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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION'S REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX

TESTIMONY OF JOSEF TOOTLE

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My name is Joe Tootle, I am a Principal Geotechnical Engineer at ENGEO Incorporated. I am a registered Civil and Geotechnical Engineer in California and have been practicing as an engineering consultant for over 20 years. My experience includes the lead geotechnical design for, and management of, multifaceted projects that have collectively included more than 100 million cubic yards of earth work; hundreds of miles of roadway improvements; public infrastructure, including bridges, tunnels, levees, detention basins, highways and light rail transit corridors; commercial, residential, and retail centers; community centers; and public buildings. (See also LAND-36.)

This testimony addresses three major adverse physical impacts of the California WaterFix ("CWF") project that are likely to result in injury to legal users of water. However, in each case, the Petitioners have not presented enough detail regarding the proposed project, existing conditions, or proposed mitigation to ensure that there will be no injury or to evaluate and describe the likely range of injuries in greater detail than what is set forth below.

1. Impacts on Groundwater Use

a. Background

The CWF project has undergone some modifications and/or refinements over the past several years. These modifications have been directed at both long-term operational impacts, as well as potential construction related impacts. In an attempt to address the potential construction related impact of temporary dewatering, according to testimony presented in support of the Petition, the CWF project was modified to include impermeable slurry cutoff walls at specific construction sites to isolate the effects dewatering activities on the surrounding groundwater. (DWR-218) Slurry cutoff walls are currently proposed for the construction of proposed intakes, pumping plants, forebay embankments, and tunnel shafts. Although this modification may be effective at reducing potential construction related impacts of dewatering, the CWF project has neglected the potential long-term impacts of the slurry cutoff wall construction at the associated cutoff wall locations.

The potential long-term effects of slurry cutoff walls along the tunnel alignments, are limited to the locations where there is a shaft (DWR-212, Figure 3-1); however, the potential for long-term effects on groundwater uses may also be impacted by proximity to the tunnels. The conceptual tunnel inverts range from 122 to 135 feet below mean sea level ("msl") for the North tunnels and from 147 to 163 feet below msl for the Main tunnels. At these depths, the tunnels will be constructed using closed-face pressurized soft ground tunnel boring machines ("TBMs"). (DWR-212, Section 11.2.5.)

Although the CWF project is not proposing impermeable slurry cutoff walls along the entire tunnel alignment, the tunnels themselves may act as a similar barrier to the existing groundwater flow. The majority of the tunnel liner will be in excess of 40 feet in outside diameter and consist of precast concrete segmental sections. Given that many water wells are located in the vicinity of the tunnel alignment and that several of these wells have screened intervals in the approximate depth range of the tunnels, partial obstruction to the current well production may likely be observed. (See LAND-58, LAND-59.)

To understand the potential impact of constructing slurry cutoff walls in the Delta, it is important to understand the near-surface soil deposits in the region. The near-surface soil deposits within the Delta, and along the majority of the project alignment, are generally very complex and are often characterized as former freshwater marsh deposits traversed by numerous existing and former delta distributary channels (Atwater 1982). Some of the complexity can be seen on Atwater's geologic map of Bouldin, Venice, and Mandevil Islands. (LAND-37, slide 1.) Many permeable sandy deposits (Qm2e) are mapped within isolated areas of less permeable mud deposits (Qpm) across the region. In addition, several concealed former channel alignments are identified that cut across many island interior locations. (DWR-212, Section 3.3.)

Historically, it was the nature of Delta distributary channels to regularly breach their natural levees and change course. This process was presumably active throughout the late Holocene when the uppermost 15 to 20 feet of existing soils along much of the project alignment were deposited, so it is likely that there are many concealed former distributary channels and associated permeable sand and silt lenses within the near-surface soil deposits. The sequencing of this complex depositional process is illustrated in LAND-37, slide 2 [Frazier and Osanik 1969]. These former channel alignments often provide both horizontal and vertical seepage pathways through less permeable fine grained soils. The original natural channels were often extensively modified by construction of levees and re-alignment during drainage of the area for agriculture. Many minor distributary channels were covered by man-made levees and later obscured by agricultural field leveling. (DWR-212, Section 3.3.)

b. Tunnels

Although the tunnels have not been specifically designed to act as permanent barriers to groundwater flow, as have the slurry cutoff walls, they have a similar potential to obstruct the flow of groundwater. The tunnels will be in excess of 40 feet in out-side diameter and will form a continuous linear feature of over 40 miles long. (DWR-212, Section 11.1.) This large project component has a distinct potential to act as an impermeable barrier to the existing groundwater flow conditions in the immediate vicinity of the proposed tunnel alignment. Given the previously described complex heterogeneity of the soils along the tunnel alignment, the effects of the potential groundwater barrier created by the tunnel structure is likely to result in a permeant and adverse alteration of the current groundwater conveyance conditions, similar to that of the slurry cutoff walls. As a result, existing water wells in the vicinity of the proposed tunnel alignment, with screen intervals near the tunnel invert elevation, may experience significant permanent decreases in well production rates.

