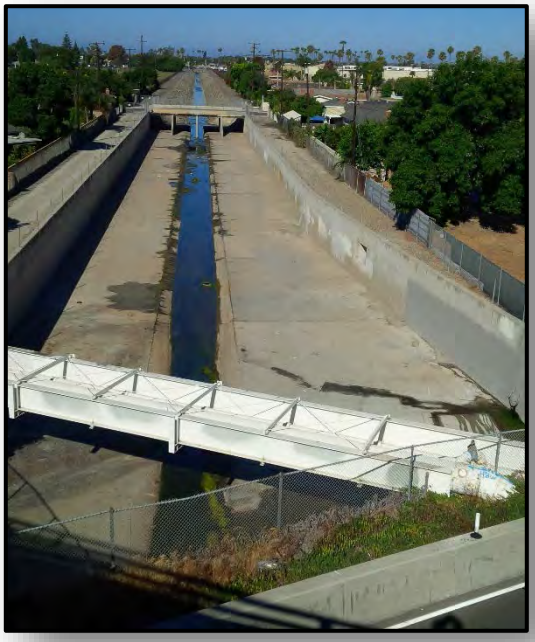
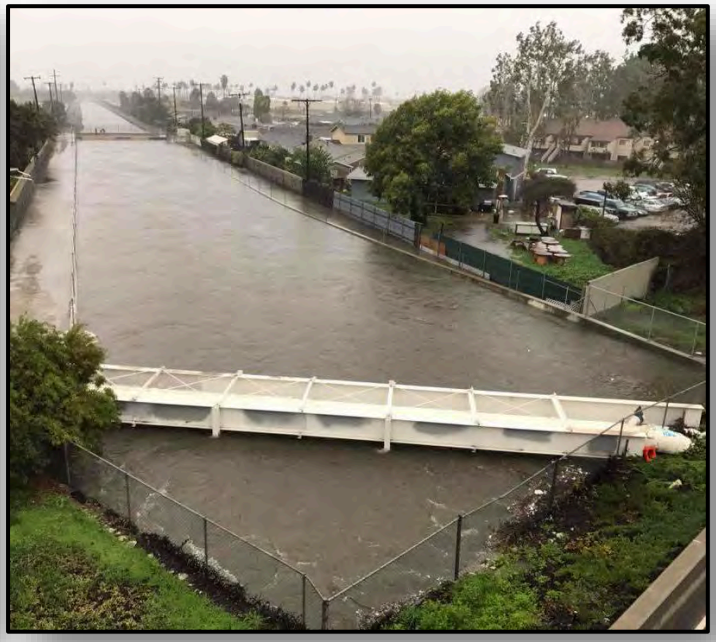
APPENDIX L – ENVIRONMENTAL CONSIDERATIONS

For

WESTMINSTER, EAST GARDEN GROVE FLOOD RISK MANAGEMENT STUDY





October 2018

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APPENDIX L – ENVIRONMENTAL CONSIDERATIONS

For

WESTMINSTER, EAST GARDEN GROVE

FLOOD RISK MANAGEMENT STUDY

1.0 Affected Environment Additional Information

This section includes species' lists that were summarized in the Westminster, East Garden Grove Flood Risk Management Study Draft main report.

1.1 Biological Resources

(1) Animal Resources

In 2014, the Northwest Habitat Institute (NHI) conducted a wildlife habitat assessment of the channels within the project area. NHI noted in their assessment many of the channels are improved (i.e., have concrete bottoms) and the area is almost completely urbanized. Additionally, the urban area around the channels appears to have a strong influence on the channels and the animal resources present. NHI identified wildlife habitat types within the Westminster project boundary through maps. Table 1 lists the wildlife species associated with the identified habitat types that may be found within the vicinity of the project area.

Table 1: List of Wildlife Species Potentially Occurring Within the Project Area Based on Present Habitat Types

Common Name	Scientific Name	Conveyance Channel				
		C02	C04	C05A	C05B	C06
Birds[a]						
Pied-billed Grebe	*Podilymbus podiceps*	X	X	X	X	X
Eared Grebe	*Podiceps nigricollis*	Xm				
Western Grebe	*Aechmophorus occidentalis*	X		X	X	X
American White Pelican[f]	*Pelecanus erythrorhynchos*	Xm		Xm		
Brown Pelican[e,i,k]	*Pelecanus occidentalis*	Xm		Xm		
Double-crested Cormorant[g]	*Phalacrocorax auritus*	X	X	X	X	X
American Bittern	*Botaurus lentiginosus*	Xm		Xm		
Least Bittern[f,h]	*Ixobrychus exilis*	X		X	X	
Great Blue Heron[j]	*Ardea heodias*	X	X	X	X	X
Great Egret[j]	*Ardea alba*	X	X	X	X	X
Snowy Egret	*Egretta thula*	X	X	X	X	X
Green Heron	*Butorides virescens*	X	X	X	X	X
Black-crowned Night Heron	*Nycticorax*	X	X	X	X	X
White-faced Ibis[g]	*Plegadis chihi*			X		
Canada Goose	*Branta canadensis*	X		X		X

Common Name	Scientific Name	Conveyance Channel				
		C02	C04	C05A	C05B	C06
Green-winged Teal	*Anas crecca*	X	X	X	X	X
Mallard	*Anas platyrhynchos*	X	X	X	X	X
Northern Pintail	*Anas acuta*	X	X	X	X	X
Blue-winged Teal	*Anas discors*	X	X	X	X	X
Cinnamon Teal	*Anas cyanoptera*	X	X	X	X	X
Northern Shoveler	*Anas clypeata*	X	X	X	X	X
Gadwall	*Anas strepera*	X	X	X	X	X
Eurasian Wigeon	*Anas penelope*	Xm		Xm		
American Wigeon	*Anas americana*	X	X	X	X	X
Canvasback	*Aythya valisineria*	X	X	X	X	X
Ring-necked Duck	*Aythya collaris*	X		X	X	
Lesser Scaup	*Aythya affinis*	X	X	X	X	X
Bufflehead	*Bucephala albeola*	Xm	Xm	Xm		
Hooded Merganser	*Lophodytes cucullatus*	X	X	X	X	X
Ruddy Duck	*Oxyura jamaicensis*	X	X	X	X	X
Turkey Vulture	*Cathartes aura*	X	X	X	X	X
Osprey[g,j]	*Pandion haliaetus*	Xm		Xm		
White-tailed Kite[e,i]	*Elanus leucurus*	Xm		Xm		
Bald Eagle[b,e,h,i,j,k]	*Haliaeetus leucocephalus*			X		
Northern Harrier[f]	*Circus cyaneus*	Xm		Xm		
Red-shouldered Hawk	*Bueo lineatus*	X				X
Red-tailed Hawk	*Buteo jamaicensis*	X	X	X	X	X
American Kestrel	*Falco sparverius*	X	X	X	X	X
Merling[g]	*Falco columbarius*	Xm	Xm	Xm		
Peregrine Falcon[e,h,j]	*Falco peregrinus*	Xm		X		
Common Moorhen	*Gallinula chloropus*	X				
American Coot	*Fulica americana*	X	X	X	X	X
Western Snowy Plover[c,h]	*Charadrius alexandrinus nivosus*	Xm		X		
Semipalmated Plover	*Charadrius semipalmatus*	Xm		Xm		
Killdeer	*Charadrius vociferus*	X	X	X	X	X
Black-necked Stilt	*Himantopus mexicanus*	X	X	X	X	X
American Avocet	*Recurvirostra americana*	X	X	X	X	X
Greater Yellowlegs	*Tringa melanoleuca*	Xm	Xm	Xm		
Lesser Yellowlegs	*Tringa flavipes*	Xm	Xm	Xm		
Willet	*Catoptrophorus semipalmatus*	Xm	Xm	Xm		
Wandering Tattler	*Heteroscelus incanus*	Xm				
Long-billed Curlew[g,h]	*Numenius americanus*	Xm	Xm	Xm		
Marbled Godwit	*Limosa fedoa*	Xm	Xm	Xm		
Sanderling	*Calidris alba*	Xm	Xm	Xm		
Western Sandpiper	*Calidris mauri*	Xm	Xm	Xm		
Least Sandpiper	*Calidris minutilla*	Xm	Xm	Xm		
Dunlin	*Calidris alpina*	Xm				
Short-billed Dowitcher	*Limnodroumus griseus*	Xm	Xm	Xm		

Common Name	Scientific Name	Conveyance Channel				
		C02	C04	C05A	C05B	C06
Long-billed Dowitcher	*Limnodromus scolopaceus*	Xm	Xm	Xm		
Wilson's Snipe	*Gallinago delicata*	Xm		Xm		
Wilson's Phalarope	*Phalaropus tricolor*	Xm		Xm		
Bonaparte's Gull	*Larus philadelphia*	Xm		Xm		
Mew Gull	*Lrus canus*	Xm		Xm		
Ring-billed Gull	*Larus delawarensis*	X	X	X	X	X
California Gull[g]	*Larus californicus*	X	X	X	X	X
Herring Gull	*Larus argentatus*	Xm		Xm		
Western Gull	*Larus occidentalis*	X	X	X	X	X
Caspian Tern[h]	*Sterna caspia*	Xm		Xm		
Royal Tern	*Sterna maxima*	Xm		Xm		
Elegant Tern[g]	*Sterna elegans*	Xm		Xm		
Forster's Tern	*Sterna forsteri*	Xm		Xm		
California Least Tern[b,d,e]	*Sterna antillarum browni*	Xm		Xm		
Black Skimmer[f,h]	*Rynshops niger*	Xm		Xm		
Spotted Dove	*Streptopelia chinensis*	Xm	Xm	Xm	Xm	Xm
Mourning Dove	*Zenaida macroura*	X	X	X	X	X
Barn Owl	*Tyto alba*	X				
Great Horned Owl	*Bubo virginianus*	X	X	X	X	X
White-throated Swift	*Aeronautes saxatalis*	X	X	X	X	X
Black-chinned Hummingbird	*Archilochus alexandri*	X	X	X		
Anna's Hummingbird	*Calypte anna*	X	X	X	X	X
Belted Kingfisher	*Ceryle alcyon*	X	X	X		
Nuttaill's Woodpecker	*Picoides nuttallii*					X
Hairy Woodpecker	*Picoides villosus*					X
Northern Flicker	*Colaptes auratus*					X
Black Phoebe	*Sayornis nigricans*	X	X	X	X	X
Say's Phoebe	*Sayornis saya*	X	X	X	X	X
Cassin's Kingbird	*Tyrannus vociferans*		X		X	
Western Kingbird	*Tyrannus verticalis*		X		X	X
Horned Lark[g]	*Eremophila alpestris*			X		
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	X	X	X	X	X
Cliff Swallow	*Petrochelidon pyrrhonota*	X	X	X	X	X
Barn Swallow	*Hirundo rustica*	X	X	X		
Western Scrub-jay	*Aphelocoma californica*	X	X			
American Crow	*Corvus brachyrhynchos*	X	X	X	X	X
Common Raven	*Corvus corax*			X	X	X
Bushtit	*Psaltriparus minimus*	X	X	X	X	X
House Wren	*Troglodytes aedon*					X
Marsh Wren	*Cistothorus palustris*		X		X	

Common Name	Scientific Name	Conveyance Channel				
		C02	C04	C05A	C05B	C06
Ruby-crowned Kinglet	*Regulus calendula*		X		X	X
American Robin	*Turdus migratorius*	X	X	X	X	X
Northern Mockingbird	*Mimus polyglottos*	X	X	X	X	X
Cedar Waxwing	*Bombycilla cedrorum*		X		X	X
Loggerhead Shrike	*Lanius ludovicianus*	X	X	X	X	X
Orange-crowned Warbler	*Vermivora celata*		X	X	X	X
Yellow-rumped Warbler	*Dendroica coronata*		X		X	X
Common Yellowthroat	*Geothlypis trichas*		X	X	X	X
Belding's Savannah Sparrow[b]	*Passerculus sandwichensis beldingi*	X	X			
Song Sparrow[f]	*Melospiza melodia*	X	X	X	X	X
Lincoln's Sparrow	*Melospiza lincolnii*		X		X	X
White-crowned Sparrow	*Zonotrichia leucophrys*		X	X	X	X
Red-winged Blackbird	*Agelaius phoeniceus*	X	X	X	X	X
Tricolored Blackbird[f,h,i,l]	*Agelaius tricolor*				X	X
Western Meadowlark	*Sturnella neglecta*			X	X	X
Brewer's Blackbird	*Euphagus cyanocephalus*	X	X	X	X	X
Brown-headed Cowbird	*Molothrus ater*	X	X	X	X	X
Hooded Oriole	*Icterus cucullatus*	X	X	X	X	X
Purple Finch	*Carpodacus purpureus*	X	X	X	X	X
House Finch	*Carpodacus mexicanus*	X	X	X	X	X
Lesser Goldfinch	*Cardeulis psaltria*	X	X	X	X	X
Lawrence's Goldfinch[h]	*Carduelis lawrencei*	X	X	X	X	X
American Goldfinch	*Carduelis tristis*	X	X	X	X	X
House Sparrow	*Passer domesticus*	X	X	X	X	X
Reddish Egret	*Egretta rufescens*			X		
Mammals						
Virginia Opposum	*Didelphis virginiana*			X		
Big Brown Bat	*Eptesicus fuscus*			X		
Desert Cottontail	*Sylvilagus audubonii*			X		
Black-tailed Jackrabbit	*Lepus californicus*			X		
California Ground Squirrel	*Spermophilus beecheyi*			X		
Botta's Pocket Gopher	*Thomomys agilis*			X		
Pacific Kangaroo Rat	*Dipodomys agilis*			X		
Western Harvest Mouse	*Reithrodontomys megalotis*			X		

Common Name	Scientific Name	Conveyance Channel				
		C02	C04	C05A	C05B	C06
California Vole	*Microtus californicus*			X		
Black Rat	*Rattus*			X		
House Mouse	*Mus musculus*	X	X	X	X	X
Coyote	*Canis latrans*	X	X	X	X	X
Gray Fox	*Urocyon cinereoargenteus*	X				
Raccoon	*Procyon lotor*	X	X	X	X	X
Long-tailed Weasel	*Mustela frenata*	X	X	X	X	
Western Spotted Skunk	*Spilogale gracilis*	X	X	X	X	
Striped Skunk	*Mephitis*			X		
South Coast Marsh Vole[f]	*Microtus californicus stephensi*	X		X		
Southern California Salt Marsh Shrew	*Sorex ornatus salicornicus*	X		X		
Amphibians and Reptiles						
Bullfrog	*Rana catesbeiana*	X	X	X	X	X
Western Fence Lizard	*Sceloporus occidentalis*	X	X	X	X	X
Common Site-Blotched Lizard	*Uta stansburiana*	X	X	X	X	X
Western Skink	*Eumeces skiltonianus*			X		
Southern Alligator Lizard	*Elgaria multicarinata*	X	X	X	X	X
Silvery Legless Lizard[f]	*Anniella pulchra*			X		
California Kingsnake	*Lampropeltis gentula californiae*			X		
Common Garter Snake	*Thamnophis sirtalis*	X	X	X	X	
Western Diamondback Rattlesnake	*Crotalus atrox*			X		
Two-striped Garter Snake	*Thamnophis hammondii*			X		
Southern Pacific Rattlesnake	*Crotalus oreganus helleri*			X		
San Diego Gopher Snake	*Pituophus catenifer annectens*			X		

Source: CDFW 2018.
[a] "m" designates migratory species
[b] state listed - endangered
[c] federal listed - threatened
[d] federal listed – endangered
[e] CDFW fully protected species
[f] CDFW species of special concern
[g] CDFW watch list
[h] USFWS birds of conservation concern
[i] BLM sensitive species
[j] CDF sensitive species
[k] USFS sensitive species
[l] state candidate - endangered

Bolsa Chica Ecological Reserve

The Bolsa Chica Ecological Reserve contains remnants of a once extensive wetland system. A tributary of the Santa Ana River called Freeman Creek flowed into the wetlands, creating a mixture of fresh and saltwater marsh, tidal sloughs, and swampland that supported dense vegetation; tulles, arroyo willows and thickets. Beginning in 2004, more than 500 acres (202.3 hectares) of the Bolsa Chica Lowlands were reconstructed to pre-urbanization conditions (approximately 1800s). The restoration has and will continue to gradually improve the habitat quality of Bolsa Chica.

The California Department of Fish and Wildlife (CDFW) provided the following list of plants, and the plant communities that they are associated with, that are found at the Bolsa Chica Ecological Reserve (Table 2).

Table 2: List of plant species found within the Bolsa Chica Ecological Reserve (Courtesy of the CDFW)

Common Name	Scientific Name		Common Name	Scientific Name
Seagrass Beds				
Eelgrass	*Zostera marina*			
Salt Marsh				
Alkali Heath	*Frankenia salina*		Alkali Weed	*Cressa truxillensis*
Cordgrass	*Spartina foliosa*		Marsh Jaumea/Salty Susan	*Jaumea carnosa*
Pacific Pickleweed	*Salicornia pacifica*		Parry's Pickleweed	*Arthrocnemum subterminale*
Saltgrass	*Distichlis spicata*		Saltwort	*Batis maritime*
California Seablite[a,b]	*Suaeda californica*		Sea Lavender/Marsh Rosemary	*Limonium californicum*
Shoregrass/Salt Cedargrass	*Distichlis littoralis*		Spiny Rush	*Juncus acutus*
Woolly Seablite	*Suaeda taxifolia*		Estuary Seablite[b]	*Suaeda esteroa*
Coastal Strand/Sand Dune				
Beach Evening Primrose	*Carnissonia cheiranthifolia*		Miner's Lettuce	*Claytonia perfoliata*
Coast Woolly-heads	*Nemecaulis denudata var. denudata*		Salt Heliotrope/Seaside Heliotrope	*Heliotropium curassavicum*
Pink Sand Verbena	*Abronia umbellata*		Red Sand Verbena	*Abronia maritima*
Beach Morning Glory	*Calystegia soldanella*		Western Ragweed	*Ambrosia psilostachya*
Silver Beach Bur	*Ambrosia chamissonis*			
Coastal Sage Scrub				
Ashy-leaf Buckwheat	*Eriogonum cinereum*		Bush Monkeyflower	*Mimulus aurantiacus*
Black Sage	*Salvia mellifera*		Bladderpod	*Cleome isomeris, Isomeris arborea*
California Boxthorn	*Lycium californicum*		Seacliff Buckwheat	*Eriogonum parvifolium*

Common Name	Scientific Name		Common Name	Scientific Name
California Buckwheat	*Eriogonum fasciculatum*		California Poppy	*Eschscholzia californica*
Coastal Sagebrush	*Artemisia californica*		Coast Goldenbush	*Isocoma menziesii*
Coastal Bush Sunflower	*Encelia californica*		Coastal Cholla	*Opuntia prolifera*
Deerweed	*Acmispon glaber*		Purple Sage	*Salvia leucophylla*
Coastal Prickly Pear	*Opuntia littoralis*		Coyote Bush	*Baccharis pilularis*
Fourwing Saltbush	*Atriplex canescens*		Fascicled Tarplant	*Deinandra fasciculata*
Santa Barbara Milkvetch	*Astragalus trichopodus*		Telegraph Weed	*Heterotheca grandiflora*
Saltbush	*Atriplex lentiformis*		Southern Tarplant[b]	*Centromadia parryi ssp. australis*
Douglas Nightshade	*Solanum douglasii*		Yarrow	*Achillea millefolium*
White Sage	*Salvia apiana*			
Freshwater Wetlands				
California Bulrush	*Schoenoplectus californicus*		Common Cattail	*Typha latifolia*
Salt Marsh Fleabane	*Pluchea odorata*		Mulefat	*Baccharis salicifolia*
Yerba Mansa	*Anemopsis californica*		Cocklebur/Common Cocklebur	*Xanthium strumarium*
Riparian Woodland				
Arroyo Willow	*Salix lasiolepis*		Black Willow	*Salix gooddingii*
Western Sycamore	*Platanus racemosa*			

Sources: CDFW 2018 and California Native Plant Society 2018.
[a] federal listed – endangered
[b] California Rare Plant

The Bolsa Chica Wetlands host numerous species of wildlife. The wetlands are an especially important migratory stop as well as nesting grounds for many avian species. Out of 420 bird species recorded for Orange County, California, 321 of those species have been sighted at Bolsa Chica in the past decade (http://bolsachica.org/the-wetlands/animals/). Bird species frequently sighted at Bolsa Chica are found in Table 3. Less frequently sighted bird species at Bolsa Chica are found in Table 4.

Table 3: Frequently observed bird species at Bolsa Chica Ecological Reserve (Courtesy of the CDFW).

Common Name	Scientific Name		Common Name	Scientific Name
Brant[f]	*Branta bernicla*		Black Tern[f]	*Chlidonias niger*
Canada Goose[a]	*Branta canadensis*		Common Tern	*Sterna hirundo*
Gadwall[a]	*Anas strepera*		Forester's Tern[a]	*Sterna forsteri*
American Wigeon	*Ana Americana*		Royal Tern[a]	*Thalasseus maximus*
Mallard[a]	*Anas platyrhynchos*		Elegant Tern[a,g]	*Thalasseus elegans*
Blue-winged Teal[a]	*Anas discors*		Black Skimmer[a,f,h]	*Rynchops niger*
Cinnamon Teal[a]	*Anas cyanoptera*		Rock Pigeon[a]	*Columba livia*
Northern Shoveler	*Anas clypeata*		Eurasian Collared-dove	*Streptopelia decaocto*
Northern Pintail[a]	*Anas acuta*		Mourning Dove[a]	*Zenaida macroura*
Green-winged Teal	*Anas carolinensis*		Barn Owl	*Tyto alba*
Redhead[a,f]	*Aythya americana*		Great Horned Owl[a]	*Bubo virginianus*

Common Name	Scientific Name		Common Name	Scientific Name
Greater Scaup	*Aythya marila*		Burrowing Owl[a,f,h,i]	*Athene cunicularia*
Lesser Scaup	*Aythya affinis*		Vaux's Swift[f]	*Chaetura vauxi*
Surf Scoter	*Melanitta perspicillata*		White-throated Swift	*Aeronautes saxatalis*
Bufflehead	*Bucephala albeola*		Black-chinned Hummingbird	*Archilochus alexandri*
Red-breasted Merganser	*Mergus serrator*		Anna's Hummingbird[a]	*Cal*
Ruddy Duck[a]	*Oxyura jamaicensis*		Rufous Hummingbird	*Selaphorus rufus*
Red-throated Loon	*Gavia stellate*		Allen's Hummingbird[a]	*Selaphorus sasin*
Pacific Loon	*Gavia pacifica*		Belted Kingfisher	*Megaceryle alcyon*
Common Loon[f]	*Gavia immer*		Nuttall's Woodpecker	*Dryobates nuttallii*
Pied-billed Grebe[a]	*Podilymbus podiceps*		Downy Woodpecker	*Dryobates pubescens*
Horned Grebe	*Podiceps nigricollis*		Northern Flicker	*Colaptes auratus*
Eared Grebea	*Podiceps nigricollis*		Olive-sided Flycatcher[f,h]	*Contopus cooperi*
Western Greb[e]	*Aechmophorus occidentalis*		Western Wood-peewee	*Contopus sordidulus*
Clark's Grebe	*Aechmophorus clarkia*		Willow Flycatcher[b,h,k]	*Empidonax traillii*
Double-crested Cormorant[a]	*Phalacrocorax auritus*		Pacific-slope Flycatcher	*Empidonax difficilis*
American White Pelican[a,f]	*Pelevanus erythrorhynchos*		Black Phoebe[a]	*Sayornis nigricans*
Brown Pelican[f]	*Pelecanus occidentalis*		Say's Phoebe[a]	*Sayornis saya*
American Bittern	*Botaurus lentiginosus*		Ash-throated Flycatcher	*Myiarchus cinerascens*
Least Bittern[a,f,h]	*Ixobrychus exilis*		Cassin's Kingbird	*Tyrannus vociferans*
Great Blue Heron[a,j]	*Ardea herodias*		Western Kingbird	*Tyrannus verticalis*
Great Egret[j]	*Ardea alba*		Loggerhead Shrike[a,f,h]	*Lanius ludovicianus*
Snowy Egret	*Egretta thula*		Warbling Vireo	*Vireo gilvus*
Reddish Egret	*Egretta rufescens*		American Crow[a]	*Corvus brachyrhynchos*
Green Heron[a]	*Butorides virescens*		Common Raven[a]	*Corvus corax*
Black-crowned Night Heron[a]	*Nycticorax*		Horned Lark[a]	*Eremophila alpestris*
White-faced Ibis[g]	*Plegadis chihi*		Tree Swallow	*Tachycineta bicolor*
Turkey Vulture	*Cathartes aura*		Violet-green Swallow	*Tachycineta thalassina*
Osprey[g,j]	*Pandion haliaetus*		Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
White-tailed Kite[a,e,i]	*Elanus leucurus*		Cliff Swallow[a]	*Petrochelidon pyrrhonota*
Northern Harrier[a]	*Circus hudsonius*		Barn Swallow[a]	*Hirundo rustica*
Sharp-shinned hawk	*Accipiter striatus*		Bushtit[a]	*Psaltriparus minimus*

