ROSE CREEK WATERSHED ASSESSMENT OPPORTUNITIES
BIOLOGICAL RESOURCES
TECHNICAL MEMORANDUM

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May 2005

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INTRODUCTION

This report is a companion document to the previously submitted Rose Creek Watershed Existing Conditions Report. This report builds on the prior report by supplementing information previously presented with additional detail developed through recent field investigations. It also serves to identify the major threats and impacts to natural biological resources and ecological processes within the Rose Creek Watershed (RCW). Some specific and some overarching recommendations are provided as a result of the observed conditions within the watershed. These recommended actions will be used to formulate an action strategy for improvements under the Watershed Management Plan.

RCW contains a diverse suite of biological resources focused within four regions: U.S. Marine Corps Air Station, Miramar (MCAS), Rose Canyon, San Clemente Canyon, and Mission Bay (Figure 1). Natural resources within the RCW study area include remnants of historically more widespread vegetation communities and wildlife habitats that continue to serve important conservation benefits for a variety of rare and sensitive plant and animal species. Most of the remaining natural lands within the RCW are designated as City of San Diego open space (*e.g.*, Rose Canyon Open Space Park, Soledad Natural Park, Marian Bear Memorial Park). In addition to the open space areas available to the public, undeveloped portions of MCAS also support valuable natural resources within RCW. The focus of this discussion does not include the lands within MCAS because the Air Station's Integrated Natural Resources Management Plan (INRMP) (2000) addresses the management and conservation of MCAS natural resources.

The City of San Diego's public parklands are readily accessible and offer a wide range of recreation opportunities (e.g., picnicking, hiking, wildlife viewing, mountain biking) for the regions growing population. However, increased population demand for natural parkland recreation opportunities will continue to place a heavy burden on natural resources within the dwindling canyon environments. Due to the biological value of the public lands within RCW, management policies should balance the interests of public access with interests of natural resource conservation and ecosystem functions within these lands. Because the RCW is predominantly built out with the exception of lands on MCAS, it is critical that management focus be placed on improving conditions of what natural landscapes remain. This means investing in capital project enhancement efforts to correct adverse conditions, and fostering stewardship efforts that will provide for long-term maintenance of desirable conditions within the watershed.

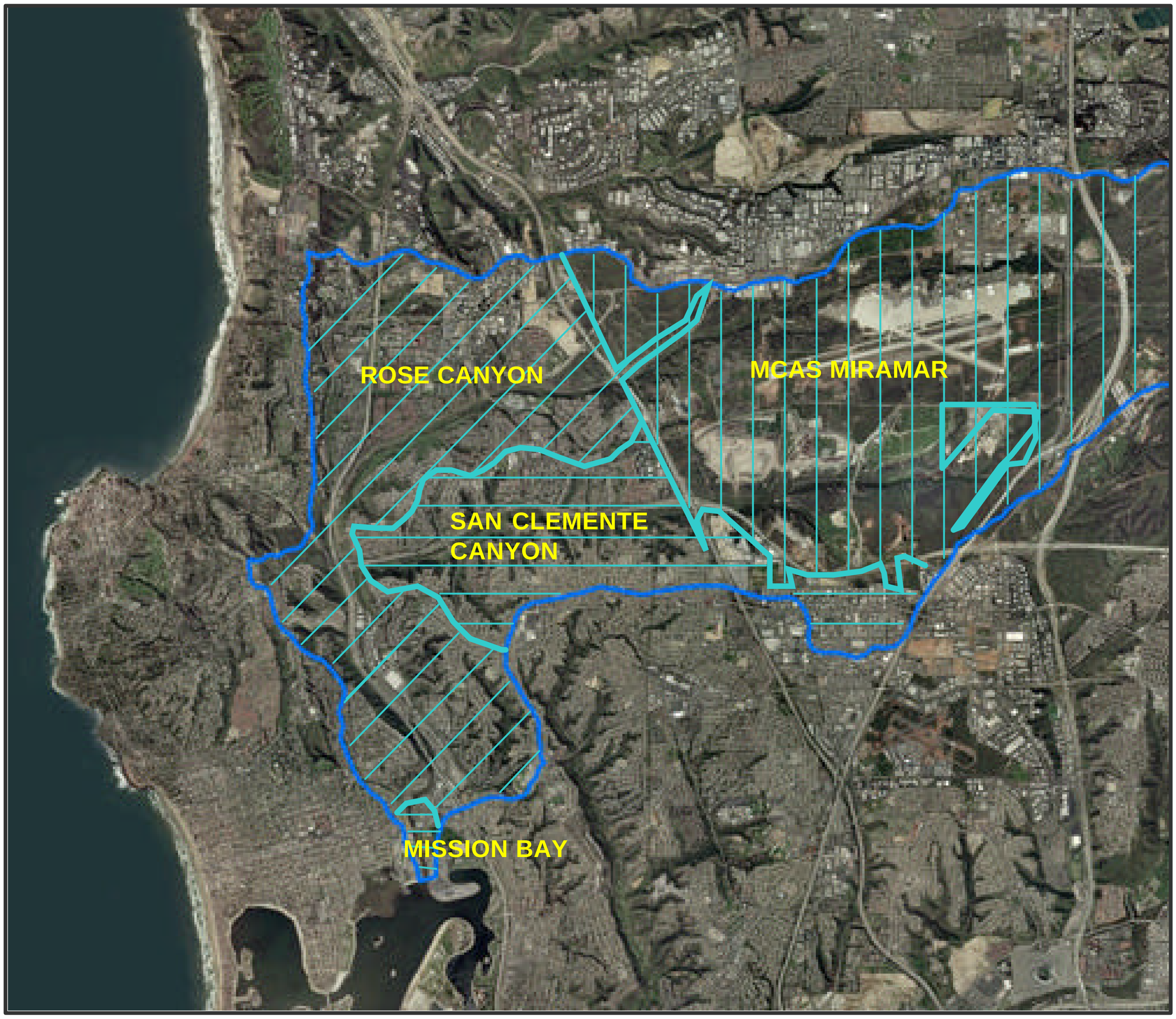

Figure 1. Focus regions of the Rose Creek Watershed

METHODS

The project team surveyed the RCW on foot from within the canyon and by driving to vantage points to survey from canyon rims. Surveys were used to identify and map vegetation communities and locations of target invasive plant species within the RCW. The boundaries between the natural vegetation types and the point locations of target invasive plants were plotted on aerial photographs in the field. The hand drawn polygons of vegetation communities and point locations of invasive plants were digitized and entered into a GIS database. Detailed maps were then produced from these data.

Because the identification of invasive plants was limited to detection during walking surveys, the probability of detection was greater for any species that stands out against background vegetation due to obvious distinguishing characteristics. It should be noted that the invasive plant species targeted possess particular characteristics that enabled them to generally be readily detected and distinguished from native vegetation. Examples of these characteristics, which are not mutually exclusive, include, color and texture differences (*e.g.*, pampas grass, giant reed, tamarisk, Hottentot fig, German ivy), leaf gloss (*e.g*., ngaio), height (eucalyptus and palms), and leaf structure (*e.g*., tree of heaven, castor bean).

Vegetation and habitat boundaries were refined during the field surveys and habitat classification errors were corrected in regional data sets. Incidental detection and records of wildlife species were made through direct observation, identification of avian songs or call notes, or by detection of sign. When applicable, additional sensitive species observations were made, these were added to the GIS spatial data sets.

In addition to completing field investigations to update habitat and exotic species inventories, database searches were made to determine the recorded distribution of sensitive species. The California Natural Diversity Database (CNDDB-2005) was reviewed, as well as, the U.S. Fish & Wildlife Service GIS Database (2005), and the MCAS Miramar INRMP (2000). Other reliable reports of sensitive species occurrences were also incorporated into the analyses performed.

Scientific nomenclature used in this report is from the following references: vegetation communities, Holland (1986) and Oberbauer (1996); flora, Hickman (1993), Baldwin *et al.* (2003); amphibians and reptiles, Crother *et al.* (2000 and 2003); birds, American Ornithologists' Union (1998 and 2004); and mammals, Wilson and Reeder (1993).

RESULTS

VEGETATION COMMUNITIES AND WILDLIFE HABITATS

The RCW supports three principal habitat groups. These include: 1) urbanized lands, consisting of developed lands, disturbed habitats, and non-native vegetation associated with urban uses (developed parks, landscaping, etc.); 2) upland habitats, consisting of all native and naturalized upland plant communities and wildlife habitats, and; 3) wetlands and waterways, consisting of all wetland, aquatic, and marine influenced habitats within the watershed. Table 1 provides a breakdown and area summary for the different habitats represented in the watershed. Urbanized lands account for nearly 55% of the watershed with vegetated urban environments accounting for less than 2.5% of these lands. Most of the remainder of the watershed (43%) is comprised of upland habitats. Wetlands and waterways occupy only about 2% of the total watershed.

Vegetation communities represented within the RCW project area (Table 1) are illustrated in Figures 2a and 2b are described in further detail within the Rose Creek Existing Conditions Report. Habitat mapping is provided in this report only as an update of information previously provided within the Existing Conditions Report.

Throughout the RCW, Southern mixed chaparral, chamise chaparral, and non-native grassland typically dominate the north-facing slopes. While, coastal sage scrub, non-native grassland and native grassland dominate the south-facing slopes. The canyon floors typically support riparian communities along the creeks and drainages, including southern willow scrub, willow riparian forest, and southern coast live oak riparian forest. In addition, freshwater marsh habitat occurs intermittently along the drainages. Along the fringing floodplain terraces, non-native grasslands and exotic species generally dominate where there was once a floodplain community. Within MCAS Miramar, undeveloped mesa tops support native shrublands, grasslands, and large vernal pool complexes.

