City of Solana Beach

Draft Land Lease / Recreation Fee Study

Revised July 2010

CIC Research, Inc

PMC®

CITY OF SOLANA BEACH

DRAFT
LAND LEASE/RECREATION
FEE STUDY

REVISED JULY 2010

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INTRODUCTION TO THE REVISED REPORT

In providing the copies of the original survey forms and electronic data to City staff and interested parties in May 2010, PMC began re-creating spreadsheets in excel to replicate the work of CIC. During this process, PMC and CIC discovered several errors which are outlined below. In response, PMC requested that CIC perform a data validation and provide new calculations and results. PMC separately validated the results.[1] The following report, corrected and revised, reflects a Land Lease/Recreation Fee of $3,100 per linear foot, an increase of 25% over the figure of $2,471 per linear foot initially presented at the April 2010 City Council meeting.

The major corrections are described below:

1. An incorrect formula was used to determine the travel time cost. In the case where a person drove/rode to the beach, the cost of the beach visit equals the time traveled multiplied by the hourly rate plus $0.54 per mile multiplied by round trip <u>distance</u>. The formula used in the initial calculations incorrectly applied $0.54 per mile to <u>travel time.</u>

   This correction resulted in a fee increase of 22% from $2,471 to $3,012 per linear foot (NPV).

2. The survey included two questions to determine a person's hourly rate. The survey asked for annual income range and occupation[2]. If the respondent answered both, the hourly rate was determined based on the average of the two. If only one question was answered, then the hourly rate was based on the question that was answered. The initial calculation incorrectly removed from the sample all surveys when the respondent did not answer the annual income question, even if the respondent provided a response to the occupation question. In correcting how the program filtered the data, an additional 26 records were incorporated into the sample.

   This correction resulted in a fee decrease of less than 1% from $3,012 to $2,986 per linear foot (NPV).

3. With the data validation, it was discovered that 101 records were not included in the calculation (records 500 through 600). These have now been included in the calculation.

   This correction resulted in a fee decrease of 4% from $2,986 to $2,878 per linear foot (NPV).

4. Data validation produced additional changes, some of which changed the data used in the determination of the Land Lease/Recreation Fee and are documented in the appendix of the corrected report as highlighted cells in the spreadsheets for counts and

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[1] PMC's review included a review of those items affecting attendance and average cost per beach trip. PMC did not review hourly median rate by occupation preferring to defer to the expertise of CIC Research.

[2] Hourly rate by occupation was determined by using 2008 national data from the Department of Labor, US Bureau of Labor Statistics, Division of Occupational Employment Statistics at http://www.bls.gov/oes/2008/may/oes_nat.htm#b15-0000

survey calculations. Regarding the memo of June 2, 2010, the corrected data revised the Winsorization[3] to $117.28 maximum and $1.00 minimum.

These changes resulted in a fee decrease of 9% from $2,878 to $2,636 per linear foot (NPV).

5. The annual attendance was initially estimated and projected to be 109,172. PMC and CIC revisited and recalculated this figure and applied the updated expansion factors. The revised estimated and projected annual attendance is now 124,700.

   This correction resulted in a fee increase of 17% from $2,636 to $3,100 per linear foot (NPV).

Table 1 on the following page outlines the corrections and the effects on the various components used in the calculation of the Land Lease/Recreation Fee (NPV).

[3] The distribution of many statistics can be heavily influenced by outliers. A typical strategy is to set all outliers to a specified percentile of the data; for example, a 90% Winsorization would see all data below the 5th percentile set to the 5th percentile, and data above the 95th percentile set to the 95th percentile. (Wikipedia accessed from http://en.wikipedia.org/wiki/Winsorizing on 5/31/10.

Table 1 Summary of Corrections

Corrections	Average Value of Beach Day per visitor (or cost of Beach trip)	Estimated, Projected Attendance	Annual Recreational Value[4]	Beach Area	Annual Land Lease Rate (per sf)	Land Lease/ Recreation Fee (NPV) (per lf)	% Change
April 2010 Report	$19.83	109,172	$1,710,854	8.18 ac	$4.80/sf	$2,471/lf	na
Mileage Correction	$24.15	109,172	$2,083,600	8.18 ac	$5.85/sf	$3,012/lf	+22%
Hourly Rate Filter	$23.96	109,172	$2067,200	8.18 ac	$5.80/sf	$2,986/lf	-1%
Include records 500-600	$23.10	109,172	$1,993,000	8.18 ac	$5.59/sf	$2,878/lf	-4%
Data Corrections	$21.15	109,172	$1,824,700	8.18 ac	$5.12/sf	$2,636/lf	-9%
Attendance	$21.15	124,700	$2,144,900[5]	8.18 ac	$6.02/sf	$3,100/lf	+17%
July 2010 Report	**$21.15**	**124,700**	**$2,144,900**	**8.18 ac**	**$6.02**	**$3,100/lf**	**∑ +25%**

It should also be noted that the surveys performed after the November 2008 stakeholder meeting contained additional data as requested by the group. For instance, occupation was added to complete the hourly rate information and/or used to average with the hourly rate derived from the annual income. In support of reported mileage, zip code and nearest intersection information was collected and used to provide mileage information if the respondent did not answer question 6.

The attached report generally reflects changes in red-line underline/strikeout format in the text. Certain tables only show the final figure that changed in red-line format. The report also now includes an Appendix 4 – Surveys, Appendix 5 – Counts, and Appendix 6 – Data Calculations.

[4] Figure is based on Adult Annual Attendance which is approximately 80% of Total Annual Attendance.
[5] Figure is based on Adult Annual Attendance which is projected, estimated to be 101,415.

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1. EXECUTIVE SUMMARY

CONTEXT

Solana Beach developed its Draft Local Coastal Program (LCP) Land Use Plan (LUP) through a multi-year process with extensive public participation. The LCP LUP reflects the collaborative effort of the various stakeholder groups. With the shared goal of identifying long-term solutions to Solana Beach's unique coastal issues, the Draft LCP LUP reflects the effort to achieve a balance of interests, rights and needs.

The Draft LCP Land Use Plan, reflecting such balance, provides for the construction of sea walls and notch fills (or other protective devices collectively referred to as "bluff retention devices") under certain, limited conditions. One consideration for allowing a bluff retention device is the requirement to pay Sand Mitigation and Land Lease/Recreation Fees to compensate for the loss of sand and loss of recreational use due to the armoring of the bluff.

GOAL OF REPORT

The goal of this report is twofold: first, to provide a method for beach valuation for use in determining a land lease/recreation fee should a protective device be constructed; and secondly, to provide an analysis for offsets to the Land Lease/Recreation Fee and Sand Mitigation Fee. Although initially considered with this study, the Sand Mitigation Fee is no longer included in this report as the various stakeholder groups and the California Coastal Commission (CCC) recommend using the formula currently applied to projects by the CCC. (Refer to the Draft Local Coastal Program Land Use Plan and its appendix for the specific formula.) However, this fee study does consider the potential offset that may be applied to both the Sand Mitigation and the Land Lease/Recreation fees.

LAND LEASE/RECREATION FEE

PMC, with CIC Research, Inc. as a sub-consultant, was retained by the City in June 2008 to prepare the Fee Report.

In general, to determine the recreational value of the beach at various locations, CIC staff conducted random surveys of beach attendees within the City of Solana Beach and performed attendance counts from July 2008 through July 2009. Using the Travel and Time Cost economic model, this data was then used to determine an average recreational value of ~~$19.83~~$21.15 per adult visitor day for the entire length of the beach. The value of a specific area of beach then depends on this average value, the number of estimated annual visitors within that area and the approximate beach area.

The number of visitors within a beach area reveals the preference of one area over another. The more crowded the beach area, the more it is valued and this approach inherently captures the heterogeneity of beach area such as quality, amenities and surf conditions. Figure 1-1 shows the average annual beach density (adult visitors days per 100 square feet of beach) along the Solana Beach coast based on the survey results. The preliminary analysis divided the beach into 35 segments. Nine separate areas within Solana Beach were identified based on beach densities. These were subsequently consolidated into a single zone based on the results of the data and in recognition that the beach is subject to dynamic processes that ultimately affect beach density on a daily, weekly, and yearly basis. The consolidation into a single zone yielded an average annual recreational land lease value of ~~$4.80~~$6.02 per square foot (or ~~$209,100~~$262,200 per acre annually) as shown in Table 1-1.[1]

TABLE 1-1 CITYWIDE LAND LEASE RATE

Segment	Annual Recreational Value	Area (ac)[1]	Segment	Annual Recreational Value	Area (ac)[1]
1	$ 120,773	0.31	19	$ 25,534	0.07
2	$ 101,450	0.38	20	$ 20,704	0.32
3	$ 30,365	0.07	21	$ 44,514	0.17
4	$ 18,633	0.06	22	$ 67,978	0.55
5	$ 16,907	0.04	23	$ 64,871	0.20
6	$ 20,359	0.18	24	$ 63,492	0.20
7	$ 11,387	0.15	25	$ 59,006	0.14
8	$ 15,528	0.45	26	$ 62,803	0.24
9	$ 4,831	0.21	27	$ 68,668	0.22
10	$ 77,295	0.55	28	$ 73,498	0.24
11	$ 271,911	0.40	29	$ 51,416	0.22
12	$ 240,165	0.43	30	$ 41,752	0.12
13	$ 41,408	0.15	31	$ 29,331	0.24
14	$ 46,238	0.11	32	$ 58,662	0.58
15	$ 24,500	0.10	33	$ 95,928	0.25
16	$ 5,867	0.01	34	$ 204,969	0.57
17	$ 16,563	0.03	35	$ 27,605	0.13
18	$ 20,014	0.09			
Total				$ 2,144,925	8.18
Annual Land Lease Rate per acre				$ 262,200	
Annual Land Lease Rate per square foot				$ 6.02	

1 There are 43,560 square feet per acre.

Such an annual Land Lease Rate would require payment[2] of approximately, ~~$2,471~~$3,100 per linear foot of wall (generally parallel to the shoreline) from all of the Solana Beach beachfront properties constructing a wall in 2010 (or other structure that would trigger the fee).

[1] The annual land lease rate is subject to review by City Council in the future and would be applicable to future permits as outlined in the DRAFT LCP Land Use Plan.

[2] Payment representing net present value using a 2% rate over the 72-year period for illustration purposes.

Table 1-2 shows the Land Lease/Recreation Fee (per linear foot) that would be charged depending on the number of lease years. The amount of the fee would depend on the number of years from the time that the structure was constructed to the end of 2081. The Land Lease/Recreation Fee incorporates the Land Lease Rate of ~~$4.80~~$6.02 per square foot, assumes a constant bluff erosion rate of 0.4 feet per year, and a seawall thickness of 2 feet. It also is based upon the Present Value of the annual Land Lease Amount using a 2% discount rate.

TABLE 1-2 LAND LEASE/RECREATION FEES

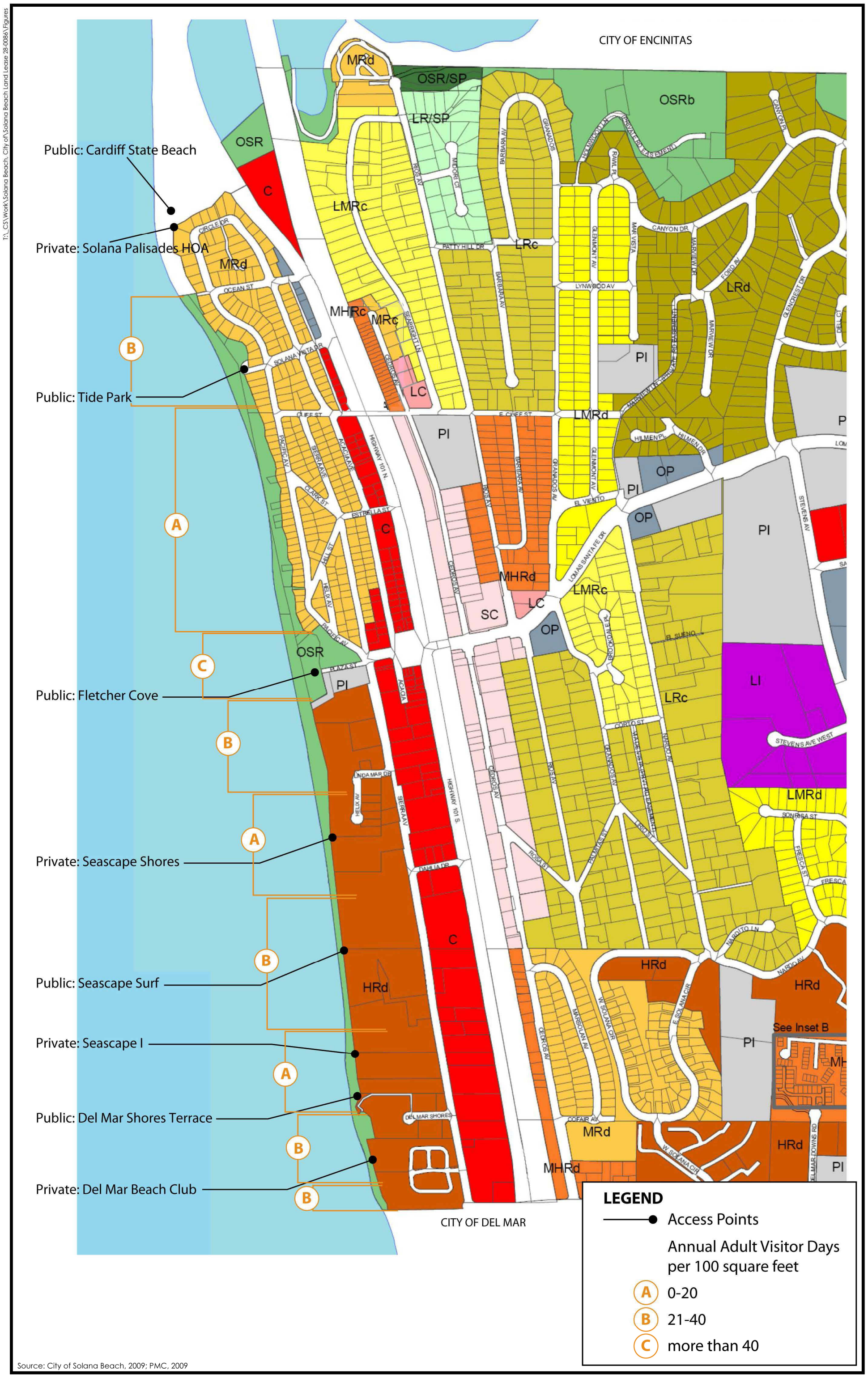
If Constructed in Year:	Number of Years of Lease	Land Lease Fee per lf (NPV)	If Constructed in Year:	Number of Years of Lease	Land Lease Fee per lf (NPV)
2010	72	$ 3,100	2046	36	$ 1,339
2011	71	$ 3,054	2047	35	$ 1,289
2012	70	$ 3,008	2048	34	$ 1,240
2013	69	$ 2,962	2049	33	$ 1,191
2014	68	$ 2,916	2050	32	$ 1,143
2015	67	$ 2,869	2051	31	$ 1,094
2016	66	$ 2,822	2052	30	$ 1,047
2017	65	$ 2,775	2053	29	$ 999
2018	64	$ 2,728	2054	28	$ 952
2019	63	$ 2,680	2055	27	$ 906
2020	62	$ 2,632	2056	26	$ 859
2021	61	$ 2,584	2057	25	$ 814
2022	60	$ 2,535	2058	24	$ 769
2023	59	$ 2,487	2059	23	$ 725
2024	58	$ 2,438	2060	22	$ 681
2025	57	$ 2,389	2061	21	$ 638
2026	56	$ 2,340	2062	20	$ 596
2027	55	$ 2,290	2063	19	$ 555
2028	54	$ 2,241	2064	18	$ 514
2029	53	$ 2,191	2065	17	$ 475
2030	52	$ 2,141	2066	16	$ 436
2031	51	$ 2,091	2067	15	$ 399
2032	50	$ 2,041	2068	14	$ 362
2033	49	$ 1,991	2069	13	$ 327
2034	48	$ 1,940	2070	12	$ 293
2035	47	$ 1,890	2071	11	$ 260
2036	46	$ 1,840	2072	10	$ 228
2037	45	$ 1,789	2073	9	$ 198
2038	44	$ 1,739	2074	8	$ 169
2039	43	$ 1,689	2075	7	$ 142
2040	42	$ 1,638	2076	6	$ 116
2041	41	$ 1,588	2077	5	$ 92
2042	40	$ 1,538	2078	4	$ 70
2043	39	$ 1,488	2079	3	$ 49
2044	38	$ 1,438	2080	2	$ 31
2045	37	$ 1,388	2081	1	$ 14

Property line moves east/landward as bluff erodes.
Present value calculated using a discount rate of 2%.
Number of years of lease includes year constructed through 2081.

