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September 24, 2002

SUBJECT: Comments on Draft Environmental Impact Statement/Report and Draft Feasibility Report: Bolinas Lagoon Restoration Project, June 2002

Dear Mr. Golden and Mr. Haddad:

I am submitting comments on the Draft Environmental Impact Statement/Report (DEIS/R) for the Bolinas Lagoon "Restoration Project", dated June 2002, within the extended comment period.

My comments cover the following subjects: (1) compliance with policy and regulations of the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) regulations, and related environmental laws; (2) technical and scientific analysis of estuarine geomorphology and ecology, with emphasis on those aspects essential to stated project purpose, need, and project design; (3) recommendations for modifying the project design, technical analyses, and especially scientific peer review.

I am commenting because of my professional interest in backbarrier estuarine ecosystems such as Bolinas Lagoon, coastal restoration ecology, and NEPA and CEQA. My qualifications include over 25 years of surveys and field studies of barrier beach ecosystems (coastal dunes, beaches, estuaries, lagoons, and tidal marshes) and applied restoration ecology of coastal ecosystems, including the coasts of California, northeastern U.S., Canada, and Britain. My professional background also includes 6 years of work in environmental regulatory analysis and compliance with the U.S. Army Corps of Engineers, San Francisco District, and 5 years of endangered species and ecosystem planning and regulations with the U.S. Fish and Wildlife Service, Sacramento Office.

Bolinas Lagoon is one of the many central California estuaries I regularly visit as part of my field investigations in coastal vegetation and landform development.

I would preface my comments with an acknowledgement that the Corps and Marin County are faced with a particularly difficult challenge in objectively evaluating the Bolinas Lagoon project. The popular belief (“folk myth”) that Bolinas Lagoon is threatened with imminent destruction by sediment filling has persisted (without empirical verification) for at least 70 years, as Rowan Rowntree documented in the 1970s (Rowntree 1973, Rowntree 1975). This popular belief, transmitted over generations, has reinforced political and institutional will to act on it, circumventing independent scientific peer review, and ignoring established global evidence and theory about tidal inlet and backbarrier lagoon development. Nostalgia and natural sciences are not equivalent, and valid ecological restoration depends on scientific understanding of natural processes in appropriate time-scales. The many inconsistencies between the conclusions of the DEIS/R and feasibility report, and their analyses, reflect this tension between wishful ecological engineering and scientific analysis.

Because of the length and technical detail of the comments, I am providing a brief executive summary, and a somewhat expanded narrative overview of the full comments, highlighting key points in less technical detail. These condense and reorganize highlighted points in the technical comments which generally follow the sequence of discussion topics in the text of the DEIS/R.

I. Executive Summary

- Unsound analysis of purpose, need, and perceived threat to Bolinas Lagoon. The arguments for purpose and need of the project are basically flawed. The stated premise of need for the project is the claim that the estuary is threatened by overfilling with sediment, causing it to convert to “uplands”. This threat does not in fact exist. Infilling of tidal lagoons with fluvial and marine-transported sediment results in growth of estuarine mudflats and tidal marsh, not conversion to “upland”, or non-wetland environments. Accelerating sea level rise (an ongoing, progressive trend) and periodic seismic subsidence (an intermittent, recurrent event) are more likely to maintain or submerge Bolinas Lagoon, and most California estuaries. Sedimentation itself, and associated changes in wetland habitats, are not real ecological threats to Bolinas Lagoon’s long-term development. On the contrary, they are essential to its long-term development. Perceived ecological threats to the lagoon are based on basic misinterpretation of *inevitable, benign, and predominantly natural cycles* of ecological changes in the backbarrier lagoon system. No California estuaries have been converted to uplands in the last 10,000 years, and none are poised to do so.
- The proposed project is fundamentally artificial coastal engineering, not “ecosystem restoration”. The proposed project *eliminates mostly natural tidal (marine origin) sediment deposits* as well as mostly man-made 19th century sediment deposits, in about equal measure. *The project’s objective in effect is not restoration, but selection and artificial maintenance of a preferred stage in (cyclic) estuary development.* The project imposes an artificial condition *against* existing, ongoing natural processes. By definition, this is coastal engineering, not coastal restoration. It proposes to destroy the majority of the naturally formed tidal marsh in the estuary for the sake of submerged tidelands, without mitigation. This is the opposite of ecosystem restoration, and is *typical of coastal engineering of harbors prior to the 1960s.*
- Deficient, flawed scientific analysis of tidal lagoon geomorphology and ecology. The DEIS/R contains many contradictions of its own data and analyses regarding historic development of the tidal lagoon habitats, particularly the relative influence of seismic subsidence (earthquake-related depth increases), watershed sedimentation, and natural processes of tidal inlets. The basic models of geomorphic and ecological development of estuaries are inconsistent, and often incorrectly applied.
- Destruction of unique and essentially natural tidal sediment bodies. The project’s second largest targeted dredging area, around Kent Island, is a natural flood tidal delta, an inherent feature of sandy tidal inlets. It is not an artifact of watershed degradation and erosion. Its marine origin is unrelated to the stated purpose of correcting artificially increased fluvial sedimentation from the watershed. Kent Island (a large, persistent, emergent dune-capped flood tidal delta) itself is a *unique geomorphic feature in California*, and is not identified as such in the DEIS/R.

- Unprecedented and unjustified destruction of wetlands for “restoration”. The project represents the *largest single-project destruction of combined tidal marsh and mudflat acreage in California since the passage of the Clean Water Act, and the only modern large-scale unmitigated loss of tidal marsh and mudflats proposed by government agencies*. It is ironically proposed under the purpose of “ecosystem restoration”. This is unprecedented, unmitigated, unmitigable, and unjustified. It contradicts state and federal policies regarding the protection and conservation of wetlands, contradicts decades of commitment of state and federal resources towards the conservation of tidal marsh and mudflats.

- Significant underestimation of “significant” impacts. The scope, severity and magnitude of environmental *impacts of the project have been substantially underestimated*. Many significant species impacts have been omitted or severely underreported. Sediment budget deficits caused by dredging near the tidal inlet will likely cause severe beach erosion along the Stinson Beach sand spit, as the flood tidal delta regenerates in the proposed Kent Island dredging pit. Rare and endangered species impacts are woefully underestimated and understated.

- Unsound alternatives analysis (NEPA), failed compliance with national environmental law and policy. The analysis of alternatives (the heart of the EIS) fails to comply with NEPA. The proposed project is not substantially different from the single alternative, and it only trivially reduces project impacts, contrary to NEPA policy. The proposal itself fails to comply with the Clean Water Act’s Section 404(b)(1) guidelines and policies for habitat development, sacrificing a more valuable natural aquatic habitat for an artificial one of lower value.

- Need for adequate independent scientific peer review. The proposed project and alternatives require critical review by an independent *qualified national or international scientific peer review panel*. The current project proposal lacks adequate and authoritative interdisciplinary expertise in estuarine ecology, geomorphology of tidal lagoon and inlet systems.

II. Narrative Overview of Comments

The project's basic premise that Bolinas Lagoon is a degraded estuary in rapid decline, and at risk of becoming an "upland" in the foreseeable future, is simply incorrect. The DEIS/R misrepresents evidence of predominantly natural cyclic and progressive geomorphic and ecological change in the lagoon as symptoms of artificially induced ecosystem degradation. The purpose and need of the proposed estuarine "restoration" (dredging) project is not supported by the majority of the scientific analysis presented, and is not supported by the global scientific literature on Holocene (post-ice age) development of estuarine lagoons behind barrier beaches (backbarrier lagoons).

The premise of progressive artificial degradation is in fact contradicted by the historic data presented on geomorphic development of Bolinas Lagoon. The purpose and need reflect instead popular beliefs derived from visual impressions of natural changes in the lagoon, informed by local folklore rather than geomorphic and ecological sciences. The DEIS/R exaggerates the long-term historic influence of human modifications of the estuary relative to natural processes. Reconstructed maps of the lagoon (presented in figures 1-3 and 3.4 in the DEIS/R, Fig. 3.2 in the feasibility report), clearly show *greater* area of subtidal waters in 1929 *after the 1906 earthquake*, more than in 1854, despite reported peak sedimentation in the late 19th century. This is not consistent with the premise that post-logging and agricultural sedimentation caused rapid, irreversible infilling of the lagoon that persisted to modern times.

