THREE MONTH POST-TRANSPLANT EELGRASS SURVEY CHANNEL SHOALS

MISSION BAY

Prepared for:

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THREE MONTH POST-TRANSPLANT EELGRASS SURVEY OF CHANNEL SHOALS MISSION BAY, SAN DIEGO

INTRODUCTION

On 19 April 1995, MBC Applied Environmental Sciences (MBC) and their subcontractor, Merkel and Associates (M&A), contracted with the City of San Diego Parks and Recreation Department (City) to assist with the Phase 1 and Phase 2 Shoreline Stabilization Projects. To ensure compliance with regulatory provisions, MBC and M&A were to assist the City with monitoring shoreline stabilization construction activities and dredge operations at Mission Bay. Assistance and monitoring was to consist of interacting with the regulatory agencies on behalf of the City, procurement of needed permits, and pre- and post-construction mapping and reporting on the eelgrass resources. After stabilization activities and dredging had been completed, eelgrass (*Zostera marina*) was to be transplanted to those locations impacted by the stabilization construction and dredge operations which resulted in a loss of eelgrass resources.

The City was obligated by regulatory requirements to replace lost eelgrass at a ratio of 1.2 ft^2 transplanted for every 1.0 ft^2 lost. The City had previously negotiated an agreement with the regulatory agencies for the City to set up a banking system whereby any excess eelgrass planted beyond their regulatory requirements (to be calculated at five years post-transplant) could be used to offset the loss of eelgrass from future construction or dredge projects.

The Channel Shoals site had been previously surveyed for eelgrass coverage on 28 December 1994. Dredging began at the Channel Shoals site on 19 March 1996 and continued through 15 April 1996. The area impacted by the dredging was 1.42 hectares (3.52 acres); however, the path of the dredge operations resulted in the loss of only 0.22 hectare (0.54 acre) of eelgrass habitat. As a result of the dredging, the City had a 0.26 hectare (0.65 acre) eelgrass transplant obligation; however, because they desired to bank excess eelgrass production, the City authorized a total transplant of 1.42 hectares of eelgrass to the Channel Shoals area of Mission Bay during the period from 10 May to 28 May 1996.

During the pre-transplant survey, the Channel Shoals area was arbitrarily divided into two sites and designated CS1 and CS2 (Figure 1). It was determined that the outlined area of CS2 totaled 4,907 m^2 (0.49 hectare) and was 233 m in length. Mitigation site CS1 totaled 9,347 m^2 (0.93 hectare) and was 391 m in length for a total of 14,254 m^2 or 1.42 hectares.

METHODS

On 27 August 1996, biologist-divers located the eelgrass mitigation areas of Channel Shoals using Differential-Global Positioning System (D-GPS) and yellow polypropylene reference lines secured to the bottom during transplant operations. These reference lines were used to facilitate the transplant and were left in place to exactly relocate the site during subsequent surveys.

These reference lines outlined 25 sections on one path (Channel Shoals 1 = CS1) and 16 on the other path (Channel Shoals 2 = CS2) for a total of 41 sections, each within the footprint of the dredge area.

Biologist-divers surveyed each section of the eelgrass transplant using tape measures, grid lines, and 0.125 m^2 quadrats to measure eelgrass turion density and areal coverage.

