From: Jim Wallace
PO Box 266
Courtland, California 95615

Subject: BDCP Draft EIR/EIS

Chapter 9, Geology and Seismicity, Section 9.3.3.9, Impact GEO-3, beginning p. 9-181

Impact GEO-3: Loss of Property, Personal Injury, or Death from Ground Settlement during Construction of Water Conveyance Features (Note: Impact Geo-3 applies at all tunnel alternatives; Section 9.3.3.9 refers to Alternative 4, the preferred alternative)

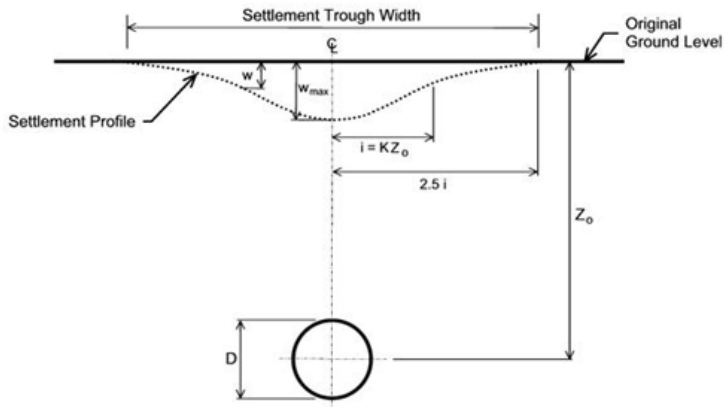
Impact Geo-3:

> Two types of ground settlement could be induced during tunneling operations: large settlement and systematic settlement. Large settlement occurs primarily as a result of over-excavation by the tunneling shield. The over-excavation is caused by failure of the tunnel boring machine to control unexpected or adverse ground conditions (for example, running, raveling, squeezing, and flowing ground) or operator error… This [large] settlement can also affect the ground surface…While this could potentially cause property loss or personal injury above the tunneling operation, instances of large settlement are extremely unlikely to occur due to pre-construction measures and other protective strategies and safety practices during construction.

Comment 1

According to US Department of Transportation, Federal Highway Administration, *Technical Design Manual for Design and Construction of Road Tunnels*, and *A Method of Estimating Surface Settlement Above Tunnels Constructed in Soft Ground*, by R.K Rowe and K.Y. Lo (National Research Council of Canada, 1983) and *Predicting the Settlements Above Twin Tunnels Constructed in Soft Ground* by D. N. Chapman, C.D.F. Rogers and D.V.L. Hunt, University of Birmingham, U.K., estimating potential ground settlement above tunnels in soft ground can be accomplished with accepted mathematical formulas. However, in the EIS all methods to estimate potential ground settlement above the twin tunnels are ignored.

The risk of ground settlement to cause personal injury above the tunnels may be low. However, the EIS ignores the potential for adverse impacts at the ground surface based on accepted soil mechanics applications. The *Technical Design Manual for Design and Construction of Road Tunnels* (US Department of Transportation, Federal Highway Administration) provides an approach to estimate ground surface settlement impacts above tunnels. Based on the design manual's mathematical formulas numbers 7-2, 7-3 and 7-4, it is possible to estimate the width and depth of a settlement trough. The design manual also states that, "In the case of parallel adjacent tunnels, surface settlement is generally assumed to be additive."



From the *Technical Design Manual for Design and Construction of Road Tunnels* (US Department of Transportation, Federal Highway Administration), Figure 7-9.

Therefore, based on published data, accepted soil mechanic applications and the proposed BDCP tunnel geometry, known or estimated groundwater conditions and soil types as stated in other chapters of the BDCP EIS, a reasonable estimate of ground surface settlement can be determined. The BDCP EIS should be revised to include such an estimate to be used to evaluate surface impacts so that an informed reviewer can understand the surface settlement effects of the twin tunnels.

Comment 2: Impact Geo-3:

The BDCP EIS's failure to estimate potential ground surface settlement above the twin parallel tunnels ignores potential surface impacts which include:

- An estimate of the width of the settlement trough which could be several hundred feet or more in width and extend the entire 35-mile length of the tunnels and how the width could vary depending on geologic and groundwater conditions,.
- An estimate of the depth of the settlement trough which could be minimal to tens of feet or more in depth and extend the entire 35-mile length of the tunnels and how the depth could vary depending on geologic and groundwater conditions.
- Effect of highways, roads, and streets from settlement.
- Effect on buried utilities.
- Effect on surface streams and rivers.
- Effect on agricultural lands and access to agricultural lands.
- The withdrawal of additional agricultural land from production within the trough.
- The requirement to purchase additional right-of-way to prevent encroachment onto land affected by settlement, and the additional costs to do so.
- The effect of flooding within the trough and how flooding could affect surrounding land uses.

