AMWG Meeting Summary
October 22, 2004

General Update

John Cain provided an update on developments with the Contra Costa Canal. The Contra Costa Water District is planning to place the canal in a pipeline which would run along the southern boundary of the project. If this effort is properly coordinated with the Dutch Slough restoration planning process, then it would reduce constraints associated with the current canal operation and would create an opportunity for integrating the existing canal into the Dutch Slough restoration site.

Conceptual Model Update

Michelle Orr and Bruce Herbold provided an update on the Conceptual Model development. Michelle described progress since the last meeting toward developing a single conceptual model within a template that starts at restoration action and moves through physical process, habitat structure, biological processes through to functional response. Although this process was useful, the resulting one-page schematic was too complex. Thus, Michelle and Bruce Herbold are working on a revised set of nested conceptual models that Bruce illustrated in a power point presentation (attached).

Break-Out Groups and Experimental Design

All three break-out groups independently coalesced around a similar design concept with an emphasis on testing the role of marsh plain elevation (figure 1). The AMWG members favored the idea of diverting Marsh Creek onto the Emerson parcel and testing the role of riparian processes on fish utilization, marsh plain evolution, and water quality. None of the groups or AMWG members felt that testing the response of varying channel density was worthwhile. In addition to marsh plain elevation the fish group proposed a design that would also test the role of scale by including a few small-scale marsh restoration cells. This would help answer the question of whether small-scale marsh restoration sites, which are far more easy to come by, would yield as much fish (splittail and juvenile salmon) benefits as large scale restorations. The geomorphology/vegetation group also suggested some meso-scale features overlaid on the large marsh plain elevation design that could be used to test the role of terminal panes and ponds, the efficacy of different channel design strategies, the ecological response on varying soil types, and the potential to expand the area of emergent marsh by cultivating tules prior to tidal inundation of subtidal areas rather than simply flooding unvegetated substrate as is normally done in tidal marsh restoration projects. The water quality group developed a scheme of small-scale experiments that could be overlaid over any larger site design. Two important issues were discussed but not resolved in the post break-out session discussion: 1) the role of connectivity between high marsh and low marsh, and 2) treatment of the deeply subsided portions along the north side of the site.

Hypotheses

The AMWG articulated a number of fish, geomorphic, and water quality hypotheses that the experimental design would test.

AMWG Meeting Minutes
October 22, 2004

Attendees:

AMWG
Bruce Herbold, Ph.D. US EPA (fish biologist)
Peter Baye, Ph.D. Private Consultant (coastal vegetation ecologist)
Mark Stacey, Ph.D. UC Berkeley (fluid dynamics)
Roger Fujii, Ph.D. USGS (water quality –dissolved organic carbon)
Stuart Siegel, Ph.D. Private Consultant (wetland scientist)
David Sedlak, Ph.D., UC Berkeley
John Takekawa, Ph.D., USGS

Consultant Team
Philip Williams, Philip Williams & Associates
Michelle Orr, Philip Williams & Associates
Lars Anderson, UC Davis, Exotic and Invasive Weed Research Laboratory
Cindy Paulson, Brown and Caldwell
Jason, Brown and Caldwell
Si Simonstad, University of Washington

Project Management Team
Lauren Hastings, California Bay Delta Authority
John Cain, NHI
Jeff Melby, Coastal Conservancy
Tom Hall, DWR

AMWG Members Not Attending
Joan Florsheim, UC Davis

Introduction and General Update

John Cain commenced the meeting at approximately 9:20. Cain reported that 3 undergraduate students from UC Berkeley's Department of Civil and Environmental Engineering had written an excellent paper[1] analyzing design alternatives for routing Marsh Creek onto the Emerson Parcel. The students had also prepared a physical model of their recommended design. Both the model and copies of the paper were available at the meeting.

[1] Carbert, Kyle. Cheung, Carmen. Frame, Erik. Easibility Study of a Bay Deltqa Wetland Restoration. Department of Civil and Environmental Engineering. University of California. Berkeley, California. USA.

