Exhibit 1 - Appendix I

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VENTURA COUNTY WATERSHED PROTECTION DISTRICT

J Street Drain Project Mosquito Technical Study

FINAL

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In collaboration with:

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH
VECTOR-BORNE DISEASE SECTION

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List of Acronyms

CDPH	California Department of Public Health
CO_2	Carbon Dioxide
EIR	Environmental Impact Report
District	Ventura County Watershed Protection District
FEMA	Federal Emergency Management Agency
MVCAC	Mosquito and Vector Control Association of California
OID	Oxnard Industrial Drain
OWWTP	Oxnard Wastewater Treatment Plant
SSIII	Surfside III Condominium Complex
VCVCP	Ventura County Vector Control Program

Executive Summary

This Technical Report provides an analysis of the mosquito production potential of the proposed J Street Drain Project compared with the current J Street Drain and the proposed project alternatives.

ES.1 PROJECT AND SETTING

The J Street Drain is a concrete-lined, trapezoidal, flood control channel located in Ventura County, operated by the Ventura County Watershed Protection District (District). An analysis of flood potential found that the J Street Drain provides capacity only up to a 10-year storm event, rather than a 100-year storm event; therefore, the District is proposing to expand the current channel in both width and depth into a rectangular channel with capacity for the runoff associated with a 100-year storm event. The J Street Drain is part of a flood control network that includes Hueneme Drain, the Hueneme Drain Pump Station, Perkins Drain, and the Oxnard Industrial Drain. The J Street Drain terminates in Ormond Beach Lagoon, which does not have a surface outlet to the Pacific Ocean. The District is prohibited from creating an outlet due to the Endangered Species Act, except during emergencies. The lack of outlet causes standing water to back up into the J Street Drain. The J Street Drain is adjacent to or near residential properties (including the Surfside III Condominium Complex), the Oxnard Wastewater Treatment Plant (OWWTP), the Halaco Superfund Site, and additional developed and undeveloped land.

During the Environmental Impact Report (EIR) process for the proposed J Street Drain Project, residents raised concerns regarding the potential for standing water contained within the channel to produce unreasonable numbers of mosquitoes capable of transmitting disease and causing a public nuisance.

ES.2 MOSQUITOES

Mosquitoes are vectors of disease worldwide. Only adult female mosquitoes bite, though a single individual may bite the same or multiple hosts many times. Generally, mosquitoes require calm, stagnant water for breeding. Flowing waters or open, exposed waters with surface disturbance from wind, waves, or animals are not suitable habitat for mosquito breeding. Similarly, waters deep enough to sustain populations of fish and other predatory aquatic organisms greatly limit suitable habitat. Wetlands and salt marshes, especially those with unmanaged, dense, emergent vegetation, are notorious mosquito breeding habitats.

Three main species of biting mosquitoes are commonly found in the J Street Dain area: *Culex tarsalis, Culex quinquefasciatus*[1], and *Culex erythrothorax*. *Culex tarsalis* and *Culex quinquefasciatus* are considered primary vectors of disease, while the role of *Culex erythrothorax* in disease transmission is believed to be minor. Because of their significance to public health and as nuisance species, the biology and ecology of these mosquitoes have been well studied. Relevant species-specific habitat preferences are described here.

- *Culex tarsalis* are opportunistic and will breed in a variety of freshwater habitats including wetlands, birdbaths, neglected swimming pools, and artificial containers.

[1] Synonymous with *Culex pipiens* in some locations.

- *Culex quinquefasciatus* are also opportunistic and will share many of the freshwater habitats used by *Culex tarsalis*, especially urban sources. This species prefers nutrient-rich water and also has a strong affinity for underground habitats such as storm drains.
- *Culex erythrothorax* are closely tied to freshwater wetlands, preferring shallow swamps and marshes or the margins of deeper water bodies that contain dense, emergent vegetation such as cattails. This species is almost never found outside these habitats.

ES.3 VECTOR CONTROL PROGRAM TRAP DATA

The Ventura County Vector Control Program (VCVCP) uses adult mosquito traps as part of their comprehensive mosquito surveillance and control plan. Traps are deployed overnight in areas of greatest concern, usually triggered by evidence of local disease transmission in birds, humans, or other animals, but also in response to local nuisance complaints. In total, VCVCP deployed adult mosquito traps in nine locations in the greater J Street Drain area in 2005, 2008, 2009, and 2010.

