Science Synthesis for Key Science Issue 10:
"Minimizing The Negative Ecosystem Effects of Infrastructure Related Effects
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1. What is the importance of the issue as it relates to the Project objectives?

The restoration project site is in the vicinity of urban development and several infrastructure facilities. This infrastructure includes power towers, flood control levees, waste water treatment plants, and road/railroad bridges. It will be important to ensure that the services provided by these infrastructure facilities continue unimpeded, and that potential conflicts do not occur between likely restoration actions and the continued presence of the infrastructure facility.

Most of the restoration options being considered for the project will involve changes in hydrology and circulation, albeit to varying degrees. This implies that infrastructure facilities may be affected to some degree, which will require mitigation (for example levees may need to be raised due to changes in water levels, or power tower foundations may require modifications due to corrosion issues). Restoration actions should be developed that minimize the need for these improvements, because they will represent a significant capital expense.

The primary infrastructure-related functions that will influence restoration actions are flood protection (levees may need to be raised) and treatment plant outflows (lower salinity regime near the outfalls).

Flood Protection

Since the existing levees are founded on poor soils, and built from the poor native soils, raising the levees will typically involve flattening the bayward side slopes by placing material as a buttress on the existing slope and along the top of the levee. To make this operation cost efficient, it is likely that the required material will come from the ponds themselves, by excavating borrow areas at some distance from the toe of levees. The restoration option therefore will need to incorporate the deeper borrow areas as well as the new material along the side slopes within the project design.

The New Chicago Marsh is a low tidal marsh that is managed by culverts and gates, which will also need flood protection. Therefore, restoration options for adjacent ponds may be driven by the need to protect this marsh in-place.

Treatment Plant Outflows

Outflows from the San Jose-Santa Clara Water Pollution Control Plant (WPCP) and Sunnyvale WPCP influence salinities in the tidal sloughs where the plants discharge (Artesian Slough and Moffett Channel). This is evidenced by the predominantly freshwater habitat in the upper reaches of Artesian Slough and near the Sunnyvale WPCP discharge point in Moffett Channel. Restoration options for the ponds along these sloughs should incorporate these characteristics within the project design.

Other Infrastructure

Other structures which may influence the restoration options include PG&E's transmission towers to which unimpeded maintenance access needs to continue, and railroad and road bridge foundations which should not be compromised by increased scour related to tidal prism induced changes in velocities.

2. What do we know about this issue as it relates to the Project?

Flood Protection

Existing levels of flood protection in the proposed restoration area are not adequately documented or analyzed, primarily because water levels and levee elevations were managed by Cargill based on salt-making operations and ongoing settlement. Also, several of their levees used to function as interior pond levees rather than flood protection levees.

Sources of available information include the Shoreline Erosion Study (USACE 1987), and studies related to flood management (Moffatt & Nichol, 2004a, 2004b, SCVWD Flood Insurance Studies). The data indicate that most of the levees separating the salt ponds from the urban development will need to be raised if tidal marsh restoration is envisioned (Moffatt & Nichol, 2004a). Along the sloughs themselves, most of the levees are high enough to provide protection from storm-related flows, which are typically higher than extreme tides (Moffatt & Nichol, 2004b). However, they may still need protection from flow-related erosion and scour.

Costs for improving the levees will significantly influence the type of restoration action for most of the ponds and/or the prioritization of restoration actions. A large component of these costs are finding suitable material to build the levees with. Concept level costs for levee improvements, assuming full tidal restoration, are presented in the Moffatt & Nichol study (2004a).

Treatment Plant Outflows

Operations of both treatment plants are regulated by NPDES permits, and have monitoring requirements that require stringent compliance. Data are collected daily and reported on a monthly basis per the NPDES permit, and are available through the Water Board. Recent studies on potential impacts to habitat in the vicinity of the San Jose WPCP are also available (Harvey & Associates, 2002). These data can be used to develop appropriate restoration actions for the ponds in the vicinity of the outfalls. The criteria most affected by the outflows are breach locations and the target species (saline versus brackish habitat type).