One of the more unique habitat features within the RCW is the remnant coastal occurrence of southern sycamore riparian woodland and southern coast live oak riparian forest within San Clemente Canyon. These woodland habitats have been nearly extirpated from the immediate coast due to historic mining activities, development, and floodplain modifications. This habitat is an important habitat for a number of migratory resident birds, including raptors, is now generally restricted to the foothills of southern San Diego County, and natural drainage systems on Camp Pendleton within northern San Diego County.

In general, the majority of the native habitat remaining within the RCW occurs on MCAS Miramar. In the lower RCW, mesa tops are almost completely developed while the canyon slopes and canyon bottoms remain undeveloped but in many areas have been disturbed. Over 85% of the lower watershed has been converted to urban uses while the trend is opposite for the upper watershed where approximately 85% remains covered in native habitats and less than 15% of the habitat has been converted to urban uses due to a degree of habitat protection offered by MCAS Miramar ownership.

Table 1. Vegetation Communities within the Study Area

Vegetation Communities/Wildlife Habitats	Total Habitat Area (Acres)	Percent of Watershed
Developed	10,448.6	44.66%
Disturbed Habitat	1,805.2	7.72%
Non-Native Vegetation	567.0	2.42%
URBANIZED LANDS	**12,820.8**	**54.80%**
Eucalyptus Woodland	373.4	1.62%
Non-Native Grassland	1,603.5	6.85%
Valley and Foothill Grassland	34.2	0.15%
Diegan Coastal Sage Scrub	2,703.9	11.56%
Coastal Sage-Chaparral Scrub	368.9	1.58%
Chaparral	399.4	1.71%
Southern Maritime Chaparral	179.9	0.77%
Chamise Chaparral	2,852.8	12.19%
Ceanothus Chaparral	23.2	0.10%
Southern Mixed Chaparral	1,260.6	5.39%
Scrub Oak Chaparral	153.6	0.66%
Coast Live Oak Woodland	152.5	0.65%
UPLAND HABITATS	**10,111.7**	**43.22%**
Vernal Pool	68.3	0.29%
Mule Fat Scrub	13.9	0.06%
Southern Willow Scrub	46.8	0.18%
Southern Arroyo Willow Riparian Forest	35.3	0.15%
Southern Cottonwood-willow Riparian Forest	173.5	0.74%
Southern Sycamore Riparian Woodland	55.7	0.24%
Southern Coast Live Oak Riparian Forest	11.6	0.05%
Non-Vegetated Channel	12.4	0.05%
Open Water	29.1	0.12%
Emergent Wetland	7.4	0.03%
Freshwater Marsh	34.8	0.01%
Cismontane Alkali Marsh	0.0	0.00%
Southern Coast Salt Marsh	1.5	0.01%
Shallow Bay	10.5	0.04%
WETLANDS AND WATERS HABITATS	**462.4**	**1.98%**
TOTAL WATERSHED AREA	**23,394.9**	

Habitats are predominantly derived from Holland Code classification system (Holland 1986) and/or San Diego County terrestrial vegetation community descriptions (Oberbauer 1996). These habitats are described in the referenced classification system documents.

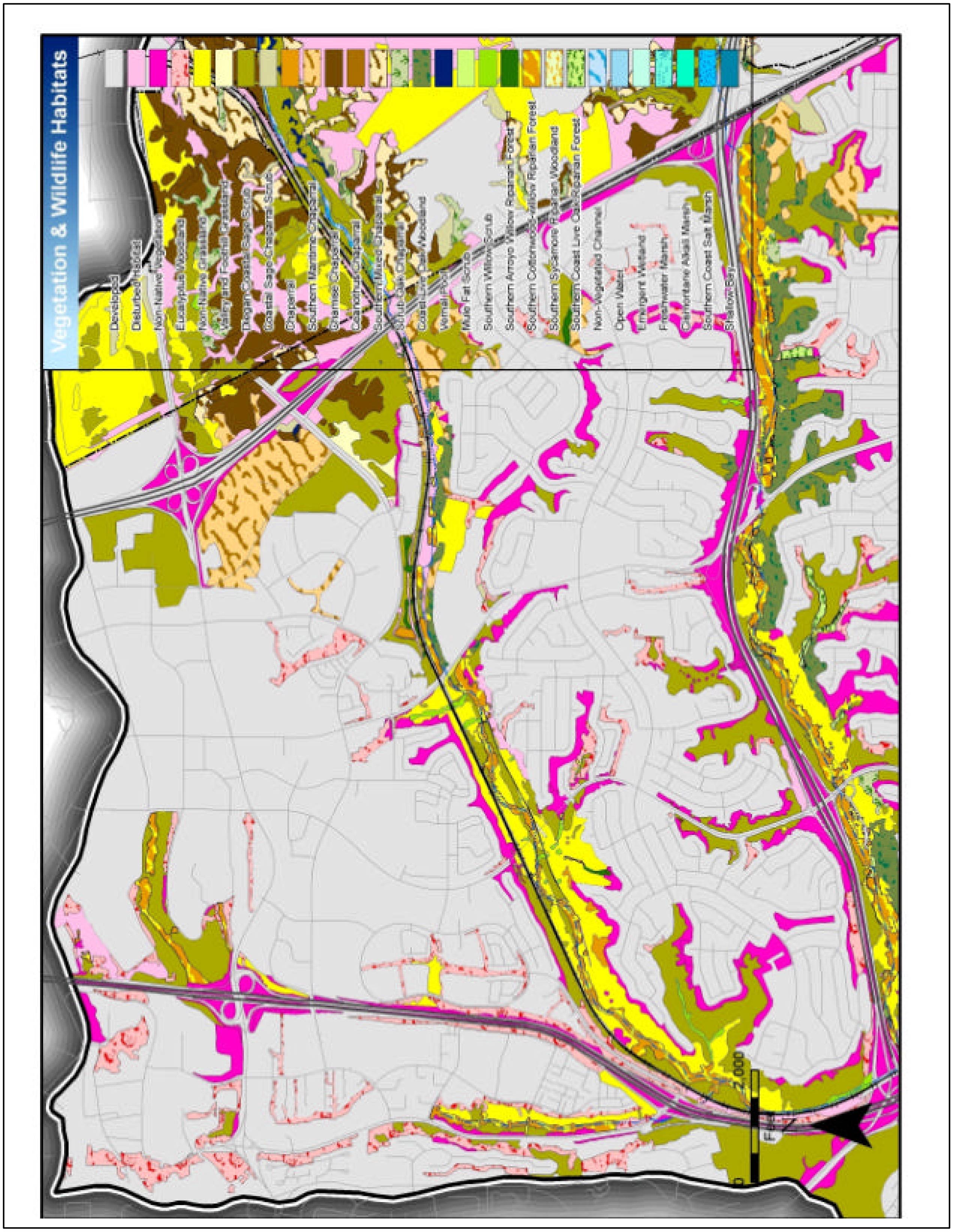

Figure 2a. Rose Creek Watershed Vegetation and Wildlife Habitats (Northern Section)

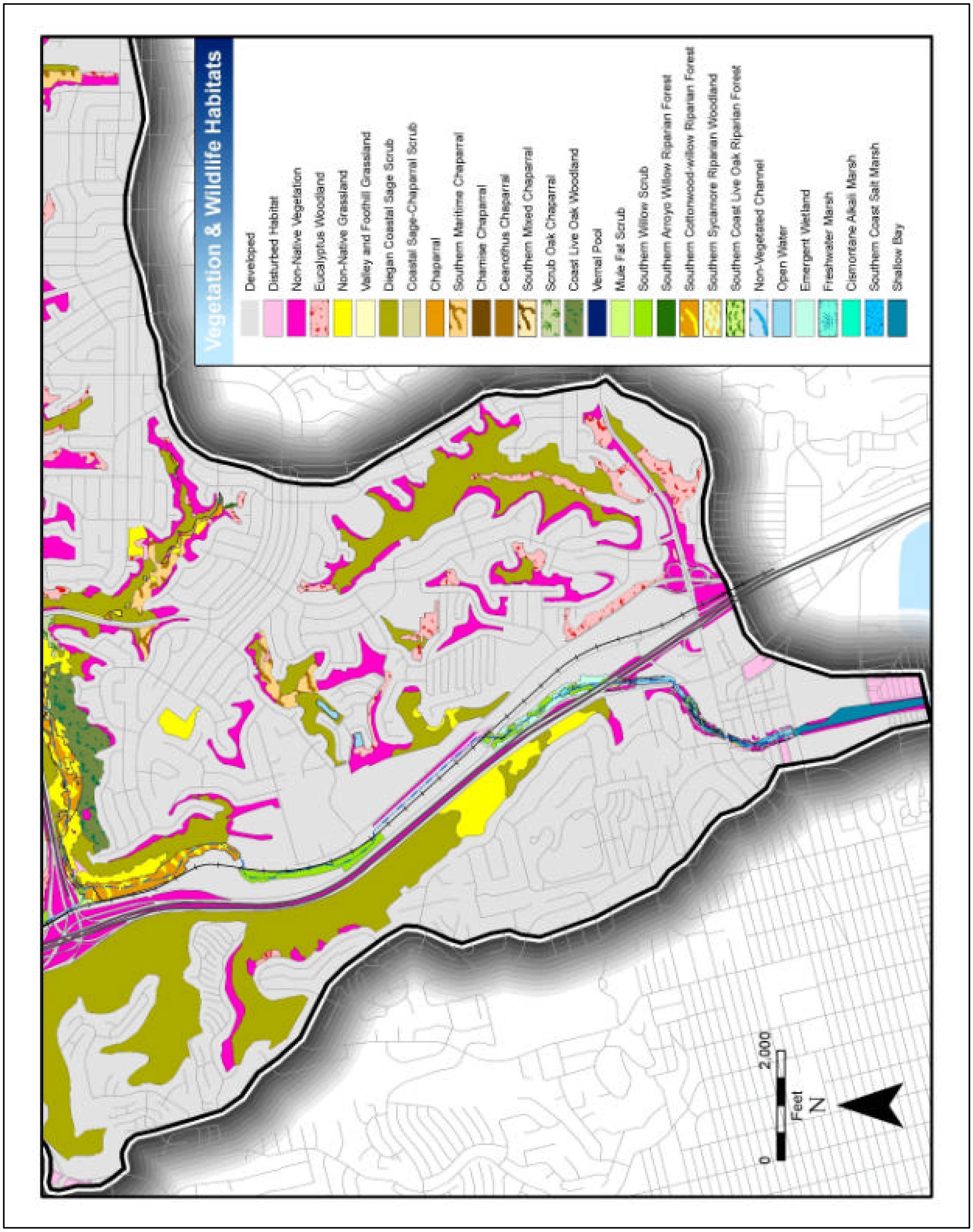

Figure 2b. Rose Creek Watershed Vegetation and Wildlife Habitats (Southern Section)