Table 1-2 represents the fee if paid in full at the time of permit issuance. As provided for in the Draft LCP Land Use Plan, the property owner also has the option of paying 1/3rd of the fee initially and the balance may be amortized and paid annually through 2081. The rate of interest for this latter option has not been determined.

The City currently collects a deposit of $1,000 per linear foot for the Sand Mitigation and Land Lease/Recreation fees combined.

Figure 1-1shows the average annual density of adult visitor days per 100 square feet of beach.



Not to scale

Figure 1-1
Beach Density

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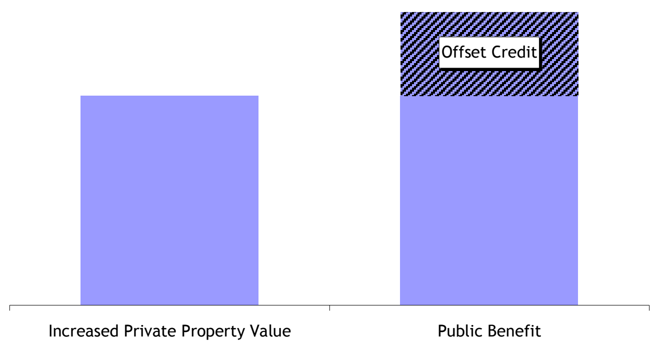
OFFSETS TO LAND LEASE/RECREATION FEES AND SAND MITIGATION FEES

With one approach, the average overall public benefit related to safety is estimated to be $21 per linear foot of wall per year which is primarily the result of the likelihood of a fatality occurring along any one stretch of beach. The other major components of public benefit would be protection of public property and the potential increased property tax revenue. These amounts are compared to the private benefit. Where the public benefit exceeds the private benefit, Council may consider an offset amount to the required fees as presented in this report (see Figure 1-2). As identified in the Draft LCP Land Use Plan, the City Council shall consider any such potential offset at a public hearing.

FIGURE 1-2 OFFSET CREDIT



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2. INTRODUCTION

LOCAL COASTAL PROGRAM LAND USE PLAN

Solana Beach's efforts to establish a Local Coastal Program have been on-going for more than a decade. In June 2008, the City Council approved a Draft LCP Land Use Plan for submittal to the California Coastal Commission (CCC) representing the collaborative planning effort initiated by the City and developed with the participation of various stakeholder groups including local environmental groups and property owners. The Draft LCP Land Use Plan was submitted to the CCC and certain revisions were made in response to comments received from the CCC. The revised version, dated September 2009, went before City Council on September 9, 2009 for a second approval to submit to the CCC.

The City's LCP consists of a Land Use Plan and a Local Implementation Plan. As part of the LCP and its implementation, the City of Solana Beach will establish a long-term shoreline management plan. The unique geology of the coastal area, as well as regional sand depletion have all caused the loss of the beach area over time, accelerating the erosion process along the coastal bluffs, threatening certain private buildings and public improvements. The Shoreline Management Plan is intended to achieve a comprehensive goal of preserving and enhancing a safe, wide beachfront for use by the public and protecting and preserving private property rights of individual bluff property owners. It is the intent that with such proper land use management, seawalls along the entire shoreline of Solana Beach will not be necessary. For instance, should the City implement a program to construct a few small artificial reefs or other devices and pre-fills the entire system with sand, the environmental quality of the Solana Beach shoreline may well be enhanced. It may also eliminate the long-term need for most additional Bluff Retention Devices.

While the plan allows the construction of limited coastal protection structures for specified periods of time, on public property, for the protection of private property, it also sets forth the conditions for allowing such construction and requires payment of mitigation fees to compensate for the loss of sand and public beach area. Constraints or requirements for these fees are set forth in the Land Use Plan.

As stated, in part, in Policy 4.80.B of the Draft LCP Land Use Plan:

> Upon issuance of the building permit for a new Substantial Infill or Coastal Structure, or upon the issuance of a renewal permit for an existing Substantial Infill or Coastal Structure, the City shall also determine the amount of the Land Lease/Recreation Fee based on the Land Lease Rate then in effect multiplied by the Land Lease Area. The Land Lease/Recreation Fee is the same as the so-called Recreation Fee since it gives the Bluff Property Owner use of the land area which otherwise might have been available for recreational use or access, albeit

with uncertainty related to use of the beach in the immediate proximity to an unprotected bluff.

The City's initial and subsequent determinations of the Land Lease Rate shall be based upon expert opinions of consultants hired by the City. Any such experts shall evaluate comparable leased beach areas based upon vertical and lateral access, parking, climate, frequency of use, safety, distance from access points, surf quality, water and air temperature, location of area leased, sand quality, time available for use of beach, beach width, tides, ocean conditions, and any other relevant variables.

To implement the fee program identified in the Draft LCP Land Use Plan, several methods to determine the recreational value of the beach were evaluated.

ECONOMIC MODEL

Various economic models were considered for establishing the recreational value of the beach. These included the Random Utility Maximization Model, the Contingent Value approach, Benefits Transfer approach and the Travel and Time Cost Model. PMC, including economist Dr. Gordon Kubota of CIC Research, recommended the Travel and Time Cost Model as the most appropriate method for determining a recreation value for the beach. Using the Travel and Time Cost Model, based on specific surveys in Solana Beach, a recreational value per beach visitor per day is estimated based on the amount of time traveling to and from the beach and the travel costs. This value represents an average for all beach visitors along the entire length of the beach within City limits. The recreational value (per visitor day) multiplied by the number of annual beach visitor days within Solana Beach is used to determine a recreational value per square foot of beach in Solana Beach which is then used to determine the annual land lease/recreation fee rate.

The advantages to the Travel and Time Cost model are:

1) Relatively simple, short, straight forward questionnaire with high percentage of participation;

2) Collects data on actual observed actions (revealed preference), not on stated preferences (as in a contingent value approach) therefore is not subject to interviewee bias;

3) Valid results with smaller sample size. Sample is collected by surveying on the beach being evaluated;

4) Cost of survey is reasonable; and

5) Survey is easy to replicate.

There are, however, certain disadvantages in this model, such as:

1) It does not account for substitution which means the approach assumes the cost of choosing another beach reflects exactly the value of that other beach;

2) Less responsive to measuring quality changes than the Random Utility Maximization Model; and

3) Requires an "on site" expansion factor for attendance.

For comparison purposes, the advantages and disadvantages of the other economic models considered are as listed below:

Random Utility Maximization Model

Advantages:

- Captures and evaluates the substitution effect in the site visit decision;
- May evaluate quality differences in sites and impact on value; and
- Frequently used for non-market evaluation.

Disadvantages:

- Requires an extensive, large, and relatively expensive household phone survey to obtain sufficient sample points to provide a value of an individual beach such as Solana Beach;
- Higher percentage of non-respondents;
- Model is complex and may be difficult to resolve;
- Uses a large population for expansion and therefore is subject to large potential errors caused by multiplying any value by a large number;
- Although based on "revealed preference," respondents are sometimes questioned on the importance of selective characteristics used to arrive at that choice; therefore some interviewee bias may be introduced; and
- Cost of the survey is considerably greater than the more simple travel and time cost approach.

Contingent Value

Advantage:

- Quantifies value of intangibles, such as views.

Disadvantage:

- Relies on survey of stated preference, instead of actual/revealed preference.

Benefits Transfer

Advantages:

- Utilizes available information from studies already completed in another location and/or context; and
- Option in lieu of other expensive and/or time intensive techniques for gross estimates.

Disadvantages:

- Not site specific.

The Travel and Time Cost Methodology was chosen over these other models, in part, due to it being replicable, applicable, and cost effective, requiring only a reasonable sample size.

PUBLIC OUTREACH

PMC/CIC met with interested parties at a City workshop in September 2008 to present information regarding the proposed fee study. A subsequent follow-up meeting was conducted in November 2008 with the LCP Land Use Plan Ad Hoc committee. The focus of the November meeting was to discuss the economic model and consider comments to improve the surveys and attendance counts. As a result of that meeting, the survey period was extended through July 2009 to capture an entire year of data and certain adjustments were made to both the survey questions and the count approach.

PROJECT TIMELINE

The following key dates comprise the schedule for completion of the report

June 6, 2008	Draft LCP Land Use Plan approved by Council for submittal to California Coastal Commission
June 2008	PMC, and CIC Research as a sub-consultant, retained by City to prepare report on Land Lease/Recreation Fee and Sand Mitigation Fee
July 2008	Begin data collection
September 18, 2008	Workshop
November 6, 2008	Ad Hoc Committee meeting
July 2009	End data collection
September 2009	Council considers June 2009 LCP/LUP
Spring 2010	Draft Fee Report released for public review and comment
Summer 2010	~~Presentation to City Council/Public Hearing~~Corrected Draft Fee Report released to public for review and comment
Fall/Winter 2010/2011	Presentation to City Council/Public Hearing
Winter/Spring 2010/2011	Final Report

ORGANIZATION OF REPORT

This report provides chapters on the Methodology, Surveys, Land Lease/Recreation Fee and Offsets. Chapter 4, Land Lease/Recreation Fee, includes discussion regarding the recreational value per visitor day, attendance by segment, why one zone within Solana Beach is recommended and the estimate of beach area.

3. METHODOLOGY/SURVEYS

INTRODUCTION

While it is easy to assign a value to public land that has a market corollary (such as a meeting hall) it is very difficult to assign a value to land in which no market exists. Beach land in California, as it is not readily purchased and has a recreational value to the public, must be evaluated using other non-market mechanisms. One could ask beach visitors how much they would be willing to pay to go to the beach. This is often referred to as a "stated" preference approach, however studies have shown that it sometimes results in either under valuing the public good if users fear that the data will be used to set an actual user charge, or over valuing it if the user doesn't fear a charge but instead inflates the value since they aren't actually asked to pay the charge. Another method is sometimes called an "implied" preference methodology. This method looks at behavior and assigns value based on the users' decisions. The specific version that was used in this study was the travel and time cost model. In this model, data is collected on the users travel to and from the activity (beach) and then a value unique to that individual is assigned for the time travel based on their hourly income.

Two Primary Data Collection Methods

Early in the development of the methodology for collecting data for the non-market evaluation it became clear that two data collection efforts would be required. One data collection program would require a survey of beach goers or visitors to gather information on travel to the beach as well as income-discerning questions as part of the inputs into the travel and time cost model. Another data collection program would be needed to develop estimates as to the number of visitors to the beach. This separate data collection program was developed to count the number of visitors to the beach to estimate the average annual visitor days for Solana Beach. The following describes the methodology used in both data collection efforts.

BEACH COUNTS

The beach was divided into 39 segments (from Encinitas to Del Mar), defined by 40 landmarks and generally identified using GPS supplied coordinates, although the 3 northernmost segments were discarded after it was determined they were located outside of the Solana Beach City limits; one other northern segment was discarded because of similarity with its adjacent northern area. On seven randomly selected days in the month, a field data collector counted attendance at the beach. The data collection days were reviewed to make certain that five days were weekdays and two were weekends. The data collector would enter the beach either from the north or southern most entry point (alternating randomly) and traverse the entire beach counting visitors on the beach or in the water just off the beach. The counts were then recorded into three categories: on the beach, wading in the water, and surfing/swimming. In addition, counts were made of adults versus children (children being under age 16 by observance to correspond with our survey which would only interview those over age 16). The first beach count was conducted on July 25, 2008 and the final one was conducted on July 23, 2009. Tally sheets and description of segments are displayed in the appendix of this report.

SURVEY OF BEACH VISITORS

The beach visitor (or beachgoer) survey was developed to obtain the data needed to estimate the value that a visitor to the beach places on that activity. The questionnaire used collected data on mode of transportation, travel distance, income, occupation, and other information for categorizing and survey control. A copy of the survey questionnaires and code book used are displayed in the appendix. Survey days were randomly selected as were start times. The interviewer would spend approximately four hours on the beach interviewing on the selected day. The survey was conducted from July 23, 2008 to July 31, 2009. During that time ~~462~~ 563 surveys were conducted.

RESULTS OF DATA COLLECTION

Beach Counts

As stated previously, in order to obtain an estimate of the number of beach visitors, a count on random days was conducted. In all, on ~~87~~ 88 randomly selected days, counts were conducted starting on July 25, 2008 and finishing on July 23, 2009. The maximum count per day was in the summer (~~730~~ 623 beach visitors on Saturday August 16, 2008) and, as expected, the lowest per day counts were in the winter where there were several days with less than 5 people on the beach at the time of counting. **Table 3-1** displays the average count per day per month.

TABLE 3-1
AVERAGE COUNT OF BEACH VISITORS PER DAY BY MONTH

	Children	Adult	Total
July-08	55.3	175.0	230.3
August-08	66.8	197.0	263.8
September-08	13.6	67.9	81.4
October-08	12.3	60.3	72.6
November-08	2.6	27.3	29.9
December-08	4.6	22.1	26.7
January-09	5.7	48.9	54.6
February-09	3.1	28.3	31.4
March-09	6.1	42.7	48.9
April-09	4.9	31.3	36.1
May-09	21.6	64.6	86.1
June-09	12.6	69.3	81.9
July-09	47.9	125.3	173.1

Source: CIC Research, July 2009

Estimate of Beach Visitors

The number of beach visitors per year was estimated based on the average daily count determined for each segment of the beach (Table 3-2). This count was multiplied by 365 days to obtain an annual estimate based solely on the counts done in the field as shown in Table 3-3.

TABLE 3-2
MEAN NUMBER OF BEACH VISITORS COUNTED PER DAY IN EACH SEGMENT

	Beach		Wading/Swimming		Surfing	
Segment	Adults	Children	Adults	Children	Adults	Children
4	1.602	0.341	0.341	0.136	2.034	0.000
5	2.375	0.943	0.307	0.398	0.659	0.000
6	0.818	0.114	0.136	0.205	0.045	0.011
7	0.455	0.068	0.091	0.057	0.068	0.023
8	0.455	0.011	0.023	0.011	0.080	0.000
9	0.477	0.011	0.102	0.023	0.091	0.000
10	0.330	0.023	0.023	0.000	0.023	0.000
11	0.466	0.102	0.045	0.000	0.000	0.000
12	0.148	0.045	0.011	0.011	0.000	0.000
13	1.455	0.227	0.114	0.011	0.977	0.000
15	5.148	1.477	0.989	0.989	2.818	0.057
16	5.932	2.420	1.330	1.261	0.648	0.034
17	0.852	0.216	0.205	0.136	0.307	0.000
18	0.955	0.057	0.261	0.170	0.307	0.000
19	0.375	0.045	0.193	0.102	0.239	0.000
20	0.057	0.023	0.057	0.011	0.080	0.011
21	0.409	0.034	0.023	0.057	0.114	0.000
22	0.466	0.068	0.114	0.034	0.080	0.000
23	0.636	0.057	0.080	0.057	0.125	0.000
24	0.534	0.023	0.080	0.011	0.068	0.000
25	1.170	0.159	0.159	0.057	0.136	0.000
26	1.614	0.261	0.216	0.148	0.409	0.000
27	1.511	0.386	0.295	0.330	0.330	0.000
28	1.341	0.545	0.341	0.477	0.409	0.000
29	1.239	0.352	0.307	0.409	0.398	0.023
30	1.023	0.489	0.341	0.364	0.705	0.000
31	1.261	0.114	0.295	0.193	0.705	0.011
32	1.443	0.057	0.170	0.136	0.807	0.011
33	0.693	0.125	0.091	0.057	0.909	0.000

	Beach		Wading/Swimming		Surfing	
Segment	Adults	Children	Adults	Children	Adults	Children
34	0.614	0.091	0.136	0.091	0.625	0.000
35	0.398	0.057	0.045	0.045	0.523	0.011
36	1.341	0.227	0.102	0.136	0.489	0.000
37	1.500	0.261	0.182	0.125	1.477	0.011
38	4.341	1.375	0.932	1.148	1.477	0.000
39	0.523	0.102	0.125	0.159	0.261	0.011

TABLE 3-3
MEAN NUMBER OF BEACH VISITORS COUNTED PER DAY IN EACH SEGMENT EXPANDED FOR ANNUAL ESTIMATE

	Beach		Wading/Swimming		Surfing		Total		
Segment	Adults	Children	Adults	Children	Adults	Children	Adults	Children	All
4	585	124	124	50	742	-	1,452	174	1,626
5	867	344	112	145	241	-	1,219	489	1,709
6	299	41	50	75	17	4	365	120	485
7	166	25	33	21	25	8	224	54	278
8	166	4	8	4	29	-	203	8	212
9	174	4	37	8	33	-	245	12	257
10	120	8	8	-	8	-	137	8	145
11	170	37	17	-	-	-	187	37	224
12	54	17	4	4	-	-	58	21	79
13	531	83	41	4	357	-	929	87	1,016
15	1,879	539	361	361	1,029	21	3,268	921	4,189
16	2,165	883	485	460	236	12	2,887	1,356	4,243
17	311	79	75	50	112	-	498	129	626
18	348	21	95	62	112	-	556	83	639
19	137	17	71	37	87	-	294	54	348
20	21	8	21	4	29	4	71	17	87
21	149	12	8	21	41	-	199	33	232
22	170	25	41	12	29	-	241	37	278
23	232	21	29	21	46	-	307	41	348
24	195	8	29	4	25	-	249	12	261
25	427	58	58	21	50	-	535	79	614
26	589	95	79	54	149	-	817	149	966
27	552	141	108	120	120	-	780	261	1,041

	Beach		Wading/Swimming		Surfing		Total		
Segment	Adults	Children	Adults	Children	Adults	Children	Adults	Children	All
28	489	199	124	174	149	-	763	373	1,136
29	452	129	112	149	145	8	709	286	995
30	373	178	124	133	257	-	755	311	1,066
31	460	41	108	71	257	4	825	116	942
32	527	21	62	50	294	4	883	75	958
33	253	46	33	21	332	-	618	66	684
34	224	33	50	33	228	-	502	66	568
35	145	21	17	17	191	4	353	41	394
36	489	83	37	50	178	-	705	133	838
37	548	95	66	46	539	4	1,153	145	1,298
38	1,584	502	340	419	539	-	2,464	921	3,385
39	191	37	46	58	95	4	332	100	431
Total	16,043	3,982	3,015	2,758	6,723	79	25,782	6,819	32,601

However, the above table underestimates the actual number of visitors to the beach as new visitors would arrive before and after the count. To account for these "missed" beach visitors, an overall adjustment was made based on the survey of beach visitors. The proportion of visitors missed was derived by examining the respondents' arrival time and estimated departure time and determining what proportion would not have been in the area during the counting time period on average. The total counts were then adjusted to reflect the number that would have been missed and reallocated to the sections on an annual basis. Table 3-4 shows the ratios for adjustment and the percentages used for that calculation. The total then was reallocated by section based on the original distribution as shown in Table 3-5.

