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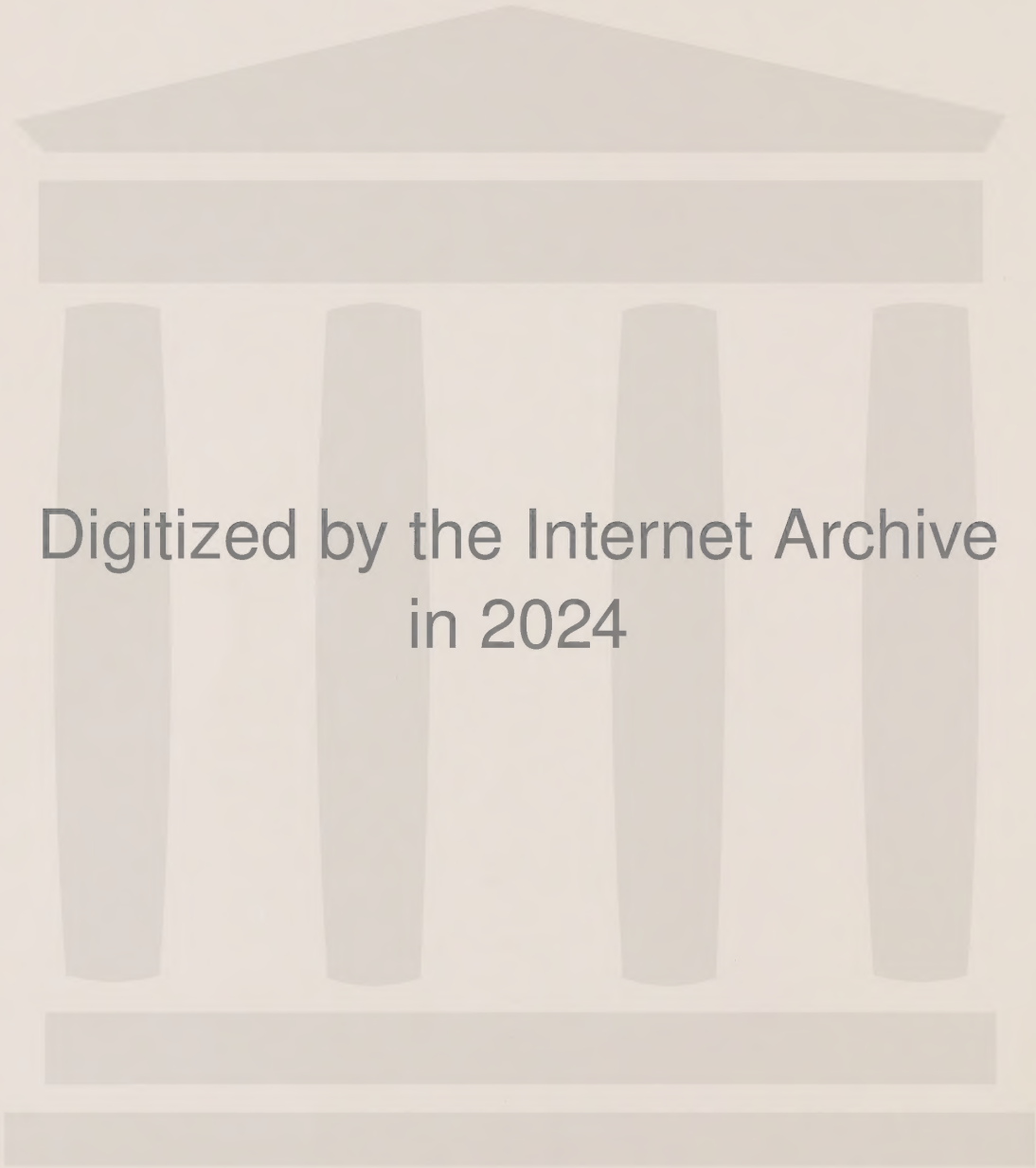
ECOLOGICAL SURVEY
OF
AQUATIC & TERRESTRIAL RESOURCES
CITY OF NEWPORT BEACH CALIFORNIA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ECOLOGICAL SURVEY
OF
AQUATIC & TERRESTRIAL RESOURCES

FOR

CITY OF NEWPORT BEACH
3300 NEWPORT BOULEVARD
NEWPORT BEACH, CALIFORNIA

BY

DR. PETER S. DIXON
GORDON A. MARSH
CONSULTANTS

JULY, 1973

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* * * * *

SECTION I

About the Authors

Dr. Peter S. Dixon

Dr. Peter S. Dixon was born and educated in England. He served as a member of the faculty of the University of Liverpool for 11 years before coming to the United States in 1965 as Visiting Professor of Botany at the University of Washington, Seattle. He accepted a permanent appointment there the following year, as Associate Professor of Botany, and then transferred to the University of California, Irvine, as Professor of Biological Sciences. His first appointment at Irvine was in the Department of Organismic Biology. He then transferred to the Department of Population and Environmental Biology to take over the Chairmanship in 1969.

Dr. Dixon's primary research interests are in water quality and the growth of algae, and he has undertaken various consulting projects in these areas. He has served as consultant to City, County and State Governments and many private organizations in the fields of water management, reclamation and recycling with respect to both marine and fresh water situations.

Dr. Dixon is author of a standard text on the red algae, and co-author of two books and he has published over ninety scientific papers and many more ephemeral articles in newspapers and magazines.

Gordon A. Marsh

Gordon A. Marsh was born in Portland, Oregon and received his formal education in Oregon and later, California.

He is presently a Senior Museum Scientist and Lecturer in the School of Biological Sciences at the University of California, Irvine. As Curator of the University's Museum of Systematic Biology, he is responsible for the development of collections which represent the flora and fauna of Southern California and adjacent regions with particular emphasis on Orange County. He is also Co-Chairman of the Committee responsible for the management of the San Joaquin Freshwater Marsh Reserve, one of many natural resource areas which are part of the University-wide Natural Land and Water Reserves System.

SECTION II

Purpose and Scope

The City of Newport Beach engaged Dr. Dixon and Mr. Marsh to provide the necessary data input on the marine and terrestrial biological communities within the City for the Natural Environment Element of the General Plan. The consultants were to identify the environmental sensitive areas that detailed studies should be required as part of the Environmental Impact Report Procedure.

Gordon Marsh was responsible for the flora and fauna of terrestrial areas and Dr. Peter Dixon was responsible for aquatic (fresh water, estuarine, marine) areas.

SECTION III

Summary

SUMMARY OF TERRESTRIAL RESOURCES

Well over thirty terrestrial habitats presently classified as an open space resource within the City of Newport Beach were examined and twenty-nine of these sites were described in detail.

Community parks, school playgrounds, golf courses and greenbelts, although an important open space resource, were not examined. The main efforts were concentrated on identifying and describing a series of natural, and previously managed undeveloped lands, and the habitat types represented by each site. For simplicity, general, rather than specific terms were used to identify the major remaining open space habitats and each is briefly discussed in the following paragraphs.

Grassland communities and their associated biota, although still represented by extensive acreage, are rapidly diminishing within the city limits because the environmental conditions preferred by naturalized grasses are also subject to urban development due to minimal grading requirements.

Only the Banning Lease - upland area overlooking the Santa Ana River flood plain; Harbor View Hills - east of MacArthur Boulevard (relocated); and San Joaquin Reservoir - east of Spyglass Hill, of the naturalized grasslands retain some semblance of a natural community

where there is a balance between native annuals (lupines, fiddleneck, owls clover) and introduced weedy annuals (mustards). The remaining grass-covered fields, except for low hills directly above or north of Back Bay, are systematically disked to reduce the potential summertime fire hazard.

In the not too distant future, it appears that this particular association of plants and animals will eventually disappear or be relegated to isolated patches of land too small to support resident wildlife within the boundaries of Newport Beach.

Freshwater marshes, lake and wetland habitats, either natural or artificial, are limited to a few specific areas of limited extent in Newport Beach. Sites where such associations may be found include:

1. Big Canyon (between Jamboree and Back Bay Drive) and between the present and new MacArthur Boulevard
2. Buck Gulley
3. Morning Canyon
4. West Upper Newport Bay - opposite 23rd Street
5. West Upper Newport Bay - along Dover Drive
6. The Delhi Flood Control Channel
7. Jasmine Creek
8. East Upper Newport Bay - near the Newporter Inn and Back Bay Drive and below Eastbluff and the former saltworks
9. San Diego Creek
10. Harbor High School - artificial ecosystem

Of these, Big Canyon, the 23rd Street marsh of Westbay, the eastbay thicket near the former salt works and the San Diego Creek channel are the most significant freshwater habitats remaining in the city.

Unlike the grassland community, wetland associations will or are expected to increase with urbanization if runoff from new developments is not entirely contained within subsurface systems. In fact, the more important sites are flourishing because of a continuous rather than intermittent flow of, in many cases, nutrient rich water.

Coastal Sage Scrub and for Chaparral association are presently found in varying degrees of entirety on the:

1. Banning Lease - bluffs and central ravine
2. Westbay bluffs
3. Big Canyon bluffs
4. Eastbay bluffs - from Big Canyon to the Newporter Inn
5. Morning Canyon
6. Buck Gulley
7. Jasmine Creek
8. San Joaquin Reservoir uplands
9. Canyon near the MWD reservoir east of Harbor View Hills

The west and east Upper Newport Bay bluffs, Buck Gulley, the undeveloped marine terrace near the San Joaquin Reservoir and the

Metropolitan Water District Canyon between Harbor View and Spyglass Hill are the primary remnants of a previously abundant coastal bluff and foothills association. Every effort should be made to maintain those areas which are already within or surrounded by urban development and set aside portions of those areas which are subject to future development. In particular, the coastal and bay blufflands support a characteristic flora which is dependant on a combination of physical characters which are unique to this narrow belt of real estate. Once disturbed, this fragile habitat is difficult, if not impossible, to repair.

The final and perhaps most significant natural resources are those associated with the ocean and coastal sandy beaches and rocky intertidal habitats as well as the Upper Newport Bay estuary, salt marsh and mud flats which also occur to a minor degree in West Newport Beach adjacent to the Santa Ana River channel.

As previously mentioned in both the marine and terrestrial sections of the report, these habitats represent a priceless aesthetic, recreational and natural resource for the public as well as the indigenous, introduced and migratory biota which are dependant on the continued existence of these marine and estuarine areas for a livelihood. Every effort should be made to maintain a balanced ecosystem which includes man, and his activities, for better or for worse.

SUMMARY OF AQUATIC AREAS

The aquatic areas falling within the limits of the City of Newport Beach consist of:

1. Newport Bay
2. Coastal intertidal areas
3. Seminiuk Slough

These three areas were surveyed, on foot and by boat, during the months of March and April, 1973.

On the basis of the visual observations made during the survey, it was concluded that the three aquatic areas are in critical condition, essentially with water quality problems occurring in all.

1. Newport Bay

   The principal problem relates to those materials being brought into the Upper Bay and, thence, the Lower Bay from the various major drainage channels, and into both parts of Newport Bay from urban/terrestrial drainage. These materials include silt in suspension, nutrients, oil, toxic compounds, and floating trash.

2. Coastal intertidal areas

   The principal problem in the beach areas relates to the quantities of trash brought in by tourists and the need to ensure adequate and continuous collection. In addition, a more complete assessment of the sand erosion situation is needed. In the

rocky intertidal areas, more rigorous enforcement of the regulations against removal of specimens is imperative.

3. Siminiuk Slough

The principal problem relates to those materials entering the Slough from oilfield drainage and urban/terrestrial run-off. These materials include silt, nutrients, oil, toxic co compounds and floating trash. In respect to these materials, some improvement in water circulation is imperitive.

For both Newport Bay and Seminiuk Slough, a considerable amount of data must be collected if rational decisions are to be made regarding the futures of the Upper Bay and Seminiuk Slough and the management of the Lower Bay is to be conducted adequately. A complete investigation of the sand erosion problem of West Newport must include some consideration of the possible impact of the proposed developments of marinas in the Santa Ana River and Seminiuk Slough. For the water quality problems of Newport Bay and Seminiuk Slough and the sand erosion problems of West Newport computer modelling will be essential.

SECTION IV

Terrestrial Resources

of

Newport Beach

INTRODUCTION

This section of the report includes information on a variety of terrestrial biological communities which are located within the present boundaries of the City of Newport Beach. Upon location, each site was examined and the existing resources were described. Following this process, the combined resources of each area were evaluated with respect to future development and/or preservation. If any aspect of environmental degradation occurred on the various sites, the conditions were included as part of the evaluation and suggestions for control or abatement were made. Previous site reports, if they exist, were not employed because of the possibility of bias.

A site by site analysis follows. Each site is referenced to the map entitled, "Location of Terrestrial Resources (Figure #1)".

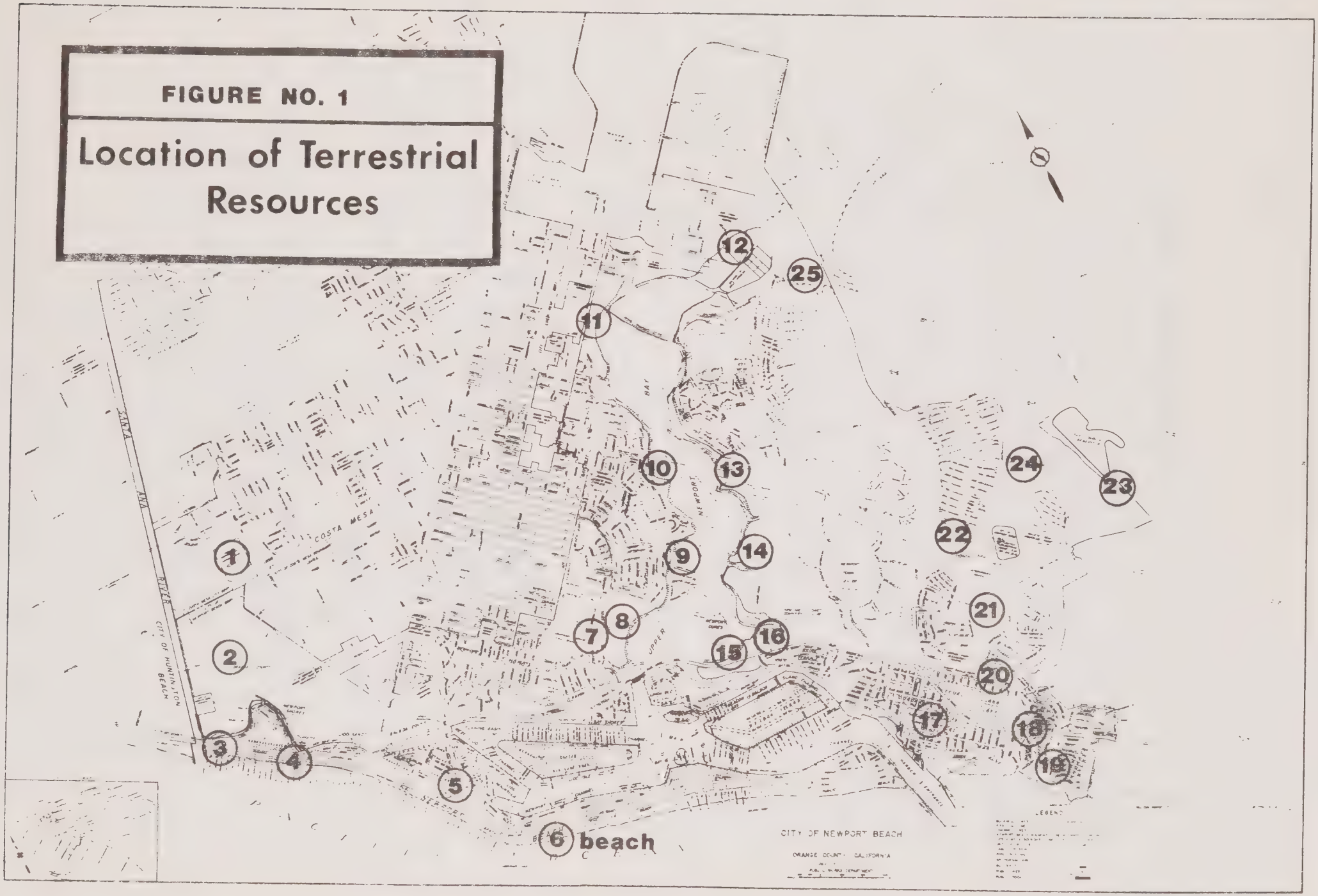
FIGURE NO. 1
Location of Terrestrial Resources
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COSTA MESA
CITY OF HUNTINGTON BEACH
UPPER NEWPORT BAY
CITY OF NEWPORT BEACH
ORANGE COUNTY, CALIFORNIA

Site No. 1 (Closed Disposal Area)

Location. Borrow pit and disposal area. Located at the extreme northwest section of Newport Beach as a rectangular intrusion surrounded by the City of Costa Mesa except for a corridor at the end of Nineteenth Street. (Map Reference: Thomas, Page 31, AB2)

Existing Conditions. Except for remnants of native vegetation on the south facing slopes of the mesa which extend in a westerly direction from Nineteenth Street, the remaining area is characterized by a variety of introduced weedy annuals which do supply food and cover for the existing animal life, help to stabilize the soil, but have no special significance as flora worthy of retention. In fact, the success plants have had in colonizing this disposal area is due to past earth removal and periodic disturbance of preexisting topographic features.