The trap data provide evidence that Ormond Beach Lagoon is producing the majority of mosquitoes in the adjacent area, while the undeveloped floodplain of the Oxnard Industrial Drain is the most mosquito-productive in the greater J Street Drain area. These data support the case that the J Street Drain, Hueneme Drain Pump Station, and Hueneme Drain in their current configuration do not provide ideal habitat for mosquitoes nor are major sources of mosquito production.

Overall, these data suggest that mosquito production is widespread within the developed areas surrounding the J Street Drain, with no evidence of sharp rises in mosquito numbers in traps located near the J Street Drain that would implicate this conveyance channel as a major source of mosquitoes.

ES.4 EVALUATION OF CHANNEL DESIGNS

Studies of various stormwater structures have been conducted in California to determine the design characteristics found to best decrease the potential for attraction, harborage, or development of mosquitoes. The most effective design characteristics are those that decrease or eliminate standing water. Shallow, sheltered, standing water (especially with vegetative cover) is one of the most conducive mosquito breeding habitats, while deep or flowing unprotected water is unlikely mosquito breeding habitat. Belowground sources of standing water are almost always suitable. Desirable design characteristics include:

- Steep sides to inhibit emergent vegetation growth;
- Flowing water;
- Deep-water areas where natural predators can live;
- Open-water areas exposed to wind, which results in surface disturbances (i.e., waves) that reduce the effectiveness of mosquito breathing siphons; and
- Proper access for mosquito treatment and vegetation management.

ES.4.1 Current J Street Drain

The current J Street Drain's concrete substrate and relatively steep sides inhibit emergent vegetation growth and associated mosquito production. The current J Street Drain has a wide, open surface exposed to substantial wind and wave action. Wind and wave action on the surface of the water prevent the breathing siphons of mosquito larvae from maintaining a connection to the air, thereby effectively drowning the larvae. In addition, water held in the J Street Drain downstream of Hueneme Road supports several fish species that opportunistically prey on mosquito larvae. Recent inspections of the J Street Drain by California Department of Health, Vector-Borne Disease Section staff confirmed that the J Street Drain does not currently provide suitable habitat to support large mosquito populations. Additionally, the open channel facilitates maintenance, monitoring, and treatment.

ES.4.2 Proposed J Street Drain Project

The proposed changes to the channel are projected to maintain or possibly amplify the aforementioned negative effects on mosquito breeding. The greater overall water volume would provide additional habitat for predator fish downstream of Hueneme Road, while the increased width would increase exposure to wind and wave action throughout the submerged reach. Vertical channel walls are considered the most desirable design choice to minimize vegetative or other cover along the channel margins and present the best scenario for preventing refuge for immature mosquitoes. The proposed channel geometry would not change ease or safety of access for mosquito monitoring and treatment or for channel maintenance.

In the event of a breach of the Ormond Beach Lagoon, the increased depth of the proposed channel is not expected to increase the probability of mosquito production for the following reasons: 1) vertical walls, lack of vegetation, and wind action in the channel would maintain poor mosquito habitat similar to pre-breach conditions, 2) mosquito predator fish living in coastal lagoons, such as the tidewater goby, are adapted to tolerate fluctuations in water level and should remain in the channel, and 3) breach events usually take place during the colder winter months, and in the event that a breach resulted in the temporary formation of isolated pools, mosquito production would be unlikely.

ES.4.3 Channel Design Alternatives

The Draft EIR presented project alternatives to the proposed J Street Drain Project and determined the environmental impacts of the alternatives. The alternative projects were:

- Alternative A: Buried box culverts
- Alternative B (the Proposed Project): Open rectangular channel
- Alternative C: Open rectangular channel with step
- Alternative D: Two separated buried box culverts
- Alternative E: Natural channel

Additionally, this study evaluated an additional alternative suggested by residents. The additional alternative would consist of pumping water out of the J Street Drain into Ormond Beach Lagoon. The evaluation does not determine whether this option would be feasible under the Endangered Species Act.

The impacts on mosquito production of each alternative as compared to the proposed project are presented in Table ES.1.