TABLE 3-4
DETERMINATION OF THE ADJUSTMENT FOR MISSING BEACH VISITORS DURING COUNT

	Percentage of Beach Visitors Missed By Counting In That Time Block	Capture Percentage (1-Missed %)	Adjustment Ratio (1/Capture %)
6:00am-7:59am	95.1%	4.9%	20.4
8:00am-9:59am	78.0%	22.0%	4.6
10:00am-11:59am	62.4%	37.6%	2.7
12 Noon-1:59pm	63.5%	36.5%	2.7
2pm-3:59pm	70.1%	29.9%	3.3
5:00am-5:59 am 4pm-7:59pm	91.1%	8.9%	11.2

The results of applying the adjustment ratio to the data are shown in Table 3-5.

TABLE 3-5
ESTIMATED ANNUAL NUMBER OF BEACH VISITORS BY SEGMENT AFTER ADJUSTMENT

	Beach		Wading/Swimming		Surfing		
Segment	Adults	Children	Adults	Children	Adults	Children	Total
4	2,300	425	489	170	2,920	-	6,306
5	3,410	1,176	441	496	946	-	6,469
6	1,175	142	196	255	65	14	1,847
7	653	85	131	71	98	28	1,065
8	653	14	33	14	114	-	828
9	685	14	147	28	131	-	1,005
10	473	28	33	-	33	-	567
11	669	128	65	-	-	-	862
12	212	57	16	14	-	-	299
13	2,088	283	163	14	1,403	-	3,952
15	7,391	1,843	1,419	1,233	4,046	71	16,003
16	8,517	3,019	1,909	1,573	930	43	15,990
17	1,224	269	294	170	441	-	2,397
18	1,370	71	375	213	441	-	2,470
19	538	57	277	128	343	-	1,343
20	82	28	82	14	114	14	334
21	587	43	33	71	163	-	897
22	669	85	163	43	114	-	1,074
23	914	71	114	71	179	-	1,349
24	767	28	114	14	98	-	1,021
25	1,680	198	228	71	196	-	2,374
26	2,317	326	310	184	587	-	3,724
27	2,170	482	424	411	473	-	3,960
28	1,925	680	489	595	587	-	4,278
29	1,778	439	441	510	571	28	3,768
30	1,468	609	489	454	1,012	-	4,032
31	1,811	142	424	241	1,012	14	3,644
32	2,072	71	245	170	1,158	14	3,730
33	995	156	131	71	1,305	-	2,658
34	881	113	196	113	897	-	2,201
35	571	71	65	57	750	14	1,529

	Beach		Wading/Swimming		Surfing		
Segment	Adults	Children	Adults	Children	Adults	Children	Total
36	1,925	283	147	170	702	-	3,227
37	2,154	326	261	156	2,121	14	5,032
38	6,232	1,715	1,338	1,432	2,121	-	12,838
39	750	128	179	198	375	14	1,645
Total	63,107	13,607	11,861	9,425	26,447	269	124,716

Total annual estimated attendance is ~~109,172~~124,700. Beach Visitor Survey

Minor discrepancy in totals due to rounding.

Total annual estimated attendance was ~~109,172~~124,700 based on the survey data and applied methodology.

Beach Visitor Survey

For one year, starting in July 2008, ~~462~~ 563 beach visitors were interviewed. Over one~~A~~ quarter (~~25~~26%) said that their primary purpose for being at the beach was surfing (Table 3-6). This was closely followed by sunning/lying on the beach (24%) and walking/running on the beach (~~21~~22%).

TABLE 3-6
PRIMARY PURPOSE FOR BEACH VISIT

Primary Purpose	Percent
Surfing/Water sports	26%
Sunning/lying on beach	24%
Walk/run on beach	22%
People watching	9%
Swimming/play in water	7%
Collecting shells, beachcomb, etc.	5%
Fishing	3%
Special event	3%
Picnic	1%
Total	100%

Source: CIC Research, July 2009

Nearly a third of those interviewed were from Solana Beach. As indicated from Table 3-7, ~~slightly over half~~ nearly a third were from outside of San Diego County (~~53~~23% other U.S. and ~~5~~6% foreign).

TABLE 3-7
LOCATION OF RESIDENCE

Residence	Percent
Solana Beach	30%
Other San Diego County	41%
Other U.S.	23%
Foreign	6%
Total	100%

Source: CIC Research, July 2009

The median age of respondents was 39 years old. As can be seen ~~on~~ in Table 3-8, those over 65 made up 13 percent of the respondents which correspond to the 13 percent who stated they were retirees.

TABLE 3-8
AGE OF RESPONDENT

Age of Respondent	Percent
Under 18	3%
18 - 24 years	14%
25 - 34 years	23%
35 - 44 years	23%
45 - 54 years	16%
55 - 64 years	8%
65 years or over	13%
	100%

Source: CIC Research, July 2009

Additional results of the survey are presented in the appendix.

The second major element of the determination of the beach value was the estimate of the average value per visitor day. This was accomplished by calculating a mean value per day based on the distance traveled, mode of transportation, and annual individual salary. The individual calculations per questionnaire are:

$$T = D * fM$$

And

$$V = I / 2080 * T + fC(T)$$

Where V = Value per Beach Visitor

T = Travel Time

D = Distance

I = Income

fM = Mode of Transportation Travel Time Factor as follows:

- For Auto (including dropped off) less than 6 miles distance *fM= 2 min/mile*2/60*
- Auto more than 6 miles *fM= 1.5 min/mile*2/60*
- Walking/Skateboarding *fM= 30 min/mile*2/60*
- Bike and Public Transportation *fM= 7.5 min/mile*2/60*

fC(T) = Cost of Transportation Factor as follows:

- For Auto (including dropped off) *fC(T)= $0.54/mile*~~T~~D*2*
- Bike/Walking/Skateboarding *fC(T)= 0*
- Public Transportation *fC(T)= $5.00*

Using the above calculation, the average (mean) value per adult beach visitor day is ~~$19.83~~$21.15.

The final value per section of beach is then calculated by multiplying the visitor day estimate by the average value. Table 3-9 presents that calculation. The final value estimate for the entire length of the beach is ~~$1.7~~$2.14 million annually.

Additional detail regarding the data and calculations is provided in the Appendix.

TABLE 3-9
ESTIMATED ANNUAL VALUE PER SEGMENT

Segment	AdultVisitorDaysPerYear				ChildrenVisitorDaysPerYear				EstimatedValue@$~~19.83~~21.15PerVisitorPerDay			
	Beach	Wading	Surfing	Total	Beach	Wading	Surfing	Total	Beach	Wading	Surfing	Total
4	2,300.4	489.5	2,920.4	5,710.3	425.2	170.1	-	595.3	$48,654	$10,352	$61,767	$120,773
5	3,409.9	440.5	946.3	4,796.7	1,176.4	496.1	-	1,672.5	$72,119	$9,317	$20,014	$101,449
6	1,174.7	195.8	65.3	1,435.7	141.7	255.1	14.2	411.0	$24,845	$4,141	$1,380	$30,366
7	652.6	130.5	97.9	881.0	85.0	70.9	28.3	184.3	$13,803	$2,761	$2,070	$18,634
8	652.6	32.6	114.2	799.4	14.2	14.2	-	28.3	$13,803	$690	$2,415	$16,908
9	685.2	146.8	130.5	962.6	14.2	28.3	-	42.5	$14,493	$3,106	$2,761	$20,359
10	473.1	32.6	32.6	538.4	28.3	-	-	28.3	$10,007	$690	$690	$11,387
11	668.9	65.3	-	734.2	127.6	-	-	127.6	$14,148	$1,380	$-	$15,528
12	212.1	16.3	-	228.4	56.7	14.2	-	70.9	$4,486	$345	$-	$4,831
13	2,088.3	163.2	1,403.1	3,654.6	283.5	14.2	-	297.6	$44,168	$3,451	$29,676	$77,295
15	7,390.8	1,419.4	4,046.2	12,856.3	1,842.6	1,233.1	70.9	3,146.5	$156,315	$30,021	$85,576	$271,911
16	8,516.5	1,908.9	930.0	11,355.3	3,019.0	1,573.3	42.5	4,634.8	$180,124	$40,373	$19,669	$240,165
17	1,223.6	293.7	440.5	1,957.8	269.3	170.1	-	439.4	$25,880	$6,211	$9,317	$41,408
18	1,370.5	375.2	440.5	2,186.2	70.9	212.6	-	283.5	$28,985	$7,937	$9,317	$46,239
19	538.4	277.4	342.6	1,158.4	56.7	127.6	-	184.3	$11,387	$5,866	$7,246	$24,500
20	81.6	81.6	114.2	277.4	28.3	14.2	14.2	56.7	$1,725	$1,725	$2,415	$5,866
21	587.3	32.6	163.2	783.1	42.5	70.9	-	113.4	$12,422	$690	$3,451	$16,563
22	668.9	163.2	114.2	946.3	85.0	42.5	-	127.6	$14,148	$3,451	$2,415	$20,014
23	913.6	114.2	179.5	1,207.3	70.9	70.9	-	141.7	$19,324	$2,415	$3,796	$25,535
24	766.8	114.2	97.9	978.9	28.3	14.2	-	42.5	$16,218	$2,415	$2,070	$20,704
25	1,680.5	228.4	195.8	2,104.7	198.4	70.9	-	269.3	$35,542	$4,831	$4,141	$44,513
26	2,316.8	310.0	587.3	3,214.1	326.0	184.3	-	510.2	$48,999	$6,556	$12,422	$67,978

Segment	AdultVisitorDaysPerYear				ChildrenVisitorDaysPerYear				EstimatedValue@$~~19.83~~21.15PerVisitorPerDay			
	Beach	Wading	Surfing	Total	Beach	Wading	Surfing	Total	Beach	Wading	Surfing	Total
27	2,169.9	424.2	473.1	3,067.2	481.9	411.0	-	892.9	$45,894	$8,972	$10,007	$64,872
28	1,925.2	489.5	587.3	3,002.0	680.3	595.3	-	1,275.6	$40,718	$10,352	$12,422	$63,492
29	1,778.4	440.5	571.0	2,789.9	439.4	510.2	28.3	978.0	$37,612	$9,317	$12,077	$59,006
30	1,468.4	489.5	1,011.5	2,969.4	609.5	453.6	-	1,063.0	$31,056	$10,352	$21,394	$62,802
31	1,811.0	424.2	1,011.5	3,246.7	141.7	241.0	14.2	396.9	$38,302	$8,972	$21,394	$68,668
32	2,072.0	244.7	1,158.4	3,475.1	70.9	170.1	14.2	255.1	$43,823	$5,176	$24,500	$73,499
33	995.2	130.5	1,305.2	2,431.0	155.9	70.9	-	226.8	$21,049	$2,761	$27,605	$51,415
34	881.0	195.8	897.3	1,974.1	113.4	113.4	-	226.8	$18,634	$4,141	$18,979	$41,753
35	571.0	65.3	750.5	1,386.8	70.9	56.7	14.2	141.7	$12,077	$1,380	$15,873	$29,331
36	1,925.2	146.8	701.6	2,773.6	283.5	170.1	-	453.6	$40,718	$3,106	$14,838	$58,661
37	2,153.6	261.0	2,121.0	4,535.6	326.0	155.9	14.2	496.1	$45,549	$5,521	$44,858	$95,928
38	6,232.4	1,337.8	2,121.0	9,691.2	1,715.0	1,431.5	-	3,146.5	$131,815	$28,295	$44,858	$204,969
39	750.5	179.5	375.2	1,035.2	127.6	198.4	14.2	340.2	$15,873	$3,796	$7,937	$27,605
Total	63,107.0	11,861.1	26,446.9	101,414.9	13,606.7	9,425.4	269.3	23,301.4	$1,334,713	$250,862	$559,351	$2,144,926

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4. LAND LEASE/RECREATION FEE

RECREATIONAL VALUE

The purpose of the Land Lease/Recreation (LLR) Fee is to compensate the public for the loss of recreational use of the beach due to the armoring of the bluff. Three components are used to determine the value per square foot of beach area for use in the LLR Fee. These include the average recreational value per adult visitor day of ~~\$19.83~~\$21.15, the estimated annual beach visitor days within a specific area and the beach area within Solana Beach.

BEACH ATTENDANCE

While the attendance survey was conducted in 35 beach segments, PMC initially considered consolidating these beach areas into 9 zones based on beach density. The highest density area for the survey period is Fletcher Cove and the lowest density area is the area located just north of Fletcher Cove.

PMC also considered an alternate approach whereby all of Solana Beach was considered a single zone and all property owners would be subject to the same Land Lease/Recreation Fee. This approach eliminates the disparity between adjoining neighbors' obligations and recognizes that beach, and consequently the beach density, along the Solana Beach coast is likely dynamic, not static, on a daily, weekly, yearly or other time measurement basis. The dispersion of beach visitors is also dependent on beach access, width and quality of beach, parking availability and other factors. These factors are expected to change during the 72-year period that the City's LCP Land Use Plan is in effect due to local, regional and federal beach nourishment projects being planned thereby impacting the localized beach density. Beach walkers and other recreational users may also move north and south through the different areas of the beach. For these reasons it is recommended then to aggregate all of the beach areas into a single zone, averaging the attendance over the entire Solana Beach area. (For purposes of this study, it is assumed that the overall beach density, measured in adult visitor days per 100 square feet, is the same each year.) Such averaging is further supported when considering the interdependence of bluff armoring. A wall constructed by one property owner may assist in protecting its neighbor's property as well, if the neighbor's property has been protected by bluff armoring already. In recognition of these dynamic and interdependent processes, it is recommended that a single Land Lease/Recreation Fee be imposed in Solana Beach that does not vary by location within Solana Beach. Such an approach then averages all of the data to calculate a single Land Lease/Recreational Rate of ~~\$4.80~~\$6.02 per square foot of beach area leased annually.

The initial 36 photo points and beach areas are shown in Figure 4-1 through Figure 4-5. These points were initially chosen based in part on a subjective estimation of similar access, beach width, sand, wall location, as well as being locations that were easily identifiable to the survey team. A greater or lesser number of points could have been chosen but these appeared to be a good starting point for this analysis. See Chapter 3 and the appendix for the attendance data associated with the 35 beach segments.