Common Name	Scientific Name		Common Name	Scientific Name
Cooper's Hawk[a,g]	*Accipiter cooperii*		House Wren[a]	*Troglodytes aedon*
Red-shouldered Hawk	*Buteo lineatus*		Marsh Wren[a]	*Cistothorus palustris*
Red-tailed Hawk[a]	*Buteo jamaicensis*		Blue-grey Gnatcatcher	*Polioptila caerulea*
American Kestrel[a]	*Falco sparverius*		Coastal California Gnatcatcher[a,c,f]	*Polioptila californica*
Merlin[g]	*Falco columbarius*		Ruby-crowned Kinglet	*Regulus calendula*
Peregrine Falcon[a,e,h,j]	*Falco peregrinus*		Western Bluebird	*Sialia mexicana*
Virginia Rail[a]	*Rallus limicola*		Swainson's Thrush	*Catharus ustulatus*
Sora[a]	*Porzana carolina*		Hermit Thrush	*Catharus guttatus*
Common Gallinula	*Porphyrio martinica*		American Robin	*Turdus migratorius*
American Coot[a]	*Fulica americana*		Northern Mockingbird[a]	*Mimus polyglottos*
Black-bellied Plover	*Pluvialis squatarola*		European Starling[a]	*Sturnus vulgaris*
Pacific Golden-plover	*Pluvialis fulva*		American Pipit	*Anthus rubescens*
Snowy Plover[a]	*Charadrius alexandrines*		Cedar Waxwing	*Bombycilla cedrorum*
Semipalmated Plover	*Charadrius semipalmatus*		Orange-crowned Warbler	*Oreothlypis celata*
Killdeer[a]	*Charadrius vociferous*		Nashville Warbler	*Oreothlypis ruficapilla*
Black-necked Stilt[a]	*Himantopus mexicanus*		MacGillivray's Warbler	*Oporornis tolmiei*
American Avocet[a]	*Recurvirostra americana*		Common Yellowthroat	*Geothlypis trichas*
Spotted Sandpiper	*Actitis macularius*		Yellow Warbler	*Dendroica petechial*
Solitary Sandpiper	*Tringa solitaria*		Yellow-rumped Warbler	*Dendroica coronate*
Greater Yellowlegs	*Tringa melanoleuca*		Black-throated Gray Warbler	*Setophaga nigrescens*
Willet	*Tringa semipalmata*		Townsend's Warbler	*Dendroica townsendii*
Lesser Yellowlegs	*Tringa flavipes*		Wilson's Warbler	*Cardellina pusilla*
Whimbrel	*Numenius phaeopus*		Spotted Towhee	*Pipilo maculatus*
Long-billed Curlew[g,h]	*Numenius americanus*		California Towhee[a]	*Melozone crissalis*
Marbled Godwit	*Limosa fedoa*		Brewer's Sparrow[h]	*Spixella breweri*
Ruddy Turnstone	*Arenaria interpres*		Vesper Sparrow	*Pooecetes gramineus*
Surfbird	*Aphriza virgata*		Lark Sparrow	*Chondestes grammacus*
Red Knot	*Calidris canutus*		Common Savannah Sparrow	*Passerculus sandwichensis*
Sanderling	*Calidris alba*		Belding's Savannah Sparrow[a,b]	*Passerculus sandwichensis beldingi*
Semipalmated Sandpiper	*Calidris pusilla*		California Least Tern[b,d,e]	*Sternula antillarum browni*
Western Sandpiper	*Calidris mauri*		Fox Sparrow	*Passerella iliaca*

Common Name	Scientific Name		Common Name	Scientific Name
Least Sandpiper	*Calidris minutilla*		Song Sparrow[a,f]	*Melospiza melodia*
Baird's Sandpiper	*Calidris bairdii*		Lincoln's Sparrow	*Melospiza lincolnii*
Pectoral Sandpiper	*Calidris melanotos*		White-crowned Sparrow	*Zonotrichia leucophrys*
Dunlin	*Calidris alpine*		Golden-crowned Sparrow	*Zonotrichia atricapilla*
Stilt Sandpiper	*Calidris himantopus*		Dark-eyed Junco	*Junco hyemalis*
Short-billed Dowitcher	*Limnodromus griseus*		Western Tanager	*Piranga ludoviciana*
Long-billed Dowitcher	*Limnodromus scolopaceus*		Black-headed Grosbeak	*Pheucticus melanocephalus*
Wilson's Snipe	*Gallinago delicate*		Blue Grosbeak	*Passerina caerulea*
Wilson's Phalarope	*Phalaropus tricolor*		Lazuli Bunting	*Passerina amoena*
Red-necked Phalarope	*Phalaropus lobatus*		Red-winged Blackbird[a]	*Agelaius phoeniceus*
Bonaparte's Gull	*Chroicocephalus philadelphia*		Western Meadowlark	*Sturnella neglecta*
Heermann's Gull	*Larus heermanni*		Brewer's Blackbird	*Euphagus cyanocephalus*
Ring-billed Gull	*Larus delawarensis*		Great-tailed Grackle	*Quiscalus mexicanus*
Western Gull	*Larus occidentalis*		Brown-headed cowbird	*Molothrus ater*
California Gull[g]	*Larus californicus*		Hooded Oriole[a]	*Icterus cucullatus*
Herring Gull	*Larus argentatus*		Bullock's Oriole	*Icterus bullockii*
Thayer's Gull	*Larus thayeri*		House Finch[a]	*Carpodacus mexicanus*
Glaucous-winged Gull	*Larus glaucescens*		Lesser Goldfinch[a]	*Carduelis mexicanus*
Least Tern[a]	*Sternula antillarum*		American Goldfinch	*Spinus tristis*
Gull-billed Tern[f,h]	*Gelochelidon nilotica*		House Sparrow	*Passer domesticus*
Caspian Tern[a,h]	*Hydroprogne caspia*		Western Snowy Plover[c,f,h]	*Charadrius nivosus*
Ridgway's Tail[b,d,e]	*Rallus obsoletus levipes*			

[a] Species that have nested at Bolsa Chica Ecological Reserve
[b] state listed - endangered
[c] federal listed - threatened
[d] federal listed – endangered
[e] CDFW fully protected species
[f] CDFW species of special concern
[g] CDFW watch list
[h] USFWS birds of conservation concern
[i] BLM sensitive species
[j] CDF sensitive species
[k] USFS sensitive species

Table 4: Less Frequently Observed Bird Species at Bolsa Chica Ecological Reserve (Courtesy of the CDFW).

Common Name	Scientific Name		Common Name	Scientific Name
Fulvous Whistling Duck[e]	*Dendrocygna bicolor*		Yellow-billed Cuckoo	*Coccyzus americanus*
Greater White-fronted Goose	*Anser albifrons*		Short-eared Owl[e]	*Asio flammeus*
Snow Goose	*Chen caerulescens*		Common Poorwill	*Phalaenoptilus nuttallii*
Ross's Goose	*Chen rossii*		Black Swift[e,f]	*Cypseloides niger*
Cackling Goose	*Branta hutchinsii*		Costa's Hummingbird[f]	*Calypte costae*
Wood Duck	*Aix sponsa*		Calliope Hummingbird	*Stellula calliope*
Eurasian Wigeon	*Anas Penelope*		Red-breasted Sapsucker	*Sphyrapicus ruber*
Canvasback	*Aythya valisineria*		Hairy Woodpecker	*Picoides villosus*
Common Pochard	*Aythya ferina*		Least Flycatcher	*Empidonax minimus*
Ring-necked Duck	*Aythya collaris*		Hammond's Flycatcher	*Empidonax hammondii*
Harlequin Duck[e]	*Histrionicus histrionicus*		Gray Flycatcher	*Empidonax wrightii*
White-winged Scoter	*Melanitta deglandi*		Dusky Flycatcher	*Empidonax oberholseri*
Black Scoter	*Melanitta americana*		Eastern Phoebe	*Sayornis phoebe*
Long-tailed Duck	*Clangula hyemalis*		Vermilion Flycatcher[e]	*Pyrocephalus*
Common Goldeneye	*Bucephala clangula*		Tropical Kingbird	*Tyrannus melancholicus*
Barrow's Goldeneye[e]	*Bucephala islandica*		Bell's Vireo	*Vireo bellii*
Hooded Merganser	*Lophodytes cucullatus*		Cassin's Vireo	*Vireo cassinii*
Common Merganser	*Mergus merganser*		Curlew Sandpiper	*Calidris ferruginea*
Red-necked Grebe	*Podiceps grisegena*		Buff-breasted Sandpiper	*Tryngites subruficollis*
Red-tailed Tropicbird	*Phaethon rubricauda*		Hutton's Vireo	*Vireo huttoni*
Magnificent Frigatebird	*Fregata magnificens*		Red-eyed Vireo	*Vireo olivaceus*
Brandt's Cormorant	*Phalacrocorax penicillatus*		Purple Martin[e]	*Progne subis*
Pelagic Cormorant	*Phalacrocorax pelagicus*		Bank Swallow[c,g]	*Riparia riparia*
Little Blue Heron	*Egretta caerulea*		Verdin	*Auriparus flaviceps*
Tricolored Heron	*Egretta tricolor*		Red-breasted Nuthatch	*Sitta canadensis*
Cattle Egret	*Bubulcus ibis*		White-breasted Nuthatch	*Sitta carolinensis*
Bald Eagle[a,b,f,g,h,i,j]	*Haliaeetus leucocephalus*		Rock Wren	*Salpinctes obsoletus*

Common Name	Scientific Name		Common Name	Scientific Name
Ferruginous Hawk[k]	*Buteo regalis*		Bewick's Wren	*Thryomanes bewickii*
Rough-legged Hawk	*Buteo lagopus*		Pacific Wren	*Troglodytes pacificus*
Prairie Falcon[f,k]	*Falco mexicanus*		Mountain Bluebird	*Sialia currucoides*
Clapper Rail	*Rallus longirostris*		Sage Thrasher	*Oreoscoptes montanus*
Lesser Sand Plover	*Charadrius mongolus*		California Thrasher	*Toxostome redivivum*
Wilson's Plover	*Charadrius wilsonia*		Red-throated Pipit	*Anthus cervinus*
Mountain Plover[e,f,g]	*Charadrius montanus*		Phainopepla	*Phainopepla nitens*
Wandering Tattler	*Tringa incana*		Lapland Longspur	*Calcarius lapponicus*
White-rumped Sandpiper	*Calidris fuscicollis*		Chestnut-collared Longspur	*Calcarius ornatus*
Sharp-tailed Sandpiper	*Calidris acuminate*		Ovenbird	*Seiurus aurocapilla*
Curlew Sandpiper	*Calidris ferruginea*		Northern Waterthrush	*Parkesia noveboracensis*
Buff-breasted Sandpiper	*Tryngites subruficollis*		Black-and-White Warbler	*Mniotilta varia*
Ruff	*Philomachus pugnax*		Palm Warbler	*Dendroica palmarum*
Red Phalarope	*Phalaropus fulicarius*		Yellow-breasted Chat	*Icteria virens*
Black-legged Kittiwake	*Rissa tridactyla*		Green-tailed Towhee	*Pipilo chlorurus*
Sabine's Gull	*Xema sabini*		Cassin's Sparrow	*Peucaea cassinii*
Laughing Gull[k]	*Leucophaeus atricilla*		Chipping Sparrow	*Spizella passerine*
Franklin's Gull	*Leucophaeus pipixcan*		Clay-colored Sparrow	*Spizella pallida*
Mew Gull	*Larus canus*		Black-throated Sparrow	*Amphispiza bilineata*
Lesser Black-backed Full Glaucous Gull	*Larus fuscus*		Nelson's Sparrow	*Ammodramus nelson*
Sooty Tern	*Onychoprion fuscatus*		White-throated Sparrow	*Zonotrichia albicollis*
Bridled Tern	*Onychoprion anaethetus*		Summer Tanager[e]	*Piranga rubra*
Arctic Tern	*Sterna paradisaea*		Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Sandwich Tern	*Thalasseus sandviciensis*		Bobolink	*Dolichonyx oryzivorus*
Pomarine Jaeger	*Stercorarius pomarinus*		Tricolored Blackbird[d,e,f,g]	*Agelaius tricolor*
Parasitic Jaeger	*Stercorarius parasiticus*		Yellow-headed Blackbird[e]	*Xanthocephalus xanthocephalus*
Spotted Dove	*Streptopelia chinensis*		Red Crossbill	*Loxia curvirostra*
White-winged Dove	*Zenaida asiatica*		Pine Siskin	*Cardeulis pinus*
Common Ground Dove	*Columbina passerina*		Lawrence's Goldfinch	*Carduelis lawrencei*

[a] state listed – endangered

[b] federally delisted - recovered
[c] state listed - threatened
[d] state candidate – threatened or endangered
[e] CDFW species of special concern
[f] USFWS birds of conservation concern
[g] BLM sensitive species
[h] CDF sensitive species
[i] CDFW fully protected species
[j] USFS sensitive species
[k] CDFW watch list

The Bolsa Chica wetlands serve as a nursery for many fish and shark species. Approximately 80 species of fish inhabit southern California bays and estuaries. The CDFW provided a list of fish species that have been documented currently at the Bolsa Chica Ecological Reserve (**Table 5**).

Table 5: List of fish species documented at Bolsa Chica Ecological Reserve by the CDFW.

Common Name	Scientific Name		Common Name	Scientific Name
Bonefish	*Albula vulpes*		Bay Goby	*Lepiodogobius lepidus*
Topsmelt	*Atherinops affinis*		California Butterfly Ray	*Gymnura marmorata*
Jacksmelt	*Atherinopsis californiensis*		Salema	*Xenistius californiensis*
California Grunion	*Leuresthes tenuis*		Sargo	*Anisotremus davidsonii*
Specklefin Midshipman	*Porichthys myriaster*		Zebra Perch Sea Chub	*Hermosilla azurea*
California Needlefish	*Strongylura exilis*		Striped Bass	*Morone saxatalis*
Bay Blenny	*Hypsoblennius gentilis*		Striped Mullet	*Mugil cephalus*
Speckled Sanddab	*Citharichthys stigmaeus*		Bat Ray	*Myliobatis californica*
Jack Mackerel	*Trachurus japonicas*		California Halibut	*Paralichthys californicus*
Gray Smoothhound Shark	*Mustelus californicus*		Thornback Ray	*Platyrhinoidis triseriata*
Leopard Shark	*Triakis semifasciata*		Diamond Turbot	*Hypsopsetta guttulata*
Giant Kelpfish	*Heterostichus rostratus*		Hornyhead Turbot	*Pleuronichthys verticalis*
Pacific Sardine	*Sardinops sagax*		Giant Sea Bass	*Stereolepis gigas*
Pacific Herring	*Clupea pallasi*		Blacksmith	*Chromis punctipinnis*
Threadfin Shad	*Dorosoma petenense*		Shovelnose Guitarfish	*Rhinobatos productus*
Staghorn Sculpin	*Leptocottus armatus*		Queenfish	*Seriphus politus*
California Tonguefish	*Symphurus atricauda*		White Seabass	*Atractoscion nobilis*
Diamond Stingray	*Dasyatis brevis*		Yellowfin Croaker	*Umbrina roncador*
Barred Surfperch	*Amphistichus argenteus*		White Croaker	*Genyonemus lineatus*
Shiner Surfperch	*Cymatogaster aggregata*		Spotfin Croaker	*Rondacor stearnsii*
Pile Surfperch	*Damalichthys vacca*		California Corbina	*Menticirrhus undulates*

Common Name	Scientific Name		Common Name	Scientific Name
Walleye Surfperch	*Hyperprosopon argenteum*		Black Croaker	*Cheilotrema saturnum*
Dwarf Surfperch	*Micrometrus minimus*		Chub Mackeral	*Scomber japonicas*
Black Surfperch	*Embiotoca jacksoni*		Spotted Scorpionfish	*Scorpaneana guttata*
Northern Anchovy	*Engraulus mordax*		Spotted Sand Bass	*Paralabrax maculatofasciatus*
Deep Body Anchovy	*Anchoa compressa*		Barred Sand Bass	*Paralabrax nebulifer*
Slough Anchovy	*Anchoa delicatissima*		Kelp Bass	*Paralabrax clathratus*
California Killifish	*Fundulus parvipinnis*		California Barracuda	*Sphyraena argentea*
Opaleye	*Girella nigricans*		Barred Pipefish	*Syngnathus auliscus*
Arrow Goby	*Clevelandia ios*		Bay Pipefish	*Syngnathus leptorhynchus*
Shadow Goby	*Quietula y-cauda*		Kelp Pipefish	*Syngnathus californiensis*
Cheekspot Goby	*Ilypnus gilbert*		Snubnose Pipefish	*Cosmoscampus arctus*
Longjaw Mudsucker	*Gillichthys mirabilis*		Round Stingray	*Urobatis halleri*
Yellowfin Goby	*Acanthogobius flavimanus*			

Numerous marine invertebrates inhabit Bolsa Bay and provide a food source for the plethora of avian species that come to the wetlands. Additionally, fish that breed and spawn in the Bolsa Chica wetlands also depend on these organisms as a food source. The CDFW provided the following list of native invertebrates that live in the Bolsa Chica Ecological Reserve (Table 6). The list includes copepods, amphipods, mussels, clams, horn snails, worms, and crabs. Non-native species that are found within the ecological reserve include oriental shrimp (*Palaemon macrodactylus*), burrowing Australasian isopod (*Sphaeroma quoyanum*), a bryozoan (*Zoobotryon verticillatum*), chain sea squirt (*Botrylloides* spp.), leathery tunicate (*Styela plicata*), Pacific oyster (*Cassostrea gigas*), ribbed horse mussel (*Geukensia demissa*), Japanese mussel (*Musculista senhousia*), and Mediterranean mussel (*Mytilus galloprovincialis*).

Table 6: List of aquatic invertebrates documented at Bolsa Chica Ecological Reserve by the CDFW.

Common Name	Scientific Name		Common Name	Scientific Name
Acorn Barnacle	*Balanus glandula*		Barrel Shell	*Acteon punctocaelatus*
Crab	*Cancer sp.*		Brown Sea Hare	*Aplysia californica*
California Bay Shrimp	*Crangon franciscorum*		Black Sea Hare	*Aplysia vaccaria*
Pacific Sponge Crab	*Cryptodromiopsis larraburei*		Pacific Calico Scallop	*Argopecten ventricosus*
Hermit Crabs	Family Paguridae		Bubble Snail	*Bulla gouldiana*
Crenulated Fiddler Crab	*Gelasimus crenulatus*		California Horn Snail	*Cerithidea californica*
Yellow Shore Crab	*Hernigrapsus oregonensis*		Chione Clams	*Chione sp.*

Common Name	Scientific Name		Common Name	Scientific Name
California Green Shrimp	*Hippolyte californiensis*		American Slipper Limpet	*Crepidula fornicate*
Kelp Humpback Shrinp	*Hippolyte clarki*		Pacific Stomach Wing	*Gatropteron pacificum*
Black-clawed Crab	*Lophopanopeus bellus*		Kellet's Whelk	*Kelletia kelleti*
Burrowing Crab	*Malacoplax californiensis*		Egg Cockle	*Laevicardium substriatum*
Bay Ghost Shrimp	*Neotrypaea californiensis*		Wavy Top Turban Snail	*Lithopoma undosum*
Lined Shore Crab	*Pachgrapsus crassipes*		Owl Limpet	*Lottia gigantean*
Pink Shrimp	*Pandalus sp.*		California Lyonsia	*Lyonsia californica*
Brown Shrimp	*Panaeus californicus*		Rough Limpet	*Maclintokia scabra*
Swimming Crab	*Portunus xantussii*		Lion's Melibe	*Melibe leonine*
Shield-backed Kelp Crab	*Pugettia product*		Bay Mussel	*Mytilus trossulus*
American Spider Crab	*Pyromaia tuberculata*		Covered-lip Nassa	*Nassarius tegula*
Furrowed Rock Crab	*Romelean branneri*		Navanax	*Navanax inermis*
Bryozoan	*Bugula sp.*		Lewis' Moon Snail	*Neverita lewisii*
Bryozoan	*Lichenopora sp.*		Smooth Brown Turban	*Norrisis norrisi*
Bryozoan	*Thalamoporella californica*		Two-spot Octopus	*Octopus bimaculoides*
Solitary Tunicate	Order Ascidiacea		Olympia Oyster	*Ostreola conchaphila*
Colonial Tunicate	Order Ascidiacea		Taylor's Sea Hare	*Phyllapylsia taylori*
Moon Jelly	*Aurelia sp.*		Black Dorid	*Polycera atra*
Anemone	Class Anthozoa		Clam	*Protothaca sp.*
Bell Jelly	*Polyorchis sp.*		Rosy Jackknife Clam	*Solen rostriformis*
Comb Jelly	*Phylum Ctenophora*		Jackknife Clam	*Tagelus californianus*
Sand Dollar	*Dendraster excentricus*		Black Turban Snail	*Tegula funebralis*
White Sea Urchin	*Lytechnius anamesus*		Clam	*Tellina sp.*
Ochre Sea Star	*Pisaster ochraceus*		Yellow Sponge	Phylum Porifera
Purple Sea Urchin	*Strongylocentrotus purpuratus*			

Terrestrial invertebrates also utilize the Bolsa Chica Ecological Reserve as documented by the CDFW (Table 7). The non-native brown widow spider (*Latrodectus geometricus*) has also been documented at the ecological reserve.

Table 7: List of terrestrial invertebrates documented at the Bolsa Chica Ecological Reserve by the CDFW.

Common Name	Scientific Name		Common Name	Scientific Name
Wandering Skipper	*Panoquina errans*		Mudflat Tiger Beetle	*Cicindela trifasciata sigmoidea*
Common Hairstreak Butterfly	*Strymon melinux*		Salt Marsh Moth	*Estigmene acrea*
Fiery Skipper Butterfly	*Hylephila phyleus*		Western Black Widow Spider	*Latrodectus hesperus*
Monarch Butterfly[a]	*Danaus plexippus*		Funnel Spider/Grass Spider	*Agelenopsis spp.*
Flame Skimmer Dragonfly	*Libellula saturata*			

[a] USFS sensitive species

Reptiles may also often be seen at Bolsa Chica. Lizards may be seen on the ground or along the wooden fences, basking in the sunlight. Snakes are seen less frequently, but are occasionally spotted from the walking trails. Rattlesnakes are also present at Bolsa Chica. There is also one amphibian that has been documented at the ecological reserve. The CDFW provided a list of common reptiles and amphibian that have been observed at the Bolsa Chica Ecological Reserve (Table 8).

Table 8: List of reptiles documented at the Bolsa Chica Ecological Reserve by the California Department of Fish and Wildlife.

Common Name	Scientific Name		Common Name	Scientific Name
Southern Pacific Rattlesnake	*Crotalus oreganus helleri*		Foothill Alligator Lizard	*Gerrhonotus multicarinatus*
Western Rattlesnake	*Crotalus viridis helleri*		Western Fence Lizard	*Sceloporus occidentalis*
Common King Snake	*Lampropeltis getulus*		Side-blotched Lizard	*Uta stansburiana*
Gopher Snake	*Pituophis melanoleucus*		Western Skink	*Eumeces skiltonianus*
Two-striped Garter Snake[b,c,d]	*Thamnophis hammondii*		Garden Slender Salamander	*Batrachoseps major major*
California Legless Lizard[a,c]	*Anniella pulchra pulchra*		Green Sea Turtle[a]	*Chelonia mydas*

[a] federal listed - threatened
[b] BLM sensitive species
[c] CDFW species of special concern
[d] USFS sensitive species

Several species of mammals may be seen at Bolsa Chica. Table 9 shows animals that have been observed at the ecological reserve by the CDFW. A non-native mammal that has been observed at the ecological reserve is the Virginia opossum (*Didelphis virginiana*).

Table 9: List of mammals documented at the Bolsa Chica Ecological Reserve by the CDFW.

Common Name	Scientific Name		Common Name	Scientific Name
Northern Raccoon	*Procyon lotor*		Mexican Free-tailed Bat	*Tadarida brasiliensis*
Audubon's Cottontail	*Sylvilagus auduboni*		Yuma Myotis Bat[a]	*Myotis yumanensis*
California Ground Squirrel	*Otospermophilus beechii*		Western Red Bat[b]	*Lasiurus blossevillii*
Pocket Gopher	*Thomomys bottae*		California Myotis Bat	*Myotis californicus*
California Vole	*Microtus californicus*		Coyote	*Canis latrans*
Striped Skunk	*Mephitis mephitis*			

[a] BLM sensitive species
[b] CDFW species of special concern

Seal Beach National Wildlife Refuge

The Seal Beach National Wildlife Refuge (NWR) was established in 1972 and is administered by the U.S. Fish and Wildlife Service. The 965 acre refuge is located within the Naval Weapons Station Seal Beach in Orange County. The refuge serves as a critical stopover and wintering habitat for thousands of birds that migrate up and down the Pacific Flyway each year. It also serves as an island of habitat in the midst of a dense urban setting for a wide variety of fish, wildlife, and plants. Figure 1 shows the habitat types found within the NWR.