The Bolinas Lagoon is *naturally maintained as an estuary* by sea level rise (now accelerating), periodic earthquakes which cause rapid subsidence (lowering) of the lagoon bottom, and natural sediment inputs from the tidal inlet (flood tidal delta crowned by Kent Island) and stream deltas. These processes are acknowledged in some portions of the DEIS/R (e.g. p. 3-48), but are understated or obscured in "promotional" descriptions of the project purpose and need. In fact, *estuaries do not become "uplands" during periods of sea level rise*, and there is no evidence that any estuary in central California has done so during the last 10,000 years (including the last 3000 years of relative stability in sea level, until recently), even during periods of peak artificial 19th century sedimentation.

Tidal lagoons that are infilled with sediment generally become complexes of tidal mudflat and marsh, not uplands. This is because tidal sedimentation is limited to the elevation of the higher daily tides, and stream delta sedimentation is limited to the height of floodwaters at the stream mouth, which depends on the simultaneous tidal elevation.

Local waves and winds can raise sediment deposits above tide elevations only on a very local scale, as on Kent Island. Even coasts of seismic uplift and copious sedimentation, such as Northern California (especially along the Cascadia fault, e.g., Humboldt Bay) have maintained their estuaries in historic times.

The DEIS/R repeatedly and erroneously asserts, without reference to any scientific literature, that conversion to uplands is the general geomorphic destiny of tidal lagoons and estuaries. This is incorrect and inconsistent with the worldwide scientific literature on Holocene backbarrier estuary evolution (Borrego et al. 1993, Davies 1980, Carter 1980). It establishes a false premise that the lagoon is threatened rather than maintained by sedimentation during a marine transgression (sea level rise). With the minor exception of alluvial riparian *wetlands* (not “uplands” by the Corps standard definition) prograding over tidal marsh (Pine Gulch Creek delta), nearly all tidal have been maintained within the lagoon in historic times. The residential development along the backbarrier shore of the Stinson sandspit (Seadrift) is the only major source of outright tidal habitat loss in the estuary.

The lack of focus on modern sea level rise as a factor in maintaining and predicting the condition of Bolinas Lagoon is a serious, basic deficiency of the DEIS/R and feasibility study. Sea level rise is fundamental to any ecological or engineering study of coastal wetlands, yet it is marginally treated in the DEIS/R and feasibility report. This is significant because contemporary acceleration of global rise in sea level tends to compensate for past or present sediment accretion, maintaining intertidal elevations – thus undermining the justification for the proposed project. It is extraordinary that a Corps of Engineers study would neglect full consideration of the impact on sea level rise.

The accelerated sedimentation of Bolinas Lagoon during the late 19th century due to artificial watershed erosion is a *history shared by all California estuaries*, especially the San Francisco Estuary’s massive deposition of hydraulic gold mining debris (Atwater 1979) and agricultural sedimentation of Tomales Bay (Niemi and Hall 1996). The artificial increase in sediment deposition in the Bolinas estuary ceased long ago in the 20th century when the watershed reforested. Modern sedimentation in the estuary from streams and especially from the marine tidal inlet is natural, and changes it causes are *no threat* to the long-term health of the estuary. Continued sedimentation will result in a natural stabilization or increase of highly valuable riparian wetland and estuarine tidal marsh and mudflat habitat during marine transgression (sea level rise), *not conversion to uplands or persistent non-tidal conditions*.

The majority of the proposed dredging area is not 19th century stream delta sediment, but is part of the large and obvious *naturally formed flood tidal delta* (the Kent Island complex). The flood tidal delta complex is derived from natural marine processes and sediment sources, not artificially increased watershed sedimentation. The Kent Island complex re-formed after the 1906 earthquake by deposition of marine (Stinson Beach) sediments transported by tidal inlet currents. Its modern post-quake regeneration is shown in aerial photographs of figures 4.3 – 4.7 in the feasibility report. Sediment grain size analysis consistent with tidal marine sand origin is presented in the feasibility report

(fig. 3.7): it shows that the *majority of the area around Kent Island matches Stinson Beach in fine sand grain size and composition*. Proposed dredging of this *essentially natural marine tidal sand deposit* is the second largest volume of dredged sediment in the project. The DEIS/R and feasibility report fail to analyze appropriately the relevance and nature of this deposit. Dredging out the Kent Island flood tidal delta complex is an *exercise in opposing natural estuarine maturation, and contradicts the stated project purpose of “restoring” the estuary*. It merely destroys the central feature of Bolinas Lagoon, one that has formed and re-formed through geologic cycles (see figure 3.4). This constitutes *artificial engineering*, not “ecosystem restoration” of the lagoon. Kent Island itself is a *geomorphically unique feature in California*, an emergent (dune-capped) flood tidal delta island, and it would be destroyed by the project.

The DEIS/R fails to provide a regional geographic context for Bolinas Lagoon’s sedimentation history and ecological development. *A comparative geographic analysis* would indicate that *all other California backbarrier lagoon estuaries*, including those of comparable shape and size (Morro Bay, Bodega Bay) *also experienced rapid sedimentation during the early historic period of intensive logging and agriculture*. They all developed rapid increases in tidal mudflat and marsh area as a result. Some backbarrier lagoons, prior to artificial stabilization of tidal inlets with jetties, naturally maintained cycles of intermittent choking of tidal flows (e.g. Elkhorn Slough, Morro Bay, Mugu Lagoon); none became uplands or permanent non-tidal lagoons. There are no actual examples of any backbarrier estuary in central California suffering anything resembling the predicted worst-case scenario for Bolinas Lagoon – not a surprising fact for a coastline undergoing general submergence. In no instance has any lagoon or estuary been managed for navigable capacity by dredging out intertidal mudflats or marsh because of unacceptable and unmitigable environmental impacts to wetlands.

The geographic significance of Bolinas Lagoon’s tidal wetlands is also understated. *Bolinas Lagoon is among the most pristine tidal marsh systems in California*, and one of the very few in central California with an intact ecotone between tidal marsh and freshwater riparian habitat. The *extent (acreage) of salt marsh habitat mapped* and quantitatively estimated in the DEIS/R *is severely underestimated (habitat maps do not match the color aerial photo of the Lagoon’s salt marsh in figure 3-5)*. Wetland delineation methods used are entirely *inconsistent with the Corps’ own standard methodology for wetland determination*. The DEIS/R also neglects to disclose that the unique high salt marsh vegetation at Kent Island would be destroyed by the project.

The DEIR/S substantially understates the scope of biological and geomorphic impacts of the proposed project. *Dredging out the huge flood tidal delta complex around Kent Island*, as proposed, would create a *strong sediment sink that would induce rapid shoreline retreat (beach erosion) along the west end of Stinson Beach*. This is neither discussed as a potential significant impact, nor is it studied at all in the feasibility report. This glaring omission is particularly ironic, because beach erosion and shoreline engineering is one of the Corps’ traditional areas of specialization in coastal engineering. The beach erosion would significantly affect roosting and feeding habitat of the federally threatened western snowy plover.

The *DEIS/R* also significantly underestimates the scope and magnitude of the project's effect on special status species, mostly because the *DEIS/R* fails to provide any regional, cumulative impact perspective on the species abundance and distribution. The reversal of tidal marsh growth would impede the recovery of the federally endangered California clapper rail, which historically inhabited the lagoon. Dredging may adversely affect elusive federally listed tidewater gobies in subtidal channels and low-energy backwater areas. It would destroy the largest, southernmost population of the rare northern salt marsh bird's-beak on the coast, in the marshes surrounding Kent Island. One of the rare salt marsh ecotypes of an owl's-clover, a single population, grows in the marginal areas between the Pine Gulch delta and salt marsh pans. The type locality of one of California's rarest coastal plants, the marsh milkvetch, would be destroyed, as would its prospects for recovery there. Rare, refugial populations of invertebrates (native estuarine snails) occur in Bolinas Lagoon.

The suggestion that dredging intertidal mudflat, tidal marsh, and riparian woodland to become subtidal habitats would "restore" (or otherwise improve) the ecological health of the estuary is a conceit, and is unjustified from a scientific or coastal conservation perspective. There is no modern precedent in California for the proposed unmitigated destruction of hundreds of acres of tidal mudflats and marsh in order to increase subtidal habitat in any estuary, even for navigational purposes. The proposal is inconsistent with State and national policies and regulations for the protection of wetlands, particularly intertidal wetlands and riparian habitat. I believe the only reason the proposal has been seriously considered is uncritical reliance on the perceived, erroneous "threat" that without intervention, the estuary is at risk of becoming upland or non-tidal.