As shown in the figures in LAND-58 (Sacramento County Wells in Vicinity of Tunnels) and LAND-59 (San Joaquin County Wells in Vicinity of Tunnels), a very preliminary investigation showed that there are several wells in the vicinity of the Tunnels that are in jeopardy of being adversely impacted by the placement of the Tunnels. Not only are they near the Tunnels, they are also at a depth that is similar to the Tunnels, making the impact more likely. (LAND-65, Drawings 33-35 [Main Tunnels: Plan and Profile].) This obstruction could affect both water availability as well as water quality.

c. Slurry Cutoff Walls

John Bednarski explained that the proposed dewatering approach during construction includes the installation of slurry cutoff walls. (Bednarski Testimony, DWR-57, p. 15, lines 7-

10.) As further described by Gwendolyn Bucholtz, slurry cutoff walls are frequently used in areas with high groundwater to form a permanent hydraulic barrier within groundwater aquifers. (DWR-218.)

Although construction of slurry cutoff walls prior to dewatering should reduce the potential adverse effects on surrounding groundwater levels during construction, the presence of the slurry cutoff walls following construction will continue to act as permeant barriers to groundwater flow. Slurry cutoff walls function by acting as nearly impermeable barriers to groundwater flow across the slurry wall alignment. This is the characteristic that allows the groundwater to be lowered within the construction area while preventing groundwater levels outside the construction dewatering area from dropping. However, the obstruction of groundwater flow across the slurry cutoff wall alignment will remain following construction.

There exists a substantial possibility that adjacent property owners that rely on drainage of shallow groundwater for agriculture production and/or use of shallow groundwater aquifers for irrigation water will be significantly adversely impacted by this introduction of nearly impermeable barriers to groundwater flow, i.e., by the proposed slurry cutoff walls. Mr. Bednarski's testimony cites the May 19, 2016 memo from Ms. Buchholz, CH2MHill to Russ Stein, Department of Water Resources, as concluding that the potential adverse effect to groundwater due to construction will not be adverse. (DWR-57, p. 15, lines 18-21, citing to DWR-218.) Ignoring the facial illogic of Mr. Bednarski's statement ("the potential adverse effects . . . will not be adverse"), the cited memo does not address at all the potential adverse post-construction effects of the proposed cutoff walls.

Yet, Ms. Buchholz's May 19, 2016 memo admits that slurry cutoff walls will prevent horizontal groundwater flow: *"Groundwater that previously moved horizontally through the soil toward the excavation location would then be redirected by the slurry cutoff wall to move around the wall and construction site."* (DWR-218, p. 4, italics added.)

Any assertion that the proposed slurry cutoff walls will not result in any adverse effects to groundwater used by overlying property owners necessarily rests on the assumption that groundwater can flow around the wall. This assumption, in turn, generally requires that the subsurface soils are homogeneous (as depicted in Figure 1 of DWR-218, p. 8) and that there are no natural barriers to groundwater flow that may be preventing groundwater from flowing around the wall. As previously described, however, the near-surface soils, across much of the project alignment, are highly heterogeneous in nature and include soils that have both relatively low hydraulic conductivities and relatively high hydraulic conductivities. (Atwater 1982.) This complex heterogeneity means that the desired effect of the slurry cutoff walls (i.e., creation of a permanent barrier to groundwater flow) will likely result in a permeant and adverse alteration of the current groundwater conveyance conditions.

d. Identification of Potential Injury

Given the highly complex nature of the soil deposits along the CWF project alignment, prediction of the magnitude and extent of the impact is extremely difficult. As previously discussed, the locations of more permeable soil deposits that may currently be aiding the drainage of existing agricultural areas or contributing to current well yields, are often difficult to identify in isolated borings or through historical aerial photograph review due to the reclamation processes that were undertaken during the last century.

Extensive geotechnical explorations that include numerous exploratory borings, cone penetration test ("CPT") soundings, and geophysical surveys can easily miss significant variations in subsurface stratigraphy and aquifer connectivity. Even the most complete studies may have difficulty predicting all of the potential consequences of altering the groundwater flow patterns. Given the complex and sensitive nature of Delta groundwater flow patterns and their critical importance to legal users of water within the Delta, the potential for injury resulting from the proposed extensive use of slurry walls is particularly high. Certainly, nothing I have seen in the CWF project documentation, including the Conceptual Engineering Report (DWR-212, LAND-65), the Bucholtz Memorandum (DWR-218), or the Mitigation Measures included in the 2015 RDEIR/S (SWRCB-3, Appendix A, Mitigation Measures AG-1 [pp. 14-7 to 14-15], GW-1, 5, 11 [pp. 7-12 to 7-18]), affords any assurance—much less a credible science-based assurance—that the project will not result in such injury.