Several shallow borrow pits dot the site, interrupting what was originally a gradually sloping alluvial plane to the Santa Ana River, partially dissected by stabilized erosion gullies. The pits are seasonally flooded with rain water. These mini-lakes contain a variety of ephemeral animal life.

The site is crisscrossed with foot paths and bicycle trails, many of which lead to the Greenville-Banning Flood Control Channel which parallels the Santa Ana River Channel and to a small, earth-lined lake south of Victoria Street in Costa Mesa.

The animal life which is dominated by small perching birds and rodents is interesting to a naturalist but a superficial inventory indicates that most of the species may be classified as residential types. It is unlikely that this particular habitat would support a significant fauna unless trees and a permanent source of free water were introduced.

Development of this area, regardless of the purpose, will require rehabilitative fill and contouring with particular attention being paid to drainage patterns and their effects on adjacent, lower lands between the Santa Ana River and the disposal area which are biologically more significant than the uplands because of existing young willow groves, permanent water and associated vegetative types which are not found on the borrow pit grounds.

Site No. 2 (Beeco, Ltd. (Banning) Property)

Location. Oil well property occupying unincorporated county land surrounded by the City of Newport Beach. (Map Reference: Thomas, Page 31, AB 2, 3, and 4).

Existing Conditions. This site includes a vast mesa area, coastal bluffs, and extensive lowlands which are part of the Santa Ana River flood plain. Most of the mesa and lowlands are dotted with oil wells, interconnecting service roads, shops and storage tanks.

The uplands are covered by a naturalized grassland which also contains adventive weeds (mainly mustards), some native, early spring-blooming wildflowers and very few native shrubs which tend to associate with the slopes or the sides of shallow ravines. Much of the grassland is partitioned into a series of rectangular plots by the oil company service roads so that continuous grass-covered fields are coincident with swales, gullies or ravines.

Vegetation associated with the bluffs differs along a north to south gradient. The gentle sloping hills to the north are grass covered and similar to the mesa vegetation. As the bluffs become steeper to the south, the slopes are covered with a variety of native perennial flowering shrubs and herbs which characterize the Coastal Sage Scrub Community. California buckwheat, California encelia, and lemonade berry are the main woody species present, encelia being the dominant member along the central bluffs which are heavily dissected

by a series of stabilized ravines and erosion gullies. The southern bluffs consist of sheer cliffs composed of unconsolidated soils which are subject to severe erosion. Extensive areas of the bluffs have been coated with a layer of asphaltum in order to stabilize the slopes. Although unsightly and toxic to many life forms, the methods were effective in prolonging the integrity of the bluffs. In time, however, plants have been able to penetrate and colonize the protective layer while it aged. At present, gully erosion has commenced along the asphaltum-covered bluffs, the result being an unsightly conglomeration of vegetation, bare, dissected bluff, and patches of crumbling pavement.

The lowlands are similar to the mesa surface in that they contain a large number of active and inactive oil wells connected by a matrix of dirt roads. However, the soil, unlike the mesa, consists of a sandy alluvial loam which is quite alkaline. As a consequence, most of the vegetation includes large numbers of a few salt tolerant weeds. Common ice plant (Mesembryanthemum crystallinum), pigweeds (Amaranthus sp.), five hook (Bassia hyssopifolia), three species of chenopods (Chenopodium), ragweed (Ambrosia psilostachya), cockle bur (Xanthium strumarium), milk thistle (Silybum marianum), and castor bean (Ricinus communis) are all common weedy plants found throughout the lowlands. Each of the above species and a number of other undesignated grasses and ruderals found on the property are indicators of alkaline soils, or frequently disturbed sites. Part of the lowlands contain a narrow estuary which separates a housing development along

the Pacific Coast Highway from the southern limits of the Banning property oil fields. Vegetation associated with this minor estuarine incursion includes pickle weed, sueda, frankenis, cord grass, bassia, and other salt-tolerant vegetation common to coastal salt marshes of Southern California.

The remaining habitat which includes the Greenville-Banning Flood Control Channel and the bed of the Santa Ana River. The biota of both of these channels was examined during the summer months of 1970 and a report was prepared for the Orange County Flood Control District by Marsh and Abbott (1972) which covers this area as well as much of the flood plain but not the bluffs or mesa.

Birds are the dominant group of animals in both variety and number. The mesa grasslands maintain moderate populations of meadowlark, house finch, mourning doves, and Brewer's blackbird. Horned larks were also common but tended to stay in partially barren localities or where the grass was shorter. Crows were moderately common as were song sparrows but burrowing owls, although present, were uncommon and found near the bluff edge where there were a number of ground squirrel burrows. Local hawks and owls use the upland and lowland fields as hunting grounds for birds and a variety of small rodents which reside there. Other mammals frequent the oil fields in low numbers.

Generally speaking, the wildlife potential of this locality is relatively low when compared to similar bluff and flood plain habitats

found to the north in the City of Costa Mesa. This is due in part to the presence of the oil company whose operations tend to discourage some forms of wildlife which are sensitive to disturbance such as noise, vehicular traffic, and weed control programs. More important, however, is the lack of suitable forage, roosting and nesting sites for perching birds and cover for larger mammals. Willow, mule fat, giant cane and castor bean thickets which are characteristic flood plain features north of the oil fields do not occur on this property.

The estuary, normally a highly sensitive environment, is limited in extent with much of the channel bordering the back yards of a number of homes. As a consequence, the estuary is used as a recreational facility for the local residents and their pets. Some shore, marsh, and wading birds do frequent the area in limited numbers but the main flocks of shore birds are found along the adjacent Banning-Greenville and Santa Ana River channels.

Much of this area is suitable for urban use but several problems will have to be solved before planning of any type is instituted. The main problem is the disposition of the existing oil wells, particularly if the lowlands are converted into a marina which is one possibility of urban use. In fact, if the marina is developed, effects of saline intrusion on inland areas will require investigation. Bluff stabilization will have to be solved whether the land is developed or not. The central valleys which breach the continuity of the bluffs are suitable for retention as part of a park but the cliffs to the

south may require grading to eliminate the old asphalt and planting to preserve the newly contoured bluffs.

Site No. 3 (Former P. E. Right-of-Way)

Location. Undeveloped strip of beach sand located between the Pacific Coast Highway, Seashore Drive, Summit Street adjacent to the Santa Ana River Channel, and Prospect Street. (Map Reference: Thomas, Pgs.30, 31; F4 and A4).

Existing Conditions. This strip of open space, approximately 3,000 feet long consists of unstabilized beach sand which is contained by concrete curbing along Seashore Drive and controlled by a chain link fence plus a row of planted oleanders, acacia, myoporum, fan palms, and naturalized herbaceous vegetation along the Pacific Coast Highway. There is a sparse growth of salt tolerant native and introduced annuals which include ice plant, beach primrose, and a noxious weed known as spiny emex. There is evidence of periodic mechanical disturbance of the sand to control emergent vegetation rather than the use of chemical herbicides.

The biota associated with this limited strip of land, being subject to both plant control management, weekend and holiday foot traffic, and general disturbance is not significant and does not require an in depth study of the effect any future development may have on the existing wildlife.

Site No. 4 (Former P. E. Right-of-Way)

Location. Prescribed by the Pacific Coast Highway, Seashore Drive, 56th and 60th Streets. (Map Reference: Thomas, Pg. 31, A4)

Existing Conditions. The substrate consists of unconsolidated, disturbed beach sands which are sparsely covered with an array of native annuals, introduced Eurasian weeds and horticultural escapes. Beach primrose represents the dominant native annual while pigweeds, ice plant and some introduced grasses form the remaining vegetative cover which is particularly dense on a low swale at the northwest corner of the property. Miscellaneous rubbish, bottles, paper and plastic cups, etc., are scattered across the landscape. Perhaps because of the uneven topography, there is no evidence of recent disking or vegetation removal by the City. Wildlife associated with this area consists of casual avian usage of birds which, for the most part, are classified as residential species. Terrestrial vertebrates were not assessed but it seems unlikely that future development of this plot, whatever it may be, will have a significant impact on the existing biota because of its depauperate nature.

Site No. 5 (32nd Street Extension)

Location. Triangle of unimproved land between 33rd Street, Balboa Boulevard, 31st Street, and private residences bordering the southern margin. (Map Reference: Thomas, Pg. 31, B5)

Existing Conditions. This lot is level and contains existing structures at the corner intersection of 33rd Street and Balboa Boulevard. The sandy surface supports an extensive ephemeral vegetative cover which consists of ice plant, beach primrose, cheese and pigweeds, low introduced grasses and Oxalis pes-capri. It does not contain or support a significant biota. Consequently, further consideration as to the potential impact development may have on the existing plant and animal life is not warranted.

Both residential and commercial units exist adjacent to or across from the property.

Site No. 6 (Ocean Front Beach)

Location. Includes a five to six mile long area of beach above the maximum high tide and adjacent to existing residential development. Artificial west and east boundaries are imposed by the presence of the Santa Ana River mouth and the west jetty to the entrance of Newport Bay and Harbor. (Map Ref: Thomas, Pgs. 30,F4; 31,A4 to D6; 33,A2)

Existing Conditions. Native and/or naturalized vegetation and associated terrestrial wildlife is sparse and presently restricted to a few isolated sites extending oceanward from the beach-front homes and apartments. These areas include extensive patches of dune-stabilizing sea fig (ice plant) just east of the Santa Ana River channel; moderately extensive cover consisting of some sea fig, beach sand-bur (Ambrosia Chamissonis) and beach primrose (Camissonia Cheiranthifolia) west and east of Ninth Street; essentially the same low beach dune vegetative association east of the Balboa Pier and between B and I Streets; and finally, a few patches of sea fig adjacent to the west jetty approach.

The remaining beach frontage between the fluctuating water's edge and these few isolated patches of native or naturalized vegetation consist of vast expanses of beach void of any wreck or detritus deposited through tidal action. Because the City of Newport Beach constantly removes solid and organic detritus such as accumulated seaweeds, this stretch of beach is ideal for recreation but a biological desert as seen through an ecologist's eyes.

Excluding subsurface and tidal marine organisms, gulls and various shorebirds are the primary vertebrate users during and particularly before people arrive or eventually leave the beach. Nesting sites of rare or endangered species of birds have not been recorded and presently do not occur along this particular section even though the least tern has utilized areas of Huntington Beach ocean front just west of the Santa Ana River as a nesting area.

Site No. 7 (Newport Harbor High School)

Location. Undeveloped strip of Orange County Flood Control District right-of-way bordered by the high school's 15th Street parking lot, and athletic field as well as back yards of homes located on St. James Road. The other leg of open space begins at 16th Street and separates the athletic field from buildings facing 16th Street and Dover Drive. (Map Reference: Thomas, Page 31, D 4).

Existing Conditions. Existing vegetation of this drainage channel consists of a mixture of naturalized annual herbaceous weeds, a row of mature New Zealand blue gum which serves as a wind break and several other volunteer or planted shrubs and trees located along both banks of the channel. These other trees which constitute an understory to the eucalyptus grove include native arroyo willow as well as specimens of elm, ash, silk oak, Prunus sp., cape plumbago and myoporum. At either end of the grove of trees, one or both banks of the channel have been recently stripped of the weedy annual ground cover. The soil has been cultivated, mulched with organic additives, contoured, and planted with young, multi-trunk sycamore trees, Platanus racemosa, and other native shrubs such as manzanita, Arctostaphylos sp.

The remaining leg of the unimproved flood control right-of-way area consists of disturbed swale supporting rank growth of introduced weedy annuals which flourish in waste areas. This entire segment of open space is presently being transformed into a riparian habitat

complete with a recirculating stream and a sequence of pools, lateral nature trails and appropriate plantings of native sycamore. Upon completion, it appears that this project will have created a significant nature interpretation center encompassing several habitat themes within the limited available space.

This project has already transformed what was apparently an eyesore and an attractive nuisance into a viable open space habitat which will attract and support a greater variety of wildlife than had previously existed. The students and staff of Newport Harbor High School are to be commended for their insight and energy in creating a nature interpretive center for use in conjunction with their biology curriculum.

Prior to initiation of this project, the wildlife associated with this flood control channel right-of-way mainly consisted of both resident, migratory and casual visiting perching birds attracted to the grove of eucalyptus and mixed native or exotic trees along the channel and in the back yards of adjacent homes. With the completion of a recirculating stream-pond complex and supplemental plantings of native sycamores and various shrubs, the area will be attractive to and support a greater variety as well as increased numbers of birds. A pre-improvement inventory of small terrestrial vertebrates may have included the western toad, feral house mice and domestic cats. By introducing a permanent source of fresh water, other amphibia such as pacific tree frogs will appear or may be introduced into this newly created artificial ecosystem. A limited number of fish may also be

introduced and an interesting array of aquatic insects will eventually invade and inhabit this aquatic environment.

Upon completion, this project may well become a model for open space use where the land, because of its small size, shape or location, cannot be developed for residential, commercial or recreational purposes. This is particularly true when the property is adjacent or close to a school or cluster of schools which can benefit from a "living laboratory".

Site #8 (Castaways Point)

Location. Triangle to Comma-Shaped Area Contained within the Peripheral Roads which Include the Pacific Coast Highway, Dover Drive, Westcliff and Polaris Drives and the Access Channel to Upper Newport Bay. (Map Reference: Thomas, Pg. 31, E5 and 5)

Existing Conditions. Except for the Newport Harbor Lutheran Church on Dover Drive just northeast of the 16th Street intersection and a trailer park located below the southern tip of the bluffs and the Pacific Coast Highway, and a decorative fountain along upper Dover Drive, the property is unimproved and consists of a nearly level mesa, about 100 feet above sea level and a steep arching bluff overlooking and forming the western boundary to the entrance of Upper Newport Bay. The bluffs continue around the southern tip of the mesa and extend northerly along Dover Drive to a point slightly beyond the 16th Street intersection. These west-facing bluffs are interrupted by a stabilized, wedge-shaped erosional ravine opposite the Cliff Drive intersection and an oblique depression which starts just southwest of the church parking lot and continues about 1,000 feet to the previously mentioned ravine.

The existing vegetation includes a wind-break row of mature New Zealand Blue Gum (Eucalyptus globulus) paralleling Westcliff Drive plus an individual specimen and grove of blue gum along the north-eastern and pre-central bluff margin overlooking Upper Newport Bay.

The 16th Street ravine and adjacent mesa tip also contain several other introduced acacia, pine, palm, and silk oak trees. Introduced European grasses and herbaceous forbs as well as some native flowering annuals cover the periodically disturbed mesa surface or highlands while the bay-facing bluffs support an interesting matrix of native perennial shrubs, cacti, and both introduced and native herbaceous species which compliment the soil-stabilizing function of the woody vegetation. Included in this array of shrubs are lemonade berry, Coulter's saltbush, California encelia and box-thorn, several species of cacti and bladderpod.

The depression contiguous to Dover Drive represents a miniature fresh-water marsh, the bottom being filled with cattail and the slopes containing a few arroyo willows.

Resident and migratory wildlife include populations of small mouse-sized rodents, California ground squirrels and pocket gophers. Birds are well represented and include grassland and surface feeders such as meadowlarks, mourning doves, blackbirds, and starlings. A variety of perching birds tend to concentrate in the small marsh, the existing trees which were planted, and particularly along the bay-side bluffs. Crows, raven, hawks, and some owls use the eucalyptus as both roosting and foraging perches.

Regardless of the ultimate disposition of this land, several aspects deserve special consideration:

1. The eucalyptus windbreak which parallels Westcliff Drive and the central grove adjacent to bay-bluffs edge should be retained, judiciously pruned, groomed and the understory of miscellaneous debris removed.

2. The bluffs overlooking Upper Newport Bay support an interesting array of plant and animal life characteristic of ocean and estuarine slopes exposed to salt-bearing air masses and the effects of wind shearing. However, severe erosional gullies caused by vegetational degradation via excessive foot traffic as well as the burrowing activities of ground squirrels and pocket gophers have seriously damaged the integrity of these bluffs are to be retained in their present condition. If the existing vegetative cover is not retained, then substitute measures which include artificial man-made structures or plantings of salt-tolerant species or a combination of both will have to be used in order to protect the bay and its marine life from excessive siltation or channel blockage through slumping induced by winter rains or artificial irrigation of the mesa surface.