John Cain also provided an update on the Contra Costa Canal. The canal on the southern edge of the Dutch Slough site is a tidally controlled artificial slough operated by the Contra Costa Water District for water supply. John reported that the Contra Costa Water District is considering an option that would entail running a pipeline parallel to and immediately north of the existing canal on the Dutch Slough properties. This pipeline option would eliminate concerns that the project would erode the existing canal bank or increase saline groundwater flow into the canal. It may be possible to build a trail on top of the pipeline and regrade the north bank of the existing canal through the Dutch Slough site. Since the proposed pipeline will serve all of the water conveyance functions currently provided by the segment of the canal through the Dutch Slough site, it may be possible to regrade and restore the canal as a more natural feature lined by marsh or riparian vegetation. Maintaining deep, open water across the canal even after the pipeline is build will provide a buffer against uncontrolled human or unwanted feral animal access. To prevent water from stagnating in the canal, some portion of the canal water would need to be circulated and discharged into Marsh Creek or the Dutch Slough site.

Conceptual Model Update

Michelle Orr and Bruce Herbold provided an update on the Conceptual Model development. Michelle presented a power point presentation (attached) that described the process we have gone through to date in development of the conceptual model. Michelle described progress since the last meeting toward developing a conceptual model within a template that starts at restoration action and moves through physical process, habitat structure, biological processes through to functional response. Although this process was useful, the resulting one-page schematic was too complex. Thus, Michelle and Bruce Herbold are working on a revised set of nested conceptual models.

Bruce Herbold presented a follow-up power point presentation (attached) on conceptual model development that depicted how he envisioned developing nested conceptual models.

Discussion

Si Simenstadt recomened reducing complex models down to their strongest interactions on the basis of both importance and uncertainty level. Critical uncertainties are ones with high importance and high uncertainty. We should focus on issues of both high importance and uncertainty rather than points of low importance and low uncertainty.

Bruce Herbold discussed some lessons from the DRERIP process where they focused on three questions regarding prioritization of potential restoration actions:

1. What do we know will work?
2. How important is it to the Delta?
3. Can we reverse it if it turns out to be a mistake?

Presentation on alternative experimental concepts, design elements, and guiding principles. (John Cain)

John Cain presented a power point presentation (attached). He prefaced the presentation by stating that the purpose of the meeting was to:

- Focus in on the key uncertainties we want to probe at Dutch Slough.
- Develop experimental restoration designs to test hypothesis associated with those uncertainties.

The presentation covered some of the criteria the AMWG may wish to consider to identify priority uncertainties and some guiding principals for developing experimental restoration design. The presentation also identified the key uncertainities that the AMWG and the Delta Habitats Group previously identified. Lastly, John identified some key design decisions he hoped the group would tackle:

- Which knobs should we turn with a minimal fill alternative vs. a major fill alternative?
- How much should we partition the site?
- How many breaches should we make and where should they be located?
- Should we connect Marsh Creek to Emerson parcel?

Discussion

Bruce Herbold informed the group of an interesting e-mail discussion in the week preceeding the AMWG meeting regarding key fish uncertainties and the potential role of ponds at the end of sloughs.

Peter Baye inquired about the role of substrate for fish and habitat and suggested that it could be a pivotal uncertainty.

Si Simenstadt raised a key question regarding the dichotomy between testing the ecological response to a restoration template that will presumably evolve rapidly in the years after restoration. Are we testing an engineering design? Or are we testing fish response? It will be difficult to test fish response, because the physical configuration of the project will be evolving, particularly in the first few years after restoration.

John Cain responded that he thought the AMWG was operating on the assumption of "what we build is what we will get." Michelle Orr seconded that she did not think there would be significant change to the physical structure of the restoration based on observations of other flooded Delta islands.

Stuart Siegel pointed out that we can separate marsh ecology variables into form, function, and process. The primary marsh plain accretion processes will be tule growth not sedimentation due to locally low sedimentation rates. Pre-cultivation of tules and subsequent flooding will establish a different form than flooding a bare site, and will jumpstart the both the biological tule accretion process as well as sedimentation.

Peter Baye raised the question of how fish will respond to ponds or panes at the upper end of sloughs. Will these features be “transparent” to fish regardless of whether they become vegetated or remain open? How will fish use them?
Lars Anderson stated that vegetation, not engineering, was going to drive these questions of restoration form and evolution. He opined that spatial separation of SAV from emergents was a mistake. We shouldn’t focus on engineering for controlling SAV. If we start importing sediment to raise the site, we will bring a seed bank of exotics that will complicate the project.

Stuart Siegel suggested that reversibility be added as a guiding principal or criteria for restoration design.

Si Simenstadt again questioned whether we would end up testing how to build a particular form rather than the ecological response to that form, presumably because the form would evolve in the first years of the project.

