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Subject: BDCP Draft EIR/EIS Comments

Chapter 7 and Appendix 7A: Groundwater

Throughout the Draft EIR/EIS a groundwater model is used to attempt to describe the environmental setting/affected environment and the environmental consequences on groundwater resources. The groundwater model used throughout the document to assess groundwater conditions in the plan area and upstream and service export areas is based on one developed by the US Geological Survey, referred to as CVHM. The application and limitations of CVHM are described in US Geological Survey Professional Paper 1776 (2009). The consulting firm, CH2MHill, listed on as one of the document preparers modified the CVHM model to assess groundwater conditions (environmental setting) and environmental consequences in the plan area (Delta) and renamed that modified model "CVHM-D", where the nomenclature "D" represents the Delta. Most of the groundwater section descriptive text and the data used as input to the CVHM and CVHM-D models were extracted from the State of California, Department of Water Resources publication, Bulletin 118-03 (February 2004).

Groundwater modeling, the project (alternatives) impacts on groundwater and the cumulative effects of the project (alternatives) on groundwater do not meet the requirements set forth in NEPA, nor does Chapter 7 or Appendix 7A of the Draft EIR/EIS identify all potential effects likely to impact groundwater resources.

Comment No. 1
The EIS fails to meet the requirements set forth in 40 CFR Section 1502.15 Affected Environment:

NEPA guidance requires that the EIS "…succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration." The EIS does not provide site-specific groundwater or aquifer data along the proposed conveyance routes or at the intake locations. The EIS uses only generalized data from published reports, primarily DWR Bulletin 118-2003. Bulletin 118-2003 provides generalized area information. No detailed groundwater or aquifer characteristic data are available for most of the project area within the Delta. The data necessary for a comprehensive, analysis of the groundwater setting along the alternative conveyance routes and intake locations are not available to a reviewer.

Section 7.1.1, *Potential Environmental Effects Area,* provides only regional generalized descriptions of the groundwater settings, and devotes significant discussion to regional groundwater conditions outside of the Delta. There are no specific discussions about groundwater or aquifer conditions in the Delta or that describe environmental and specific groundwater conditions within the alternative alignments. However, Section 7.3, *Environmental Consequences*, attempts to "describe[s] the potential groundwater-related effects that could result from project construction, operation, and maintenance." Regional groundwater data extracted from Bulletin 118-2003, the primary reference used in EIS Chapter 7, provides virtually no specific groundwater or aquifer data for project alternatives locations and site-specific groundwater data.

The EIS avoids reference to existing groundwater data as published in DWR Bulletin 118-3, *Evaluation of Ground Water Resources: Sacramento County*, 1974, which provides geologic data for superjacent stream channel deposits which cross-cut the northern Delta and which will affect and be affected by proposed dewatering and construction activities. Furthermore, the EIS makes no attempt to describe the sedimentary textures or aquifer characteristics along the alignment alternatives, instead relying on groundwater modeling as described in and derived from USGS Professional Paper 1766, *Groundwater Availability of the Central Valley Aquifer, California.* However, according to Professional Paper 1766, the groundwater aquifer-system deposits in the Central Valley used to model groundwater availability, including the Delta, are derived from "the, lithologic data from approximately 8,500 drillers' logs of boreholes ranging in depth from 12 to 3,000 feet below land surface were compiled and analyzed to develop a 3-D texture model. The lithologic descriptions on the logs were simplified into a binary [two textures] classification of coarse- or fine-grained. The percentage of coarse-grained sediment, or texture, then was computed from this classification for each 50-foot depth interval of the drillers' logs. A 3-D texture model was developed for the basin-fill deposits of the valley by interpolating the percentage of coarse-grained deposits onto a 1-mile spatial grid at 50-foot depth intervals from land surface to 2,800 feet below land surface."

This modeling approach which is poorly described in the EIS ignores that only about 500 well logs were used to determine groundwater levels and only about 200 well logs out of 8,500 were used to describe aquifer textures (clay, silt, sand, gravel, etc.) for the entire Central Valley of California. The EIS describes how the USGS model, called CVHM, was modified (CVHM-D) from one-square mile modules to ¼ mile modules to analyze groundwater conditions in the project area. However, the modified model, CVHM-D, adds no new data, relies on essentially two wells in the Delta and provides no site specific groundwater data that describes the environmental setting along the alternative conveyance alignments.

