

US EPA ARCHIVE DOCUMENT



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
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April 25, 2011

William N. Brostoff  
U.S. Army Corps of Engineers  
San Francisco District  
1455 Market Street  
San Francisco, CA 94103-1398

Subject: Draft Supplemental Environmental Impact Statement (DSEIS)/ Subsequent Environmental Impact Report for the Sacramento River Deepwater Shipping Channel (SRDWSC), Contra Costa, Solano, and Yolo Counties, California, February 2011 (CEQ 20110055)

Dear Mr. Brostoff:

The U.S. Environmental Protection Agency (EPA) has reviewed the above project pursuant to the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations (40 CFR Parts 1500-1508), our NEPA review authority under Section 309 of the Clean Air Act, and the provisions of the Federal Guidelines (Guidelines) promulgated at 40 CFR 230 under Section 404(b)(1) of the Clean Water Act (CWA). We thank the U.S. Army Corps of Engineers (USACE) for agreeing to accept EPA's comments through April 25, per your email communication with Tom Kelly, of my staff.

EPA has rated the DSEIS as *Environmental Concerns – Insufficient Information* (EC-2) (please see the enclosed "Summary of EPA Rating Definitions"). Primary among our concerns is that the DSEIS (1) does not sufficiently consider the beneficial use of dredged sediments produced by the project, consistent with USACE-led interagency sediment management planning efforts in the Delta; (2) does not fully assess the likely water management consequences of water quality impacts from the project; and (3) does not address potentially significant direct and secondary impacts to listed fish species.

EPA has participated in the USACE-led Delta Long Term Management Strategy (LTMS) process, along with other State and federal agencies, the Ports, dredging community, and local interests, for more than 4 years. An analogous partnership, also under USACE leadership, has shown success in San Francisco Bay. One of the primary objectives of the Delta LTMS, as stated in the February 2007 Charter, is to identify opportunities for the beneficial use of Delta sediments for levee rehabilitation and ecosystem restoration. The proposed Sacramento River Deepwater Shipping Channel (SRDWSC) project does not reflect these goals, despite being one of the most significant dredging projects in the Delta. The SDEIS proposes to stockpile 10 million cubic yards of sediment immediately adjacent to the SRDWSC, but offers little evidence that proposed stockpiles are anything other than disposal sites. We recommend the Final Supplemental Environmental Impact Statement (FSEIS) reevaluate placement sites, prioritize beneficial reuse locations over strategic stockpiling, and consider disposal sites as the lowest priority, consistent with USACE and EPA national policy.

EPA is also concerned that the project's salinity impacts are not fully disclosed in terms of water management effects. The text of the SDEIS, which concludes that the project does not have water quality impacts (p. 131), contradicts the data provided in Appendix L, which presents modeled water quality violations. The model indicates that violations will occur at many locations, including the Delta drinking water intakes for the Contra Costa Water District, Central Valley Project (CVP), and the State Water Project (SWP), which, collectively, serve millions of people. The California State Water Resources

Control Board requires the U.S. Bureau of Reclamation (USBR) and the California Department of Water Resources (DWR) to operate the CVP and SWP in a manner that ensures water quality standards are met at the impacted monitoring locations. It is likely that these agencies would need to release additional water from dams to address the impacts of the proposed project. We recommend USACE work closely with the USBR and DWR to evaluate this connected action in the FSEIS.

Likely increases in freshwater releases could have substantial indirect effects on endangered fish, such as winter-run salmon. In addition, Delta smelt, a State and federally listed endangered species, appear to spawn most regularly in and around the proposed project area. Although the DSEIS states that USACE and the Port are consulting with the U.S. Fish and Wildlife Service, the document does not present any analysis of the impacts to Delta smelt or winter-run salmon.

We have enclosed detailed comments to provide additional information on these concerns, as well as our concerns about compensatory mitigation, mercury and methylmercury, air emissions, and cumulative impacts.

We appreciate the opportunity to review the SDEIS and look forward to continued coordination with USACE. When the FSEIS is published, please send a copy to me at the address above (Mail Code: CED-2). If you have any questions, please contact me at (415) 972-3521 or contact Tom Kelly, the principal reviewer for the project, at (415) 972-3856 or [kelly.thomasp@epa.gov](mailto:kelly.thomasp@epa.gov).