In the final analysis, the project's unacceptable impacts are due to the re-invention of a modest small-harbor navigational dredging project into an inflated, disproportionate, "ecological restoration" project. Re-casting the dredging project in the guise of "ecological restoration" circumvents conventional Corps cost-benefit analysis that would apply to harbor dredging projects. The proposal misapplies the concept of estuarine restoration at a huge and unacceptable environmental and economic cost, and risks regional and national damage to the credibility of ecological restoration in public works projects.

I am confident that a *qualified national or international scientific peer review panel* would largely confirm these conclusions. The current project proposal lacks adequate and authoritative interdisciplinary expertise in estuarine ecology, geomorphology of tidal lagoon and inlet systems.

III. Text-specific comments: DEIS/R

Section 1.2. Purpose and Need.

Omission of dredging proposal history. The DEIS/R fails to disclose the *historic context* of dredging for navigational purposes in Bolinas Lagoon, and the Corps' earlier involvement in planning studies and cost-benefit analyses. These area explained in Rowntree (1973, 1975), which is cited by the DEIS/R only for less important information.

Accelerated sedimentation: The DEIS/R here introduces the oversimplified and incorrect claim that “Bolinas Lagoon has been filling in at an accelerated rate as a result of human activity since European colonization...For the past 150 years, tidal prism...declined at a noticeable rate”. This contradicts the more accurate account of the lagoon’s history on page 3-48, which correctly identifies the non-progressive, seismic subsidence cycle that governs the estuary’s tidal prism. It also contradicts the feasibility report, which accurately states on page 3-2 that “In 1998, the lagoon looked similar to the way it did in 1854”. Page 3-48 states that the 1906 earthquake restored about 50 million cubic feet of tidal prism lost because of 19th century fluvial sedimentation. Even this discussion, however, fails to note that increased depth of the lagoon after 1906 itself can induce temporary increased tidal sedimentation rates (“rebound” of the submerged flood tidal delta), just as sedimentation rates increase with depth following dredging. The idea that there is a constant or “normal” sedimentation rate in an estuary that undergoes periodic seismic subsidence makes little sense, and is highly misleading. The feasibility report adds that “there are many discrepancies” among reports of the sedimentation rate timeline of the lagoon, which may reflect the non-linear nature of sedimentation rate change in such a system. The DEIS/R and feasibility report fail to produce unambiguous evidence of excessive contemporary or recent fluvial sediment inputs to the lagoon, instead reasoning as though the massive, discrete 19th century fluvial deposition episodes never ended.

“Disappearing” habitat equivocation. The DEIS/R text is very misleading and ambiguous in stating that “Bolinas Lagoon is an example of an estuarine habitat that is rapidly disappearing along the Pacific Coast flyway”...(p. 1-3). The statement ambiguously suggests that the lagoon itself is disappearing as a tidal habitat, which is factually incorrect. It equivocates between the relatively pristine, protected Bolinas Lagoon wetlands, and estuarine wetlands in the region which have literally been converted to urban, agricultural, or industrial lands. This equivocation has no place in the statement of purpose and need, which must clarify, not obscure, matters of public interest.

Accuracy of inlet closure prediction. The DEIS/R uncritically raises the prediction that “the mouth of the lagoon is predicted to begin closing intermittently within the next 50 years”, without reference to the predictive accuracy, empirical verification, or statistical power of the model used to make the prediction. In fact, the model used to predict inlet closure (O’Brien 1971; feasibility report p. 5-6) is an older, outdated, crude,

oversimplified model developed for large navigable tidal inlets. It has not been calibrated for fine-sand lagoons with complex inlet bedforms, tidal deltas, and sand spit interaction, which are key components to inlet choking and closure in small navigable or non-navigable inlets in California (Webb et al. 1991).

A notable recent failure of simplified models based on linear relationships between tidal prism, wave power, and inlet closure indices, is at Crissy Field, Presidio, San Francisco. The predicted time of probable or frequent inlet closure was more than two decades; the actual, observed time of repeated closures was less than one year. The modelling was performed by highly qualified regional expert hydrologists (Phil Williams and Associates). The point is not the source of error or its nature, but the *empirical limitations and inherently low predictive accuracy of older conventional tidal inlet models applied to smaller tidal inlets and lagoons*, which are relatively more responsive to feedback from depositional bedforms and sand bodies (shoals, bars, spits). Given the tremendous importance given to the alleged threat of inlet instability as a foundation of the need for the project, it requires far greater critical analysis. Casual reporting of a statistically insignificant model prediction as though it were a confident, foregone conclusion is both misleading and scientifically irresponsible.

Inlet closure or choking (partial closure) are not simply determined by two variables, wave power and tidal prism, the principal variables of the older tidal inlet models of Bruun (1968, 1978) and O'Brien (1971). Morphological controls (configuration and size of bedforms, sand bodies in the flood tidal delta complex), longshore transport rates, and sand grain size variation are highly significant factors for inlet closure and breaching. The fine sand grain size of Stinson Beach would favor low beach height, and inefficient lagoon seepage. The south-facing shoreline orientation, wide dissipative beach profile, and shelter from northwest swell (strong wave refraction) reduce the rates of longshore transport of sand and wave heights compared with most of the coast. Low beach height, low rates of seepage, and wave-sheltering of the tidal inlet all reduce the chances of persistent inlet closure. This is probably why there is no history of inlet closure at Bolinas, even prior to the 1906 earthquake. Other central California lagoons, prior to jetty construction (Morro Bay, Elkhorn Slough) were subject to tidal inlet choking and intermittent closure, but these are all west-facing, essentially unsheltered beaches. Southern California lagoons have coarser sand (greater beach height, steeper slopes) and greater wave energy and exposure, so their inlets are even less comparable with Bolinas.

Because of the importance attributed to the risk of inlet closure for perceived environmental threats and the stated purpose and need for the project, I suggest that the consequences and risks of inlet closure be delegated to coastal geomorphologists with recognized expertise (long research and publication history) to provide scientific peer review and independent authoritative, scientific opinion. More recent, comprehensive and realistic conceptual models of mesotidal inlets (e.g. Kana et al. 1999, for ebb tidal deltas) should be applied to the flood and ebb tidal delta system at Bolinas.

Analysis of project purpose statement. The statement of project purpose is excessively complex, circular, and unclear because it attempts to unify several incongruous,

potentially incompatible aims. The first clause of the purpose, “increase tidal volume” is straightforward, but relates only indirectly and contingently (instrumental to) to the second major clause, “to restore intertidal and subtidal habitat in Bolinas Lagoon”, and the subordinate clause, “in a manner that prevents the need for regular maintenance dredging during the project period”. This fails as a statement of purpose pursuant to NEPA because it is *so narrowly constructed that it virtually defines the proposed project*, and excludes reasonable alternatives to the basic, underlying purpose of estuarine restoration. This is a type of vicious circularity in reasoning that courts have consistently ruled to be invalid in both NEPA and CWA documents.

If “increase tidal volume” is not an essential, underlying purpose, a virtue in itself, it does not belong in the statement of purpose. In effect, increasing tidal prism is the means proposed to achieve the end, which is habitat restoration. As a means, not an end, it belongs in the description of the project or alternatives, not in the statement of purpose. Including it in the statement of purpose biases the alternatives analysis, and establishes an arbitrary, exclusionary circularity between purpose, design, and alternatives.

“Restore intertidal and subtidal habitat” is problematic as a purpose for another basic reason: as the feasibility report states blithely (and correctly) on p. 3-2, “In 1998, the lagoon looked similar to the way it did in 1854...The size of Kent Island, the size and layout of the channels [subtidal habitat], and the extensive mudflats are all very much the same.” . If the pattern and relative abundance of subtidal and intertidal habitats were roughly the same in 1854 and 1998, there is obviously little justification for “restoration”, and less for massive ecological impacts to achieve it. Indeed, it is difficult to imagine what “restoration” would mean for an estuary which is structurally indistinguishable from its pre-settlement condition. This is only one of many glaring contradictions established by the project purpose and the large body of data on its geomorphic and ecological history.