Mark Stacey offered that options 1-5 in the power point presented by John Cain essentiall came down to density vs. elevation. He suggested, however, that we may also want to consider the variable of connectivity. Perhaps we could test the function of a marsh with both high and low marsh vs. low and high marshes that were not connected.

Phil Williams reminded the group that PWA needed to finalize a deliverable by May and to do that they needed to get some clarity on the conceptual model. In developing designs in the break-out groups, Phil asked that everybody consider the following factors.

- What is the critical uncertainty they would like to test
- What is the hypothesis?

Si Simenstadt once again offered that if test response to structure rather than ecological processes, we need to consider the stustainability of experimental design.

David Sedlack stated that he thought the presentation focus on elevation and channel density made sense and questioned whether there were any other overall questions, and if so, what they were.

Stuart Siegel asked what are the attributes of the chanel network that pertain to fishery functions. What is the fish reponse to marsh plain elevation?

John Takekawa offered that we probably want to or need to test the extremes (of density or elevation) to get a response. He questioned how much latitude there was to divide the site into various cells with different conditions.

Michelle Orr raised the question of topology once again and reduced it to the following design decieisons:

- Where do we put open water in relation to emergent marsh?
- What will be the effect of integrating Marsh Creek into the design?

Peter Baye, on the topology question, once again suggested that we need to rely more on reference sites to inform the restoration design.

Si Simenstadt asked about how adaptive management would be employed to change restoration at Dutch Slogh if the original action did not perform as anticipated.

Bruce Herbold offered several points about the presentation and discussion: We should use results of Decker Island and the Breach Study sites to better inform our questions. Bruce cautioned against the strong potential for pseudo replication at Dutch Slough. Lastly he asked the group to consider what we can measure as opposed to what we want to measure.

Phil Williams provided some guidance on spatial and temporal scales. He suggested that we need useful results in the 10-20 year time frame. That doesn't preclude long-term studies but requires that we have some results in the shorter term. On the spatial scale, he cautioned that if we are studying effects of channel size, we needed to cross some threshold of marsh size or order to adequately test that.

Lars Anderson remarks concluded the morning session: We know what the 3-4 key uncertainties are: complexity of channels, elevation, open water issues, and connectivity between them.

Break-Out Groups

John Cain divided the meeting into three break-out groups: water quality, geomorphology and vegetation, and fish and birds. Each group was asked to: develop a drawing of their preferred experimental design, identify the uncertainties their design would address, and articulate the hypotheses associated with the design.

Water Quality	**Geomorph/Vegetation**	**Fish and Birds**
Cindy Paulson,	John Cain	Bruce Herbold
Jason	Stuart Siegel	Si Simenstad
David Sedlack	Lars Anderson	Bruce Herbold
Roger Fujii	Mark Stacey	Lenny Grimaldo
	Peter Baye	John Takekawa
	Lauren Hastings	Phil Williams
	Jeff Melby	

<u>Break-Out Summary</u>

Surprisingly, all three break-out groups independently coalesced around a similar design concept with an emphasis on testing the role of marsh plain elevation (figure 1). The AMWG members favored the idea of diverting Marsh Creek onto the Emerson parcel and testing the role of riparian processes on fish utilization, marsh plain evolution, and water quality. None of the groups or AMWG members felt that testing the response of varying channel density was worthwhile. In addition to marsh plain elevation the fish group proposed a design that would also test the role of scale by including a few small-scale marsh restoration cells. This would help answer the question of whether small-scale marsh restoration sites, which are far more easy to come by, would yield as much fish (splittail and juvenile salmon) benefits as large scale restorations. The geomorphology/vegetation group also suggested some meso-scale features overlaid on the large marsh plain elevation design that could be used to test the role of terminal panes and ponds, the efficacy of different channel design strategies, the ecological response on varying soil types, and the potential to expand the area of emergent marsh by cultivating tules prior to tidal inundation of subtidal areas rather than simply flooding unvegetated substrate as is normally done in tidal marsh restoration projects (figure 2). The water quality group developed a scheme of small-scale experiments that could be overlaid over any larger site design.

Two important issues were discussed but not resolved in the post break-out session discussion: 1) the role of connectivity between high marsh and low marsh, and 2) treatment of the deeply subsided portions along the north side of the site. The experimental design generally endorsed by the group contemplates separating much of the site into low marsh and high marsh areas that are largely or partially isolated from each other. However, low marsh that grades into high marsh may function differently than low marsh and high marsh that are hydrologically separated. Some AMWG members proposed a modification of the design that includes additional areas with low marsh grading into high marsh with a common channel system (figure 3).