3. The existing miniature fresh water marsh is a interesting habitat which is being perpetuated by the flow of a spring or nuisance water from church property and street run-off. If retained, it could be extended to include part or all of the lower wedge-shaped ravine as a mini-park.

Noise generated by the heavy traffic flow along Dover Drive could considerably lessen the potential educational or recreational value of this site. In addition, the area could become a public nuisance as a mosquito-breeding ground unless it was incorporated into an integrated use plan and managed.

Site #9 (North Star Beach)

Location. Bordered by Polaris and Galaxy Drives above the bluffs and North Star Lane and the bay frontage at the lower elevations. (Map Reference: Thomas, Page 31, F4)

Existing Conditions. This triangle of undeveloped, moderately level, bayside frontage appears to consist of dredged sands rather than parent material which has eroded from the western cliffs, the upper elevations of which contain landscaped home sites extending to the cliff margin. Central portions of the beach contain a sand-stabilizing cover of annual introduced grasses, and native beach primrose which is the dominant ground cover. The margin of beach surface fronting the bay lacks the characteristic expanse of emergent salt-marsh vegetation. Except for a small stream of fresh nuisance water issuing from a drain pipe at the cliff base which maintains a few volunteer arroyo willows along the seep, the remaining herbaceous or shrubby vegetation is restricted to the cliff face or to a narrow strip of beach sand contiguous to bottom margins of the bay cliffs where subsurface moisture tends to accumulate.

Existing wildlife is concentrated in two zones; the cliff-face and contact area of level beach which also includes the seep-associated willows; and the sand-bay interface which is frequented as a resting and feeding site for gulls and a variety of shore birds.

The intervening sand-shell surface is similar to ocean front areas utilized as nesting sites for terns. However, examination failed to locate nests of any type. Although the land is posted, there is

evidence of regular trespass by pedestrians as well as cycle traffic and dogs from adjacent developments are common inhabitants. Any one of these factors is sufficient to discourage nesting birds.

Except for a narrow silt-sand strip of beach just north of the Coast Highway, this area represents the last segment of western Upper Bay beach frontage which does not contain homes, concrete bulkheads, and boat slips between the highway and projecting escarpment of Dover Shores cliffs.

Although the existing vegetation and terrestrial wildlife is of minimal value when compared with other areas of Upper Newport Bay and does not appear to warrant an in-depth study, the marine environment is particularly sensitive. Consequently, any plans which include the extension of comparable structures which exist south of this area will require further analysis.

Site #10 (Upper Newport Bay - West Side)

Location. West Bay Bluffs, beach and tidal flats located between North Star Beach and Santiago Drive as it intersects with Tustin Avenue. (Map Reference: Thomas, Pg. 31, F3 and 4)

Existing Conditions. This area covering more than a mile of bay frontage is, with minor exceptions, completely developed with private residences occupying the entire level mesa adjacent to the cliff edges. Furthermore, there is a distinct change in both the parent material and slope configurations from north to south.

The vegetative cover of these cliff faces, consisting of both native and naturalized plants, is lush, dense, and nearly continuous on shallow slopes but patchy, restricted to upper margins or a narrow band along the cliff bottoms and entirely lacking on sandstone cliffs.

The extent of available shoreline also varies from north to south and further reflects the nature of the cliff face, its resistance to erosion, and the effect tides may have on its future existence. In general, the bay shore is narrow and subject to periodic innundation along the southern section of West Bay while the surface between the cliffs and water's edge increases to the north.

Terrestrial plants with varying degrees of salt tolerance have successfully occupied this zone between cliff and high tide; and in some instances, they have formed a continuous transition between those

species of cord grass or glasswort which require periodic immersion in saline waters and the ice plants which cannot tolerate any submersion.

This shoreline is, for the most part, of a non-recreational nature and is used only by the casual hiker; by children living near points of moderately easy access; and by the motor bike enthusiast. However, the primary occupants of this area are avian rather than human and include a variety of shorebirds and water fowl and other salt-marsh inhabitants which are dependent on this and related habitats for their survival. Numerical values assigned to the various groups of birds occupying this area vary with the amount of preferred habitat available and this is a function of the tides. Generally speaking, there are fewer numbers of birds seen along this narrow western shoreline than there are on the opposite shore or immediately to the north. This does not mean that it is a less valuable resource; it only means that the resource is not as extensive and cannot support larger numbers of birds.

Several problems affecting environmental quality of this site were noted during the survey. Much of the intertidal shore line contains an excess of flotsom. Composition of this debris consists mainly of twigs, sticks, fragments of processed lumber, and entire planks; but, oranges, beverage cans, and a variety of plastic and other man-made products are well represented. Several dead gulls were also found on the mud flats and intertidal zone. Few of these products are flushed from Upper Newport Bay so that preventative as

well as maintenance measures will be required to retard debris production.

Erosion of the cliffs, particularly at points of easy access, is becoming a serious problem even though these entrances are posted with no trespassing signs. Casual foot traffic following single pathways can be tolerated but multiple paths concentrated in prescribed areas is damaging to the vegetative cover. Gully erosion ensues without benefit of such cover and the process has been accelerated recently by motor and trail bike invasion.

Minor erosion of the semi-consolidated cliffs is evident in a few prescribed localities where nuisance water is seeping down the cliff face from the yards of private residences. Attempts have been made to reduce the erosive nature of the water flow by providing shallow, concrete-faced channels and these measures appear to be successful in protecting the cliffs from further damage. Some uncontrolled runoff still exists where small sail boats being stored in backyards are washed down in the yards rather than on front driveways or the street.

In addition to erosion, localized pooling of fresh water along the shore has created a mosquito breeding problem which will require surveillance and correction.

If development which involves either the cliffs, shore or marine zone is contemplated, further study concerned with the impact on

the existing wildlife of both terrestrial and marine aspects will be necessary.

Because of the fragile nature of the cliffs which will not survive development without extensive stabilization measures, it is suggested that this moderately narrow zone of real estate be set aside as permanent open space and that the existing problems which are presently impacting the area be solved.

Site #11 (North/West Upper Newport Bay)

Location. Bordered by Del Mar Avenue; Irvine Avenue; Santiago Drive; and the Margin of Upper Newport Bay. (Map Reference: Thomas, Page 31, F1 and 2)

Existing Conditions. The property is unimproved and consists of four general habitat types based on general topography, exposure, and prevailing aquatic systems. The uplands include open, gradually contoured hills and fields extending bayward, and averaging ± 40 feet in elevation. Vegetative cover consists of an annual grass-forb flora which is periodically disked to prevent a potential fire hazard from developing in the summer months. The uplands south of 23rd Street are lower, contain seeps and wetland vegetation (cattails, Typha) adjacent to Irvine Avenue and are replaced by salt-tolerant weeds such as Russian thistle, bassia and telegraph weed near the bayside.

The uplands are traversed by a freshwater marsh land originating opposite 23rd Street and following an oblique swale which enters back bay. Existing vegetation includes arroyo willow, rush, cattail, water-tolerant grasses, and herbaceous annuals.

The third habitat is the narrow bluffland face which lies between the disturbed uplands and the marine zone. Vegetation associated with and stabilizing these slopes include a mosaic of native and introduced perennial shrubs, trees (toyon), cactus and herbaceous annuals. Several indigenous species, although not considered to be

endangered, are characteristic features of coastal or bay bluffs and, as such, may eventually be eliminated from the city limits unless select sites are put aside as mini-preserves.

The fourth and final habitat includes the littoral and marine zones which border the bluff lands and extend, to varying degrees, over the mud flats. A predictable sequence of salt-tolerant plants occur in zones extending out from the shore. These zones are dependent in part on the tidal fluctuations.

Each habitat supports a characteristic fauna with some species overlap between dry and wet or fresh to marine environments. However, many animals, birds in particular, exhibit extreme habitat partitioning and are dependent on a specific resource limited to a particular niche.

Uplands extending to, but not including the bluffs, and extending from Del Mar Avenue to, but not including, the 23rd Street fresh water marsh are suitable for development and will have a minimum impact on the existing biota of this terrace. The small segment of upland south of and isolated by the marsh contains several seeps and should be investigated before development is contemplated. If existing conditions preclude residential development, a small park is envisioned as one possible solution.

The bluffs have been locally degraded by pedestrian and two-wheeled vehicles and will require stabilization. A particularly fine array

of coastal bluff plants exists on the bay-facing slopes of two of the steeper hills and warrant consideration for retention. Mature specimens of California Christmas berry or toyon are scattered along the bluffs and should be retained if development is feasible along the bluff margins. Otherwise, pedestrian walks and bicycle paths would be a suitable use.

The fresh water marsh should be retained and set aside for nature study and interpretation. This area would also serve as an access corridor to the Upper Newport Bay tidelands and estuary.

The littoral zone adjacent to the bluffs should not be developed. The clapper rail, one of California's official rare and endangered species, occupies this and several other sites along the littoral zone of Upper Newport Bay. In addition, avian usage of this particular environment has been discussed and evaluated in a series of reports, the latest representing a year's field study of and literature review by Sexton (1972).

Site #12 (North Upper Newport Bay)

Location. Artificial boundaries include the Delhi Ditch (Orange County Flood Control District Channel F01); part of Irvine Avenue private residences in County territory which overlook but are separated from the bay shore by a broad strip of open land; and the area north of the San Diego Creek Channel (Orange County Flood Control District Channel F05). (Map Ref: Thomas, Pg. 28, A6; 32, AB1)

Existing Conditions. Except for a continuous series of open, grass-covered fields and gentle sloping bluffs which overlook and form the north shore of Upper Newport Bay, the other unimproved properties extend inland along the Delhi Ditch toward Palisades Road on the west and follow Jamboree Road to Palisades Road on the east. Santa Ana Heights is included within this roughly "U"-shaped belt of disturbed open fields and grasslands. The western arm of the "U" consists of two parcels of land divided by Mesa Drive East. Both plots are covered in varying degrees with barley, bromegrasses, wild mustards and radish, Russian thistle, filaree and isolated patches of native lupine and fiddleneck during the early spring months. Both areas are highly disturbed fields traversed by motor bike or foot paths. Some areas contain mounds of concrete blocks, asphalt, other miscellaneous solid wastes and soil. The central portion of the land south of Mesa Drive east is depressed, mainly barren and contains a horse training oval. This land, bordered by a deep, earth-faced ditch is connected to the north bay shore by the

flood control channel and by gently rolling, wild oat covered fields bordered with homes on either side.

The eastern leg of the "U" is much wider than the western leg; consists of cultivated barley fields adjacent to the intersections of Palisades and Jamboree Roads; contains Bayview School and the surrounding playfield as an intrusion area within fields of wild oats; supports some remnants of coastal sage scrub vegetation upon approaching the flood plain of San Diego Creek as it enters Upper Newport Bay.

These legs are connected by a much narrower strip of land between the north bay shore and a few Santa Ana Heights homes which overlook "Back Bay". As previously mentioned, the north shore includes gentle hills covered with mustard and a wild oat grassland with some scrub chaparral elements along portions of the sloping bluffs. Patches of cactus and castor bean are also present. Several horse trails cross the open fields and these are also used by joggers, hikers and some motor bike enthusiasts. There is some evidence of gully erosion along the western bluffs where dirt-bike riders have eliminated the natural ground cover.

The entire zone of open space around Santa Ana Heights is fairly uniform with much of the total surface area covered with cultivated or naturalized grasslands and invasive mustards, radish and other Eurasian weeds which frequent disturbed habitats.

The only significant differences occur along the margins of the

flood control channel where rain water impounds on either side of the dikes or where fresh water entering the bay from either the flood control channel or San Diego Creek creates a fresh to brackish marsh which is capable of supporting tule (Scirpus) and cattail (Typha) thickets. Two other areas include vestiges of the scrub community and the extensive contact zone between salt flat or marsh vegetation and salt tolerant terrestrial vegetation.

Wildlife associated with north shore open space does not appear to be as diverse nor as abundant when compared to other terrestrial habitats of similar or smaller acreage surrounding Upper Newport Bay. This apparent lack of animal diversity suggests that the relatively uniform nature of the grasslands and weedy fields which dominate most of the north shore area is the contributing factor responsible for minimum wildlife values in this sector.

Much of the wildlife consists of either ground inhabiting birds or foraging hawks and owls. White-tailed kites have been recorded from these fields on numerous occasions while western meadowlarks, mourning doves, a few California quail, and house finches are abundant residents. A number of other perching birds are found in association with the north shore and open fields of back bay throughout the year but they are not represented by unusual numbers of types. A particularly rare sighting of the Swamp Sparrow, an eastern bird, was recorded during the mid-winter of 1971-72 from north bay but further sightings were not made during the following winter.

Reptiles are randomly distributed and include the side-blotched lizard and occasional gopher, king and coachwhip snakes.

Mammals include the California ground squirrel, desert cottontail, pocket gopher, and several mice, the western harvest mouse being usually more abundant than other species in this particular area.

Coyote scat, while not particularly common, was found along the flood control dike road. Other smaller carnivores undoubtedly occur in this unincorporated area of Santa Ana Heights but they were not observed during the study. Local residents familiar with native animals are probably the best source of information concerning resident wildlife.

Since the extensive floods of 1969, a number of significant habitat changes have taken place on the mud, salt flats and eastern shore line opposite North Shore and on either side of the San Diego Channel as it enters Upper Newport Bay.

Silt deposition from winter floods have transformed the old salt works ponds into a salt flat which is gradually increasing in elevation and becoming dry enough to support such activities as trail bike maneuvers. A variety of salt-tolerant vegetation is already invading this naturally reclaimed surface where salt ponds once existed. In addition, mud flats adjacent to north shore are being invaded by a number of salt marsh plants which had been unable to colonize until changes in elevation of the flats altered the tidal

depths and extent of surface coverage. In other words, large mud flat areas are inundated only during the higher tides. If succession continues, higher areas could become incipient islands or peninsulas.

Perhaps the most significant change since 1969 is the development of a new habitat along the east shore between the former salt works and the bluffs adjoining Back Bay Drive. Increased elevations of the salt works site plus a continuous flow and seep of surface runoff from new residential developments higher on the bluffs have created a marshy habitat which has been invaded by cattails, mule fat and willow. These primary invaders plus a varied herbaceous understory have created a riparian thicket which is occupied and supports a variety of birds. Avian usage of this thicket includes foraging, roosting and nesting activities.

In conclusion, the terrestrial portion of the north shore area which includes the two landlocked legs is not as sensitive as other upland sites peripheral to Upper Newport Bay. The lack of diverse habitats has reduced the overall wildlife potential except for those areas which are influenced by tidal fluctuations or by the presence of fresh water.

Development is possible on much of this land except for depressed areas adjacent to the Delhi Ditch. Territory south of Mesa Drive, although capable of being developed, should be retained as open space in spite of the apparent minimal values to local and migratory wildlife. North shore acts as a wildlife communication corridor,

connecting Westbay with the San Diego Creek Channel, the San Joaquin Fresh Water Marsh and Eastbay sites, all of which represent significant wildlife habitats.

Site #13 (Big Canyon)

Location. A swath of unimproved canyon bottom located between Back Bay Drive and Jamboree Road. The mesas on either side of the canyon have been recently developed and contain residential units. An extension of the canyon located between Jamboree Road and the proposed Corona del Mar Freeway has been improved by incorporation into the Big Canyon Country Club development. (Map Ref: Thomas, Pg. 32, A3, 4; B4).

Existing Conditions. This canyon, of all the upland areas surrounding Upper Newport Bay, contains the richest array of floristic associations and supports a substantial variety of resident and migratory wildlife as well as casual visitors.

Brush covered or grassy fields cover limited areas on either side of the central riparian thicket paralleling the year around flow of runoff water issuing from the Big Canyon Country Club golf course and peripheral homes. Remnants of coastal sage scrub and chaparral elements form a mosaic of dense brush which covers portions of south-facing slopes between a canyon bottom fresh water marsh replete with rush and cattail and landscaped yards along the canyon edge. The riparian zone is characterized by the presence of small isolated groves and continuous thickets of arroyo willows which were subordinate to other floral elements in 1964 but now dominate much of the canyon bottom. Such explosive growth is apparently due to the continuous supply of water which is probably nutrient rich.

Although a complete inventory of the flora was not undertaken, more than eighty different species of plants were noted during a casual late spring walk through the canyon. Included among this number were perennial native shrubs, cacti, a variety of native and introduced weedy annuals, water tolerant and dry field grasses, native annual wild flowers, some garden escapes and rush or cattail thickets.

As can be expected, the associated wildlife is rich, diverse and abundant. The cliche, "something for everyone", definitely applies to Big Canyon; particularly, when more than 85 species of birds have been recorded from a circumscribed area which not only contains residential, high density dwellings along both canyon margins but considerable foot traffic and casual trespass use in spite of postings intended to discourage such activities.

Avian usage is particularly diverse and includes the roadrunner, burrowing owls, barn owls, five species of hummingbirds during a given year, hawks seeking small rodents or birds, cactus wrens, towhees, blackbirds, mocking birds, and several warblers, some considered to be rare or uncommon, to mention only a few examples.