Mitigation provided for groundwater interference may be inadequate to prevent injury. As identified in the 2015 RDEIR/S, the CWF construction impacts would include: groundwater supply depletion, groundwater recharge interference, groundwater level alteration, and groundwater well capacity reduction. (RDEIR/S, Impact GW-1.) Although, mitigation of these potential construction-phase impacts could be achieved through the installation of slurry cutoff walls as described above, the potential impact of, and proposed mitigation for, the construction of permanent barriers to groundwater flow (i.e., slurry cutoff walls) is not adequately addressed. Mitigating the potential temporary construction-phase interference with, or alteration of, groundwater resources by constructing permanent barriers to groundwater flow may prevent a temporary injury, but may just as likely create a permanent injury. These potential permanent impacts do not appear to be adequately addressed by the proposed CWF project design or mitigation measures.

2. Spoils Disposal

Section 22.0 of the CER, Spoils Disposal Sites, states:

> Significant thicknesses of non-supportive or organic soils must be removed in the course of forebay, pumping plant, and shaft construction. Large volumes (approximately 30.7 million cy) of re-usable tunnel material (RTM), consisting of saturated soils mixed with bio-degradable polymers, are generated by tunneling operations. Large volumes (approximately 8 million cy) of dredge material are also expected to be removed from NCCF and SCCF. Smaller quantities of excess excavated materials are expected at other facility sites, including about 1.9 million cy at IF and approximately 1.6 million cy at each intake site.
>
> Organic materials will be stockpiled for placement over completed disposal areas. Soils that are unsuitable for reuse as restoration material, flood fight material, and engineered fill need to be disposed. These materials will be characterized and disposed appropriately. The presence of hazardous materials or environmental working conditions in or adjacent to potential spoil disposal sites will need to be evaluated. Hazardous materials excavated during construction needs to be segregated from other construction spoils and properly handled in accordance with state regulatory requirements.

(DWR-212, p. 207.)

The numbers here are staggering, even for engineers familiar with large tunneling and excavation projects. The total of 45.4 million cubic yards would be three times that in square yards if the material was spread out to a depth of 1 foot (which it might need to be for drying and conditioning, leaving aside the question of how one might dry out such material in winter), that is 136.2 million square yards or 28,140 acres. Drawings in Volume 2 of the CER shows possible locations for “disposal areas”, principally on Glanville Tract near the Intermediate Forebay (including locations within the Stone Lakes National Wildlife Refuge boundary), on Bouldin Island, and on Byron Tract near the revised Clifton Court Forebay, but these locations have changed before and may well change again. (LAND-65.) The CER provides a list of rules to be followed in siting these facilities but then simply states: “as more information about the nature and volumes of soil generated becomes available, distances and sizes of disposal areas will be refined and identified.” (DWR-212, p. 207.)

I have been unable to locate any detailed design and analysis or credible commitments or assurances in the CWF submissions regarding disposal of spoils. Mr. Bednarski does make some comments but these are limited to reusable tunnel material:

> The excavated material will be saturated with water and might be plasticized due to the use of biodegradable additives (e.g. foam or soil conditioner). [(Reusable Tunnel Material Testing Report, March 2014). Details on disposal and reuse of tunnel material are described in Section 3B.2.18, Appendix A, Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement (RDEIR/SDEIS)]. (Exhibit SWRCB-3.) Treatment and disposal of the decant liquids from the excavated material will require permitting in accordance with current National Pollutant Discharge Elimination System (NPDES) and Regional Water Quality Control Board regulations.

(DWR-57, p. 19, lines 2-9.)

However, Section 3B.2.18, Appendix A, of the RDEIR sets forth only obtuse and generic environmental commitments, not actual analysis of impacts or potential injury to other water users. (SWRCB-3.) It provides no detail on locations or designs and provides no credible assurance that there will not be injury to other water users.