The experimental design developed in the break-out session did not identify a preferred treatment of the subsided areas. However, there was consensus that the subsided areas should be partially or totally isolated from the marsh components. The group discussed various options for these zones including: 1) managing as deep, non tidal perrenial water with islands for waterfowl, 2) managing as non-tidal tule marsh or other treatment to reverse subsidence, 3) managing as tidal open water (deep or shallow) directly connected to the main sloughs.

Fish Group

Experimental Variables (knobs)

- Elevation: high marsh vs. low marsh. Differences in elevation will result in differences in residence time. Low marsh has greater residence time.
- Scale – large size vs. small size marsh networks. Small channels vs. large channels.
- Freshwater input from marsh creek on Emerson parcel.
- Channel shape embedded into larger design on some channel segments.

Measure performance of the following parameters

- Consumption rates
- Growth
- Survival
- Predation

Main hypotheses:

- More food, feeding, and spawning in high residence time environment (low marsh).
- Less predation in low residence time environments (high marsh).

The fish group explicitly did not vary channel density because they assumed more channel edge was better for fish

They included small restoration plots to the importance of channel network scale on fish utilization and channel processes such as velocity.

North end of parcels diked and managed as perennial, non-tidal wetlands with islands for increased bird utilization.

Water Quality Group

The water quality group did not develop a spatial design (drawing) of their proposed restoration. Rather, they proposed an experimental design that would test several cells overlaid on the larger restoration project. The cells would be located in areas with varying conditions to measure rates of meHg and DOC production under different biogeochemical conditions.

There design would test the following uncertainties:

- Which type of habitat (open water, low marsh, or high marsh) produces the most meHG?
- What type of system or environment transfers methyl mercury to the food chain?
- What mechanisms control long and near term transfer of HG.
- Tidal wetting and drying vs. seasonal wetlands.

After the meeting, Cindy Paulson provided a summary water quality hypothesis and uncertainties (Appendix A).

Geomorphic and Vegetative Group

The group focused on designs to test geomorphic and vegetation uncertainties rather than on geomorphic designs to test fish response.

Knobs

- Elevation
- Channel density/orders
- Marsh Creek
- Location and connectivity of various habitat types (open water vs. marsh)
- Pre-cultivation of tules vs. ongoing vegetation.

The group concluded that elevation/plant relationships well understood and thus not important. But the group, at the suggestion of Peter Baye, highlighted the importance of sand vs. peat, pre-vegetation (secondary succession) vs. no planting (primary succession) and micro levees along channel vs. no levees.

The geomorphic groups design conclusions:

- Elevation is the key knob.
- Should test out a design with channel defined by levees constructed in sub-tidal open water environment
- It may be worth testing uncertainties about ponds and panes, but there was doubt regarding their importance.
- Pre-cultivation of tules before tidal inundation will accelerate marsh accretion, maximize area of emergent marsh, decrease area of SAV, and is therefore the recommended course of action.

Hypotheses

Elevation

- Fish community structure and its performance variables (consumption rates, growth, survival, predation) are influenced by the elevation of the marsh plain surface.

- High elevation marsh plains support more small natives because there are fewer predators due to increased wetting and drying, and because more food for small natives.

- Low marsh plain elevation likely to support more growth due to increased residence time, improved access, and higher spring time temperatures.

- Low marsh plain likely to support more splittail spawning than high marsh due to longer duration of inundation during the egg incubation period.

Channel Size and characteristics

- Small drainage areas will support less natives per acre. Numerous mechanisms at play: less habitat options in small drainages . . . ,

- High order channels will have higher residence time which should translate into better food production and consumption rates for fish.

- Channels that dewater (or have very shallow water at low tide) will support more small native fish because conditions will be less favorable for larger predators.

<u>Mesoscale Features – Ponds/Substrate/Channel Shape/Vegetation</u>

Definition: Isolated depressions (not connected to the channel)
Ponds – perennially wet
Panes – intermitantly dry

- Character of high marsh vegetation will be different on sandy dredged spoils than vegetation on native antecedent topography.

- Terminal ponds will increase tidal prism in a small channel and thereby increase velocity which in turn will reduce SAV density.