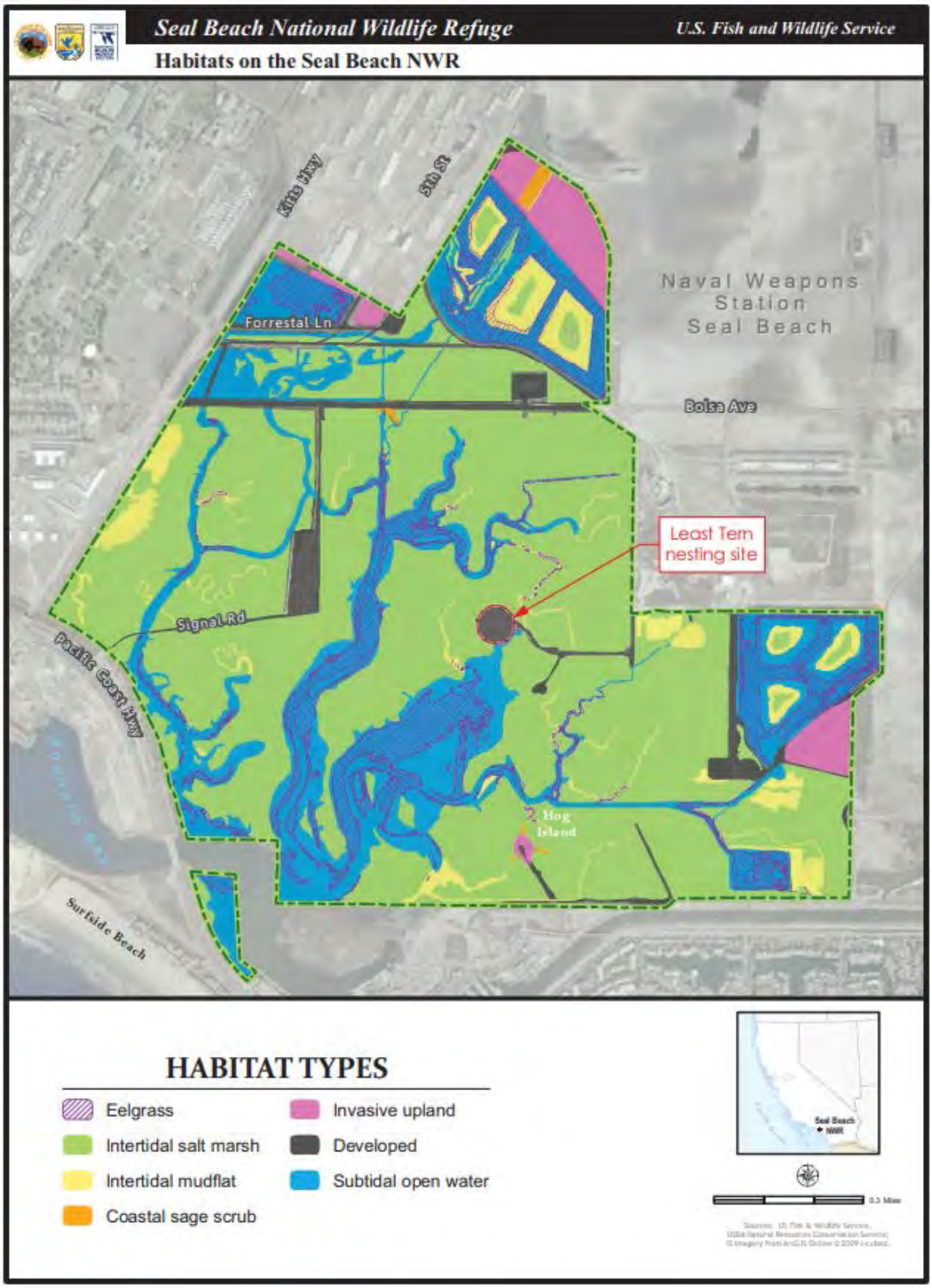

Figure 1: Habitat Types on the Seal Beach NWR (Map from USFWS 2018)

The north coast of Orange County supports some of the most important remnant wetlands in southern California. Up until the early 1900s, this area was a vast network of coastal marshes. Today, portions of this coast are included in the Orange Coast Wetlands Important Bird Area (IBA). This IBA protects some of southern California's most extensive wetlands, and is most notable for its number of breeding terns. Huge flocks of migrating shorebirds (15-20,000 in fall, winter and spring, Page and Shuford 2000) and waterfowl, wintering geese, and foraging raptors travel freely up and down the coast here. Included in the IBA is Seal Beach National Wildlife Refuge.

Two federally endangered bird species are known to breed at Seal Beach NWR, the California Least Tern and the Light-footed Clapper Rail. In regards to the California Least Tern, between 1986 and 1998 the NWR supported an average of 150 breeding pairs. The Light-footed Clapper Rail used to have more breeding pairs at Seal Beach NWR; however, only about seven pairs remain currently (down from several dozen in the mid-1990's). Other bird species that are considered USFWS birds of conservation concern, BLM sensitive species, and/or CDFW fully protected species/watchlist may be observed utilizing the habitat at Seal Beach NWR. The extensive grassland and open country habitat types present at Seal Beach NWR, along with the other wetlands included in the Orange Coast Wetlands IBA, represent a majority of the raptor habitat along the immediate coast of the Los Angeles Basin, with the hawk and owl community of Seal Beach NWR potentially being the largest and most diverse. Ferruginous Hawk, Prairie Falcon, and Short-eared Owl are scarce, but regular winter residents of Seal Beach NWR. Burrowing Owl nests in weep holes in the weapons storage units of Naval Weapons Station Seal Beach (one of two breeding colonies in coastal southern California). The sparse, flat grassland at Seal Beach NWR is one of just four sites in the U.S. that supports wintering Pacific Golden-Plover, and a handful of Mountain Plover has recently rediscovered the NWR as a wintering area. Hundreds of geese, representing all four regularly-occurring species, winter at Seal Beach NWR, the largest concentration in coastal southern California. Table 10 includes a list of bird species that have been observed at the Seal Beach NWR.

Table 10: Birds Observed at Seal Beach National Wildlife Refuge.

Common Name	Scientific Name		Common Name	Scientific Name
Brant[f]	*Branta bernicla*		California Gull[g]	*Larus californicus*
Greater White-fronted Goose	*Anser albifrons*		Ring-billed Gull	*Larus delawarensis*
Canada Goose[a]	*Branta canadensis*		Western Gull	*Larus occidentalis*
Cackling Goose	*Branta hutchinsii*		Red-necked Phalarope	*Phalaropus lobatus*
Snow Goose	*Chen caerulescens*		Bonaparte's Gull	*Chroicocephalus philadelphia*
Ross's Goose	*Chen rossii*		Herring Gull	*Larus argentatus*
Tundra Swan	*Cygnus colmbianus*		Glaucous-winged Gull	*Larus glaucescens*
Mute Swan	*Cygnus olor*		Glaucous Gull	*Larus hyperboreus*
Gadwall[a]	*Anas strepera*		California Least Tern[a,d]	*Sternula antillarum browni*
American Wigeon	*Ana americana*		Caspian Tern[a,h]	*Hydroprogne caspia*
Eurasian Wigeon	*Anas penelope*		Black Tern[f]	*Chlidonias niger*
Mallard[a]	*Anas platyrhynchos*		Common Tern	*Sterna hirundo*
Blue-winged Teal[a]	*Anas discors*		Forester's Tern[a]	*Sterna forsteri*

Common Name	Scientific Name		Common Name	Scientific Name
Cinnamon Teal[a]	*Anas cyanoptera*		Royal Tern[a]	*Thalasseus maximus*
Northern Shoveler	*Anas clypeata*		Elegant Tern[a,g]	*Thalasseus elegans*
Northern Pintail[a]	*Anas acuta*		Black Skimmer[a,f,h]	*Rynchops niger*
Green-winged Teal	*Anas carolinensis*		Rock Pigeon[a]	*Columba livia*
Redhead[a,f]	*Aythya americana*		Mourning Dove[a]	*Zenaida macroura*
Ring-necked Duck	*Aythya collaris*		Spotted Dove	*Spilopelia chinensis*
Greater Scaup	*Aythya marila*		Common Ground Dove	*Columbina passerine*
Lesser Scaup	*Aythya affinis*		Barn Owl	*Tyto alba*
Canvasback	*Aythya valisineria*		Great Horned Owl[a]	*Bubo virginianus*
Long-tailed Duck	*Clangula hyemalis*		Short-eared Owl[e]	*Asio flammeus*
Surf Scoter	*Melanitta perspicillata*		Burrowing Owl[a,f,h,i]	*Athene cunicularia*
Bufflehead	*Bucephala albeola*		Lesser Nighthawk	*Chordeiles acutipennis*
Common Goldeneye	*Bucephala clangula*		White-throated Swift	*Aeronautes saxatalis*
Hooded Merganser	*Lophodytes cucullatus*		Black-chinned Hummingbird	*Archilochus alexandri*
Common Merganser	*Mergus merganser*		Anna's Hummingbird[a]	*Calypte anna*
Red-breasted Merganser	*Mergus serrator*		Costa's Hummingbird[h]	*Calypte costae*
Ruddy Duck[a]	*Oxyura jamaicensis*		Rufous Hummingbird	*Selaphorus rufue*
Red-throated Loon	*Gavia stellata*		Allen's Hummingbird[a]	*Selaphorus sasin*
Pacific Loon	*Gavia pacifica*		Belted Kingfisher	*Megaceryle alcyon*
Common Loon[f]	*Gavia immer*		Red-breasted Sapsucker	*Sphyrapicus ruber*
Pied-billed Grebe[a]	*Podilymbus podiceps*		Downy Woodpecker	*Dryobates pubescens*
Horned Grebe	*Podiceps auritus*		Northern Flicker	*Colaptes auratus*
Red-necked Grebe	*Podiceps grisegena*		Western Wood-Peewee	*Contopus sordidulus*
Eared Grebe[a]	*Podiceps nigricollis*		Hammond's Flycatcher	*Empidonax hammondii*
Western Grebe	*Aechmophorus occidentalis*		Pacific-slope Flycatcher	*Empidonax difficilis*
Clark's Grebe	*Aechmophorus clarkia*		Black Phoebe[a]	*Sayornis nigricans*
Double-crested Cormorant[a]	*Phalacrocorax auritus*		Say's Phoebe[a]	*Sayornis saya*
Pelagic Cormorant	*Phalacrocorax pelagicus*		Ash-throated Flycatcher	*Myiarchus cinerascens*
Brandt's Cormorant	*Phalacrocorax penicillatus*		Cassin's Kingbird	*Tyrannus vociferans*
American White Pelican[a,f]	*Pelecanus erythrorhynchos*		Western Kingbird	*Tyrannus verticalis*

Common Name	Scientific Name		Common Name	Scientific Name
Brown Pelican[f]	*Pelecanus occidentalis*		Horned Lark[a]	*Eremophila alpestris*
American Bittern	*Botaurus lentiginosus*		Tree Swallow	*Tachycineta bicolor*
Great Blue Heron[a,j]	*Ardea herodias*		Violet-green Swallow	*Tachycineta thalassina*
Great Egret[j]	*Ardea alba*		Northern rough-winged Swallow	*Stelgidopteryx serripennis*
Cattle Egret	*Bubulcus ibis*		Cliff Swallow[a]	*Petrochelidon pyrrhonota*
Little Blue Heron	*Egretta caerulea*		Barn Swallow[a]	*Hirundo rustica*
Snowy Egret	*Egretta thula*		Bushtit[a]	*Psaltriparus minimus*
Tricolored Heron	*Egretta tricolor*		House Wren[a]	*Troglodytes aedon*
Reddish Egret	*Egretta rufescens*		Marsh Wren[a]	*Cistothorus palustris*
Green Heron[a]	*Butorides virescens*		Rock Wren	*Salpinctes obsoletus*
Black-crowned Nigh Heron[a]	*Nycticorax nycticorax*		Bewick's Wren	*Thryomanes bewickii*
White-faced Ibis[g]	*Plegadis chihi*		Blue-grey Gnatcatcher	*Polioptila caerulea*
Turkey Vulture	*Cathartes aura*		Ruby-crowned Kinglet	*Regulus calendula*
Osprey[g,j]	*Pandion haliaetus*		Mountain Bluebird	*Sialia currucoides*
White-tailed Kite[a,e,i]	*Elanus leucurus*		Western Bluebird	*Sialia mexicana*
Bald Eagle[b,e,h,i,j,k]	*Haliaeetus leucocephalus*		Hermit Thrush	*Catharus guttatus*
Golden Eagle[e,g,h,i,j]	*Aquila chrysaetos*		American Robin	*Turdus migratorius*
Northern Harrier[a]	*Circus hudsonius*		Northern Mockingbird[a]	*Mimus polyglottos*
Sharp-Shinned Hawk	*Accipiter striatus*		European Starling[a]	*Sturnus vulgaris*
Cooper's Hawk[a,g]	*Accipiter cooperii*		American Pipit	*Anthus rubescens*
Red-Shouldered Hawk	*Buteo lineatus*		Sage Thrasher	*Oreoscoptes montanus*
Red-Tailed Hawk[a]	*Buteo jamaicensis*		California Scrub Jay	*Aphelocoma californica*
Ferruginous Hawk[g]	*Buteo regalis*		American Crow[a]	*Corvus brachyrhynchos*
Swainson's Hawk	*Buteo swainsoni*		Common Raven[a]	*Corvus corvax*
American Kestrel[a]	*Falco sparverius*		Cedar Waxwing	*Bombycilla cedrorum*
Merlin[g]	*Falco columbarius*		Loggerhead Shrike[a,f,h]	*Lanius ludovicianus*
Prairie Falcon[g,h]	*Falco mexicanus*		Warbling Vireo	*Vireo gilvus*
Peregrine Falcon[a,e,hj]	*Falco peregrinus*		Orange-Crowned Warbler	*Oreothlypis celata*
Clapper Rail	*Rallus crepitans*		Nashville Warbler	*Oreothlypis ruficapilla*
Virginia Rail[a]	*Rallus limicola*		Common Yellowthroat	*Geothlypis trichas*
Light-footed Ridway's Rail[b,d]	*Rallus longirostris levipes*		Yellow Warbler	*Dendroica petechia*

Common Name	Scientific Name		Common Name	Scientific Name
Sora[a]	*Porzana Carolina*		Yellow-Rumped Warbler	*Dendroica coronata*
American Coot[a]	*Fulica Americana*		Black-Throated Gray Warbler	*Setophaga nigrescens*
Black-Bellied Plover	*Pluvialis squatarola*		Townsend's Warbler	*Dendroica townsendii*
Pacific Golden-Plover	*Pluvialis fulva*		Hermit Warbler	*Setophaga occidentalis*
Snowy Plover[a]	*Charadrius alexandrinus*		Wilson's Warbler	*Cardellina pusilla*
Mountain Plover[f,h,i]	*Charadrius montanus*		Green-Tailed Towhee	*Pipilo chlorurus*
Semipalmated Plover	*Charadrius semipalmatus*		Spotted Towhee	*Pipilo maculatus*
Killdeer[a]	*Charadrius vociferous*		California Towhee[a]	*Melozone crissalis*
Black Oystercatcher	*Haematopus bachmani*		Chipping Sparrow	*Spizella passerina*
Black-Necked Stilt[a]	*Himantopus mexicanus*		Lark Sparrow	*Chondestes grammacus*
American Avocet[a]	*Recurvirostra americana*		Common Savannah Sparrow	*Passerculus sandwichensis*
Greater Yellowlegs	*Tringa melanoleuca*		Belding's Savannah Sparrow[a,b]	*Passerculus sandwichensis beldingi*
Willet	*Tringa semipalmata*		Large-billed Savannah Sparrow	*Passerculus sandwichensis rostratus*
Lesser Yellowlegs	*Tringa flavipes*		Nelson's Sharp-Tailed Sparrow	*Ammodramus nelsoni*
Wanderling Tattler	*Tringa incana*		Fox Sparrow	*Passerella iliaca*
Whimbrel	*Numenius phaeopus*		Song Sparrow[a,f]	*Melospiza melodia*
Long-Billed Curlew[g,h]	*Numenius americanus*		Lincoln's Sparrow	*Melospiza lincolnii*
Marbled Godwit	*Limosa fedoa*		White-Crowned Sparrow	*Zonotrichia leucophrys*
Ruddy Turnstone	*Arenaria interpres*		Golden-Crowned Sparrow	*Zonotrichia atricapilla*
Black Turnstone	*Arenaria melanocephala*		Western Tanager	*Piranga ludoviciana*
Surfbird	*Aphriza virgate*		Black-Headed Grosbeak	*Pheucticus melanocephalus*
Red Knot	*Calidris canutus*		Blue Grosbeak	*Passerina caerulea*
Sanderling	*Calidris alba*		Lazuli Bunting	*Passerina amoena*
Spotted Sandpiper	*Actitis macularius*		Lapland Longspur	*Calcarius lapponicus*
Western Sandpiper	*Calidris mauri*		House Sparrow	*Passer domesticus*
Least Sandpiper	*Calidris minutilla*		Red-Winged Blackbird[a]	*Agelaius phoeniceus*
Baird's Sandpiper	*Calidris bairdii*		Tricolored Blackbird	*Agelaius tricolor*

Common Name	Scientific Name		Common Name	Scientific Name
Pectoral Sandpiper	*Calidris melanotos*		Western Meadowlark	*Sturnella neglecta*
Dunlin	*Calidris alpine*		Yellow-Headed Blackbird[f]	*Xanthocephalus xanthocephalus*
Stilt Sandpiper	*Calidris himantopus*		Brewer's Blackbird	*Euphagus cyanocephalus*
Ruff	*Philomachus pugnax*		Brown-Headed Cowbird	*Molothrus ater*
Short-Billed Dowitcher	*Limnodromus griseus*		Hooded Oriole[a]	*Icterus cucullatus*
Long-Billed Dowitcher	*Limnodromus scolopaceus*		Bullock's Oriole	*Icterus bullockii*
Common Snipe	*Gallinago gallinago*		House Finch[a]	*Carpodacus mexicanus*
Wilson's Phalarope	*Phalaropus tricolor*		Lesser Goldfinch[a]	*Carduelis psaltria*
Red Phalarope	*Phalaropus fulicarius*		American Goldfinch	*Spinus tristis*
Heermann's Gull	*Larus heermanni*		Northern Red Bishop	*Euplectes franciscanus*

[a] Species that have nested at Bolsa Chica Ecological Reserve
[b] state listed - endangered
[c] federal listed - threatened
[d] federal listed – endangered
[e] CDFW fully protected species
[f] CDFW species of special concern
[g] CDFW watch list
[h] USFWS birds of conservation concern
[i] BLM sensitive species
[j] CDF sensitive species
[k] USFS sensitive species

In 2013, benthic invertebrate surveys were conducted within Anaheim Bay, including portions of Seal Beach NWR. During the surveys a total of 56 species were captured, and of these, 20 species were captured within the vicinity of Seal Beach NWR. Abundant species over the length of the surveys included the bubble snail (*Bulla gouldiana*), green shrimp/grass shrimp (*Hippolyte californiensis*), broken back shrimp (*Heptacarpus sp.*), and speckled scallop (*Argopecten ventricosus*). Also observed on the NWR in previous surveys was the California brackish water snail (*Tryonia imitator*), a species identified by the State of California as imperiled. Table 11 shows the benthic species captured during the 2013 surveys.

Table 11: Benthic Invertebrates Observed within Vicinity of Seal Beach NWR during 2013 surveys.

Phylum	Scientific Name	Common Name
Bryozoa	*Zoobotryon verticillatum*	Spaghetti Bryozoan
Mollusca	*Arcularia tiarula*	Mud Dog Whelk
	Argopectem ventricosus	Speckled Scallop
	Bulla gouldiana	Bubble Snail
	Caesia perpinguis	Western Fat Dog Whelk
	Cerithidea californica	California Hornsnail
	Crepidula sp.	Slipper Shell
	Kelletia kelletii	Kellet's Whelk

Phylum	Scientific Name	Common Name
	Laevicardium substriatum	Pacific Egg Cockle
	Navanax inermis	Navanax
Arthoropoda	*Cancer oregonensis*	Pygmy Rock Crab
	Emerita sp.	Mole Crab
	Farfantepenaeus californiensis	Brown Shrimp
	Hemigrapsus oregonensis	Yellow Shore Crab
	Heptacarpus sp.	Broken Back Shrimp
	Hippolyte sp.	Grass Shrimp
	Pachygrapsis crassipes	Lined Shore Crab
	Palaemon macrodactylus	Oriental Shrimp
	Portunus xantusii	Xantu's Swimming Crab
	Pugettia producta	Northern Kelp Crab

Source: USFWS 2014

In 2013, fish surveys were also conducted within Anaheim Bay, including portions of Seal Beach NWR. A total number of 57 fish species were captured during the surveys, with 36 species identified within the vicinity of Seal Beach NWR. Abundant species over the length of the surveys included topsmelt (*Atherinop affinis*), northern anchovy (*Engraulis mordax*), and queenfish (*Seriphus politus*). Table 12 shows the fish species captured during the 2013 surveys.

Table 12: Fish Species Observed within Vicinity of Seal Beach NWR during 2013 surveys.

Scientific Name	Common Name
Atherinop affinis	Topsmelt
Engraulis mordax	Northern Anchovy
Seriphus politus	Queenfish
Cymatogaster aggregata	Shiner Surfperch
Paralabrax nebulifer	Barred Sand Bass
Urobatis halleri	Round Stingray
Ilypnus gilberti	Cheekspot Goby
Leuresthes tenuis	California Grunion
Leptocottus armatus	Staghorn Sculpin
Sardinops sagax	Pacific Sardine
Syngnathus leptorhynchus	Bay Pipefish
Heterostichus rostratus	Giant Kelpfish
Clevelandia ios	Arrow/Shadow Goby
Paralichthys californicus	California Halibut
Paralabrax clathratus	Kelp Bass
Roncador stearnsii	Spotfin Croaker
Paralabrax maculatofasciatus	Spotted Sand Bass
Umbrina roncador	Yellowfin Croaker
Fundulus parvipinnis	California killifish
Hyperprosopon argenteum	Walleye Surfperch
Hypsoblennius gentilis	Bay Blenny
Acanthogobius flavimanus	Yellowfin Goby
Porichthys myriaster	Specklefin Midshipman
Anisotremus davidsonii	Sargo
Xenistius californiensis	Salema
Syngnathus auliscus	Barred Pipefish

Scientific Name	Common Name
Atractoscion nobilis	White Seabass
Mustelus californicus	Gray Smooth-hound Shark
Anchoa compressa	Deepbody Anchovy
Strongylura exilis	California Needlefish
Atherinops californiensis	Jacksmelt
Embiotoca jacksoni	Black Surfperch
Symphurus atricaudus	California Tonguefish
Gymnura marmorata	California Butterfly Ray

Source: USFWS 2014

(2) State Listed Species and Species of Special Concern

There are approximately 240 species listed as state threatened, endangered, special concern, rare, and sensitive species within Orange County. Table 13 lists only those species that are found within Orange County and are listed as state threatened, endangered, or species of special concern. The CDFW, in a letter dated January 12, 2018, listed the following specific state-listed species and state sensitive species and habitats as occurring within the Bolsa Chica Ecological Reserve, which is within the project area: western snowy plover (*Charadrius nivosus nivosus*), Ridgway's rail (*Rallus obsoletus levipes*), California least tern (*Sternula antillarum browni*), Belding's savannah sparrow (*Passerculus sandwichensis beldingii*), peregrine falcon (*Falco peregrinus*), burrowing owl (*Athene cunicularia*), coastal California gnatcatcher (*Polioptila californica californica*), northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), osprey (*Pandion haliaetus*), black skimmer (*Rynchops niger*), white-faced ibis (*Plegadis chihi*), reddish egret (*Egretta rufescens*), California seablite (*Suaeda californica*), woolly seablite (*Suaeda taxifolia*), estuary seablite (*Suaeda esteroa*), coastal woolly-heads (*Nemacaulis denudata var. denudata*), southern tarplant (*Centromadia parryi ssp. australis*), red sand verbena (*Abronia maritima*), and green sea turtle (*Chelonia mydas*). Per the letter, sensitive marine resources include eelgrass (*Zostera marina*) beds, beach habitat, intertidal and subtidal habitat, nesting/spawning habitat (including grunion, *Leuresthes tenuis*, habitat), mud flats, sand flats, dunes, coastal strand, and salt marsh.

Table 13: State listed species identified for Orange County, California.

Common Name	Scientific Name	Status		Common Name	Scientific Name	Status
Plants						
San Diego Button-celery	*Eryngium aristulatum var. parishii*	FE, SE		Salt Marsh Bird's-beak	*Chloropyron maritimum ssp. maritimum*	FE, SE, CRP
Gambel's Water Cress	*Nasturtium gambelii*	FE, ST, CRP		California Orcutt Grass	*Orcuttia californica*	FE, SE
Ventura Marsh Milk-vetch	*Astragalus pycnostachyus var. lanosissimus*	FE, SE, CRP		Los Angeles Sunflower	*Helianthus nuttallii ssp. parishii*	CRP
Southern Tarplant	*Centromadia parryi ssp. australis*	CRP		San Bernardino Aster	*Symphyotrichum defoliatum*	CRP

Common Name	Scientific Name	Status		Common Name	Scientific Name	Status
Coulter's Goldfields	*Lasthenia glabrata ssp. coulteri*	CRP		Estuary Seablite	*Suaeda esteroa*	CRP
Davidson's Saltscale	*Atriplex serenana var. davidsonii*	CRP		Coast Woolly-heads	*Nemacaulis denudata var. denudata*	CRP
Mud nama	*Nama stenocarpa*	CRP		Decumbent Goldenbush	*Isocoma menziesii var. decumbens*	CRP
Smooth Tarplant	*Centromadia pungens ssp. laevis*	CRP		Coulter's Saltbush	*Atriplex coulteri*	CRP
Aphanisma	*Aphanisma blitoides*	CRP		Many-stemmed Dudleya	*Dudleya multicaulis*	CRP
South Coast Saltscale	*Atriplex pacifica*	CRP		Chaparral Sand-verbena	*Abronia villosa var. aurita*	CRP
Salt Spring Checkerbloom	*Sidalcea neomexicana*	CRP		Parish's Brittlescale	*Atriplex parishii*	CRP
Prostrate Vernal Pool Navarretia	*Navarretia prostrata*	CRP				
Birds						
Cooper's Hawk	*Accipiter cooperii*	WL		California Least Tern	*Sternula antillarum browni*	FE, SE, FP
Swainson's Hawk	*Buteo swainsoni*	ST		Elegant Tern	*Thalasseus elegans*	WL
Northern Harrier	*Circus cyaneus*	SSC		Yellow-breasted Chat	*Icteria virens*	SSC
Osprey	*Pandion haliaetus*	WL		Yellow Warbler	*Setophaga petechia*	SSC
Barrow's Goldeneye	*Bucephala islandica*	SSC		American White Pelican	*Pelecanus erythrorhynchos*	SSC
Least Bittern	*Ixobrychus exilis*	SSC		Double-crested Cormorant	*Phalacrocorax*	WL
Western Snowy Plover	*Charadrius alexandrines nivosus*	FT, SSC		Yellow Rail	*Coturnicops noveboracensis*	SSC
Mountain Plover	*Charadrius montanus*	SSC		California Black Rail	*Laterallus jamaicensis coturniculus*	ST, FP
Western Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	FT, SE		Light-footed Ridgway's Rail	*Rallus obsoletus levipes*	FE, SE, FP
Southern California rufous-crowned sparrow	*Aimophila ruficeps canescens*	WL		Long-billed Curlew	*Numenius americanus*	WL

Common Name	Scientific Name	Status		Common Name	Scientific Name	Status
Belding's Savannah Sparrow	*Passerculus sandwichensis beldingii*	SE		Short-eared Owl	*Asio flammeus*	SSC
Large-billed Savannah Sparrow	*Passerculus sandwichensis rostratus*	SSC		Burrowing Owl	*Athene cunicularia*	SSC
Lesser Sandhill Crane	*Grus Canadensis canadensis*	SSC		Coastal California Gnatcatcher	*Polioptila californica californica*	FT, SSC
Purple Martin	*Progne subis*	SSC		Coastal Cactus Wren	*Campylorhynchus brunneicapillus sandiegensis*	SSC
Bank Swallow	*Riparia riparia*	SE		Olive-sided Flycatcher	*Contopus cooperi*	SSC
Tricolored Blackbird	*Agelaius tricolor*	SC, SSC		Vermilion Flycatcher	*Pyrocephalus rubinus*	SSC
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	SSC		Least Bell's Vireo	*Vireo bellii pusillus*	FE, SE
White-tailed Kite	*Elanus leucurus*	FP		Fork-tailed Storm-petrel	*Oceanodroma furcata*	SSC
California Brown Pelican	*Pelecanus occidentalis californicus*	FP		Short-tailed albatross	*Phoebastria albatrus*	FE, SSC
Black Skimmer	*Rynchops niger*	SSC				
Mammals						
Western Mastiff Bat	*Eumops perotis californicus*	SSC		American Badger	*Taxidea taxus*	SSC
Big Free-tailed Bat	*Nyctinomops macrotis*	SSC		Southern California Saltmarsh Shrew	*Sorex ornatus salicornicus*	SSC
South Coast Marsh Vole	*Microtus californicus stephensi*	SSC				
Fish						
Arroyo Chub	*Gila orcuttii*	SSC		Tidewater Goby	*Eucyclogobius newberryi*	FE, SSC
Santa Ana Speckled Dace	*Rhinichthys osculus ssp.*	SSC				
Amphibians and Reptiles						
Foothill Yellow-legged Frog	*Rana boylii*	SSC; SC		Western Pond Turtle	*Emys marmorata*	SSC
Western Spadefoot	*Spea hammondii*	SSC		Two-striped Gartersnake	*Thamnophis hammondi*	SSC

Common Name	Scientific Name	Status		Common Name	Scientific Name	Status
Southern California Legless Lizard	*Anniella stebbinsi*	SSC		Coast Horned Lizard	*Phrynosoma blainvillii*	SSC
Orange-throated Whiptail	*Aspidoscelis hyperythra*	WL				

[a] Status Designations: FE – federally endangered, FT – federally threatened, FC – federal candidate species, FP – federal proposed species, SE – state endangered, ST – state threatened, SSC – state species of species concern, SC – state candidate species, WL – state watch list, CFP – CDFW fully protected species, and CRP – California Rare Plant (with Ranking of 1A, 1B, 2A, or 2B).