Sincerely,

/S/

Kathleen M. Goforth, Manager  
Environmental Review Office  
Communities and Ecosystems Division

Enclosures: Summary of Rating Definitions  
Detailed Comments

cc: Lieutenant Colonel Torrey DiCiro, U.S. Army Corps of Engineers,  
San Francisco District  
Tom Sheeler, Port of West Sacramento  
Matt Jones, Yolo-Solano Air Pollution Control District  
Karen Huss, Sacramento Metropolitan Air Pollution Control District  
Genevieve Sparks, Central Valley Regional Water Quality Control Board  
Becky Victorine, U.S. Bureau of Reclamation  
Mike Chotkowski, U.S. Bureau of Reclamation  
Kari Kyler, California Water Resources Control Board  
Lucinda Shih, Contra Costa Water District  
Steve Culberson, U.S. Fish and Wildlife Service  
Maria Rea, National Marine Fisheries Service

### **Beneficial Use of Dredged Material**

#### *National Dredging Policies and the Delta LTMS Program*

The National Dredging Team (NDT) was established in 1995 to implement the National Dredging Policy, in part through the 2003 "Action Agenda" recommendations<sup>1</sup>. These recommendations included maximizing the beneficial use of dredged material for environmentally-sound projects. The NDT in turn established Regional Dredging Teams (RDTs) with a goal to maximize beneficial reuse of dredged materials<sup>2</sup>. The interagency Delta Long Term Management Strategy (Delta LTMS) is an official RDT, with the participation of State and federal agencies, the Ports, the dredging community, and local interests. Since USACE funds, chairs, and manages the Delta LTMS, it should have drawn from the Delta LTMS and its goals more directly in the development of the SDEIS for the proposed project.

The Delta LTMS program was initiated to develop a dredged material management plan for the Delta, largely in response to well documented concerns about vulnerability of levees to failure due to storms, floods, earthquakes, and sea level rise<sup>3</sup>. The importance of the beneficial use of dredged materials to the maximum extent practicable is the first goal listed in the Delta LTMS's 2007 Charter signed by USACE. The SRDWSC project (together with the proposed Stockton Deep Water Ship Channel project) will generate many times the volume of dredged material than that of all other Delta dredging projects combined for many years to come, making management of dredged sediment from these projects the *de facto* long term management strategy for the region. For that reason, the Delta LTMS has looked to both projects to implement the LTMS's long term goal for beneficial use. We discussed this need specifically in our July 29, 2008 scoping comments (attached, and incorporated as part of these comments).

#### Recommendation:

The FSEIS should discuss USACE policies and programs that promote beneficial use to the maximum extent practicable, and their relation to the SRDWSC project.

The Delta LTMS goal of maximizing use of dredged material to maintain Delta levees should be used as a primary evaluation factor in the selection of dredged material placement sites.

#### *Stockpiling*

The DSEIS proposes little or no direct use of any of the 10 million cubic yards of dredged material that the SRDWSC project will generate. It proposes placement at 10 locations (Table 19) that have received dredged material from past maintenance or the original SRDWSC construction in 1990. Of these 10 proposed sites, nine are stockpiles adjacent to the channel itself. Only S20, also adjacent to the channel, is listed as a placement and reuse site, but there is only anecdotal evidence from the property manager that any reuse has in fact occurred, and neither reuse dates nor quantities are provided. This suggests that dredged material placement decisions evaluated in the DSEIS were

<sup>1</sup> [http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/about\\_actionagenda.cfm](http://water.epa.gov/type/oceb/oceandumping/dredgedmaterial/about_actionagenda.cfm)

<sup>2</sup> Identifying, Planning, and Financing Beneficial Use Projects Using Dredged Material, Beneficial Use Planning Manual, U.S. Environmental Protection Agency (EPA 842-B-07-001) and U.S. Army Corps of Engineers, October 2007

<sup>3</sup> For example, See Calfed Bay-Delta Levees at <http://calwater.ca.gov/calfed/newsroom/Levees.html>

driven by convenience and cost, without including a range of practicable beneficial placement options.