- Vegetation encroachment is less likely in small channels terminating in ponds then in small channels that do not terminate in ponds. The mechanism is increased tidal prism and associated scour.

- Terminal ponds increase meHG and non-native species. If not sufficiently deep, terminal ponds will be rapidly colonized by emergent vegetation or egeria.

- Isolated depressions in the marsh plain will have higher soil and water salinity levels. Depending on salinity levels, this could impact vegetation type and improve conditions for native SAV

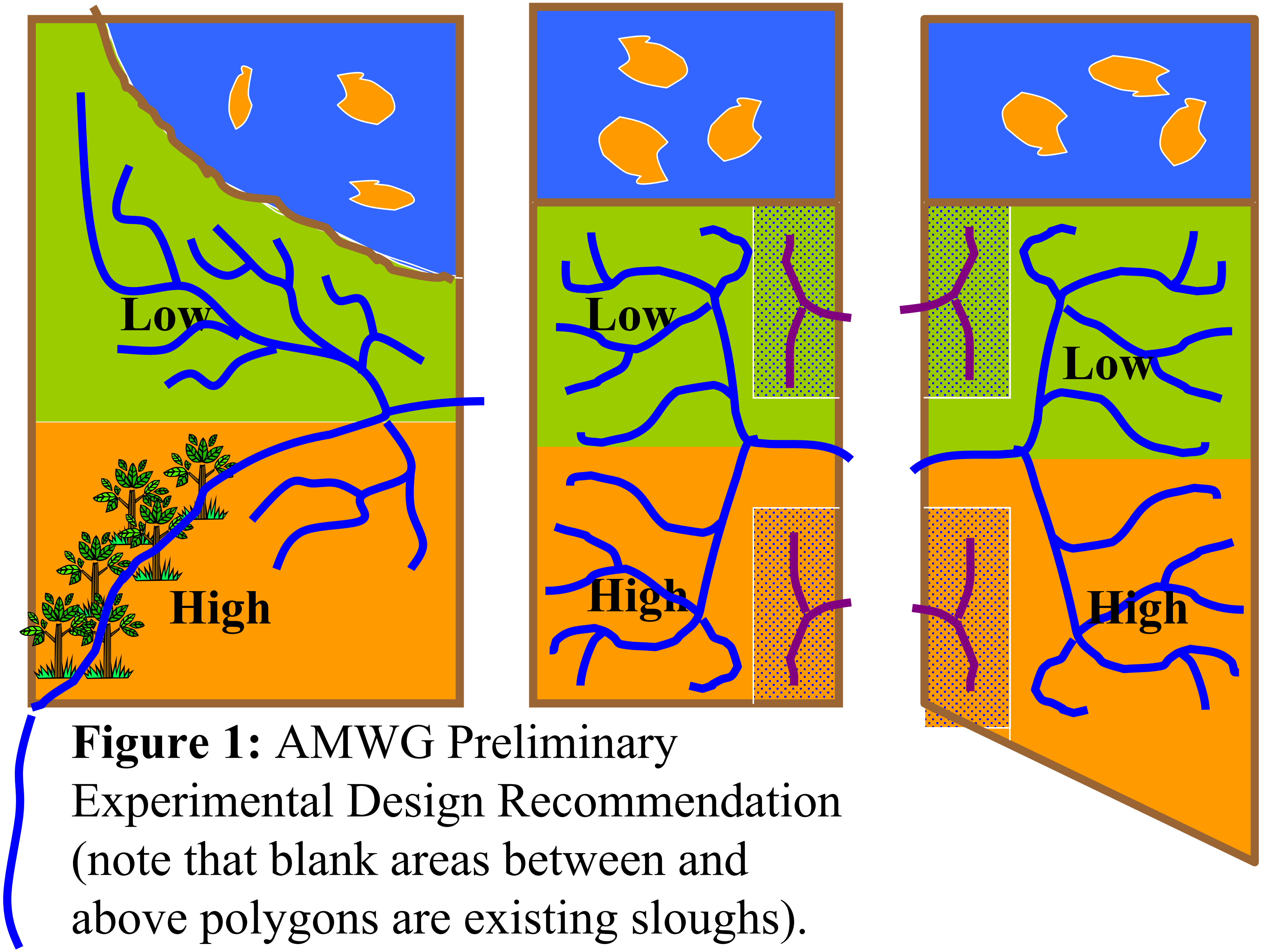
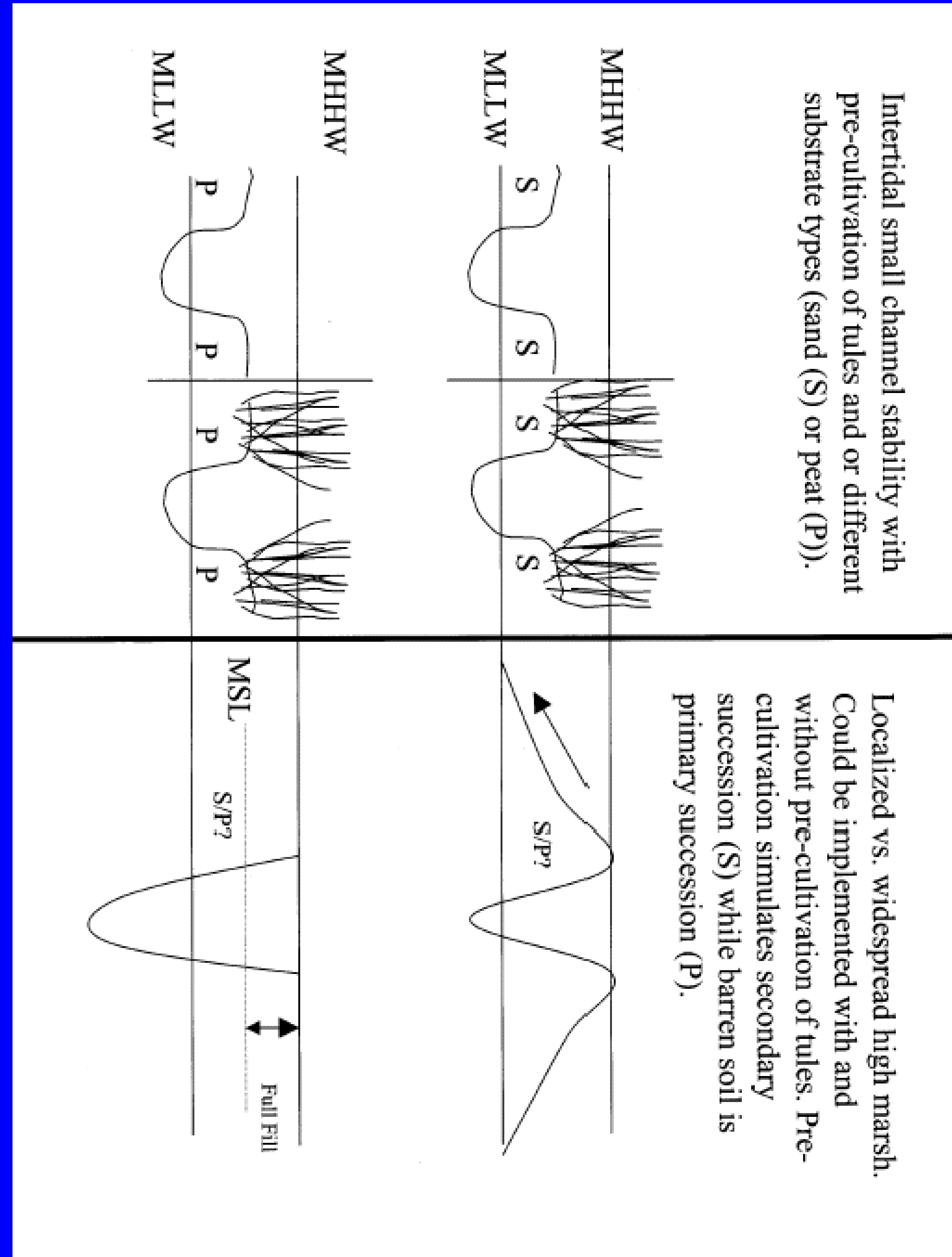