On February 12, 2014 at a public open-house meeting held for the BDCP EIR/EIS in Clarksburg, this reviewer talked with Gwendolyn Buchholz, PE, Vice President, CH2M-Hill. Ms. Buchholz is listed as a preparer of Chapter 7. Ms. Buchholz said that she was responsible for groundwater modeling for the BDCP EIR/EIS and that the groundwater models used to evaluate the environmental setting, and the project impacts on the groundwater were lacking in site-specific data and that their usefulness was very limited. Ms. Buchholz was also unaware of geologic data acquired by CH2M-Hill from six-boring along a portion of the southern proposed alignment of one tunnel alternative which contradicted modeling data input and which called into question the conclusions reached in the EIS regarding tunnel impacts on groundwater.

Based on the absence of groundwater data as required by 40 CFR Section 1502.15, it is not possible for a reviewer to independently understand the environmental setting for the alternative alignments or at the intakes along the Sacramento River.

Therefore, the EIS must be revised to provide site specific groundwater and aquifer data along the alternative conveyance routes and at the proposed intake locations so that a reviewer can understand the environmental setting for groundwater resources, and evaluate project impacts and mitigation measures and assess the likelihood that the EIS has failed to address other impacts and mitigation measures..

Comment No. 2
The EIS fails to meet the requirements set forth in 40 CFR Section 1502.16 Environmental Consequences:

Section 7.3 *Environmental Consequences,* states that, "The potential for interaction between the canal alignments and the underlying aquifer system in the Delta Region was evaluated using a numerical model, Central Valley Hydrologic Model-Delta (CVHM-D), described in subsection 7.3.1.2, *Analysis of Groundwater Conditions due to Construction and Operations of Facilities in the Delta*."

The EIS does not include an analysis of the environmental consequences to groundwater resources from the construction or operation of any of the proposed tunnel alignments, even though it appears that a tunnel, rather than a canal is the preferred alternative.

Therefore, the EIS must include specific groundwater modeling analysis of the tunnel alignments on groundwater resources and describe how the tunnels, with inverts at approximately 150-feet below the existing ground surface, will affect groundwater flow, groundwater quality and availability of groundwater resources.

Comment No. 3

Section 7.3.1.1 *Analysis of Groundwater Conditions in Areas that Use SWP/CVP Water Supplies* states that, "It is assumed that in areas that experience increased SWP/CVP water supplies, groundwater withdrawals would decline, and depending upon the local groundwater characteristics, groundwater elevations may rise. It is further assumed that if SWP/CVP water supplies decrease in areas that have historically relied upon groundwater for major portions of the water supply, groundwater withdrawals would increase to replace the reduction in SWP/CVP surface water supplies."

This statement contradicts the *Purpose Statement* (Chapter 2, Section 2.4) which states that, "The … Purpose Statement reflects the intent to advance the coequal goals set forth in the Sacramento–San Joaquin Delta Reform Act of 2009 of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The above phrase—*restore and protect the ability of the SWP and CVP to deliver up to full contract amounts*—is related to the upper limit of legal CVP and SWP contractual water amounts and delineates an upper bound for development of EIR/EIS alternatives, not a target. It is not intended to imply that increased quantities of water will be delivered under the BDCP. As indicated by the "up to full contract amounts" phrase, alternatives need not be capable of delivering full contract amounts on average in order to meet the project purposes. Alternatives that depict design capacities or operational parameters that would result in deliveries of less than full contract amounts are consistent with this purpose."

Therefore, how can the project proponents assume that increased deliveries will be forthcoming under BDCP? Increased exports to supplement groundwater withdrawals should not be considered unless the BDCP EIS *Purpose and Need* is modified to reflect the need. Additionally, the EIS offers no evidence that increased groundwater withdrawals within the export service area will occur. The assumption used in the BDCP EIS that increased water exports with mitigate groundwater withdrawals in the export service areas is unfounded and should not be used as a justification for the BDCP, and without supporting evidence the assumption is not a legitimate direct, indirect or cumulative effect; therefore not an environmental consequence.

Comment No. 4

Section 7.3.1.2 *Analysis of Groundwater Conditions Associated with Construction and Operations of Facilities in the Delta.*

In the Central Valley Hydrologic Model–Delta Methodology portion of 7.3.1.2, the EIS lists five modifications to the CVHM for application to the project, to create model CVHM-D. One model modification reduced the grid-cell size from 1 mile square to ¼ mile square in order to provide more Delta-specific detail. "This modification allowed for greater precision in model output in the Delta Region." However, this modification relies on the assumption that spatial information, such a groundwater levels and aquifer texture characteristics are available within the original one-square mile grid-cell. According to Professional Paper 1766, Figure C15, *Distribution of Calibration Data*, in the case of the Delta region, there are no data points. That is, the US Geological Survey did not use any data from the Delta in CVHM.