Section 1.3. Project Area

Estuarine lagoon fate as “uplands”. The DEIS/R correctly states that “Estuarine lagoons generally have a relatively short life-span in geologic terms.” It then adds quite incorrectly, “The natural progression of such lagoons is to fill in and gradually become transformed, first into wetland habitat and *then into upland habitat.*”[emphasis added]. As indicated below, this is a fundamental error, and is not supported by any modern authoritative scientific texts or review papers in coastal geomorphology.

I can find no modern scientific text or credible scientific publication on estuarine geomorphology which supports the DEIS/R statement that the fate of lagoons is to accrete into uplands. On the contrary, the long-term development of tidal lagoons in marine transgressions (rising sea level), is normally a transition from subtidal shallows, intertidal mudflats, to tidal marsh and channel systems which may equilibrate with rising sea level (Carter 1980, Allen and Pye 1992, Pethick 1993). Even alluvial deposition associated with stream delta progradation on the California coast results in expansion of riparian *wetlands*, not “uplands”: this is evident throughout the riparian bottomlands of

Tomales Bay and Drakes Estero valleys as they grade into historic tidelands. The worldwide phenomenon of estuarine lagoon filling is based on succession from subtidal shallows to tidal marsh creek and mudflat systems, not uplands (Borrego et al. 1993).

Given the importance of this “upland fate” premise as a justification of the project, it is essential that it be corrected. I am confident that such an egregious error could not survive scientific peer review.

Tidal sedimentation alone cannot result in emergence of tidal marsh above the elevation of the highest tides. Wave-reworking of estuarine sand (followed by dune accretion) can locally cause emergence above tidal elevation, as at Kent Island, but this is indeed exceptional on the California coast. Seismic uplift (not an issue at Bolinas, which intermittently subsides seismically) may cause temporary emergence of tidal marsh and temporary conversion to upland, but even this is soon reversed by aerobic decomposition of organic matter in drained marsh soil, which causes subsidence. *Tidal marsh soils tend to equilibrate with high tide elevations when sediment is available.* Under theoretical stable sea level, tidal marshes in backbarrier lagoons could reach equilibrium and long-term stability. In fact, sea level is not stable, but is rapidly rising.

A far more realistic concern for contemporary estuaries is failure of sedimentation and marsh peat accumulation to keep pace with *accelerating sea level rise*, resulting in submergence (drowning) of intertidal habitats. In this respect, tidal sedimentation in Bolinas Lagoon is a “healthy” indicator of its resilience to rapid sea level rise (Pethick 1993). Estuarine submergence and emergence during sea level fluctuations is the primary reason lagoons are geologically ephemeral. The DEIS/R and feasibility report entirely lack balance in evaluation of the relative threats of historic watershed sedimentation and sea level rise (measured and forecast). The DEIS/R does, I concede, consider the cumulative impact of dredging and seismic subsidence, but sea level rise is equally significant, and somewhat more predictable. Nationally and internationally, sea level rise is among the foremost scientific concerns for long-term estuarine management, as indicated by the contemporary estuarine scientific literature.

Section 2.2. **Development of Alternatives**

Range of alternatives, screening of alternatives eliminated. The range of alternatives selected for detailed analysis is unreasonably restricted by the unreasonably narrow, circular, overspecified project purpose. The project purpose is so narrowly matched to the proposed alternative that it allows only an essentially identical, minor variation of the project to be considered as a nominal “alternative”. As stated on p. 2-3, the two alternative “vary only with regard to excavation in Pine Gulch Creek delta”, which is essentially a single mitigation (avoidance) measure assigned to the proposed project. The difference is minor (86 versus 103 acres riparian wetland destroyed), and the *pro forma* “alternatives” are otherwise indistinct twins. This is invalid in NEPA (40 CFR 1502.14; see also 46 Fed. Reg. 18026, March 1981, 1b; *Dubois v. U.S. Department of Agriculture*, 102 F.3d 1273 (1st Cir. 1996), cert. denied, 521 U.S. 1119 (1997)).

If the project purpose were more candidly and simply stated as a harbor improvement project aimed at keeping navigable access to a permanent tidal inlet and prescribed internal tidal channels, then options such as minimal maintenance dredging or even (rejected) jetties could be more fully and objectively compared with the massive dredging proposal on their merits. It is ironic that jetties were rejected because they “would not restore lost habitat” (in contrast with the proposed project, which would directly cause the loss of hundreds of acres of existing tidal wetland habitat), and because it would be “an eyesore” (in contrast with over 400 acres of dredging in a 1000+ acre lagoon over 10 years).

The fact that an alternative is locally unpopular prior to full NEPA evaluation (“It would not have public support”) is hardly a valid reason for eliminating a candidate alternative with reduced environmental impact. I am not advocating jetties as an environmentally preferable alternative, but it is instructive from a NEPA perspective that Bodega Harbor, Moss Landing, and Morro Bay (all small coastal lagoons like Bolinas) all have Corps of Engineers-constructed jetties to maintain open tidal inlets. It is unexplained why the Corps would presume the same to be beyond consideration at Bolinas. Overall, the selection and rejection criteria for candidate alternatives appear to have double-standards and bias in favor of the locally preferred project alternative.

Disposal alternatives and conservation of marine sand in local sediment cells.

All California beaches are subject to long-term retreat and erosion during marine transgression (sea level rise). Mining of beach sand (removal of sand from littoral sand transport cells) increases beach erosion. At the Golden Gate National Recreation Area’s Ocean Beach in San Francisco, even small amounts of wind-blown sand removed from the seawall and Great Highway are kept within the littoral cell by replacement at the updrift (south) end of the beach system, to avoid contributing to net sediment deficits. Any disposal of sand dredged from the flood tidal delta complex (tidal inlet vicinity, Kent Island area) at Bolinas Lagoon represents net export from the littoral cell, and *net deficits to the sediment budget of the beach system. The volume of sediment proposed for removal from the Kent Island compartment of the littoral cell is highly significant, nearly 400,000 cubic yards.*

Stinson Beach is a small littoral cell with finite source of sand resupply. The littoral cell of Stinson Beach includes shallow subtidal Bolinas Bay and the flood tidal delta complex of Kent Island (see fig. 3.7, feasibility study). Dredge removal of sand in the flood tidal delta complex (Kent Island and adjacent shoals, proposed 376,000 cubic yards) would be compensated among sediment compartments within the littoral cell by increased transport and trapping of beach sand to the lagoon. (see “cumulative impact of seismic subsidence, dredge-deepening, and beach erosion”, below). This indicates a major risk of significant net beach erosion, which is marginally addressed at all as a qualitative phenomenon (impact 4.4.1, p. 4-21). Beach erosion of this magnitude is not mitigable because there are no regionally available sources of suitably textured sand for beach nourishment (Dillon Beach sand quarry cannot mitigate a 400,000 cubic yard sediment deficit).

Because Stinson beach erosion affects a developed residential shoreline and includes valuable recreational and wildlife habitat, there is an urgent need to consider alternatives which would retain dredged sand within the littoral cell. This does not necessarily mean direct placement on the supratidal beach, the only option superficially considered and dismissed on page 2-26. The reasons for eliminating within-cell disposal of sand cited were undersized grain size and inappropriate color. Grain size gradients occur within littoral cells, with coarsest grains found in the surf zone and beach; smaller grains occur seaward of the surf zone and in the lagoon. Sand color is a function of mineral films formed by iron reduction and oxidation, and these are subject to weathering under wave and current transport. Disposal of dewatered dredged sand in shallow subtidal or intertidal beach zones should be at least considered as mitigation for inducing large sediment budget deficits within the littoral cell of Stinson Beach. Placement of dredged sand on the supratidal beach would be inappropriate.

Chapter 3 – **Affected Environment.**

Section 3.2.3. **Circulation and Tidal Flows**

Figure 3-4, the inferred, reconstructed “historic change in configuration of Bolinas Lagoon” carries heavy interpretive weight, and requires rigorous evaluation as well as careful, consistent interpretation. Neither is presented. Nothing in the DEIS/R reflects the basic and accurate statement in the feasibility report regarding net change to the tidal habitat distribution of the lagoon over the full cycle before and after the 1906 earthquake and 19th century pulse of fluvial sedimentation: “In 1998, the lagoon looked similar to the way it did in 1854...the *size of Kent Island, the size and layout of the channels, and the extensive mudflats are all very much the same...*Regular seismic events have continued this cycle of lowering the lagoon bottom after hundreds of years of sediment accrual [sic], keeping the lagoon open...”(feasibility report p. 3-2, emphasis added). Despite this graphic and narrative depiction of long-term, unsteady, dynamic near-equilibrium of the system, the preceding “purpose and need” discussion lapses back to the myths of persistent estuarine degradation, upland conversion, and imminent threats of inlet closure. It is as though there were multiple mutually incommunicative authors to the document, some focused on the true cyclic, dynamic geomorphic development of the estuary, and others focused on subjective local perceptions, with bias towards the proposed project..