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3.0 404(b)(1) Analysis

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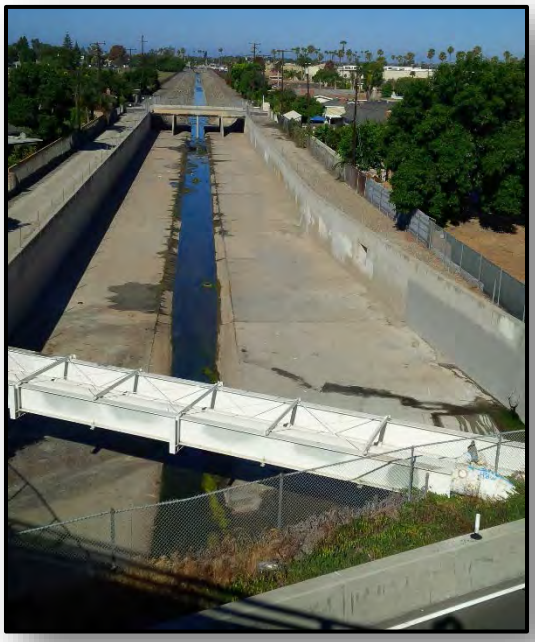
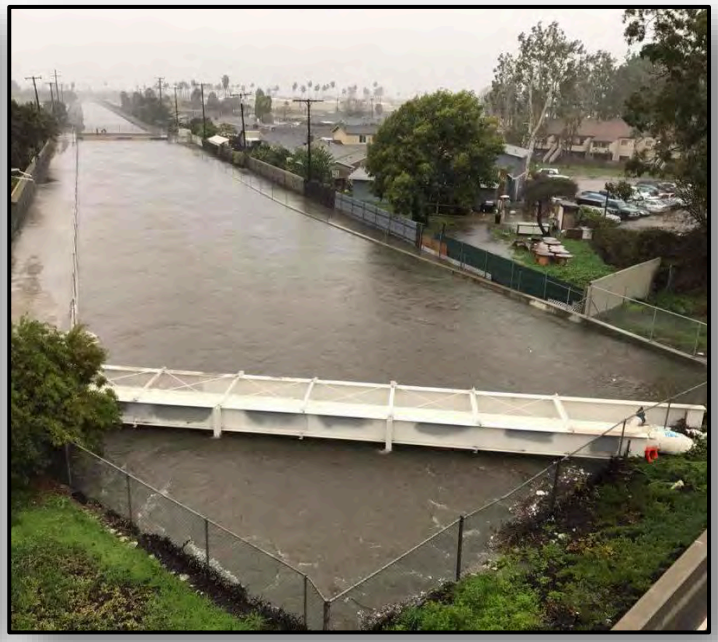
Westminster, East Garden Grove
Flood Risk Management Study
404(b)1 Analysis





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Chicago District
October 2018

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I. Project Description

a. Location

The project is located within the Westminster watershed in western Orange County, California, approximately 25 miles southeast of the City of Los Angeles. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach. Included in the project area are four drainage channels (known as C02, C04, C05, and C06) as well as portions of the Pacific Coast Highway (PCH) and Interstate 405 (I-405). The channels outfall into the Pacific Ocean, and portions of the coastal area, including Outer Bolsa Bay and the Bolsa Chica Ecological Reserve, are also part of the project area. Figures 2 and 3 show the watershed and features within the study area.

Figure 2: Westminster Watershed and the Study Channels Overlaid on the FEMA 1% ACE Floodplain (Source: FEMA National Flood Hazard Layer).

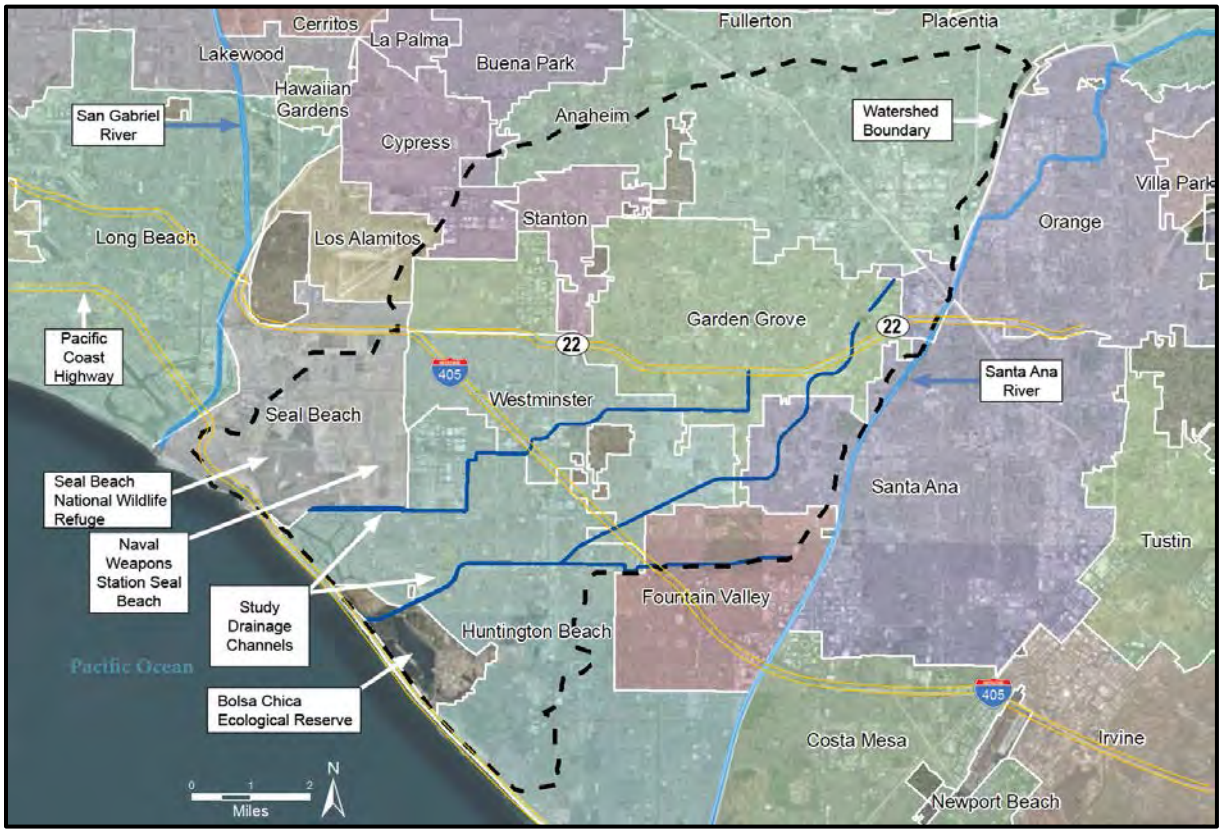

Figure 3: Study Area.

b. General Description

The National Economic Development (NED) Alternative is the Minimum Channel Modifications Alternative. Under the Minimum Channel Modifications Alternative (Tables 14 and 15, and Figure 4), flood risk would be reduced within the watershed by improving both conveyance efficiency and capacity of existing channels. The leveed areas in the downstream reaches of C02 and would be improved to reduce the risk of levee failure. Modifications in these reaches would include installation of steel sheet pile channel walls and preservation of existing soft bottom, tidally-influenced habitat.

Additional downstream measures would be combined with the in-channel measures to address existing flooding in Outer Bolsa Bay and to account for increased flow volumes that result from increased conveyance capacity in the channels. The tide gates on C05 would be replaced in order to improve the flow conditions through the lower reaches of the C05 channel. The current tide gates leak and therefore allow saltwater to intrude upstream in C05. This saltwater influence extends upstream of Outer Bolsa Bay for approximately 2.5 miles. The replacement of the tide gates as part of this alternative would be configured to allow for continued tidal influence in the lower reaches of C05, thus lessening impacts to the existing ecological conditions.

The Minimum Channel Modifications Alternative also includes the widening of the Outer Bolsa Bay channel just upstream of the Warner Avenue Bridge. Widening of the channel would require that the

Warner Avenue Bridge and the pedestrian bridge at the Bolsa Chica Conservancy be increased in span as well. Widening of the Outer Bolsa Bay channel would improve conveyance as well as the hydraulic efficiency of the lower reaches of C05.

A 2,500 foot long and 3 foot tall floodwall would be built along PCH at Outer Bolsa Bay to reduce impacts from flooding on traffic.

Lastly, compatible nonstructural measures would be incorporated into the Minimum Channel Modifications Alternative to lessen the life safety risk associated with flooding in the project area. Compatible nonstructural measures that were considered include removal of impediments to flow.

Table 14: Channel Modifications within Co2/C04 under the Minimum Channel Modifications Alternative.

C02/C04			
Channel	**Reach**	**EXISTING CONDITIONS**	**MINIMUM CHANNEL MODIFICATIONS ALTERNATIVE**
C02	23	Earthen trapezoidal	Widened to 230' soft bottom with double sheet piles on both sides
C04	20	Riprap lined trapezoidal from C02 to Bolsa Chica St.; Earthen & riprap trapezoidal from Bolsa Chica St. to Graham St.; Earthen trapezoidal from Graham St. to McFadden Ave.; Riprap trapezoidal from McFadden Ave. to Bolsa Ave.; Earthen & riprap trapezoidal from Bolsa Ave. to Edwards St. Concrete lined rectangular from Edwards St. to I-405	Concrete lined trapezoidal from C02 to Edwards St.; Concrete lined rectangular from Edwards St. to I-405 (existing);
C04	21	Concrete lined rectangular	No change from existing condition
C04	22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular with soft bottom from Magnolia St. to Brookhurst; Riprap trapezoidal from Brookhurst St. to Westminster Ave.; Concrete lined trapezoidal from Westminster Ave. to SR-22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular from Magnolia St. to Brookhurst; Concrete lined trapezoidal from Brookhurst St. to SR-22

Table 15: Channel Modifications within C05/C06 under the Minimum Channel Modifications Alternative.

C05/C06			
Channel	**Reach**	**EXISTING CONDITIONS**	**MINIMUM CHANNEL MODIFICATIONS ALTERNATIVE**
C05	1	Earthen levee from tide gates to Warner Ave. w/ some SSP on south bank near Graham St.; SSP rectangular from Graham St. to Warner Ave.; Earthen levees from Warner Ave. to 1,300 ft upstream of Edwards Ave.	Sheet pile/soft bottom/splash walls (various heights) from tide gates to existing rectangular channel west of Golden West St.
C05	2	Concrete lined rectangular	No change from existing condition
C05	3	Riprap lined trapezoidal from C05/C06 confluence to Woodruff St.; Concrete rectangular from Woodruff St. to I-405	Concrete lined trapezoidal from confluence with C06 to Beach Blvd.; Concrete lined rectangular from Beach Blvd. to I-405
C05	4	Concrete lined rectangular from I-405 to Quartz St.; Riprap lined trapezoidal from Quartz St. to Bushard St.	Concrete lined rectangular from I-405 to Magnolia St.; Concrete lined trapezoidal from Magnolia St. to Bushard St.
C05	5	Riprap lined trapezoidal from Bushard St. to Brookhurst St.; 1,300 ft of concrete lined trapezoidal upstream of Brookhurst St.; Riprap lined trapezoidal to 3rd St.	Concrete lined trapezoidal
C05	6	Concrete lined trapezoidal	No change from existing condition
C05	7	Covered concrete conduit	No change from existing condition
C05	8	Concrete lined trapezoidal	No change from existing condition
C05	9	Concrete lined trapezoidal	No change from existing condition
C05	10	Covered concrete conduit	No change from existing condition
C05	11	Covered concrete conduit	No change from existing condition
C05	12	Concrete lined trapezoidal (first 1400') and covered concrete conduit (next 1000')	No change from existing condition
C06	13	Earthen trapezoidal from C05/C06 confluence to Bolsa Ave./RT-39; Riprap lined trapezoidal from Bolsa Ave./RT-39 to Ross Lane	Concrete lined trapezoidal
C06	14	Concrete lined rectangular	No change from existing condition
C06	15	Covered concrete conduit	No change from existing condition
C06	16	Concrete lined rectangular	No change from existing condition
C06	17	Earthen and riprap lined trapezoidal	Concrete lined trapezoidal
C06	18	Mile Square Park-concrete low flow v-channel	No change from existing condition
C06	19	Riprap lined trapezoidal	Concrete lined trapezoidal

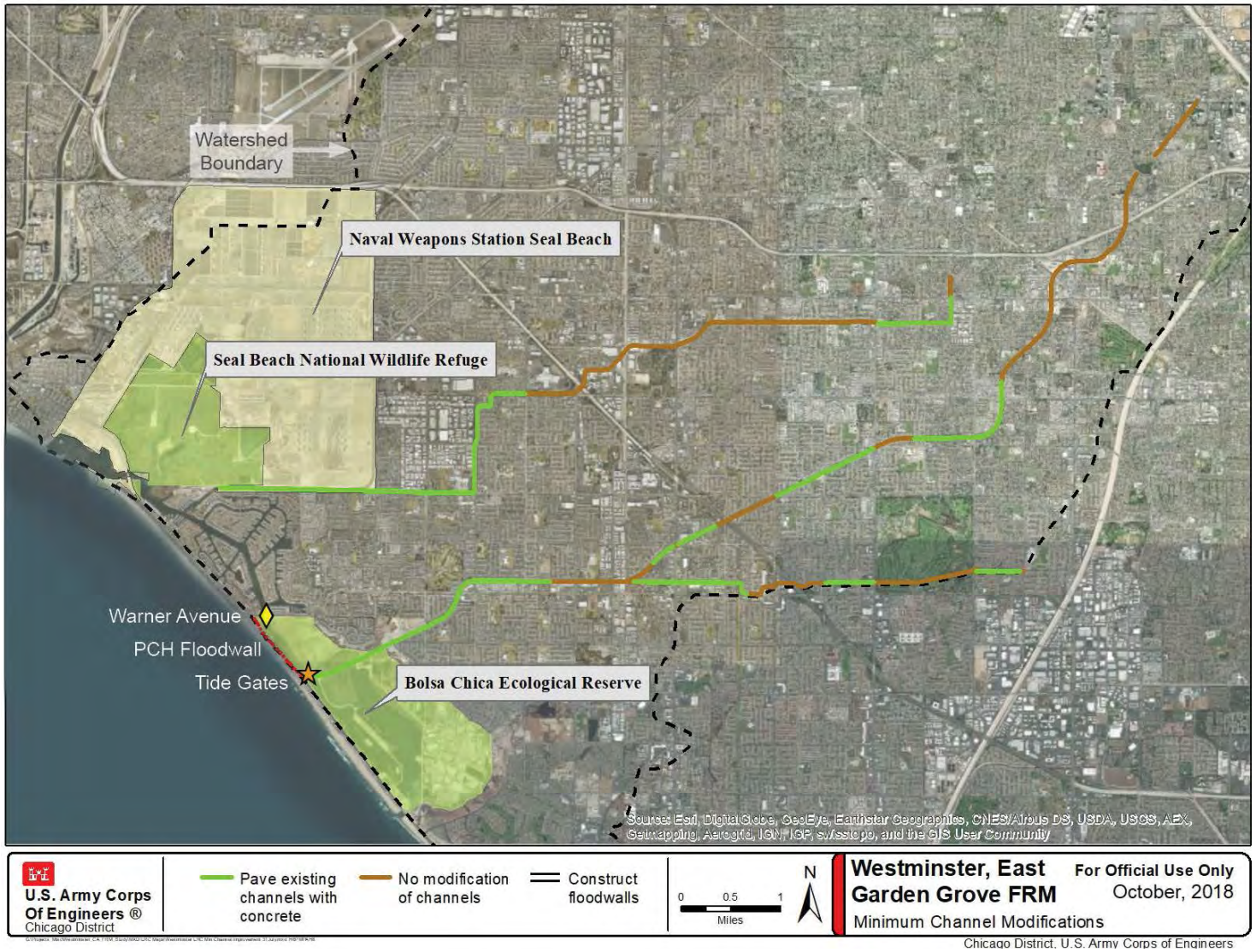

Figure 4: Minimum Channel Modifications Alternative

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The Locally Preferred Plan (LPP) is the Maximum Channel Modifications Alternative. The Maximum Channel Modifications Alternative (Tables 16 and 17, Figure 5) includes the same measures as described above for Minimum Channel Modifications Alternative, except under Maximum Channel Modifications Alternative the maximum channel alignments would be implemented throughout the channels, not just the downstream reaches (i.e., Reach 23 of C02 and Reach 1 of C05). The Maximum Channel Modifications Alternative would allow the non-Federal sponsor — Orange County Public Works (OCPW) — to meet their goal of containing the 0.01 annual chance of exceedance (ACE) storm event.

Table 16: Channel Modifications within C02/C04 under the Maximum Channel Modifications Alternative

C02/C04			
Channel	**Reach**	**EXISTING CONDITIONS**	**MAXIMUM CHANNEL MODIFICATIONS PLAN**
C02	23	Earthen trapezoidal	Widened to 230' soft bottom with double sheet piles on both sides
C04	20	Riprap lined trapezoidal from C02 to Bolsa Chica St.; Earthen & riprap trapezoidal from Bolsa Chica St. to Graham St.; Earthen trapezoidal from Graham St. to McFadden Ave.; Riprap trapezoidal from McFadden Ave. to Bolsa Ave.; Earthen & riprap trapezoidal from Bolsa Ave. to Edwards St. Concrete lined rectangular from Edwards St. to I-405	80' Concrete rectangular with middle 48' left earthen from C02 to McFadden Ave.; 68' Concrete rectangular with middle 40' left earthen from McFadden Ave.to Bolsa Ave.; 55' Concrete rectangular from Bolsa Ave. to Edwards St.; 3 crossings replaced of different dimensions
C04	21	Concrete lined rectangular	Navy Railroad Reroute
C04	22	Concrete lined compound from Beach Blvd. to Magnolia St.; Concrete rectangular with soft bottom from Magnolia St. to Brookhurst; Riprap trapezoidal from Brookhurst St. to Westminster Ave.; Concrete lined trapezoidal from Westminster Ave. to SR-22	Base of concrete lined channel increased to 35' from Beach Blvd. to Magnolia St.; Soft bottom channel from Magnolia St. to Brookhurst St. concrete lined; Concrete lined trapezoidal from Brookhurst Street to Westminster Ave.; 18' Concrete rectangular from Westminster Ave. to SR-22

Table 17: Channel Modifications within C05/C06 under the Maximum Channel Modifications Alternative

C05/C06			
Channel	**Reach**	**EXISTING CONDITIONS**	**MAXIMUM CHANNEL MODIFICATIONS PLAN**
C05	1	Earthen levee from tide gates to Warner Ave. w/ some SSP on south bank near Graham St.; SSP rectangular from Graham St. to Warner Ave.; Earthen levees from Warner Ave. to 1,300 ft upstream of Edwards Ave.	Sheet pile/soft bottom/splash walls (various heights) from tide gates to existing rectangular channel west of Golden West St.
C05	2	Concrete lined rectangular	Concrete lined rectangular with 1' splash walls from Golden West St. to Gothard St.; Concrete lined rectangular from Gothard St. to C05/C06 confluence
C05	3	Riprap lined trapezoidal from C05/C06 confluence to Woodruff St.; Concrete rectangular from Woodruff St. to I-405	Concrete lined rectangular; Some sections of 1' splash wall between Beach Blvd. and Woodruff Rd.; 2 crossings replaced of different sizes
C05	4	Concrete lined rectangular from I-405 to Quartz St.; Riprap lined trapezoidal from Quartz St. to Bushard St.	Concrete lined rectangular with splash walls (various heights); 3 crossings replaced of different sizes
C05	5	Riprap lined trapezoidal from Bushard St. to Brookhurst St.; 1,300 ft of concrete lined trapezoidal upstream of Brookhurst St.; Riprap lined trapezoidal to 3rd St.	Concrete lined rectangular with splash walls (various heights); 5 crossings replaced of different dimensions
C05	6	Concrete lined trapezoidal	Concrete lined rectangular; 1 crossing replaced
C05	7	Covered concrete conduit	No change from existing condition
C05	8	Concrete lined trapezoidal	Concrete lined rectangular
C05	9	Concrete lined trapezoidal	Concrete lined rectangular
C05	10	Covered concrete conduit	Concrete lined rectangular
C05	11	Covered concrete conduit	No change from existing condition
C05	12	Concrete lined trapezoidal (first 1400') and covered concrete conduit (next 1000')	Concrete lined rectangular with splash walls (various heights); Haster Basin inlet culverts modified
C06	13	Earthen trapezoidal from C05/C06 confluence to Bolsa Ave./RT-39; Riprap lined trapezoidal from Bolsa Ave./RT-39 to Ross Lane	Concrete lined rectangular at confluence; Concrete lined trapezoidal from confluence to Ross St.; 2 crossings replaced of different sizes
C06	14	Concrete lined rectangular	Concrete lined rectangular from Ross St. to Asari Lane; Concrete lined rectangular with splash walls (1.5-2') from Asari Lane to Riverbend Dr.
C06	15	Covered concrete conduit	Covered concrete conduit; 1 crossing replaced
C06	16	Concrete lined rectangular	No change from existing condition

C05/C06			
Channel	**Reach**	**EXISTING CONDITIONS**	**MAXIMUM CHANNEL MODIFICATIONS PLAN**
C06	17	Earthen and riprap lined trapezoidal	Concrete lined trapezoidal
C06	18	Mile Square Park-concrete low flow v-channel	Mile Square Park-concrete low flow v-channel
C06	19	Riprap lined trapezoidal	Concrete lined trapezoidal

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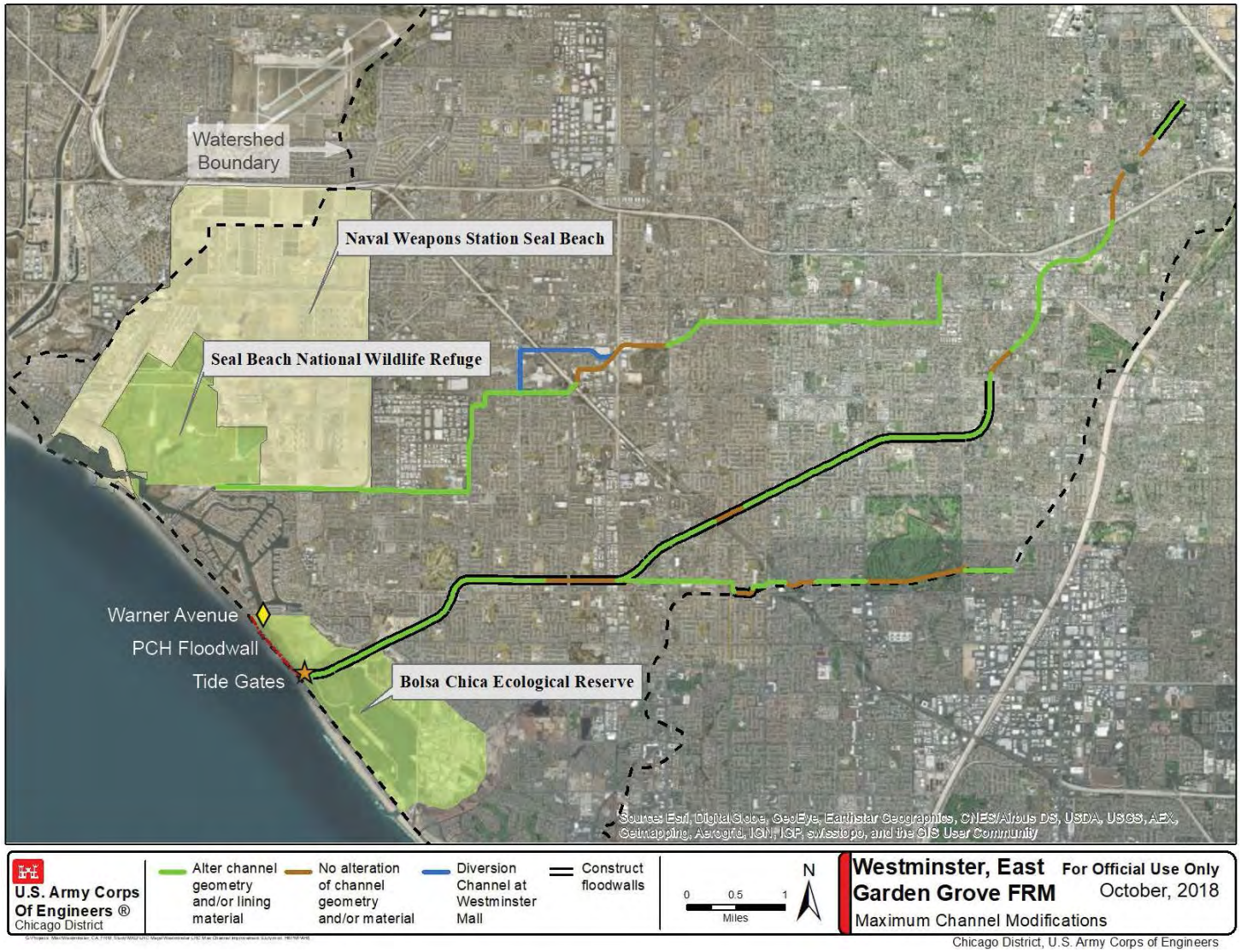

Figure 5: Maximum Channel Modifications Alternative (LPP)

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c. Authority and Purpose

The Westminster Feasibility Study is being conducted in accordance with the study resolution adopted by the Committee on Public Works, House of Representatives Committee on Public Works on May 8, 1964 (Flood Control Act of 1938).