Table ES.1. Impacts of Alternatives on Mosquito Production Compared with Proposed Project

Alternative	Effect on Habitat	Effect on Maintenance & Chemical Applications	Overall Impact
A: Buried box culverts	• Reduced disturbance to water surface • Reduced fish habitat • Altered mosquito species	• Difficult to access	Negative
C: Open rectangular channel with step	• Similar surface water disturbance and fish habitat	• Increased maintenance required	Similar
D: Two separated buried box culverts	• Reduced disturbance to water surface • Reduced fish habitat • Altered mosquito species	• Difficult to access	Negative
E: Natural Channel	• Increased disturbance to water surface • Increased fish habitat • Creation of mosquito habitat at margins	• Increased maintenance required • Reduced accessibility • Reduced effectiveness of treatment	Negative
Additional Alternative	• Creation of stagnant puddles • Creation of habitat in sump	• Increased maintenance required • Increased treatment required	Negative

ES.5. EVALUATION OF ADDITIONAL SOURCES

In addition to the J Street Drain, there are other potential mosquito breeding sites in the surrounding area. The following sources were identified and evaluated for their potential to produce large numbers of mosquitoes.

- **Ormond Beach Lagoon**: Locations of optimal habitat and substantial potential to produce large numbers of mosquitoes.
- **OWWTP**: Multiple locations of suitable habitat. Actively monitored and treated by VCVCP to keep OWWTP from producing substantial mosquitoes.
- **Hueneme Drain**: While containing some shoreline vegetation, overall poor mosquito habitat similar to current J Street Drain.
- **Hueneme Drain Pump Station**: Poor potential breeding source, similar to Hueneme Drain.
- **Other Urban Sources**: Many potential sources, with some that may be substantial. Common struggle for vector control agencies statewide.
- **Other Open-Space Sources**: Wetlands in undeveloped areas may provide optimal habitat and become substantial sources.

ES.6. CONCLUSIONS

This analysis found no evidence to suggest that the current configurations of the J Street Drain, Hueneme Drain Pump Station, or Hueneme Drain provide high-quality habitat for, or produce large numbers of mosquitoes. However, the evaluation of the greater J Street Drain area revealed that the OWWTP, the undeveloped floodplain of the Oxnard Industrial Drain, and urban areas may produce substantial numbers of mosquitoes. The evaluation of the proposed J Street Drain Project found the proposed channel configuration to have similar or less mosquito breeding potential than the current J Street Drain channel. The proposed changes would likely amplify the channel's negative effects on mosquito breeding and, therefore, should have no change to public health with regard to mosquito production. The alternatives presented in the Draft EIR, as well as the additional proposed alternative, would be expected to have similar or greater mosquito breeding potential, as compared to the proposed project.

1 Introduction

The J Street Drain is a concrete-lined, trapezoidal, flood control channel located in Ventura County in the City of Oxnard adjacent to the City of Port Hueneme. The J Street Drain extends approximately north-south from Redwood Street to the coast and discharges into the Ormond Beach Lagoon. The Ventura County Watershed Protection District (District) operates the drain as part of a flood control network that includes Hueneme Drain, the Hueneme Drain Pump Station, Perkins Drain, and the Oxnard Industrial Drain (Figure 1) (HDR, 2009).

1.1 BACKGROUND AND PURPOSE

The mission of the District is, in part, to control and conserve flood and storm waters and to protect watercourses, watersheds, public highways, human life and property from damage or destruction from these waters. In pursuit of this mission, engineering studies are completed by and for the District regarding the flooding potential within its jurisdiction. An analysis of the flood potential within the City of Oxnard (Tetra Tech, 2005; URS, 2005) found that the J Street Drain provides capacity only up to the 10-year storm event, and thus is susceptible to flooding during any greater storm event. Precipitation in an exceeding storm event could overtop the channel and cause flooding in the adjacent residences, businesses, and public infrastructure, including an International Paper recycling facility and the Oxnard Wastewater Treatment Plant (OWWTP). The Federal Emergency Management Agency (FEMA) requires properties located within areas susceptible to a 100-year flood event to buy flood insurance (FEMA, 2007). FEMA Flood Insurance Rate Maps (FIRMs) for the J Street Drain area are based on outdated analyses conducted in 1984 and 1985, which conclude that J Street Drain conveys the 100-year storm and adjacent properties do not require flood insurance.

In light of the 2005 study findings and to fulfill its mission, the District has proposed that the capacity of the J Street Drain be increased to handle the runoff associated with a 100-year storm event. The J Street Drain Project is a proactive solution by the District for protecting the residential, commercial, and industrial areas around the J Street Drain as well as preventing residents from being required to purchase flood insurance following a future FIRM update. Furthermore, protecting the OWWTP from flood damage is a matter of public safety, not least because a release of untreated sewage would affect adjacent properties including the Surfside III condominium community, the paper recycling facility, Ormond Beach, Ormond Beach Lagoon, and the Pacific Ocean. Additionally, the nearby Halaco Superfund Site, which is contaminated with heavy metals and radioactive slag, also may be susceptible to untreated sewage releases.