Figure 1: AMWG Preliminary Experimental Design Recommendation (note that blank areas between and above polygons are existing sloughs).

Figure 2: Scheme for testing different channel sections, on different substrates, with differing initial states.



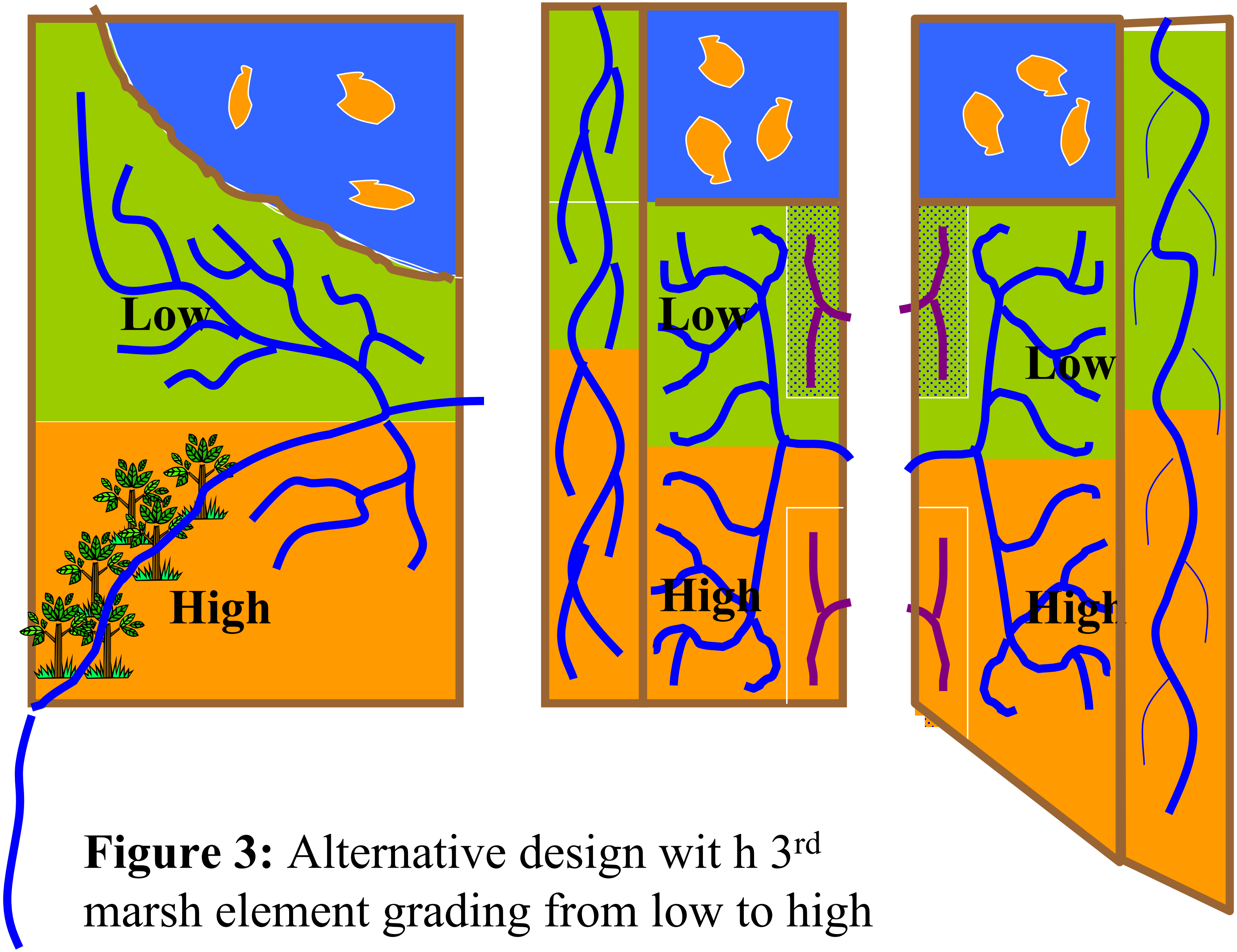


Figure 3: Alternative design wit h 3rd marsh element grading from low to high

APPENDIX A
Dutch Slough Restoration Project
Potential Effects of Restoration on Mercury Methylation and Bioaccumulation and Possible Means to Mitigate Effects

Key Uncertainties and Tentative Hypotheses to be Tested
December 7, 2004 – Final Draft

On October 20, 2004, members of the Dutch Slough Restoration Project Adaptive Management Work Group met to discuss design considerations for this project. During this meeting, the water quality break-out group (David Sedlack of the University of California, Berkeley, Roger Fuji of the United States Geological Survey, and Cindy Paulson and Jason Grant of Brown and Caldwell) focused on issues surrounding methylmercury. It was decided that water quality should not be used so much as a restoration design component as a consideration for design refinement and testing through adaptive management. The intent is to evaluate water quality during the restoration process in small-scale experimental plots throughout the project area. Five primary tentative hypotheses related to uncertainties in water quality issues are presented below.