How then does the EIS use CVHM and CVHM-D to calibrate and model groundwater conditions in the Delta or specifically, along the alternative conveyance alignments if there are no data? Dividing one-mile square grid cells into ¼ mile grid cells does not improve model precision if there are no data.

The EIS must explain how subdividing one-mile square grid cells devoid of data into ¼-mile grid cells, also devoid of data, improves the model precision and how these data-less grind-cells provide meaningful input to model groundwater conditions along the alternative alignments.

Comment No. 5

The EIS fails to meet the requirements set forth in 40 CFR Section 1502.22 Incomplete or Unavailable Information:

The EIS fails to comply with NEPA at the most basic level, as set forth in 40 CFR Section 1502.22 Incomplete or Unavailable Information and Section 1502.24 Methodology and Scientific Accuracy. Chapter 7 (Groundwater) is extremely difficult to objective review and develop meaningful comments because there is virtually no data in the EIS which leads to conclusions that allows a reviewer to critically evaluate the impacts to groundwater or mitigation measures. At the Clarksburg BDCP open house we asked several "BDCP Staff" - all CH2MHill employees, if they could explain how they modeled groundwater conditions without any data - literally only 2 data points in 400,000 acres. Gwen Buchholz, VP at CH2MHill and the lead modeler, said that she had no data and was forced to create a model because they were under a time constraint to get the EIS out. She admitted that the groundwater model used to describe the affected areas was virtually useless. She told us that their assumption was that the tunnel would be bedded on a sand layer they saw in one boring at about 150 feet bgs. We told her that we had reviewed boring data (collected by CH2MHill) that clearly showed the tunnel invert would bed on fat clays. She said if that were true, it would change the analysis...it is true, but not evaluated in the EIS.

At the same Clarksburg open house we spoke with Praba Pirabarooban, DWR Supervising Water Resources Engineer. We asked him to explain how the tunnels are constructed: 3 boring machines working at once; each machine dropped to tunnel depth (about 150 feet) in an excavation; pre-cast concrete tunnel parts, each 10-feet long and representing 1/8 if the circumference (45 degrees), bolted and glued together (about 304,000 individual precast concrete pieces held together by about 12,000,000 bolts) . Mr. Pirabarooban admitted he had virtually no data to inform the design of the tunnel and very limited data about construction of the intakes. For instance, he had data from one boring in the Sacramento River which showed a clay layer at 30 feet bgs. Therefore, the entire dewatering plan (sheet pile construction) and intake construction protocols in the EIS are based on one boring, he actually thought that clay layer in the Delta would be continuous for about one mile along the river and about 1000 feet east of the river. There are no data to confirm this assumption. According to the EIS, DWR relied on two technical memorandums prepared by DWR to estimate dewatering protocols. I took us about one month, but we finally obtained the Tech Memos. Mr. Pirabarooban was a quality control reviewer for one the memos which said, that to dewater the intake construction sites will require anywhere from 200 to 1,000,000 gpd. But a final pumping protocol could not be determined without more data...data DWR never acquired before they prepared the EIS. It makes it very difficult to review an EIS when there is no data from which we can reasonably evaluate any impacts. We asked Mr. Pirabarooban what percentage of data he had for the tunnel design; he said about 15% for one alignment. DWR probably had less than 5% of the necessary data when compared to the alternative alignments. Mr. Pirabarooban agreed with that. We asked him how long would it take to acquire and analyze enough data to design the tunnels, his answer- about 1.5 to 2 years and $1.5 billion.

According to *Technical Memorandum: Definition of Existing Groundwater Regime for Conveyance Canal Dewatering Evaluation*, DWR 9AA-31-05-145-002, Task Order No. WGI-15, Subtask 2, January 21, 2010, section 3.0 Approach:

> p. 3-1: Although several thousand borings have been drilled throughout the Delta, mostly for geotechnical evaluation of manmade levees, almost none of these borings are located in the immediate vicinity of proposed project facilities. More relevant data for this investigation was found in previous studies for the Peripheral Canal. In addition, the project database included data from numerous United States Geologic Survey (USGS) and DWR groundwater monitoring wells surrounding the Delta. However, none of these well were located in the immediate vicinity of proposed project features.
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> p. 3-4: Although more than 100 groundwater monitoring wells were identified within the project area, the spatial distribution of these wells is not uniform across the project area. Additionally, the density of wells with respect to near surface hydrogeologic conditions is insufficient to produce a project-wide groundwater map detailed enough for site-specific dewatering analysis. Therefore, it is not possible to determine the site specific variation of initial depth to groundwater along each ... alignment.