The District released a Draft Environmental Impact Report (Draft EIR) for the proposed J Street Drain Project in 2009 that provided details of the project and an analysis of potential environmental impacts resulting from the project (HDR, 2009). The proposed J Street Drain Project would change the channel cross-section from trapezoidal to rectangular, deepen it by four feet, and widen it by ten feet. The changes in channel geometry, depth, and width would increase the volume and surface area of standing water within the J Street Drain (HDR, 2009). During the Draft EIR public review and comment process, several residents from the Surfside III condominium community commented that the Draft EIR did not fully analyze the potential impacts to public health from the proposed J Street Drain Project (Loewenthal, Hillshafer & Rosen LLP, 2010). Specifically, residents raised concerns regarding the potential for any increase in the area of standing water contained within the channel to produce unreasonable numbers of mosquitoes capable of transmitting disease and causing a public nuisance.

This report provides an analysis of current mosquito production potential in and around the current J Street Drain and any possible changes to this potential as a result of construction of the proposed J Street Drain Project. This report will also evaluate alternative channel designs detailed in the Draft EIR and additional alternatives for their mosquito production potential.

1.2 ENVIRONMENTAL SETTING

An important feature of the J Street Drain is that it discharges into Ormond Beach Lagoon, a coastal wetland which does not have a surface outlet to the ocean due to a large, natural sand berm at its terminus. During the wet season, the berm that impounds the lagoon occasionally breaches naturally when stormwater runoff is sufficient, but ocean wave and wind action repair the breach relatively quickly, again disconnecting the lagoon from the ocean. Depending on the water level within the lagoon, water backs up in the J Street Drain as far as Hueneme Road. Prior to 1992, the District regularly breached the berm in order to prevent water and silt buildup in the J Street Drain. However, in 1992 the United States Fish and Wildlife Service stopped this practice by issuing a cease-and-desist order under the Endangered Species Act, citing the presence of endangered and threatened species found around and within Ormond Beach Lagoon, specifically the California brown pelican, California least tern, western snowy plover, and tidewater goby. The tidewater goby is an endangered fish found in abundance within Ormond Beach Lagoon and in J Street Drain up to 100 meters upstream of the Hueneme Drain Pump Station (Entrix, Inc., 2007). Therefore, as legally bound, the District has ceased all manual breaching of the berm except for emergency situations. Furthermore, all management activities in and around Ormond Beach Lagoon, including mosquito and vector control, must take into consideration the presence of endangered and threatened species.

Ormond Beach Lagoon and J Street Drain support several fish species that consume mosquito larvae as juveniles, adults, or both. These mosquito predators include the tidewater goby, California killifish, carp, goldfish, green sunfish, mosquito fish, rainwater killifish, staghorn sculpin, and topsmelt. The above fish species were observed in J Street Drain over the course of 13 biological surveys conducted between April 4, 2005 and December 15, 2006 (Entrix, Inc., 2007).

Another important hydrological feature within the local flood control network is the Hueneme Drain Pump Station, which transfers water from the Hueneme Drain to the J Street Drain. The Hueneme Drain Pump Station was created in the 1960s because the Hueneme Drain, fed by the naturally occurring Bubbling Springs, was bisected by the J Street Drain, which effectively cut off the Hueneme Drain from its outlet (HDR, 2009). A forebay is included as part of the Hueneme Drain Pump Station that acts as the sump for the pumps. The Hueneme Drain Pump Station was reconstructed in 2005-2007 to provide pumping capacity for the 100-year storm event and to replace all aging pumps, including the jockey pump. During the reconstruction, an agitator and a floatable oil skimmer were added to the forebay; these were not original components. The purpose of the agitator is to create enough turbulence to diffuse sediment into the water and prevent it from collecting. The oil skimmer was added to improve water quality by collecting any oil and grease floating on the water surface. Sediment, oil, and grease are sent to an appropriate disposal facility, in compliance with applicable local, state, and federal laws. The jockey pump and agitator operate automatically approximately four hours every day. The oil skimmer is operated manually when oil and grease are observed. The larger pumps are activated only during high storm flows and maintenance testing, at which times the jockey pump and sediment tank are bypassed. There was no hydrologic change (e.g., additional standing water) to the Hueneme Drain, Hueneme Drain Pump Station, or J Street Drain after the reconstruction as daily flow volumes passing through the pump station are similar to pre-project conditions, and the pump forebay was not enlarged. Flow volumes are based on the natural output of Bubbling Springs and urban runoff generated by City of Port Hueneme residents and businesses.