Mammals include the usual variety of small rodents which frequent coastal mesophytic riparian or drier grass and brush thickets. A family of fox have been reported from the canyon, one of few families remaining within the immediate bay area of Newport Beach. Opossums, skunk and coyotes are other carnivores which still frequent the canyon although they are seldom seen. Cottontail rabbits and

California ground squirrels are still moderately common in spite of the diminishing acreage of fields and brush-covered slopes which have been developed.

Big Canyon, as it presently exists between Back Bay Drive and Jamboree Road, is a valuable natural resource and one that should be retained as permanent open space. Few areas remain within the present City limits of Newport Beach that exhibit such a variety of habitats and an extensive native and naturalized flora and fauna. Only one area within the canyon has a low biotic value. The south side of the west end of the canyon contains an earthen dike and central basin composed of what appears to be deposits dredged from the channel bottom of Upper Newport Bay. Salts are leaching from the surface and except for some sparse vegetation which has invaded lateral berms, most of the dry central mud surface is void of plant and animal life.

If development is contemplated for any part of the canyon which is not already impacted by the presence of structures, a complete inventory of the existing biota should be prepared. Values should then be assigned to the existing habitat types and associated plants and animals of the Canyon on what is still available within the City limits of Newport Beach rather than what remains in the County or Southern California. A specific habitat or natural resource may be both rare and/or endangered within Newport Beach even though comparable habitats and their indigenous plants and wildlife are still relatively common throughout Orange County.

Without development, some problems exist which will require eventual solution. These include:

1) Quality of runoff water percolating through the canyon and flowing into Upper Newport Bay;
2) Additional slope stabilization in limited areas where peripheral development and subsequent landscape irrigation has created minor gully erosion;
3) Controlled access, particularly for motorized vehicles;
4) A specific plan for use of this resource. If the area is retained as a natural or semi-natural wildlife center, some management, however small, will be required because of its central locality within an urban community.

Site #14 (Newporter North)

Location. Unimproved mesa, valley, and bluffs bordered by Back Bay Drive; San Joaquin Hills Road; Jamboree Road; and the Newporter Inn. (Map Reference: Thomas, Pgs. 31, F4, 5; 32 A4, 5)

Existing Conditions. This property includes three primary topographic features and their associated biota. Most of the area consists of a moderately level open field which shows signs of previous agricultural use or periodic disking or mowing to reduce the fire potential of the annual crop of weedy forbs which cover much of the mesa surface. In addition to the drier waste fields, two open ditches containing immediate surface runoff as well as irrigation runoff from the Irvine Coast Country Club golf course cross the uplands and discharge into a large metal pipe which conveys these surplus waters to Upper Newport Bay. Both surface ditches support an extensive thicket of cattail and rush.

The second area includes the bayside bluffs which vary considerably in degree of slope and plant cover. In general, the slopes are covered with a substantial growth of coastal sage scrub with California sagebrush as the dominant number of the community. Other important members of this bluff association include lemonade berry (Rhus integrifolia), buckwheat (Eriogonum fasciculatum), tree tobacco (Nicotiana glauca), elderberry (Sambucus mexicana) and prickly pear and cholla cactus (Opuntia spp.). Additional woody flowering perennials and an extensive variety of herbaceous native and introduced

annuals appear in open spaces and as part of the scrub understory in response to winter rains and subsequent warm periods during the early spring.

The third and final habitat is an open, broad-based ravine which separates the Newporter Inn and golf course from the elevated open fields to the north. The bottom of the ravine is low, wet, and densely covered with water-tolerant grasses and a variety of annual weeds. The slopes on either side of the ravine are dry for most of the year and support an extensive growth of introduced grasses, mustards and other low growing native and introduced forbs. Cardoon or wild artichoke (Cynara cardunculus) is common throughout the ravine and some patches of California sagebrush occur along the upper slope margins, particularly adjacent to Bay Side Drive.

The wildlife is varied and essentially reflects the nature of the vegetation which characterizes a particular habitat. Ground inhabiting birds which include mourning doves, meadowlarks, pipits, horned larks, burrowing owls, and some sparrows frequent the level open fields and exposed slopes on either side of the ravine. A variety of raptors (hawks and larger owls) also utilize the disturbed fields and ravine as a hunting ground for small mammals and birds. Blackbirds are associated with the rush-cattail filled ditches crossing the mesa and killdeer are also found on the mesa while snipe are fairly common residents of the wetlands at the ravine bottom. California quail frequent contact zones between the open fields and the coastal sage

scrub which covers the bluffs.

The relative abundance of terrestrial vertebrates found in this extensive area was not determined except for the obvious presence of rabbits and ground squirrels. A variety of small rodents undoubtedly occur and are fairly common throughout the entire locality while larger predators, seldom seen because of their nocturnal habits, occur in reduced number because access is limited to the bayside perimeter and most protective cover is also restricted to the bluff slopes.

It is apparent that wildlife values of this site are variable and depend on the qualitative nature of each habitat. Open fields contain larger populations of only a few species while scrub-covered slopes tend to have a greater variety of plants or animals but fewer individuals on a per capita basis. As a consequence, wildlife values associated with these particular open fields is lower than the bluff or ravine habitats.

This land represents a valuable piece of real estate since minimal grading operations would be required for maximum development and eventual economic returns. Also, it is convenient to major business, industrial, shopping, and recreational centers as well as providing an excellent view of Upper Newport Bay.

In conclusion, there appear to be at least two conflicting viewpoints concerning the ultimate disposition and use of this land. It is a valuable open space resource but it is also a prime site for

development. Each concept is valid and can be supported by a variety of persuasive arguments. It is even possible that elements from both or other land use proposals could be integrated into a multi-use concept where the bluffs could be retained while the uplands are either totally or partially developed.

Regardless of the final decision, the quantity and quality of existing surface runoff from this and adjacent properties as well as potential slope instability problems of the bluffs will require further study and resolution, particularly if proposed development encroaches on any part of the bluffs.

Site #15 (South of Newport Dunes)

Location. Presently undeveloped land except for the corner of East Coast Highway and Jamboree Road. Back Bay Drive and Newport Dunes Aquatic Park complete the north and east borders. (Map Ref: Thomas, Page 31, F 5).

Existing Conditions. This site consists of moderately flat, elevated bluff-lands which overlook the Newport Dunes Area parallel to the East Coast Highway and a nearly level plot of land fronting on Jamboree Road. Much of the surface area of the upper bluffs has been previously cleared on either side of a service station which occupies the north-west corner of the intersection. The cleared surface is stabilized with a low ice plant ground cover and the remaining field supports an extensive growth of annual mustard, grasses and other invasive weedy species. The unimproved lot below the bluffs along Back Bay Drive is very sandy, has a large number of shells and shell fragments exposed on the surface and does support a few volunteer annuals which are too scattered to be of any particular significance.

Except for the bluff slopes which do contain some natives intermixed with weedy species, the overall vegetation reflects the disturbed nature of this site.

The value of this area to local wildlife is minimal because of the lack of cover, isolation by and proximity to major highways and roads as well as disturbance from casual trespass. The soils are

extremely porous and except during years of higher than average rainfall, productivity of the existing vegetation is too low to support or be particularly attractive to local ground-inhabiting birds which constitute the main species of vertebrate animal life which frequent the area.

Although this land, presently constitutes open space, its value as a natural resource is low because of its location and the degraded nature of the existing environment. The available bluff-land is quite limited, affords a view of Upper Newport Bay and is probably more suited to development than as open space.

If this site is scheduled for eventual development, there is no need to consider the impact on existing vegetation and wildlife except for the bluffs and associated biota directly above the trailer park homes located between the aquatic park and the bluff bottom. The bluffs do not appear to be totally stabilized and any development which encroaches on or in any way alters the integrity of these bluffs may have adverse effects in terms of erosion. The existing vegetation, if left intact, may not be capable of stabilizing the soil once construction begins and other means of erosion control will have to be investigated.

Site #16 (Jamboree Road Site)

Location. Unimproved strip of land opposite the Newporter Inn. Between Jamboree Road and the Irvine Coast Country Club Golf Course. (Map Reference: Thomas, Pg. 31, F5)

Existing Conditions. This site represents an isolated remnant of dry farming and grazing lands, eighty percent of which is periodically disked to reduce the fire hazard and weed seed production from naturalized European grasses and mustards which represent the dominant vegetation covering the gently rising slopes east of Jamboree Road. Additional introductions which characterize the site and reflect its disturbed nature include Russian thistle and cardoon or wild artichoke.

Some native vegetation still remains in association with a short ravine perpendicular to Jamboree Road at the northern boundary, an elevated terrace, and a surface seep zone parallel and adjacent to the southern boundary. California sagebrush is the primary sub-shrub on the ravine slopes. Other naturalized forbs and grasses do occur but they are not significant except as a cover or food source for some birds and small rodent populations.

The mesa or terrace supports remnants of coastal sage scrub vegetation which includes scattered specimens of coast goldenbush and California buckwheat. Neither of these community index species exist in appreciable numbers.

A small but continuous flow of fresh water overflow from an Irvine Coast Country Club golf course water hazard or lake seeps across the

southern edge of the property. This seep contains a small grove of arroyo willows and an herbaceous understory of water-loving plants which include cattails and volunteer wild celery. This association, differing markedly from the disturbed grassland and wastefields on either side, is attractive to a variety of resident and migratory birds which occupy this diminutive habitat.

Most of the avian wildlife associated with the ravine, central grassland or seep zone are common "residential" species which are found on the Newporter Inn grounds and golf course or frequent the Irvine Coast Country Club golf course grounds. Occasional migrants, casual visitors and local hawks, particularly during the winter months, have been reported on the power line poles which overlook this elongate wedge of land between Jamboree Road and the golf course.

In spite of the apparent variety of habitats, the wildlife potential has been degraded by previous development. Terrestrial vertebrates are or will shortly be excluded from the site by surrounding arterial systems. Exceptions include low numbers of resident pocket gophers, ground squirrels and small mice.

This land, because of its location and disturbed condition, does not represent a particularly valuable wildlife resource. Development will have a minor impact on the total remaining biotic resources which exist within the city limits of Newport Beach. An in-depth analysis of the biotic feature is not justified.

Site #17 (Bayside Drive)

Location. Section between Begonia and Marguerite Avenues. (Map Reference: Thomas, Pg 33, AB1)

Existing Conditions. Both sides of Bayside Drive are developed and contain either the front or back yards of private residences or commercial units except for a corridor of undeveloped open space paralleling Bayside Drive's northern or inland side.

Remnants of native sagebrush-scrub vegetation persists along the upper slopes and cliff face opposite the intersection of Begonia Avenue. These native elements are intermixed with a variety of introduced ground covers and volunteer weedy species. The remaining area continuing along the south or seaward side of the drive has been planted with a wide variety of roadside ornamentals or is occupied by a series of landscaped homes immediately adjacent to the street.

The opposite side is either landscaped or contains existing structures at either end of the drive but the central area has a broad, undeveloped corridor between developed land and the street. Bare ground comprises most of the corridor's surface except for a nearly continuous row of acacia and eucalyptus which serves to screen the bare ground from the motorist's view.

This elongate piece of undeveloped land is unsightly when compared to the park-like aspect bordering most of this portion of Bayside Drive

and its present use appears to be that of an informal parking lot.

As previously noted, the existing plant life is composed of ornamentals. or volunteer species which are broadly classified as weeds. The acacia-eucalyptus plantings are a significant visual and accoustical screen. They are also used by some resident birds as roosting and nesting sites. In fact, perching birds represent the major form of native vertebrate wildlife associated with all properties on either side of Bayside Drive.

Site #18 (Buck Gully)

Location. An extensive canyon, approximately two and one-half miles long. The first 1/4 mile extending from Little Corona Beach to the Pacific Coast Highway is developed on both sides with Evening Canyon Drive, Hazel Drive, and Poppy Street providing the lateral limits. The canyon edge is also developed on both sides for another 1/4 mile section northeast of the Pacific Coast Highway where extensions of both Poppy Street and Hazel Drive form the western edge of the canyons while a series of cul-de-sacs and short drives comprise the equally developed eastern edge. The remaining two miles of canyon extending toward Signal Peak in the San Joaquin Hills is developed or in the process of being developed only on the west and north sides of the canyon. (Map Ref: Thomas, Pgs. 32, BC1-2; 33, CD, 6)

Existing Conditions. Vegetation associated with the moderately steep slopes approaching 40-45^{o} in the laterally developed section of the canyon which extends between the Coast Highway and Little Corona Beach consists of a picturesque mixture of native, naturalized and planted exotic trees and shrubs. Native lemonade berry, elderberry and toyon or California Christmas berry represent dominant tree-shrub species while acacias, eucalyptus, myoporum, and plantings of a horticultural variety of native wild lilac (Ceanothus) add to the visually pleasing and "wild" nature of this area. The canyon bottom contains a small stream bordered with dense shrub thickets including poison oak. Upon approaching the beach, the bottom and lateral slopes

open up and do not support a moderately dense shrub cover. Giant cane thickets are found along the stream side and individual property owners have taken advantage of these gentler slopes which enable them to have swimming pools and similar private recreational areas on lateral terraces. Yards containing these facilities are completely encompassed by chain link fencing, undoubtedly, a code requirement with respect to swimming pools.

This quarter mile section of Buck Gully represents a stable community where native and landscaped home sites blend together and form a seemingly natural habitat. Resident wildlife is varied, abundant and it has seemingly attained a natural balance with the existing cover and available resources.

Further development which would materially affect this balance of the canyon slopes or bottom is not recommended unless the proposed project is visually compatible with or will eventually conform to the surrounding elements upon completion.

The portion of Buck Gully north of the Coast Highway and extending to Fifth Street is similar to the preceding section in that the slopes support an extensive native and naturalized shrub cover supplemented with compatible landscaped introductions. The gully bottom is narrower and less enclosed by peripheral vegetation. Also, except for an open eucalyptus grove at the north end of this reach opposite of Fifth Street, trees are not as prevalent.

This portion of Buck Gully is similar to the coastal reach and the same restraints with respect to development also apply.

The next portion of Buck Gully extending inland is adjacent to part of the Harbor View Hills development and scarcely resembles the preceding canyon configurations. North-facing slopes support extensive but isolated patches of California sagebrush surrounded by open field covered with naturalized grasses, field mustard, wild artichoke and herbaceous patches of early spring annuals. South-facing slopes directly below the Harbor View Hill homes and continuing up canyon are also covered with the same grass-mustard cover except for fill or graded slopes which have been planted with ice plant. The canyon bottom is moderately wide and contains a similar but slightly weedier vegetation than lateral slopes. This portion of the gully has been heavily grazed by cattle over the years which accounts in part for the stark, open nature of this reach when compared to the two previous sections.

Portions of the canyon bottom contain a shallow-faced concrete channel to prevent gully erosion produced by winter rains and to convey surface run-off waters generated by home sprinkler systems. An additional system of interconnecting-concrete-lined channels is found on steep, fill-slopes of the western canyon margin. These artificial erosion control systems, while presently visible, will eventually be masked by new landscaping and the invasion of peripheral naturalized vegetation. The uppermost reach of Buck Gully forms a natural boundary to the Spy

Glass Hill development presently under construction. An extension of San Joaquin Hills Road follows the northern border of the canyon which proceeds in a southerly direction from the lower Harbor View Hills reach.

Slopes of the canyon directly below those home sites which will front on, or at least be between, the canyon and San Joaquin Hills Road are covered, for the most part, with a low, dense native shrub cover representing elements of both the coastal sage scrub and chaparral plant communities. The scrub cover does not form a continuous belt but is periodically interrupted by clearings which support either a grass-mustard and ruderal vegetation or extensive patches of cactus.

This native scrub cover, responsible for slope stabilization, includes a variety of perennial species from such genera as Eriogonum, Rhus, Salvia, Quercus, Artemisia, Encelia, Heteromeles, Haplopappus, Cercocarpus, Mimulus, and Rhamnus. It also supports a varied and species-rich annual flora as well as an interesting and varied fauna.

These particular south-facing slopes are similar in degree of slope and general vegetative composition to the lower reaches of Buck Gully on either side of the Coast Highway except that the array of environmentally compatible varieties of introduced trees and shrubs following development have not been planted as yet.

The opposite slopes consist primarily of open grasslands previously subject to cattle grazing. A few pure stands of California sagebrush

remain as islands within this range land while further islands of dense scrub containing specimens of toyon still exist as remnants of what had been an extensive community prior to the introduction of cattle in southern California.

Erosion; incidental production of year-round streams or pools; fire; education of the homeowner with respect to beneficial and dangerous animals; and an evaluation of a natural resource which lacks presently endangered species are several of main problems which require further analysis and solutions for this and other comparable areas of the San Joaquin Hills.