The acknowledged near-identical morphology of the lagoon in 1854 and 1998 highlights the self-contradiction of the project purpose as “ecosystem restoration”. All the reconstructed stages of the lagoon’s history are snapshots in cyclic estuarine development during a progressive marine transgression. No one stage is inherently “original” or “natural” in a sense of stable, ancient ecosystem structure. It clearly demonstrates that the project design is to force the estuary to an arbitrarily selected historical stage of development during historic times (not 1854, obviously) with deeper water conditions prevailing over larger areas than 1854 or today. The 1929 condition of the estuary is preferable from a navigational perspective, not an ecological perspective. There is no ecological reason to view natural geomorphic maturation after the 1906 earthquake, re-

expanding valuable tidal mudflat and marsh, as an environmentally inferior stage of development.

Natural tidal sediment of marine origin versus watershed sediment. This subject is perhaps the most important underlying scientific issue related to the project's purpose and need, yet it is among the most superficially investigated. The discussion of sediment deposition omits (or avoids) the most basic questions about sedimentation: *what proportion of the historic sedimentation in the lagoon is derived from natural tidal transport of beach sand* (marine origin), and what proportion of historic sedimentation is fluvial? Of the fluvial component, what proportion of the net deposition since 1854 is "unnatural", attributable to deforestation and agriculture in the watershed? In the absence of this inquiry, the DEIS/R lapses into an invalid tacit assumption (a bias related to local beliefs) that all sedimentation is bad or unnatural. The majority of available evidence indicates that about half of the area proposed for dredging to "restore" the estuary is *predominantly natural tidally transported sediment derived from the beach and nearshore* (marine origin). The feasibility report and DEIS/R circumvent this critically important distinction, an omission which favors the proposed project design.

The feasibility report essentially balks at these questions, acknowledging that only a "best guess" for the overall "average" or "normal" lagoon infilling rate is possible (a normative concept which has little scientific meaning over the late Holocene epoch [geologic time], and is laden with simplifying assumptions). The cursory treatment of the past attempts to discriminate among marine and fluvial sediment sources (p. 3-10, feasibility report) is inadequate and unacceptable for a purported "restoration" project which aims at correcting only human-caused degradation related to the watershed. The grain size distribution map (fig 3.7), and standard geomorphic interpretation of flood tidal delta patterning, indicate the overall pattern of marine-dominant sediment deposits in the lagoon, and provide a preponderance of available evidence for independent tidal transport and source of the flood tidal delta sediments. The distribution of near-surface fine sand *occupies about half of the lagoon bottom*. The match between sediment grain size of Stinson Beach and the flood tidal delta complex (both shown in yellow, fig. 3-7) is probably also matched by grain roundness/angularity patterns, which the report alleges (without reference to methodology or review) "were not as discernable as had been hoped". This is probably a failure of the research effort, not the intrinsic limitations methods or their costs: powerful contemporary tools in sediment analysis are sufficient to address this question, and geomorphic analysis can corroborate such analyses.

Weak and inconsistent evidence on modern sedimentation. For all the weight given to the belief that the lagoon continues to suffer from undue sediment burdens, the evidence reviewed on p. 3-12 to 3-16 of the DEIS/R is remarkably equivocal and weak. It cites the short-term U.S. Geological Survey study (Ritter 1973) which found evidence of net export of sediment from the estuary, not net accretion of sediment – a conclusion which is inconsistent with the premise of the proposed project. No other evidence of net lagoon accretion due to watershed sedimentation is discussed in this section. Bathymetric (depth) surveys which indicate changes in lagoon volume do not discriminate clearly between stream and tidal (beach, nearshore) sources of sediment.

Only long-term interpretations of the USGS study results are offered to support the belief that fluvial sedimentation is a significant contribution to modern bathymetric change. The arguments offered are valid, but imbalanced. They do not consider the more likely possibility that most of the bathymetric change recorded (especially beyond the North Basin) may be due to entirely natural tidal sand transport, which agrees with the grain size distribution map of figure 3.7 in the feasibility report.

The discussion on sedimentation also revealed how weak (or incredible) some of the sedimentation analysis has been. The unbelievable estimate of 40,000 cubic yards per year of wind-blown sand entering the lagoon is a case in point. This is contradicted by all field evidence: there are no dune deposits landward of the low, unstable foredune, and no dune transgressions across the modern spit because of obstacles (residential development) to dune movement. Suspended sand transport is a trivial source of sand compared with bedload (saltation) and creep. The spit terminus is capped by dune vegetation which traps and stabilizes most bedload transport of sand. Again, local beliefs cited by Ritter (1973) seem to be the only support for this mechanism, not scientific evidence. I am familiar with rates of foredune sand transport, and their field indicators, throughout the central and northern California coast, and I am confident that wind-transport of sand is negligible compared with tidal transport of sand through the inlet. Again, I am confident that this opinion would be confirmed by scientifically sound study and peer review.

If other estimates or assumptions about sediment transport and deposition in Bolinas Lagoon are as weak as those discussed in connection with wind-transport, the credibility of the analysis as a whole deserves great skepticism.

There is no doubt that streams discharging into Bolinas Lagoon deliver sediment and form deltas. What is doubtful is whether *contemporary* fluvial deposition of sediment occurs at a magnitude comparable to (natural) tidal inlet sediment transport, or historic post-logging rates. The DEIR/S fails to address this adequately, and treats all sedimentation in the lagoon as though it were a pathologic condition. This implicit assumption is unjustified.

Dynamics of the tidal inlet and flood tidal delta. The discussion of tidal inlet dynamics (p. 3-16) is oversimplified and misleading, and discussion of the highly relevant nature and origin of the flood tidal delta (Kent Island flood tidal delta/shoal complex) is nearly lacking. Its nature is superficially but correctly identified on p. 3-42, yet is omitted from relevant context throughout the rest of the document. The Kent Island complex re-formed after the 1906 earthquake by deposition of marine (Stinson Beach) sediments transported by tidal inlet currents. Its modern post-quake regeneration is shown in aerial photographs of figures 4.3 – 4.7 in the feasibility report. Sediment grain size analysis consistent with tidal marine sand origin is presented in the feasibility report (fig. 3.7): it shows that the majority of the area around Kent Island *matches Stinson Beach in fine sand grain size*. Surficial tidal delta sands also match the beach in mineral composition (very high proportion quartz, well-sorted, rounded). Stratigraphic analysis could confirm whether the internal structure of the intertidal portions of the Kent Island complex are consistent with flood tidal delta deposition.

Proposed dredging of this *essentially natural marine tidal sand deposit* is the second largest volume of dredged sediment in the project. Its tidal origin and nature, however, are independent of the alleged source of estuarine degradation from the watershed. The DEIS/R and feasibility report fail to analyze the key nature of this deposit.

Dredging out the Kent Island flood tidal delta complex would be an *exercise in opposing natural estuarine maturation*. It attacks a predominantly marine-influenced tidal sediment deposit, not a (watershed) fluvial delta, and *contradicts the stated project purpose of “restoring” the estuary*. It merely destroys the central feature of Bolinas Lagoon, one that has formed and re-formed through geologic cycles (see figure 3.4). This constitutes *artificial engineering*, not “ecosystem restoration” of the lagoon. Kent Island itself is a *geomorphically unique feature in California*, an emergent (dune-capped) flood tidal delta island, and it would be destroyed by the project.

For critical analysis of the discussion on tidal inlets and inlet closure, please see discussion on “accuracy of inlet closure prediction” above.

Regulatory considerations. The discussion of the Clean Water Act omits reference to the most pertinent provisions of the Section 404(b)(1) guidelines, which govern discharges (including those incidental to dredging) in wetlands. The preamble of the Section 404(b)(1) regulations explicitly discusses “habitat development and restoration of water bodies”, precisely the purported purpose of the project. The policy recommendations here (p. 85344, Federal Register vol. 45, No 249, Dec. 24, 1980) are not reflected in the planning of the Bolinas Lagoon project, and are partly in conflict with them. Corps civil works projects involving dredging must substantively comply with the 404(b)(1) guidelines even though they are not subject to the Corps permit process, and Council on Environmental Quality guidance (CEQ, Nov. 17, 1980) establishes national policy for the Corps and EPA to evaluate all EIS dredge-related projects for compliance with the 404(b)(1) guidelines, even where projects are exempt from regulation under Section 404(r).