Figure 1. J Street Drain and Area Features (From Draft EIR, HDR, 2009)

2 Introduction to Mosquitoes

This section provides information on mosquitoes relevant to the J Street Drain Project.

2.1 MOSQUITOES AS A NUISANCE AND A VECTOR FOR DISEASE

Worldwide, mosquitoes are the most important insect vectors of diseases. A vector is any insect or other animal capable of harboring and transmitting human diseases to humans. In the United States, diseases that can be transmitted to humans via mosquitoes include West Nile virus, western equine encephalitis, St. Louis encephalitis, and malaria. Disease-causing viruses and blood parasites are transmitted via the bite of infected female mosquitoes when they are attempting to take a blood meal (i.e., biting); however, relatively few female mosquitoes in the environment are infected at any given time (Herrington, 2003). In California, a variety of publicly-funded local agencies control mosquito populations in developed areas to reduce the potential for disease transmission and to alleviate the public nuisance of mosquito bites. It has been speculated that California has studied mosquitoes more thoroughly than any comparably sized area of the world, as evidenced by the resources expended for control and research by local and state agencies (Bohart and Washino, 1978). However, the mosquito's rapid development, ability to fly long distances as adults, and opportunistic use of standing water in urban areas guarantees that *eradication of all mosquitoes is not possible*.

2.2 MOSQUITO LIFE CYCLE

The mosquito life cycle is characterized by four distinct stages: egg, larva, pupa, and adult (Figure 2). In those species of greatest public health concern in California, a raft of eggs is laid on the surface of standing water where they float for approximately 48 hours and then hatch into the water as larvae. The larvae do not have gills and instead rely on a special siphon tube used to break the surface tension of the water to breathe atmospheric air. Larvae feed on microorganisms and organic matter in the water column, and grow in size until they metamorphose into the pupal stage. The pupal stage is a resting, non-feeding stage during which the adult mosquito develops. After a few days in the pupal stage, the winged adult emerges from the water and flies away. The time from eggs being laid to adults emerging is typically 7-10 days. Adult mosquitoes must feed to survive, but only female mosquitoes take blood. They use the protein in the blood to develop eggs for the next generation (CDPH and MVCAC, 2010). A single female mosquito may bite the same or multiple hosts many times.

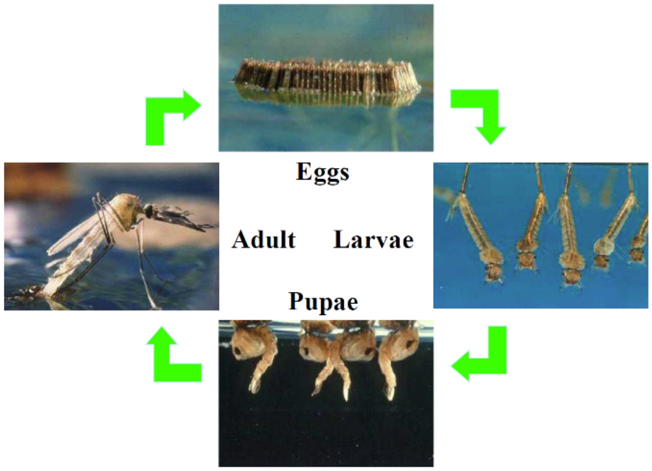

Figure 2. Mosquito Life Cycle Stages (Eldridge, 2008)

Adult mosquitoes may be lured by a number of different attractants. After mating, newly emerged females are attracted to air-borne cues such as carbon dioxide (CO_2), heat, and body odors in order to find a host and take a blood meal for egg development. After several days of rest in a protected location, their attraction shifts to air-borne odors emanating from waters that are potential larval habitats. Artificial lights can be somewhat attractive to certain species, but usually only in less developed areas with few competing light sources.

