Attachment C

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TECHNICAL MEMORANDUM

DATE: July 29, 2005

TO: Barbara Salzman

COMPANY: MAS

FROM: Don Danmeier

RE: Bahia Wetland Restoration Project
Summary of Changes to Preliminary Design of September 2004

PWA Ref. #: 1689.00

This memorandum summarizes changes to the preliminary design for the Bahia Wetland Restoration Project described in the Preliminary Design Report (administrative draft) dated September 23, 2004. Further consideration of constructability and implementation costs, as well as additional consultation with Marin Audubon Society, has resulted in changes to several features. Revisions to the September 2004 design are described below and shown in the attached figures, which show schematic cross sections and preliminary dimensions.

- Revised excavation of starter channels and berms. The proposed preliminary design includes excavation of 'starter' channels in the baylands to facilitate development of a dendritic drainage network over time and to provide drainage at low tide when shallow water friction may otherwise lead to areas of ponding. Complete drainage will encourage vegetation establishment, limit the time when wave agitation may inhibit sedimentation, and disturb mosquito breeding. Excavation of channels in Central Bahia and Mahoney Spur is important since material in these baylands consist of dewatered dredge material that is expected to be resistant to erosion relative to material deposited in antecedent channels through estuarine sedimentation. Channel excavation in Mahoney Spur is especially beneficial since the higher bed elevation there reduces the likelihood of dendritic channel network forming naturally (remnant channels are absent in Central Bahia and Mahoney Spur).

  Based on a desire to increase the complexity of the channel system while reducing construction costs, we have revised the channel layout and cross sections of the starter channels. The revised design include a more sinuous channel system but less volume of excavated material (on a linear foot basis). Full-size channel sections will be excavated to breach dimensions immediately inboard of the perimeter levee and then reduce in size to a 'T'-section. The top and wide portion of the channel will be constructed with a conventional excavator, while a rotary ditcher is used to cut the lower portion. Material excavated from conventional equipment will be placed within the

reach of the excavator to construct 'uncontrolled' berms near the starter channels. These features will increase high tide refuge in the interior of the baylands as well as train tidal flows along the desired path. Berm elevations shall be no greater than +6.0 ft NAVD. The placed material will be derived from construction of the larger trapezoidal starter channels and the top part of the smaller T-section channels. Material excavated by the rotary ditcher will be dispersed over the adjacent grade.

- Fewer Levee breaches and reduced pilot (outboard) channels. As part of the Phase 1 restoration, three breaches (instead of four) will be constructed through the perimeter levee to allow daily tidal action to Mahoney Spur and Central Bahia. These breaches have been sized to drain Central Bahia and Mahoney Spur, as well as a portion of the West Bahia tidal prism. This breach plan differs from the September 2004 design to avoid impacts to the marshes owned by the Bahia Homeowners Association.

  Hydraulic geometry relationships have been used to determine the equilibrium dimensions of breaches based on the expected long-term conditions. To simplify the project description, the preliminary design of these three breaches was adjusted slightly from their equilibrium geometry to have the same dimensions. For ease of construction, we have made bottom elevations and widths consistent for all Phase 1 breaches, with 3:1 (horizontal:vertical) or flatter side-slopes. The breach excavation will extend into the outboard marsh approximately 50 ft. Some tidal scour is expected along the sides and bottoms of the constructed breaches since the initial tidal prism is greater than the long-term value. However, we do not expect tide range to be muted or exchange limited.

  Pilot channels will be excavated through the existing tidal marsh between the banks of Black John Slough and the HOA channel to facilitate tidal exchange. These elements are intended to avoid delays in site evolution associated with the time required to naturally scour a connection between the breached bayland and adjacent tidal sloughs. To reduce potential impacts to California clapper rail habitat, the outboard pilot channels will be cut at least 50 ft away from existing tidal creeks in the fringe marsh. In addition to the pilot channels on the outboard side of Breaches CB, MS1 and MS2, a small pilot channel will be constructed on the outboard side of Breach WB2 to enhance tidal flows from the flow control structure to Black John Slough. (Breach WB2 will be constructed in Phase 2.)

  We recommend constructing pilot channels with the same cross-section as the adjacent levee breach to avoid muting of the tidal range. However, a much smaller pilot channel (depth ≈ 5 ft; bottom width ≈ 1.5 ft) may be constructed to reduce impacts to existing biological resources and reduce implementation costs. The small pilot channel will facilitate scour to the larger equilibrium channel size by removing erosion-resistant vegetation and initiating a flow path. We expect the smaller pilot channel to limit tidal exchange and reduce the tide range inside the

baylands until scour enlarges the channel to its equilibrium size. In the absence of any pilot channel construction, levee breaches will be located as close as possible to existing tidal creeks in the fringe marsh and natural tidal scour will gradually increase channel depth and width until equilibrium is reached. (This would slow down development of a vegetate marsh and reduce the tide range inside the breached baylands until existing tidal creeks are enlarged.)

- West Bahia culvert (Phase 1) and breaches (Phase 2). A flow control structure (i.e. one or more culverts with gates) and continuing overtopping at low section of the existing perimeter levee will provide muted tidal action to West Bahia during Phase 1. The flow control structures will be replaced by a full-size levee breaches as part of implementation of Phase 2. During the interim (between implementation of Phases 1 and 2), this element will sustain a muted tide hydrology in West Bahia and initiate tidal scour along the pilot channel at WB2 and along Black John Slough.