The 404(b)(1) guidelines preamble recommends “selecting the nearest similar natural ecosystem as the model in the implementation of the [habitat restoration] activity”. The project has entirely avoided any comparative geographic analysis of central coast estuaries. Perhaps this is because *Bolinas Lagoon is, by comparison, among the most pristine tidal lagoons in California*, equaled only by the small Big River estuary (Mendocino), Drakes Estero (which suffers from active cattle grazing and historic dams and railroad berms) and Morro Bay (which has a tidal inlet stabilized by jetties and a massive delta formed by agricultural sedimentation a century ago). The lack of a better ecological model of tidal marsh and lagoon development than Bolinas Lagoon points to the self-contradiction of “restoring” an intact, viable estuary.

The 404(b)(1) guidelines preamble also warns, “*One viable habitat, however, should not be sacrificed in an attempt to create another...* when a significant ecological change in the aquatic environment is proposed...the permitting authority should consider the ecosystem that will be lost as well as the environmental benefits of the new system. [emphasis

added]”, and “Where development and restoration techniques proposed for use have not yet advanced to the pilot demonstration stage, initiate their use on a small scale to allow corrective action if unanticipated adverse impacts occur”. These specific, pertinent Clean Water Act policy considerations are neither addressed in the DEIS/R, nor reflected in the development of alternatives. This is a major deficiency in the planning process. Although the Corps civil works program does not regulate its own activities with self-issued permits, it is obliged to comply substantively with the policies and provisions of its Clean Water Act regulatory authority.

Biogeographic context (Section 3.3.1.) The DEIS/R focuses on a mere listing of biological attributes of Bolinas Lagoon’s wetlands, and provides none of the essential geographic context for understanding of the “affected environment” and “environmental setting” recommended by the Council on Environmental Quality, which establishes national NEPA guidance (CEQ 1997).

The biogeographic significance of Bolinas Lagoon’s tidal wetlands is understated by lack of comparison with other estuaries along the California coast. *Bolinas Lagoon is among the most pristine tidal marsh systems in the state*, and one of the very few in central California with an intact ecotone between tidal marsh and freshwater riparian habitat. It includes rare intact ecotones (transition zones) between riparian and tidal marsh habitats, tidal marsh pans, estuarine beach-dune slacks, and some unique stands of high marsh vegetation. For example, the high marsh ecotone at Kent Island is the only location in California which includes a zonation from Vancouver wildrye (*Leymus x vancouveriensis*), red fescue (*Festuca rubra*) to saltgrass, pickleweed, and northern saltmarsh bird’s-beak (*Cordylanthus maritimus* ssp. *palustris*).

Vegetation and habitat description, definition, and quantification are inconsistent and incorrect. (section 3.3.2). The *extent (acreage) of salt marsh habitat mapped* and quantitatively estimated in the DEIS/R *is severely underestimated (habitat maps do not match the color aerial photo of the Lagoon’s salt marsh in figure 3-5)*. Wetland delineation methods used are entirely *inconsistent with the Corps own standard methodology for wetland determination*.

The DEIS/R states on p. 3-21 that “for the purposes of this EIS/EIR, habitats are defined by the Corps as follows: upland habitat is the area between 2.54 and 7.00 NGVD, intertidal habitat is from –1.36 to 2.54 feet NGVD...”. This conflicts with the document itself and with national Corps definition of wetlands. Table 3-1 (local tidal datums) shows that mean sea level at Bolinas Lagoon is slightly above that of the Golden Gate and Drakes Bay. The elevation of Mean Higher High Water, which is the approximate elevation of the pickleweed-jaumea-saltgrass salt marsh plain, is 2.7 NGVD at the Golden Gate and 2.92 NGVD at Drakes Bay. The lower elevation of “upland” applied to Bolinas is 2.54 NGVD, below both these reference MHHW elevations. *Therefore, the “local” definition of “upland” includes most tidal pickleweed salt marsh and all high salt marsh/ecotone. Calling a tidal salt marsh an “upland” is obviously incorrect and unacceptably misleading.* It causes the severe underestimation of salt marsh at Bolinas Lagoon.

This erroneous demarcation of marsh and upland is also inconsistent with both Corps wetlands determination methodology, and the definition of Waters of the United States in Corps regulations. The legal upper boundary of tidal waters and tidal wetlands under the Clean Water Act, Section 404, the high tide line (33 CFR 328.3) is defined as "...the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by ...a more or less continuous deposit of fine shell or debris on the foreshore....other physical markings or characteristics, vegetation lines...the line encompasses spring high tides and other high tides that occur with periodic frequency...." The high tide line is obviously above and includes the plane of MHHW. The Corps 1987 wetland delineation manual provides the national basis for a multiple-variable (vegetation, soil, hydrology) identification method of wetlands which is ignored by the DEIR/S. The DEIR/S also ignores the national Cowardin (U.S. Fish and Wildlife Service) classification system for wetlands.

This underestimation of salt marsh also appears in habitat maps, which are inconsistent with color aerial photographs in the DEIS/R (figs. 1-2, 3-5) and mapped habitats (figure 3-9). The obvious extensive salt marsh in the lee of Kent Island is entirely omitted from the map.

The consistent underestimation of tidal marsh by all methods (elevation boundaries, maps, and rejection of all legal and scientific federal definitions applied to tidal wetlands) gives the appearance of deliberate understatement of tidal marsh and tidal marsh impacts in Bolinas Lagoon. It is also tendentious, biased in support of the perceived threat used to justify the purpose and need of the project. *This is a very serious scientific and legal deficiency*, and must be corrected. All estimates of "Changes in Bolinas Lagoon Habitat Acreages over Time" presented in table 3-2, and all biological conclusions based on them, should be presumed to be incorrect until valid and accurate estimates of salt marsh and other wetland habitats are prepared. Standard methods of aerial photograph interpretation and mapping, combined with ground-truthing and reference of generally accepted wetland definitions and boundaries would provide this.

Salt marsh vegetation errors and omissions (including environmental consequences). The description and analysis of the salt marsh vegetation and plant community at Bolinas Lagoon is superficial, erroneous, and incomplete.

The DEIS/R fails to cite contemporary published peer-reviewed study of the marsh (Allison 1992), and omits key information. It incorrectly states that *Atriplex watsonii* occurs there, a species with a northern limit in San Luis Obispo, hundreds of miles south (the correct species is *A. semibaccata*, a non-native plant).

It omits the fact that Bolinas Lagoon supports the largest, southernmost population of the rare northern salt marsh bird's-beak on the coast (*Cordylanthus maritimus* ssp. *palustris*; cited in table 3-3, but not discussed in terms of significance or impact on p. 3-34), and that all population locations of this species would be destroyed by proposed dredging.

It similarly omits reference to the single population of the rare salt marsh population of *Castilleja ambigua* ssp. *ambigua* (salt marsh owl's-clover) at the north end of the Pine Gulch Creek delta/tidal marsh edge; the only other persistent salt marsh localities exist at Rodeo Lagoon, Limantour Estero and Point Pinole (San Pablo Bay).

Bolinas Lagoon is the type locality of the rare *Astragalus pycnostachyus* var. *pycnostachyus*, and dredging would destroy the only suitable habitat for reintroduction of this locally extinct species. This is omitted from the DEIS/R.

Other unique features such as the relict and active fluvial delta levees with red alder and willow “fingers” growing into salt marsh in series of wet years are omitted. The Pine Gulch Creek delta supports some of the finest examples of riparian/salt marsh ecotones in California. None of these relevant aspects of Bolinas Lagoon’s distinct tidal plant community is discussed.

Wildlife community errors and omissions (including environmental consequences).

The federally endangered tidewater goby (*Eucyclogobius newberryi*) is not discussed in the context of estuarine wildlife communities (p. 3-24), though it appears in table 3.3.