Nearly all species of mosquitoes have a definite seasonality that varies depending on the geographic region (Eldridge, 2008). Temperature is important in mosquito production and the development of larvae. Many mosquitoes experience a hibernation-like period during the winter at which time mosquito production ceases (Eldridge, 2008). In Ventura County and other parts of southern California, mosquito production decreases substantially beginning in the cooler late fall or winter months and then increases from spring into summer (personal communication, Marco Metzger, November 29, 2010).

2.3 MOSQUITO BREEDING

Mosquitoes are inherently linked to water since all the immature life stages are aquatic. However, not all sources of water are conducive to mosquito breeding. Generally, mosquitoes require calm, stagnant water for breeding as opposed to open, exposed water. Flowing waters or waters with surface disturbance from wind, waves, or animals are not suitable habitat for mosquito breeding because they prevent egg, larval, and pupal stages of mosquitoes from maintaining a surface connection to the air. Even small surface disturbances create inhospitable conditions. Similarly, waters deep enough to sustain populations of fish and other predatory aquatic organism greatly limit suitable habitat (Metzger, 2004). As an example, large lakes only produce mosquitoes along shorelines protected from wind and predators by vegetation. Waters that contain substantial emergent (e.g., cattails, bulrush) or floating vegetation (e.g., duckweed, hyacinth) provide refuge for developing mosquito larvae by creating calm, predator-free habitats (Bohart and Washino, 1978). Wetlands and salt marshes, especially those with unmanaged, dense, emergent vegetation, are notorious mosquito breeding habitats.

2.4 LOCAL MOSQUITO SPECIES

Three main species of biting mosquitoes are commonly found in the J Street Dain area: *Culex tarsalis, Culex quinquefasciatus*[2], and *Culex erythrothorax*. *Culex quinquefasciatus* and *Culex tarsalis* are considered primary vectors of encephalitis viruses (e.g., West Nile virus) while the role of *Culex erythrothorax* in virus transmission is believed to be minor (Goddard et al., 2002). All three species readily bite humans and can become a nuisance, thus they are primary targets of control efforts in Ventura County and throughout the state. Each species has habitat preferences for larval development. Because of their significance to public health and as nuisance species, the biology and ecology of these species have been well studied. Relevant species-specific habitat preferences are described here.

- *Culex tarsalis* are opportunistic and will breed in a variety of freshwater habitats including wetlands, birdbaths, neglected swimming pools, and almost any artificial container (Bohart and Washino, 1978). *Culex tarsalis* larvae are known to occur in brackish marshes as long as the salt content does not exceed one percent. However, *Culex tarsalis* larvae are not tolerant of polluted waters (e.g., nutrient rich waters). Adult *Culex tarsalis* are known to disperse from their origins up to several kilometers (Reisen and Lothrop, 1995).
- *Culex quinquefasciatus* prefer nutrient-rich freshwaters containing high concentrations of organic matter and also have a strong affinity for underground areas such as storm drains. However, they are also opportunistic and will share many of the habitats used by *Culex tarsalis*, especially urban sources and nutrient-rich treatment wetlands. Adult *Culex quinquefasciatus* can travel up to 1.5 kilometers from their origin, but generally travel less than 1 kilometer (Schreiber et al., 1988).
- *Culex erythrothorax* are closely tied to freshwater wetlands, preferring swamps and marshes or the margins of water bodies that contain dense, emergent vegetation such as cattails (Walton et al., 1999). This species is almost never found outside these habitats. Adult *Culex erythrothorax* are known to disperse from their origins up to approximately 1 kilometer (Bohart and Washino, 1978), but the majority of adults appear to remain relatively close to their preferred wetland habitats.

2.5 MOSQUITO TREATMENT OVERVIEW

The state of California has over 60 publicly-funded local vector control agencies that serve to protect the public from vectors and vector-borne diseases. Like most programs in the state, the Ventura County Vector Control Program (VCVCP) focuses the bulk of its efforts on mosquito control on minimizing populations of vector and nuisance mosquitoes to protect public health and quality of life throughout Ventura County. Creation of the VCVCP was approved in 1993. The Mosquito Abatement and Vector Control District Law[3] provides authority to the VCVCP to address any altered property that supports the development, attraction, or harborage of vectors; any water that is a breeding place for vectors; and any activity that supports the development, attraction, or harborage of vectors. Mosquito control is not intended to eliminate all mosquitoes.

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[2] Synonymous with called *Culex pipiens* in some locations.

[3] California Health and Safety Code, Division 3, Chapter 1.