BIOLOGICAL MANAGEMENT ISSUES

In completing the biological investigations and analyses of the ecological state of the watershed, several key management issues were identified. First and foremost, it is recognized that within the lower RCW, below MCAS Miramar, conservation and development boundaries have been almost fully defined. It is unrealistic to expect that any significant new habitat areas will be protected or habitat linkages will be made. The consequence of this reality is clear in that it is essential to make the best of what remains. To this end, the focus need for management action is on identified threats and biological degradation issues.

Key biological resource management issues within the RCW relate to habitat fragmentation and habitat degradation. These issues include the following:

- **Habitat Fragmentation**
  - Adverse Edge Effects
  - Tenuous Habitat Linkages and Movement Corridors
  - Wildlife Mortality at Movement Corridors

- **Habitat Degradation**
  - Narrowing Riparian Zones
  - Invasive Species Infestations
  - Extensive Transient Encampments

Habitat Fragmentation

Habitat fragmentation is the process and result of reducing and/or isolating habitats due to the modification of surrounding natural lands. This process profoundly affects species interactions and species richness within the remaining habitat islands. Many such habitat islands are fragments of formally more widespread habitats and resident organisms. Also, fragmented habitats may no longer be able to support large predators. The presence of these large predators (*e.g.*, mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), and coyote (*Canis latrans*)) has been demonstrated to hold in check populations of smaller meso-predators. In the absence of large predators, smaller meso-predators [domestic or feral cat (*Felis catus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus*), etc.] become more abundant as large predators no longer limit their populations. Without the presence of large predators, avian and small mammal diversity and abundance declines, presumable due to increased predation pressure from non-native meso-predators (Crooks and Soule 1999a, Crooks and Soule 1999b, Giusti and Tinnin 1993).

Currently, populations of meso-predators (feral cat, striped skunk, raccoon, gray fox) as well as the larger predators (bobcat and coyote) still occur within the RCW and are likely to persist given proper management of the habitat and functional movement routes.

Free-ranging domestic animals also have a direct impact on local fauna. The introduction of domestic cats has been shown to result in decreased avifauna diversity and abundance (Crooks 2000). These meso-predators are known to take small mammals, birds, and reptiles indiscriminately (Crooks 1998). Domestic dogs will also take small game and disrupt the behavior of larger species, including deer.

Habitat fragmentation also applies to the salt marsh habitat of San Diego Bay. It is estimated that only approximately 12% of the historic salt marsh habitat remains in San Diego Bay. The salt marsh habitats have become fragmented due to the construction of levees, roads, and other barriers, which disrupt the connection to both middle-intertidal and upland-transition habitats that are necessary for species movements (USDoN 2000). In the immediate area where Rose Creek flows into the San Diego Bay, remnants of salt marsh habitat (i.e., Kendall-Frost Mission Bay Marsh Reserve) currently support populations of the light-footed clapper rail (*Rallus longirostris levipes*) and Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) (Unitt 2004).

<u>Adverse Edge Effects</u>

Habitat fragmentation results in an increase in the amount of edge, the boundary between the remaining natural lands and the modified landscape. While diversity may be highest at natural occurring edges or natural ecotones, there are significant negative effects to biodiversity associated with the creation of edges due to adjacent habitat loss. Boundary areas often have altered microclimates, hydrology, and soil conditions. Native flora is apt to encounter increased competition from weedy species, which in turn affects the value of the habitat for wildlife. Edges between natural systems and human land uses can amplify these detrimental edge effects, and add others such as increased incidences of disease and pollution risks (Peck 1993).

Woodland species are more susceptible to depredation at edges than within the interior of a habitat patch; they are also more likely to experience brood parasitism and increased competition for nesting cavities from non-native species. Several studies have demonstrated a negative correlation between nest depredation and the size of vegetation remnants. Within fragments, the search pattern of predators may be simplified by what is essentially a one-dimensional habitat, resulting in higher predation efficiency (Major *et al.* 1999).

Increases in artificial light also typically occur in association with development-induced edges. Such adverse impacts include physiological and behavioral impacts on resident wildlife and plants. The presence of artificial nighttime light has implications for a number of species, including the potential to artificially increase predation rates on vulnerable species.

Within the lower RCW, nearly all portions of the mesa tops are built out to the rims of the remaining canyons. In most cases, edge effects extend outward from both canyon rims and even overlap. This configuration of development and natural habitat creates the worst possible condition for habitat degradation by urban drainage, debris discharges, and exotic species invasions. The configuration is slightly better with respect to artificial illumination and noise pollution within the natural habitats. However, even for these areas, roadways through the canyons, such as State Route-52 and Genesee Avenue, add to the adverse edge effects by increasing traffic noise, lighting, and road kill risks.

Narrow constrictions within the lower RCW impact movement of wildlife. The detrimental effects are worsened by adverse edge conditions and real or perceived threats generated by adjacent land uses and activities. Over much of the canyons' length, vegetation along the upper slopes of the canyon has been thinned or replaced with prostrate groundcover, thereby further exposing the adjacent land uses and narrowing the available habitat connections. East of I-805, the more intact native habitat areas have much better edge conditions. Large contiguous blocks of habitat extend uninterrupted thereby limiting edge environment exposure by wildlife.

Tenuous Habitat Linkages and Movement Corridors

At the landscape level, the network of natural lands within the RCW is linked to adjacent open space areas both inside and outside of the watershed by habitat corridors. However, the few inter-watershed corridors that do remain are, small in size, composed of marginal habitat, contain significant hazards to wildlife, and may be lost to future development. The natural habitats outside the RCW that remain connected to the RCW project area include Carroll Canyon to the north and the San Diego River watershed through MCAS to the east. Eastgate Mall Road and Miramar Road (Figure 3) effectively block the best connection from the RCW to Carroll Canyon to the north. This creates a tenuous connection between these canyon systems across an area that exhibits extreme wildlife losses due to road kills (see later discussion on this issue).

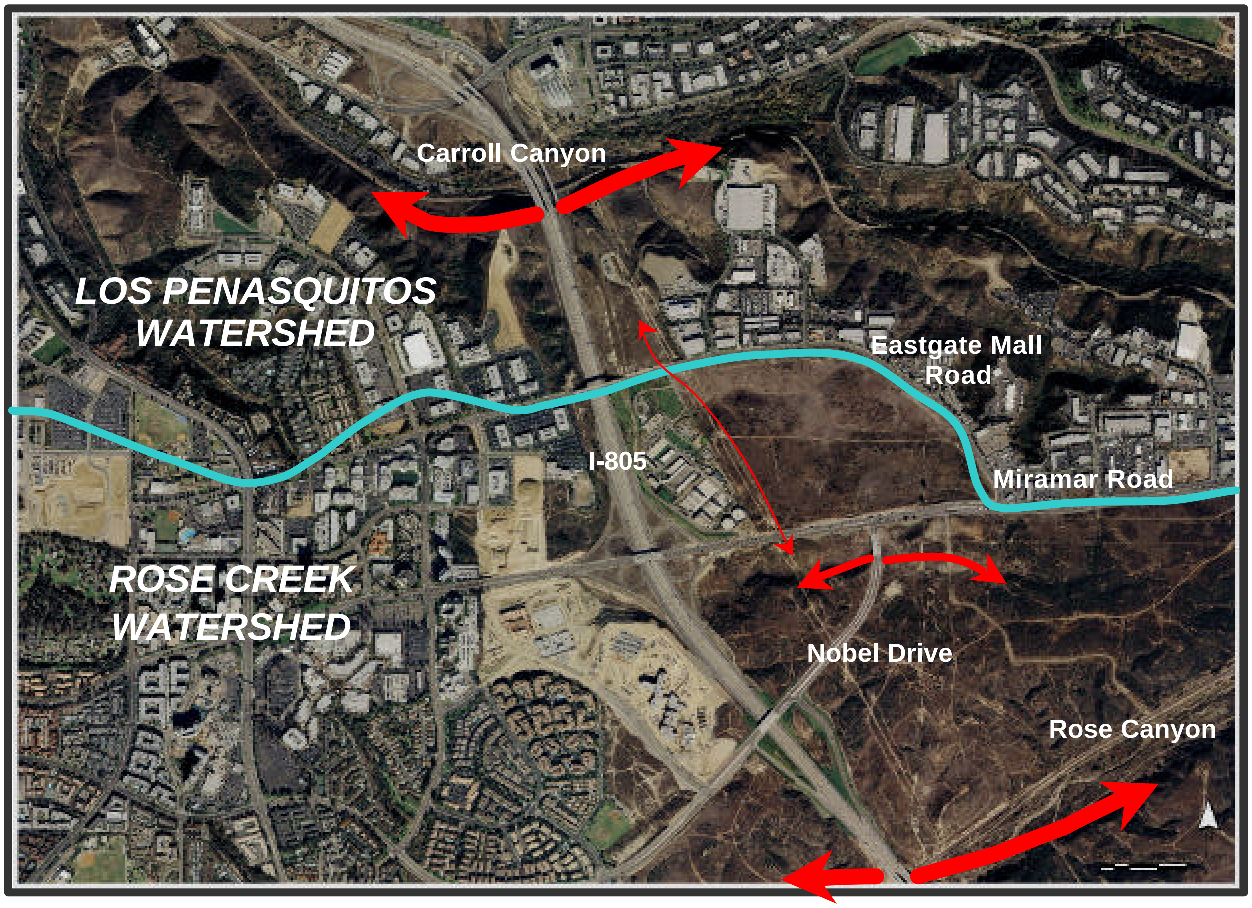

Figure 3. Habitat link between Carroll Canyon and Rose Creek. Red arrows show the relative strength of connections