EPA supports strategic stockpiling, consistent with Delta LTMS goals. If stockpiling allows for subsequent planned beneficial use of materials, we consider it strategic placement, but the DSEIS offers no evidence that the nine proposed stockpiles are anything other than disposal sites. Consequently, EPA does not agree that stockpiling, as proposed in the DSEIS, equates to beneficial use, as suggested on page 58 of the SDEIS. We believe the approach described in the SDEIS is inconsistent with the goals of the Delta LTMS and EPA policies encouraging beneficial use, and note that it appears inconsistent with USACE national policies.

*Recommendation:*

The FSEIS should include criteria differentiating dredged material disposal sites from strategic stockpiles by emphasizing the likelihood of sediment reuse, including need, accessibility, and practicability of using dredged material for specific projects in the vicinity of stockpile sites.

*Placement Site Selection*

EPA is concerned that the DSEIS eliminated practicable beneficial use sites from consideration, and does not demonstrate the proposed project would comply with the Clean Water Act (CWA) Section 404(b)(1) Guidelines (Guidelines). Potential beneficial use placement sites should be retained in the analysis and evaluated in terms of the costs to the overall project as well as the benefits of the reuse. The DSEIS includes a project objective to “maximize the potential for beneficial use of dredged material as practicable” (p. ES-3). Although we agree with the objective, the DSEIS does not prioritize beneficial use of dredged material.

The DSEIS uses a three-tier screening process to narrow the range of placement sites from 120 to the 10 selected sites. The screening criteria give equal weight to the three types of placement locations (disposal, stockpile, and reuse sites), resulting in the elimination of potentially practicable beneficial use sites.

- The Tier 1 Criteria (page 61-62) eliminated sites needing more than 10,000 feet of pipeline to access them (i.e, requiring a booster pump) due to cost and "likely...unpredictable delays." Aside from estimating a \$3 per cubic yard cost for a booster pump, the DSEIS provides no evaluation of whether those increased costs could render any or all such sites impracticable as defined in the Guidelines. Tier 1 Criteria also eliminate sites for which the route of the hydraulic pipeline itself might affect adjacent land uses. In EPA's experience, dredged material transport pipelines are relatively easy to successfully route around various kinds of obstacles (including many of the examples listed on DSEIS page 61) without significantly affecting other uses. In other cases, some temporary effects might be acceptable. Overall, we believe Tier 1 screening eliminated 90 potential sites from detailed analysis without proper justification.
- The Tier 2 Criteria (p. 65) eliminate further placement sites that would require the use of mechanical dredging equipment. These criteria appear to have been applied incorrectly in at least one location, the Montezuma Wetlands Restoration Project placement site. While Montezuma normally receives sediment by mechanical dredging equipment, the SDEIS provides no reason the site could not accommodate direct hydraulic pipeline placement (e.g., of material from the western reaches of the deepening project). In fact, direct placement is likely to reduce facility charges normally associated with this site. Additionally, no booster pump is needed to reach this site.

- The Tier 3 Criteria (p. 65-66) used a reach-specific evaluation to eliminate four more sites based on “redundant capacity” in areas with closer suitable sites, but the criteria did not consider the priorities among placement site locations. For example, these criteria eliminated VS-PR1, a placement and reuse site, in favor of an apparent disposal site.

The Placement Site Report (Appendix I), prepared as supporting information for the DSEIS, did not include consideration of any potential commercially held property (including locations separately approved for various construction projects). Following the completion of the Placement Site Report, a commercial site owner offered to reuse sediment for construction and levee reinforcement (p. 70-71). In light of the value of commercial placement sites, the FSEIS should further explore potential commercial sites available for reuse of dredged materials from the project.

Recommendations:

The FSEIS should re-evaluate potential beneficial use and placement sites, based on a revised set of screening criteria. The revised screening process in the FSEIS should be based on giving highest priority to selection of beneficial use sites (“placement and reuse” sites). Second priority should be given to strategically-located stockpiles, at or in close proximity to specific reuse needs and opportunities (so that a minimum of subsequent rehandling of the material will be needed for the reuse). Lowest priority should be given to disposal sites (i.e. no expectation for reuse).

The existing Montezuma Wetlands Restoration Project should be carried forward for detailed evaluation in the FSEIS, and the operators of the site contacted regarding costs and logistics of direct hydraulic placement.

The FSEIS should supplement the Placement Site Report with additional information on commercial sites available for reuse of dredged materials from the project.