Other Infrastructure

If water levels change within a pond due to a restoration option, some modifications to the access ramps that provide continuous maintenance access to the transmission towers may be required. If water levels are anticipated to increase, the foundations may also need improvements to prevent corrosion related effects. Costs to provide these

improvements will be part of the implementation, and may influence the ultimate option or phasing of the restoration.

Significant increases in tidal prism in a slough typically result in increases in peak velocities. The channel bed typically scours out as a result of this increase in velocity. If structures such as bridges or culverts are present across these sloughs, their foundations may experience scour near the bed of the slough. Changes are not expected to be significant for most of the road bridges, because they are upstream of most of the ponds and the channel there may experience a modest increase in velocity, which can be addressed by protecting the foundation. Similarly, the Southern Pacific railroad bridge across Coyote Creek, and most of the pedestrian bridges across the smaller sloughs may have to be protected. Although the costs to protect these structures are not expected to be significant, the presence of these structures may influence the restoration option itself.

3. What is the level of certainty of our knowledge?

Existing studies and analyses of flood protection, albeit limited, indicates that the interior levees are not adequate to provide the necessary level of flood protection. The level of improvements will depend largely on the type of restoration action selected for each of the ponds. For any of the managed pond options (water levels are managed to maximize shorebird use) the implication is that the existing bayfront levees will need to be maintained for flood protection, just as Cargill has been maintaining the levees. Therefore, there is a strong relationship between type of restoration option and costs for levee improvements.

The treatment plant outfalls have also been in place for several years and monitoring results indicate that there is a strong relationship between the flows and habitat type in the receiving sloughs. Monitoring for restored projects at Warm Springs and others in the study area is also an important source of information related to habitat type and effects of salinity.

The following factors are important in evaluating certainties and uncertainties:

- Duration and frequency of monitoring data;
- Geographical extent of locations that are monitored;
- Number of projects in the South Bay region that have been analyzed and that are in agreement with each other (e.g., City of San Jose monitoring and modeling efforts, ISP for the ponds, and studies by SCVWD, USGS, and Stanford);
- Effects of watershed hydrology (Bay-wide as well as local) relative to treatment plants;
- Future urbanization in the area which would affect infrastructure size and location.

4. What predictive tools exist for gaining an understanding of this issue and what tools are needed to reduce uncertainty to an acceptable level?

Predictive tools are used widely in ecological restoration projects. A main strength of predictive measures, such as empirical analyses (based on field data and observations) and computer models, is their ability to simulate (to various levels of accuracy) the effects of potential restoration actions.

Several reports including the following have summarized available and/or required tools for predictive analysis.

- South Bay Salt Pond reports (Moffatt & Nichol, 2004c)
- Stanford research (salinity, primary productivity, etc.)
- USGS projects (sediment budget, wind wave resuspension)
- Cargill ISP work
- Science Team comments on consultant work products

5. What are the potential restoration targets and performance standards linked to the objectives for evaluating the progress of the restoration project?

Infrastructure effects can be considered as constraints, and as such need to be addressed in the restoration design. The restoration target is to ensure that the services provided by this infrastructure are not compromised. Performance measures, which are metrics used to assess progress towards the restoration target(s), should come from Issues 3, 4, 5, and 6.

Measures to minimize potential negative impacts to the restoration project include the following:

- Adaptive management of channel geometry and configuration (adjust breaches),
- Locating levee breeches where impacts are minimized,
- Selection of appropriate pond/control structure design features.

6. What key questions essential to the success of the restoration need to be addressed through further studies, monitoring, or research?

A priority area of research related to the infrastructure issues includes the effects of treatment plant outflows on habitat (geographic range and habitat response). This is essential to the success of the restoration project in light of its potential impact to the local sloughs. Implementing a monitoring program tailored towards achieving project objectives is essential to reducing uncertainty in restoration activities. Ongoing monitoring efforts include the following:

- on-going ISP monitoring (SFRWQCB)
- other compliance-related monitoring data (WWTPs, RMP, County General Permit required, etc)