Interstate-805 acts as a significant north-south trending obstruction to the free movement of ground-dwelling animals between the RCW project area and MCAS East Elliot, Mission Trails Regional Park and other open space lands located further east. Flying animals such as invertebrate, bird, and bat species are not as restricted and likely cross over this obstruction relatively freely. Interstate-805 spans Rose Canyon by a large-span bridge, which provides relatively unrestricted wildlife movement along the canyon bottom for even large mammals, such as mule deer, between the RCW and MCAS. However, within San Clemente Canyon, the configuration of the Interstate-805/State Route-52 interchange restricts this habitat connection to a low elevation bridge structure under a sizable interchange. The constriction through this area is further semi-impaired by the presence of the Miramar Landfill on MCAS property along a significant portion of the linkage. Consequently, this constricted habitat link between the large areas of natural lands of the RCW and MCAS would not be expected to function as efficiently as the large freeway bridge span over Rose Canyon. Other major restrictions along the corridor include Interstate-15, which serves as a significant barrier for ground-dwelling wildlife to move between RCW/MCAS to the west, and the contiguous open space of East Elliot (MCAS), Mission Trails Regional Park, to the east. A small culvert connection under I-15 limits wildlife movement to and from upper San Clemente Canyon. While the existing infrastructure of the Genesee Avenue crossing was designed for water flowage and railroad needs, it functions poorly in regard to a wildlife linkage.

A number of channel segments have been armored and built up on both sides. These create significant and perhaps even worse barriers to wildlife movement than do small culverts where some degree of cover is provided to wildlife making use of the corridors. Perhaps the greatest channel armoring barrier to wildlife movements within the watershed is found at the lower end of the watershed at the vertical sided concrete channel beneath East Mission Bay Drive (Figure 4). This unvegetated concrete channel is frequently flooded and has vertical sides that abut high traffic businesses such as In-N-Out Burger. Other barren concrete trapezoidal channel sections occur upstream along Rose Creek.

Figure 4. Vertical walled concrete channel of Rose Creek at East Mission Bay Drive

Wildlife Mortality at Movement Corridors

Road-related wildlife mortality is a common problem in areas where roads cross through wildlife habitat; the roads within the RCW are no exception. Solutions to this problem are varied and are often site-specific. Road related mortality can be a significant source of population declines in some species and signs are often visible along well-traveled roadways. Eliminating the problem is fraught with challenges, so minimizing the interaction between vehicles and wildlife usually becomes the primary means to minimize road kills.

While losses of animals are of great concern, much effort has been invested in curbing wildlife surface crossings and animal-automobile interactions for public safety reasons. Collisions with large animals, such as deer, can result in serious human injuries and deaths as well as property damage. However, even greater losses occur as a result of attempts to avoid wildlife in the roadways.

Within urban areas with relatively poor linkages to larger habitat blocks, even the loss of individual animals may result in significant depressions in populations because of poor recruitment of animals back into the vacant territories. In some instances mortality may be substantial and even greater than on-site recruitment or emigration of replacement individuals. If this is the case for a particular species, local extirpation from the habitat can occur. For non-flying species, functional land connections are critical to the prevention of isolating populations.

All of the roadway crossings of the canyons pose some degree of constraint to wildlife movement and road kill threat. However, one area in particular has been identified as a place of high mammal mortality due to collisions with road traffic. This area is located along Miramar Road in the vicinity of the Nobel Drive intersection. This stretch of Miramar Road is bound by natural habitats to the north and south and provides a tenuous watershed habitat linkage to Carroll Canyon (Figure 5).

To the north of Miramar Road is a disconnected area of MCAS bounded by the arch of Eastgate Mall Road and associate development on the east and north; and the North City Water Reclamation Plant and I-805 on the west. To the south of Miramar Road are the larger tracts of habitat on MCAS Miramar. M&A biologists have previously noted large numbers of mammal carcasses in this area including deer, coyote, bobcat, skunk, rabbit, and fox.

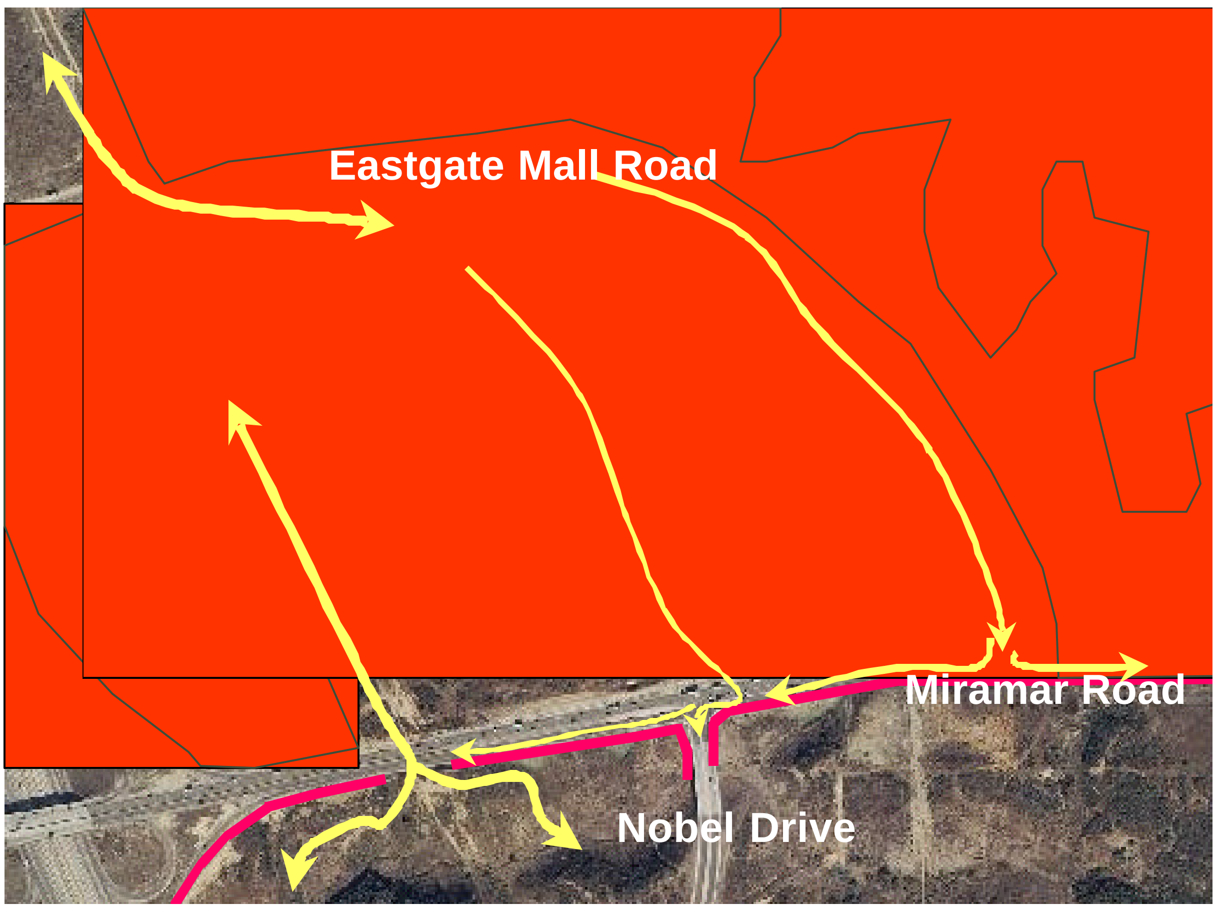

Figure 5. Fencing along the southern edge of Miramar Road and urban development along Eastgate Mall Road serve to funnel wildlife onto as many as eight lanes of traffic with high speed off ramps of I-805.