Impact Geo-3:

> Site-specific geotechnical investigations are needed to design the extent and type of ground improvement that may be required. Ground improvement would be required to facilitate support of tunnel shafts, control groundwater at the locations of the shafts, prevent development of undesired tunnel-induced surface settlements and provide pre-defined zones for TBM [tunnel boring machine] maintenance interventions.
>
> However, during detailed project design, a site-specific subsurface geotechnical evaluation would be conducted along the pipeline/tunnel alignment to verify or refine the findings of the preliminary geotechnical investigation. The tunneling equipment and drilling methods would be reevaluated and refined based on the results of the investigations, and field procedures for sudden changes in ground conditions (e.g., excavate and replace soft soil; staged construction to allow soft soil to gain strength through consolidation) would be implemented to minimize or avoid ground settlement.

Comment 3:

The BDCP EIS relies exclusively on the twin tunnel concept to meet the purpose and need of the BDCP. However, there is virtually no detail and no significant discussion regarding the impacts of the tunnel construction on surface settlement. Therefore, a reviewer can not reach any conclusion on the project's effects or mitigation measures. Although not specifically called out, Impact Geo-3 relies on "adaptive management" techniques and future engineering studies and design to allay any concerns regarding surface settlement, and ignores published data that provides methods to estimate surface settlement impacts. The BDCP EIS proponents and preparers clearly know that published data to estimate surface settlement is available because language within the BDCP EIS is very similar to, or nearly the same as, language in various professional publications that address surface settlement caused by tunnels in soft ground. However, the preparers have chosen not to cite any published design manuals or professional papers, probably because doing so would force the preparers to acknowledge that large scale surface settlement and significant adverse effects are likely to occur during the construction of the twin tunnels. Therefore, the BDCP EIS preparers should revisit available technical publications and fully disclose to the public an estimate of surface settlement and the likely impacts.

Impact Geo-3

> The geologic units in the area of the Alternative 4 modified pipeline/tunnel alignment are shown on Figure 9-3 and summarized in Table 9-26. The characteristics of each unit would affect the potential for settlement during tunneling operations. Segments 1 and 3, located in the Clarksburg area and the area west of Locke, respectively, contain higher amounts of sand than the other segments, so they pose a greater risk of settlement.

Comment 4

Figure 9-3 does not show the location of the Alternative 4 tunnel alignment. Therefore, the reference to Figure 9-3 is confusing and should be corrected in the BDCP EIS. Alternative 4 is not located west of the community of Locke and the location shown in Figure 9-3 should not be considered in the vicinity of the Alternative 4 alignment.

Table 9-26, Surficial Geology Underlying Alternative 4/ Modified Pipeline/Tunnel Alignment by Segments, lists only surficial deposits. A surficial deposit is defined by the American Geological Institute (Dictionary of Geologic Terms, 1983) as, "Pertaining to or lying in or on a surface, specifically, the surface of the earth". Surficial geology is not a term that is applied to geologic deposits or geologic units at depth. The Atwater (1982) report cited in the BDCP maps surficial deposits and specifically identifies those deposits as shallow, near surface deposits, based largely on soil types; not 150 feet deep, the depth of the tunnel inverts. Therefore, the BDCP EIS should be revised to eliminate references to surficial geology as an indicator of potential ground surface settlement. Additionally, the title of Table 9-3 should be changed to "Surficial Geology Overlying Alternative 4/ Modified Tunnels Alignment by Segments".

Comment 5: Impact Geo-3

The title of Impact Geo-3 is "Loss of Property, Personal Injury, or Death from Ground Settlement during Construction of Water Conveyance Features" (section 9.3.3.9). Therefore it is misleading why the impact refers to:

> The results of the site-specific evaluation and the engineer's recommendations would be documented in a detailed geotechnical report prepared in accordance with state guidelines, in particular *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (California Geological Survey 2008).

It is not clear from the BDCP EIS how surface settlement impacts from twin tunnels can be mitigated using *Guidelines for Evaluating and Mitigating Seismic Hazards in California*. Therefore, the BDCP EIS must clarify how these guidelines are applied to surface settlement impacts and what those impacts could be.

Impact Geo-3 seems to assume that surface settlement from twin tunnels is akin to slope stability issues associated with landslides and that all risks from surface settlement will be addressed in the design phase of the project. Impact Geo-3 concludes:

> Conformance to these and other applicable design specifications and standards would ensure that construction of Alternative 4 would not create an increased likelihood of loss of property, personal injury or death of individuals from ground settlement. Therefore, there would be no adverse effect.

At best, the BDCP EIS vague about design specifications and gives no hint of what "other applicable design specifications and standards" might be. The BDCP does not cite any technical manuals or professional papers regarding methods to estimate ground surface settlement and asks the public to trust that the a qualified tunnel engineer and operator will be retained to construct twin 44-foot diameter tunnels in soft ground, entirely within groundwater aquifers, at tunnel invert depths of 150-feet for a distance of 35-miles. The BDCP EIS should be revised to take a hard look at its conclusion that the twin tunnels would have no adverse effect.