The purpose of the feasibility study is to evaluate flood risk within the Westminster watershed following the completion of channel modifications and major flood control projects for the Santa Ana River and the removal of the Westminster watershed from the Santa Ana River 100 year floodplain. Flood risk within the watershed can be attributed to drainage channels that collect surface runoff and convey it to the Pacific Ocean. Preliminary analysis shows that flows overtop the C02/C04 and C05/C06 channel systems during a 4% annual chance of exceedance (ACE) storm event, putting approximately 400,000 area residents as well as approximately 44,000 structures at risk of inundation. Overbank flooding also impacts traffic in the project area, causing closures on local roads as well as major routes, including I-405. In total, the study area experiences approximately $130,000,000 (FY2019 price levels, 2035 base year, 2.875% federal discount rate) in equivalent annual direct damages as a result of overbank flooding. The evaluation of flood risk includes identifying measures to reduce flood hazards associated with the Westminster channels, such as risks to life safety, damages to residential and commercial structures and public infrastructure. The evaluation also considers measures to reduce flood impacts downstream of the channels in the vicinity of Outer Bolsa Bay.

Specific activities for the Minimum and Maximum Channel Modifications Alternatives include:

- Widening and lining with concrete the existing channel footprint for portions of the four channels;
- Installing 2500 linear feet of flood wall along PCH;
- Widening the channel area that flows under the bridge at Warner Avenue;
- Replacing tide gates at the outfall of C05.

The precise footprints of these activities is not defined, however, at least portions of the work will occur in waters of the United States, such that the provisions of Title 40, Chapter 1, Subchapter H apply.

d. General Description of Dredged or Fill Material

(1) General Characteristics of Material

The channels are natural earth, with riprap and/or concrete lining in portions. Except during precipitation events, the channel flows are low (typically 2 cfs or less).

Bolsa Chica Ecological Reserve is a tidal basin restored in an area that had been previously used for a gun club and for oil extraction. The soft bottom materials have been chemically characterized in the past; contaminants included arsenic, barium, beryllium, chromium, cobalt, copper, lead, mercury, nickel, oil and grease, PCBs, vanadium and zinc. As part of the restoration of the reserve, contaminated sediment was dredged with the highest concentration materials being disposed of off-site. Clean sediment was used to blend with remaining contaminated sediment for the construction of habitat areas.

Warner Avenue Bridge crosses the channel connecting Huntington Harbour with Outer Bolsa Bay. Channel construction plans identify riprap areas along the channel including near the bridge. One boring taken near Warner Ave. bridge but within the embankment (not in the channel) identifies the

embankment as mainly clay and silt, with a layer of peat at an approximate elevation of 30 ft. The peat is underlain by silts and sands. The physical and chemical quality of the sediment within the channel is not known.
Channel C05 includes tide gates at the outfall to Outer Bolsa Bay. The conditions of the sediment near the gates is not known.

Pacific Coast Highway runs between Outer Bolsa Bay and the Pacific Ocean. The floodwall placement is not delineated in detail, so it is not known if the floodwall would be constructed within the existing embankment area for the highway or if the floodwall footprint would encroach on Outer Bolsa Bay. The sediment quality in Outer Bolsa Bay is not known.

(2) Quantity of Material

The Minimum Channel Modifications Alternative includes the excavation of approximately 1,178,800 total cubic yards (CY) of material and the placement of approximately 484,900 total CY of material (**Table 18**). The Maximum Channel Modifications Alternative includes the excavation of approximately 2,078,800 total CY of material and the placement of approximately 724,900 total CY of material (**Table 19**).

Table 18: Quantities of Material for the Minimum Channel Modifications Plan

Feature	Material Excavated (CY)	Material to be Placed (CY)
Channels	1,100,000	410,000
Tide Gates	7,000	7,300
Warner Avenue Bridge	66,000	63,800
PCH Floodwall	5,800	3,800

Table 19: Quantities of Material for the Maximum Channel Modifications Plan

Feature	Material Excavated (CY)	Material to be Placed (CY)
Channels	2,000,000	650,000
Tide Gates	7,000	7,300
Warner Avenue Bridge	66,000	63,800
PCH Floodwall	5,800	3,800

(3) Source of Material

The source material for paving channels, constructing a new bridge, constructing a floodwall, and for the foundation for any gates will be new and clean construction materials including concrete, metals, rock, and plastic or rubber gaskets as needed. These clean and inert, new materials are not expected to be a major source of contamination for the water. Care would be taken during construction to ensure erosion control and to minimize turbidity in the harbor areas.

e. Description of the Proposed Discharge Site(s)

(1) Location

It is proposed that all materials excavated, including soils, sediment and waste concrete and rock, be disposed of upland in an appropriate licensed disposal facility.

(2) Size

The Minimum Channel Modifications Alternative includes channel modifications in approximately 10 of 23 total reaches while the Maximum Channel Modifications Alternative includes channel modifications in approximately 19 of 23 total reaches. Both alternatives include increasing the span of Warner Avenue Bridge, replacing the tide gates at the downstream end of Reach 1 C05, and constructing a floodwall along the PCH where it is adjacent to Outer Bolsa Bay.

(3) Type of Site

The drainage channels are constructed channels for the purpose of urban drainage. The soft bottom areas of the channels support low quality plants in some reaches, however, the majority of the channels are hardscaped and/or scoured leaving bare surfaces.

Outer Bolsa Bay and Bolsa Chica Ecological Reserve are tidally influenced backwater areas separated from the Pacific Ocean by urban features (i.e., PCH). Work in these areas could include both upland and in-water work.

(4) Type of Habitat

The project area is surrounded by urban development. The drainage channels may perform as low quality habitat or wildlife corridors, particularly for birds. The channels that are currently paved or lined with riprap provide little habitat however the confluences of C02 and C04, which are hydrologically connected to Anaheim Bay, potentially facilitate wildlife movement. It is anticipated that smaller and human-tolerant species, such as raccoon, opossum, striped skunk, fox, and coyote, are likely present within the study area partly due to open space located downstream of the project area.

The downstream portions of the channels (C02 and C05) transition from freshwater marsh areas to brackish marsh, and then to coastal salt marsh in Huntington Harbor and Outer Bolsa Bay. The areas include several types of estuarine habitat: tidal marsh, salt marsh, mudflats, tidal creeks, tidal pools, and salt pannes. **Figure 6** is a map of the habitat types within Bolsa Chica Reserve, which is a higher quality habitat than much of the project area.

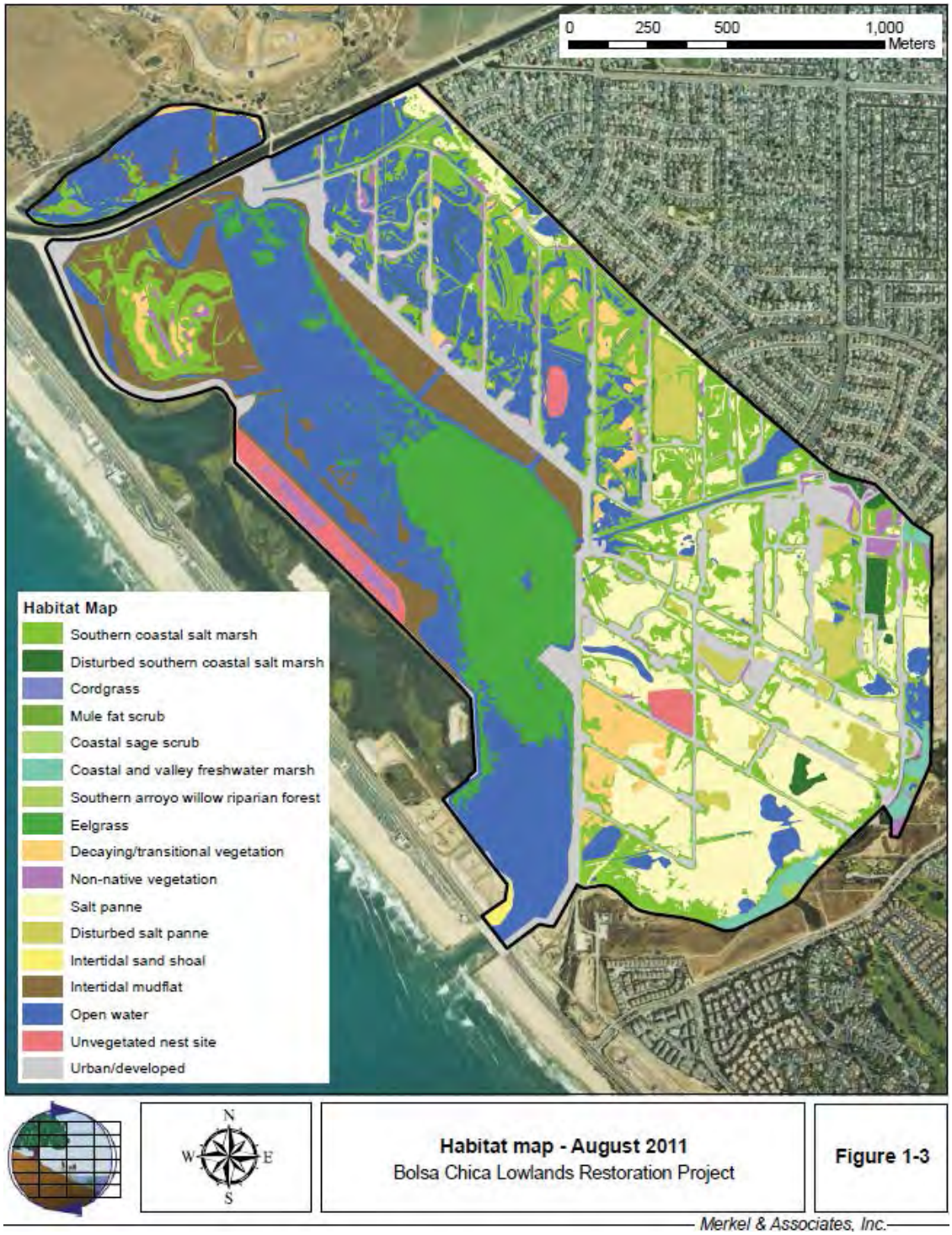

Figure 6: Habitats Present within the Bolsa Chica Lowlands Restoration Project Including Eelgrass (Merkel & Associates 2013).

(5) Timing and Duration of Discharge

The anticipated timeframe is several years in the future. Construction would occur in segments, with the overall work broken out into discrete portions. For example, the widening at Warner Avenue Bridge would be a separate project, while various portions of channel would be paved as separate projects. The timing of any work that could impact habitat or sensitive species could be adjusted to account for environmental windows (i.e., to avoid nesting periods, spawning times for fish). The duration of construction for both the Minimum and Maximum Channel Modifications Alternatives is not expected to last more than 15 years.

f. Description of Placement Method

Soil excavation would occur using land based earth excavation equipment such as backhoes. In-water excavation of soils or sediment would occur mechanically. Construction within Reach 23 of C02 and Reach 1 of C05 (driving of sheetpile) would be done in the dry; however, only half of the channel would be dry (i.e., water would be allowed to still flow through half of the channel). Construction within the other channel reaches would be done in the dry (placement of concrete) with water from upstream being pumped around the construction site and downstream. Construction of the tide gates, Warner Avenue Bridge, and the floodwall along PCH (placement of stone, concrete, foundations for the floodwall) would be done in the dry, except for stone placement along bank areas. Stone placement would be done mechanically, using earthmoving or mechanical equipment. Soil and sediment for disposal would be placed upland for staging and dewatering or would be placed directly into trucks for hauling to the disposal site. No sediment or untreated return water would be placed in the channels nor in the bay/harbor/estuary areas.

II. Factual Determinations

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope

The study area is located on the coastal plain of Orange County, which extends from the City of Irvine to the Orange/Los Angeles County border. The coastal plain is divided into two (2) sub-plains, the Downey Plain and the Tustin Plain. The Downey Plain comprises the alluvial fans of the Los Angeles, San Gabriel, and Santa Ana Rivers (Poland et al. 1956). The Downey Plain has a uniform grade with an average grade of 20 feet per mile (6.1 meters per kilometer). The Tustin Plain is nearly flat and gently slopes to the southwest.

(2) Sediment Type

The soils within the project area are summarized in the table below. Little information is available on the sediment within the harbor/bay/estuary portions of the project.

Table 1: Project soil types.

Soil Type	Soil Characteristics	Depth to Water Table
Beaches	Sandy, gravelly, or cobbly coastal shores.	0-72 inches
Bolsa Silt Loam	Mixed alluvium that generally occurs on large alluvial fans.	36-72 inches
Bolsa Silt Loam, Drained	Mixed alluvium derived from igneous, metamorphic and sedimentary rock. Typically occur on alluvial fans.	>80 inches
Bolsa Silty Clay Loam	Mixed alluvium generally occurring on alluvial fans.	36-72 inches
Bolsa Silty Clay Loam, Drained	Mixed alluvium derived from igneous, metamorphic and sedimentary rock. Typically found on alluvial fans.	>80 inches
Hueneme Fine Sandy Loam	Stratified alluvium derived from sedimentary rock found on alluvial fans.	42-60 inches
Hueneme Fine Sandy Loam, Drained	Stratified alluvium derived from sedimentary rock found on alluvial fans.	>80 inches
Metz Loamy Sand	Alluvium derived from mixed found typically on alluvial fans.	>80 inches
Metz Loamy Sand, Moderately Fine Substratum	Mixed alluvium derived from igneous, metamorphic and sedimentary rock found on alluvial fans and flood plains.	>80 inches
Myford Sand Loam, 9 to 30 percent slopes, eroded	Alluvium derived from sandstone typically found on floodplain terraces.	>80 inches
Omni Clay, Drained	Mixed alluvium found on depressions.	>80 inches
Omni Silt Loam, Drained	Mixed alluvium found on depressions.	>80 inches
Thapto-histic Fluvaquents	Organic material and/or mixed alluvium found on beach plains.	24-42 inches
Tidal Flats	Stratified clay to sand deposits found adjacent to bays and lagoons and is regularly inundated by tidal flow.	0 inches

(3) Dredged/Fill Material Movement

Sediment and soil to be removed will be excavated mechanically, stockpiled upland, dewatered (as needed) and hauled via truck to the disposal site. Concrete and other construction materials will be moved by truck to the project area and will be placed mechanically.

(4) Physical Effects on Benthos

A portion of the existing periphyton, epibenthic plankton, and benthic macroinvertebrate habitat and organisms around the Warner Avenue Bridge, possibly along the floodwall alignment, and at the tide gate location will be disturbed during construction activities. These areas are a small portion of the existing habitat and is not expected to cause a detrimental loss of benthic organisms and habitat.

(5) Other Effects

The project construction could cause water quality impacts if best management practices, including erosion control and stormwater pollution prevention practices, are not followed. Any environmental impacts caused by the short-term increases in suspended solids due to the construction activities are anticipated to be temporary and minimal; the use of best management practices as a proactive approach is recommended.

(6) Actions Taken to Minimize Impacts

Construction will use best management practices to prevent material spills or uncontrolled discharges into the river, and to control erosion and stormwater run-off. Upland work areas will be subject to erosion control and will be permanently stabilized when work is completed. Dredging activities will also use best management practices to minimize solid suspension. Excess soil and sediment disposal will occur upland with return water treatment and/or controls to prevent the release of anthropogenic compounds to the channels.

b. Water Circulation, Fluctuation and Salinity Determinations

(1) Water

(a) Salinity

The drainage channels provide fresh water to the Bolsa Bay estuary areas. Bolsa Bay is brackish or saline, depending on the extent of the tidal influence on specific portions of the bay area. The source of salinity is the tidal influence. The extent of the drainage area is not changing with either the Minimum or Maximum Channel Modifications Alternatives, and the total stormwater runoff input to the bay/harbour is also not changing. The timing of flows may be affected by the channel modifications; with a smooth lined channel it is anticipated that the storm runoff period will be shorter and with a higher peak flow.

(b) Water Chemistry

Construction materials will be new, inert materials such as concrete, metals and other new materials. Short-term effects on the water quality are expected because of temporary increases in the concentration of suspended solids and turbidity following the construction and dredging operations. The temporary increase of suspended solids is expected to cause short-term decreases in water clarity and minor changes to the color of the water, particularly if erosion controls are not used. The long term water chemistry of the system should not be impacted by the implementation of this project.

(c) Clarity

As discussed above, the new construction materials are not expected to be a source of contamination, and dredged sediment will be placed upland with no direct return of untreated water. Short-term effects on clarity may occur because of temporary increases in the concentration of suspended solids and turbidity during in-water work activities. The temporary increase of suspended solids is expected to cause short-term decreases in water clarity.

(d) Color

The proposed work is not anticipated to cause any considerable long-term effects or changes to the water color, but a temporary increase of suspended solids during construction could cause short-term and minor changes to the color of the water.

(e) Odor

The proposed construction is not anticipated to cause any considerable long-term effects on, or changes to, the odor of the water. The upland placement of the dredged sediment could cause temporary upland odor impacts in the immediate environs of a sediment staging or dewatering operation, due to the anaerobic nature of most sediment. These odors would dissipate over a relatively short time as the sediment dries and is hauled to the disposal site.

(f) Taste

The proposed work would not be anticipated to cause any long-term effects on, or changes to, the taste of the water. Water in the drainage channels and from the bay/estuary is not used as a drinking water source.

(g) Dissolved Gas Levels

The proposed work is not anticipated to alter dissolved gas levels in the drainage channels nor in the bay/harbor/estuary.

(h) Nutrients

Temporary increases of turbidity during construction could produce minor, localized effects on nutrient levels in the water column. The project will not change the runoff area or sources of nutrients in stormwater runoff.

(i) Eutrophication

Eutrophication is typically caused by excessive nutrient levels. As discussed above, the proposed work activities could produce minor, localized effects on nutrient levels in the water column during construction, but these effects are expected to be short-term, minor, and aesthetic impacts. The proposed work is not expected to impact eutrophication in the system.

(j) Others as Appropriate

No other impacts were identified.

(2) Current Patterns and Circulation, Current Flow and Water Circulation

(a) Current Patterns and Flow

Flows in the drainage channels occur during precipitation events. These channels drain rapidly toward the ocean, and outlet into Huntington Harbour, Anaheim Bay, and Outer Bolsa Bay. The downstream ends of the channels, including the outfalls, are tidally influenced.

(b) Velocity

The velocity of water in the channels varies. Velocities in the channels during storm events may increase over current velocities. Water flow in the bay/harbor area is not expected to be changed.

(c) Stratification

The drainage channels are not thermally stratified; much of the channel length holds little water and the shallow depths do not allow for stratification. The harbors and bays are also not thermally stratified due to the tidal influences. The Minimum and the Maximum Channel Modifications Alternatives will have no impact on the stratification conditions within the project area.

(d) Hydrologic Regime

Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to have the effect of making the drainage channel flows more "peaky". That is, water will travel faster and the resulting hydrograph will be a sharper peak due to the improved channel conditions. Both alternatives are expected to have an impact on the time needed for drainage of upland areas, but not to impact the overall quantity of water that is received from any specific storm event.

(3) Normal Water Level Fluctuations

Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to impact the water level at the outlet (downstream) since those areas are controlled by tidal conditions.

(4) Salinity Gradients

Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to impact the salinity gradients already in the system (due to the upstream drainage of freshwater into a tidal zone). Both alternatives are not anticipated to change the overall volume of water that would drain into Outer Bolsa Bay or Huntington Harbour.

(5) Actions That Will Be Taken to Minimize Impacts

Neither the Minimum nor the Maximum Channel Modifications Alternatives are anticipated to result in any long-term effects on, or changes to, the water quality, current patterns or flow, water circulation, or the normal water level fluctuation of the Westminster watershed. Temporary construction impacts, such as turbidity increases, are possible. Proactive erosion control and stormwater pollution prevention practices will be used to limit any temporary impacts.

c. Suspended Particulate/Turbidity Determinations

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Disposal Site

Both the Minimum and Maximum Channel Modifications Alternatives are expected to produce minor and temporary increases of suspended solids and turbidity in the local vicinity any in-water work. Plumes of suspended particles may be visible and aesthetically displeasing until the particles gradually settle and the plumes dissipate. All soil and sediment disposal will be upland to minimize impacts to the bay areas.

(2) Effects (degree and duration) on Chemical and Physical Properties of the Water Column

(a) Light Penetration

Both the Minimum and Maximum Channel Modifications Alternatives are expected to cause minor, temporary, and localized increases of suspended solids during construction that in turn could cause a temporary decrease the clarity of the water and reduce the penetration of light through the water column. If the penetration of light is reduced for an extended period of time, it can lower the rate of photosynthesis and "primary productivity" of an aquatic area. Primary productivity generally refers to the fixation of solar energy by green plants (i.e., autotrophs) in a terrestrial ecosystem, or phytoplankton for an aquatic ecosystem. Persistently high turbidity can cause adverse impacts to sight-dependent species because the reduced clarity can hinder the feeding ability of these species, and thereby limit their growth and increase their susceptibility to disease.

In regards to elevated suspended solids concentrations, it explains the following in 40 CFR 230.21:

> "The extent and persistence of these adverse impacts caused by discharges depend upon the relative increase in suspended particulates above the amount occurring naturally, the duration of the higher levels, the current patterns, water level, and fluctuations present when such discharges occur, the volume, rate, and duration of the discharge, particulate deposition, and the seasonal timing of the discharge."

Since the minor, temporary, and localized increases of suspended solids due to the Minimum or Maximum Channel Modifications Alternatives' activities are anticipated to be low relative to the levels of suspended solids that typically result from storm events and adverse weather conditions, the alternatives are not expected to cause any long-term adverse impacts on the chemical or physical properties of the water column.

(b) Dissolved Oxygen

Minor, temporary, and localized increases of suspended solids at proposed construction sites could result in slight reductions in the level of dissolved oxygen water in the column. This is because the biological and chemical content of the suspended material may react and in turn deplete some of the dissolved oxygen in the water column.

(c) Toxic Metals and Organics

Because of the urban nature of the watershed, it is presumed that any sediment and soil will be of generally poor chemical quality; no sediment or soil will be placed in-water for disposal. Rather all excess soil and sediment disposal will occur upland with no direct return of untreated water. The materials proposed for channel lining or other construction will be new, clean construction materials that are not expected to release toxic metals or organics.

(d) Pathogens

The drainage area for the channels includes an urban environment; the surrounding drainage area is not affected by the Minimum or Maximum Channel Modifications Alternatives. The sediment and water in the channels as well as in the outfall areas may reflect the urban area and its potential pathogen sources such as uncontrolled waste disposal (dumping). Since all sediment will be disposed of upland with no direct return of untreated water, any pathogens entrained in the sediment will not be released to the environment. The construction materials that will be used for the approach channel and control technology construction will be new, clean materials that are not anticipated to be a source of pathogens.

(e) Aesthetics

The existing drainage channels reflect the urban drainage area, and uncontrolled dumping and garbage in the channels is not uncommon. The proposed lined channels will be more regular in shape and appearance, which may lend a small improvement in aesthetics, however overall no great change is anticipated. The drainage channels are not used for recreation activities that depend on aesthetics. The Bolsa Chica Ecological Reserve is the most aesthetically appealing portion of the project area. Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to impact the aesthetics of the water in the estuary and the reserve.

(f) Others as Appropriate

Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to cause any other adverse effects on the chemical and physical properties of the water column.

(3) Effects on Biota

(a) Primary Production, Photosynthesis

Neither the Minimum nor the Maximum Channel Modifications Alternatives are expected to cause any long-term adverse impacts to the harbor/bay/estuary environment.

(b) Suspension/Filter Feeders

Both the Minimum and the Maximum Channel Modifications Alternatives may cause some minor, temporary, and localized increases of suspended solids, which could benefit suspension/filter feeders, but, since the effects are anticipated to be low relative to the levels of suspended solids that typically result from storm events and adverse weather conditions, the project is not expected to cause any long-term effects on the suspension/filter feeders.

(c) Sight Feeders

Persistently high turbidity can cause adverse impacts to sight-dependent species because the reduced clarity can hinder the feeding ability of these species, and thereby limit their growth and increase their susceptibility to disease. Both the Minimum and Maximum Channel Modifications Alternatives will cause minor, temporary, and localized increases of suspended solids, but, as mentioned previously, the effects are anticipated to be low relative to the levels of suspended solids that typically result from storm events and adverse weather conditions.

Although there may be minor, temporary, and localized impacts, the project is not expected to cause persistent, long-term adverse effects on the sight feeders.