The EIS ignores these statements from a document upon which Chapter 7 of the EIS relies for much of its credibility and scientific accuracy. The EIS must be revised to meet CFR 40 Section 1502.22 and include an explanation of the limits of available data and how those data gaps influence the usefulness of the CVHM-D groundwater model.

Comment No. 6
The EIS fails to meet the requirements set forth in 40 CFR Section 1502.24 Methodology and Scientific Accuracy:

The EIS fails to meet the NEPA requirements of 40 CFR Section 1502.24. Professional and scientific integrity is compromised throughout EIS Chapter 7 by citing only portions or sections of reference material which agree with the project proponents desired outcome. This selective data presentation violates Section 1502.24, and makes it impossible for comprehensive review of the proposed project's impacts and mitigation measures.

Therefore, revise EIS Chapter 7 to meet the basic requirements of 40 CFR Section 1502.24 and to provide reviewers with a scientifically objective evaluation of the proposed project's impacts and relevant mitigation measures. Examples of the use of selective data include, but are not limited to:

Comment 6a

Section 7.1.1.1 Central Valley Regional Groundwater Setting; p. 7-3, beginning line 4, Regional Hydrogeology Overview; The EIS ignores or uses only selected data from three Chapter 7 references which describe the complex stratigraphy and lithologic character of the Delta and the site-specific groundwater conditions affecting project alternatives. The EIS uses only selective data or ignores the limitations of California Department of Water Resources, 2003, *California's Groundwater*. Bulletin 118, Update 2003; California Department of Water Resources, 2010, *Technical Memorandum: Definition of Existing Groundwater Regime for Conveyance Canal Dewatering and Groundwater Evaluation.* Delta Habitat Conservation and Conveyance Program, Document Number: 9AA-31-05-145-002, and California Department of Water Resources, 2010, *Technical Memorandum: Analysis of Dewatering Requirements for Potential Excavations,* Delta Habitat Conservation and Conveyance Program, Document Number: 9AA-31-05-145-001. From Chapter 9, the EIS ignores significant portions of Norris, R. M., and R. W. Webb. 1990, *Geology of California* Second Edition, New York: John Wiley & Sons, Inc. which describes the complex geologic setting of the Delta because it does not fit the pre-determined, simplified lithologic conditions for project groundwater modeling (Norris and Webb, beginning on page 434).

The EIS does not explain that Figure Number 9-3 used for groundwater analysis and geology which is adapted from Atwater (Atwater, B. F. 1982. *Geologic Maps of the Sacramento–San Joaquin Delta, California: U.S. Geological Survey*. (Miscellaneous Field Studies Map MF-1401, scale 1:24,000), Reston, VA) and that the Atwater map is essentially a surficial geology map that provides data to only a few feet below the existing ground surface.

Comment 6b

Section 7.3.1, Methods of Analysis. The EIS does not disclose that CVHM is a general, overall water balance tool model. CVHM specifies that groundwater water levels are generalized aquifer characteristics from selected wells and are culled to include just fine or coarse sand in 50 to 100 foot thick layers. This omission in the EIS prevents the reviewer from thoroughly understanding the implication of the dewatering and project construction impacts. Additionally, the "refinement of CVHM" to CVHM-D for the Delta only reduced the 1 sq. mi. grid to ¼ sq. mi. CVHM-D did not reduce the layer thickness to less than 50 feet; nor did it add additional texture (lithologic) descriptors.

CVHM-D model calibration is critical to the evaluation and interpretation of project impacts on groundwater resources. Water level in wells is necessary for this calibration. No wells for calibration were used in the Delta area. A general water balance in the Delta has been produced by the model, but the EIS does not provide specifics for subsurface geology, engineering characteristics, dewatering programs, or domestic well interference.

Comment 6c

The EIS refers to existing ground water levels and flow directions (p. 7-40). None of the groundwater parameters necessary to evaluate existing conditions have been measured or calculated. The EIS only guesses at the groundwater elevations within one of two feet of depth and generalizes the groundwater flow direction based on topography and existing, present-day, drainage patterns. In the near-flat Delta terrain, surveys accurate to centimeters are necessary to accurately delineate the flow directions and head boundaries. The EIS fails to meet basic scientific standards.