Absent this missing detail on the location and design of spoil handling facilities, it is impossible to quantify the likely injury to adjacent legal users of water. Unmentioned is the fact that water quality in the Delta peats below the irrigated zone is very poor. Any such materials will need to be handled separately and safely disposed of. At least some facilities will require liners with leak detection systems. Such liners will disrupt normal infiltration of precipitation and hence groundwater flows even more than unlined stockpiles. Unlined stockpiles, on the other hand, will likely cause local mounding of the groundwater. Lined or unlined stockpiles, and final disposal areas, will also disrupt existing patterns of surface drainage and likely disrupt irrigation systems. Unless treatment and disposal of decant and other liquids is flawless, there will be injury to other water users and to the waters of the State. Simply stating an intention to acquire the required permits provides little assurance that these injuries will not occur.

3. Loss of Ground as a Result of Tunneling Activities, with Catastrophic Impacts on Levees and Islands

It is well known that many of the Delta islands and tracts are subsided below the normal range of water levels in the rivers and sloughs and that they are only kept dry by the levee system. (See, for instance, Figure 14, Chapter 5, of the Economic Sustainability Plan of the Delta Protection Commission [SDWA-139].) More than half of the length of the proposed WaterFix tunnels cross islands that are subsided by as much as 15 feet or more below Elevation 0. Any breach of the levees on these islands leads to flooding of that island with resultant catastrophic disruption to legal users of water. This injury would not be restricted to a single island because even a single flooded island puts pressure on adjacent islands and also causes salt water intrusion that impacts all water users in the Delta including export water users. The WaterFix proponents acknowledge the possibility of settlement of the levee foundation and damage as a result of the proposed tunneling activities. (See, e.g., Bednarski Testimony, DWR-57, p. 26, lines 15-16.) Petitioners also admit the need for further studies "based on the initial assessment from field reconnaissance and engineering surveys, geotechnical exploration and analyses will be performed for levee sections that need further evaluations" (DWR-57, p.26, lines 21-23), and then they discuss potential measures that might be employed to mitigate the injury. (See, e.g., DWR-57, p. 27, lines 10-16.)

However, this focus on potential mitigation measures rather than on a "no injury" analysis, though common in the context of an EIR/EIS analysis, does not address the requirement of Water Code section 1701.2, subdivision (d) that petitioners demonstrate a reasonable likelihood that the proposed change will not injure any other legal user of water. In fact, there can be little assurance (and Petitioners have provided none) that the ambitious tunneling activities at critical locations, such as under levees, will not result in serious injury to affected landowners and others who rely on the continuing integrity of the Delta's complex levee system.

Potential mitigation measures are not the same as assurances of a reasonable likelihood of "no injury." This distinction may seem academic in some contexts, but the consequences of a levee failure leading to flooding of one or more islands include not only injury to water users on those islands but also to water users on adjacent islands. Flooded islands exert pressure on not only adjacent islands, but, potentially, all water users in the Delta as a result of salinity intrusion, not to mention economic losses and potential loss of life. In short, this is a classic example of a potential problem that might have a relatively low probability of occurrence but which has very large consequences. Arguing that the probability of occurrence can be made smaller and smaller by the adoption of best practices does not significantly change the risk of significant injury. While similar tunneling activities in other locations may not have the same consequences, the consequences in the Delta, where many water users are linked together by shared use of the same levee system, are many orders of magnitude greater. Under these circumstances, merely outlining potential strategies for mitigating the injury does not address the problem.

It should also be noted that of all the locations along the proposed tunnel alignments, the river and slough crossings, where the water table is higher than it is on the surrounding islands and tracts, are likely more vulnerable to loss of ground incidents.

Beyond the fact that the Delta is an environment that is particularly sensitive to "accidents" associated with tunnel construction, two other factors, both well known in engineering design and construction, contribute to a significant risk of injury to water users. The first is that there tend to be more problems when large projects are designed and constructed by design and construction entities, such as the Delta Conveyance Facility Design and Construction Enterprise, that lack a significant background of experience in the same kind of project. (See LAND-71, p. 33.) An oft-cited example of this is the design and construction of the new East Spans of the San Francisco – Oakland Bay Bridge. Another example, although in somewhat different circumstances, is the delays and cost overruns that occurred in the design and construction of Metropolitan's own Inland Feeder Tunnels.

The second factor is that more problems tend to arise with the construction of larger diameter tunnels. The technical reasons for this are well understood, and there are many actual examples, such as the Eisenhower Tunnels on I-70 in Colorado and the Alaskan Way Viaduct Replacement Tunnel in Seattle.

Thus, while good faith efforts can be made to mitigate loss of ground incidents at river and slough crossings, not only the environment of the Delta but also organizational factors, make elimination of the risk extremely problematic. Given the potential for catastrophic injury, after-the-fact apologies and explanations will bring little consolation to water users in the Delta.

I declare under penalty of perjury under the laws of the State of California that the foregoing statements are true and correct.

Executed on the 1st day of September, 2016, at San Ramon, California.

Josef Tootle