The relationship between accreting sand spit and beach, and habitat for the federally threatened western snowy plover, is not discussed at all. This omission in turn avoids identifying the potential impact of dredging Kent Island on the significant erosion of the west end of Stinson Beach (see “cumulative impact of seismic subsidence, dredge-deepening, and beach erosion”, below)

The discussion of habitat requirements of the federally threatened California red-legged frog is incorrect in stating that the species needs deep permanent sources of freshwater for breeding. The species actually competes as well or better in seasonal ponds and marshes with standing water that persists into summer, but not fall, and it tolerates brackish water at least below 4 parts per thousand. Because the frog can seasonally re-occupy and breed in quiet isolated summer scour pools of stream channels, it should be presumed to occur in Pine Gulch Creek and any backwater pools in its delta.

The superficial, trivial analysis of “no impact” to harbor seals neglects any consideration of the effect on habitat structure, specifically the dredging of high-intertidal haul-outs. The larger significant impact is not temporary disturbance due to the presence of the dredge, but the long-term elimination of traditional seal haul-out sites adjacent. Seals are not adversely affected by intermittent tidal inlet closure, as indicated by the large colony at the Russian River mouth; individuals feed up to a mile upstream of the mouth.

The DEIS/R fails to identify significant impacts to the recovery of the federally endangered California clapper rail, an historic inhabitant of Bolinas Lagoon (Table 3-3). Clapper rails are again vagrant inhabitants of Tomales Bay, where they are probably limited by poor high tide escape cover (J. Evens, pers. comm. 2001). Eliminating cordgrass and high salt marsh (especially thick gumplant cover around the Pine Gulch Creek delta) would be highly detrimental to the Clapper rail’s prospects of recovery.

Impairing the recovery of an endangered wildlife species is no less significant than “take” of mere individuals.

Superficial and inconsistent discussion of seismic subsidence recurrence interval (Section 3.4.2). Since the lagoon deepens itself, without dredging, through seismic subsidence, the probable recurrence interval of this event is particularly relevant to (a) predictions about inlet closure with simplified models, and (b) purpose and need of the project. In sequential paragraphs of p. 3-43, the DEIS/R states “for the North Coast South segment of the San Andreas Fault the probability of a magnitude 6.7 quake is estimated to be 12 percent in the next 30 years”, and “there is a 30 percent probability that within the next 30 years an earthquake similar in magnitude to the 1906 earthquake will occur on the northern segment of the San Andreas fault”. These sequential statements appear to be quite inconsistent, with a nearly 3-fold error. They also unreconciled with the statement on page 4-10 that “an earthquake of magnitude similar to the 1906 earthquake is estimated to occur on average about once every 300 years on the portion of the San Andreas Fault that lies north of Monterey County.” These conflicting statements are serious deficiencies because of the importance of seismic subsidence to the natural long-term maintenance of the lagoon, and the analysis of project purpose and need. They also reflect deficient scientific review and editorial control of the DEIS/R.

Since the (doubtfully) projected risk of inlet closure is “due” by 2058, this is particularly important to the assessment of purpose and need, and to evaluation of the compound (cumulative) impact of dredging and seismic subsidence. The subject requires clarity, rigor, and consistency. Conclusions depending on this analysis should be suspended in judgement. The relevance between the seismic recurrence interval and the project purpose and need should be made explicit.

Rigorous evaluation of Bolinas Lagoon Resource Management Plan policies.

The requirement that “...dredging should be permitted only after documentation of need is established” and “...only as permitted under existing Coastal Act Policies”, and the NEPA requirement for a “hard look” at environmental impacts, are not adequately met by the disjunct and inconsistent discussions of seismic subsidence cycles and historic sources of sedimentation (pp. ES-4, 3-40, 3-34, 4-47, 3-48, 4-3 to 4-5). The purpose and need for the dredging project should be rigorously reviewed by a qualified interdisciplinary scientific peer review panel, with expertise in coastal geomorphology and tidal marsh ecology.

Chapter 4 – **Environmental Consequences**

Need for consistent and expanded discussion of lagoon processes (p. 4-3). Page 4-3 provides an illuminating, accurate, but exceptional discussion of lagoon geomorphology in the context of sedimentation, seismic subsidence, and sea level rise. These seminal perspectives (p. 4-3) are not carried through the text:

“within the recent geologic past the area that is now lagoon has probably experienced large fluctuations in its size and character...left alone the lagoon might survive the threat of closure of its inlet if the graben undergoes another episode of subsidence. It is *almost certain that the fault processes that have maintain the lagoon will continue to occur* [emphasis added].

What is missing is critical discussion of the subsequent statement that “But the risk that inlet channel will close...and that more habitat will be lost...is thought be unacceptable...” There is no reference to how this risk was judged to be “unacceptable”, what values were compared and weighed, and whose judgment and authority was responsible. For an issue of ultimate importance for the purpose and need of the project such as this, such an omission of disclosure is unacceptable under CEQA and NEPA. The statement of “unacceptable risk” is not linked to the USGS forecast of seismic recurrence interval for the fault, nor is there internal reference to other chapters of the DEIS/R.

Cumulative impact of seismic subsidence, dredge-deepening, and beach erosion.

The analysis of 4.2.2. fails to consider the cumulative effect of the compound deepening of the lagoon by dredging and seismic subsidence on erosion of the adjacent Stinson Beach (updrift littoral cell, east of the tidal inlet and proposed Kent Island “pit”). This is potentially highly significant for beach erosion, habitat loss of western snowy plovers, storm damage intensity and frequency for shorefront residences, and recreational use of GGNRA shoreline. The superficial and qualitative discussion of beach erosion under “erosion of tidal inlet channel and banks” (p. 4-21) describes only “minor loss of beach sand”, not volumes of sand transport proportional with the volume lost (and demanded by) the removal of the flood tidal delta complex.

Anoxic sediment chemistry of “turbidity”. The discussion of water quality impacts from “construction” (dredging) considers only turbidity in terms of suspended sediment concentration, not the inevitable chemistry of highly reduced, anoxic sediments below the lagoon surface. Reduced iron sulfide and free hydrogen sulfide are significantly more toxic in shallow tidal waters than mere aerobic suspended silt and colloidal clay. The concentrated dispersion of black (reduced iron) turbidity plumes would have much more severe impact on fish, marine mammals, and estuarine productivity than turbidity alone. This highly probable and high-magnitude impact, as an aspect of deep dredging in organic estuarine sediment, is not adequately treated in the conditional language of page 4-5. Unlike most navigational dredging, the proposed dredging is targeted for very shallow or intertidal estuarine environments, which limits potential dispersion of an anoxic suspended sediment plume.

Unstated hydrologic model accuracy or precision. Mitigation measure 4.2.3. identifies sediment transport modelling to address potential impacts to circulation. The statistical power and accuracy of the model, its potential for calibration to local conditions, are not stated. If the model is merely heuristic (instructive but not empirically predictive with

statistical significance), it is not acceptable as a substantive mitigation measure under NEPA or CEQA.

Lagoon closure assessment. The analysis and discussion of lagoon closure impacts (p. 4-8) is woefully inadequate, and inconsistent. See comments on “accuracy of inlet closure prediction” above. The assumption that “there will be no major subsidence of the lagoon...” contradicts the statement on page 4-3 that “It is almost certain that the fault processes that have maintain the lagoon will continue to occur...”. The omission of any explicit reference to the primary importance of sea level rise to lagoon closure, and the lack of sea level rise as a controlling variable for tidal prism, is a “fatal flaw” of the discussion and analysis. The deficiencies in accuracy of modern sedimentation rates (see comments on “accelerated sedimentation” and “natural tidal sediment of marine origin versus watershed sediment”, above) make this discussion misleading and unreliable.

Inconsistent estimates of tidal prism changes due to compound impacts of seismic subsidence and dredging. There is a huge gap between the amount of tidal prism estimated to have been regenerated in Bolinas Lagoon by the 1906 earthquake (50 million cubic feet (= 1,851,852 cubic yards; p. 3-48, citing Bergquist 1993) and the amount of tidal prism estimated to be caused by an equivalent seismic subsidence of one foot (p. 4-10: 720, 000 cubic yards, excluding 300,000 cubic yards of subtidal volume added). Even if the 300,000 cubic yards of subtidal volume were included in the estimate, there is a highly significant apparent discrepancy between the cited Bergquist estimate, the estimate on p. 4-10, and the feasibility report’s evaluation of historic bathymetry. The units used to express changes in tidal prism should be made consistent throughout the document, and estimated values should be consistent or at least commensurate.