*Future Maintenance Dredging*

The DSEIS does not address future maintenance dredging. The document says that a Dredged Material Management Plan (DMMP) addressing maintenance dredging for the next 20 years will be included with the FSEIS (p. 42). Unfortunately, no description of the DMMP is provided. We are particularly concerned that the selection of placement sites for the deepening project material will constrain or otherwise affect the choice of potential placement sites for material from future maintenance dredging of the channel. Since the 10 placement sites proposed in the DSEIS will be essentially filled with deepening material (with little or no expectation that material from those sites will be removed for beneficial use), those sites would not be available for long-term management of much maintenance material. Given that the DSEIS screening criteria already identified the closest and least costly sites for the deepening material, other sites for maintenance material may be further away (and more costly), or perhaps entirely new sites may need to be developed over time that may involve wetland losses or other impacts.

Recommendation:

The DMMP's evaluation of future placement sites should be integrated with the FSEIS evaluation of initial placement sites in order to identify the maximum degree of beneficial use of material from the deepening and future maintenance dredging combined.

**Water Quality**

*Water Quality Standards*

The SDEIS is internally inconsistent regarding impacts to water quality. The project’s impact on drinking water intakes in Section 3.1 substantially differs from the analysis in Appendix L. Section 3.1 of the DSEIS defines significance criteria in this context as “a violation of water quality standards, including adopted TMDLs, which would impair beneficial uses of water” (see WQ-1, p. 131). Although Section 3.1 of the DSEIS states that “[n]o drinking water intakes exist within the study area; therefore, drinking water would not be affected by any of the alternatives,” Appendix L contradicts this statement and notes the following modeled violations of water quality standards at drinking water intakes (based on modeling of 1994-95 water conditions):

Drinking Water Intakes with Predicted Salinity Increases Above Water Quality Standards for Municipal <i>(from information presented in Appendix L page 257-8, and 552-3)</i>				
Drinking Water Intake (Interagency Station Number)	Modeled Violations under the No Action Alternative (Year 0)	Additional Modeled Violations due to the Proposed Alternative (Year 0)	Modeled Violations under the No Action Alternative (Year 50)	Additional Modeled Violations due to the Proposed Alternative (Year 50)
Contra Costa Rock Slough Export (CHCCC06)	86	4	37	4
West Canal at the mouth of Clifton Court Forebay (CHWST0)	27	4	0	0
Delta Mendota Canal at the Tracy Pumping Plant (CHDMC004)	7	5	0	0
Contra Costa Old River Export (ROLD034)	48	2	8	8

Although the SDEIS modeling indicates the project would result in water quality violations, EPA does not expect these to occur, based on California State Water Resources Control Board’s Revised Decision 1641. This decision requires the U.S. Bureau of Reclamation (USBR) Central Valley Project and the Department of Water Resources (DWR) State Water Project to manage their water projects to comply with all delta water quality standards.

The likely impact of the project would be the need for additional water releases by USBR or DWR to achieve Delta water quality standards. Neither this requirement, nor the likely connected action(s) required of USBR and DWR to comply with it, are discussed in the DSEIS. The impacted intake locations collectively provide water to millions of people, and represent water quality compliance points for the State Water Resources Control Board’s Revised Decision 1641.

Appendix L also shows that the project’s effect on agricultural water quality is relatively small, but it still created modeled violations. These are demonstrated by Figure 5.6-16 – Old River at Tracy

Road Bridge (ROLD059) in Appendix L, which estimates 13 days of violation (of the agricultural water quality standard) without the project in Year 50 and 14 days of violation with the project.

*Recommendation:*

The FSEIS should discuss the proposed project's apparently significant increases in salinity in critically dry years.

USACE should work closely with the USBR and DWR to evaluate connected actions resulting from the project, such as upstream release of water to ensure water quality standards are achieved, and discuss such connected actions in the FEIS.

The FSEIS should clarify whether the connected action would require the purchase of existing water rights by the project proponent to ensure water quality standards are achieved.

The quantity of water needed to meet water quality standards should take into consideration reductions in water delivery that occur in critically dry water years and account for modeling uncertainty.

Although the 1994-95 is the driest year with available data necessary for modeling, the FSEIS should include a narrative discussion of the potential effects of the projects during more severe and prolonged droughts.