(4) Actions taken to Minimize Impacts

In order to minimize any adverse impacts of the Minimum or Maximum Channel Modifications Alternatives, in water work will be scheduled to avoid major spawning, migration and nesting times that could be impacted by the construction.

d. Contaminant Determinations

A contaminant determination has not been prepared at this time; sediment data that meet the requirements for the State of California Tiered Assessment of sediments approach are not available. The sediment is presumed to be of uncertain quality due to urban impacts. Evidence suggests that sediment in Bolsa Chica Ecological Reserve may have low concentrations of anthropogenically source compounds, in spite of past remediation efforts. The urban nature of the watershed suggests that multiple sources may contribute chemical pollutants to the bay/harbor/estuary. For these reasons, it is proposed that all soils and sediments be disposed of upland. A contaminant determination will be performed when additional project details are available. All actions will comply with the newly proposed 2018 Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries of California, Sediment Quality Provisions. Any sediment characterization activities will be coordinated in advance with the Santa Ana Regional Water Control Board.

e. Aquatic Ecosystem and Organism Determinations

(1) Effects on Plankton

Plankton are pelagic, which means they live within the water column itself, as opposed to benthic organisms that live along the bottom. Plankton generally drift along with the water currents and/or float on or near the water surface, as opposed to nekton, which are active swimmers that can propel themselves through water currents. Plankton are typically divided into phytoplankton, which includes photosynthesizing species like algae that derive energy from sunlight, water, and carbon dioxide, and zooplankton, which consume food in order to derive energy. Although most planktonic species are small and often microscopic, there are large plankton organisms that are still considered to be plankton because they drift with the water current. There are not expected to be significant plankton resources in the drainage channels themselves, such that work associated with the Minimum and Maximum Channel Modifications Alternatives would not be expected to impact plankton. The work in the bay/harbor areas is localized. Although plankton are present in the estuary areas, the proposed work is not expected to have significant impacts on the plankton populations in the bay.

(2) Effects on Benthos

Benthos refers to the organisms (plants and animals) that inhabit the bottom of a sea, stream or lake. The drainage channels are not considered to represent significant benthic habitat. The proposed work in the Outer Bolsa Bay area is limited in area. The proposed work areas may impact the benthic community in the immediate environs of the project, however due to the small area (compared to the entire bay/estuary area), this impact is expected to be minor.

(3) Effects on Nekton

Nekton refers to the aquatic life (organisms) that can swim freely and are generally independent of the water currents. This includes fish eggs and larvae. Proposed channel work for both the Minimum and Maximum Channel Modifications Alternatives is not expected to impact nekton. The proposed work in Outer Bolsa Bay may have a minor impact on the areas immediately adjacent to the work. The proposed work areas are small compared to the entire bay, so that any impacts are anticipated to be small.

(4) Effects on Aquatic Food Web

The proposed work in the drainage channels under both the Minimum and Maximum Channel Modifications Alternatives is not expected to impact the local food web because the drainage channels are not considered to be significant habitat supporting the food web. Any impacts to Outer Bolsa Bay are expected to be localized to the construction area, and are not expected to impact the larger food web in the tidal areas.

(5) Effects on Special Aquatic Sites

(a) Sanctuaries and Refuges

The Bolsa Chica Ecological Reserve and the Seal Beach National Wildlife Refuge are within the study area for the Minimum and Maximum Channel Modifications Alternatives. Both the Minimum and Maximum Channel Modifications Alternatives are not expected to have any impact to the Seal Beach National Wildlife Refuge. Both the Minimum and Maximum Channel Modifications Alternatives include construction of a floodwall along PCH, replacement of the tide gates on Reach 1 of C05, and increasing the span of Warner Avenue Bridge which are all located within the Bolsa Chica Ecological Reserve. Construction activities are expected to have an adverse impact to species utilizing the area, however, these impacts are expected to be temporary and would be reduced to less than significant with the implementation of environmental commitments which are discussed in the draft main report. Increasing the span of Warner Avenue Bridge is expected to have a long-term significant and unavoidable impact due to the permanent removal of approximately 1 acre of land upstream of the bridge that is currently constricting flow through this area. The construction of the floodwall along the PCH where it is adjacent to Outer Bolsa Bay is also expected to have a long-term significant and unavoidable impact due to the permanent removal of approximately 0.2 acres of upland habitat where the floodwall will be located. Additionally, the Minimum Channel Modifications Alternative would impact approximately 23.7 acres of seasonal wetlands/ soft-bottom habitat within the flood control channels while the Maximum Channel Modifications Alternative would impact approximately 9.3 acres of seasonal wetlands/ soft-bottom habitat within the flood control channels. Mitigation for the loss of the upland and adjacent fringe wetland habitat within Outer Bolsa Bay and loss of seasonal wetlands within the flood conveyance channels would be necessary.

(b) Wetlands

The Minimum Channel Modifications Alternative would impact approximately 23.7 acres of seasonal wetlands/soft-bottom habitat located in the flood control channels within the project footprint, approximately 1 acre of upland and adjacent fringe wetland habitat due to the

modification of Warner Avenue Bridge, and approximately 0.2 acre of upland habitat due to construction of the floodwall along PCH. The Maximum Channel Modifications Alternative would impact approximately 9.3 acres of seasonal wetlands/soft-bottom habitat located in the flood control channels within the project footprint, approximately 1 acre of upland and adjacent fringe wetland habitat due to the modification of Warner Avenue Bridge, and approximately 0.2 acre of upland habitat due to construction of the floodwall along PCH. Project activities associated with both alternatives will affect the seasonal wetlands/soft-bottom habitat within the channels through hydrological interruption and direct removal of the wetlands during construction. However, the impacts are considered temporary based on the fact that these wetlands would be naturally scoured annually (or more frequently) by any significant rain event under normal operating practices of the flood control channels. In addition, surveys conducted in May 2018 of the vegetation present within the channels concluded that the seasonal wetland areas appear to be low-functioning wetlands with little value.

Regardless of the value of the seasonal wetlands within the flood control channels, they do provide habitat to resident and migratory wildlife. Therefore, impacts to these seasonal wetlands are expected to require mitigation. In addition, increasing the span of Warner Avenue Bridge and constructing the flood wall along the PCH would adversely impact approximately 1 acre of upland and adjacent fringe wetland habitat and approximately 0.2 acre of upland habitat, respectively. The impact to these habitats would also require mitigation due to the impact being significant and unavoidable.

(c) Mud Flats

Mud flat habitat does exist within the study area. Specifically, there is mud flat habitat within Reach 23 of C02 and Reach 1 of C05. Construction within these reaches for both the Minimum and Maximum Channel Modifications Alternatives includes widening these reaches, driving sheetpile along the walls, and leaving the channel bottom soft. Therefore, no loss in mud flat habitat is expected with the implementation of the Minimum or Maximum Channel Modifications Alternatives. Increasing the width of Reach 23 and Reach 1 of C02 and C05, respectively, would actually increase the amount of soft-bottom habitat.

(d) Vegetated Shallows

Vegetated shallow habitat would be impacted by the modification to the Warner Avenue Bridge. Approximately 1 acre of upland and adjacent fringe wetland habitat would be removed permanently upstream of the bridge. This would result in a loss of less than 1 acre of vegetated shallow habitat. The construction of the floodwall along the PCH also has the potential to impact vegetated shallow habitat depending on the exact footprint of the floodwall.

(e) Coral Reefs

There are no coral reefs within the project area so this topic is not applicable.

(f) Riffle and Pool Complexes

There are no riffle and pool complexes present in the vicinity of the project, so this topic is not applicable.

(6) Threatened and Endangered Species

The USFWS's Environmental Conservation Online System Information for Planning and Consultation (ECOS-IPaC) was queried regarding federally-listed species that may be present within the study area. An official species list was obtained November 2, 2017 (Consultation Code 08ECAR00-2018-SLI-0137), and this list was confirmed again via the ECOS-IPaC website on May 10, 2018. Thirteen federally-listed threatened, endangered, or candidate species are listed on the USFWS official species list as occurring within the study area. The California Department of Fish and Wildlife (CDFW) also noted that the green sea turtle (*Chelonia mydas*) and California seablite (*Suaeda californica*), both federally-listed species, are also found within the study area.

In addition to federally-listed species, there are approximately 77 state species listed as state threatened, endangered, candidate, special concern, fully protected, watch list, and rare plant that may be found within the study area. In addition, the CDFW in a letter dated January 12, 2018, listed the following state-listed species and state sensitive species and habitats as occurring within the Bolsa Chica Ecological Reserve: western snowy plover (*Charadrius nivosus nivosus*), Ridgway's rail (*Rallus obsoletus levipes*), California least tern (*Sternula antillarum browni*), Belding's savannah sparrow (*Passerculus sandwichensis beldingii*), peregrine falcon (*Falco peregrinus*), burrowing owl (*Athene cunicularia*), coastal California gnatcatcher (*Polioptila californica californica*), northern harrier (*Circus cyaneus*), Cooper's hawk (*Accipiter cooperii*), osprey (*Pandion haliaetus*), black skimmer (*Rynchops niger*), white-faced ibis (*Plegadis chihi*), reddish egret (*Egretta rufescens*), California seablite (*Suaeda californica*), woolly seablite (*Suaeda taxifolia*), estuary seablite (*Suaeda esteroa*), coast woolly-heads (*Nemacaulis denudata var. denudata*), southern tarplant (*Centromadia parryi ssp. australis*), red sand verbena (*Abronia maritima*), and green sea turtle (*Chelonia mydas*). Per the letter, sensitive marine resources include eelgrass (*Zostera marina*) beds, beach habitat, intertidal and subtidal habitat, nesting/spawning habitat (including grunion, *Leuresthes tenuis*, habitat), mud flats, sand flats, dunes, coastal strand, and salt marsh.

Construction activities associated with channel modifications would impact foraging activities by special status species such as California least tern, western snowy plover, black skimmer, and peregrine falcon. Construction activities within Reach 23 of C02 and Reach 1 of C05 as well as the replacement of the tide gates could impact nesting activities by special status species, such as the Belding's savannah sparrow. Construction activities could also impact the green sea turtle which is known to occur within Bolsa Chica Ecological Reserve as well as within the vicinity of Reach 23 of C02. Construction activities would likely temporarily keep green sea turtles from utilizing habitat and foraging in the area where construction is occurring. The implementation of environmental commitments are expected to reduce these impacts which would be temporary in duration (lasting only as long as construction is occurring).

(7) Other Wildlife

Other local wildlife such as raccoons, opossums, fox and other small ubiquitous species that survive in urban areas maybe be disrupted during construction activities, but are not anticipated to be significantly impacted. These species are highly tolerant of human activities and are expected to relocate themselves during construction with no impact on the overall species occurrence.

(8) Actions to Minimize Impacts

Best management practices will be used for all construction. Construction will be conducted in the dry when possible. All excess soil and sediment will be disposed of upland at an appropriate disposal facility. Erosion and turbidity controls and best management practices for construction will be used for all projects.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination

A mixing zone is not applicable because sediment will be placed upland with no direct return of untreated water.

(2) Determination of Compliance with Applicable Water Quality Standards

The project is expected to comply with all applicable water quality standards and no violations are anticipated.

(3) Potential Effects on Human Use Characteristic

(a) Municipal and Private Water Supply

The drainage channels and bay/estuary are not used for drinking water. Both the Minimum and Maximum Channel Modifications Alternatives could reduce infiltration from the channels to the local shallow aquifers due to paving of the channel bottoms. Since the channels do not hold water continuously but only during precipitation events, the amount of impact to infiltration is expected to be minor.

(b) Recreational and Commercial Fisheries

No effects on commercial fisheries will occur in regards to the Minimum or Maximum Channel Modifications Alternatives, since commercial fishing does not occur within the vicinity.

(c) Water Related Recreation

The drainage channels are not used for recreation. The Bolsa Chica Ecological Reserve is a recreational feature. Impacts to the reserve will be limited since significant construction is not proposed for that area. Increasing the span of Warner Avenue Bridge may cause some temporary navigation restrictions that could impact recreational boaters. Navigation notices would be used to provide advance notice to boaters, to limit temporary impacts during construction.

(d) Aesthetics

There may be minor and temporary effects on the aesthetic quality of the air, water, and visual quality, and increases in noise levels due to the construction activities. All impacts are expected to be relatively minor and short term. The aesthetic effects will be temporary and will only impact those people in the immediate vicinity of construction work.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

The Bolsa Chica Ecological Reserve is an approximately 1,300 acre coastal estuary located in the City of Huntington Beach, Orange County, California. The reserve is bordered on the north by Warner Avenue, on the west by the Pacific Coast Highway and Bolsa Chica State Beach, on the south by Seapointe Avenue, and on the east by residential neighborhoods. Construction activities at the Warner Avenue Bridge could cause a temporary impact to the reserve.

Huntington Harbour is located on the northwest corner of Huntington Beach bordering Seal Beach and Sunset Beach. The harbor encompasses five man-made islands bounded by a network of navigable channels and the land surrounding them. Huntington Harbour is not expected to be impacted by the Minimum or Maximum Channel Modifications Alternatives.

The Seal Beach National Wildlife Refuge was established in 1972 and is administered by the U.S. Fish and Wildlife Service to protect and conserve essential habitats for threatened and endangered species. The 965 acre refuge is located within the Naval Weapons Station Seal Beach, in Orange County, California and encompasses remnant saltwater marsh in the Anaheim Bay estuary. Seal Beach Refuge is not expected to be impacted by the Minimum or the Maximum Channel Modifications Alternatives.

g. Determination of Cumulative Effects on the Aquatic Ecosystem

There are no identified significant cumulative effects on the aquatic ecosystem due to the Minimum or Maximum Channel Modifications Alternatives.

h. Determination of Secondary Effects on the Aquatic Ecosystem

There are no identified secondary effects on the aquatic ecosystem due to the Minimum or Maximum Channel Modifications Alternatives.

III. Findings of Compliance or Non-Compliance with the Restrictions on Discharge

a. Adaptation of the Section 404(b)(l) Guidelines to this Evaluation

There were no adaptations of the Section 404(b)(l) guidelines for this evaluation.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem

The feasibility study document discusses the practicable alternatives that were evaluated. It is expected that all of the alternatives considered, besides the "no action" alternative, would have similar impacts.

c. Compliance with Applicable State Water Quality Standards

The proposed construction will comply with the California Construction General Permit Order (currently 2009-0009-DWQ but subject to update). Work in or near the bay/estuaries will comply with the California Sediment Quality Objectives, Clean Water Act Section 401 and the Porter-Cologne

Water Quality Control Act, and will be protective of the natural environment. Excess soils and dredged sediment will be placed upland for disposal with no direct return of untreated water. None of the proposed activities are anticipated to cause any considerable long-term effects on, or changes to, the water chemistry or quality. Short-term effects on the water quality are possible because of temporary increases in the concentration of suspended solids and turbidity due to construction and dredging operations. To minimize impacts, erosion control and stormwater pollution prevention practices will be implemented proactively. Overall the project is expected to comply with all applicable water quality standards and no violations are anticipated.

d. Compliance with Applicable Toxic Effluent Standard or Prohibition Under Section 307 Of the Clean Water Act

The project is in compliance with applicable Toxic Effluent Standards under Section 307 of the Clean Water Act; with the Endangered Species Act of 1973; with the National Historic Preservation Act of 1966; and with the Marine Protection, Research, and Sanctuaries Act of 1972.

e. Compliance with Endangered Species Act of 1973

Pursuant to the ESA, USFWS and NMFS has regulatory authority over Federally-listed species. Under the ESA, a permit to "take" a listed species is required for any Federal action that may harm a listed species. ESA, Section 7 prohibits Federal agencies from authorizing, funding, or carrying out activities that are likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its critical habitat. By consulting with USFWS and NMFS before initiating projects, agencies review actions to determine if they could adversely affect listed species or their habitat and design their programs and projects to conserve listed and proposed species. USFWS and NMFS coordination with other Federal agencies is important to species conservation. USFWS is the administering agency for non-marine species. NMFS is the administering agency for marine species, including anadromous fish species.

USACE has initiated coordination with the USFWS and NMFS with scoping letters which were sent November 30, 2017. Coordination with these two agencies will continue as the project progresses and will ensure that the proposed project is in full compliance with Section 7 of the Act.

f. Compliance with Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection, Research, and Sanctuaries Act of 1972

Essential Fish Habitat (EFH) for groundfish, coastal pelagic species, and finfish and market squid has been designated in Anaheim Bay, Huntington Harbour, and Inner and Outer Bolsa Bay. EFH for these species also extends upstream into Reach 23 of C02, and Reaches 1 and 2 of C05. The draft main report and the EFH assessment found in the Draft main report serve as preliminary consultation with the NMFS under Section 16 of U.S.C. It is expected that the National Marine Fisheries Service (NMFS) will provide comments during the public review on the EFH assessment in the draft report. Any conservation recommendations provided by the NMFS during the public review and in subsequent consultation will be considered and responded to by USACE. Once USACE considers and responds to any conservation recommendations provided by NMFS, the proposed project will be in compliance with this Act.

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant Adverse Effects on Human Health and Welfare

The proposed fill (construction of the lined channels, widened bridge, floodwall, tidal gates) activity is not expected to have any long-term adverse impacts on human health or welfare, including;

(a) Municipal and private water supplies,
(b) Recreational and commercial fisheries,
(c) Plankton,
(d) Fish,
(e) Shellfish,
(f) Wildlife communities (including community diversity, productivity, and stability), or
(g) Special aquatic sites

(2) Significant Adverse Effects on Life Stages of Aquatic Life and Other Wildlife Dependent on Aquatic Ecosystems

No significant adverse effects are anticipated.

(3) Significant Adverse Effects on Aquatic Ecosystem Diversity, Productivity and Stability

No long-term adverse effects are expected on aquatic ecosystem diversity, productivity or stability.

(4) Significant Adverse Effects on Recreational, Aesthetic, and Economic Values

As described earlier, the project may have minor and temporary effects on recreational, and aesthetic values. In regards to recreation, the work at the Warner Avenue Bridge may cause temporary navigation restrictions which could impact recreational boaters. The project will also cause minor and temporary effects on the aesthetic quality of the air, water, and visual quality in the area close to the project site. Increases in noise levels due to the construction will also occur, but is expected to be minor and temporary. The aesthetic effects will be temporary and will only impact those people in the immediate vicinity. No impacts to economic values of the area are expected.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem

The main step that will be taken to minimize potential adverse impacts is that dredged sediment will be disposed of upland with no untreated return water. This will prevent the release of anthropogenic compounds associated with the sediment. Good housekeeping and best management practices including erosion control and stormwater pollution prevention practices will be used for all construction activities to minimize localized impacts to water.

i. On the basis of the guidelines, the proposed disposal site for the discharge of the dredged material is specified as complying with the requirements of these guidelines, with the inclusion of appropriate and practical conditions to minimize adverse impacts to the aquatic ecosystem.

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4.0 Preliminary Compendium Report for Water Quality and Sediment in the C05 (Garden Grove-Wintersburg Channel), Westminster, California

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PRELIMINARY COMPENDIUM REPORT FOR WATER QUALITY AND SEDIMENT IN THE CO5 (GARDEN GROVE-WINTERSBURG CHANNEL) WESTMINSTER, CALIFORNIA

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SECTION 1.0 – INTRODUCTION

1.1 BACKGROUND

This Water Quality and Sediment Compendium Report summarizes the existing data available for water quality and sediment within the East Garden Grove-Wintersburg Channel of the Westminster Flood Risk Management Project (proposed project). The purpose of the report is to provide a comparison of current water quality conditions specifically in the East Garden Grove-Wintersburg (C05) to conditions in the channel from two decades ago (i.e., 1990s).

The proposed project will examine opportunities to improve the function of the constructed flood control channels or storm drains of the C05, Oceanview (C06), Westminster (C04), and Bolsa Chica (C02) Channel Systems. These channels are part of the Westminster watershed. The Westminster watershed is designated with the letter "C" by Orange County. As such, these channels are numbered C05, C06, C04, and C02, as identified above. The proposed project would allow the modification of the C05, C06, C04, and C02 channels to provide 100-year flood conveyance of stormwater.

CO5 and its tributaries, including C06, collect and convey runoff over approximately 28 square miles to Outer Bolsa Bay (Figure 1). CO5 begins upstream of Haster Basin in the City of Garden Grove and is approximately 11 miles long. C06 extends for about 4 miles and originates east of Mile Square Park in the City of Fountain Valley and flows westerly to the City of Huntington Beach where it discharges into the C05 channel northeast of the intersection of Gothard Street and Warner Avenue. Current data for CO5 are from a sampling station at Gothard Street. CO5 terminates with one-way flap gates at the south end of Outer Bolsa Bay. From Outer Bolsa Bay, runoff is conveyed under the Warner Avenue Bridge through Huntington Harbour, Anaheim Bay and ultimately the Pacific Ocean. Tidal waters flow between Outer and Inner Bolsa Bay through tide gates that partly restrict tidal exchange (CSLC et al. 2001). The tidal range in Inner Bolsa Bay is muted to about 22 percent of that of Outer Bolsa Bay.

1.1.1 Watershed

The proposed Project is located within the Anaheim Bay-Huntington Harbour Watershed (Hydrologic Unit Code [HUC] 180702010001), which encompasses approximately 80 square miles of Orange County. The Anaheim Bay-Huntington Harbour Watershed lies on flat coastal plains bounded by the Santa Ana River, Talbert Mesa, the Pacific Ocean and the Westminster Channel system. The watershed includes portions of the cities of Anaheim, Cypress, Fountain Valley, Garden Grove, Huntington Beach, Los Alamitos, Santa Ana, Seal Beach, Stanton, and Westminster in the County of Orange. The watershed covers an area that is predominantly urbanized. Typical flow in the Anaheim Bay-Huntington Harbour Watershed is almost completely dry weather runoff. There is no dominant river for the watershed that drains a substantial portion of the watershed. Channels that drain the watershed include Stanton Storm Channel; CO2; Anaheim Harbor City Channel; CO4; CO5; and CO6.

Figure 1 Project Vicinity Map

(to be provided by Corps)

1.1.2 Flood Plains

The Project area is within the 100-year flood plain. The Project area is designated as Zone A, which represents areas subject to inundation by the 1-percent-annual-chance flood event (FEMA 2015).

1.1.3 Groundwater Resources

Groundwater in the project area occurs within the Coastal Plain of Orange County groundwater basin, which underlies a coastal alluvial plain with total storage capacity of about 38,000,000 acre-feet. Orange County Water District manages this groundwater basin. Recharge is predominantly from percolation of Santa Ana River flow, infiltration of precipitation, and injection into wells.

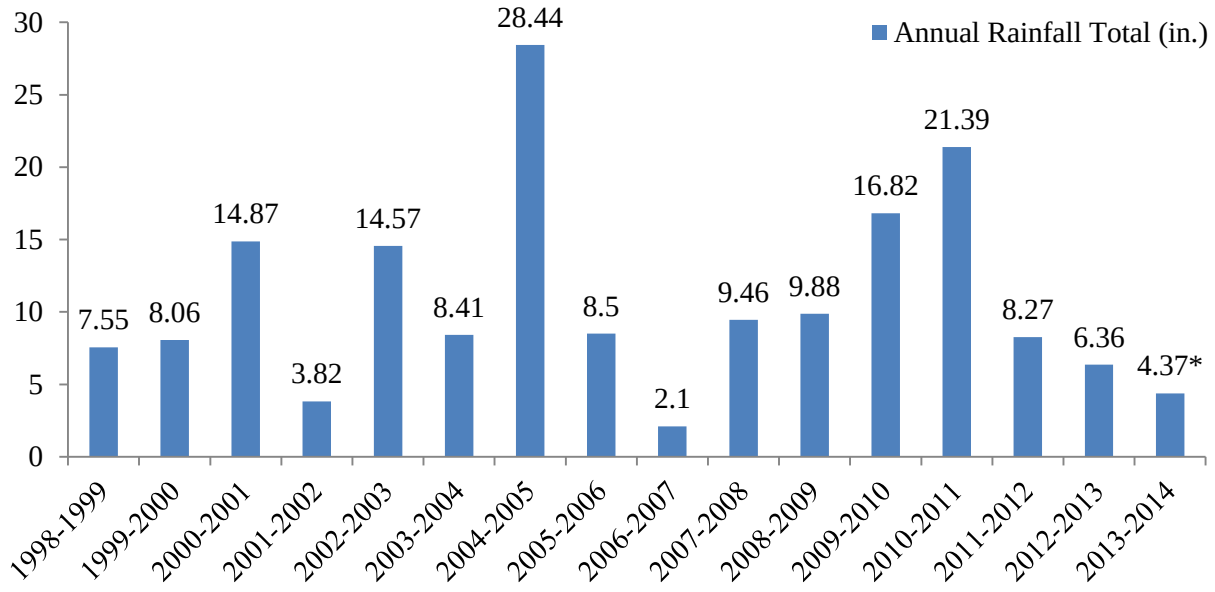
1.1.4 Topography

The headwaters for the channels within the watershed begin in the northern and eastern reaches of the watershed, which has a very low slope, having once been primarily swamplands or low coastal floodplains for the San Gabriel and Santa Ana rivers. All the channel reaches within the watershed are improved (lined) for flood control.

1.1.5 Climate

The climate in Orange County is classified as Mediterranean, which is characterized by pronounced seasonal changes in rainfall (i.e., dry summer and rainy winters) with relatively modest transitions in temperature. The average annual rainfall varies between 10 and 15 inches. Most rainfall occurs generally between December and March during a few large storm events (Orange County Watersheds and Coastal Resources Division, 2003). A graph of the total annual rainfall in the Santa Ana Region is provided in Figure 2.

Figure 2 Annual Rainfall in Santa Ana Region



*A lack of rain overall limited the storm monitoring efforts in the Santa Ana Region for 2013-14.

SECTION 2.0 – EXISTING DATA PLANS AND PROGRAMS

2.1 CLEAN WATER ACT

Section 303 of the CWA requires that the state identify and prioritize waters that do not meet, or are not expected to meet water quality standards by technology-based controls alone. Lists of these waters are included in the Section 303(d) lists submitted to the USEPA.