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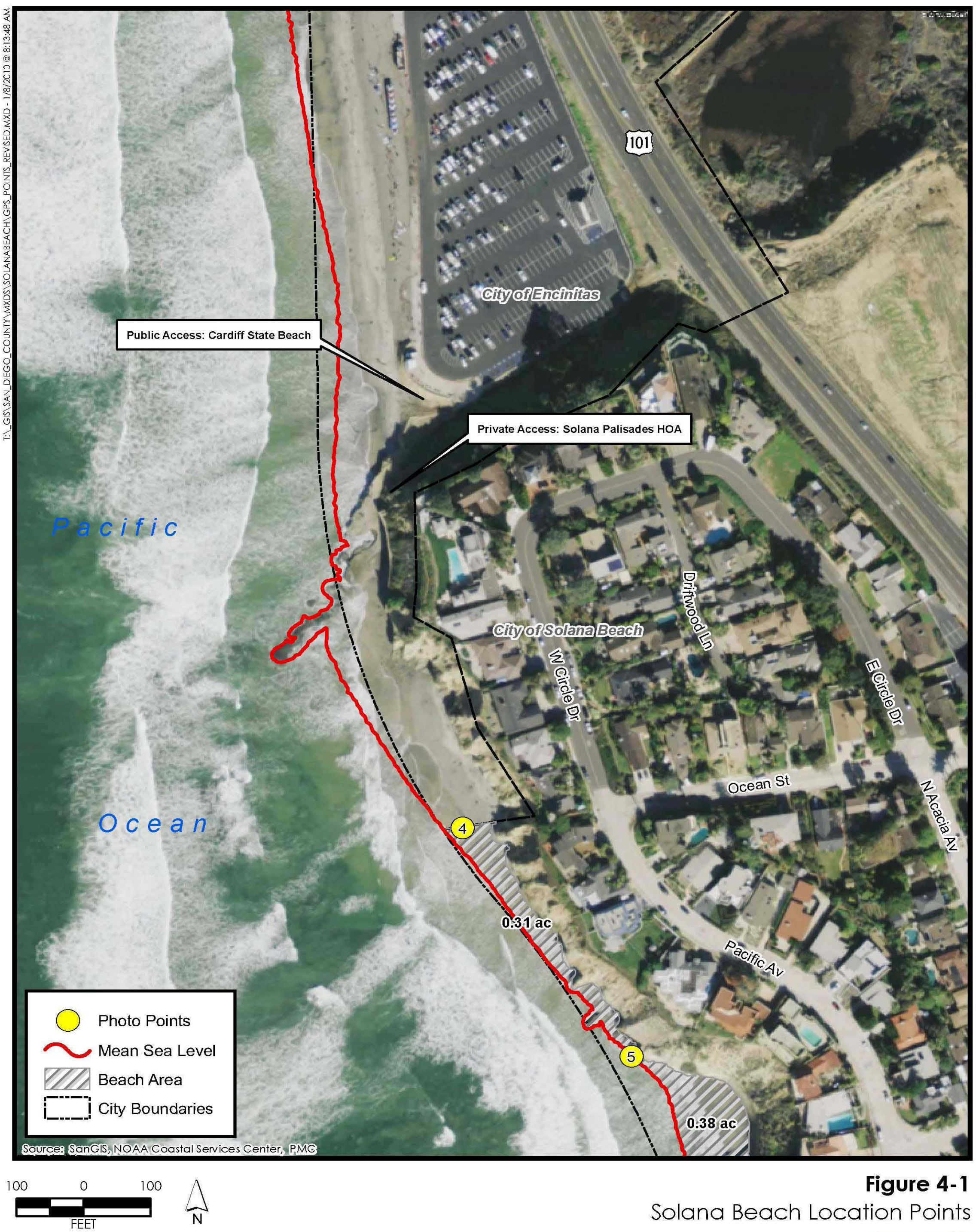

Figure 4-1
Solana Beach Location Points

PMC

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Figure 4-2
Solana Beach Location Points

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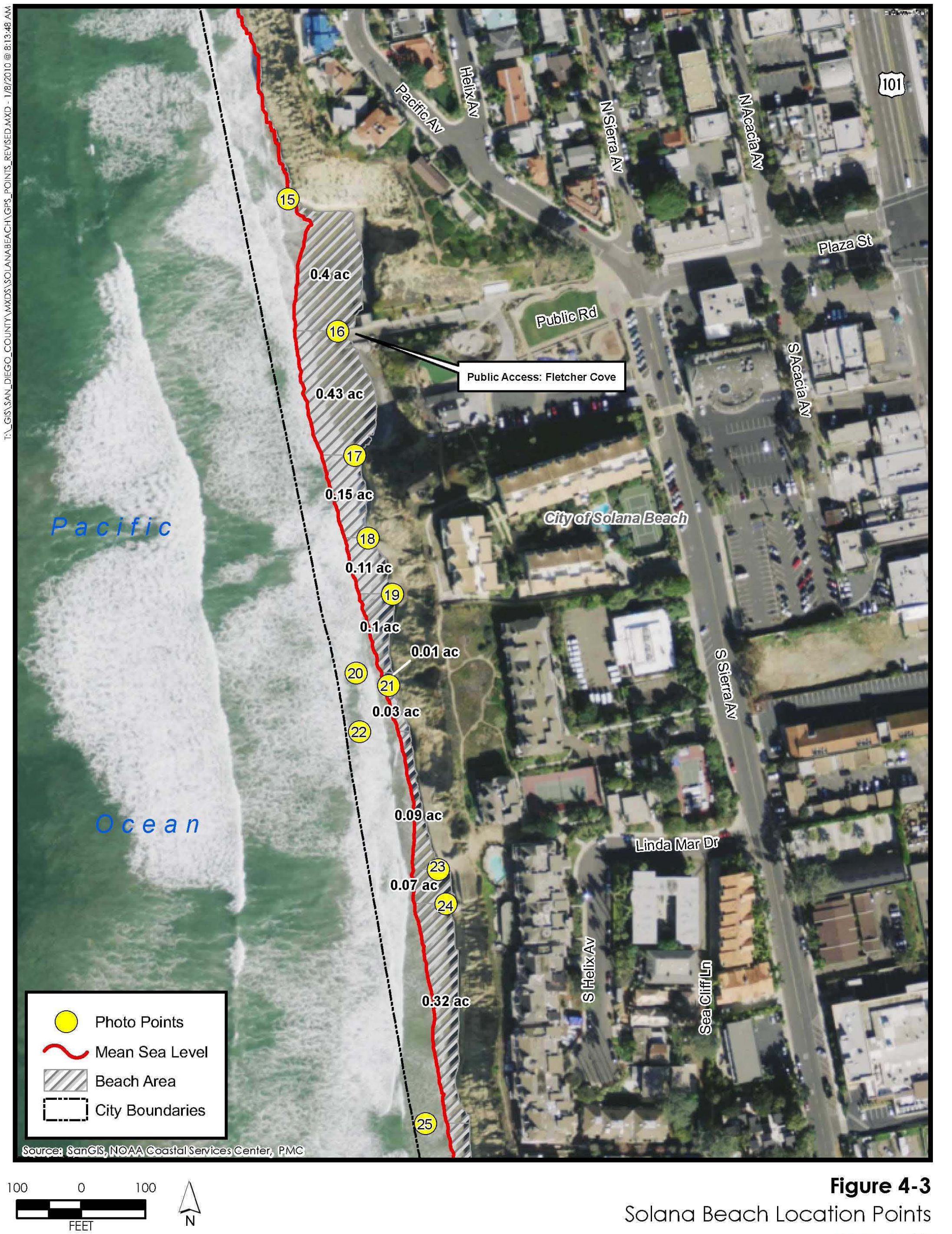

Figure 4-3
Solana Beach Location Points

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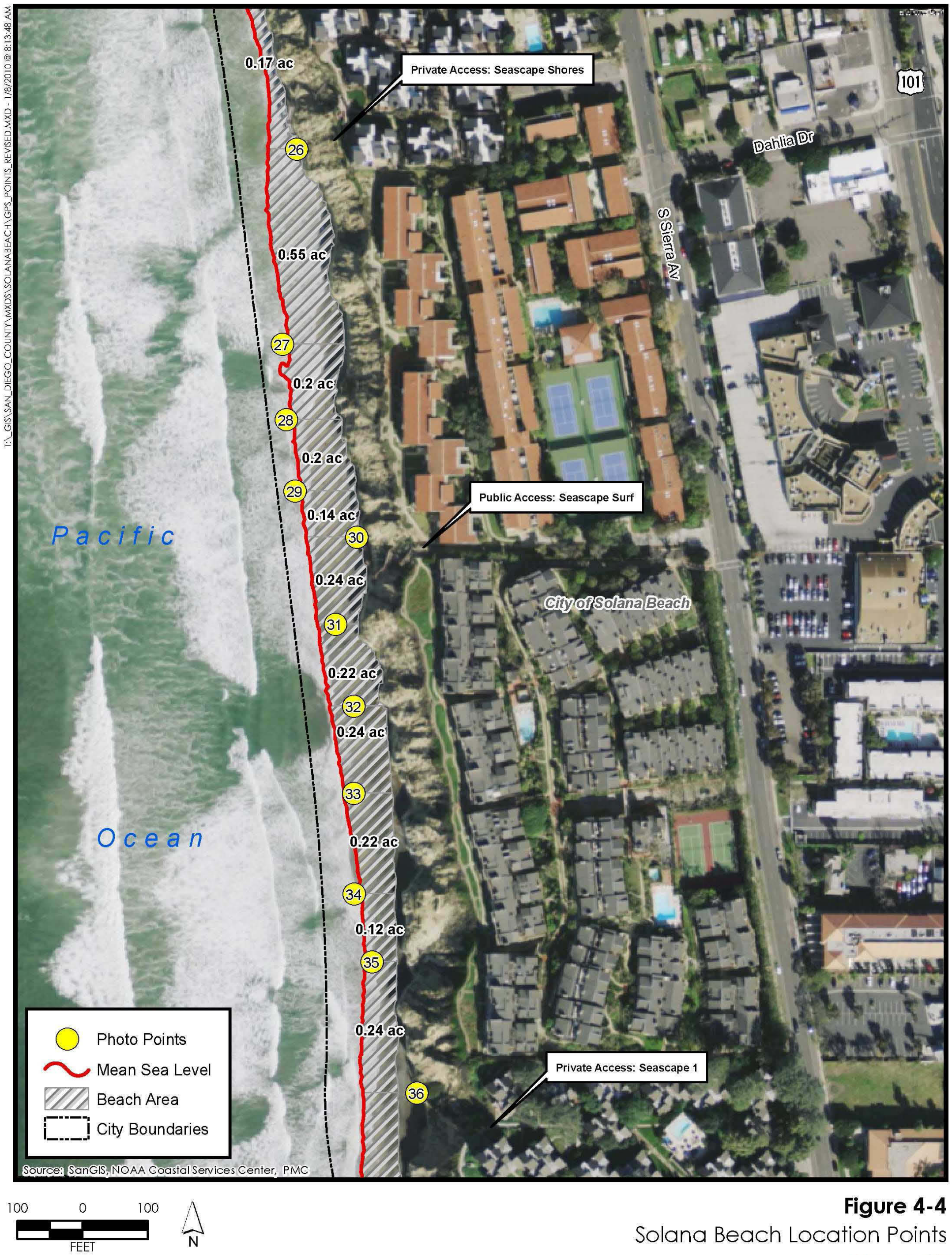

Figure 4-4
Solana Beach Location Points

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Figure 4-5
Solana Beach Location Points

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BEACH AREA ESTIMATES

A critical factor in determining the recreational value per square foot of beach is the area of beach available. The width of the beach changes throughout the day and year depending on tides, beach nourishment, weather and sand volume and movement. Over the long-term, if sea level rises, this would also affect the beach area available to the public. Several methods were considered to determine beach availability, such as aerial mapping, direct measurement and evaluating beach topography and tide elevation data. However, as the beach area is dependent on dynamic coastal processes, and that level of analysis is beyond the scope of this report, PMC reviewed existing, available data for applicability to this project. The average beach width is on the order of 50 feet measured from the toe of the cliff to the approximate mean sea level contour. (Mean sea level contour is estimated from LIDAR data available from UCSD[3].)

The beach areas shown in the Figures were consolidated for the entire Solana Beach coast. Table 4-1 reflects the 35 segments, the estimated beach value by segment and the overall beach area to determine an average annual Land Lease Rate of ~~$4.80~~ $6.02 per square foot (~~$1.71~~$2.14 million divided by 8.18 acres).

TABLE 4-1 LAND LEASE RATE

Segment	Annual Recreational Value	Area (ac)[1]	Segment	Annual Recreational Value	Area (ac)[1]
1	$ 120,773	0.31	19	$ 25,534	0.07
2	$ 101,450	0.38	20	$ 20,704	0.32
3	$ 30,365	0.07	21	$ 44,514	0.17
4	$ 18,633	0.06	22	$ 67,978	0.55
5	$ 16,907	0.04	23	$ 64,871	0.20
6	$ 20,359	0.18	24	$ 63,492	0.20
7	$ 11,387	0.15	25	$ 59,006	0.14
8	$ 15,528	0.45	26	$ 62,803	0.24
9	$ 4,831	0.21	27	$ 68,668	0.22
10	$ 77,295	0.55	28	$ 73,498	0.24
11	$ 271,911	0.40	29	$ 51,416	0.22
12	$ 240,165	0.43	30	$ 41,752	0.12
13	$ 41,408	0.15	31	$ 29,331	0.24
14	$ 46,238	0.11	32	$ 58,662	0.58
15	$ 24,500	0.10	33	$ 95,928	0.25
16	$ 5,867	0.01	34	$ 204,969	0.57
17	$ 16,563	0.03	35	$ 27,605	0.13
18	$ 20,014	0.09			
Total				$ 2,144,925	8.18
Annual Land Lease Rate per acre				$ 262,200	
Annual Land Lease Rate per square foot				$ 6.02	

1 There are 43,560 square feet per acre.

[3] Data obtained on 9/17/09 created by Southern California Beach Processes Study (SCBPS)/Coastal Data Information Program (CDIP) part of Scripps Institution of Oceanography (SIO) in cooperation with Bureau of Economic Geology, University of Texas at Austin as published in: NOAA's Ocean Service, Coastal Services Center (CSC), Charleston, SC.

SAMPLE FEE CALCULATION

A sample calculation for the Land Lease/Recreation Fee is shown below using the Land Lease Rate of ~~$4.80~~$6.02 per square foot. Assuming the lease is to begin this year (2010) and continues through 2081, a linear erosion rate of 0.4' per year, a wall thickness of 2' and a 50' long wall, the total Land Lease/Recreation Fee would be ~~$286,848~~$359,800. The net present value of the fee assuming a discount rate of 2% over the period results in a total fee of ~~$123,571~~$155,000 or ~~$2,471~~$3,100 per linear foot. Table 4-2 shows the calculation of the land lease area for each year the structure is in place.

TABLE 4-2
ANNUAL LAND LEASE AREA

Year of Lease	Estimated Erosion (ft)	Estimated Lease Area[1]	Year of Lease	Estimated Erosion (ft)	Estimated Lease Area[1]	Year of Lease	Estimated Erosion (ft)	Estimated Lease Area[1]
1	0.4	120 sf	25	10.0	600 sf	49	19.6	1080 sf
2	0.8	140 sf	26	10.4	620 sf	50	20.0	1100 sf
3	1.2	160 sf	27	10.8	640 sf	51	20.4	1120 sf
4	1.6	180 sf	28	11.2	660 sf	52	20.8	1140 sf
5	2.0	200 sf	29	11.6	680 sf	53	21.2	1160 sf
6	2.4	220 sf	30	12.0	700 sf	54	21.6	1180 sf
7	2.8	240 sf	31	12.4	720 sf	55	22.0	1200 sf
8	3.2	260 sf	32	12.8	740 sf	56	22.4	1220 sf
9	3.6	280 sf	33	13.2	760 sf	57	22.8	1240 sf
10	4.0	300 sf	34	13.6	780 sf	58	23.2	1260 sf
11	4.4	320 sf	35	14.0	800 sf	59	23.6	1280 sf
12	4.8	340 sf	36	14.4	820 sf	60	24.0	1300 sf
13	5.2	360 sf	37	14.8	840 sf	61	24.4	1320 sf
14	5.6	380 sf	38	15.2	860 sf	62	24.8	1340 sf
15	6.0	400 sf	39	15.6	880 sf	63	25.2	1360 sf
16	6.4	420 sf	40	16.0	900 sf	64	25.6	1380 sf
17	6.8	440 sf	41	16.4	920 sf	65	26.0	1400 sf
18	7.2	460 sf	42	16.8	940 sf	66	26.4	1420 sf
19	7.6	480 sf	43	17.2	960 sf	67	26.8	1440 sf
20	8.0	500 sf	44	17.6	980 sf	68	27.2	1460 sf
21	8.4	520 sf	45	18.0	1000 sf	69	27.6	1480 sf
22	8.8	540 sf	46	18.4	1020 sf	70	28.0	1500 sf
23	9.2	560 sf	47	18.8	1040 sf	71	28.4	1520 sf
24	9.6	580 sf	48	19.2	1060 sf	72	28.8	1540 sf

[1] Estimated lease area based on assumption of a seawall thickness of 2' extending 50' along the bluff plus the area that would have been available that year for recreational use had the seawall not been constructed and erosion allowed to occur.

The land lease rate of ~~$4.80~~$6.02 per square foot applies to the area that the wall occupies as well as to the area that would have been available for recreational purposes had erosion been allowed to occur. So each year, the area leased increases by the erosion rate multiplied by the wall length as shown in Table 4-2 and Figures 4-6A and 4-6B.