Inconsistent underestimation of “enhanced wave attack” (p. 4-22). Failure to accurately predict sand spit erosion due to indirect sediment budget effects of dredging have resulted in a significant underestimate of the potential for increased wave energy in the tidal inlet. Retreat of the spit is highly likely as its sediment is transported to the major sediment sink of the excavated Kent Island flood tidal delta complex, as stated (understated) on page 4-21 (“most of the channel widening would come from erosion of the west end of the sand spit”). The distal end of the spit is the only significant wave barrier for the lagoon. Deeper water of the enlarged inlet would act as a lens to focus wave energy into the lagoon, allowing less wave energy dissipation from to bottom friction. The effects of former higher inlet wave energy are apparent in the historic photos of figures 4.3 and 4.4 of the feasibility report, which show wave-reworking of flood tidal delta shoals into an emergent “interior” barrier island beach, Kent Island (an emergent flood delta). The months of the photos are not given, but such extensive arcuate shoreline development on Kent Island would have occurred during earlier phases of spit retreat, probably in winter.

A recent example of significantly increased wave exposure due to inlet enlargement and migration is at the Mad River, Humboldt County, which had to be artificially stabilized in 1992.

Concluding comments.

Given the unprecedented magnitude of tidal marsh and mudflat destruction proposed as “restoration” of Bolinas Lagoon, the extraordinary stakes demand the most scientifically rigorous and consistent evaluation of purpose and need, alternatives, and environmental impacts under NEPA and CEQA. From both a regulatory and scientific standpoint, I regret to conclude that the DEIS/R is woefully deficient in both aspects, and even more importantly, contradicts itself and its feasibility report frequently. Some of the errors may be due to the difficulty in managing a large and complex body of information, but some errors appear to be exceptionally consistent and systematic (such as significant underestimation of tidal marsh). Other errors seem prejudiced in favor of the purported threats of “upland conversion” and lagoon closure used to justify the project’s purpose and need.

The scientific basis for the purpose and need of this “ecological restoration” project is weakly and inconsistently argued. The proposal itself, in my professional experience, is one of the least credible and most inflated “ecological restoration” concepts I have reviewed in the last 25 years, either in California or elsewhere. I have grave concerns that its poor scientific foundation for this “restoration” concept could undermine public and government support of valid coastal ecosystem restoration in the region for many years to come. I do not believe that his harsh evaluation is undue or unfair, especially given the magnitude of the project, and objective of “ecological restoration”.

Of all tasks needed to finalize the EIS/R, I recommend that an independent scientific peer review panel, with interdisciplinary expertise in coastal geomorphology (particularly in tidal inlets, beaches, and lagoons) and estuarine ecology (particularly paleoecology and community dynamics of tidal marshes) is the most essential. The local technical advisory panel does not and cannot fulfill this role. The U.S. Geological Survey, the University of California, and other academic institutions with internationally recognized scientific expertise would be appropriate sources for a scientific peer review panel.

Specific analytic tasks needed for an adequate final EIS/R include: (1) geographic comparative analysis of the sedimentation and ecological history of Bolinas Lagoon and other California estuaries; (2) focused study of the environmental consequences of tidal choking (partial or intermittent, unstable inlet closure); (3) realistic analysis of inlet stability and lagoon habitat change based on the best available data on sea level rise, seismic recurrence intervals, and accurate field data on tidal and fluvial sedimentation; (4) analysis of the project effect on the entire littoral cell’s sediment budget, with focused attention to the rate and magnitude of beach erosion following dredging of the Kent Island flood tidal delta complex; (5) comprehensive quantitative re-assessment of habitat types and distribution, using established, scientifically sound methods and definitions (based on ground truthing of current infrared aerial photographs); (6) re-assessment of biological impacts based on comprehensive regional biogeographic context, including regionally rare and declining species.

Adequate, complete, and accurate technical analysis is particularly important to support meaningful comments from federal and state resource agencies, whose staff rely on the accuracy and completeness of NEPA/CEQA documents. Resource agency staff usually do not have the time to fact-check basic information provided in an EIS/R.

If the purpose and need statement were appropriately recast more broadly, the alternatives analysis could include a reasonable, moderate-scale navigational dredging project which is specifically designed to improve recreational and commercial boat access to designated portions of the lagoon. This reduced project alternative could avoid most of the excessive, unacceptable, and unmitigable impacts of the proposed project. As a political outcome of the NEPA/CEQA process, such a downscaling of project purpose and scope would better serve the general public interest in the lagoon, and the estuarine environment as well. Mitigation for a downscaled project could be proportionally reduced to removal of modern artificial fills at the edges of the lagoon, or other ecological enhancements that do not destroy more valuable existing habitats.

Sincerely,

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Attachment: Literature cited.

Copies:

Hon. Barbara Boxer

Agencies:

California Department of Fish and Game, Yountville (C. Wilcox)
California Regional Water Quality Control Board, San Francisco Bay Region, Oakland
California Coastal Commission, San Francisco
U.S. Environmental Protection Agency, San Francisco (M. Monroe)
U.S. Fish and Wildlife Service (M. Littlefield, C. Goude,
W. White)
U.S. Geological Survey, Biological Resources Division (K. Miller, J. Takekawa)
U.S. National Park Service, Golden Gate National Recreation Area, San Francisco (B.
O'Neill)
U.S. National Park Service, Point Reyes National Seashore (D. Neubacher)
Gulf of the Farallones National Marine Sanctuary, San Francisco (E. Ueber)

Organizations:

Marin Audubon Society, Larkspur (B. Salzman)
Golden Gate Audubon Society, Oakland (A. Feinstein)
Environmental Action Committee of West Marin (C. Caufield)

Integrity in Natural Resources, Healdsburg (J. Hansen)
Point Reyes Bird Observatory, Bolinas
San Francisco Estuary Institute, San Leandro (J. Collins, R. Grossinger)
Sierra Club, San Francisco Chapter, San Francisco (R. Gravanis)

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LITERATURE CITED

Allen, J.R.L. and K. Pye, eds. 1992. Saltmarshes: Morphodynamics, Conservation, and Engineering Significance. Cambridge University Press. 184 pp.

Allison, S.K. 1992. The influence of rainfall variability on the species composition of a northern California salt marsh plant assemblage[Bolinas Lagoon]. *Vegetatio* 101: 145-160.

Bruun, P. 1968. Tidal inlets and littoral drift. Bulletin No. 23/21, Permanent International Association of Navigation Congresses.

Bruun, P. 1978. Stability of Tidal Inlets. Elsevier Scientific Publ., Amsterdam, Holland.

Borrego, J. J.A. Morales, and J.G. Pendon. Holocene filling of an estuarine lagoon along the mesotidal coast of Huelva: The Piedras River Mouth, Southwestern Spain. *Journal of Coastal Research* 9: 242-254.

Carter, R.W.G. 1988. Coastal Environments: an Introduction to the Physical, Ecological, and Cultural Systems of Coastlines. Academic Press. 617 pp.

Council on Environmental Quality 1997. CEQ Guidance Regarding Cumulative Effects. Council on Environmental Quality, Washington, DC.

Davies, J.L. 1980. Geographical Variation in Coastal Development. Second Edition. Longman. 212 pp.

Kana, T.W., E.J. Hayter, and PIA. Work. 1999. Mesotidal sediment transport at U.S. tidal inlets: conceptual model applicable to mixed energy settings. *Journal of Coastal Research* 15: 303-313.

Niemi, T.M. and N.T. Hall. 1996. Historical changes in the tidal marsh of Tomales Bay and Olema Creek, Marin County, California. *Journal of Coastal Research* 12: 90-102.

O'Brien, M.P. 1971. Notes on tidal inlets on sandy shores. Technical Bulletin HEL 4-5 (May), Hydraulic Engineering Laboratory, University of California, Berkeley.

Pethick, J. 1993. Shoreline adjustments and coastal management: physical and biological processes under accelerated sea level rise. *The Geographical Journal* 159: 162-168.

Rowntree, R. 1975. Morphological Aging in a California estuary: myth and institutions in coastal resource policy. *Geosciences and Man* 12: 31-41.

Rowntree, R. 1973. Morphological change in a California estuary, sedimentation and marsh invasion at Bolinas Lagoon. Ph.D. dissertation, University of California, Berkeley.

Webb, C.K., D.A. Stow, and H.H. Chang. 1991. Morphodynamics of southern California inlets. *Journal of Coastal Research* 7: 167-187.