The extent of animal losses in this area appear to be out of scale for what might be expected for similar sized roadways in the region. To gain a better understanding of the potential causes of this phenomenon, an examination of the area was undertaken to explore the site conditions and habitat and barrier geometries. The review indicated that a corridor for animal movement exists between the remaining habitats north and south of Miramar Road. Despite its narrow configuration, the corridor connection to the north into Carroll Canyon extends through the MCAS–Eastgate Mall open space along the existing natural gas and electrical transmission line easement. However, for the most part, the Eastgate Mall open space is a biological cul-de-sac, natural habitat surrounded by non-habitat barriers. In its current state the Eastgate Mall open space functions as a mortality sink for some mammals because it likely attracts individuals by providing important resources (*e.g.*, food, dispersal opportunities) while also having many significant hazards associated with it. Once an animal is within the Eastgate Mall open space area, additional open space may be visually located immediately to the south across Miramar Road. However, a chain-link fence, constructed adjacent to the road surface prevents most animals from accessing the natural lands that may be visible to them (Figure 6). The fence design is a formidable barrier for all animals that do not have the ability to fly (*e.g.*, birds, bats, etc.) or pass through the mesh (*e.g.*, snakes, small mammals). The fence design consists of an 8-foot high chain-link fence topped with three strands of barbed wire affixed to extension arms angled out.

Animals must cross Miramar Road at grade. These crossings typically happen at night. On the south side of the road, animals encounter the chain-link fence and proceed to follow the fence line either east or west in search of breaks in the fencing. As cars approach, startled animals often will run along the fence searching for a gap until the last moment when they will dart back towards the other side of Miramar Road. Because animals are trapped on the roadway surface without cover as vehicles approach, they are susceptible to panic flight behavior that frequently puts them in a collision course with the on-coming traffic.

Figure 6. Area of high mammal mortality; view of Miramar Road facing west with a view of the intersection with Nobel Drive

Habitat Degradation

Narrowing Riparian Zones

Historical flow in the drainages within the RCW was highly seasonal with surface flows correlated with periods of rainfall events and subsequent runoff. Consequently, due to the effects of urbanization, (*e.g.,* increase of impermeable surfaces, artificial watering of ornamental plantings, and channelization) many of the watershed's canyon drainages currently exhibit perennial or semi-perennial flows and pooling as well as exacerbated flows during episodic discharges. Through time, altered hydrologic conditions have had and continue to have deleterious effects on the hydrology and geomorphology of the stream channels that have ultimately resulted in

Figure 7. Channel incision

reduced native riparian habitat, slope erosion, and increase in exotic species invasions. The increase in the extent of impervious surface area in the watershed (see Hydrologic Modifications Technical Memorandum) is directly related to the increase in stream discharge rates and greater flow velocities. As a result, a significant amount of erosion and channel incision has taken place in both the small and larger channels within the watershed (Figures 7 & 8). Furthermore, due to the

Figure 8. Stream bank erosion

stabilization of large expanses of upland areas, there has been a reduction in bed load sediment supply (sand, gravel, cobble, rock). Consequently, with a net loss of streambed aggregation, drainages are unable to maintain the natural dynamic balance of removal and deposition of material within a channel. Channel incision changes the streambed profile from wide and shallow to narrow and deep. As a consequence of this process, over-bank flooding and scouring of the riparian terraces is significantly reduced and discharge flows are further contained. These conditions have an additive effect to further degradation in the form of increased flow velocities, channel erosion and bank failures. In addition to loss of channel and floodplain width, the incised creek beds also create enhanced conduits for groundwater drainage. As a result the water table within the alluvial canyon floor is lowered and adjacent floodplain areas dry more quickly than is natural.

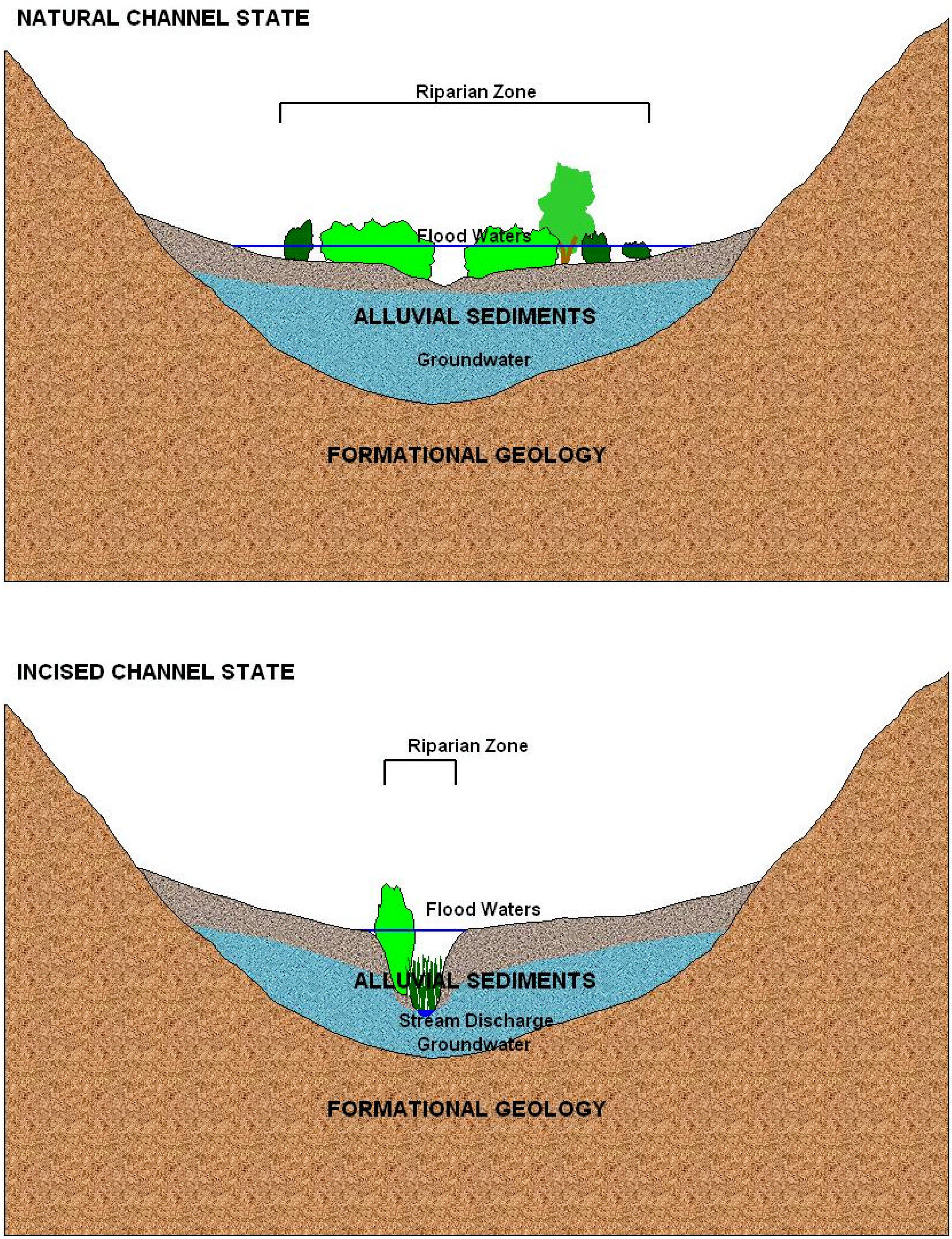

Figure 9. Effects of Channel Incision on Riparian Habitats

In addition, the width of the riparian vegetation and habitat is reduced. The interrelated changes of streambed profile, hydrology, and vegetation are illustrated conceptually in Figure 9.

Invasive Species Infestations

Invasive species infestation is second only to habitat destruction as a cause for the reduction of biodiversity worldwide (Czech 2004 and Wilcove et al 1998). Some exotics may exert pressure on biological communities by one or more of the following mechanisms: herbivory; predation; competition; and/or as a vector for transmittance of pathogens and diseases. Because the RCW is surrounded by landscapes altered by urbanization, non-native invasive species are now plentiful, diverse, and constantly testing the ecological resistance of the remaining natural lands of the RCW. Opportunity for invasive plants and animals has come from the transportation and introduction by well-intentioned people, well before the true characteristics of these deleterious species were known. Countless species considered benign at one point in time have demonstrated themselves to be a formidable threat to the biodiversity within the RCW. However, not all non-native species have the ability to spread quickly beyond the place they are introduced and out-compete the native flora and fauna. Those that do spread quickly are considered an unwanted invasive species and should be targeted for eradication or control to minimize their impact on the quality of the remaining natural lands of the RCW.

Invasive Plants

The natural lands within RCW have been altered to various degrees due to historic and current causes. Impacts to native vegetation began with the early homesteaders of this region. The homesteaders practiced widespread cattle and sheep grazing, and disked the coastal plains and mesa tops for agricultural purposes. It has been widely reported that this was the era when invasive-type exotic plant species were first introduced into this region. Notably some of the most prolific invasive species were introduced during this era for purposes of resource production or agricultural crops. Many of the Eurasian grasses were introduced during early settlement periods both intentionally as robust grazing materials for livestock as well as through incidental seed transport along new travel corridors, both by land and sea. During the late 1800s and early 1900s, eucalyptus was introduced as a fast growing hardwood with the intent of using materials for lumber and railroad ties. While eucalyptus never was widely used for either lumber or railroad ties due to its tendency to crack and twist when dried, it did become a popular shade tree and was burned for fuel for a long period.

Eurasian grasslands, and eucalyptus woodlands have become so well established in southern California that they now are considered to be naturalized communities supporting their own biological values. While such communities are accepted as a reality in which complete native habitat areas have been displaced, the further expansion of these exotics should not be fostered. Eurasian grasslands (non-native grasslands) presently occupy 1,603.5 acres of the RCW while Eucalyptus woodlands occupy an additional 373.4 acres of the watershed. For purposes of discussion of invasive species, areas that have been fully converted to eucalyptus woodlands have been treated as a habitat, while scattered eucalyptus trees derived from these groves and landscape plantings, which now invade the remaining natural canyon areas, have been treated as invasive exotics.