Site #19 (Morning Canyon)

Location. A canyon of slightly less than 3/4 of a mile long, perpendicular to the coastline which passes through Cameo Shores and Cameo Highlands on either side of the Pacific Coast Highway. Seaward and Rockford Roads form artificial boundaries on the reach northeast of Coast Highway while Morning Canyon Road and Milford Drive form the canyon limits as it traverses Cameo Shores. (Map Reference: Thomas, Page 33, BC2).

Existing Conditions. Both margins of the canyon on either side of the Coast Highway are, with minor exceptions, developed and contain a series of private homes whose backyards overlook or extend down the slopes. The reach situated north of Coast Highway and the unimproved hills and ravines of the Irvine Ranch have been partially cleared of native and naturalized vegetation, particularly by individual homeowners on the west side of the canyon where the slopes are gradual. Some native toyon or California Christmas berry remain but much of the coastal sage scrub has been replaced with a wide variety of ground covers and exotic trees. The much steeper, west facing canyon slopes still contain fifty percent cover with such native coastal sagebrush species as California buckwheat, toyon, lemonade berry, black sage, and California sage brush. Exotics have been planted but they usually do not extend down slope to the canyon bottom which has been previously cleared of all vegetation and now contains a volunteer grass-forb ground cover.

The remaining sector of canyon traversing Cameo Shores between the highway and the beach is characterized by being covered with extensive thickets of native lemonade berry, Rhus integrifolia, which dominate both slopes of the canyon and form a nearly impenetrable barrier to foot traffic. Individual homeowners have replaced or supplemented some of the native ground cover with various trees and shrubs but in spite of these minor intrusions, this canyon contains the purest and densest stand of lemonade berry within the Newport Beach city limits.

As can be expected, this shrub-covered section of canyon is frequented by a large number of birds while the understory contains a variety of native rodents and small carnivores whose foot prints were left on damp soil along the seasonal rain-fed stream and nuisance water flow from adjacent homes.

Since both sides of the canyon above and below the Coast Highway already contain existing homes, future impact on this area should be minimal. However, development of Irvine Company land north of Cameo Highlands will affect Morning Canyon and will require a careful analysis of grading operations and control of runoff and nuisance water production.

Site #20 (Fifth Avenue)

Location. Grant Park and State of California transportation corridor. This area is bounded by peripheral streets which include Goldenrod, Harbor View, Sandcastle and Fifth Streets. (Map Ref: Thomas, Page 33, B6, 1).

Existing Conditions. This strip of unimproved land was intended to contain a portion of the coastal freeway. At present, Marguerite Avenue divides the corridor into two sections. The western piece has been used as a dump site for surplus soil; has an abandoned basketball court; and gully erosion is an immediate problem which will require repair and stabilization. Vegetation includes an array of introduced Eurasian weedy species covering much of the waste fields. A gully containing Jasmine Creek's nuisance water flow separates Grant Park from the abandoned field.

Pines and acacia have been planted along the park-side slopes of Jasmine Creek where they not only help to stabilize the soil but also serve to screen out the former transportation corridor. The creek bottom contains a thicket of rushes and other water-loving vegetation.

A series of power line poles extend up or along Jasmine Creek and are used as observation roosts by hawks.

The fields east of Marguerite are covered with a nearly uniform growth of wild oats and some mustard which replaces or supplements the disturbed grassland at the western edge of Buck Gully.

Rodents, ground inhabiting, seed or insect-eating birds and an occasional hawk represent the main vertebrate types which frequent this corridor.

Existing vegetation is not particularly significant nor is the attendant wildlife which is species poor but numerically rich. Meadowlarks, mourning doves and house finches represent the main bird life seen on the corridor fields although many other birds, some in large numbers, randomly frequent this corridor.

Several existing features of this site will require management regardless of whether it becomes a park, greenbelt or a residential area.

Any development will require erosion control measures for the south facing slopes of Buck Gully. The property between Jasmine Creek and Marguerite presently requires fill and erosion control.

Site #21 (Jasmine Creek)

Location. Undeveloped site containing the Orange County Flood Control Department Harbor View Dam and retaining basin. Bordering streets include Marquerite Avenue, Harbor View Drive, San Joaquin Hills Road, Crown and Sandpiper Drives. (Map Ref: Thomas, Page 32, BC6 and Page 33, BC1).

Existing Conditions. This plot of land, formerly used for dry farming and grazing, is presently surrounded by existing developments except along the south margin below Harbor View Drive.

A complete description of the site, its existing resources and ultimate disposition are available in an environmental impact statement prepared by Raub, Bein & Frost and Associates of Costa Mesa, California and Reynolds & Associates of Newport Beach. The report is entitled, "Jasmine Creek, Tract No. 7967".

Although the vegetation and wildlife growing on or associated with this tract does not include any species which, because of their rarity, require special consideration, two types of tree or tree-like shrubs are visually attractive on which is otherwise an open, moderately uniform habitat.

Specimens of silver dollar gum, Eucalyptus polyanthemos, planted around an abandoned reservoir in the northwest corner are a visually significant site resource. In addition, there are several individuals, including a small cluster, of native toyons found on the ravine slopes

which may or may not be equated with the existing eucalyptus trees.

Of the various birds and mammals which presently occupy the site, the white-tailed kite, formerly an endangered raptor, is the most interesting of all the animals which use but do not live on the plot of land. These hawk-like birds are small rodent feeders, concentrating mainly on California meadow mice or western field mice which represent their preferred food. Development of this particular site will discourage further use by local kites. Fortunately, comparable habitats with fresh water ponds or stream flow adjacent to disturbed grasslands still exist in Orange County and will continue to support the rodent-kite system.

Site #22 (Harbor View Hills)

Location. Unimproved section of Big Canyon extending between the present MacArthur Boulevard (proposed Corona del Mar Freeway route) and the newly established MacArthur Boulevard route between Ford and San Joaquin Hills Road. (Map Ref: Thomas, Page 32, C5)

Existing Conditions. The entire upper margins on either side of this canyon have or are presently being developed and contain a series of private residences along the northern edge and a newly-constructed townhouse complex along the southern edge. Both slopes of the canyon face are steep-sided and support an array of mainly introduced annual grasses and forbs. Isolated patches of California sagebrush still remain and are restricted to the upper slopes of the canyon. Included within the mustard and perennial rye-brome-wild oats grassland are isolated individuals of coast goldenbush (Haplopappus), gum plant (Grindelia), annual sunflower (Helianthus), and a few California buck-wheat (Eriogonum). The canyon bottom is, for the most part, broader at the upper or southern end and narrows slightly as it approaches the proposed freeway section of MacArthur Boulevard. There is a continuous stream flow and several natural impoundments throughout the reach. Cattails and rush are forming thickets around the ponds and long the stream banks but thus far willows have not invaded the site. The source of the water was not specifically determined but much of it appears to be surface runoff and percolation from artificial irrigation of Pacific View Memorial Park turf located due east of the canyon. The remainder is coming from newly landscaped slopes between

the townhouse development and the canyon bottom.

A few specimens of elderberry, Sambucus mexicana, are the only conspicuous native perennial shrubs in the canyon.

Resident wildlife is relatively sparse. House finch, mourning doves, blackbirds, starlings, and some meadowlarks are common. A number of other birds undoubtedly frequent the site but species diversity is low and reflects the degraded nature of the existing vegetation which is remarkably homogenous except for the response of marsh-loving plants to recent stream flow and impoundments in the canyon bottom. California ground squirrels are abundant and pocket gophers are also prevalent judging from the number of burrow signs along the arid canyon slopes.

According to a sign posted at the entry of a macadam bicycle path which parallels part of the north canyon edge, this section of Big Canyon is scheduled to become a nature park which will serve the developing community. This option seems to be a logical land use solution for this canyon. It would serve as both a visually attractive and useful open space resource for residents on either side of the canyon. By incorporating the existing stream flow into a design which includes native trees and shrubs, the entire canyon bottom and slopes could be converted into a recreational area which is not only functional but would serve to attract a greater avian wildlife assemblage than presently exists. In addition, a nature park and its associated vegetative cover would assist in stabilizing the canyon

slope soils which are exhibiting erosive tendencies on the south slopes.

Site #23 (Spyglass Hill)

Location. Spyglass Hill - San Joaquin Reservoir. Presently undisturbed terraces and ravines adjacent to and located between these two landmarks. (Map Reference: Thomas, Page 32, D4, 5 and 6)

Existing Conditions. The vegetation associated with this extensive area of marine terraces consists of open grasslands containing native and introduced annual forbs along with patches of low growing sage scrub on the level, drier exposed surfaces. The slopes and bottoms of ravines and small canyons traversing the terraces are more mesic and support a dense shrub cover of sage scrub and some chapparal elements.

The main shrubs concentrated particularly on north-facing slopes include Rhus integrifolia (lemonade berry); Rhus laurina (laurel-leaf sumac); Heteromeles arbutifolia (toyon); Salvia mellifera (black sage); and Erigonum fasciculatum (California buckwheat). Black sage and California buckwheat along with bee sage (Salvia apiana); scrub oak (Quercus dumosa); and deer weed (Lotus scoparius) plus a variety of introduced grasses form the dominant cover of the drier or xeric terrace surfaces.

Cattle and some deer were the dominant herbivores of these terraces prior to the development of Spy Glass Hill. The cattle have since been removed to interior grazing lands. Other animals associated with these terraces and gullies include a variety of perching and grassland inhabiting birds. Hawks, such as the sparrow and red-tailed,

frequent these lands, using power transmission line poles as observation roosts. White-tailed kites have hunted the grass fields in past years, feeding on certain members of the twelve species of small mammals (mainly rodents) which are known to occur in this particular area. Larger mammals include the jack and cottontail rabbits, skunk, coyote, fox, and an occasional bobcat.

These terraces and gully or canyon slopes, although heavily grazed and browsed, do support one of the more extensive remnants of the coastal sage community remaining within the present Newport Beach City limits. Any development of this area will require further evaluation.

Site #24 (M.W.D. Reservoir Area)

Location. Undeveloped canyon adjacent to the Metropolitan Water District reservoir and extending up to the northern margin of the Spyglass Hill development. (Map Reference: Thomas, Page 32, D4)

Existing Conditions. This is the only canyon containing a significant native biota on the grass-covered hillsides between the northern boundary of Pacific View Memorial Park and a new shopping center which is under construction at the intersection of Ford Road and the relocated MacArthur Boulevard. The surrounding hillsides were previously dry-farmed and grazed but this singular canyon and one lateral fork were too steep to utilize for that purpose.

The present mouth of the canyon is perpendicular to and terminates at MacArthur Boulevard. Some elderberry exists in the canyon bottom and a number of mature specimens of toyon or California Christmas berry, some naturally grazed into a standard tree farm, are found along the lateral slopes and extend up the first fork of the canyon. The main canyon proceeds in a southerly direction up a steep slope and eventually terminates in a series of residential back yards on Spyglass Hill. Vegetation in this area between the fork and below the development is dense, virtually obscures the canyon bottom, and consists of poison oak and other native shrubs with toyon being the dominant member. A slight flow of runoff water exists throughout the canyon and both the herbaceous annual and perennial growth response to the continuous flow is marked in contrast to the arid, sagebrush covered

slopes on either side.

The left-hand fork of the canyon is much drier throughout its length but there is an isolated, shrub-covered area of the canyon bottom at about the same elevation of the shrub grove in the main canyon.

The wildlife is varied and differs considerably from the fauna associated with the surrounding grasslands. In general, the total numbers of canyon associates are lower but there is a much greater number of species present.

Pacific tree frogs were calling during the site visit and a large variety of perching birds were observed along the canyon bottom and lateral sage-brush covered slopes. Turkey buzzards use this and the lateral canyon fork as a nighttime roost, several being flushed from the area during the early morning hours.

Since this small canyon is the only refugium of a native sagebrush-scrub-chaparral flora and associated wildlife found along the grass-covered slopes above relocated MacArthur Boulevard and between Ford Road and Pacific View Memorial Park, it seems that incorporation of this small canyon complex into the open space plan of the City would be desirable. This canyon has the potential of being semi-developed into a community nature-interpretation center if a sufficient acreage is included and a recreational-educational approach is taken by those individuals responsible for planning such a facility.

Site #25 (North - North Ford Area)

Location. Undeveloped and partially developed acreage situated between the San Diego Creek Channel; Jamboree Road; Bison Avenue and its proposed extension; and MacArthur Boulevard in its present alignment. (Map Reference: Thomas, Pages 32, BC 1, 2)

Existing Conditions. This portion of Eastbluff consists of an upland area which has been partially terraced into a series of level pads, some of which already contain industrial units located on two pre-existing streets. Additional buildings are already under construction and it is evident that the remaining open space is scheduled for additional structures. Steep slopes created when these terraces were carved out of former bluff lands have been planted with an interesting array of introduced trees, shrubs and ground cover which has not only controlled erosion but also serves to screen off existing structures from the passing motorists' view. Much of the success in establishing erosion control on these artificially created and planted slopes is due to a system of irrigation which promoted rapid plant growth and slope coverage. Several slopes have not been planted and gully erosion has begun even though some weedy annuals have invaded the terraced banks. Graded but empty pads also support a variety of weeds such as Russian thistle, Indian and white sweet clover, filaree and telegraph weed.

The remaining land situated within the prescribed artificial boundaries of the site is a lowland between Jamboree Road and MacArthur Boulevard.

This area, located at the confluence of Bonita Canyon and San Diego Creek as it enters Upper Newport Bay, is an alluvial flood plain previously used as irrigated farmland until 1969 when sheet flooding converted agricultural land to waste, weed-covered fields.

Wildlife associated with this locality reflects the disturbed nature of both the terraced hills and the farmland which has been altered through previous flooding and invasion of mainly alkali-tolerant weeds.

Amphibia tend to concentrate around fresh water rain pools present in the lowlands during the winter months and shift to irrigated sites in the industrial upland area during the drier part of the year. Reptiles include several common species of insectivorous lizards and the random snake (gopher, king or coachwhip) which frequent weed-covered fields for a variety of small rodents which are common inhabitants of weedy fields and waste places. The avifauna, while not particularly varied does include a variety of perching, insect and seed-eating birds as well as the occasional hawk which use the lowland as a feeding ground particularly during the late fall and winter months.

The lowland area includes and has a greater wildlife potential than the uplands but neither location is particularly outstanding when compared to similar habitats in Orange County. Furthermore, industrial developments are already occupying some of the open space within this particular site and the projected Corona del Mar Freeway and nearby interchange system will encourage further industrial expansion into the lowland zone after channelization of San Diego Creek is completed west of the proposed freeway.

Existing problems which require immediate preventative measures include: 1) gully erosion of undeveloped terrace slopes and pads; 2) extended areas of rain pooling and potential mosquito breeding sources just east of Jamboree Boulevard.

If development takes precedence over open space utilization, the entire lowland will have to be filled well above flood plain elevations and runoff channels will be necessary to protect any structures built in the flood plain zone. In addition, surface runoff from landscaped industrial sites or parking lots may need quality monitoring if excessive volumes enter Back Bay.

SECTION V

AQUATIC RESOURCES

OF

NEWPORT BEACH

I. NEWPORT BAY

A. INTRODUCTION

Newport Bay is an estuary, although the amount of freshwater entering it varies considerably as a result of the highly seasonal precipitation as well as marked annual fluctuations in rainfall. Historically, the flows of freshwater into the Bay have changed greatly from time to time, due principally to the vagaries of the Santa Ana River. The outline of the Upper Bay was formed by the erosive action of the Santa Ana River in prehistoric times. More recently the only flows to the Upper Bay from the River have been due to occasional spillage during periods of overflow. Prior to 1825, the mouth of the Santa Ana River was at the Alamitos outlet, near Seal Beach, but in that year extensive flooding caused a major movement of the River so that its entry to the sea became located at what is now the west end of the Lower Bay. The mouth of the Santa Ana River was established at its present location due to extensive levee contruction in the 1920's. The existing configuration of the Lower Bay is a consequence of more recent accidents in the flows of the Santa Ana River and man-made modifications. Prior to the flood of 1825 there were various tide-washed sandbanks off Upper Newport Bay but, essentially, the entrance to the Upper Bay was exposed to the Pacific Ocean. The flood of 1825 created a sandbank which was exposed at all states of the tide forming an island. This island was enlarged by subsequent floods, particularly that of 1861, after which a spit was formed

which subsequently became the Balboa Peninsula. It is very probable that the sandbanks which formed the bases for Lido Isle and Balboa Island represent the remains of an inner previously-formed sand spit similar to the later sand spit which became the Balboa Peninsula. As a result of dredging activities and the consolidation of the spoil dumps, further islands have been created during the present century, so that there are now seven islands in the Lower Bay. Three islands occur in the Upper Bay, one of which (Shellmaker Island) has been converted into a peninsula through a road connection. Dike construction in the uppermost portion of the Upper Bay created various lagoons which were used for salt production until damage too extensive for repair closed down this activity in 1969. Dredging of parts of the Upper Bay was carried out in connection with the development of Dover Shores and Newport Dunes and for the present water-ski area.