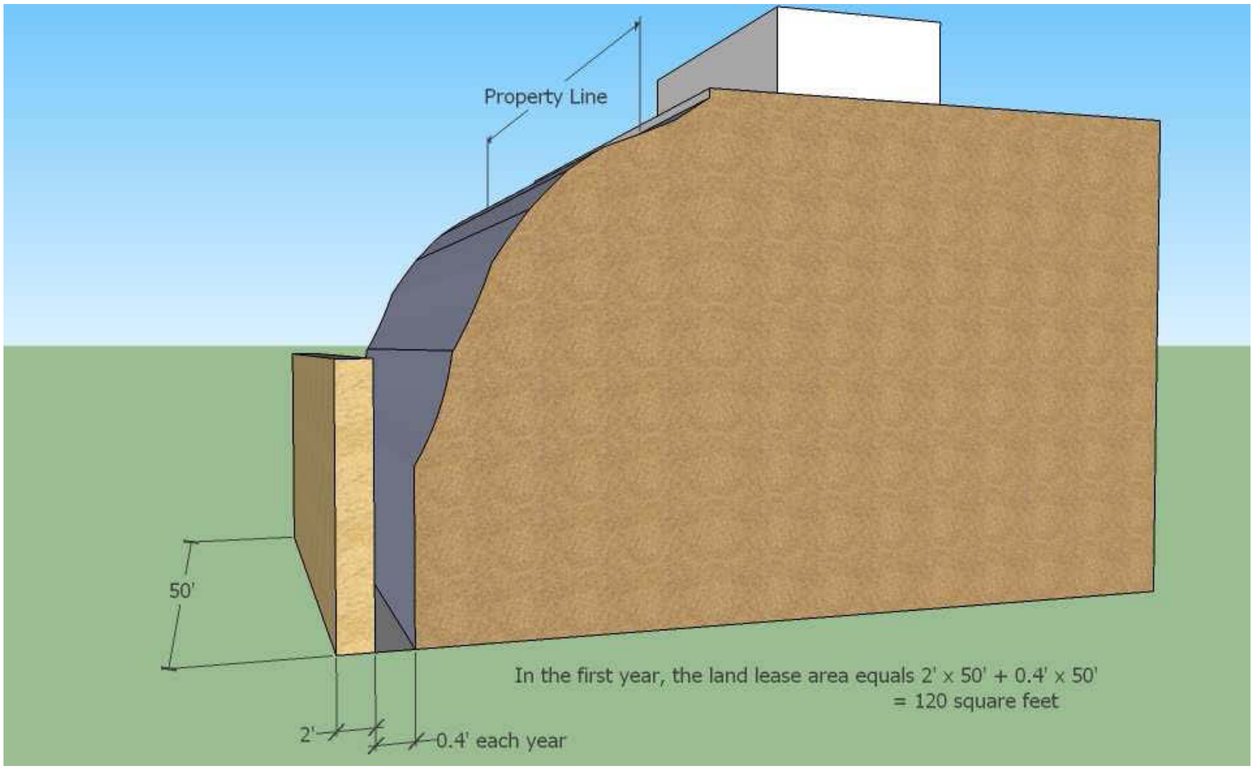

FIGURE 4-6A – LAND LEASE AREA FOR FIRST YEAR

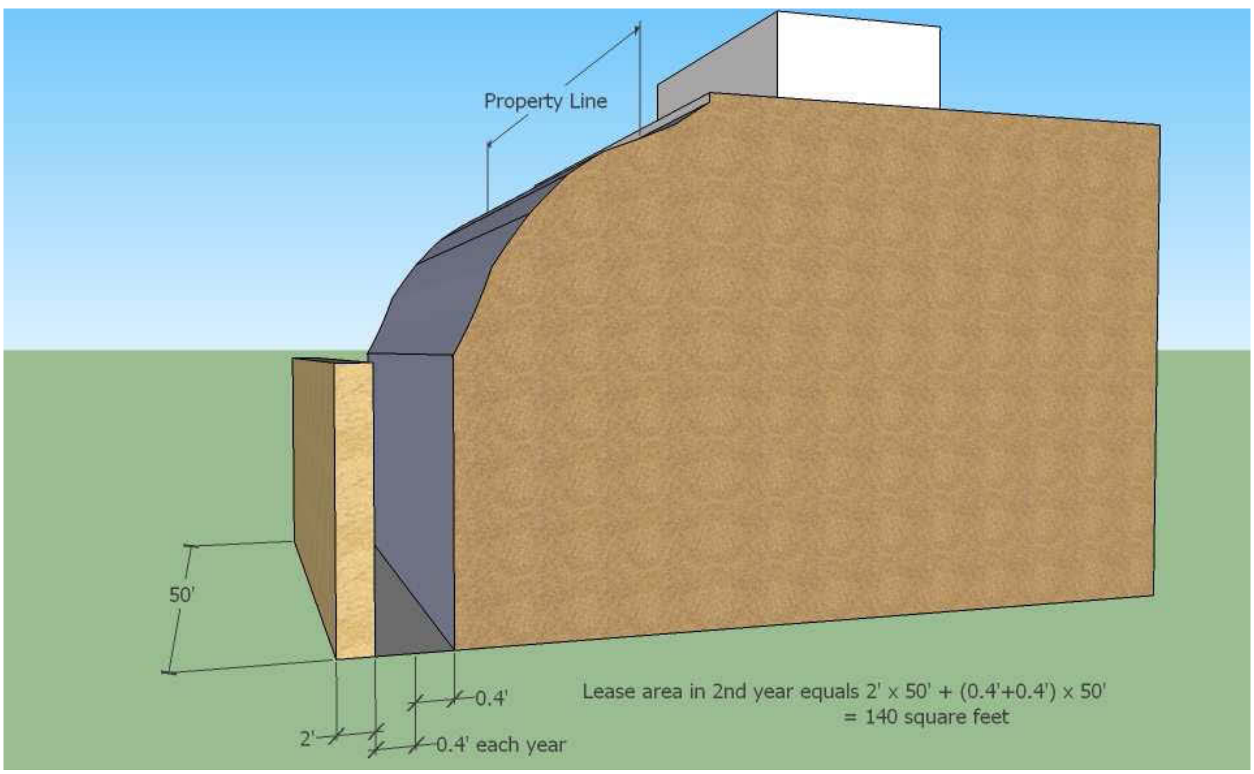

FIGURE 4-6B - LAND LEASE AREA FOR SECOND YEAR

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Table 4-3 shows the annual Land Lease Amount based on the Land Lease Areas shown in Table 4-2 and the Land Lease Rate of ~~$4.80~~$6.02 per square foot. The Net Present Value of the annual Land Lease Amount is shown as well based on a discount rate of 2%.

TABLE 4-3
ANNUAL LAND LEASE AMOUNT

Year of Lease	Estimated Lease Area[1]	Annual Lease Amount	NPV of Annual Lease Amount	Year of Lease	Estimated Lease Area[1]	Annual Lease Amount	NPV of Annual Lease Amount
1	120 sf	$ 722	$ 722	37	840 sf	$ 5,057	$ 2,479
2	140 sf	$ 843	$ 826	38	860 sf	$ 5,177	$ 2,488
3	160 sf	$ 963	$ 926	39	880 sf	$ 5,298	$ 2,496
4	180 sf	$ 1,084	$ 1,021	40	900 sf	$ 5,418	$ 2,503
5	200 sf	$ 1,204	$ 1,112	41	920 sf	$ 5,538	$ 2,508
6	220 sf	$ 1,324	$ 1,200	42	940 sf	$ 5,659	$ 2,513
7	240 sf	$ 1,445	$ 1,283	43	960 sf	$ 5,779	$ 2,516
8	260 sf	$ 1,565	$ 1,363	44	980 sf	$ 5,900	$ 2,518
9	280 sf	$ 1,686	$ 1,439	45	1000 sf	$ 6,020	$ 2,519
10	300 sf	$ 1,806	$ 1,511	46	1020 sf	$ 6,140	$ 2,519
11	320 sf	$ 1,926	$ 1,580	47	1040 sf	$ 6,261	$ 2,518
12	340 sf	$ 2,047	$ 1,646	48	1060 sf	$ 6,381	$ 2,516
13	360 sf	$ 2,167	$ 1,709	49	1080 sf	$ 6,502	$ 2,513
14	380 sf	$ 2,288	$ 1,768	50	1100 sf	$ 6,622	$ 2,509
15	400 sf	$ 2,408	$ 1,825	51	1120 sf	$ 6,742	$ 2,505
16	420 sf	$ 2,528	$ 1,879	52	1140 sf	$ 6,863	$ 2,500
17	440 sf	$ 2,649	$ 1,930	53	1160 sf	$ 6,983	$ 2,494
18	460 sf	$ 2,769	$ 1,978	54	1180 sf	$ 7,104	$ 2,487
19	480 sf	$ 2,890	$ 2,023	55	1200 sf	$ 7,224	$ 2,480
20	500 sf	$ 3,010	$ 2,066	56	1220 sf	$ 7,344	$ 2,471
21	520 sf	$ 3,130	$ 2,107	57	1240 sf	$ 7,465	$ 2,463
22	540 sf	$ 3,251	$ 2,145	58	1260 sf	$ 7,585	$ 2,453
23	560 sf	$ 3,371	$ 2,181	59	1280 sf	$ 7,706	$ 2,443
24	580 sf	$ 3,492	$ 2,214	60	1300 sf	$ 7,826	$ 2,433
25	600 sf	$ 3,612	$ 2,246	61	1320 sf	$ 7,946	$ 2,422
26	620 sf	$ 3,732	$ 2,275	62	1340 sf	$ 8,067	$ 2,410
27	640 sf	$ 3,853	$ 2,302	63	1360 sf	$ 8,187	$ 2,398
28	660 sf	$ 3,973	$ 2,328	64	1380 sf	$ 8,308	$ 2,386
29	680 sf	$ 4,094	$ 2,351	65	1400 sf	$ 8,428	$ 2,373
30	700 sf	$ 4,214	$ 2,373	66	1420 sf	$ 8,548	$ 2,360
31	720 sf	$ 4,334	$ 2,393	67	1440 sf	$ 8,669	$ 2,346
32	740 sf	$ 4,455	$ 2,411	68	1460 sf	$ 8,789	$ 2,332
33	760 sf	$ 4,575	$ 2,428	69	1480 sf	$ 8,910	$ 2,318
34	780 sf	$ 4,696	$ 2,443	70	1500 sf	$ 9,030	$ 2,303
35	800 sf	$ 4,816	$ 2,456	71	1520 sf	$ 9,150	$ 2,288
36	820 sf	$ 4,936	$ 2,468	72	1540 sf	$ 9,271	$ 2,273
Total						$ 359,755	$ 154,981

Based on an average Land Lease Rate of $6.02 per square foot.
NPV calculated assuming a discount rate of 2%.
For those projects permitted prior to 2010, see appendix.

As stated in the Draft LCP Land Use Plan, the public land lease area is limited by the seaward fee simple property line of the subject bluff property. However, if erosion had been allowed to occur, the property line would recede easterly. Consequently, the Land Lease Area theoretically (and it follows then that the Land Lease/Recreation Fee) is not affected by the location of the property line.

The Land Lease/Recreation Fee varies by the number of years the bluff armoring structure is in place. Table 4-4 reflects the varying rate (as measured in present value and per linear foot of wall) by number of years of lease assuming 50-foot long wall, with a 2-foot thickness and a coastal erosion rate of 0.4 feet per year. The Cumulative Lease Amount is the sum of the annual Land Lease Amounts shown in Table 4.3. For example, if the lease is for 72 years, the Cumulative Lease Amount is equal to the sum of the Annual Lease Amount for years 1 through 72 (shown in Table 4-4). If the lease is for 71 years, the Cumulative Lease Amount is equal to the sum of the Annual Lease Amount for years 1 through 71, and so forth. The Cumulative NPV of Lease Amount follows the same approach but using the NPV Annual Lease Amount column shown in Table 4-3. The Land Lease Fee per lf (NPV) column reflects the Land Lease/Recreation Fee per linear foot depending on the year the structure is permitted. This latter column is provided for calculating the fee for walls other than 50 feet long. As shown in Table 4-4 the longer the lease, the higher the Land Lease/Recreation Fee will be.

TABLE 4-4
LAND LEASE/RECREATION FEE FOR NUMBER OF YEARS LAND IS LEASED

If Permitted in Year:	Number of Years of Lease	Cumulative Lease Amount	Cumulative NPV of Lease Amount	Land Lease Fee per lf (NPV)
2010	72	$359,755	$ 154,979	$ 3,100
2011	71	$350,484	$ 152,706	$ 3,054
2012	70	$341,334	$ 150,418	$ 3,008
2013	69	$332,304	$ 148,116	$ 2,962
2014	68	$323,394	$ 145,798	$ 2,916
2015	67	$314,605	$ 143,466	$ 2,869
2016	66	$305,936	$ 141,120	$ 2,822
2017	65	$297,388	$ 138,760	$ 2,775
2018	64	$288,960	$ 136,387	$ 2,728
2019	63	$280,652	$ 134,001	$ 2,680
2020	62	$272,465	$ 131,602	$ 2,632
2021	61	$264,398	$ 129,192	$ 2,584
2022	60	$256,452	$ 126,770	$ 2,535
2023	59	$248,626	$ 124,337	$ 2,487
2024	58	$240,920	$ 121,894	$ 2,438
2025	57	$233,335	$ 119,440	$ 2,389
2026	56	$225,870	$ 116,978	$ 2,340
2027	55	$218,526	$ 114,506	$ 2,290
2028	54	$211,302	$ 112,027	$ 2,241
2029	53	$204,198	$ 109,540	$ 2,191
2030	52	$197,215	$ 107,046	$ 2,141
2031	51	$190,352	$ 104,546	$ 2,091
2032	50	$183,610	$ 102,041	$ 2,041
2033	49	$176,988	$ 99,532	$ 1,991
2034	48	$170,486	$ 97,019	$ 1,940
2035	47	$164,105	$ 94,503	$ 1,890
2036	46	$157,844	$ 91,985	$ 1,840
2037	45	$151,704	$ 89,466	$ 1,789
2038	44	$145,684	$ 86,948	$ 1,739
2039	43	$139,784	$ 84,430	$ 1,689
2040	42	$134,005	$ 81,914	$ 1,638

TABLE 4-4 (CONTINUED)
LAND LEASE/RECREATION FEE FOR NUMBER OF YEARS LAND IS LEASED

If Permitted in Year:	Number of Years of Lease	Cumulative Lease Amount	Cumulative NPV of Lease Amount	Land Lease Fee per lf (NPV)
2041	41	$128,346	$ 79,402	$ 1,588
2042	40	$122,808	$ 76,893	$ 1,538
2043	39	$117,390	$ 74,390	$ 1,488
2044	38	$112,092	$ 71,894	$ 1,438
2045	37	$106,915	$ 69,406	$ 1,388
2046	36	$101,858	$ 66,927	$ 1,339
2047	35	$96,922	$ 64,459	$ 1,289
2048	34	$92,106	$ 62,002	$ 1,240
2049	33	$87,410	$ 59,560	$ 1,191
2050	32	$82,835	$ 57,132	$ 1,143
2051	31	$78,380	$ 54,721	$ 1,094
2052	30	$74,046	$ 52,328	$ 1,047
2053	29	$69,832	$ 49,955	$ 999
2054	28	$65,738	$ 47,604	$ 952
2055	27	$61,765	$ 45,276	$ 906
2056	26	$57,912	$ 42,974	$ 859
2057	25	$54,180	$ 40,699	$ 814
2058	24	$50,568	$ 38,453	$ 769
2059	23	$47,076	$ 36,239	$ 725
2060	22	$43,705	$ 34,058	$ 681
2061	21	$40,454	$ 31,913	$ 638
2062	20	$37,324	$ 29,807	$ 596
2063	19	$34,314	$ 27,740	$ 555
2064	18	$31,424	$ 25,717	$ 514
2065	17	$28,655	$ 23,740	$ 475
2066	16	$26,006	$ 21,810	$ 436
2067	15	$23,478	$ 19,931	$ 399
2068	14	$21,070	$ 18,106	$ 362
2069	13	$18,782	$ 16,338	$ 327
2070	12	$16,615	$ 14,629	$ 293
2071	11	$14,568	$ 12,983	$ 260
2072	10	$12,642	$ 11,403	$ 228
2073	9	$10,836	$ 9,892	$ 198
2074	8	$9,150	$ 8,453	$ 169
2075	7	$7,585	$ 7,090	$ 142
2076	6	$6,140	$ 5,807	$ 116
2077	5	$4,816	$ 4,608	$ 92
2078	4	$3,612	$ 3,496	$ 70
2079	3	$2,528	$ 2,474	$ 49
2080	2	$1,565	$ 1,549	$ 31
2081	1	$722	$ 722	$ 14

Property line moves easterly as cliff erodes.
Present value calculated using a discount rate of 2%.
Number of years of lease includes year permitted through 2081.

