as in all estuaries), there is a gradient from predominantly riverine forcing in the upstream (eastern) parts of the Delta to predominantly marine (tidal) forcing in the western Delta.

- An integrative program of data collection, analysis, synthesis, and forecasting for populations and habitats of interest will help managers understand ecosystem and population response to management actions.
- Entrainment will be a characteristic of any conveyance system and will have to be addressed regardless of configuration
- Ecosystems are remarkably resilient – the problem is reconciling human desires for ecosystem services with what the available complex, self-organizing system will offer when adapting to future change
- Any alternative to through-Delta conveyance will take decades to construct. Even if it is decided to proceed with an isolated facility it will be necessary to make through-Delta conveyance work as effectively as possible for many years

Messages Associated With Individual Presentations:

Through-Delta Conveyance Options – Ron Ott

- Improving water quality for export while resolving fishery concerns has been the stated objective for the three modifications of a through-Delta conveyance system considered in CALFED Stage 1: a) Reoperated Delta Cross-Channel, b) Modified Franks Tract, and c) Through-Delta Facility with an intake at Hood[*]
- In evaluating these options we've learned a lot about how fish, water, and salt move through the Delta: circulation patterns at river bends affect fish behavior; fish move in the water column differently during the day and night; reconfiguration of slough entrances may reduce fish entrainment; and other relationships
- Hydrodynamic modeling tools coupled with sophisticated data collection methods have provided much insight about what will happen to water and fish given various through-Delta configurations
- It is difficult to predict what the specific effects of a particular design or operational change to through-Delta configuration will mean hydrodynamically – "ground-truthing" is a crucial component of incremental designs for through-Delta conveyance
- For various reasons outputs from hydrodynamic models are neither definitive nor complete (e.g. we have not yet overcome difficulties of extending 3-dimensional models to model the entire Estuary, nor have we properly reviewed available particle tracking models)
- Physical (hydrodynamic) understanding and predictability of the Estuary is greater than biological (ecological) understanding or predictability – and will likely remain so
- Piecemeal evaluation of project components will not add up to an understanding of regional impacts at full project build-out –

[*] In this context "Through-Delta Facility" includes an intake at Hood with a return to the South Fork of the Mokelumne River at New Hope Tract

comprehensive, regional evaluation of conveyance facility operation must be maintained over the lifetime of a through-Delta conveyance system (e.g. flow criteria are now used to close the DCC in winter – this has system-wide effects that may change with future sea level rise)

Conceptual Approaches to Water and Environmental Management – Denise Reed

- Be explicit with objectives. This forces recognition of trade-offs up front and highlights what's "on the table"
- Use benchmarks when possible to enhance clarity of objectives and to help manage public expectations (e.g. performance measures)
- It is difficult to use generalities to set project priorities – even decisions "to protect wildlife" mean different things to different people – it is critical to identify specific project objectives in order to successfully plan and evaluate alternative configurations
- A broad analytic framework is needed to allow scientists and decision-makers to look in a holistic way at the effects of different choices
- The State must recognize the nature of trade-offs between environmental protection and water quality improvement. Decision-analysis support tools have been developed that improve the objectivity of decisions involving social and environmental trade-offs
- Visions for the future do not provide objectives useful for getting us there – there are choices and trade-offs to be made with regard to how, why, and where to go
- Use guiding principles (e.g. those used by the Delta Vision Stakeholders Coordination Group http://deltavision.ca.gov/DeltaVisionStakeholderReports.shtml) to help formulate how to proceed, recognize constraints, consider alternative futures, and be ready for unintended consequences
- In managing coastal ecosystems, guiding can mean staying out of the way – passive engineering may be more appropriate than real-time manipulation
- Integrate planning, investment, and management decision-making into an iterative, learning process rather than a linear, time-dependent one
- Constantly re-examine assumptions underlying engineered solutions to environmental challenges
- Don't forget what we already know – in other words, don't allow concerns about our current knowledge gaps to prevent us from making use of existing knowledge

Hydrodynamics Issues – Pete Smith

- Changes in basin hydrology and in approaches to water management will result in altered Delta water quality because the relationships between Sacramento and San Joaquin River hydrology, timing, volume, etc., will also change

- Hydrodynamic complexity stems, in part, from conveyance system configuration. The specifics of proposed changes to the system will influence what hydrodynamic conditions will exist into the future
- Recent analyses show turbidity is an important component of Delta smelt habitat that may factor into management actions
- Eliminating or altering San Joaquin River connections with Clifton Court Forebay will dramatically alter hydrodynamics in the south Delta
- There will likely be changes to food web linkages as the result of any "re-plumbing" of the Delta; for example, altered hydraulic residence times can change phytoplankton communities and therefore change food availability to other organisms (e.g. fish)
- Hydrodynamic variability is an important factor determining the extent of an "entrainment zone" Delta-wide, and should be included in plans regarding reconfiguration of through-Delta conveyance