Section 401 of the CWA specifies than any applicant for a federal license or permit to conduct any activity that may result in any discharge into navigable water shall provide the licensing or permitting agency with a certification. The certification shall indicate that the project complies with all water quality standards, including beneficial uses, water quality objectives, and the state antidegradation policy.

Section 402 of the CWA permits discharge of a pollutant based on certain discharge conditions as part of the National Pollutant Discharge Elimination System (NPDES). The NPDES program establishes enforceable effluent limitations on discharges, require monitoring, designate reporting requirements, and require BMPs.

Section 404 of the CWA regulates the discharge of dredge or fill materials into waters of the US. The program is jointly administered by the USACE and US Environmental Protection Agency (USEPA) The USACE enforces the Section 404 provisions and reviews applications for individual and nationwide permits. The USACE also verified jurisdictional delineations identifying waters of the US.

Total Maximum Daily Load (TMDL) is a regulatory term in the (CWA, describing a value of the maximum amount of a pollutant that a body of water can receive while still meeting water quality standards.[1] Alternatively, TMDL is an allocation of that water pollutant deemed acceptable to the subject receiving waters.

2.1.1 Beneficial Uses

Waterbodies in the East Garden Grove-Wintersburg Channel watershed fall under the jurisdiction of the California Regional Water Quality Control Board (RWQCB), Santa Ana Region. The RWQCB sets water quality objectives and beneficial uses for surface and ground water in the Water Quality Control Plan Santa Ana River Basin (RWQCB 1995). The RWQCB lists the receiving waters of CO5 as Sunset Bay-Huntington Harbour, Inner and Outer Bolsa Bay, and Bolsa Chica Ecological Reserve.

Table 2-1 shows designated beneficial uses for these C05 receiving waters. No beneficial uses have been set for CO5 itself. Designated beneficial uses common to all three receiving waterbodies include contact and non-contact water recreation (REC-1, REC-2), wildlife habitat (WILD), rare, threatened, or endangered species (RARE), spawning, reproduction and development (SPWN), and marine habitat (MAR). Sunset Bay-Huntington Harbour beneficial uses also include commercial and sports fishing (COMM) and navigation (NAV). Beneficial uses of Bolsa Bay and Bolsa Chica Ecological Reserve include preservation of Biological Habitats of Special Significance (BIOL). Additional designated beneficial uses are shellfish

harvesting (SHELL) in Bolsa Bay and estuarine habitat (EST) in Bolsa Chica Ecological Reserve.

2.1.2 303(d) List

Table 2-2 shows the pollutants for which CO5 and Huntington Harbour have been placed on the Santa Ana Region 303(d) List of Water Quality Limited Segments. CO5 is on the 303(d) list for unionized ammonia from an unknown source as a Category 5A, which is "a water segment where standards are not met and a TMDL is required, but not yet completed, for at least one of the pollutants being listed for this segment." CO5 is not listed on the 303(d) list for pH or water temperature.

Huntington Harbour is on the 303(d) list for chlordane, copper, lead, nickel PCBs, and sediment toxicity all from unknown and multiple sources. CO5 is not the only contributor to Huntington Harbour. Huntington Harbour also is on the 303(d) list for pathogens from urban runoff/storm sewers. The pathogen impairment is focused at the 11th Street, Anderson Street Marina, Clubhouse Marina and Sunset Aquatic Park locations. These locations exceed the enterococcus bacteria standard.

2.1.3 California Toxics Rule

USEPA promulgated CWA 303(c) water quality criteria for priority toxic pollutants in California's inland surface waters and enclosed bays and estuaries in the California Toxics Rule (CTR). The CTR supplements, and does not change or supersede, the criteria that USEPA promulgated for California in the National Recommended Water Quality Criteria, but fills gap in California's water quality standards necessary to protect human health and aquatic life beneficial uses. The Criterion Maximum Concentration is the highest concentration of a pollutant to which aquatic life can be exposed for a short period of time (1-hour average) without deleterious effects. The Criterion Continuous Concentration is the highest concentration of a pollutant to which aquatic life can be exposed for an extended period of time (4 days) without deleterious effects. These values are listed in Table 3.4-4.

Table 2-1 Beneficial Uses of East Garden Grove Wintersburg Channel and Receiving Waters

BAYS, ESTUARIES, AND TIDAL PRISMS	BENEFICIAL USE																				Hydrologic Unit	
	MUN	AGR	IND	PROC	GWR	NAV	POW	REC1	REC2	COMM	WARM	LWRM	COLD	BIOL	WILD	RARE	SPWN	MAR	SHEL	EST	Primary	Secondary
Sunset Bay – Huntington Harbour	+					X		X	X	X					X	X	X	X			801.1	
Bolsa Bay	+							X	X	X				X	X	X	X	X	X		801.1	
Bolsa Chica Ecological Reserve	+							X	X					X	X	X	X	X		X	801.1	

Table 2-2 Santa Ana Region 303(d) List of Water Quality Limited Segments

REGION	WATER BODY NAME	WATER	WATERSHED CALWATER/ USGS HUC	POLLUTANT POTENTIAL SOURCES	ESTIMATED AREA ASSESSED	FIRST YEAR LISTED	TMDL REQUIREMENT STATUS	DATE
8	East Garden Grove Wintersburg Channel	River & Stream	80111000/18070201	Ammonia (unionized)/source unknown	2.9 Miles	2010	5A	2021
8	Huntington Harbour	Bay & Harbor	80111000/18070201	chlordane/source unknown	221 Acres	2006	5A	2019
				copper/source unknown	221 Acres	2002	5A	2019
				Lead/source unknown	221 Acres	2006	5A	2019
				Nickel/source unknown	221 Acres	2002	5A	2019
				PCBs (Polychlorinated biphenyls)(tissues)/source unknown	221 Acres	2002	5A	2019

Final 2010 Integrated Report (CWA Section 303(d) List / 305(b) Report), USEPA Final Approval: October 11, 2011

Table 2-3 California Toxics Rule

Constituent	Freshwater		Saltwater	
	Criterion Maximum Concentration (µg/L)	Criterion Continuous Concentration (µg/L)	Criterion Maximum Concentration (µg/L)	Criterion Continuous Concentration (µg/L)
Arsenic	340	150	69	36
Cadmium	4.3	2.2	43	9.3
Chromium (VI)	16	11	1100	50
Copper	13	9	4.8	3.1
Lead	65	2.5	210	8.1
Nickel	470	52	74	8.2
Selenium		5	290	71
Silver	3.4		1.9	
Zinc	120	120	90	81
Cyanide	22	5.2	1	1
Pentachlorophenol	19	15	13	7.9
Aldrin	3		1.3	
gamma-BHC	0.95		0.16	
Chlordane	2.4	0.0043	0.09	0.004
4,4'-DDT	1.1	0.001	0.13	0.001
Dieldrin	0.24	0.056	0.71	0.0019
alpha-Endosulfan	0.22	0.056	0.034	0.0087
beta-Endosulfan	0.22	0.056	0.034	0.0087
Endrin	0.086	0.036	0.037	0.0023
Heptachlor	0.52	0.0038	0.053	0.0036
Heptachlor Epoxide	0.52	0.0038	0.053	0.0036
Polychlorinated biphenyls (PCBs)		0.014		0.03
Toxaphene	0.73	0.0002	0.21	0.0002

Note: Values for metals have been converted to total recoverable.
µg/L - micrograms per liter.
Source: California Toxics Rule 2000

2.2 SANTA ANA REGION BASIN PLAN

The Water Quality Control Plan for the Santa Ana River Basin (1995, updated 2014) contains water quality objectives to reasonably protect and to maintain or enhance the beneficial uses of water. The objectives and criteria contained in the Basin Plan are presented in Table 2-4. The standards represent maximum levels that allow beneficial uses of the water basin to continue unimpaired.

Enclosed bays include indentations along the coast that enclose an area of oceanic water within distinct headlands or harbor works. Estuaries includes waters located at the mouths of streams, including coastal lagoons, that serve as areas of mixing for fresh and ocean waters. Regional objectives for enclosed bays and estuaries include algae, bacteria/coliform, residual chlorine, color, floatables, oil and grease, dissolved oxygen, pH, radioactivity, solid/suspended/settleable solids, sulfides, surfactants (surface-active agents), taste and odor, temperature, toxic substances, and turbidity. Inland surface waters include streams, rivers, lakes, and wetlands in the Region. Regional objectives for inland surface waters include algae, unionized ammonia, site-specific unionized ammonia objective for the Santa Ana River System, bacteria/coliform, boron, chemical oxygen demand, chloride, residual chlorine, color, total dissolved solids (total filterable residue), floatables, fluoride, hardness (as $CaCO_3$), total inorganic nitrogen, metals, methylene blue-activated substances (MBAS), nitrate, oil and grease, dissolved oxygen, pH, radioactivity, sodium, solid/suspended/settleable solids, sulfate, sulfides, surfactants (surface-active agents), taste and odor, temperature, toxic substances, and turbidity.

Table 2-4 Select Water Quality Objectives from the Santa Ana River Basin Plan

Objective	Bays and Estuaries
	Criteria
Algae	Waste discharges shall not contribute to excessive algal growth in receiving waters.
Residual Chlorine	Shall not exceed 0.1 mg/L.
Coliform Bacteria	REC-1 - Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30-day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period. SHEL – Fecal coliform: median concentration not more than 14 MPN (most probable number)/100 mL and not more than 10 of samples exceed 43 mpn/mL.
Dissolved Oxygen	Shall not be depressed to levels that adversely affect beneficial uses as a result of controllable water quality factors.

Objective	Bays and Estuaries Criteria
pH	Shall not be raised above 8.6 or depressed below 7.0 as a result of controllable water quality factors; ambient pH levels shall not be changed more than 0.2 units.
Temperature* (new discharges)	Bays - Elevated temperature waste discharges shall comply with limitations necessary to assure protection of beneficial uses. The maximum temperature of waste discharges shall not exceed the natural temperature of the receiving waters by more than 20°F. Thermal waste discharges having a maximum temperature greater than 4°F above the natural temperature of the receiving water are prohibited. Estuaries - Elevated temperature waste discharges shall comply with the following: a.) The maximum temperature shall not exceed the natural receiving water temperature by more than 20°F. b.) Elevated temperature waste discharges either individually or combined with other discharges shall not create a zone, defined by water temperatures of more than 1°F above natural receiving water temperature, which exceeds 25 percent of the cross- sectional area of a main river channel at any point. c.) No discharge shall cause a surface water temperature rise greater than 4°F above the natural temperature of the receiving waters at any time or place. d.) Additional limitations shall be imposed when necessary to assure protection of beneficial uses. Thermal waste discharges having a maximum temperature greater than 4°F above the natural temperature of the receiving water are prohibited.
Toxic Substances	Concentrations in the water column, sediments or biota shall not adversely affect beneficial uses.
Turbidity	Increases in turbidity which result from controllable water quality factors shall comply with the following: Natural turbidity 0-50 NTU = Maximum increase of 20% Natural turbidity 50-100 NTU = Maximum increase of 10 NTU Natural turbidity greater than 100 NTU = Maximum increase of 10%
	Inland Surface Waters
Un-ionized ammonia	Calculated numerical UIA-N objectives as well as corresponding total ammonia nitrogen concentration for various pH and temperature conditions shown in tables in the Basin Plan.
Coliform Bacteria	MUN – Total coliform less than 100 organisms/100 mL. REC-1 - Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30-day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period. REC-2 – Fecal coliform: average less than 2,000 organisms/100 mL and not more than 10% of samples exceed 4,000 organisms/100 mL for any 30-day period.
Nitrate	Nitrate-nitrogen concentrations shall not exceed 45 mg/L (as NO3) or 10 mg/L (as N) in inland surface waters designated MUN as a result of controllable water quality factors.
pH	Shall not be raised above 8.5 or depressed below 6.5 as a result of controllable water quality factors.
*As identified in the "Water Quality Control Plan for Control of Temperature in the Coastal and Interstate Waters and Enclosed Bays and Estuaries of California (Thermal Plan, updated 1998)." Source: Santa Ana River Basin Water Quality Control Plan (1995, updated 2014).	

2.3 CALIFORNIA OCEAN PLAN

The State Water Resources Control Board (SWRCB 2012) has established objectives for the protection of marine aquatic life in the California Ocean Plan. For purposes of identifying the difference in objectives for the receiving waters compared to the subject channel (i.e., CO5), those objectives are listed in Table 2-5.

Table 2-5 California Ocean Plan Water Quality Objectives

Constituent	Limiting Concentrations			
	Units of Measurement	6-Month Median	Daily Maximum	Instantaneous Maximum
Arsenic	µg/L	8	32	80
Cadmium	µg/L	1	4	10
Chromium (Hexavalent)	µg/L	2	8	20
Copper	µg/L	3	12	30
Lead	µg/L	2	8	20
Mercury	µg/L	0.04	0.16	0.4
Nickel	µg/L	5	20	50
Selenium	µg/L	15	60	150
Silver	µg/L	0.7	2.8	7
Zinc	µg/L	20	80	200
Cyanide	µg/L	1	4	10
Total Chlorine Residual	µg/L	2	8	60
Ammonia (expressed as nitrogen)	µg/L	600	2400	6000
Acute Toxicity	TUa	N/A	0.3	N/A
Chronic Toxicity	TUc	N/A	1	N/A
Phenolic Compounds (non-chlorinated)	µg/L	30	120	300
Chlorinated Phenolics	µg/L	1	4	10
Endosulfan	ng/L	0.009	0.018	0.027
Endrin	ng/L	0.002	0.004	0.006
HCH	ng/L	0.004	0.008	0.012
Radioactivity	Not to exceed limits specified in Title 17, Division 1, Chapter 5, Subchapter 4, Group 3, Article 3, Section 30253 of the California Code of Regulations.			

2.4 SANTA ANA REGIONAL WATER QUALITY MONITORING PROGRAM ELEMENTS

2.4.1 Receiving Waters Monitoring Program

This report includes a summary of data collected as part of the Orange County Stormwater Program Unified Program Effectiveness Assessment (PEA) Unified Annual Progress Report for the Santa Ana Region. The Orange County Stormwater Program (OCSWP) is a cooperative municipal regulatory compliance initiative focused on the management of urban and stormwater runoff for the protection and enhancement of Orange County's creeks, rivers, streams, and coastal waters (County of Orange and OCFCD 2013). The primary objective of the Program is to satisfy the requirements of area-wide municipal National Pollutant Discharge Elimination System (NPDES) permits (NPDES CAS618030), specifically, RWQCB Order R8-2009-0030 (Santa Ana Regional Board). The NPDES permits were first adopted in 1990 and subsequently renewed in 1996 (Second Term), 2002 (Third Term), and 2009 (Fourth Term).

2.4.1.1 Mass Emissions Monitoring

Mass Emissions monitoring provides the estimate of total annual masses of constituents transported by flood control drainage channels to receiving waters during both dry-weather and stormwater runoff conditions. Mass emissions monitoring also provides water chemistry data to assess water quality with respect to acute and chronic toxicity criteria from the CTR. Toxicity testing is conducted with freshwater organisms for dry weather runoff samples and with a combination of freshwater and marine organisms for stormwater runoff samples.

2.5 NATIONAL STATUS AND TRENDS PROGRAM

No comparable criteria exist for the protection of aquatic life from contaminated sediments. As a part of the National Status and Trends Program, the National Oceanographic and Atmospheric Administration (NOAA) published and updated effects-based sediment quality values for evaluating the potential for constituents in sediment to cause adverse biological effects (Long and Morgan 1990, Long et al. 1995). Those values are referred to as Effects Range-Low (ER-L) and Effects Range-Median (ER-M). The ER-L concentrations are equivalent to the lower tenth percentile of available data screened by NOAA and indicate the low end of the range of concentrations at which adverse biological effects are observed or predicted in sensitive species and/or sensitive life stages. These values are to be used as guidelines only and not as thresholds and not associated with any regulatory requirements. The ER-M values are concentrations based on the NOAA screened data at which effects are observed or predicted in Table 2-6.

Table 2-6 Sediment Effects Guideline Values for Protection of Marine Aquatic Life

Parameter	Effects Range-Low (ER-L)	Effects Range-Median (ER-M)
Metals (mg/Kg)		
Antimony	2.0	2.5

Parameter	Effects Range-Low (ER-L)	Effects Range-Median (ER-M)
Arsenic	8.2	70
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	46.7	218
Mercury	0.15	0.71
Nickel	20.9	51.6
Silver	1	3.7
Zinc	150	410
Organics (µg/Kg)		
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1100
Fluorene	19	540
2-Methyl naphthalene	70	670
Naphthalene	160	2100
Phenanthrene	240	1500
Low-molecular weight PAH	552	3160
Benz(a)anthracene	261	1600
Benzo(a)pyrene	430	1600
Chrysene	384	2800
Dibenzo(a,h)anthracene	63.4	260
Fluoranthene	600	5100
Pyrene	665	2600
High molecular weight PAH	1700	9600
Total PAH	4022	44792
p,p'-DDE	2.2	27
Total DDT	1.58	46.1
Total PCBs	22.7	180

ER-L = Effects Range Low - Concentration at lower tenth percentile at which adverse biological effects were observed or predicted.
ER-M = Effects Range Median - Concentration at which adverse biological effects were observed or predicted in 50% of test organisms.
mg/Kg - milligrams per kilogram.
µg/Kg - micrograms per kilogram.
Source: Long et al. 1995.

2.6 ASSEMBLY BILL 411

Assembly Bill (AB) 411 requires the State Department of Health Services to adopt regulations requiring the testing of all beaches for total coliform, fecal coliform, enterococci, streptococci bacteria, and chemical pollutants including, but not limited to, PCBs, PAHs, and mercury on a weekly basis from April 1 to October 31, inclusive, of each year if certain conditions are met. AB 411 also includes protective minimum standards for the location of monitoring sites and monitoring frequency, to require posting in clearly visible points along affected beaches whenever state standards are violated. AB 411 would require the local health officer to notify the Director of Parks and Recreation within 24 hours of any beach posting, closure, or restriction, and would require the Director of Parks and Recreation to establish a telephone hotline and update it daily to inform the public of beach postings, closures, and restrictions.

The minimum protective bacteriological standards for waters adjacent to public beaches and public water-contact sports areas shall be as follows:

(1) Based on a single sample, the density of bacteria in water from each sampling station at a public beach or public water contact sports area shall not exceed:

(A) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or

(B) 10,000 total coliform bacteria per 100 milliliters; or

(C) 400 fecal coliform bacteria per 100 milliliters; or

(D) 104 enterococcus bacteria per 100 milliliters.

(2) Based on the mean of the logarithms of the results of at least five weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station at a public beach or public water contact sports area, shall not exceed:

(A) 1,000 total coliform bacteria per 100 milliliters; or

(B) 200 fecal coliform bacteria per 100 milliliters; or

(C) 35 enterococcus bacteria per 100 milliliters.

SECTION 3.0 – ANALYSIS OF EXISTING DATA

3.1 MASS EMISSIONS PROGRAM

Patterns of CTR exceedances for CO5 during dry weather and wet weather (e.g., stormwater) conditions have been summarized as part of the annual mass emissions monitoring program conducted by the County. The sampling location for CO5 is at Gothard Street (i.e., EGWCO5). A measured concentration greater than that guidance value is considered an exceedance. Acute samples represent instantaneous maximum concentration and chronic samples represent a 4-day average concentration.

Countywide, constituents detected most frequently in exceedance of their respective tolerance interval are primarily nutrients (nitrate as N, ammonia as N, and orthophosphate as PO_4), bacteria (Enterococcus), and metals/trace elements toxicity, primarily selenium and copper.

Trace Metals

Sites are provided a score based on the exceedance percentages compared to the total number of samples within the region for water quality. Site scores are identified as “very good” with 0% - 15% exceedances, “good” with 16% - 40% exceedances, “fair” with 41% - 75% exceedances, and “poor” with 76% - 100% exceedances. Dry weather and wet weather concentrations of trace metals between 2006 and 2014 are provided in Appendix A.

Between 1991 and 1997, concentrations of cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), nickel (Ni), silver (Ag), and zinc (Zn) have been measured in waters of CO5. In CO5, zinc was detected in all samples. Copper, lead, and nickel were detected in over half the samples. Cadmium, chromium, and silver were only occasionally detected. Occasionally, copper, nickel and zinc exceeded the California Ocean Plan and National and/or California Toxics Rule limitations during the 1990s. Detected chromium, lead, and silver sometimes exceeded either the California Ocean Plan or the National and/or California Toxics Rule limitations. Copper concentrations were elevated above the National and/or California Toxics Rule limitation at all sites tested within CO5 during the 1990s.

Between 2004 and 2008, none of the samples showed an exceedance for zinc under acute conditions or copper under chronic conditions. There was one exceedance in the 2007-2008 season out of 83 acute samples within the region. Between 2004 and 2008, the site score was very good. Table 3-1 presents the number of samples and exceedances for three constituents.

Table 3-1 Exceedances of CTR Criteria at CO5 2004-2008

Season	Samples				Exceedances of CTR Freshwater Criteria Maximum Concentration at CO5		
	Regional		CO5		Acute		Chronic
	Acute	Chronic	Acute	Chronic	Cu	Zn	Cu
2004-2005	103	24	4	2			
2005-2006	107	25	9	2			N/A
2006-2007	82	20	8	2	0	0	0
2007-2008	83	21	9	2	1		

Between 2009 and 2014, none of the samples showed an exceedance for cadmium (Cd), nickel (Ni), lead (Pb), zinc (Zn), or selenium (Se). During the 2009-2010 season, both of the dry weather samples from CO5 showed an exceedance of copper (Cu). CO5 showed an exceedance for copper in stormwater samples in each season except for 2011-2012 and 2012-2013. Between 2009 and 2014, the site score was very good. Table 3-2 presents the number of samples and exceedances for six constituents.

Table 3-2 Exceedances of CTR Criteria at CO5 2008-2014

Season	Samples				Exceedances of CTR Freshwater Criteria Maximum Concentration at CO5											
	Regional		CO5		Cd		Cu		Ni		Pb		Zn		Se*	
	dry	st	dry	st	dry	st	dry	st	dry	st	dry	st	dry	st	dry	st
2008-2009	82	93	2	4	N/A	N/A		1			N/A	N/A			N/A	N/A
2009-2010	71	92	2	10	N/A	N/A	2	9							N/A	N/A
2010-2011	79	101	2	8	0	0	0	5	0	0	N/A	N/A	0	0	0	0
2011-2012	73	52	2	6	0	0	0	0	0	0	0	0	0	0	0	0
2012-2013	83	29	2	2	0	0	0	0	0	0	0	0	0	0	0	0
2013-2014 (Acute)	100	22	2	2	0	0	0	1	0	0	0	0	0	0	0	0
2013-2014 (Chronic)	100	22	2	2	0	0	0	1	0	0	0	0	0	0	0	0

General Minerals and Nutrients

Nutrient enrichment was detected at CO5 in 1991-1997, where ammonia and ammonium ranged from 0.1 to 2.2 mg/L, and phosphate generally ranged from 0.1 to 3.5, although one observation was 63 mg/L (CSLC et al. 2001). Nitrate typically ranged from 0.2 to 19 mg/L. Phosphate and nitrate were elevated in CO5 during winter and spring between 1991 and 1997, probably as a result of stormwater runoff. Waters in CO5 were brackish, with moderate total dissolved solids concentrations. Between 1991 and 1997, the channel waters had relatively low nutrient, sulfate, and total organic carbon concentrations. Dry weather and wet weather concentrations of nutrients between 2006 and 2014 are provided in Appendix A.

Organic Compounds

In 1996, Tetra Tech, Inc. tested for concentrations of total extractable petroleum hydrocarbons (TEPHs), polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), organochlorine (OC) pesticides, organophosphorus (OP) pesticides, and chlorinated (OC) herbicides in surface waters of the waters of the Lowlands, Bolsa Bay, and CO5. Several organic contaminants were detected in waters of CO5 in 1996, except for PCBs and OC pesticides, which were not detected. No California Ocean Plan or National Toxics Rule limitations are available for comparison with the measured organic contaminants. No TEPHs were detected in CO5. PAHs were detected in runoff areas of CO5, which had detectable concentrations of pesticides and herbicides.

Samples from 2005-2006 detected PCBs, organochlorine, organophosphate and pyrethroid pesticides. Samples from 2007-2010 detected acid extractable compounds, base/neutral extractable compounds, polynuclear aromatic hydrocarbons, organochlorine, organophosphate and pyrethroid pesticides. By 2008, there is a decline in dimethoate. Concentrations of OP pesticides can vary by orders of magnitude at a site during the course of a storm. The two samples from C05 collected on consecutive days in January 2009 both showed significant amounts of pyrethroid pesticides with the greater concentrations occurring near the onset of the storm. By 2010, concentrations of the organophosphate pesticides, Diazinon and Chlorpyrifos (aka Dursban) in samples collected at Mass Emissions sites show a steady decline. However, detectable amounts of Malathion, another OP pesticide are still found. Malathion is the OP pesticide that most commonly detected at the site.

2010-2011 season detected both organophosphorus and pyrethroid pesticides, with the pyrethroid pesticides more prevalent in stormwater samples. 2011-2012 samples detected organochlorine pesticides, polynuclear aromatic hydrocarbons, and pyrethroid pesticides, of which there were three exceedances of pyrethroid pesticides (i.e., cyfluthrin, permethrin). CO5 was not sampled for organic compounds in 2012-2014. Stormwater samples from the Mass Emissions sites regionally from 2013-2014 show that detection patterns continue to suggest a shift towards the use of synthetic, pyrethroid pesticides and away from organophosphate pesticides in urbanized areas. The synthetic pyrethroid pesticide group was detected nearly five times more often than the organophosphorus pesticides during storm events in the Santa Ana Region.

3.2 TOXICITY

Statistics for the analysis of toxicity include Acute Toxicity Units (TUa) and Chronic Toxicity Units (TUc). The lowest TUc possible, which indicates no toxicity, is 1. Zero is the lowest TUa value possible. As toxicity increases, the toxic units increase. Lethal concentration (LC) concentration that causes mortality (e.g., 50%) of the organisms. The lower the LC percentage, the more toxic the sample. Inhibition concentrations (IC) are the concentrations that cause an inhibition (e.g., 25 percent or 50 percent) of an organism's function such as growth, or cell density. The lower the IC percentage, the more toxic the sample. Chronic effects are estimated using the "No Observable Effects Concentration" (NOEC), for both survival and reproduction. The lower the value of the NOEC, the more toxic the sample.