The introduction of exotic species into the RCW occurred at an astronomical rate from the early 1900s through the mid-1900s. Reliable shipping and trade routes and exotic introduction pathways had already been established between San Diego, the eastern U.S., Mexico and South America, as well as the Far East. With the intensification of development in the watershed, came a proliferation of ornamental landscape plants. Some were introduced for their hardy nature and exotic look (e.g. pampas grass, giant reed, ngaio, Brazilian pepper tree, various palms). Others were introduced as fire retardant, robust ground cover and aesthetics (*e.g*., Hottentot fig [iceplant], nasturtium, German ivy). German ivy is able to resist being overgrown by native shrubs as well as introduced grasses. With the mild climate of coastal southern California, exotics from both temperate and tropical climates readily became established and, absent natural environmental controls, many of these new introductions became established as aggressive invasive species throughout the region, including within the RCW.

With significant land use changes in the watershed, exotic invasive species received a further boost. Summer irrigation became common and non-seasonal runoff and groundwater seepage increased, thus, creating numerous seeps along steeper canyon slopes and converting seasonally dry creeks into perennial or semi-perennial streams. Drought adapted native plants declined while the high soil moisture created favorable conditions for invasive plant species such as Brazilian pepper, giant reed, pampas grass, tamarisk, and castor bean to spread.

Of the 10,574.2 acres of natural habitat lands within the RCW, 19.8% are dominated by exotic species, including eucalyptus woodlands and non-native grasslands. Excluding these exotic habitat features, 1.0% of the watershed is dominated by invasive exotic species. The lower watershed supports the vast majority of the infestations and the majority of the most noxious weeds. While the list of potential exotic species within the watershed is extensive, those that have become established as verified escapees and which show invasive tendencies are identified in Table 2 along with the total acreage of the watershed now occupied by the species. Identified infestation areas within the watershed are illustrated in Figures 10a and 10b.

Table 2. List of the most common invasive plant species in Rose Creek Watershed

Common Name	Scientific Name	Area (acres)
Hottentot Fig	*Carpobrotus edulis*	86.0
Pampas Grass	*Cortaderia jubata*	16.4
Nasturtium	*Tropaeolum majus*	11.8
Brazilian Pepper Tree	*Schinus terebinthifolius*	3.1
Giant Reed	*Arundo donax*	3.0
California Fan Palm	*Washingtonia filifera*	0.7
Shamel Ash	*Shamel uhdei*	0.6
Canary Island Date Palm	*Phoenix canariensis*	0.6
Acacia	*Acacia* spp.	0.6
Tamarisk	*Tamarix parviflora*	0.3
Eucalyptus	*Eucalyptus* spp.	0.3
Ngaio / Myporum	*Myoporum laetum*	0.2
Landscape/Ornamental Trees	various	0.2
Castor Bean	*Ricinus communis*	0.1
Mission-Olive	*Olea europea*	0.1
German Ivy	*Senecio mikanioides*	0.0
Thistle plants	various species	0.0
Total Area of Invasive Plant Dominance		**110.6**

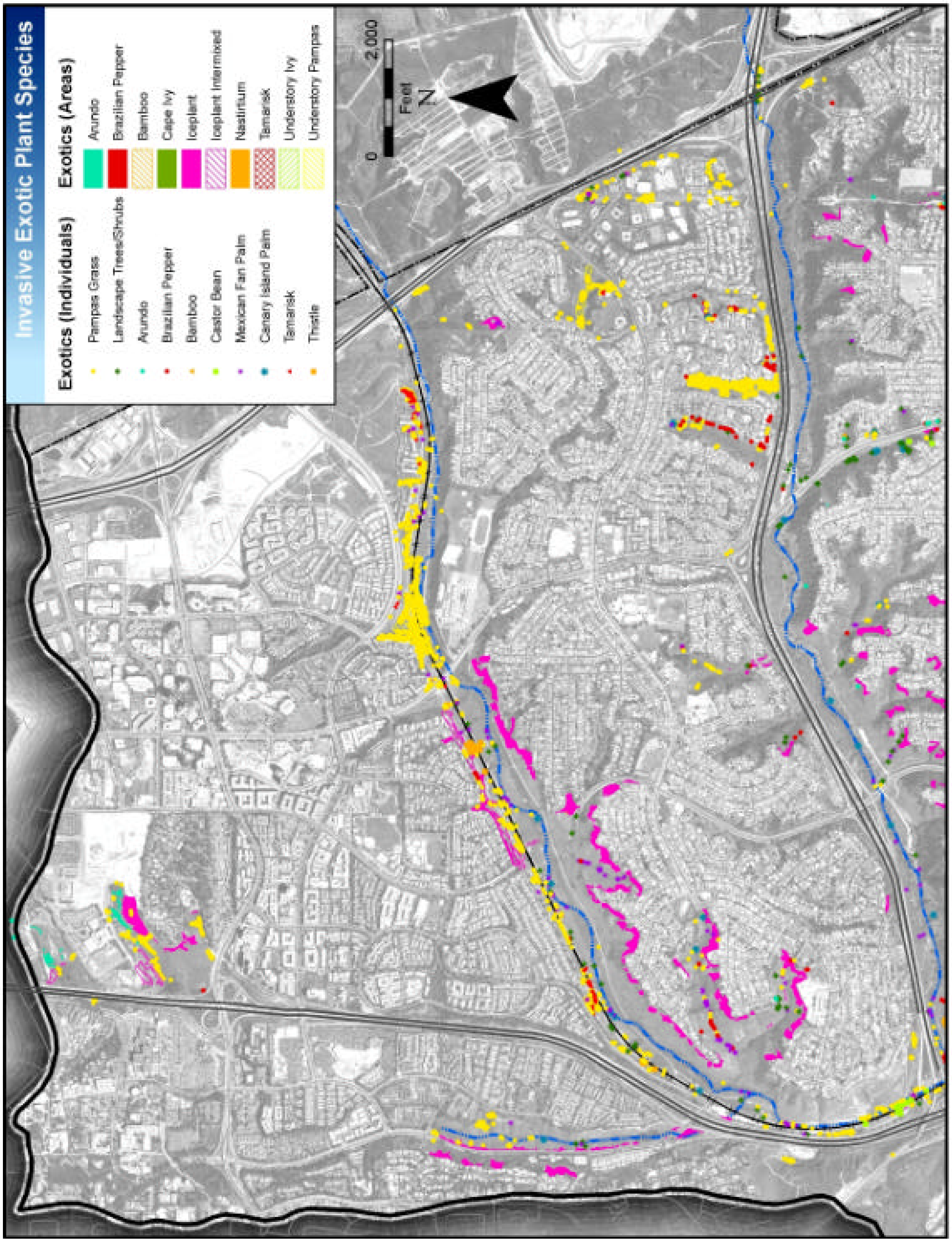

Figure 10a. Rose Creek Watershed Invasive Plant Distribution (Northern Section)

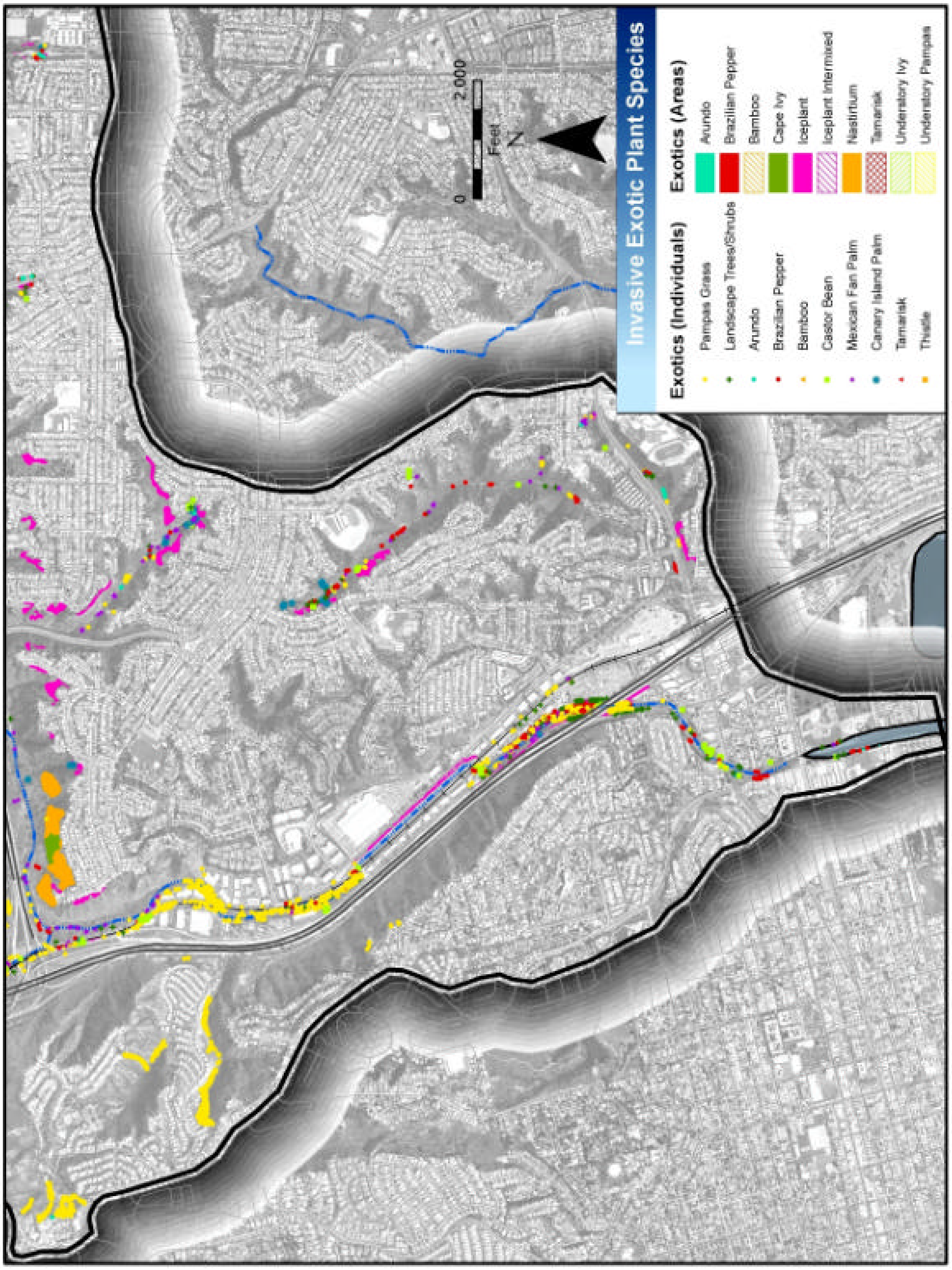

Figure 10b. Rose Creek Watershed Invasive Plant Distribution (Southern Section)

While all of the species that have been included in Table 2 have a high potential to become significant pest species within the RCW, four species account for 96.7% of the identified infestation problems and warrant priority control effort. These include Hottentot fig, pampas grass, giant reed, Brazilian pepper tree, and eucalyptus.