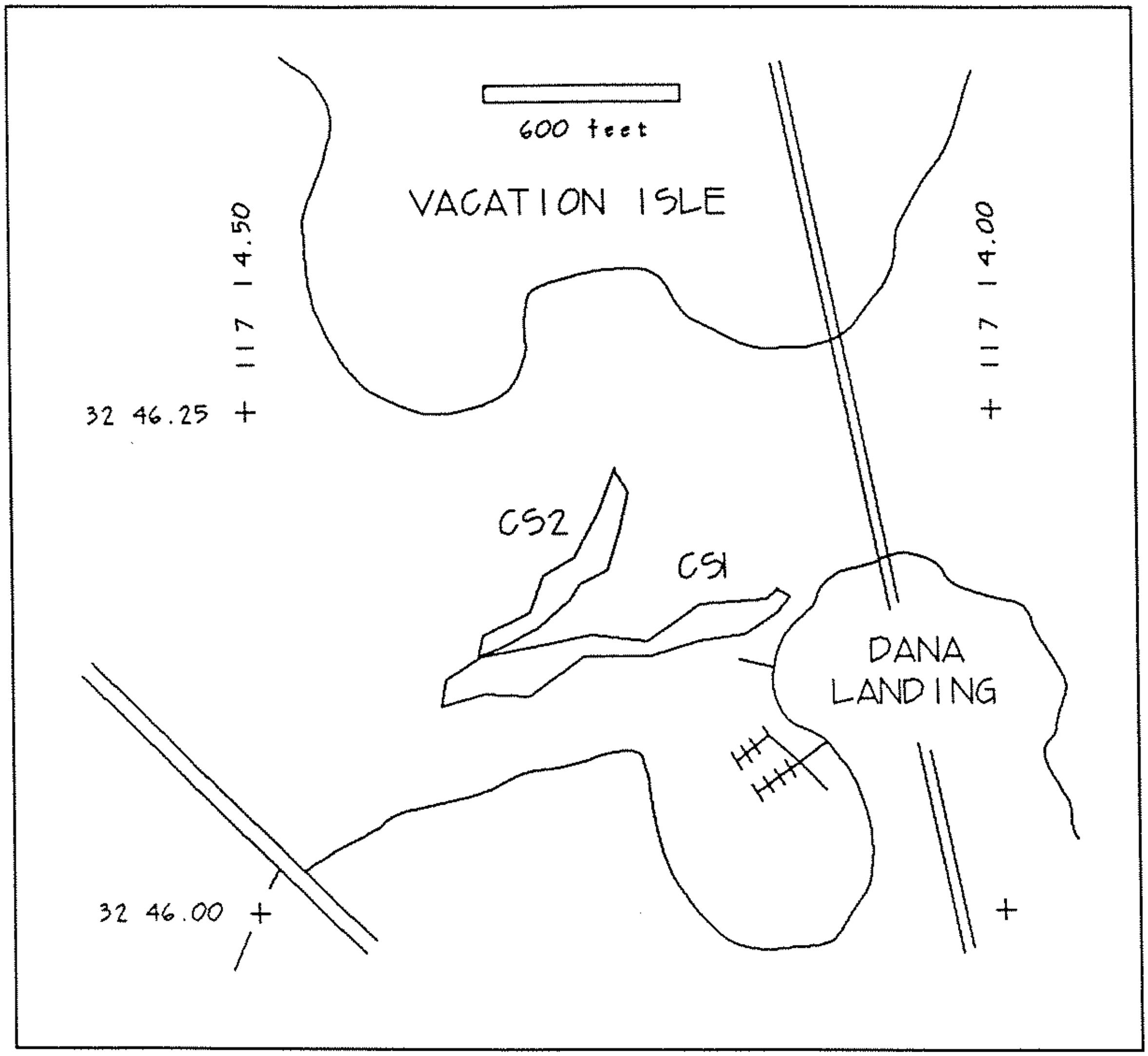

Figure 1. Location of Channel Shoals eelgrass mitigation transplant site.

Calculation of total area vegetated was determined by recording missing turion bundles or area covered by eelgrass along three transects of three to four meters width along the length of the transplant sites. The area covered by the three transects was 5,935 m^2 and the area of the 41 sections was 14,254 m^2, resulting in a survey of approximately 42% of the mitigation site area. Assuming an area of 1 m^2 per missing bundle, total missing bundles for the transects were extrapolated to the total transplant area to determine the total missing bundles and area unvegetated.

Turion density determinations at the mitigation site for the three-month survey were non-random because the area coverage of most of the individual turion bundles was still less than 0.125 m^2 or less than 12.5% of the area. Randomly placed quadrats would have elicited little meaningful information on the growth of the turions in the bundles, as the chance of including a turion would be low. Therefore, eelgrass bundles representative of the area, as determined by each biologist-diver, were selected for density counts which were reported as turions per m^2. In total, 38 determinations of density were recorded throughout the mitigation transplant site.

A control eelgrass bed located adjacent and parallel to the transplant site was compared to the transplanted bed, to allow biologists to evaluate any potential fluctuations in the status of the transplanted bed caused by changing environmental conditions.

Turion densities were recorded every 10 m along four 50-m transects through the control bed. These quadrats were randomly placed, with the exception that, if the area was unvegetated, the quadrat was moved to the nearest vegetated area. Barren areas along each transect were also noted for determination of eelgrass areal coverage.

RESULTS

The three month monitoring survey (3-Month) determined that the transplanted area had lost a considerable amount of eelgrass. Of the 14,354 turion bundles planted in the 1.42 hectares site, approximately 6,741 (47%) were still in place and growing and about 7,613 (53%) bundles were missing (Table 1). Losses were not uniform over all 41 sections in the two areas of the transplant. Large sections of CS1 were virtually denuded of vegetation, whereas equally large sections of CS2 were intact and functioning well. The success rate of CS1 was 21.3% while that of CS2 was 88.4%.

Table 1. Channel Shoals eelgrass transplant area, percent survival, density, and other survey parameters.