Newport Bay is divided into two parts by the constriction which exists at the Coast Highway Bridge. The Upper Bay is surrounded for the most part by Bluffs and although there has been some development, major modification involves less than 10% of the periphery. In contrast, the Lower Bay is bounded only in part by bluffs on the northern and eastern borders and its periphery is largely made up of sandy/muddy islands protected by man-made bulkheading. The Lower Bay is totally developed residentially and as a small boat harbor. Thus, the Upper and Lower Bays differ very considerably both in their geological structure and in the extent of modification by man's activities and it is best that they be treated as separate areas for environmental purposes.

UPPER NEWPORT BAY

Description. Upper Newport Bay is an elongate sinuate body of water, some 3.5 miles in length, oriented in a general northeasterly direction. Despite its length, the Upper Bay is narrow, rarely exceeding half a mile in breadth and much less than this in places. Bluffs extend along most of each side of the Upper Bay, with an average height of the order of 100 ft. The general outline of the Upper Bay and the occurrence of these Bluffs are a reflection of its formation by the Santa Ana River in prehistoric times. A benchlike shelf exists at the foot of the Bluffs in many parts of the Upper Bay. This shelf may be as much as 150 ft. in width in some places whereas in other locations, as at the extreme north end of North Star Beach, it is virtually non-existent. The average height of the bench on the east side of the Upper Bay, some 5 feet above extreme high water, is greater than the average height on the west side (3 feet) although more obscure because of the construction on it of Backbay Drive. Two un-named islands occur in the Upper Bay which may once have formed part of these benches although natural siltation and additions of dredge spoil have probably modified their topography considerably. Shellmaker Island obviously was once in a similar state to the two un-named islands although the height of this has been increased considerably at the southern end and the "island" is now a peninsula as a result of the construction of a road connecting it to the eastern shore. The remains of what was probably an island at some time exists at the extreme southern end of the Upper Bay, off the Bayside Village Trailer Park,although this is now an

elongate peninsula at low tide connected to the eastern shore at its easterly end and much modified by dredging and spoil addition.

The total area of the Upper Bay, between the marginal bluffs, consists of more than 1,000 acres, of which about 700 acres are covered at extreme high water. The total shoreline is of the order of 70,000 ft. The depth of water in the Upper Bay has varied considerably due to changes in the rates at which deposition and erosion of silt occurred and also through artificial dredging operations. At the present time the maximum depth of water probably does not exceed 20 feet while at the most northerly end of the Upper Bay the depth does not exceed a few inches at high tide. As a consequence, a considerable area of intertidal sand and mud is exposed by the falling tide particularly at the northern end of the Upper Bay and about 300 acres of water exist at the extreme low water of peak tides. The extent of exposed mud appears to be increasing, and the amount of open water at low tide is diminishing, as a result of increases in the amount of silt entering the Upper Bay. The amount of deposition in the vicinity of Jamboree Road has been so great that this area can no longer be considered part of the intertidal system and is being colonized by terrestrial vegetation. The two un-named islands and the northern part of "Shell-maker Island" are covered by salt marsh vegetation, while are of salt-marsh also occur in places on the marginal benches, under the Bluffs. The saltmarshes of the islands are much less modified than those along the bluffs. This is due, most probably, to their relative isolation and the reduced amount of trampling.

Water Flows in the Upper Bay. As in all estuaries, the water in the Upper Bay is a mixture of seawater entering from the ocean and freshwater from terrestrial drainage. The salt content of the water in Upper Newport Bay shows complex variations due to tidal changes and complex seasonal changes in rainfall and run-off. Seawater enters the Upper Bay from the Lower Bay after the various mixing processes which have occurred in the latter. The open-sea tidal curve for California is complex, being of the asymmetric semidiurnal pattern and the complex geometry of the Lower Bay introduces further variations so that in the Upper Bay the tidal oscillations of water level are particularly complicated. The freshwater entering Upper Newport Bay is derived from various channels and also from immediate terrestrial run-off. The inflows to the Upper Bay depend to a large extent on the annual rainfall and although this is usually restricted to the winter months, there are marked fluctuations from year to year. At the weather station of the Irvine Ranch, the source of information nearest to the Upper Bay, rainfall in past years has been as follows:

1965-1966: 13.43 inches
1966-1967: 14.25 inches
1967-1968: 7.41 inches
1968-1969: 21.28 inches
1969-1970: 7.06 inches

The principal drainage channels leading into the Upper Bay are as follows:

1. San Diego Creek: This is the major source of freshwater passing

into the Upper Bay at the present time, draining about 80 per cent of the total catchment area (c. 120 sq. miles). Prior to the present century, the San Diego Creek did not drain at all into Newport Bay but terminated in Tustin Swamp during the dry season and discharged into the Santa Ana River during wet weather. Bonita Creek represents a drainage area of slightly less than 6 sq. miles which has always drained into Newport Bay. Since the diversion of San Diego Creek, Bonita Creek has flowed into the latter about one half mile from the Upper Bay rather than directly into the Bay. In the present discussion of water flows into the Upper Bay, figures cited for the San Diego Creek will also include flows derived from Bonita Canyon. The variation in rainfall cited previously and the daily fluctuations in precipitation produce marked changes in the quantities of water passing from the San Diego Creek into the Upper Bay. Unlike many streams in Southern California, there is always a minimal flow in the San Diego Creek even in the driest season. This minimal flow, which occurs in September/October, is of the order of 1.5 million gallons per day. This flow is derived principally from agricultural irrigation return. Maximal flows occur after heavy rain in the catchment area. Precise measurement of the amount of water passing into the Upper Bay after heavy rain is difficult but rough estimates of the quantity suggest that it can be as high as 35,000 million gallons per day.

2. Delhi Ditch: This is the second most important source of fresh water passing into the Upper Bay, draining most of the remaining

catchment area (c. 17 sq. miles). As with the San Diego Creek, there is a minimal flow in the Delhi Ditch during the driest months. Estimates of quantity are even more difficult than for the San Diego Creek although it would appear that minimal flows are of the order of 100,000 gallons per day. As with San Diego Creek, this minimal flow is derived from agricultural irrigation return. Maximal flows occur after heavy rain and these have been estimated at 1,000 million gallons per day.

3. Big Canyon: This is a much smaller channel draining from the east into the central portion of Upper Newport Bay, with a catchment area of 2 sq. miles. Unlike the San Diego Creek and Delhi Ditch there is no flow during the driest months due to the absence of agricultural irrigation in the catchment area but this may well change following construction of the Big Canyon Country Club with its irrigated golf course. At present, flows in Big Canyon appear to be restricted to short periods after rain when estimated flows of the order of 20 million gallons per day have been recorded.

In addition to the major channels flowing into the Upper Bay, there are many smaller drains receiving storm run-off from residential areas. The largest of these, in terms of flow, is that which collects water from a large area of the City of Costa Mesa and discharges into the Upper Bay on the west side in the vicinity of Dover Shores. There are many others, of varying sizes, and it is impossible to obtain even rough estimates of the flows after rain or during the dry season.

There are various indications that, with the increasing development of residential property on both sides of the Upper Bay and the resulting yard irrigation, the dry season flows from these various storm drains are becoming increasingly significant in terms of quantity.

The major movement of water within the Upper Bay results from the tidal oscillations on the open coast. Information on tidal oscillations for the open coast is collected as an aid to navigation and is reasonably complete for that purpose. Unfortunately, for most estuaries, knowledge of tidal movements is usually far from complete. For Newport Bay, with the complex geometry which occurs, information on tidal movements is particularly scanty. It has been shown (Stevenson & Emery, 1958) that the tidal range in the Upper Bay is less than at the open coast, with the highest ranges at the Coast Highway bridge and at the Narrows, the two positions of maximum constriction. Tidal current values are at a maximum at the Coast Highway bridge, with the average velocity ranging from 2.3 feet per sec. at maximum spring tides to 0.8 feet per sec. at minimum neap tides. In general, velocities on the ebb are greater than at the flood. The extent to which the incoming sea water mixes with the freshwater flowing into the estuary is not known in detail. In most estuaries, there is a layer of freshwater lying over saline water, due to differences in density between the two types of water and reduced mixing. It has been suggested (Williams & North, 1970) that such a situation can be demonstrated in the Upper Bay although the

data are not fully complete. This suggestion implies that internal mixing is limited in the Upper Bay and this makes very difficult any attempt to calculate the time necessary for the water in the Upper Bay to be renewed. It has been suggested (Williams & North, 1970) that about 40 per cent of the water present in the Upper Bay at high tide is discharged during the ebb although further development of this figure is not possible without more detailed information on the mixing processes and their effectiveness.

3. Water quality in the Upper Bay

Historically, interest, concern and legal safeguards in all parts of the world have been directed towards control of water quantity rather than water quality. Information regarding water quality in Newport Bay is somewhat scanty. In recent years various investigations have been made but these have been intermittent and of short duration so that even now no single total picture is available. Data which have been obtained are, however, sufficient to indicate several areas of concern. Water quality involves various aspects:

a. Suspended Solids. The quantities of silt or sand suspended in the various waterflows are of critical importance in any area and are of particular significance in an estuary such as Newport Bay. The movement of materials in suspension and their subsequent settlement depend on the size of the particles involved and the water flow rates. As a result of the various interactions of particle size and flow rate there can be selective movement and settlement of particles of different types as well as changes in character so that an area may be

associated with settlement at one time and erosion at another. Considering the freshwater flows now entering the Bay, San Diego Creek is by far the most significant in terms of suspended solids. As has been mentioned, San Diego Creek did not enter the Upper Bay at all until the beginning of the present century so that suspended solids derived from this source are a relatively modern characteristic of the Upper Bay. An earthfill dam with a capacity of 3,000 acre feet was constructed in the 1940's across the creek in order to provide some regulation of flood run-off and to serve as a siltation basin but this was later removed in the 1960's. At the time of removal, the channel was defined more precisely by levee construction so that run-off, particularly storm run-off, now passes directly to the Upper Bay without hindrance. The minimal flows which occur in September/-October have little suspended solid content although the quantity carried by storm flows is very high. Precise measurements of the quantities involved are not available. Estimates of the average amounts of silt passing into the Upper Bay are of the order of 30 acre-feet per annum although it is obvious that the storm flow of 1969 brought in a quantity far in excess of that figure. The remaining freshwater flows entering the Upper Bay are much less significant than San Diego Creek. However, it is obvious that the increasing urbanization and constructional activity in the watershed of the Upper Bay are causing quantities of silt to be moved to it through storm drains.

The seawater which enters the Upper Bay does so only after passage

through the Lower Bay. It would appear that the greater movement of suspended solids is from the Upper Bay to the Lower Bay rather than in the opposite direction. Such silt as is transferred on a rising tide from the Lower Bay to the Upper Bay would appear to be of a finely particulate type suggesting that it is material which originated in the Upper Bay and was merely being redistributed.

b. Nutrients. Ultimately, the biotic community in the Upper Bay is dependent on the growth and population characteristics of the plants which serve as the primary producers of the area, namely, the phytoplankton, the benthic algae and the higher plants of mudflat and saltmarsh. The growth of these plant populations is governed by the nutrients available, particularly nitrates and phosphates.

The minimal flows of both San Diego Creek and the Delhi Ditch are made up almost exclusively of agricultural irrigation return, while the storm flows from these two sources of freshwater are derived to a great extent from agricultural drainage. High levels of the materials necessary for plant growth are likely to occur in these freshwater flows. The drainage from Big Canyon has been previously from cattle grazing areas although, with the construction of the golf course, there is likely to be an increase in the amounts of fertilizers applied to this drainage area. More important even than this is the drainage from storm drains which, with increasing urbanization, will receive increasing amounts of drainage from yards and patios where fertilizer application is usually excessive. Algal growths of considerable extent can now be detected increasingly from storm drains around the

Upper Bay. By comparison with the nutrient-rich freshwater flows, the seawater entering the Upper Bay is relatively nutrient poor and probably contributes little to nutrient levels.

In addition to waterborne nutrients one has also to consider the consequences of fecal additions. Bird populations are extensive, particularly at certain times of the year, and there are increasing numbers of dogs and horses in the area. Dog control regulations request that fecal materials be deposited in gutters so that fecally-derived flows to storm drains can be considerable on occasions.

c. Additions of Materials Other Than Nutrients. With increasing mechanization and the complexity of agricultural practices, and the spread of urbanization and industrialization in the watershed, all manner of materials are being introduced into the Upper Bay through the freshwater flows. It is not possible to categorize these in detail but the major constituents to be expected will include:

i) herbicides, pesticides and "control" chemicals used agriculturally and domestically in yards,

ii) petroleum products, rubber, lead and other by-products of automobile use derived from road flushing, particularly in the first storm of winter,

iii) petroleum products derived from power boats or fuelling operations,

iv) heavy metals or various sorts derived from the "light industries" now developing.

d. Floating Materials. The aspect of deteriorating water quality most obvious to the general public is the occurrence of floating trash. This can result from perfectly natural events, such as the uprooting of vegetation or the dying back of plant materials. These natural events can be accelerated by human activities or completely "unnatural" phenomena introduced. San Diego Creek appears to be a major source of floating trash in Upper Newport Bay. This trash is largely of agricultural origin, shown by the numbers of oranges likely to be found in the Bay after each winter storm. Increases in natural vegetation or phytoplankton populations can be produced by increases in the quantity of nutrients present and these pose many problems in Upper Newport Bay. It is obvious that most of the scum which occurs from time to time is derived from the phytoplankton species. Finally, it is to be regretted that the increased recreational uses of Upper Newport Bay have led to an increase in the amounts of trash which occur and there have been several instances in which domestic or constructional trash has been deliberately dumped.

The major problem with such floating materials is in terms of its quantitative evaluation. The occurrence and positions of such trash fluctuate according to the conditions of wind and tide so that the amount of floating material present in any one area may increase or decrease apparently without explanation and it is obvious that the position at which it is most obvious may bear no relation to the place of origin. The islands and shoreline of the Upper Bay frequently display quantities of trash left behind by the falling tide and this

will pass into circulation once the tide has risen adequately for reflotation. This is particularly true of the islands which are covered with trash above the height of the highest tides. This trash has been trapped during high tides after storms when the water level rose above normal levels and it will remain on the islands until a similar height is achieved. This means that a storm may result in a particularly large quantity of floating material released from such positions by the increased height of water.

e. Dissolved Oxygen Concentrations. The quantity of oxygen present in water is critically important for a large number of organisms. Compared with the quantity present in the atmosphere (21 per cent.) the amount of oxygen present in water at saturation levels is very much lower, 10 parts per million in freshwater and 8 parts per million in seawater, at the average temperatures of Upper Newport Bay. Thus, any process which leads to a decrease in the amount of oxygen at a rate greater than that at which it can be replenished is likely to lead to total deoxygenation. Such deoxygenation will eliminate almost all of the desirable elements of the biotic community leaving only the bacteria and tubificid sludge worms. Deoxygenation can result most frequently from the bacterial breakdown of excess organic materials such as trash, plant or animal debris, particularly where enhanced growth has occurred due to nutrient enrichment. This is why control of floating and other trash is so critical and why nutrients which stimulate plant growth should not be allowed to increase in concentration. Furthermore, gas transfer

between water and the atmosphere can be almost totally inhibited by a mono-molecular film of gasoline such as frequently occurs on the waters of the Upper Bay. A further consideration is that the temperatures in water in Upper Newport Bay fluctuate more than in the Lower Bay, where seawater from the open sea is entering and mixing due to tidal activity. These greater changes in temperature, which are characteristic of all shallow estuaries, have the effect of reducing the levels of dissolved oxygen, which may diminish by as much as 50 per cent simply due to the higher temperature and lower solubility of oxygen. Thus, in the Upper Bay, it is particularly critical that a close watch be kept on dissolved oxygen concentrations.

f. Coliform and Other Bacterial Counts. One of the few aspects of water quality which has been of general concern for many years has been with respect to public health and hygiene. The standard bacteriological test has been to count the numbers of cells of Escherichia coli present in a water sample. This organism occurs predominantly in the intestinal flora of man and animals and its frequency of occurrence in a water sample is taken as an indication of the level of fecal contamination. There have been many investigations of Newport Bay with respect to the bacterial levels during the past 10 years and in many of these the water in the Upper Bay did not meet accepted standards for swimming.

The basic difficulty is that coliform bacteria can occur in water as

a contaminant from soil as well from feces and the feces may well be derived from animals other than man. The bird populations are high in the Upper Bay throughout the year and particularly high concentrations occur during periods of migration, so that coliform counts from this source need to be evaluated more critically than has been the case so far. Also, counting of coliform bacteria is far less satisfactory for seawater than for freshwater as they tend to die rapidly in the former medium. There is no evidence that sewage-derived pathogenic organisms harmful to man diminish in a similar manner so that one could have seawater heavily contaminated with pathogens but with no trace of coliform bacteria.