Rather, the goal is to reduce adult mosquito populations to a level that minimizes the probability of people and animals becoming infected with mosquito-transmitted diseases (CDPH, 2008b).

Mosquito control usually occurs through an integrated pest management strategy that utilizes a variety of measures to control mosquitoes. Because adult mosquitoes are widespread in the environment, larval control in aquatic habitats is the most effective means for reducing mosquito populations and therefore is the foundation of most mosquito control programs in California. Minimizing the number of adults that emerge is crucial to reducing the incidence and risk of disease. The measures most often utilized to control larvae include habitat modification, biological controls, and chemical application. For example, habitat modification might include creating ditches through swamps and marshes and/or thinning or removing emergent vegetation within and along the margins of water bodies to promote water circulation, reduce cover, and encourage natural predators. Biological controls include the use of fish and aquatic invertebrates to prey on mosquito larvae. Chemical application is a more target-direct and, therefore, more often utilized way to abate mosquitoes than habitat modification or biological controls. Mosquito control formulations that specifically target larvae (i.e., larvicides) are the most effective materials for controlling mosquitoes (CDPH, 2008a).

The application of larvicides to control mosquitoes is done only after establishing the need to do so by the presence of mosquito larvae detected during mosquito monitoring and surveillance. Larval mosquito monitoring includes identifying and checking likely larval developmental sites for the presence of mosquito larvae and then treating the water to kill the mosquito larvae before they emerge as flying, biting adults. Personnel working for vector control agencies who apply pesticides in California are certified by California Department of Public Health (CDPH) (CDPH and MVCAC, 2010). The VCVCP uses a focused approach for larvicide application to target known mosquito breeding grounds and does not use a “blanket approach” to treat all waterbodies. The VCVCP applies larvicides in this manner as part of its objective to minimize the volume of chemicals in the environment. Furthermore, it is not efficient or effective to target all waterbodies as many waterbodies have habitat characteristics which make them unlikely breeding grounds for mosquitoes, as discussed previously. The VCVCP uses two categories of larvicides, both of which are considered relatively non-toxic to non-target organisms and have no documented ecological side-effects when applied according to the label:

- VectoLex (*Bacillus sphaericus*) and VectoBac (*Bacillus thuringiensis israelensis*) are microbial larvicides. These products work by exploiting insecticidal toxins found in natural bacteria that only have significant effects on the target insects (CDPH and MVCAC, 2010).
- Methoprene is an insect growth regulator that comes in several formulations including extended release pellets, briquettes, and ingots, water-soluble packets, and liquid. Methoprene disrupts the physiological development of larvae, which prevents adults from emerging from the water body. Methoprene has minimal non-target effects and has no use restrictions in California (CDPH and MVCAC, 2010).

It is often difficult to pinpoint “hot spots” of mosquito breeding due to the vast number of potential sources in developed areas. An important tool used by vector control agencies, including the VCVCP, is an adult mosquito trap. Traps are deployed in areas suspected of producing large numbers of mosquitoes based on historical data, disease surveillance data, and public complaints. Trap captures allow the VCVCP to count and identify mosquitoes to determine the potential public health risk and the need for control. Adult mosquito surveillance can also be used as a feedback or quality control mechanism to determine how effectively an overall program reduces mosquito populations (CDPH and MVCAC, 2010). With limited resources, vector control programs prioritize adult mosquito surveillance for use in tracking diseases such as West Nile virus and evaluating the efficacy of control measures. Public complaints are addressed through field visits to assess if additional treatment is needed, though may not result in the deployment of adult traps.

2.6 MIDGES

Midges are a diverse group of small, non-biting flies closely related to mosquitoes. Many species have a strong resemblance to mosquitoes in size and appearance (Figure 3 and Figure 4), and they often share the same aquatic habitats. Midges cannot bite and are not vectors for disease. Midge larvae are usually found in wetlands and marshes, as well as wastewaters including wastewater treatment plant lagoons and urban runoff channels (Grodhaus, 1975); however, unlike mosquitoes, midge larvae do not breathe atmospheric air and often live attached to surfaces or in sediments. As a result, midges do not have the same restrictions as mosquito larvae and are often very abundant in the bottom sediments of open bodies of water. Midges often hatch simultaneously in blooms during the spring or summer, resulting in large masses of midges grouped together near wetlands and marshes. Many species are strongly attracted to artificial light sources and also use structures as resting sites. Thus, they can become extreme nuisances seasonally by massing in and around residences and other structures. Midges have a shorter life span than mosquitoes that entails finding a mate in order to lay eggs before they die (Grodhaus, 1975).