Samples were considered to be toxic if the organism response test results (i.e., survival, reproduction, or growth) were less than 80% effect. Toxicity was found occur in less test samples of dry weather samples in comparison to stormwater samples collected from CO5, which mirrors the results of toxicity within inland receiving waters regionally. Table 3-3 shows a summary of the toxic units for dry weather samples between 2005 and 2014. Actual concentrations for toxicity tests from dry weather samples are provided in Appendix B. Table 3-4 shows a summary of the toxic units for dry weather samples between 2005 and 2014. Actual concentrations for toxicity tests from wet weather samples are provided in Appendix B.

Table 3-3 Toxicity in Dry Weather at CO5 2005-2014

Date	# Samples	Matrix	Weather	Ceriodaphnia Reproduction	7d Ceriodaphnia Reproduction	7d Ceriodaphnia Survival	48 hr Ceriodaphnia Survival	Acute Ceriodaphnia Survival	96 hr Hyallela Survival	Acute Hyallela Survival	96 hr Selenastrum Growth	Chronic Selenastrum Growth
				TUc	TUc	TUc	TUa	TUa	TUc	TUa	TUc	TUc
8/23/2005			D							0		1
11/14/2005			D							0.59		8
6/25/2007	24		D	1		1		1		0		2
9/18/2006	24		D	1		1		1		0.44		1
10/1/2007			D	1			0					
10/8/2008	24		D	1			0				1	
6/23/2009	24		D	1			0				1	
9/20/2010	24	FW	D		1	1	0				1	
6/7/2011		FW	D		1	1	0				1	
8/30/2011	24	FW	D		1	1			1		1	
6/11/2012	24	FW	D		1	1			1		1	
9/17/2012	24		D	1		1		0	1		1	
5/28/2013	24		D	1		**1**		0	1		1	
9/23/2013	24		D	1		1		0	1		1	
6/2/2014	24		D	1		**1**		0	1		1	

Table 3-4 Toxicity in Wet Weather at CO5 2005-2014

Date	# Samples	Matrix	Weather	Ceriodaphnia Reproduction	7d Ceriodaphnia Reproduction	7d Ceriodaphnia Survival	Acute Ceriodaphnia Survival	Mysidopsis Growth	7d Mysidopsis Growth	Acute Mysidopsis Survival	7d Mysidopsis Survival	Sea Urchin Fertilization	Chronic Sea Urchin Development
				TUc	TUc	TUc	TUa	TUc	TUc	TUc	TUc	TUc	TUc
10/18/2005			ST		1				1		1	2	
3/29/2006			ST										
10/14/2006	6		ST	1			0	>2		1.23	>2	1	1
2/11/2007	12		ST	1			0	1		0	1	8	2
12/7/2007			ST	2				1		2		1	1
2/22/2008			ST	1				1		2		2	1
11/4/2008	1		ST					1		2		>16	4
1/23/2009	6		ST					2		2		1	1
11/20/2010	12	FW	ST		1	1			1		1	1	
3/20/2011	12	FW	ST		1	1			1		1	2	
10/4/2011	6	FW	ST		>1	1			1		1	>2	
3/17/2012	11	FW	ST		1	1			1		1	1	
2/20/2013	12		ST	1		1	0				2	1	
10/9/2013	10		ST	1		1	0				1	1	

3.3 BACTERIA

Intestinal bacteria are sampled as indicators of fecal contamination in water and of overall microbial water quality. If found in significant concentrations in water, coliform bacteria are considered to indicate the potential presence of human and/or animal fecal waste. Total coliform is measured in terms of the number of coliform organisms per unit volume. Total coliform numbers can include nonfecal bacteria. Therefore, measurement of fecal coliforms is considered a better predictor of fecal contamination.

The County of Orange Health Care Agency has monitored coliform bacteria in water samples in CO5. Results from 1991 to 1997 indicate that these runoff areas represent potential bacteriological contaminant sources for the nearby wetland. Total coliform densities in CO5 were variable, ranging from 140 to 80,000 MPN per 100 mL during dry weather. During wet weather, total coliform densities were substantially elevated (2,400 to 160,000 MPN per 100 mL) in CO5.

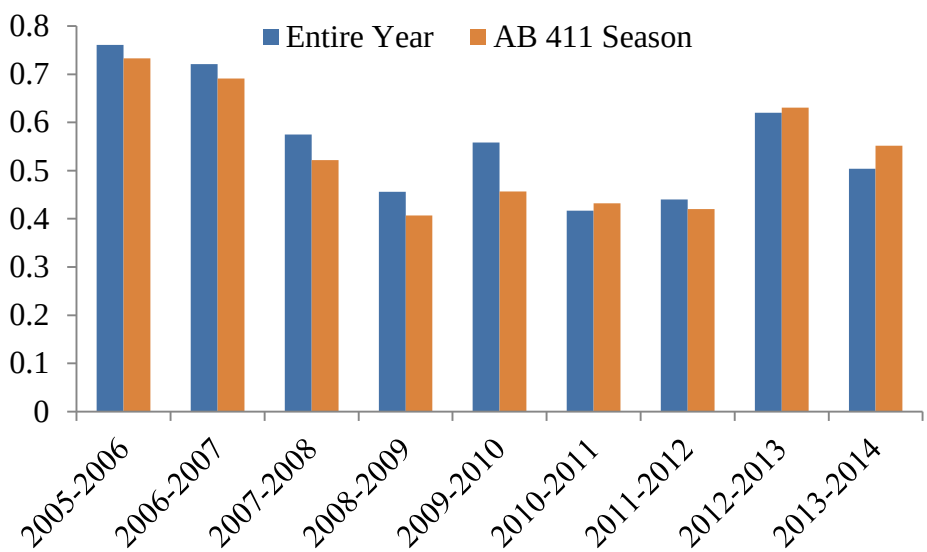
The total number of AB 411 exceedances is divided by the total number of sample tests, resulting in a proportion for each drain between 0 and 1.0. Categories for AB411 exceedances are: 0 - <0.14, 0.14 - <0.40, 0.40 - < 0.75, and 0.75 – 1.0. Table 3-5 and Figure 3 show the exceedances of bacteria criteria between 2005 and 2014.

Table 3-5 Exceedances of Bacteria Criteria at CO5 2005-2014

Year	Entire Year		AB 411 Season	
	n	Avg Hits	n	Avg Hits
2005-2006	*	0.761	*	0.733
2006-2007	*	0.721	*	0.691
2007-2008	*	0.575	*	0.522
2008-2009	38	0.456	27	0.407
2009-2010	46	0.558	27	0.457
2010-2011	44	0.417	27	0.432
2011-2012	39	0.44	19	0.42
2012-2013	50	0.62	28	0.631
2013-2014	47	0.504	29	0.552

* data not available, n = number of samples, avg hits = total number of exceedances for total coliform, fecal coliform, and enterococcus combined divided by the total number of sample tests

Figure 3 Exceedances of Bacteria Criteria at CO5- by Sampling Season



SECTION 4.0 – DISCUSSION

Recent data (i.e., 2005-2014) on CTR exceedances in CO5 generally are very good in both dry and wet weather. Patterns of toxicity in CO5 generally are very good in both dry and wet weather. Exceedance ratings of AB 411 during the AB 411 season (i.e., April to October) are better than exceedance ratings over than the entire year. Based on the review of recent water quality data for CO5, although there are occasional exceedances of CTR criteria, toxicity, and bacteria, the frequency and concentrations of these exceedances are less than that identified from two decades ago.

SECTION 5.0 – LITERATURE CITED

California Regional Water Quality Control Board

2014 Water Quality Control Plan, Santa Ana River Basin (8). Update to include approved amendments from 2008 and 2011. July 2014.

California State Lands Commission, United States Fish and Wildlife Service, and the United States Army Corps of Engineers

2001 Final EIR/EIS for the Bolsa Chica Lowlands Restoration Project, Volume 1. Submitted by Chambers Group, Inc. Prepared for California State Lands Commission, United States Fish and Wildlife Service, and the United States Army Corps of Engineers. April 2001.

County of Orange and Orange County Flood Control District (OCFCD)

2005 Section C-11, Santa Ana Region Appendices: Water Quality Monitoring Summary and Analyses. In *Unified Annual Progress Report Program Effectiveness Assessment (Santa Ana Region), 2004-2005 Reporting Period*. November 15, 2005.

2006 Section C-11 Tables, Santa Ana Region Water Quality Monitoring Summary and Analyses Tables. In *Unified Annual Progress Report Program Effectiveness Assessment (Santa Ana Region), 2005-2006 Reporting Period*. November 15, 2006.

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2010 Section C-11 Tables (Santa Ana Region), Santa Ana Region Water Quality Monitoring Summary and Analyses Tables. In *Unified Annual Progress Report Program Effectiveness Assessment (Santa Ana Region), 2009-2010 Reporting Period*. November 15, 2010.

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United States Environmental Protection Agency (USEPA)

2000 Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California; Final Rule. 40 CFR Part 131. Federal Register. Rules and Regulations. Vol. 65, No. 97, Thursday, May 18, 2000.

APPENDIX A – DRY WEATHER AND WET WEATHER CONCENTRATIONS OF TRACE METALS BETWEEN 2006 AND 2014

Dry Weather and Wet Weather Concentrations of Trace Metals Between 2006 and 2014
Load

						Nutrients										Trace Metals			
Period	Volume Sampled ac-ft	Type	Nitrate as NO3	NH3 as N	TKN	Total Phos. as PO4	Ortho Phos. as P	TSS	VSS	Cd	Cr lbs	Cu	Pb	Ni	Ag	Zn	As	Se	Hardness as CaCO3
Oct 14-16, 2006	12	Total	140.6	45	147	26.34	1.19	867	222	0.02	0.06	0.78	0.1	0.42	0.01	2.977	0.11	0.05	9614
		Diss								0.01	0.03	0.501	0.02	0.39	0.01	1.752	0.1	0.04	
Feb 11-15, 2007	50	Total	678.7	39.4	200	115	19.02	2880	934	0.04	0.3	2.939	0.53	0.61	0.03	12.3	0.33	0.09	19728
		Diss								0.03	0.1	1.428	0.07	0.47	0.03	4.488	0.26	0.05	
Dec 7-11, 2007	62	Total	822	37.9	128.7	122	22.9	2633	772	0.042	0.29	2.2	0.44	0.61	0.04	9.36	0.34	0.06	21731
		Diss								0.042	0.21	1.3	0.04	0.54	0.04	5.72	0.3	0.05	
Feb 22-26, 2008	219	Total	1713	69.3	524	370.1	20.5	12182	2577	0.149	0.88	7.1	1.53	1.66	0.15	22.39	0.91	0.27	54146
		Diss								0.149	0.38	4.5	0.15	1.31	0.15	10.47	0.8	0.37	
Jan 23-27, 2009	4	Total	0.03	0.002	0.01	0.006	0	0.2	0.08	0.004	0.03	0.5	0.04	0.07	0.003	0.73	0.03	0.007	0.76
		Diss								0.001	0.01	0.18	0.006	0.06	0.001	0.35	0.02	0.007	
Nov 20-23, 2010	44	Total	366	33	316	160	11	13780	3322	0.04	0.7	5.28	1.14	0.74	0.03	14.22	0.36	0.17	10639
		Dissolved								0.03	0.13	1.97	0.03	0.33	0.03	2.44	0.18	0.3	
Mar 20-24, 2011	559	Total	4550	128	2883	2177	61	381775	83662	0.84	14.3	78.23	33.02	15.14	0.38	347.02	5.55	0.82	162962
		Dissolved								0.38	0.94	16.81	0.38	3.3	0.38	19.6	1.71	0.5	
Oct 4-6, 2011	139	Total	0.6	0.07	0.63	0.26	0.02	36	8.1	0.1	2	16	3.5	2.9	0.1	41	1.1	0.29	22
		Dissolved								0.1	0.37	4.2	0.28	1.6	0.1	5.6	0.62	0.11	
Mar 17-19, 2012	71	Total	0.28	0.02	0.17	0.09	0.01	7.8	1.8	0.04	0.4	5.5	1.1	0.76	0.01	16	0.36	0.08	12
		Dissolved								0.01	0.19	2.9	0.08	0.46	0.01	4	0.26	0.09	
Feb 19-21, 2013	8.37	Total	762.4	7.18	112.8	30.5	1.03	2519	952	0.027	0.158	2.06	0.312	0.31	0.026	6.26	0.179	0.099	22468
		Dissolved								0.026	0.066	1.49	0.026	0.24	0.026	2.24	0.153	0.09	
Oct 9-11, 2013	10.01	Total	143.16	15.96	200.86	24.36	1.05	1391.75	543.24	0.005	0.099	1.12	0.125	0.513	0.003	3.677	0.148	0.044	5209
		Dissolved								0.003	0.061	0.776	0.047	0.481	0.003	2.754	0.133	0.036	

Dry Weather and Wet Weather Concentrations of Trace Metals Between 2006 and 2014
Mean

						Nutrients				Trace Metals									
Period	Volume Sampled ac-ft	Type	Nitrate as NO3	NH3 as N	TKN	Total Phos. as PO4 mg/L	Ortho Phos. as P	TSS	VSS	Cd	Cr	Cu	Pb	Ni ug/L	Ag	Zn	As	Se	Hardness as CaCO3 mg/L
Oct 14-16, 2006	12	Total	4.31	1.38	4.5	0.81	0.04	27	6.8	0.46	1.93	23.9	3.19	12.7	0.25	91.27	3.43	1.38	295
		Diss								0.25	0.92	15.4	0.46	11.8	0.25	53.71	2.91	1.26	
Feb 11-15, 2007	50	Total	4.99	0.29	1.47	0.85	0.14	21	6.9	0.27	2.18	21.6	3.89	4.5	0.25	90.48	2.43	0.69	145
		Diss								0.25	0.74	10.5	0.48	3.5	0.25	33.02	1.9	0.37	
Dec 7-11, 2007	62	Total	4.9	0.22	0.76	0.72	0.14	15.6	4.6	0.25	1.72	13.07	2.61	3.59	0.25	55.6	2.01	0.33	129
		Diss								0.25	1.26	7.99	0.25	3.18	0.25	33.9	1.78	0.29	
Feb 22-26, 2008	219	Total	2.9	0.12	0.88	0.62	0.03	20.5	4.3	0.25	1.48	11.97	2.56	2.78	0.25	37.6	1.53	0.46	91
		Diss								0.25	0.65	7.52	0.25	2.2	0.25	17.6	1.34	0.62	
Jan 23-27, 2009	4	Total	5.4	0.39	2.2	1.1	0.08	37	15	0.37	2.5	46	4	6.1	0.28	67	2.5	0.64	140
		Diss								0.09	1.3	17	0.55	5.8	0.09	32	2.2	0.64	
Nov 20-23, 2010	44	Total	3.1	0.27	2.64	1.34	0.09	115	28	0.29	5.8	44.1	9.51	6.2	0.25	119	3	1.4	89
		Dissolved								0.25	1.1	16.5	0.25	2.8	0.25	20	1.5	0.3	
Mar 20-24, 2011	559	Total	3	0.08	1.9	1.43	0.04	251	55	0.55	9.4	51.5	21.73	10	0.25	228	3.7	0.5	107
		Dissolved								0.25	0.6	11.1	0.25	2.2	0.25	13	1.1	0.3	
Oct4-6, 2011	139	Total	3.2	0.4	3.33	1.4	0.11	193.01	42.65	0.25	5.25	42.65	9.27	7.58	0.25	109.55	2.93	0.77	116.48
		Dissolved								0.25	0.97	11.17	0.73	4.3	0.25	14.85	1.64	0.28	
Mar 17-19, 2012	71	Total	2.93	0.25	1.79	0.96	0.1	80.76	18.33	0.2	2.09	28.26	5.7	3.92	0.07	83.52	1.84	0.44	112.24
		Dissolved								0.05	0.96	15.04	0.44	2.38	0.07	20.97	1.34	0.44	
Feb 19-21, 2013	8.37	Total	5.3	0.2	1.57	0.32	0.01	35	9	0.26	1.6	20.4	2.99	3.3	0.26	43	1.9	0.7	160
		Dissolved								0.26	0.5	13.8	0.26	2.5	0.26	18	1.5	0.7	
Oct 9-11, 2013	10.01	Total	5.3	0.59	7.38	0.9	0.04	51	20	0.18	3.6	41.2	4.59	18.9	0.11	135	5.4	1.6	191
		Dissolved								0.11	2.2	28.5	1.73	17.7	0.11	101	4.9	1.3	

APPENDIX B – ACTUAL CONCENTRATIONS FOR TOXICITY TESTS FROM DRY AND STORM WEATHER SAMPLES

Actual Concentrations for Toxicity Tests from Dry Weather Samples, Part I

				Ceriodaphnia Reproduction						7d Ceriodaphnia Reproduction						7d Ceriodaphnia Survival					
				Conc.						Conc.						Dilution					
				Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc	
8/23/2005			D																		
11/14/2005			D																		
6/25/2007	24		D	13.3	17.6	100		>100	1							80	100			>100	1
9/18/2006	24		D	19.2	19.2	100		**>100**	1							100	100			**>100**	1
10/1/2007			D						1												
10/8/2008	24		D						1												
6/23/2009	24		D						1												
9/20/10	24	FW	D							26.6	29	100	>100	>100	1	100	100	100	>100	>100	1
6/7/2011		FW	D							20.6	24.6	100	>100	>100	1	100	100	100	>100	>100	1
8/30/2011	24	FW	D							21.9	17.7	100	**>100**	**>100**	1	100	100	100	**>100**	**>100**	1
6/11/2012	24	FW	D							22.2	27.1	100	**>100**	**>100**	1	100	100	100		90	1
9/17/2012	24		D	18.9	29	100	**>100**	**>100**	1							100	100	100	>100	>100	1
5/28/2013	24		D	25.7	24.7	100	**>100**	**>100**	1							100	100	**100**	**>100**	**>100**	**1**
9/23/2013	24		D	19.2	26.9	100	**>100**	**>100**	1							100	100	100	**>100**	**>100**	1
6/2/2014	24		D	24.5	25.5	100	**>100**	**>100**	1							100	100	**100**	**>100**	**>100**	**1**

Actual Concentrations for Toxicity Tests from Dry Weather Samples, Part II

				48 hr Ceriodaphnia Survival						Acute Ceriodaphnia Survival						96 hr Hyallela Survival						
				Dillution						Dillution						Dillution						
				Control	100%	NOEC	IC25	IC50	TUa	Control	100%	NOEC	IC25	IC50	Tua	Control	100%	NOEC	IC25	IC50	TUc	TUa
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc		
8/23/2005			D																			
11/14/2005			D																			
6/25/2007	24		D							100	100			>100	1							
9/18/2006	24		D							100	100			**>100**	1							
10/1/2007			D						0													
10/8/2008	24		D						0													
6/23/2009	24		D						0													
9/20/10	24	FW	D	100	100	100	>100	>100	0							100	100	100	>100	>100		0
6/7/2011		FW	D	100	100	100	>100	>100	0							100	100	100	>100	>100		0
8/30/2011	24	FW	D	100	100	100	**>100**	**>100**								100	95	100	**>100**	**>100**	1	
6/11/2012	24	FW	D	100	100	100	200	90								100	100	100	**>100**	**>100**	1	
9/17/2012	24		D							100	100	100	>100	>100	0	100	100	100	**>100**	**>100**	1	
5/28/2013	24		D							100	100	100	**>100**	**>100**	0	100	100	100	**>100**	**>100**	1	
9/23/2013	24		D							100	100	100	**>100**	**>100**	0	100	90	100	**>100**	**>100**	1	
6/2/2014	24		D							100	100	100	**>100**	**>100**	0	90	100	100	**>100**	**>100**	1	

Actual Concentrations for Toxicity Tests from Dry Weather Samples, Part III

				Acute Hyallela Survival						96 hr Selenastrum Growth						Chronic Selenastrum Growth					
				Dillution						Dillution						Dillution					
				Control	100%	NOEC	IC25	IC50	TUa	Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		Cell Dt	Cell Dt	% conc	% conc	% conc		Cell Dt	Cell Dt	% conc	% conc	% conc	
8/23/2005			D		100				0									200		>100	1
11/14/2005			D		90				0.59									12.5		**>100**	8
6/25/2007	24		D	100	100			>100	0							1101400	154750	50		78	2
9/18/2006	24		D	90	85			**>100**	0.44							1070500	2E+06	100		>100	1
10/1/2007			D																		
10/8/2008	24		D												1						
6/23/2009	24		D												1						
9/20/10	24	FW	D							2418000	2E+06	100	>100	>100	1						
6/7/2011		FW	D							1354500	2E+06	100	>100	>100	1						
8/30/2011	24	FW	D							1314750	2E+06	1770000	**>100**	**>100**	1						
6/11/2012	24	FW	D							1292750	2E+06	1616500	**>100**	**>100**	1						
9/17/2012	24		D							122550	2E+06	100	>100	>100	1						
5/28/2013	24		D							1076250	1E+06	100	**>100**	**>100**	1						
9/23/2013	24		D							158800	2E+06	100	**>100**	**>100**	1						
6/2/2014	24		D							1332750	2E+06	100	**>100**	**>100**	1						

Actual Concentrations for Toxicity Tests from Storm Weather Samples, Part I

				Ceriodaphnia Reproduction						7d Ceriodaphnia Reproduction						7d Ceriodaphnia Survival					
				Conc.						Conc.						Conc.					
				Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc	
10/18/2005			ST								100	100		>100	1						
3/29/2006			ST																		
10/14/2006	6		ST	20.3	14.8	100		>100	1												
2/11/2007	12		ST	15	25.6	100		>100	1												
12/7/2007			ST						2												
2/22/2008			ST						1												
11/4/2008	1		ST																		
1/23/2009	6		ST																		
11/20/2010	12	FW	ST							25	25	100	>100	>100	1	90	100	100	>100	>100	1
3/20/2011	12	FW	ST							19.9	26.8	100	>100	>100	1	90	89	100	>100	>100	1
10/4/2011	6	FW	ST							18.8	12.7	<100	77.05	>100	>1	100	80	100	>100	>100	1
3/17/2012	11	FW	ST							17.3	17.2	100	>100	>100	1	100	90	90	>100	100	1
2/20/2013	12		ST	17	20	100	>100	>100	1							90	100	100	>100	>100	1
10/9/2013	10		ST	16.8	21.8	100	>100	>100	1							90	80	100	>100	>100	1

Actual Concentrations for Toxicity Tests from Storm Weather Samples, Part II

				Acute Ceriodaphnia Survival						Mysidopsis Growth						7d Mysidopsis Growth					
				Conc.						Conc.						Conc.					
				Control	100%	NOEC	IC25	IC50	TUa	Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		mg/ind	mg/ind	% conc	% conc	% conc		mg/ind	mg/ind	% conc	% conc	% conc	
10/18/2005			ST														100	100		>100	1
3/29/2006			ST																		
10/14/2006	6		ST	100	100			>100	0	0.29	0.05	<50		30	>2						
2/11/2007	12		ST	100	100			>100	0	0.16	0.27	100		>100	1						
12/7/2007			ST												1						
2/22/2008			ST												1						
11/4/2008	1		ST												1						
1/23/2009	6		ST												2						
11/20/2010	12	FW	ST													0.181	0.22	100	>100	>100	1
3/20/2011	12	FW	ST													0.296	0.27	25	>100	>100	1
10/4/2011	6	FW	ST													0.269	0.364	100	>100	>100	1
3/17/2012	11	FW	ST													0.231	0.173	100	0.146	0.211	1
2/20/2013	12		ST	90	100	100	>100	>100	0												
10/9/2013	10		ST	100	90	100	>100	>100	0												

Actual Concentrations for Toxicity Tests from Storm Weather Samples, Part III

				Acute Mysidopsis Survival						7d Mysidopsis Survival					
				Conc.						Conc.					
				Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc	
10/18/2005			ST								92.5	100		>100	1
3/29/2006			ST												
10/14/2006	6		ST	100	43			81	1.23	95	35	<50		75	>2
2/11/2007	12		ST	100	100			>100	0	100	98	100		>100	1
12/7/2007			ST						2						
2/22/2008			ST						2						
11/4/2008	1		ST						2						
1/23/2009	6		ST						2						
11/20/2010	12	FW	ST							85	82.5	100	>100	>100	1
3/20/2011	12	FW	ST							85	85	100	>100	>100	1
10/4/2011	6	FW	ST							80	77.5	100	>100	>100	1
3/17/2012	11	FW	ST							90	75	100	77.5	90	1
2/20/2013	12		ST							82.5	0	50	20.422	32.986	2
10/9/2013	10		ST							97.5	95	100	>100	>100	1

Actual Concentrations for Toxicity Tests from Storm Weather Samples, Part IV

				Sea Urchin Fertilization						Chronic Sea Urchin Development					
				Conc.						Conc.					
				Control	100%	NOEC	IC25	IC50	TUc	Control	100%	NOEC	IC25	IC50	TUc
Date	# Samples	Matrix	Weather	%	%	% conc	% conc	% conc		%	%	% conc	% conc	% conc	
10/18/2005			ST		0	50		74.23	2						
3/29/2006			ST												
10/14/2006	6		ST	100	99	100		>100	1	100	99	100		>100	1
2/11/2007	12		ST	100	83	12.5		>100	8	100	93	50		>100	2
12/7/2007			ST						1						1
2/22/2008			ST						2						1
11/4/2008	1		ST						>16						4
1/23/2009	6		ST						1						1
11/20/2010	12	FW	ST	0.972	0.975	100	>100	>100	1						
3/20/2011	12	FW	ST	0.88	0.7	38 50	>62	>62	2						
10/4/2011	6	FW	ST	1	0.91	<50	>100	>100	>2						
3/17/2012	11	FW	ST	1	1	100	>100	>100	1						
2/20/2013	12		ST	100	100	100	>100	>100	1						
10/9/2013	10		ST	95.2	97	100	>100	>100	1						