  Installation of a 48-inch corrugated metal pipe with slide and flap gates is recommended at WB2 subject to revision during final design. The non-adjustable gate will direct discharge form the bayland to the undersized pilot channel, providing tidal scour along the inlet channel prior to implementation of Phase 2. (Installation of additional culverts at other locations was considered but ultimately rejected due to prohibitive construction costs. Although multiple culverts would increase the circulation prior to implementation of Phase 2.) The construction of a singe flow control structure at WB2 will still improve drainage and reduce the level of existing mosquito production in West Bahia. One or more additional culverts may be installed at WB1 to enhance drainage of West Bahia.

  Implementation of Phase 2 will occur adaptively, based on monitoring data collected from Black John Slough, and consists of excavating full-size breaches at the locations along the perimeter levee. These full-size breaches have been sized based on the predicted long-term equilibrium dimensions assuming that flow is equally distributed through the four breaches. As in the Phase 1 breaches, trapezoidal breaches will be excavated for ease of construction. The breach excavation will extend into the outboard marsh approximately 50 ft.

- Reduced earthwork along the transitional habitat. The side-slope of the band of upland/wetland transitional habitat has been changes from 20:1 to 10:1 in order to reduce the amount of material that is transported away from the RV lot. The reduced project includes placing the majority of excavated material adjacent to the RV lot in order to reduce trucking costs (we have assumed the unit cost for marshplain excavation and onsite placement provided for peninsula work). This change will result in a steeper slope along the band of transitional habitat and greater extent of vegetation benches along the southeast corner of Central Bahia.

- Fill Placement to Accelerate Marsh Vegetation. In order to accelerate rapid establishment of tidal marsh habitat in areas close to existing populations of California clapper rail or SMHM habitat,

the preliminary design includes construction of broad areas at elevations suitable for immediate colonization of vegetation as well as expanded areas that gently slope up to lowered levees. Areas of fill placement have been selected based on existing high grades – where the aerial extent of marsh habitat per cubic yard of imported fill is maximum – or their proximity to valuable rail or SMHM habitat.

Earth excavated from the RV lot and/or imported from the western peninsula will be placed to construct broad benches with gently slopes between +3.5 ft NAVD (approximately mean tide level) and +6.0 ft NAVD (slightly below MHHW) in order to increase the area within the bayland available for rapid colonization of marsh vegetation. Small channels (depth ~ 3 ft, bottom width ~ 1.5 ft) shall be cut to enhance ecological value for California clapper rail habitat.

- Eliminations of West Bahia fetch breaks. Due to high costs and difficulties associated with construction these elements in the relatively low and ponded West Bahia bayland, fetch breaks have been eliminated from the design.

- Restoration Actions at the East Bahia Peninsulas. Restoration actions at the East Bahia site have been incorporated into the restoration design at the West Bahia site by defining grading plans and volumes. Excavation by land-based equipment will restore tidal wetland habitat and enhance seasonal wetland values at the peninsulas, as well as provide fill for construction of 'vegetation benches' at the West Bahia project site (see above). Extent of marshplain excavation at the peninsulas is mostly constrained by construction costs. Since the dewatered fill material is expected to be resistant to tidal scour, relative to deposits of natural estuarine sedimentation, starter channels will be constructed at the time of marshplain excavation.

  The existing surface of the Western and Eastern Peninsulas will be lowered to an average of +5.3 ft NAVD, approximately 1 ft below natural marsh elevations. Grades of the new marsh surface will slope down towards the constructed channels, so actual elevations are likely to be between 0.5 and 1.0 ft below MHHW with a half-foot vertical tolerance.

  On the Western Peninsula a levee would be constructed along the PGE easement, wide enough to allow truck access and avoiding the power towers. Crest elevation will be increased to approximately +10.5 ft NAVD to maintain existing flood protection from extreme events to the HOA lagoon with an allowance for subsidence and sea level rise. The slopes of the levee crest to the new marsh would vary between 10:1 and 15:1 to create an undulating upland edge to the marsh and to define drainage areas for the new marsh.

  On the East Peninsula the outer levee would be removed. The existing inner levee elevation (approx. +13 ft NAVD), which is higher than the outer levee, will be maintained. The slope to the new marsh would vary between 10:1 and 15:1 to create an undulating upland edge.

The Central Peninsula will be converted to tidal/seasonal wetlands and uplands, where high areas will be inundated only on extreme tides. This would continue the shallow 1:10 to 1:20 slopes used along the levees to provide transitional habitat along the inside of the central peninsula. Material would be re-graded within the Central Peninsula to allow a tidal connection to the East Peninsula. This alternative would result in a long gradual transition between tidal and seasonal wetland along the Central Peninsula. The seasonal wetland in this transitional area will be partly sustained by infrequent high tides.

Material generated by excavation at the Central and East Peninsulas will be placed on-site, either along levees and transitional zones or along the upland areas immediately south of the peninsulas that is owned by MAS.

- Vegetation Management. A Vegetation Management Plan has been developed by the project ecologist and will be incorporated into the final design as appropriate. Many of the elements described in the VMP have already been integrated into to preliminary design (e.g., side-casting of material during starter channel excavation to build berms). Construction of marsh nuclei clusters may also be feasible since minimal earthwork is expected. Other portions of the VMP are currently being reviewed in order to assess how they may be incorporated into the design, construction budget and implementation schedule.