Comment No. 7
Section 7.3.1.2, p. 7-36, beginning line 19.

The EIS states, "The parameters used to simulate the dewatering projects were obtained from two DWR technical memoranda: *Definition of Existing Groundwater Regime for Conveyance Canal Dewatering and Groundwater Evaluation* (California Department of Water Resources 2010a) and *Analysis of Dewatering Requirements for Potential Excavations* (California Department of Water Resources 2010b). Each dewatering project was simulated using CVHM-D."

However, according to *Technical Memorandum: Analysis of Dewatering Requirements for Potential Excavations,* DWR Document Number 9AA-31-05-145-001, Task Order WGI-15, February 28, 2010 (Technical Memo-1), section 1.1, p. 1-1: "Task Order WGI-15, Conveyance Canal and Construction Area Groundwater Evaluation, is designed to develop a more detailed understanding of the near-surface hydrogeologic regime and excavation dewatering requirements for proposed water conveyance options in the Sacramento River–San Joaquin River Delta ("the Delta")." The term "near-surface" refers to, "The pipeline excavation depth was assumed to be 30 feet below ground water surface. The dewatering target was assigned as 5 feet below the pipeline excavation depth (i.e. 35 feet bgs)." (Section 3.3.2, p. 3-7). Although the tunnel alignment *per se* will not be dewatered, there are numerous locations along the proposed tunnel alignment which are proposed to be dewatered to depths up to 150 feet below the existing ground surface. Therefore, project dewatering effects on groundwater, to tunnel alternatives invert depths from 36 feet to 150 feet below the exiting ground surface are ignored in the EIS.

Figure 3-3 (Technical Memo-1) shows one proposed tunnel alignment but does not show any alternative tunnel alignment, or Alternative 4, the preferred alignment and does not accurately show the proposed location of the intakes. Therefore, how can the EIS, which relies on Technical Memo-1, comply with 40 CFR Section 1502.14, Alternatives including the proposed action, and with CFR 40 Section 1502.24 Methodology and scientific accuracy?

Comment No. 8
Section 7.3.1.2, p. 7-36, beginning line 23.

The EIS states, relying on *Technical Memorandum: Analysis of Dewatering Requirements for Potential Excavations*, states that, "Each dewatering project was simulated using CVHM-D. The effects of each dewatering simulation were compared to the simulation of the No Action Alternative baseline conditions to obtain an estimate of the incremental impacts of dewatering activities." However, the EIS ignores Technical Memo-1 which states (Section 5.0 Data Needs, p. 5-1):

> A numerical model or analytical calculation **could** be employed to estimate the subsidence that **might** occur as direct result of dewatering. However, the usefulness of such a modeling/analysis effort would also depend on gathering site-specific thicknesses of potentially compressible units, values for inelastic and elastic storage coefficients. The estimates for pre-consolidation head are also needed to evaluate potential dewatering induced subsidence. The results of the subsidence assessments would be used to evaluate the potential for dewatering impacts to the surrounding topography, including nearby levee systems. The necessary data for this type of modeling/analyses could be acquired though geotechnical borings and acquisition of undisturbed core samples. However, dewatering of one or more test excavations as suggested ...would be necessary to confirm and refine the model's predictions.

Section 5.0, Data Needs of *Technical Memorandum: Analysis of Dewatering Requirements for Potential Excavations*, identifies "some data gaps" including dewatering analysis of peat, site specific aquifer parameters, installation of "numerous groundwater monitoring wells", collection of groundwater quality data and "Once site-specific data have been collected, it is recommended that previously created flow evaluations be updated to reflect these new data. Additional scenarios could then be created to optimize dewatering methods or to determine the feasibility of alternate methods." (p. 5-2) None of these data gaps are addressed in the EIS. How does the EIS comply with CFR 40 Section 1502.24 Methodology and scientific accuracy and 40 CFR 1502.22 Incomplete or unavailable information?