Hottentot Fig

Patches of Hottentot fig, or 'ice plant', is a common site along the steep canyon slopes of the lower RCW. Propagated by sprouting roots from broken sections or cuttings, this species is often planted as a fire retardant ground cover. Its robust nature allows it to spread prolifically and it readily grows into mats of dense ground cover. However, over time the ice plant spreads beyond the confines of the residential properties and begins to encroach into the public lands of RCW (Figure 11). Currently, in several locations along the perimeter of the canyon the ice plant flows down slope from its source forming extensive areas of the ever-expanding non-native plant. The ice plant further degrades the ecosystem of RCW by overgrowing native plants and providing limited suitable habitat for most wildlife. It does, however, provide excellent habitat for a number of exotic species including the black rat, house mouse, Virginia opossum, and Argentine ant. Due to their shallow root system and heavy weight, ice plant has been found to be not as effective at controlling erosion on a slope as previously thought. In some situations, it is now believed that using ice plant as a ground cover may even increase the likelihood of slope failure.

Figure 11. Hottentot fig dominates slopes below neighborhoods within the lower watershed

Pampas Grass

Clusters of pampas grass are easily detected throughout the watershed with particularly aggressive stands being found in a few smaller finger canyons. This species forms dense clusters and can overtake hillsides due to its ability to out compete native plant species (Figure 12). Its seeds are spread by the action of wind so it can easily spread to new areas. In many areas of the watershed, large patches of pampas grass have become established in only a matter of a few short years. These patches of pampas grass will continue to spread along the moist slopes below development and along the riparian fringe as seed is broadcast from established infestations and remaining pampas

Figure 12. Pampas grass often form dense patches.

grass in public and private landscaping within the watershed. This species is difficult given the nature of its spread and the abundance of pampas grass in private yards throughout the region, however it should be a major target for control efforts.

Giant Reed

Giant reed is found in scattered occurrences throughout the watershed. An aggressive and relatively successful effort to eliminate giant reed from several locations within the watershed has previously been undertaken by volunteer groups. Because this species is sterile and only spreads by rhizomotous means and fragmentation of rootstock, this species is more controllable than most invasives. These efforts are strategically employed working from the upstream areas to downstream areas of the watershed.

Brazilian Pepper

Brazilian pepper trees are well established and occur in dense thickets along the wetter portions of the riparian zones within the RCW. Birds that eat the fruit and then deposit their dropping in other areas spread this plant within and likely between different watersheds. It is presumed that the tree canopies of this species do not provide the suitable habitat that the native willows provide due to the avoidance of many sensitive bird species. Brazilian pepper trees are notorious for hosting significant ant populations subsequently small nestling birds may be killed by marauding ants.

Eucalyptus

Several species of eucalyptus have been commonly used as ornamental plantings as well as wind breaks in urbanized areas in the vicinity of RCW. Without periodic removal and management of saplings, ongoing recruitment can form expanding groves that displace native plant communities and associated wildlife. Understory development is inhibited by the production of allelopathic substances and by carpeting the ground with shed bark strips, leaves, and limbs. In addition, the debris that accumulates under the trees is extremely flammable and under severe weather conditions provides a potential source of drifting burning material. The shed debris can also facilitate the spread of the Argentine ant by maintaining moist substrate conditions. However it should be noted that the height and structure of large eucalyptus trees often provides suitable nesting and perching opportunities for an entire suite of raptor species.

Invasive Animals

Invasive plants identified as occurring within the RCW are listed in Table 3. Species accounts for these species are provided below.

Table 3. List of the most common invasive animal species in Rose Creek Watershed

Common Name	Scientific Name	Status in Watershed
Argentine ant	*Iridomyrmex humilis*	Abundant throughout lower watershed
African clawed-frog	*Xenopus laevis*	Abundant in permanent freshwater pools
Bullfrog	*Rana catesbeiana*	Common in permanent freshwater pools
Brown-headed Cowbird	*Molothrus ater*	Common throughout lower watershed
Black Rat	*Rattus rattus*	Common at urban edges in lower watershed
House Mouse	*Mus musculus*	Common at urban edges in lower watershed
Feral Domestic Cat	*Felis catus*	Occurs in lower watershed
Virginia Opossum	*Didelphis virginiana*	Common throughout entire watershed

Argentine Ant

The Argentine ant is well established within the RCW as it is in coastal southern California. It is a frequent pest in homes, disturbed habitats, as well as in natural habitats that provide sufficient moisture. Due to its dependence on surface moisture it invades unoccupied areas by way of watercourses as well as irrigated landscapes, iceplant and around structures (Figure 13). This species can not be readily eradicated because they are known to form enormous cooperative colonies across entire landscapes, however, some degree of control may be afforded by reducing pathways of spread in natural areas. Argentine ants can be voracious consumers of nearly everything, including small rodents, reptiles, and birds. This species has been implicated in the reduction of habitat quality for numerous native fauna from ant species to small mammals.

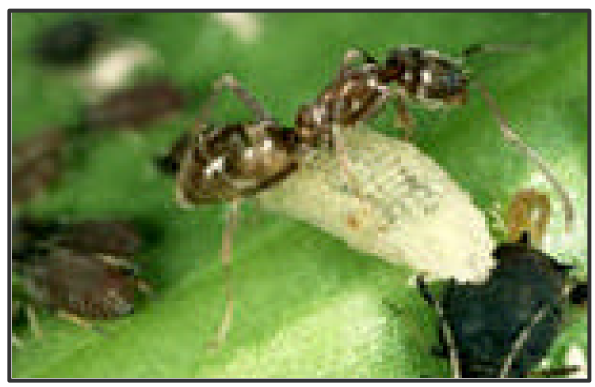

Figure 13. Argentine ants are most common in areas of moist substrate

African Clawed-frog

The African clawed-frog is a hardy aquatic frog that rarely leaves the water (Figure 14). It was widely marketed through the pet trade during the 1970's (they are no longer legal to possess without written consent from CDFG). The spread of the African clawed-frog likely continues due to the periodic release of unwanted pets or translocation of captured individuals.

The African clawed-frog's diet consists of aquatic organisms such as zoobenthos, zooplankton, insects, tadpoles, and small fish. Consequently, within the creek reaches that are occupied by African clawed-frogs, native amphibian larvae are at great risk of predation. However, the relative impact of predation would depend on the abundance and density of the predator, prey, and available refugia.

The occurrence of this species within the RCW is also linked with the relatively recent provision of perennial waters associated first with the creation of stockponds and ultimately through the input of unseasonal urban generated runoff.

Figure 14. Adult African clawed-frogs rarely leave the water of quiet perennial pools

Bullfrog

Having been introduced into California in the 1850's, the bullfrog has since become wide spread in the state. This frog is closely associated with the permanent waters of ponds and in the quiet portions of creeks and rivers. It diet is only limited to what it can fit it it's mouth; it is known to eat invertebrates, fish, frogs, lizards, snakes, turtles, small mammals, and occasionally birds and bats (Figure 15). It's high reproductive output and non-specific diet enables it to build large populations in disturbed aquatic habitats quickly. It's large size tadpoles are also unpalaptale to many wading birds furthering its survivability. It is notable that this species' presence within the RCW is directly linked with the relatively recent provision of perennial waters associated first with the development of stockponds and ultimately through unseasonal runoff from irrigation and consistent storm drain discharges.

Figure 15. The bullfrog is closely associated with perennial pools

Brown-headed Cowbird

The brown-headed cowbird arrived in southern California within the first decade of the 1900's and is best known as the bird that affects the reproductive success of riparian bird species by brood parasitism. The cowbird is now well established in our region including within the RCW. The most effective methods used to combat or minimize cowbird impacts on native riparian songbirds such as the least Bell's vireo (*Vireo bellii pusillus*) are to reduce the suitability of habitat for cowbirds, minimize edge habitat where brood parasitism tends to occur by maintaining broad riparian systems, and trapping the adult cowbirds. Reducing cowbird habitat suitability typically means minimizing the abundance of turf areas, reduction of equestrian presence, and avoiding conversion of scrubland and woodland habitats to grasslands. Trapping of cowbirds as a management tool has been used successfully in coastal southern California for nearly 20 years resulting in improvements in the populations of many riparian and upland birds, including least Bell's vireo. However, because cowbirds appear to be a species that cannot be readily eradicated from the region, on-going control will likely be necessary in perpetuity.