4. Biota

A recent compilation (Frey et al., 1970) lists the organisms which have been recorded from Upper Newport Bay. The report includes some primary data but is largely a compilation of data derived from various investigations made at different times during the past 30 years. As such, the report suffers from the weaknesses inherent in such a compilation although it is a very valuable catalog, the only one which exists, of the organisms which have been reported at some time in the area.

The most significant biological resources of Upper Newport Bay are the fish, shellfish and wildfowl populations. The marine fishes includes both resident and transient species while many species such as anchovies, croakers, surfperch, halibut, rockfishes and some

sharks and rays use the Upper Bay as a spawning and/or rearing habitat. Of the shellfish, clams are the most abundant but much of the digging is for bait purposes. Scallops, mussels, and native oysters are also present, together with shore crabs and ghost shrimp. The Upper Bay provides food and rest areas for large numbers of wintering wildfowl, the principal species including pintail, widgeon, teal, scoter and merganser. Shore birds which use the area include egrets, sandpipers, willets and godwits.

A comprehensive inventory based upon critical current investigations is still needed so that the extent of future changes can be evaluated.

5. Problems of Upper Newport Bay

The major environmental problems of Upper Newport Bay all relate to water quality, essentially in respect to materials brought in by the flows entering from the San Diego Drain, the Delhi Ditch and the urban/terrestrial run-off. These materials include:

a). Silt and material in suspension.
b). Nutrients, which stimulate plant growth.
c). Floating materials and trash.
d). Toxic materials such as herbicides, pesticides, heavy metals, oil, etc., derived from domestic and industrial activity.

The quantities and qualities of these flows are changing constantly as the watershed changes from a predominantly agricultural area to a residential/industrial area. In general, this change will increase

both quantity and diversity of the materials which are entering, so that restriction of water circulation and flushing becomes increasingly critical.

6. Recommendations

The basic recommendation regarding the Upper Bay can be expressed very simply. It is that a considerable amount of necessary information and data about it must be acquired at the earliest opportunity. Changes have occurred on many occasions during the history of the Upper Bay and further changes are to be expected in the future. What must be avoided is the accidental loss of amenity as a consequence of man-made modifications and changes whose implications have not been considered in sufficient detail. With the accelerated rate at which "development" of the watershed is occurring it is imperative that the City of Newport Beach be aware of all the changes which occur, not merely in the Upper Bay itself, or in its close vicinity, but throughout the entire watershed draining into the Bay. It is inevitable that changes in all these three areas will have an effect on the Bay. In general the basic change will be from an agricultural watershed to one where light industry and residential property predominate but the consequences of this will be considerable. The particular points which must be kept under constant scrutiny or about which data are needed, or for which information should be obtained and records maintained include:

1. Quantitative Estimates of All Flows Into the Upper Bay. Estimates

of flows in the major tributaries are available although probably not in as much detail as is necessary, particularly during times of peak flow. In addition, with increasing urban development, the amounts of water derived from domestic run-off are increasing and should be quantified. The significance of this urban/domestic run-off lies in its content of fertilizers, detergents and the products of automobile use, as discussed later. Once accurate estimates are available of the quantity of water involved it will be possible to suggest ways by which the content of unwanted materials can be controlled, the run-off treated, and its disposal considered.

2. Qualitative Estimates of All Flows Into the Upper Bay.

a. Suspended Solids

The amount of silt in suspension brought into the Upper Bay is critical. The Upper Bay could be eliminated if several storms of the magnitude of that experienced in 1969 occur in rapid succession. Prior to 1900, the amount of material entering the Bay was much less than at present because the San Diego Creek had no connection. Serious thought should be given to possible sites for the construction of settlement basins where the sediment loading of the stream could be reduced before entering the Bay. Obviously, accurate estimates of the amounts of silt involved and of the possible benefits to be gained from the construction of siltation basins must be available.

b. Nutrients

The watershed of the Upper Bay is still largely agricultural in nature

while the minimal flows of the two major tributaries are derived almost entirely from agricultural irrigation return. The urban run-off component which, as indicated previously, is of unknown extent but it is known to be rich in fertilizers. Thus, virtually all freshwater flows entering the Bay are nutrient rich, to a greater or lesser extent. The continued well-being and indeed existence of the Bay as a habitat depends upon the extent to which nutrient materials entering are controlled, because unwanted growth in aquatic habitats leads to oxygen depletion. All flows entering the Bay need to be monitored at intervals in terms of inorganic chemical content; an algal bioassay procedure is probably the best to use for the evaluation of nutrient enrichment levels.

c. Materials Other Than Nutrients

As has been indicated, the flows entering from the San Diego Creek, the Delhi Ditch, and above all from urban run-off are likely to contain chlorinated hydrocarbons derived from pesticides, herbicides etc., heavy metal contaminents from domestic and industrial activity in the watershed, as well as hydrocarbon films from vessel usage in the Bay and from the urban run-off component. All these materials are toxic to some extent to living organisms. Quantitative estimates are needed for these various introductions so that a realistic control program can be planned.

d. Floating Materials

Analysis of the origin and nature of the floating material present in

the tributary streams and of its subsequent redistribution in the Upper Bay should be undertaken so that the nuisance might be abated.

e. Dissolved Oxygen

The Upper Bay is an area which is receiving both nutrients, which stimulate production and toxic materials which are lethal to living organisms. In order to assess the general well-being of an area receiving materials of these kinds and for the purpose of determining the availability of oxygen in the environment, oxygen being necessary for the survival of the biota, routine measurements of dissolved oxygen provide an admirable general method for determining the general conditions prevailing in any body of water.

3. Biological Survey. As indicated, there is no up-to-date survey of the biota present in the Upper Bay and it is imperative that some information is available on the organisms present, their abundance, and the changes in occurrence and density which take place from year to year. On a long-term basis, an annual re-evaluation of the biota is to be recommended, for general survey purposes, and for the detection of long-term changes.

4. Hydrological Survey. Measurement of all the individual parameters listed above is meaningless without a more complete picture of the hydrology of the Upper Bay than is available at the present time. Not only has one to be able to detect the various materials present and estimate their concentrations but also to be able to predict their movements and their ultimate fates, so that their roles in the biotic

system of the Upper Bay can be fully evaluated. Information on the hydrology of the Upper Bay is extremely scanty at the present time and the elimination of this deficiency is a critical requirement. A hydrological survey of the Upper Bay as it exists at the present time is only the first step. The changes in movement and fate of every component entering the Bay will be influenced by changes in the outline and topography, so that some predictive potential is also needed for the assessment of proposed changes and 'developments' in the Upper Bay. The only way by which it will be possible to integrate the chemical, biological and hydrological complexities of the situation and to evaluate the various proposals for modification is by a mathematical model. Various suggestions have been made that a physical model of the Upper Bay should be contructed, but this would be phenomenally expensive to construct and operate and its potential by comparison with that of the mathematical model extremely limited. A physical model is satisfactory if only the hydrology is under investigations; for chemical parameters there are difficulties; for biological parameters it is totally incapable of dealing with organisms and their activities.

C. LOWER NEWPORT BAY

1. Description. Lower Newport Bay is an elongate body of water some 4 miles in length, oriented in a general northwest/southeasterly direction. The Upper Bay enters at a point about midway between the entrance and the innermost part of the Lower Bay. The maximum width of the Lower Bay is about half a mile although the presence of the various islands complicates the general picture. The Lower Bay, as mentioned previously in the Introduction, is bounded by Bluffs on the northern and eastern sides, the southern and southwestern boundaries being provided by the Balboa Peninsula. This peninsula is a consolidated sand spit only a few feet above highwater mark of extreme tides. The Lower Bay contains some seven islands formed initially from sand banks but subsequently enlarged by dredge spoil. All the islands are now consolidated by complete bulkheading as a result of the total development of the Lower Bay. The development is largely for residential purposes and as a small boat harbor, with some small industrial activity principally in connection with the latter function.

Excluding the islands, the total extent of water in the Lower Bay is about 1,200 acres and the total shoreline is about 120,000 feet. The depth of water in the major channels is maintained at about 20 feet by dredging although the depth is much less than this in the innermost channels, particularly in the vicinity of Newport Island. Because of the extensive dredging operations there is little development of tidal flats such as occur in the Upper Bay and the beaches which are exposed

at low water are generally short and steeply sloping.

2. Water Flows in the Lower Bay. The water in the Lower Bay is a mixture of seawater entering from the ocean, the drainage from the Upper Bay and such terrestrial run-off as passes directly into it. The open-sea tidal curve for California is complex being of the asymetric semidiurnal pattern, with a maximum daily oscillation of the order of 6.4 feet and a monthly mean oscillation of the order of 3.6 feet. The quantity of water draining into the Lower Bay from the Upper Bay on any day depends on the freshwater flows into and from the Upper Bay and the tidal amplitude. The flows into the Upper Bay vary from storm flows of the order of 20,000 million gallons per day with the maximum recorded at 35,000 million gallons per day to the minimal flows of the order of 2 million gallons per day. No estimates are available of the quantity of water which passes into the Lower Bay from urban run-off through storm drains and from such domestic sources as patio washing and yard irrigation.

3. Water Quality in the Lower Bay

a. Suspended Solids

As indicated previously, the movement of materials in suspension and their subsequent settlement depend on the sizes of the particles involved and the water flow rates. As a result of the various interactions of particle size and flow rates there can be selective movement and settlement of particles of different types as well as changes in character so that an area may be associated with settlement at one

time and erosion at another. The water flow from the Upper Bay, derived largely from the San Diego Creek, is the major source of freshwater derived silt passing into the Lower Bay and, as has been indicated, this is a relatively new development following the relocation of the Creek to flow into the Upper Bay in the early 1900's. The storm flows through the Upper Bay carry large quantities of silt while the minimal flows of September/October have little suspended material but in neither case are accurate estimates of the quantities involved available. The tidal input to the Lower Bay derived from tidal action occurs year-round but, once again, exact quantitative data on the silt carried are not available.

b. Nutrients

The growth of Plant populations and thence the higher steps in the food chain depend on the nutrients available, particularly nitrates and phosphates. The freshwater flows derived from the Upper Bay are rich in nutrients as are also the direct flows from storm drains and from urban run-off. By comparison, the seawater entering the Lower Bay is relatively nutrient poor. Although illegal, there are indications on occasions of sewage discharges in the bay and residential usage of boats is likely to influence these.

c. Addition of Materials Other Than Nutrients

The Lower Bay will receive all the flows from the Upper Bay, together with contaminants of urban run-off either directly or from the storm drains, and all the products of industrial activity in its vicinity. The materials which it will receive include:

i) herbicides, pesticides and other "control" chemicals used agriculturally or domestically in yards and patios,

ii) petroleum products, rubber, lead and other by-products of automobile use derived from the flushing of roads and parking lots, particularly in the first storms of winter,

iii) petroleum products derived from power boats and by spillage during fuelling operations,

iv) heavy metals derived from domestic gutter and paint run-off, and from the various boat maintenance operations carried out professionally around the bay and from innumerable amateur operations of the same kind.

d. Floating Materials

The occurrence of floating trash is that aspect of water quality most obvious to the general public. The floating trash in the Lower Bay is made up of that material which is passed from the Upper Bay together with other floating materials of local origin. The trash noted in the Lower Bay includes:

i) trash of agricultural origin derived from the drainage areas of the San Diego Creek and the Delhi Ditch,

ii) trash derived from the decay and breakdown of phytoplankton and vegetation in the Upper Bay,

iii) trash derived from the dumping of domestic and constructional debris in the Upper Bay,

iv) locally derived trash from all the various recreational activities in the Lower Bay.

The major problems with this floating trash are with its quantitative evaluation and in the detection of its origin. The occurrence and positions of such trash fluctuate according to the conditions of wind and tide so that the amount of floating material present in any one area may increase or decrease apparently without explanation and the position at which it is most obvious may bear no relation to its place of origin.

e. Dissolved Oxygen Concentrations

As stated previously, the quantities of oxygen present in water are critically important for a large number of organisms and any process which leads to a decrease in the amount of oxygen at a rate greater than that at which it can be replenished is likely to lead to total deoxygenation. Such deoxygenation will eliminate all of the desirable elements of the biotic community leaving only bacteria and tubificid sludge worms. Deoxygenation can result from the bacterial breakdown of excess organic materials such as trash, plant or animal debris, particularly where enhanced growth has occurred due to nutrient enrichment. This is why the control of floating and other trash is so critical, in addition to its obvious aesthetic considerations, and why nutrients which stimulate the growth of algae and other vegetation should not be allowed to increase in concentration. Gas transfer between the atmosphere and water can be diminished and even almost totally eliminated by a mono-molecular film of gasoline such as has been frequently noted on the waters of the Lower Bay. A further consideration is that, due to constructional changes, the water

circulation has been much reduced in various parts of the Lower Bay, particularly in the vicinity of Newport Island. Diminished circulation will inevitably result in reduced concentrations of dissolved oxygen. Thus, in the Lower Bay as in the Upper Bay, it is particularly critical that a close and continuous watch be kept on dissolved oxygen levels.

f. Coliform and Other Bacterial Counts

The basic approach and problems associated with investigations of coliform bacteria in Newport Bay, as a whole, have been discussed previously. Various investigations of Lower Newport Bay during the past few years have indicated that bacterial counts in excess of those recommended for water contact sports or swimming were being exceeded. Full and repetitive bacteriological surveys of the Lower Bay, not merely for coliform organisms but complete studies are a critical need.

4. Biota. Although there is a compiled inventory of the biota of the Upper Bay there is no equivalent publication for the Lower Bay. This lack is particularly critical in view of the extensive changes of topography, shoreline and bottom which have accompanied the development of the Lower Bay. In general, the biota of the Lower Bay are less numerous and less diverse than those of the Upper Bay. The only conspicuous invertebrate present is the mussel, which apparently is capable of surviving in places on the concrete bulkheads. There are fish populations present, on occasions often of some abundance and able to support a small sport-fishing activity.

A comprehensive inventory based upon critical investigations is still needed so that future changes and their extent can be evaluated.

5. Problems of Lower Newport Bay. The major environmental problems of Lower Newport Bay, like those of Upper Newport Bay, relate to water quality. The similarity is understandable when one considers that the principal source of freshwater entering the Lower Bay is derived from the Upper Bay and that all those materials which enter the Upper Bay pass eventually into the Lower Bay. There is, in addition, the large number of freshwater flows derived from urban/-terrestrial run-off which pass directly into the Lower Bay. The materials brought in from the Upper Bay and which also pass directly into the Lower Bay include:

a). Silt and material in suspension.

b). Nutrients, which stimulate plant growth.

c). Floating materials and trash.

d). Toxic materials such as herbicides, pesticides, heavy metals, oil, etc. The quantities and qualities of those flows which enter the Lower Bay from the Upper Bay are constantly changing as a result of changes in the watershed while the urban/terrestrial run-off passing directly into the Lower Bay is becoming more richer as the population density around the Lower Bay increases. In general, these changes will increase both quantity and diversity of the materials which are entering the Bay so that restrictions of water circulation become increasingly critical.

6. Recommendations. The basic recommendation regarding the Lower Bay can be expressed very simply. It is that a considerable quantity of data must be acquired at the earliest opportunity. Unlike the situation in the Upper Bay where the information is needed as a basis for future, rational planning, the position for the Lower Bay is slightly different in that there is little opportunity for major modification in the future but the information is needed with just as much urgency if the management of the Lower Bay is to be conducted with greatest possible benefit for all interested parties. The particular points which must be kept under particular scrutiny, or about which data are needed, or for which information should be obtained and records maintained include:

1). Quantitative estimates of all flows to the Lower Bay.

Estimates of flows to the Lower Bay from the Upper Bay, and from the sea are not available at the present time. In addition, the amount of water derived from urban run-off is becoming increasingly critical and must be quantified. The significance of this urban/-domestic run-off lies in its content of fertilizers, detergents and the products of automobile use, as discussed later. Once accurate estimates are available of the quantity of water involved it will be possible to suggest ways by which the content of unwanted materials can be controlled, the run-off treated, and its disposal considered.