Comment No. 9
Section 7.3.3, p. 7-39, beginning line 6

The EIS states, "The assessment of effects resulting from implementation of the BDCP alternatives is complicated by the fact that locations and construction details for existing production wells in the vicinity of the project are unknown at this time." This statement is misleading and is contradicted by *Technical Memorandum: Definition of Existing Groundwater Regime for Conveyance Canal Dewatering Evaluation*, DWR 9AA-31-05-145-002, Task Order No. WGI-15, Subtask 2, January 21, 2010, section 3.0 Approach, which states that, " Although more than 100 groundwater monitoring wells were identified within the project area, the spatial distribution of these wells is not uniform across the project area. Additionally, the density of wells with respect to near surface hydrogeologic conditions is insufficient to produce a project-wide groundwater map detailed enough for site-specific dewatering analysis. Therefore, it is not possible to determine the site specific variation of initial depth to groundwater along each ... alignment." (p. 3-4)

Additionally, *Technical Memorandum: Definition of Existing Groundwater Regime for Conveyance Canal Dewatering Evaluation*, DWR 9AA-31-05-145-002, Task Order No. WGI-15, Subtask 2, states that, "Appendix A contains individual hydrographs of groundwater wells monitored by DWR within the project area." Appendix A contains 102 groundwater well hydrographs. the location of each hydrograph is known. Therefore the EIS choose to ignore available groundwater data.

Comment No. 10
Section 7.3.3.9, p. 7-81, beginning line 25

The EIS states, "Operation of the tunnel would have no impact on existing wells or yields given the facilities would be located more than 100 feet underground and would not substantially alter groundwater levels in the vicinity."

The BDCP proposed two tunnels, not one; the EIS should be corrected. The EIS should be corrected to reflect a tunnel invert depth of 150 feet below the existing ground surface.

The EIS offers no evidence or data to support the above statement. Throughout the EIS, the project proponents have stated that there are limited groundwater data available for analysis and that much of Much of the Chapter 7 analysis of project impacts to groundwater resources is based on two technical dewatering memorandums prepared by DWR and the CVHM-D groundwater model, neither were used to evaluate groundwater resources to depths of 100 feet or greater. The construction and operation of two tunnels, each 44 feet in outside diameter, buried at 106 feet to about 150 feet below the surface could have significant impacts of groundwater resources.

Based on geotechnical borings (dated April 2013) from Mandeville and Bacon Islands, acquired by DWR and CH2MHill for the tunnel alignments, but not used in the preparation of the EIS, the interbedded lithologic units at depths between 100 and 150 feet below the existing ground surface range in thickness from one foot to about 17 to 20 feet and include 30 or more lithologic types. Some of the lithologic units at the tunnel depths exhibit aquifer characteristics – silty sand, fine grain sand, etc. The majority of lithologic units are clays which may act as aquitards or aquicludes. The EIS makes no attempt to assess the impacts of dual tunnel construction on groundwater resources at depths of 106 to 150 feet below the existing ground surface.

Based on DWR Bulletin 118-3*, Evaluation of Ground Water Resources: Sacramento County*, July 1974, reprinted April 1980, there are buried channels composed of permeable sand and gravels incised into less permeable silt and clay, resulting in a network of meandering tabular aquifers which are normal or near-normal to the proposed tunnels alignments. The buried channel aquifers represent the former locations of major rivers including the Sacramento, American and Consumnes. These buried, highly permeable channels will be intersected by tunnel construction. It is likely, that in the north Delta, these buried tabular aquifers serve as drinking water and agricultural water supplies. However, the EIS does not address impacts to groundwater users who withdraw groundwater from these permeable aquifers.

Comment 11
The impacts to groundwater resources which are not addressed in the EIS include –

Impact GW 7(1): Dual tunnel construction will intersect producing aquifers and reduce or interfere with pre-existing wells. The impact would result in lowered groundwater levels and reduced well capacities and discharge rates and would affect residential and agricultural available groundwater.

Impact GW 7(2): Pumping pre-existing groundwater wells within the vicinity of the tunnel alignments will cause groundwater drawdown beneath the tunnels and may aversively affect the structural integrity of the dual tunnels. Pumping wells within the vicinity of the dual tunnels create radii of influence which lower groundwater levels. Withdrawing groundwater from beneath the dual tunnels will adversely affect the structural integrity of the lithologic units on which the tunnels are bedded.

Impact GW 7(3): Pumping during dewatering activities at the intakes and at specific locations along the tunnels alignments, may cause reversals in groundwater gradients and groundwater flow directions. The shallow groundwater gradients are susceptible to alterations that would affect pre-existing domestic and agricultural water wells.

Impact GW 7(4): Construction of the forebays, which intercept the unconfined aquifer, will change the gradient and depth to groundwater. Groundwater levels up-gradient of the forebays will be increased and depth to groundwater down-gradient of the forebays will be in reduced and may cause extremely shallow ground conditions that will damage building foundations, roadways and irrigation canals.