Black Rat

The black rat is a common inhabitant of coastal environments. It originates from Southeast Asia and has been introduced at seaports worldwide. It has spread prolifically throughout most civilizations where it gains food and shelter in association with human habitations. The black rat was the species responsible for transmitting bubonic plague throughout Western Europe during the Middle Ages. The black rat is an omnivore eating many different food items, including, grains and fruits, insects, reptiles and amphibians, other mammals, and small birds and eggs. Within the RCW, this species is common in urbanized areas and at the Miramar Landfill. It is expected to be less common in more natural terrain within the eastern portion of the watershed.

House Mouse

The house mouse is a ubiquitous pest rodent associated with civilizations worldwide. Introduced from southwestern Asia, this species is an opportunist that survives well in association with urban environments, but it generally does not do well too far away from subsidized environments where food and shelter are plentiful and there is substantial protection from predators. Within the RCW, this species is common in the lower watershed, but it is not likely to be a regular component of the mammalian fauna in areas east of I-805 except around the Miramar Landfill and around the smaller pockets of development in these areas.

Feral Domestic Cat

Within the RCW, the feral domestic cat is most common in the lower portion of Rose Creek in the area above and below the Mission Bay Drive bridge (Figure 16). In this area, feral cats pose a much higher threat to native species than elsewhere within the watershed due to several factors: the close proximity of urban areas provides a frequent source of abandoned domestic cats; the dense cover of the riparian zone serves as refugia habitat for cats; the narrow configuration of the riparian zone bordered by commercial and industrial establishments limits the amount of habitat for the native meso-predators such as the bobcat and coyote; and the presence of transients along this reach of Rose Creek provides for food subsidies to the feral cat population. Elsewhere in the RCW, feral cats are not uncommon, but the populations are kept under control both by minimal introductions, and high mortality rates due to predation. Feral cats are virtually non-existent in the upper portions of the watershed on MCAS Miramar.

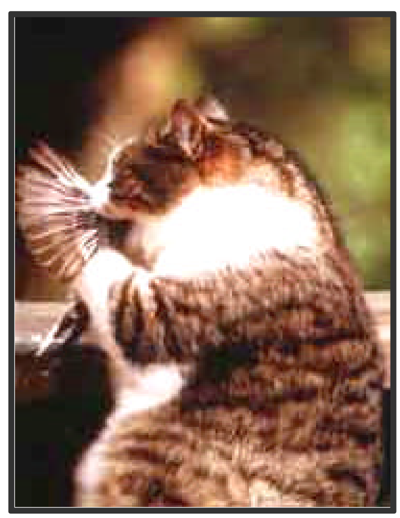

Figure 16. Domestic cat preying on a song bird

Virginia Opossum

The Virginia opossum is a native of southeastern North America. This species has spread northward and westward in association with human introductions early in the 20th century when pet opossums escaped or were set free in many locations. The species has done very well and now is a common associate of most areas with significant human presence. This species is a scavenger, but is also a major predator on bird eggs.

Transient Encampments

The presence of transients within natural open space areas creates numerous and varied problems. Because riparian zones often support dense vegetation, transients often seek out these habitats to establish encampments. Within lower Rose Creek, several large and some smaller transient encampments exist (Figure 17). Within and around the encampments, vegetation is often thinned out, trash middens develop, and human waste is common.

Because of high amounts of nocturnal activities at these camps as well as the considerable presence of human scent, many more secretive animals may avoid moving through restricted corridors where encampments exist. One such animal that is discouraged from using areas around human habitation is the coyote. This species plays a critical role as a top predator in southern California coastal habitats and coyotes are critical to maintaining population controls on meso-predators (*i.e.*, skunks, opossums, raccoons, feral cats, etc.). Absent the presence of coyotes, populations of these predators and scavengers can be sustained at very high levels and adversely impact prey species populations.

Converse to many less tolerant species, transient camps tend to be attractants for opportunistic human tolerant species such as feral cats, black rat, house mouse, Virginia opossum, striped skunk, and raccoon. The localized increase in populations of these opportunists, both through subsidized feeding and reduction of predation pressures, tends to result in adverse impacts to many prey species consumed by these meso-predators.

During high flow events, trash and debris from encampments as well as human feces are washed into downstream portions of Rose Creek and into Mission Bay. Much of this debris ends up trapped on vegetation, thus increasing the effective roughness of the riparian habitat and accelerating erosion locally. When material is washed into Mission Bay, a significant amount of the debris is deposited on the bottom of the Bay near the Rose Creek mouth, or within the coastal salt marshlands of lower Rose Creek and the Northern Wildlife Preserve. Where debris is deposited in these areas, vegetation loss is a common result. Further, the human waste discharges from the transient camps may contribute to failures of water quality standards in Mission Bay and pose health and safety concerns to the general public.

Figure 17. A transient encampment located in the lower Rose Creek in the vicinity of East Mission Bay Drive overpass

BIOLOGICAL RECOMMENDATIONS FOR WATERSHED IMPROVEMENTS

This section identifies key actions that may be taken to accomplish ecological improvements within the RCW. Recommendations are presented as bulleted actions that will be used as a focus in development of more specific actions under the Watershed Management Plan. To address the identified issues effectively will require both directed corrective actions of a capital project nature, as well as long-term or perpetual management effort investment and community outreach. Because much of the natural land presently exists as managed public lands for natural resource conservation and passive public recreation uses, property ownership issues may be limited. However, there are still significant regulatory, public utilities, and flood management concerns that will need to be addressed for many of the more extensive management actions to be implemented.

Table 4 outlines future management action recommendations. The table links the recommended actions with the issue areas it will assist in resolving. In addition, the priority of the action is identified for each recommendation. While future management will likely be dynamic and adaptive, it is expected that from these recommendations, specific actions may be identified under the Watershed Management Plan. This plan that will provide for immediate opportunities to improve conditions, as well as the development of more extensive programmatic actions that may take a greater effort to initiate but which are deemed critical to the restoration and enhancement of biological functions within the watershed.

Table 4. Recommendations for Ecological Improvements in the Rose Creek Watershed

Recommended Action	Priority	Habitat Fragmentation			Habitat Degradation		
		Adverse Edge Effects	Tenuous Habitat Linkages and Movement	Wildlife Mortality at Movement Corridors	Narrowing Riparian Zones	Invasive Species Infestations	Extensive Transient Encampments
Identify sites and opportunities to reduce habitat degradation through: 1) trail consolidation and reclamation; 2) strategic fencing; 3) restoration of disturbed lands.	High	X	X				
Identify opportunities to improve wildlife movement at poor habitat connections through directive fencing, vegetative screening, replacement or enhancement of structures, or reduction of adverse influences.	Moderate		X	X			X
Conduct additional hydrologic analyses to determine the extent of the opportunity to restore channel bed conditions and reclaim floodplain functions.	High	X	X		X	X	
Conduct pilot programs to restore channel grades and floodplain conditions through aggregation and stepped reach energy dissipation.	Moderate	X	X		X	X	
Conduct pilot programs to restore eroded banks and repair side drainage degradation using various mixes of biostabilization and soft-engineering structures (gabions, geo-grids and cellular mats, etc).	High				X		
Seek opportunities to remove or modify concrete segments of channels or to enhance habitats along channel reaches to improve connectivity of habitats across these armored reaches of the drainages.	Moderate	X	X		X		
Develop and implement a plan to alleviate road kills along Miramar Road between I-805 and Eastgate Mall Road.	High	X	X	X			
Strengthen habitat linkages to natural lands outside the RCW project area focusing on connections to MCAS and Carroll Canyon.	Moderate	X	X	X			
Ensure that projects along the MSCP MHPA adhere to adjacency standards and seek opportunities to have redevelopment repair past adverse edge conditions.	High	X	X				
Evaluate and repair tributary storm drain erosion areas to restore riparian habitats and improve functional connectivity drainage areas adjacent	High	X	X		X		

Recommended Action	Priority	Habitat Fragmentation			Habitat Degradation		
		Adverse Edge Effects	Tenuous Habitat Linkages and Movement	Wildlife Mortality at Movement Corridors	Narrowing Riparian Zones	Invasive Species Infestations	Extensive Transient Encampments
uplands by reestablishing natural grades and habitat interfaces.							
Develop an invasive species management plan that considers lands that may serve as sources of invasive propagules or founder populations even if they occur outside of the RCW. The invasive species management plan should be based on targeting species that are: 1) the fastest spreading (will occupy large areas in the near future); 2) the most pervasive (currently occupying the greatest amount of area), and; 3) are the easiest to control or eradicate. Initial efforts to remove invasive species should begin on higher elevations such as canyon rims and upstream areas.	High	X	X	X	X	X	
Continue local volunteer efforts to map and eradicate infestations of exotic species in the canyons while focusing this effort in a manner that provides optimal value to ultimate success of the efforts. This is done by working within a systematic control plan, promoting the efforts through outreach and acknowledgements, and enlisting assistance in the community to remove and replace invasive species present in cultural landscapes.	High				X	X	
Work with resource and regulatory agencies to develop comprehensive permits and agreements for implementation of management plan actions.	High	X	X	X	X	X	X
Continue the outreach program to involve local citizens for their input, project development, and implementation.	High	X	X	X	X	X	X
Seek viable and acceptable alternative to iceplants to provide non-flammable groundcovers in canyon rim yard landscapes. Promote these alternatives through a focused outreach campaign in the watershed.	High	X				X	
Consider and plan for coastal salt marsh restoration at the mouth of Rose Creek when contemplating watershed enhancement efforts affecting erosion, sedimentation, transport, and hydrologic modifications.	High		X		X	X	

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