*Rare and Endangered Species Impacts*

Delta smelt, a state and federally listed endangered species, appear to spawn most regularly in and around the Sacramento Deep Water Ship Channel. The project has the potential to greatly affect this habitat. The DSEIS states that USACE and the Port are consulting with the U.S. Fish and Wildlife Service, but does not present any analysis of the impacts to Delta smelt or winter-run salmon.

As mentioned in the *Water Quality Standards* comments above, the likely impact of modeled violations would be the need for additional water releases by USBR or DWR to ensure that water quality standards in the Delta are achieved. This action, providing greater flows to offset the impact of the channel deepening project, could also affect carryover storage in upstream reservoirs and thereby affect both the yield of reservoirs and the protection of spawning conditions for salmon below the reservoirs (including endangered winter-run salmon that rely on cold water releases from Shasta Dam). This impact is not discussed in the DSEIS.

*Recommendation:*

The FSEIS should ensure that that all designated beneficial uses under the Clean Water Act will remain adequately protected, including habitat support functions for species of concern.

The FSEIS should discuss the effects of the connected action on carryover storage in reservoirs, and the subsequent reduction in cold water availability, including impacts on water supply, habitat and listed winter-run salmon.

**Compensatory Mitigation**

We are concerned that the compensatory mitigation, proposed in the DSEIS for wetland and riparian impacts appears to be inconsistent with the 2008 federal Mitigation Rule (40 CFR 230, subpart J).



The DSEIS identifies a mitigation site owned by the Port (a portion of lower Prospect Island), but proposes preservation only, without enhancement. A preservation-only approach does not meet the requirements of CWA Section 404, including the federal Mitigation Rule, unless the property to be preserved is under imminent threat of impact or loss. The SDEIS provides no documentation that the Port's property is under such threat and is critical to preserve.

Recommendation:

The FSEIS should describe how proposed mitigation approaches are in compliance with the 2008 Mitigation Rule, and propose additional measures (including an alternate location) to mitigate for aquatic impacts as necessary.

### Mercury and Methylmercury

The Central Valley Regional Water Quality Control Board (CVRWQCB) approved Resolution R5-2010-0043 on April 22, 2010 for control of methylmercury and total mercury in the Sacramento-San Joaquin Delta Estuary (i.e. the methylmercury Total Maximum Daily Load or TMDL). This Resolution adopting the TMDL has not been approved by the State Water Resources Control Board or EPA, however the State Board is currently taking public comment, and approval of the Resolution is expected to be considered at the June, 2011 State Board Hearing. Since approvals may be forthcoming in the near future, we recommend including a discussion of how the project will comply with the TMDL's requirements.

The SDEIS states that "The Central Valley RWQCB is currently developing a TMDL for mercury levels to meet water quality standards for the Delta" (p. 120). Consequently, the SDEIS does not discuss compliance with the CVRWQCB's amendments, such as: "1) Employ management practices during and after dredging activities to minimize sediment releases into the water column; and 2) Ensure that under normal operation circumstances, including during wet weather, dredged and excavated material reused at upland sites, including the tops and dry-side of levees, is protected from erosion into open waters." The SDEIS should also discuss compliance with the other methylmercury TMDL requirements, including characterizing the total mercury mass of material removed from Delta waterways, and conducting monitoring studies to evaluate management practices to minimize methylmercury discharges from dredge return flows and dredge material reuse sites. The DSEIS does discuss recent and ongoing mercury studies (p. 120-121), which may address the CVRWQCB's above requirement to monitor and study management practices. The TMDL anticipates comprehensive study plans and reports by stakeholder groups to further define and discuss these requirements.

Recommendations:

The FSEIS should discuss compliance with each of the CVRWQCB TMDL requirements, including:

- characterize the total mercury mass and concentration of material to be removed;
- describe the results of recent studies on the relationship between dredging and methylation of mercury;
- management practices to minimize sediment releases to the water column;
- ensure that dredged and excavated material at upland sites is protected from erosion into open waters; and
- participate and assist with stakeholder study plans and reports as required.

If appropriate based on recent studies or new information, the FSEIS should revise mitigation measures or best management practices to minimize the discharge of mercury and methylmercury during dredging, transport, disposal, stockpiling or reuse of sediment.