2). Qualitative estimates of all flows into the Lower Bay.

a. Suspended solids

Estimates of the amounts of suspended solids brought into the Lower Bay by the flows from the Upper Bay, from the sea, and from urban run-off are critical if any meaningful program

for the control of silt in the Lower Bay is to be put into effect. In addition, it is obvious that some consideration be paid to the movement of silt materials within the Lower Bay due to the relocation of the silts derived from these suspended materials must be evaluated as the development of sandbanks within the Lower Bay which hinder mooring operations cause considerable annoyance.

b. Nutrients

The nutrient contents of the two major flows to the Lower Bay, from the Upper Bay (which is derived from agricultural drainage) and from the sea must be quantified as well as that of the urban run-off component which is of unknown extent although known to be rich in fertilizers and fertilizer-derived nutrients. The continued well-being of the Lower Bay as a habitat depends on the extent to which the entry of nutrient materials is controlled, because unwanted growth in aquatic habitats leads to oxygen depletion. All flows entering the Lower Bay need to be monitored at intervals in terms of inorganic chemical content; an algal bioassay procedure is probably the best to use for the evaluation of nutrient enrichment levels.

c. Materials other than nutrients

As has been indicated, the flows entering the Lower Bay from the Upper Bay are likely to contain chlorinated hydrocarbons derived from pesticides, herbicides etc., heavy metal contaminants from domestic and industrial activity in the

watershed. A certain amount will also be received from the urban/domestic run-off passing into the Upper Bay and a similar amount derived from those flows which pass directly into the Lower Bay. The various domestic and industrial activities of the Lower Bay will also be received directly. All these materials are toxic to some extent to living organisms. Quantitative estimates are needed for these various introductions so that a realistic control program can be planned.

d. Floating materials.

Analysis of the origin and nature of the floating materials which occur so that this nuisance can be abated.

e. Dissolved oxygen.

Measurement of dissolved oxygen concentrations is an admirable way by which to ascertain the state of any body of water and, in those dead-end channels which occur in the Lower Bay, a particularly critical parameter. Concentrated attention should be given to these dead-end situations because all appear to be in a state of deterioration. The channels about Newport Island and the Rhine indicate the dangers of such dead-ends and it is difficult to see why, with these examples to hand, the Promontory Point development should have been contemplated. A closed-off inlet of this form, with minimal water circulation is a prime situation for deterioration of water quality and it is to be hoped that adequate consideration was given in the planning stages to these essential features. All parts of the

Upper Bay receive both nutrients, which stimulate production, and toxic materials, which are lethal to living organisms. For an area such as the Lower Bay, there is no better way by which to consider the very different effects of these materials than by the routine measurement of dissolved oxygen. This will indicate the availability of oxygen which is essential for the survival of the biota and thus the general conditions prevailing.

3). Biological Survey.

There is no inventory of the organisms present now or at any time in the Lower Bay. It is imperative that information is available on the organisms present, their abundance and the changes in occurrence and distribution which take place from year to year. On a long-term basis, an annual re-evaluation of the biota is to be recommended, for general survey purposes, and for the detection of long-term changes.

4). Hydrological Survey.

Measurement of all the individual parameters listed above is meaningless without a more complete picture of the hydrology of the Lower Bay than is available at the present time. Not only has one to be able to detect the various materials present and estimate their concentrations but also to be able to predict their movements and their ultimate fates, so that their roles in the biotic system of the Lower Bay can be fully evaluated. Information on the hydrology of the Lower Bay is extremely scanty at the present time and the elimination of this deficiency is a critical requirement. A

hydrological survey of the Lower Bay is only the first step. Changes in movement and fate of any component entering the Lower Bay is also needed for a full management program, so that some predictive potential is also needed. The only way by which it will be possible to integrate the chemical, biological and hydrological complexities of the situation is a mathematical model. Various suggestions have been made that a physical model will be sufficient, but it would be expensive to construct and operate and its potential by comparison with that of a mathematical model is extremely limited. A physical model would be satisfactory if only the hydrology had to be considered; for chemical parameters there are difficulties; for biological parameters it is totally incapable of dealing with organisms and their activities.

There are several suggestions that a second opening from the Lower Bay sea should be developed in order to improve circulation but without this hydrological information it would be an invitation to disaster.

5). Future Planning for the Lower Bay.

Once the data mentioned previously has been obtained it will be possible to consider the most rational procedure for the management of the Lower Bay. One critical development is the operation of a model to be used for the experimental analysis of management procedures. It might be thought that, as the physical limits of the Lower Bay are essentially fixed, a physical model would be the best to use. While this is strictly true in the limited sense, a physical model would not permit investigation of the effects of the establishment

of additional channels from the Lower Bay to the sea. Moreover, it would not be possible to introduce into such a physical model any of biological parameters which are considered significant. As has been shown previously, a model for the Upper Bay would have to be a mathematical rather than a physical model and it would seem most logical to use the same basic principle for the modelling of both areas. Only in this way will it be possible to obtain an integration of the many physical, hydrological, chemical and biological complexities of the Bay as a whole.

III COASTAL INTERTIDAL

1. Description. The coastal intertidal portion of the City of Newport Beach stretches from the Santa Ana River to Cameo Shores, a distance of about seven miles. The coast between the Santa Ana River and the Balboa Jetty is entirely made up of sandy beach. The coast on the opposite side of the harbor entrance is made up of sandy beach with about one mile of rocky intertidal between the end of the state/city beach park and the city boundary at Cameo Shores. The topography of the coastal areas now occupied by sandy beach reflects the historical changes in position of the Santa Ana River. Prior to 1825, the mouth of the Santa Ana River was at the Alamitos outlet, near Seal Beach, but in that year extensive flooding caused a major movement of the river so that its entry to the sea became located as what is now the west end of the Lower Bay. The mouth of the Santa Ana River was established in its present position through levee construction in the 1920's. There were various tide-washed sandbanks off the mouth of Upper Newport Bay prior to 1825 some of which were probably the remains of a much earlier southeasterly-directed sandspit. The flood of 1825 created an elongate sandbank outside this and with subsequent enlargements, particularly in the flood of 1861, it formed a spit which subsequently became the Balboa Peninsula. The stretch of rocky intertidal at the eastern limits of the city represents the outliers of the San Joaquin Hills. These hills are composed of conglomerates with some resistance to wave erosion. A wave-cut terrace has been formed with a moderately high

cliff of some 50 or so feet in height, behind it, and headlands and bays. The two most prominent bays falling within the city limits are Cameo Shores and Little Corona.

2. Sandy Beach. With the exception of about one mile of rocky intertidal at the easterly limit of the City of Newport Beach, the whole of the coastal intertidal is occupied by sandy beach. These beaches have heavy usage for recreational purposes, particularly in the region between Newport Pier and the mouth of the Santa Ana River and the Big Corona city/state beach.

a). Biota

Throughout, the sandy beach is very dynamic in terms of its physical stability because of the marked seasonal changes in deposition and erosion. The often frequent surf action results in a steep scarp and this, together with the marked sand movements, is unfavorable for the development of obvious macroscopic biological diversity such as occurs in the rock intertidal. The supratidal areas do contain large numbers of beach hoppers and rock runners which scavenge on the natural and tourist-introduced debris which occurs on the beach and kelp-flies which feed on cast-up brown algae. Despite the absence of obvious large organisms in the intertidal sandy areas, this area is not totally sterile but contains large numbers of microscopic organisms specialized for existence in the interstitial spaces between the sand particles. The main function of these interstitial organisms is to break down organic debris into smaller fractions

which are then further decomposed by bacterial activity. Immediately below the surf zone, and occasionally exposed by exceptionally low tides, is a region containing a large number of macroscopic organisms. Of these, the two most conspicuous are the Pismo clams and sand dollars, the shells of which are often cast up on the beach. Associated with these two major components are a whole range of other forms, crabs, snails, starfish and fish, which are either dependent on the sand dollars or rely on organic debris which accumulates immediately below the surf zone. A number of organisms may also move up into the zone immediately below the surf on a seasonal basis or when the surf is minimal, particularly fishes such as surf perch, corbina, shovelnose sharks and rays. The sandy beaches are also the specific spawning habitat for grunion. The adults come in immediately after high spring tides and spawn, the eggs incubating and hatching, and then being washed out again on the next series of spring tides one lunar month later.

b). Problems of Sandy Beach Areas

The two major problems of the sandy beach areas are trash, particularly that derived from recreational activity, and sand movements, particularly erosion.

1. Trash

Visitors to the beach for recreational activity leave behind immense quantities of trash. Despite large numbers

of receptacles provided for this trash a considerable amount lies loose on the beach, particularly after holiday weekends, in the most popular areas. In addition, a certain amount of trash is left behind by the receding tide and brought back into circulation once again by the rising tide. A certain amount of detritus is also present derived from deposited fragments of marine algae but usually only after particularly heavy ocean swells. In general, the cleanup operations on the city beaches are carreid out with high efficiency so that the detrimental effects of trash accumulation, such as flies, mosquitos, sand fleas, etc., are minimal and usually non-existent.

2. Erosion

The most serious problem of the sandy beach areas is erosion, particularly in the portion between the Santa Ana River and the Balboa Jetty. The erosion varies considerably from year to year, and throughout any one year, as a consequence of the fluctuations in wind and wave directions. During the winter, the prevailing wind is usually from the west. The coast between the Santa Ana River and Newport Pier is oriented in a northwest/southeasterly direction so that the general wave action which this westerly wind developes meets the beach at an angle of 45^{o}. As a result there is an essentially southerly drift along this section of the beach during the winter. The results of this sand movement can be seen at the present time (April, 1973) at the jetties at the entrance of the Santa Ana

River and at the eight stone jetties which have been constructed recently between 28th Street and 56th Street. At this time, sand is accumulating on the northwest side of all except those at 28th, 32nd and 36th Streets, where it is approximately equal on both sides. During the winter, there is little erosion of the beach between Newport Pier and the Balboa Jetty because of its orientation and, if anything, there is likely to be a little accretion. In summer, the general wind direction and the resulting wave direction are more southerly. The waves tend to meet the beach between Newport Pier and the Balboa Jetty at right angles in summer so that there is little lateral transport of sand but rather, a prominent scarp is formed. In the section between the Santa Ana River and Newport Pier, the southerly winds of summer meet the beach once again at an angle of 45^{o} producing further lateral sand movement but in a direction opposite to that which occurred during the westerly swells of winter. The lateral sand movement is most marked when heavy swells come in from the south from tropical storms, as in 1939 and 1968. Similar sand movements can be detected on the beach of Big Corona, Little Corona and Cameo Shores although the magnitude of these movements is much less because of the protection from the various headlands and from the two long jetties at the entrance to the harbor.

It is often claimed that the degree of erosion is increasing but in the absence of particularly detailed information on wind

and wave directions, the quantity of sand moved and the direction of movement and the swell characteristics when maximum movement takes place it is difficult to make any positive statements. It should be remembered that the whole of the Balboa Peninsula is nothing more than a sand spit of relatively recent origin and likely to be merely an ephemeral topographical feature. Various recent developments could well have influenced the erosion and accretion processes, such as:

1. Construction of flood control systems on the Santa Ana to spread out the maximum storm flows have reduced the quantity of sand and silt which is reaching the sea through deposition further back in the river system.
2. The canalization of the Santa Ana River and the construction of several jetties at its mouth are inhibiting the southward drift of sand during the winter period of westerly wind and wave movements.
3. The construction of eight stone jetties for the purpose of preventing lateral sand movement

3. Rocky Intertidal. The rocky intertidal area extends from the south end of Corona del Mar state/city beach park to the city boundary at Cameo Shores, a distance of one mile. The shore is made up of exposed reefs with shallow tide pools and surge channels. The rocky area extends seawards but at a depth of about - 10 ft below the lowest tides it is replaced by a large sand-covered plateau.

a. Biota

The rocky intertidal area contains considerable diversity of plants and animals. The two most conspicuous plants are the

large brown alga Egregia (feather boa) and the surf grass (Phyllospadix), which is a flowering plant although not a grass. The upper parts of the intertidal are relatively depauperate with large numbers of algae although these are of small size and a few barnacles, limpets. This depauperization could be due to overexposure to extreme conditions of temperature and light intensity or to overcollecting and trampling by the merely curious. The lower portions of the intertidal, which are exposed less than the upper parts, have a more rich representation of plants and animals, particularly in the small pools which occur. The pools contain large quantities of coralline and other red and brown algae, the coralline algae forming a turf-like development. The animal populations present include various snails, mussels, chitons, barnacles sea anemones and starfish, with various smaller fishes, particularly blennies and cottids. At the lowermost levels dense stands of the smaller kelps occur with a few small representatives of the giant kelp (Macrocystis) although this is by no means as well developed as on other parts of the coast.

The flora and fauna of Cameo Shores and Little Corona are similar to those which occur from here eastwards to Dana Point although less diverse than those of some places in this stretch. The biota of Little Corona is less rich than that at Cameo Shores, both in terms of species composition and density of individual species. One consequence of the construction of

stone jetties in West Newport is that some development of flora and fauna is occurring although much restricted by sand abrasion.

b. Problems of Rocky Intertidal Areas

The area of Little Corona was surveyed for intertidal flora by Dawson (1958) in 1957 and, from his brief records, there would appear to have been some deterioration during the past 15 years. This deterioration would appear to be the result of excessive collection of specimens as well as simple trampling by the curious. Walking over the intertidal by a large number of people will gradually eliminate all the softer plants and animals. The numbers of people who walk over the intertidal in Little Corona and Cameo Shores is unbelieveably high. During the present survey of the coast, the following approximate numbers were counted; within a five minute period.

	3p.m., normal working day	3p.m., school holiday time
Little Corona	35	185
Cameo Shores	8	25

The effects of trampling of the intertidal are likely to increase in the future due both to the increase in interest in the natural world and to the increase in numbers of visitors. Despite the widespread posting of the area, a considerable number of specimens is still being removed. It is probable that the relative richness of Cameo Shores compared with Little Corona is due to the restrictions of access.

4. Recommendations.

a. Continued emphasis on the collection of trash at the sandy beaches, particularly during holidays and weekends.

b. A complete investigation of the erosion problem, in order to provide information on wind and water movements, and the swell characteristics during which maximum movement occurs. As with Newport Bay a model would be the best way by which to evaluate the data obtained. A computer model, rather than a physical model, is essential if the consequences of proposed alterations and new developments are to be evaluated prior to acceptance. The proposed marina at Newport Shores is probably the most critical of these proposals at the present time.

c. More rigid enforcement of the regulations against removal of specimens from the rocky intertidal areas. These have been designated as being of reserve status but most people appear to be unaware of the significance of this status or the reasons for the establishment of reserves.

IV. SEMINIUK SLOUGH

1. Description. Seminiuk Slough contains an area of water restricted to relatively narrow, finger-like channels, which are, in total, several miles in length. The general outline is complex. The principal channel commences at the point where the Coast Highway crosses the Banning Channel and the Santa Ana River. It is of an essentially sinuate shape, initially lying parallel to the Coast Highway and then curving away in a wide sweep before eventually returning with the innermost and lying with 100 yards of the Coast Highway. This principal channel is bounded on the southern side by the residential property which, strictly speaking, does not fall within the limits of the City of Newport Beach. There are various channels within the Banning Property, none of which are particularly well defined as this area is flat swampy marshland. The eastern end of the principal channel is backed by Bluffs which are about 100 feet in height with a narrow shelf, some 100 feet in width, at their base. The principal channel of communicates with the Banning Channel through a large pipe, so that the wet area lying within Newport Shores is subject to tidal action, although there is no open passage for the various small boats which are maintained in the area. The innermost end of the principal channel is being filled at the present time.

Seminiuk Slough is yet another relic of the historical vagaries of the Santa Ana River in that it consists of the various channels occupied by the river between 1825 and the canalization of the 1920's.

2. Water Flows. The water flows are derived from the Banning Channel through a large (2 ft diameter) pipe, a drain from the oilfield area and the general terrestrial and urban run-off. The water level within the Newport Shores area undergoes tidal fluctuation but the general circulation is obviously limited. The main drain from the oilfield area was running with a flow of the order of 50,000 gallons per day at the time of investigation but it is not known where this comes from. If it is merely terrestrial run-off its quality might not be too bad although if it contains any saline wastes from oil extraction in the Banning Property its quality would be particularly bad unless proper treatment occurred.

3. Water Quality. Nothing is known about water quality in the area but there are obvious indications that circulation is minimal with all the resulting problems of deoxygenation and deterioration. For an area receiving oilfield drainage as well as urban run-off this is critical.

4. Biota. Nothing is known of the biota of the area.

5. Problems of Seminiuk Slough. The principal problem in Seminiuk Slough relates to water quality, in particular to those materials entering from oilfield drainage and the urban/terrestrial run-off. These materials include silt, nutrients, oil, toxic compounds and floating trash. In respect to these, some improvement in water circulation is imperative.

6. Recommendations.

1. The water circulation within Seminiuk Slough will have to

be increased if the adverse effects of deoxygenation are not to be made worse.

2. A full study of water quality in all aspects, chemical and bacteriological, is essential.

3. In view of the proposal that a marina be developed adjacent to the Santa Ana River, certain critical studies should be undertaken:

   a. A computer-based model with full predictive potential linked to the studies of water flow and water quality will be indispensable if the hydrological and circulation problems of the area are to be overcome.

   b. A full and complete investigation of the sand erosion problem in West Newport in relation to the impact of this new development is imperative.

It would appear that this proposal is one which should be encouraged only after a very full investigation of these points and an indication that the problems listed above can be overcome satisfactorily.

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