Date:	July 1996		September 1996	
Survey Type:	Initial		3 month	
Parameter / Area:	hectares	(acres)	hectares	(acres)
Transplanted area	1.42	(3.52)	1.42	(3.52)
Survey coverage	1.42	(3.52)	0.67	(1.65)
Loss of coverage	0	(0)	0.75	(1.87)
Percent survival (%)	100		47.0	
Transplant turion density (m^2)	12.1		9.3	
Areal loss of eelgrass coverage due to construction	0.22	(0.54)	0.22	(0.54)
Required mitigation area	0.26	(0.65)	0.26	(0.65)
Area available for banking	1.16	(2.87)	0.40	(1.00)
Average control bed density (m^2)	219		218	
Average control bed coverage (%)	84		91	

Non-random, focused sampling for turion densities was accomplished at 38 locations throughout the transplant sections (Table 2). These samples indicated that the initial planting densities had decreased from 12.1 to 9.3 turions per 0.125 m^2, a reduction of approximately 23%. Where eelgrass survived, densities of individual turion bundles were not uniform and ranged from two to 21 surviving shoots per turion bundle.

Control eelgrass bed turion densities averaged 27.2 turions per 0.125 m^2 and ranged from 14 to 42 turions per 0.125 m^2 (Table 3). Coverage ranged between 43 and 49 m per 50 m transect and averaged 45.5 m per 50 m transect.

DISCUSSION

The observed pattern of eelgrass growth appears to indicate that tidal currents in the main channel are responsible for the losses noted. The bulk of the area with missing eelgrass was within the 371-m-long and 18- to 45-m-wide mitigation site (CS1) parallel to the main channel and was mostly restricted to the first 157 m of the upchannel portion of the site. Of note, the 223-m-long site (CS2) situated at approximately 45° to the main mitigation site was progressing very well with close to a 90% survival rate.

No current velocity studies were conducted, but observations by the biologists indicated that the currents were substantially stronger in the third of the channel adjacent to the Dana Harbor entrance than in the two-thirds of the channel situated adjacent to Vacation Island. It also appears that the currents are not as strong at the south end of the channel nearest the harbor entrance, possibly contributing to the greater success noted at that location.

Table 2. Transplant densities per eelgrass bundle.

Density (m^2)						Mean
8	10	4	19	4	21	
12	9	8	8	2	7	
19	14	12	6	13	15	
11	8	8	7	3		
3	10	10	8	3		
5	7	8	7	14		
11	5	14	12	10		9.34

Table 3. Control bed turion densities per 0.125 m^2 and coverage per 50 m.

Control Bed Density (0.125m^2)				Mean
32	30	31	37	
39	28	17	18	
14	27	25		
27	14	32		
19	42	31		
16	36	29		
Length of 50 m transect vegetated (m)				
43.0	46.0	49.0	44.0	45.5

Direct observations of the sediments indicate that in the area with the greatest losses, sediment grain size was much coarser than at the distal end and at mitigation site CS2 where success was greater. A large portion (approximately 55%) of the area transplanted had coarse sandy soil, while the remainder of the area was fine sand. The coarse, sandy soil was loose which is indicative of high current regimes; despite this, eelgrass continues to grow vigorously under these conditions on isolated banks within and fringing the channel, indicating that the area can support eelgrass beds. Failure appears to be due to the inability of the turion bundles to remain anchored. The sand placed around each bundle was slowly excavated away by the winnowing action of the current until each of the individual anchor systems failed. The problem remains on how to overcome this and accomplish the objective of stabilizing the sand. The transplant techniques were obviously ineffective with the combination of loose, coarse sand and high currents encountered at this site. Growing substantial amounts of eelgrass at the CS1 channel site appears problematic, as the techniques utilized are the best available at this time. Eelgrass is surviving in a few small areas, therefore it may be possible to enhance these areas at a later date.

Turion bundles that survived the currents are growing and a large portion (>30%) were larger than when planted and were thriving. Although the six-month survey will occur as days are becoming shorter and growth slows, it should serve to determine the progress of the transplant. If the initial observations of loss at the three-month juncture are the nadir for eelgrass growth at this site, as we conjecture, then the transplant will stabilize, survive, and slowly regain area, albeit at a lower areal coverage than planted.

CONCLUSION

The transplant effort has resulted in mixed success. It appears that the coarser sediment areas of the transplant will not be able to sustain large eelgrass meadows. However, it may be possible for the remaining established eelgrass turions to slowly form eelgrass islands in several locations. This colonization could be enhanced at a later date.

Our recommendations are that the site be allowed to develop until the one-year survey and then its potential as an eelgrass banking resource be reassessed. No remedial measures are necessary at this juncture, as the remaining eelgrass should be allowed time to stabilize the sediments in order to have a reasonable chance for success. The areal coverage of eelgrass at the site is still far in excess of regulatory requirements, allowing a very good buffer and a potential for banking credits.