Based on the above table, if a permit for construction is issued in 2010, there would be 72 years of lease and the Land Lease/Recreation Fee would be paid in full at a rate of ~~$2,471~~$3,100 per linear foot. If a permit for construction is issued in 2020, there would be 62 years of lease and the Land Lease/Recreation Fee would be paid in full at a rate of ~~$2,099~~$2,632 per linear foot of wall.

If a permit for construction is issued in 2070, there would be only 12 years of lease and the Land Lease/Recreation Fee would be paid in full at a rate of ~~$233~~$293 per linear foot of wall. It should be noted that this latter case is unlikely to occur. The LCP Land Use Plan, once approved, only covers the planning horizon through 2081 so the expense of the wall is likely too high for such a short term use. Secondly, it is anticipated that there will be updates to the LCP Land Use Plan that would control the requirements for coastal development. And lastly, the Draft LCP Land Use Plan provides for updating the variables and/or assumptions used in the fee calculation. The information for the latter years shown in Table 4-3 then is for informational purposes only and for completeness of data. It is anticipated that the Land Lease/Recreation Fee will be updated before the end of 2081.

As shown in Table 4-4, the cumulative fee amount for a 50-foot long wall would be ~~$286,848~~$359,800 and the corresponding Net Present Value is ~~$123,571~~$155,000, if permitted in 2010. The City currently collects a deposit of $1,000 per linear foot of wall. This means the City would have collected $50,000 to date for a 50-foot long wall. Not considering potential offsets to the Land Lease/Recreation Fee, the property owner would then be responsible for the difference equal to ~~$73,571~~$105,000 plus the Sand Mitigation Fee amount.

As provided for in the Draft LCP Land Use Plan, the property owner has the option of paying 1/3rd of the fee initially and amortizing the balance through 2081, at an interest rate to be determined by the City.

For those projects permitted prior to 2010, refer to the Appendix for the Land Lease/Recreation Fee.

The following chapter discusses the potential offset to the Land Lease/Recreation Fee and Sand Mitigation Fee.

5. OFFSETS

OVERVIEW

As part of the fee determination process, the Draft LCP Land Use Plan contemplates an offset to those fees for any proven quantified monetary public benefit flowing from a Coastal Structure, Sea Cave or Notch Infill (collectively referred to as a bluff retention device (BRD)) that exceeds the quantified monetary private benefit.

The Draft LCP Land Use Plan Policy 4.61 states, in part:

> The benefits to the City and the public, as determined by Council action, and approved by the Coastal Commission, that are associated with the Bluff Retention Device shall be offset against any such fees in accordance with Policy 4.80.

This chapter identifies the potential offset credits for Council consideration based on:

- Public Safety
- Protection of Public infrastructure/Access
- Property tax revenue increase

Based on a typical example provided later in this chapter, where the Land Lease/Recreation Fee is assumed to be $123,550 for a 50-foot BRD, the private benefit is estimated at $250,000 and the public benefit at$192,860. Consequently, no offset would be applied to the payment of the Sand Mitigation and Land Lease/Recreation Fees. Also note that the example assumed a Land Lease/Recreation Fee payment of ~~$2,471~~$3,100 per linear foot; it does not address the Sand Mitigation Fee. The City currently collects $1,000 as a deposit toward the Sand Mitigation Fee and Land Lease/Recreation Fee.

The following analysis considers only quantifiable offset amounts. It does not consider "negative" offset credits such as loss of quality of beach experience, aesthetics, etc.

BASIS OF THE PUBLIC BENEFITS OFFSET CREDIT

The Solana Beach Local Coastal Program, Land Use Plan Policy 4.80 under the heading of "Mitigation Offset Credit", states the following:

> The Sand Mitigation and Land Lease/Recreation Fees shall be offset over time by an amount determined by the City Council, after a public hearing to account for any proven quantified monetary public benefit flowing from the Bluff Retention Device that exceeds the quantified monetary private benefit (e.g., the increase in the value of the Bluff Property). Any such credit shall also be adjusted as referenced above in Policy 4.80

and shall not exceed the dollar amount of the total of the Sand Mitigation and Land Lease/Recreation Fee paid by the Bluff Property Owner.

The public benefit offset credit is therefore associated with the private benefit realized from the construction of a bluff retention device (BRD) and is limited by two quantities:

1) The amount which the public benefit exceeds the private benefit, and;

2) The total of the Sand Mitigation and Land Lease/Recreation Fees.

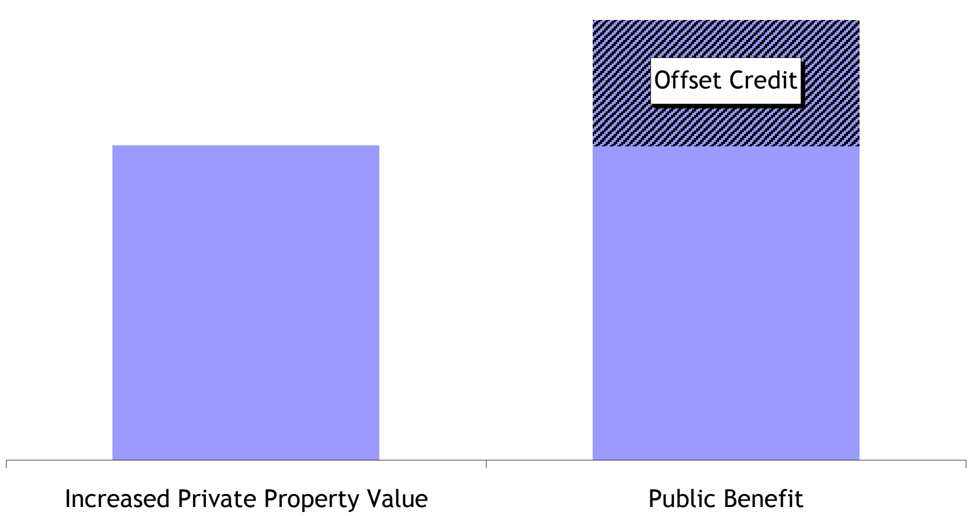
The first limiting quantity derives from the presumption that while the public may benefit from the BRD, the bluff top property owner also benefits from the BRD which is placed on public property and enhances the stability of the bluff and therefore the value of the bluff top property. If these two benefits are equal there should be no offset, since the public and the property-owner are deriving the same utility from the BRD. However, if the public's benefit exceeds the private benefit then the property owner is seen as subsidizing the public (or, conversely, the public is benefiting at the property-owner's expense and as a result of their actions) in the amount of the difference. This subsidy is eliminated if the Sand Mitigation and Land Lease/Recreation Fees (mitigation fees) are offset by the amount of the difference.

From the above policy considerations arise at least two potential outcomes:

1) The real increase in property values attributable to the BRD will exceed any quantifiable public benefit and thus no offset would ensue.

2) Public benefits will exceed any increase in real property values attributable to the BRD; therefore an offset in the amount of the difference should be applied, even to the extent that the net fee is zero.

FIGURE 5-1 OFFSET CREDIT



Derivation of the Offset Credit

To establish the applicable offset credit requires that public benefits be quantified. The most direct way to quantify these benefits is to evaluate the costs that the public would have incurred over a period of time had the BRD not been in place. Therefore benefits may be assumed as stemming from the avoidance of costs absorbed by the public (either the general public or the City itself). The public costs correspond to the quantifiable public benefits created by constructing a BRD, which may include:

- Public safety
- Protection of public property and infrastructure, including but not limited to public beach access, parking lots, public roads etc.
- Increased taxable assessed private property valuation

The corresponding real costs from bluff erosion and eventual failure include: injury and loss of life, damage and/or destruction to city property and infrastructure (access stairways, roadways, utilities, city-owned buildings) potential loss of sales tax revenues from fewer visitors and private property losses leading to reduced assessed property valuations and taxes collected.

These costs are due to episodic geologic events: damage to public infrastructure and claims due to loss of life and limb that may occur from a single bluff failure episode or series of episodes over the course of time.

Episodic Cost Evaluation – Probabilistic Event Modeling

Evaluation of the expected episodic cost involves the likelihood that a bluff failure causing a specified loss occurs within a given period of time and the quantification of that loss. In any one year, the cost can be represented by the following formula, which is specific to a particular bluff location:

Expected cost in year (i) = Probability of a cost-incurring event in year (i) x Cost of Event

For some costs, damage to infrastructure or bluff-top homes for example, the probability will be zero throughout many of the earlier years until progressive bluff retreat begins to threaten landward infrastructure and properties.

On the other hand, for any given location along the bluff face there is a non-zero probability of a bluff failure in any one year having the potential to cause injury or death. The probability of failure is a function of the bluff stability which is related to the bluff factor of safety and may be assigned a value (from zero to 1) based on the geologic characteristics of the particular section of bluff. The likelihood of a bluff failure causing injury or death is increased by the density of beach users. The loss due to injury or death may be formulated as follows:

Expected cost due to injury or death = P(SF) x M x D x C

Where:

P(SF) = Probability of bluff failure in a location as a function of a bluff stability conditions described by a site geologic assessment[4];

M = Mortality factor, is the rate at which bluff failure causes death or injury. It is determined by dividing total number of documented bluff failures that have occurred over a given period of time in a given section of beach by the number of fatalities or injuries as a direct result of bluff failures over that same period within the same section;

D = Beach occupancy density factor that shall be defined as the ratio of the average occupancy per unit length of beach at the particular location, as determined by the zonal beach survey data, to the average occupancy per unit length of the entire relevant study area;

C = Mortality cost factor is the cost of a single death. The Environmental Protection Agency's statistical value of $6.9 million is used as the cost factor.[5]

Average Fatality Loss over Encinitas-Solana Beaches 1990-2009

An average fatality loss analysis requires two sets of data:

- the number of bluff failures that have occurred during a specified period of time; and
- the number of fatalities that occurred as a result of the bluff failures.

No bluff-related fatalities have occurred along Solana Beach since documentation of bluff failures began. Therefore, in order to obtain failure-fatality data upon which to base an average fatality loss analysis it is necessary to extend the analysis beyond Solana Beach to include Encinitas where both failures and fatalities (one) have occurred. Over the 19 year period between 1990 and 2009 there were approximately 126 documented bluff failures along the Encinitas and Solana Beach coastlines, about 6.6 failures per year[6] One of these failures resulted in a fatality for a mortality rate per documented failure of 1/126 = 0.008.

The combined length of bluffs from Batiquitos Lagoon (South Carlsbad State Beach, at the southerly parking lot) to the southerly end of Solana Beach is approximately 17,300 feet[7]. From this data, a bluff failure rate for a segment of bluff corresponding to the width of a typical bluff

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[4] The probability of failure at a given bluff location may be related to the probability that internal resisting forces or capacity is less than the load or driving force at that location. Resistance and load are variables which are dependant on a basic set of site-specific parameters that are fundamentally uncertain, such as presence of internal cracks, water and sand lenses *(Lu, Qin and Williams pg 2746)*.

[5] "Value of Statistical Life Analysis and Environmental Policy: A White Paper", April, 2004, National Center for Environmental Economics, U.S. Environmental Protection Agency

[6] USACE 2000d, cited in California Beach Restoration Study report, Jan. 2002 and Solana Beach bluff failure log 2002-2009.

[7] Only beach frontage along sandstone bluffs that are geologically similar to those along Solana Beach were included in this total; measurements were taken from Google Earth and the California Coastal Records Project series of oblique photos.

property in Solana Beach, 50 feet, is approximately 0.019 failures per year is calculated (6.6/346 50-foot segments). This is the overall failure rate along the bluff face in any given year and does not consider the specific bluff conditions with respect to failure at any particular location. The product of the rate of bluff failure, the mortality rate and the statistical value of life equals the expected cost per year due to loss of life from bluff failures: 0.019 x 0.008 x $6,900,000 = $1,049 per year per 50 foot section of bluff.

Geologic Basis of Events – Sea Cliff Bluff Erosion and Failure

Bluff failure that results in loss of property or life is part of a complex series of events involving several geologic processes that begin with marine erosion causing the characteristic notching at the base of the Torrey Sandstone (sea cliff or lower) bluff. The Torrey Sandstone formation is resistant relative to the Pleistocene terrace sands which it underlies. The sandstone bluff face rises from a wave-cut platform that supports a fairly thin covering of beach sand. The presence of the wave-cut platform and the sand veneer to a great extent controls the marine erosion taking place at the base of the bluff. Marine erosion is the direct result of the impact of waves breaking on the bluff face. The force of translation waves–those that approach the shoreline--is a function of wave height and period. Wave height is limited by the still water depth at the bluff face; wave height is generally about 78% of still water depth. In order for a wave to break on the bluff face therefore, the platform and beach would have to be submerged. This condition occurs most frequently in the absence of beach sand, cobble or other material that would dissipate wave energy, such as sandstone from a fallen sea cliff or rip-rap placed for that purpose. At low tide waves crest away from the bluff face, expending much of their energy before reaching the bluff and therefore do not cause a significant amount of erosion[8]. The beach sand, cobble and other material, in effect, move the waterline seaward and away from the bluff creating a tide that is low relative to the bluff

Marine erosion, which creates the notches at the base of the bluff, is active whenever the sea level, tide, swells, barometric pressure, storm surge, and sea waves combine to form breaking waves on the bluff[9]. The erosive processes acting at the toe of the bluff involve abrasion, scouring, incision, and hydraulic fracturing of rock. These processes are incremental in the sense that notches may grow in depth and height without necessarily indicating an immediate bluff failure. Marine erosion is gradual and progressive until the intergranular shear force in the sandstone along the failure plane is overcome by the unsupported weight of the cliff above the notch and the terrace deposit above that. The likelihood of failure at any one point in time is a function of the degree to which the resistance of the rock to shear failure is greater than overburden load (i.e. "factor of safety").

[8] Crampton pg. 16

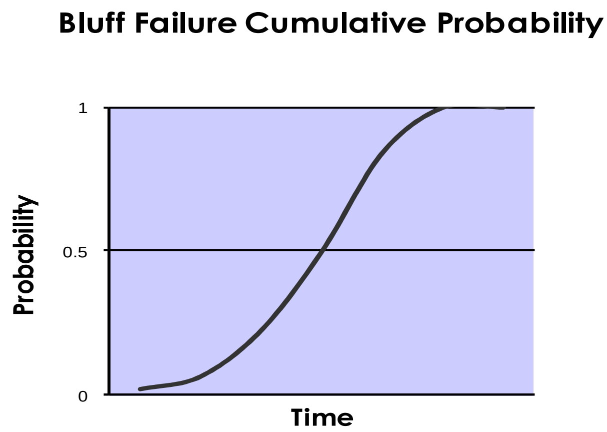
[9] Crampton pg. 37

Photo 1 – Showing the relatively vertical and resistant Torrey Sandstone with a notch developing at the base and the terrace deposit of the upper bluff sloping back above the sandstone.

Along with the marine erosion, which is limited to a certain height above the water surface, due to still water depth-limited wave height, but which in storm conditions can be 20 feet or more above the water surface, there occurs subaerial erosion (erosion that takes place above the water surface, caused by wind, rain, ocean spray, plant growth, drainage and other processes) acting on the higher portion of the Torrey Sandstone and on the sloping, less resistant terrace layer of the upper bluff. Although marine erosion is the dominant process, the subaerial processes create the upper bluff equilibrium slope angle (angle of repose) of around 34 degrees.

The continual undercutting of the bluff by marine erosion results in a second order increase in load (the load increases at an increasing rate over time) while resistive forces remain more or less constant. Therefore, at any given location along the bluff face the probability of failure (P_f) can be expected to increase over time. In order to evaluate the expected cost function in any single year, it is necessary to approximate what the value of P_f is for that year. In other words without the BRD, bluff stability can be expected to deteriorate according to a time-dependent, non-linear function. The following cumulative probability curve represents the increasing probability of failure as time and erosion progress:

FIGURE 5-2



The probability of failure may be stated as equal to the probability that resistance R is less than load L[10]:

$$P_f = P_r \{R<L\}$$

The condition R = L is the bluff failure state (i.e. when the factor of safety equals 1).

The expected values of resistance and load, calculated using given geotechnical parameters and the respective variance of resistance and load, derived from the range of values for the same parameters may be used to calculate a slope reliability index in place of a factor of safety or probability of failure[11], the reliability index is formulated as:

$$I_r = \frac{E[R] - E[L]}{\{V[R]+V[L]\}^{1/2}}$$

Where E[R] and E[L] are the calculated values of resistance and load respectively and V[R] and V[L] are the respective variances.