<u>Uncertainty No 1:</u> Do **methylmercury production rates** vary with the type of restoration environment?
<u>Tentative Hypothesis No 1:</u> The Dutch Slough Restoration project will increase methylmercury production within the project area, unless otherwise mitigated.

Previous research has indicated that methylmercury production is enhanced in wetland ecosystems. Therefore, it is hypothesized that the Dutch Slough Restoration Project will increase methylmercury production within the project area. However, it is unknown which of the three tidal marsh sub-habitats to be restored (open water, high marsh or low marsh) yields the greatest methylmercury production rates. The experimental plots to be incorporated into the restoration design could be used to test the various mechanisms thought to be involved with methylmercury production, including: the wetting/drying cycle area, tidal-marsh elevation and vegetative type.

<u>Uncertainty No. 2:</u> Can soil **substrate** adaptive management measures reduce methylmercury production rates?
<u>Tentative Hypothesis No 2:</u> Soil substrates used to construct the restored wetlands could be modified to minimize methylmercury production.

Limited data are available regarding the range of mercury concentrations present within the Dutch Slough area soils. During the restoration process, samples could be collected from the foundation soil (either in-situ or imported) and analyzed for total and methyl mercury. Sediment samples could also be analyzed for reactive mercury. It is hypothesized that adaptive management measures could be undertaken in the experimental plots to isolate soil with elevated mercury concentrations from biological pathways, thereby reducing methylmercury production (e.g., capping contaminated soils with clean sediment). In addition, soil amendments could be added to experimental plots to evaluate mitigative effects (e.g., iron or gypsum). Data collected from the experimental plots could be compared with one another and with data generated from sampling conducted from the general restoration area to evaluate the respective impact on methylmercury production.

Uncertainty No. 3: What is the effect of **Marsh Creek** versus **other mercury sources** on mercury/methylmercury levels?

Tentative Hypothesis No. 3: The use of Marsh Creek water will not significantly increase the mercury/methylmercury levels within the area to be restored in the Dutch Slough project.

Marsh Creek will likely be used as the fresh water source for the Dutch Slough Restoration Project. It is hypothesized that loads of mercury and/or methylmercury from Marsh Creek will not significantly affect mercury/methylmercury levels within the restored tidal marsh habitat. However, the contribution and ecosystem impact of these loads as compared with other mercury sources for the project area are unknown. Experimental plots could be situated within the riparian habitat of the Marsh Creek inflow to determine if these loads are impacting the surrounding habitat at similar or elevated rates during the restoration process, and possibly continuing once restoration has been completed.

Uncertainty No 4: What are the mechanisms that can be controlled within restored wetlands to limit or mitigate methylmercury **bioaccumulation**?

Tentative Hypothesis No 4: Methylmercury bioaccumulation can be limited and/or mitigated through the selection of appropriate design criteria.

The bioaccumulation of methylmercury into and up the food chain is of concern due to the adverse effects associated with the health of fish and birds. Regulatory threshold levels of mercury/methylmercury to mitigate this concern are not yet well defined. The scientific understanding of the mechanisms controlling methylmercury bioaccumulation is also still emerging. One possible mechanism that could be controlled may be the degree of wetting/drying, particularly to minimize water edges. Biota samples of target species could possibly be collected throughout the tidal marsh and analyzed for methylmercury levels to assess the overall ecosystem mercury impact. However, bioaccumulation rates are difficult to pinpoint to localized tidal marsh sub-habitats due to the mobility of the biological receptors.

Uncertainty No. 5: What is the magnitude of the methylmercury **mass flux** created from this size and type of wetland restoration project?

Tentative Hypothesis No. 5: The Dutch Slough Restoration Project will increase the mass flux of methylmercury into the greater Bay-Delta.

Because methylmercury production is generally enhanced in restored wetlands, there is concern about overall effects of restoration on mercury levels in the area. It is hypothesized that the Dutch Slough Restoration Project will increase the mass flux of methylmercury to the greater San Francisco Bay-Delta. However, the magnitude and overall contribution of this flux is unknown and the variability of fluxes among different sub-habitat types is also unknown. The net mass flux of methylmercury could be monitored in the water entering and leaving the tidal marsh, and possibly various sub-habitats, during the restoration project and after restoration has been completed. The magnitude of this flux could possibly be extrapolated to other Bay-Delta wetland restoration projects to assess potential cumulative effects.