Water Quality Issues – Robin Stewart

- Any reconfiguration of through-Delta conveyance will bring with it hydrologically-mediated sediment and contaminant transport complications: transport routes and pathways change, water source and mixtures will change, flushing times will change, local and regional water chemistry will change
- Water quality is the culmination of lots of process chemistry, and specific changes locally can have regional implications. For example, we currently find that there is more methyl mercury in tributaries to the Delta than in the Delta itself – this relationship could change if process chemistry changes
- Food web relationships can mediate water chemistry in the ecosystem (e.g. at Camp Far West Reservoir the pelagic food web seems to more effectively accumulate methyl mercury than does the benthic food web; in Suisun Bay the benthic community accumulates selenium more effectively than the pelagic food web)
- Certain aquatic species have been found to be "super-accumulators" of various environmental pollutants (e.g. overbite clam and selenium) – altering through-Delta hydrology will likely change how, where, and what species are accumulating pollutants and where these accumulated pollutants end up
- Understanding the origin, transport, and fate of selenium, mercury, and other contaminants in the Delta will be critical to an integrated water management plan using through-Delta conveyance
- Integration of existing information using a process-based approach is a critical missing component of current Delta contaminants research and management

Environmental Issues – Matt Nobriga

- The cardinal rule of applied ecology: "if you change the system, the system will change"
- Changes to the Delta's geometry and hydraulics will change ecosystem function. Thus, any change in system conveyance has potentially far reaching ecological consequences
- Each species has a hierarchy of need: habitat↔food↔reproduction↔dispersal. Changes in the aquatic environment of the Delta will have implications at all levels of these hierarchies
- Organisms that are nearest intake facilities have the highest probability of being entrained. Proximity of aquatic organisms to the location of through-Delta intake facilities will largely influence what is entrained and when
- Aquatic habitats are inherently dynamic, and have temporal variability in several parameters simultaneously (salinity, temperature, transparency, for example) – it is difficult to manage for specific aquatic habitat configurations while maintaining large-scale water diversions in a tidal environment because flow regimes and habitat quality are intimately linked
- Species invasions have changed the estuarine food web. They may also have increased the influence of water exports from the Delta on fish food availability in the low-salinity zone
- The Delta ecosystem will continue to change in the future
- The evaluation of conveyance alternatives needs to develop beyond its present focus on fish passage to consider broad implications for ecosystem function

Synthesis – Bruce Herbold

- Recognize that ecosystems are not just fish and birds but include the economy, humans, and cultural resources
- The unexpected happens – design water and environmental management to be robust to change and surprise
- Ecosystems are not fragile: water management systems predicated upon predictable ecosystem behavior may be
- Although our ability to predict physical system behavior is stronger than our ability to predict ecosystem behavior, our understanding of hydrodynamics in relation to fish habitat, entrainment, and population response has nonetheless expanded dramatically in recent years
- For any conveyance design we should recognize that hard structures eventually fail over time
- Exporting water from the Delta involves trying to maximize the beneficial uses of diversions for drinking water, irrigation, and municipal and industrial uses simultaneously with maximizing beneficial ecosystem uses of this same water within an estuary that tends to mix marine and freshwater sources wherever they coexist. It is clear that sustained, long-

term management of these beneficial uses cannot include maximization of any one of them without seriously degrading another

- Confidence when attempting to engineer ecosystems is folly (e.g. supposing that environments won't change or that earthquakes won't happen)
- Societal needs for ecosystem services change with time (e.g. preference for extractive services – exported drinking water – may give way to preference for aesthetic ones – wildlife viewing)
- When considering reconfiguring Delta conveyance we will need to be especially vigilant to the water quality issues presented as the result of changing inputs (both quantities and sources) from the San Joaquin River

Public Discussion – Issues Raised

- What will be the changed needs of a through-Delta conveyance system with regard to trucking, handling, and hauling of salvaged species?
- Can we identify more specific features of habitats needed to achieve conservation of particular species?
- Sea level rise will impact whatever system of conveyance is imposed – but wouldn't some parts of the current system work better if sea level were higher (e.g. more hydraulic head to move water through gravity-flow facilities)?
- Proposed San Joaquin by-pass locations need to take advantage of local knowledge of topography. Locals say the proposed Stewart Tract site is too high, but Paradise Cut has potential. A bypass would flood only very rarely on the San Joaquin but at other times might provide good wildlife habitat
- How do the items discussed in this workshop result in a more informed Delta conveyance policy?
- Can we approach our conveyance infrastructure using an incremental approach and learn as we go?

Final Comments – Michael Healey

- As a scientific and technical community, we don't have the capacity to pre-analyse the multitude of conveyance options. As the discussion begins to focus on a few alternatives we will be better able to focus our limited capacity
- Biological understanding is not as developed as physical understanding at this time. Ecologists simply cannot say with any certainty what flows and hydrology will be most beneficial for the Delta ecosystem
- Whatever conveyance approach is decided upon will be implemented incrementally, so through-Delta conveyance will be with us for many years to come.