If the reliability index, I_r, is assumed to be distributed normally, then the probability of failure may be given as:

$$P_f = N(-I_r)$$

[10] *Baecher*

[11] The value of the ratio of resistive forces R to load L is the slope Factor of Safety: FS = R/L. In any given slope stability analysis both F and L are the expected values of normally distributed random variables that are estimated by geotechnical parameters: cohesion, friction angle and density. However, FS is not normally distributed and therefore no probability can be assigned directly, for example, to incipient failure at FS =1

N represents the cumulative normal function with a mean of zero (representing the limiting failure state) and standard deviation of one.[12]

Calculating Forces

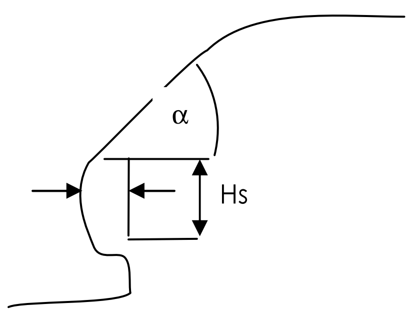
The complexity of the internal structure of the sandstone makes a deterministic prediction of when a notch or sea cave will collapse impractical[13]. In the above probability model the parameters of load and resistance are fundamentally dependent on notch depth and the cohesive strength of the sandstone.

The growth in notch depth caused by marine erosion is the fundamental process causing the overhanging load to eventually exceed the resistive forces. The horizontal increase in depth was formulated by Sunamura as a function of wave height and compressive strength of the eroding material.[14]

Simplified Notch Failure Model

A notch will fail when the weight of the overhang exceeds the internal cohesive forces acting along the vertical plane extending upward from the back of the notch:

FIGURE 5-3 NOTCH FAILURE



From the figure, the weight of the material above the notch, or L is:

$$\left[D\, H_s \delta_S + \frac{\delta_T\ D \tan \alpha}{2} \right]$$

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[12] This formulation using the probability of a given value of the reliability index is called a first-order second moment (FOSM) analysis and is typically used in place of factor of safety probability analysis to calibrate design safety parameters across different applications. Its use here is intended solely for the purpose of generating values of probabilities of bluff failure due to progressive marine erosion over a given period of time

[13] Lu

[14] Sunamura, Tsuguo, 1982. "A Predictive Model for Wave-Induced Cliff Erosion", *Journal of Geology*, Vol. 90

Where D is the notch depth perpendicular to the face, H_s is limited to the thickness of the Torrey Sandstone layer between the top of the notch and the interface with the Terrace Deposit (or clean sand lens), δ_s is the density of the sandstone and δ_T is the density of the surcharge material. The load moment acting at mid-point of the sandstone notch overhang is: LxD/2.

The load moment causes collapse by pulling the notch overhang down and away. The cohesion of the sandstone resists the load moment. The total resisting moment developed by the cohesion is $0.5C_sH_s^2$, where C_s is the cohesive strength of the sandstone. A factor of safety of one occurs when Resisting Moment = Load Moment.

Example calculation of failure probability with Initial Depth of 7 ft.:

Let: D = 7 ft.

H_s = 10 ft.

δ_S = 125 pcf , +/- 5pcf

δ_T = 120 pcf, +/- 5pcf

C_s= 800 psf,[15] +/- 200 psf

α = 40 degrees

Results:

Load moment = 39,260 ft.-lbs. per foot

Resisting moment = 42,660 ft.-lbs. per foot

Factor of Safety = 1.02

Reliability Index: I_r = .13

Probability of Failure: $N(-Ir)$ = .45

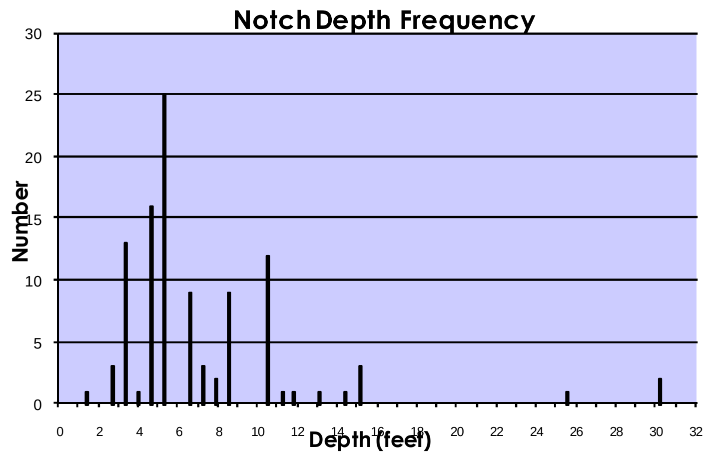
The simplified bluff failure model was calibrated to result in a bluff failure probability of .50 occurs when FS = 1 at a notch depth of approximately 7 feet. The 7-foot depth is the weighted average of the notch depths observed by TerraCosta Consulting as part of a study of bluff retreat during the period 1997-2000.[16] The chart below indicates the number of observed notch depths:

---

[15] The cohesive strength of the Torrey Sandstone is indicated in some reports as up to 3,000 psf *(Soils Engineering Construction)*. The above value of 800 +/- 200 psf reflects the in-situ condition of the sandstone considering weathering, groundwater, fracturing and other factors that would compromise intergranular integrity. Note also that the variance terms in the reliability index formula: V(R) and V(L) are functions of the given range in values of C_s and δ, respectively.

[16] Lu, Chia-Chi, Qin, Wenkai and Williams, Bruce "Statistical Simulation for Coastal Bluff Failure Induced by Storm Waves" in *Coastal Engineering, 2004*

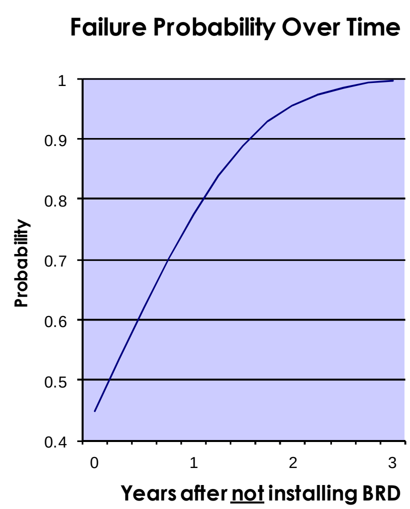
FIGURE 5 - 4



Very few notches were observed in excess of 15 feet, with 90% of the depths between 3 and 11 feet. Therefore, the weighted average depth was taken as the depth at which probability of failure is about 50%.

Figure 5 shows the increasing probability of failure that would occur over the immediate three year period had the BRD not been installed at the location described in the example. If the notch depth increases at rate of 0.4 feet per year, the probability of failure would approach 100% by the end of the third year:

FIGURE 5-5



Annual Failure Probability and Expected Loss

Since a bluff safety hazard exists in varying degrees at every point along the bluffs in Solana Beach, a bluff failure event resulting in a fatality may occur in any given year at any given location. The expected loss due to death over the entire period that the BRD would have been in place is therefore the summation of the individual annual incremental probabilities multiplied by the cost and density factors over the period of time. The expected loss is represented by the formula:

$$\Sigma \Delta P_i \times PAF \times M \times D \times SVL$$

ΔP_i = The spatial average increase in probability of bluff failure in year i for the site;

PAF = Probability Adjustment Factor is introduced to account for the fact that the cross-section shown in Figure 3 above is the most critical section of the notch where H_s is thinnest. At the ends of the notch the factor of safety would be much higher due to end friction with the failure probability approaching zero. In the example below PAF = 0.50, essentially averaging the maximum failure probability at the critical section with zero failure probability at the ends;

M = the mortality factor is 0.8% (1 fatality from approximately 126 reported bluff failures along Encinitas and Solana beaches, 1990-2009)[17];

D = the density factor, is a locational weighting factor and based on occupancy of section of beach along proposed BRD relative to the entire beach study area over which the mortality factor is calculated. D is assumed to be 1 in this example;

SVL = The current EPA's statistical value of life of $6.9 million (2008 dollars)

Each year, as the probability of failure increases, the expected loss from injury or death also increases and is cumulative over the failure cycle. The chart below calculates the expected loss due to bluff failure based on the notch depth increasing at 0.4 feet per year; this is the loss avoided by installing the BRD:

Years (after BRD is installed)	Notch Depth (feet)	Factor of Safety	Reliability Index	Probability	Incremental Increase in Probability of Failure (ΔP_i)	Probabilty Adjustment Factor	Loss per failure event (M x SVL)	Expected Loss Increment in Year i after Installation (ΔP x adj. factor x C)
0	7	1.02	0.13	0.45	-		-	-
1	7.4	0.90	-0.76	0.54	0.326	0.500	$55,200	$9,001
2	7.8	0.87	-1.71	0.62	0.180	0.500	$55,200	$4,980
3	8.2	0.85	-2.72	0.70	0.041	0.500	$55,200	$1,123
		Total expected loss which is avoided by installing BRD years 1 - 3:						$15,103

The total expected loss of $15,100 is the loss avoided during the <u>initial</u> failure cycle after installation of a BRD. In this example, with a Torrey Sandstone thickness of 10 feet and beginning notch depth of 7 feet and assuming notch depth erosion at 0.4 ft per year, bluff failures can be expected to occur every 21 years (the time required for the notch depth to grow from zero to 8.2 feet). Over the 72 years that the BRD is in place, the failure cycle would have repeated itself, beginning each cycle with a notch depth of zero, approximately 3.4 times. Using the same assumptions as in the chart above, the total benefit due to avoidance of injury or death over the 72 year period (including the initial failure cycle) is calculated at: $97,900 which is the sum of

[17] USACE 2000d, cited in California Beach Restoration Study report, Jan. 2002

the initial cycle (last three years at $15,100) plus three full 21-year cycles at $27,600 each. (Note that during one complete failure cycle, wherein it is virtually certain that a failure will occur, the expected loss is simply the mortality rate M x SVL x Probability Adjustment Factor: .008 x $6.9 million x .5). During the final five years of the 72 year period before BRD removal (what would have been the first five years of the fourth cycle), the failure probability and the expected loss is essentially zero *(see Figure 6)*.

For simplicity, the above example assumes that the bluff conditions, the incremental increase in probability ΔP_i and the other parameters, including the probability adjustment factor, are constant along the entire length of the proposed BRD. It is unlikely that the bluff conditions will be uniform in an actual application of the model. Where the conditions are observed to change significantly along the bluff, a series of cross-sectional analyses would be conducted over the length of the proposed BRD resulting in a series of expected loss values for each cross-section.

The site specific analysis above, which results in an expected avoided loss of $97,900 over a 72 year period is comparable to the avoided loss determined by applying the overall average public safety benefit of $20.98 per foot per year (which was found to occur over the entire Encinitas-Solana Beach) to a 50 foot-wide BRD (the typical length that would be installed to protect a bluff-top property located north of Fletcher Cove): 50ft.x72yrsx$20.98 = $75,528.

Offset to the Mitigation Fee

The calculation of potential offset to the mitigation fee requires an evaluation of the private as well as the public benefits attributable to the BRD. An example offset calculation is presented below that assumes the private benefit is equivalent to the construction cost of the BRD. We assume that whether a BRD is constructed or not, is an economic decision where the cost of the BRD is compared to the before and after differential of the value of the property that is to be protected. Presumably, one would not pay more to have a BRD constructed than the value such construction adds to the property. Consider the extreme case, where the before-BRD property value is zero (as in the case where, due to the geologic hazard, there would be no offers to purchase the property) and the after-BRD value is equal to the market value of similar, BRD-protected, bluff-top homes which is, for example, $3.5 million. The net property value increase/private benefit is $3.25 million (market value less the cost of a 50 foot BRD at $5,000 per foot). However, the extreme case neglects the latent value of the property that is inherent due to the possibility of remedying the geologic hazard by obtaining all necessary permit and approvals constructing a BRD. Therefore, the market would dictate that a minimum value exists for the market value of a bluff-top property before installation of a BRD that is equivalent to difference between full market value and the cost of a BRD that, if constructed, would restore the property to that full market value. A possible additional value-added increment that may also be considered is the current market differential between BRD-protected and non-BRD protected properties, if any such differential is found to exist among otherwise comparable properties.

In the following example, the higher of the two values of public safety benefit calculated above, $97,900 (the one calculated using a site-specific analysis), is added to the present value of the potential increased property tax revenue stream (due to the increase in property value) over 72 years--$94,960--and compared to the private benefit:

Offset Calculation

Public Benefit = Expected Avoided Loss over 72 years:	$97,900
Plus increased property tax revenue over 72 yrs (present valued)[b]:	$94,960
Total Public Benefit:	$192,860
Less Private Benefit (increased property value) attributable to BRD[a]:	($250,000)
Potential Offset: Net difference between private and public benefits:	($57,140)

[a] Valuation based on cost of BRD assuming 50 foot length, $5,000 per foot

[b] Total of property tax revenue (1% of the increase in assessed valuation) discounted at 2%

In this example the private benefit exceeds the total public benefit by $57,~~100~~140, thus there would be no offset to the mitigation fee. Note, also that the increased property value is assumed to occur with construction of the BRD. However, the trigger for assessing increased property value likely would not occur until after the sale of the property.

Key variables in the Probability Model

Expected avoided loss and the potential offset are dependent on several variables, either global or site specific. The site specific variables that could change are:

- Thickness of the Torrey Sandstone (dimension H_s between the top of notch and the Terrace Deposit. The probability of failure is sensitive to H_s—the thicker the sandstone layer above the top of the notch the less likelihood there is for notch collapse with any given notch depth. An increase of five feet, using $H_{s=}$15 in the above example (with a starting notch depth of 8.6 feet), results in a total expected loss of $89,239. (the relationship between notch depth and H_s is shown graphically in Figure 7)

- Beach occupancy or density factor in the example is given as 1, which implies that the occupancy of the beach area along the bluff face is equal to the average occupancy along the entire stretch of beach for which the bluff failure-mortality rate is calculated. For example, the total annual day-use attendance for Encinitas and Solana beaches (beach area over which the mortality rate is calculated) is about 2.7 million over a total beach length of approximately 8 miles, for an average of .06 annual person days per foot.[18] If the subject location is in an area with occupancy of .03 APD per foot the expected avoided loss would be half the example.

- The calculated land lease/recreation fee itself.

Another relevant site-specific variable in the calculation of the offset amount is the BRD construction cost, if the BRD valuation method is adopted as the measure of private benefit.

[18] Attendance estimate for Encinitas and Solana Beaches is from King, 2001. Solana Beach attendance is given as 158,000 in the King study. The entire Encinitas-Solana Beach area is used in this analysis since mortality rate, M = 1%, is based on the single fatality along this stretch of beach (in Encinitas) within the period (1990-2000) that over 90 bluff failures were reported (in USACE 2000d) to have occurred.

The global variables are the mortality rate, which is derived from reported bluff failures in the beach areas included (Encinitas and Solana Beach in this case) and associated fatalities and use of the EPA's statistical value of life.

It is important to note that the expected loss analysis starts with a notch depth such that failure is a 50/50 proposition. In fact, the slope stability analyses conducted for the purposes of substantiating the factor of safety of a section of bluff and required as part of the application for a BRD permit in Solana Beach begin with the assumption of notch failure *(Soil Engineering Construction, Inc)* and the subsequent exposure of a clean sand lens and a vertical bluff face[19].

Terrace Deposit (Upper Bluff) Failure as Consequence of Lower Bluff Failure

The marine erosion process as it contributes to upper slope failure is described in Crampton:

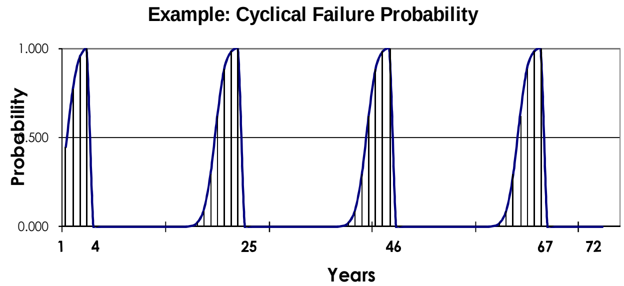
"Continuing long-term retreat of the lower bluff gradually creates an over-steepened slope in of the upper bluff (the Terrace Deposit), causing it to decline (by erosion and/or slope failure) to a more sustainable angle of repose. The process continues and repeats in a series of episodes. In the Solana Beach area before the 1997-98 El Niño storm season, upper-bluff slope inclinations characteristically ranged between approximately 37 and 53 degrees. As the upper bluff slope approaches the high end of this range, episodes of massive slope failure are typically caused by insufficient soil strengths to sustain the steeper slope angles and are often aggravated by the combined effects of groundwater seepage and rainfall (pg 23)."