## Air Emissions

### *Reducing Truck Traffic and Highway Congestion*

In describing the DWSC deepening project, the Port of West Sacramento website states<sup>4</sup>

#### *“Channel Deepening*

The proposed channel deepening project at the Port of West Sacramento will allow more modern, fuel efficient, fully loaded cargo ships to travel the channel to transport cargo from the Bay Area to West Sacramento. The project will reduce 24,585 annual truck trips off the I-80 corridor.”

A City of West Sacramento press release<sup>5</sup> states, “[t]he project will reduce regional freeway congestion and air emissions.” While reducing truck trips and freeway congestion is environmentally beneficial, increased cargo ships could have a negative effect on the Sacramento Valley Air Basin.

#### *Recommendation:*

The FSEIS should evaluate the net air quality effect of trucking and traffic changes associated with the project.

### *Projected Baseline Emissions*

The DEIS baseline emissions for NO<sub>x</sub>, in 2009, from ocean going vessels (including harbor craft) are 37 tons per year (Appendix P, p. 35). The State Implementation Plan (SIP) for the Yolo-Solano Air District lists 0.09 tons per day, or 33 tons per year<sup>6</sup> of emissions from ocean going vessels for 2008. While these values differ slightly, EPA is more concerned about projected emissions. The DEIS baseline (and project) estimates 83 (57) tons per year of NO<sub>x</sub> emissions in 2018 and 91 (63) tons per year in 2023, but the Yolo-Solano SIP estimates 2020 emissions at 0.06 tons per day, or 22 tons per year. While we are not questioning the DEIS emissions estimate for ocean going vessels, we do note their inconsistency with the SIP.

#### *Recommendation:*

The project proponent should work with the Air District to correct SIP emissions data for all criteria pollutants.

## Cumulative Impacts to Air Quality

The Port of Sacramento, along with the Port of Stockton and the Port of Oakland, were recently awarded a Department of Transportation, Maritime Administration (MARAD) grant<sup>7</sup>. MARAD’s Marine Highway Corridors project<sup>8</sup> also discusses a proposal to remove 180,000 truck trips from Interstate 580, 80 and 205. These projects should be discussed in terms of their cumulative impacts.

<sup>4</sup> "City of West Sacramento - Air Quality." *City of West Sacramento - Homepage*. Port of West Sacramento. Web. 15 Mar. 2011. <[http://www.cityofwestsacramento.org/city/port/environment/air\\_quality.asp](http://www.cityofwestsacramento.org/city/port/environment/air_quality.asp)>.

<sup>5</sup> Port of West Sacramento Channel-Deepening Funding in President’s 2010 Budget <<http://www.cityofwestsacramento.org/civica/inc/displayblobpdf2.asp?BlobID=3985>>

<sup>6</sup> See <http://www.arb.ca.gov/app/emsmv/emssumcat.php>

<sup>7</sup> California Green Trade Corridor Transportation Investment Generating Economic Recovery (TIGER) Federal Register 75 (November 9, 2010) page 79602

<sup>8</sup> See [http://www.marad.dot.gov/documents/Marine\\_Highway\\_Corridors13\\_Sep\\_10.pdf](http://www.marad.dot.gov/documents/Marine_Highway_Corridors13_Sep_10.pdf)

While EPA acknowledges the air quality benefits of the project's increased cargo shipping efficiency, we believe the reduced shipping cost, which is the sole economic benefit quantified in the SDEIS, will provide an economic benefit that allows existing port operations to increase shipping and draw new port operations. This economic growth is noted in the previously mentioned City of West Sacramento press release, which highlights the deepening project as helping to "generate tremendous private investment in Northern California and create the family wage jobs that are greatly needed to restore our nation's economy." The cumulative effects analysis should consider both the expansion of existing businesses, due to reduced shipping costs, and other investments in new port operations.

*Recommendation:*

The FSEIS should discuss plans to ship freight from the Port of Oakland, and other west coast ports, to the Port of Sacramento.

The FSEIS should discuss cumulative impacts associated with reasonably anticipated growth of existing and new port operations. The FSEIS should also describe any added indirect air emissions associated with growth.

**Miscellaneous Comment**

The lower chart of Figure 8 (Changes in X2 [km]) is inconsistent with Figure 11, which is intended to be a cumulative plot of data in Figure 8.