After a massive failure, slope angles are reduced to the point where soil strengths are again sufficient to withstand driving forces. The marine erosion process starts over again with the probability of upper bluff (sea cliff) failure, temporarily at least, at zero but progressively increasing from year to year. Over a number of years, the sea cliff/upper bluff failure process at a particular location may be represented by a sequence of failure probability functions. From year 1 to the 72 year maximum established in the LCP, the cyclical probability function that was described in the above example is depicted graphically in the following chart:

---

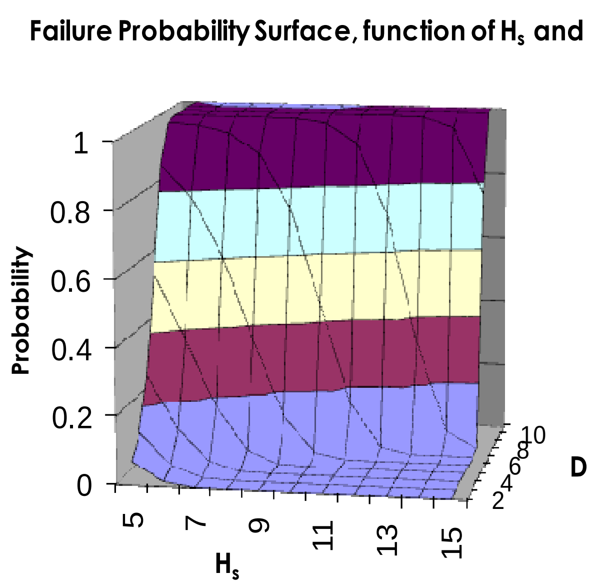
[19] For practical purposes the upper bluff stability analysis is limited to the slope conditions immediately after a sea cliff notch collapse because of the inherent uncertainties involved in modeling the collapse of the notch, or sea cave, itself. To be conceptually correct the risk of upper slope failure is the product of a joint probability distribution of two events: a notch/sea cave collapse and subsequent failure of the upper bluff. Therefore, the actual total expected loss would be evaluated from the probability of the initial notch failure plus the probability of upper bluff failure given the probability of notch collapse. However, given that a decision to apply for a BRD permit in the first place is based on the upper slope conditions at a particular site (relatively steep angle and exposure of clean sand lens), in addition to the depth of a notch, or sea cave, it may be assumed that upper bluff failure is coincidental with notch collapse-–that one event leads directly to the other within a short time frame. Admittedly, this may be an over-simplifying assumption since there is the possibility that the initial (notch) failure is not complete (that is, resulting in a bluff face that is not completely vertical from platform to clean sand interface) and that the failure process would actually occur in stages at a particular location with a portion of the bluff falling followed by the collapse of an adjacent or overhead block. In this way the failure of a "keystone" portion of bluff could actually increase the likelihood of further failures occurring as a chain of events. These "after failures", which would include upper bluff failures, may or may not release sufficient material to cause injury or death, however the time frame within which these after-failures are enveloped is probably small enough to be considered within the same cycle of the major event which spawned them (the initial notch or sea cave failure) and therefore may be assumed to be all part of the same event for purposes of evaluating probability of failure and expected loss.

FIGURE 5-6



The actual shape of each of the probability functions in the above sequence and the period between failures--the frequency of failure--depends on the physical nature of the Torrey Sandstone (location and direction of fracturing), beach topography, presence of sand on the wave platform, characteristics of the Terrace Deposits and many other factors. In this analysis the two key factors are: 1) the growth of the bluff toe notches ΔD that cause bluff instability and general failure, and 2) the thickness of the Torrey Sandstone H_s. The steepness of the upper slope, α, along with the presence of a clean sand lens, although both critical in the analysis of upper bluff stability, are relatively minor factors in the equations that determine sea cliff failure probability. The failure probability for any combination of notch depth D and H_s can be estimated, using the following chart:

FIGURE 5-7



Expected Loss of Public improvements from Future One-time Episode

The probabilistic model described above is used to evaluate the public's stream of benefits stemming from the avoidance of one type of episodic cost from the cyclical failure events: avoidance of risk due to an on-going hazard to life and limb. The timing of single-episode events that occur at some point in the future which cause either total or partial damage to pubic or private improvements (the latter resulting in a loss to the public of property tax revenues), depend on: 1) distance of the public or private improvements from the top of the upper bluff slope that would be protected by the proposed BRD, and 2) the geologic characteristics affecting bluff stability and retreat (notch depth, thickness and integrity of the sandstone, presence of sand lens, slope angle, etc.). An initial assessment of the existing conditions would reveal the relative imminence of bluff failure and also the longer-term prognosis for bluff failures that would threaten improvements.

The first step in evaluating the potential loss due to damage to improvements is to assess the level of risk that public or private improvements are subject given the site configuration, distance of improvements from bluff, condition of bluff (notch or sea cave depth, steepness of upper bluff, presence of exposed sand lens, etc.). The expected loss—the probability weighted cost of damage that would have occurred had the BRD not been in place—is calculated over a 72 year period and is dependent on location of the improvements relative to the bluff. Most public improvements fall into one of two categories based on location and risk timeframe:

Near-term risk – Near term risk involves threats to improvements from bluff failures that may occur within a 1-4 year period--similar to the episodic evaluation in that failure is fairly imminent. Impending failure such as this would be indicated by a factor of safety approaching or less than 1. Improvements such as the public beach access stairways, driveways and walkways; bluff top improvements such as parking lots, structures, pedestrian viewpoints, railings, and drainage facilities are exposed to bluff failure risk in public areas such as Fletcher Cove and Tide Park and the three public access points south of Fletcher Cove. In Fletcher Cove, potential damage to the lifeguard station and the Community Center on Pacific Avenue that may occur within a few years if measures are not taken. These measures may include some type of BRD; however a BRD that is constructed to protect adjacent private property would not necessarily benefit the Fletcher Cove improvements unless the BRD were extended specifically to benefit the public improvements. In fact, there exists no situation along the bluff face where the installation of a BRD for the primary purpose of protecting a private bluff-top property would also provide direct protection to any public improvement. In the case of Fletcher Cove, the extension of a BRD on the bluff to the north of the Cove (the bluff top property address at this location is 139 Pacific Avenue) could conceivably wrap around the northerly portion of the Cove and protect the Community Center, the drainage outfall and the access ramp. Depending on the geologic conditions of the bluff below 139 Pacific Avenue, the risk to public improvements could be in the near term.

Long-term risk – Other improvements, such as Pacific Avenue and other streets in the vicinity, are threatened only in the long term--after several bluff failure cycles have occurred. An example is a section of Pacific Avenue closest to the bluff top north of Fletcher Cove. This section, near 337 Pacific Avenue is about 65 feet from edge of pavement to top of slope and could potentially benefit from a BRD constructed for the sole purpose of protecting the adjacent private property. At a bluff retreat rate of .4 ft per year, this section of Pacific Ave. would not be threatened for approximately 65'/.4' per yr. = 163 years, well beyond the time when BRD's would need to be removed in accordance with the LCP policy. Adjacent private properties, however, could be threatened much sooner. Due to end erosion effects, even private properties protected by a BRD would be threatened if either adjacent property were not also protected. Depending on the position of the private improvements, the threat to adjacent property could become imminent within the next failure cycle.

Near-term Risk Evaluation

Near term impacts are those that would occur within the initial failure cycle, typically within one to four years depending on geologic parameters of the slope or bluff face. As discussed above, a potential public benefit offset may be realized for protection of the public improvements located in and adjacent to Fletcher Cove. Notably, the Community Center on Pacific Avenue may derive benefit from a BRD constructed to protect the property at 139 Pacific Ave immediately to the north (see also the geotechnical report for the Fletcher Cove Community Center, June 4, 2009, TerraCosta Consulting Group). Although, in general, there does not appear to be an imminent risk of sea cliff and subsequent upper bluff failure below 139 Pacific Avenue, a notch/sea cave is developing in the area of the Torrey Sandstone interface with the less resistant claystone where the bluff face turns back to a north-south direction. Assuming that the notch depth is currently 7 feet, its depth is increasing at the rate of .4 feet per year, and the other model parameters are as in the above example, sea cliff failure may occur within four years. Subsequent failure of the upper bluff such that the Community Center is threatened is not a given, since a separate slope stability analysis is necessary to determine the factor of safety of the upper bluff following lower bluff failure. However for the sake of this analysis we consider that the upper bluff factor of safety is such that the current probability of slope failure is .50 (the same as the lower bluff) the upper slope would fail along with notch collapse in about four years. The location of the slope failure plane is also undetermined, but at its closest point the Community Center is 26 feet from the top of the slope, close enough to be in jeopardy should the slope give way. Given all the above assumptions, constructing an extension of a BRD protecting 139 Pacific Avenue would benefit the Community Center. The potential public benefit would be based on an evaluation of possible courses of action and determining the lowest cost option among the following:

1) Replacing/relocating the Community Center;

2) Constructing a BRD;

3) Undertaking one or a combination of the following remedial measures:

   – Armoring the slope (constructing a concrete apron over the slope) below the Community Center;

   – Installing a notch fill at the bluff toe;

   – Annual sand replenishment within Fletcher Cove.

4) The cost of replacing the 1,400 sq. ft. Community Center at the same site is estimated at $300,000 (construction costs only). Demolition and relocating to another parcel in the same neighborhood would add approximately $500,000 to the cost.

5) A BRD of 50 feet would be the minimum length required to protect the Community Center for 72 years. Constructing a 50 foot long BRD along the sea cliff below the Community Center site would cost an estimated $250,000.

6) The remedial measures are temporary and represent an on-going expense to maintain protection:

- Slope armoring with tie-backs is effective only where adequate toe support exists; armoring may give way with every successive notch collapse and would need to be replaced every 20-25 years. Each slope armoring costs an estimated $120,000 based on a 4,000 sq. ft of slope area at $30 per square foot. 72 years of protection by slope armoring could potentially cost up to $300,000.

- A notch fill would last approximately 10 years before needing to be restored. Up to seven notch fills at an estimated average cost $40,000 each would be required for a total cost of $280,000.

- To provide protection for up to 50 lineal feet of bluff, 5,000 cubic yards of sand would be needed every year at a cost of $7.50 per yd. for a 72 year total present discounted cost of $1.4 million.[20]

The least cost option for protection of the Community Center is construction of up to 50 feet of BRD at $250,000. Therefore the public improvement benefit from avoidance of a near-term one-time event would be $250,000.

The on-going expected public safety benefit is evaluated based on the overall average avoided cost found for Encinitas-Solana Beach: $20.98 per foot per year. For this example a density factor of 1.5 is used to reflect the higher beach occupancy at this location.

The total expected loss over 72 years is $441,~~834~~839[21]. The total public benefit is found by adding the present discounted value of the potential increased tax revenue of $275,384 (based on the $725,000 cost of only the 145 foot section of BRD that protects the bluff-top property) for a combined public benefit of $967,223.

Offset Calculation

Public Improvement Benefit = lowest cost Community Center protection alternative:	$250,000
Public Safety Benefit = Expected Avoided Loss over 72 years:	$441,839
Plus increased property tax revenue over 72 yrs (present valued)[a]:	$275,384
Total Public Benefit:	$967,223
Less Private Benefit (increased property value) attributable to BRD[b]:	($725,000)
Land Lease/Recreation Fee (195 foot length, ~~$2,471~~$3,100 per foot)[c]:	$604,500
Potential Offset: Net difference between private and public benefits:	$242,223
Difference, net Land Lease/Recreation Fee:	$362,277

[a] Total of property tax revenue (1% of the increase in assessed valuation) discounted at 2%, based on cost of BRD

[b] Valuation based on cost of 145 foot BRD assuming, $5,000 per foot

[c] Assumed fee ~~$2,471~~ $3,100 per lineal foot of BRD based on maximum 72 years in place.

In this example, the potential offset of $242,223--the difference between the private and public benefit--may be applied as a credit against the Land Lease/Recreation fee to potentially reduce the Land Lease/Recreation fee to ~~$239,622~~$362,277. Note that even though a 195-foot

[20] Unit costs and application rate of 100 cu. yd. per lineal foot as recommended in the Public Beach Restoration Program, California Beach Restoration Study Report—SANDAG Beach Replenishment Program. Annual cost of $37,500, present value discount rate = 2%

[21] $20.98 x 195 feet x 1.5 x 72yrs. = $441,839

BRD is constructed and subject to the Sand Mitigation and Land Lease/Recreation Fee, only 145 feet of it should be considered in the increase to the value of the private property, however all 195 feet is considered in the calculation of public safety benefit.

In an alternative scenario, the City would construct the 50 feet of BRD using its own funds and the bluff-top property owner would then construct only 145 feet, and not be eligible for an offset since the total public benefits--$603,931--would be less than the private benefit of $725,000.

Alternative Scenario

Public Improvement Benefit = lowest cost Community Center protection alternative:	$0
Public Safety Benefit = Expected Avoided Loss over 72 years:	$328,547
Plus increased property tax revenue over 72 yrs (present valued)[b]:	$275,384
Total Public Benefit:	$603,931
Less Private Benefit (increased property value) attributable to BRD[a]:	($725,000)
Potential Offset is $0 because the private benefit exceeds the public benefit:	$0
Land Lease/Recreation Fee (145 foot length, ~~$2,471~~ $3,100 per foot):	$449,500

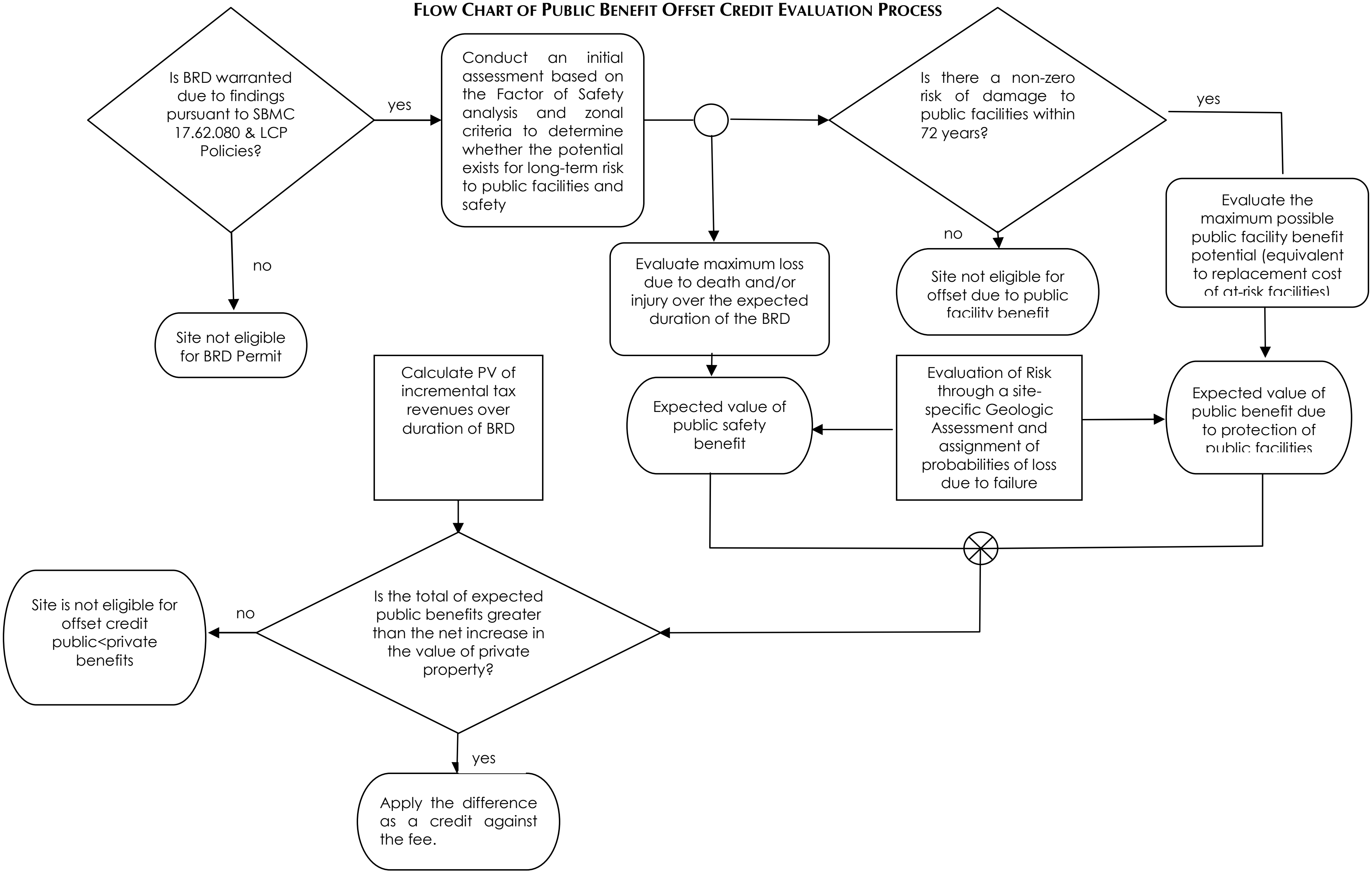
[a] Valuation based on cost of 145 foot BRD assuming $5,000 per foot

[b] Total of property tax revenue (1% of the increase in assessed valuation) discounted at 2%, based on cost of BRD

Note that the foregoing near-term risk evaluation represents a unique public improvement benefit opportunity that may not be replicable anywhere else along the Solana Beach bluff.

The flow chart in Figure 7 illustrates a suggested process for determining the applicable mitigation fee offset credit.

FIGURE 5-8
FLOW CHART OF PUBLIC BENEFIT OFFSET CREDIT EVALUATION PROCESS



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