Figure 3. Adult Female Midge (©Bruce Marlin http://www.cirrusimage.com/fly_midge.htm)

Figure 4. Adult Mosquito (left) versus Adult Midge (right) (http://www.glacvcd.org/Contents/Vector-Services-Info/Midges.aspx)

3 Vector Control Program Data Analysis

This section analyses available adult mosquito trap data from the VCVCP. The data were used in this analysis to recognize mosquito sources and compare relative abundance in areas surrounding the J Street Drain.

3.1 ADULT MOSQUITO SURVEILLANCE

The VCVCP uses adult mosquito traps as part of their comprehensive mosquito surveillance and control plan. The traps use CO_2 as an attractant and capture only female mosquitoes. However, it should be noted that traps, because they are deployed overnight, represent only a “snap shot” in time of the mosquito population in an area. Attempts are made to deploy traps during representative weather conditions.

Traps provide the VCVCP with quantitative data vital to decision-making in regards to mosquito control for the protection of public health. Mosquitoes captured in the traps can serve some or all of the following uses: 1) to monitor mosquito abundance and species composition in a local area, 2) to collect specimens for laboratory testing to determine if disease pathogens (e.g., encephalitis viruses) are circulating within the local mosquito population, 3) to provide early detection of exotic (i.e., non-native species), and 4) to evaluate the effectiveness of local mosquito control efforts. Although trap data may help pinpoint local areas where mosquito populations require additional control, the VCVCP typically only treats bodies of water against mosquito larvae based on direct evidence of immature mosquitoes in the waterbody rather than due to the presence of adults in the area.

The VCVCP has limited resources available that must be used to protect the entire County. Adult mosquito traps are deployed in areas of greatest concern, usually triggered by evidence of local disease transmission in birds, humans, or other animals, but also in response to local nuisance complaints. For this reason, the number and location of traps deployed often varies seasonally and yearly. During 2008-2010, citizen complaints from the Surfside III Condominium Complex, located in the area near the terminal end of the J Street Drain, led the VCVCP to increase their surveillance efforts in the immediate vicinity in an attempt to identify both the species present and their potential points of origin. As a result, more data were generated for this area during this two-year period than in previous years. It should also be noted that trap data are collected during the late spring through early fall. Mosquito production is generally low during the late fall and winter months, thus traps are typically not deployed at those times. This section discusses the relevant trap data collected in the J Street Drain area between 1999 and 2010. A map of the locations for which trap data were collected in the J Street Drain area is presented in Figure 5. SSIII indicated on the map shows the origin of citizen complaints about mosquitoes.

Figure 5. Map of Adult Mosquito Trap Locations in the greater J Street Drain Area

3.2 DATA ANALYSIS: ORMOND BEACH LAGOON AREA

Adult mosquito traps were deployed at two sites in the Ormond Beach Lagoon area: one at the south end of Perkins Road and the other at Hueneme Drain at J Street Drain, which is at the terminus of the J Street Drain. The Perkins Rd. site had been sampled periodically since 2002, whereas the J Street Drain site was a new site added in 2010, specifically in response to the citizen complaints from the Surfside III Condominium Complex. Data collected from these sites are summarized in Figure 6 and Figure 7, respectively.

At both locations, *Culex erythothorax* was the dominant species captured, with the bulk of captures in the Perkins Rd. trap site. As discussed in Section 2, this species is closely tied to densely vegetated wetlands and would not be expected to breed outside this habitat, nor to travel long distances from its point of origin (Walton et al., 1999; Bohart and Washino, 1978). This strongly suggests that the primary source of these mosquitoes is the Ormond Beach Lagoon, which provides this type of habitat. Less frequent breaching of the lagoon berm over the past two decades (see section 1.2 above) has likely improved mosquito breeding habitat by maintaining more standing freshwater for longer periods of time and allowing stands of emergent vegetation to increase in size and density. There are comparatively low numbers of all mosquito species captured at the Hueneme Drain site at the terminus of J Street Drain. This provides additional evidence that the lagoon is producing the majority of mosquitoes in this immediate area and supports the case that the J Street Drain, Hueneme Drain Pump Station, and Hueneme Drain in their current configuration do not provide ideal habitat for mosquitoes nor are major sources of mosquito production.

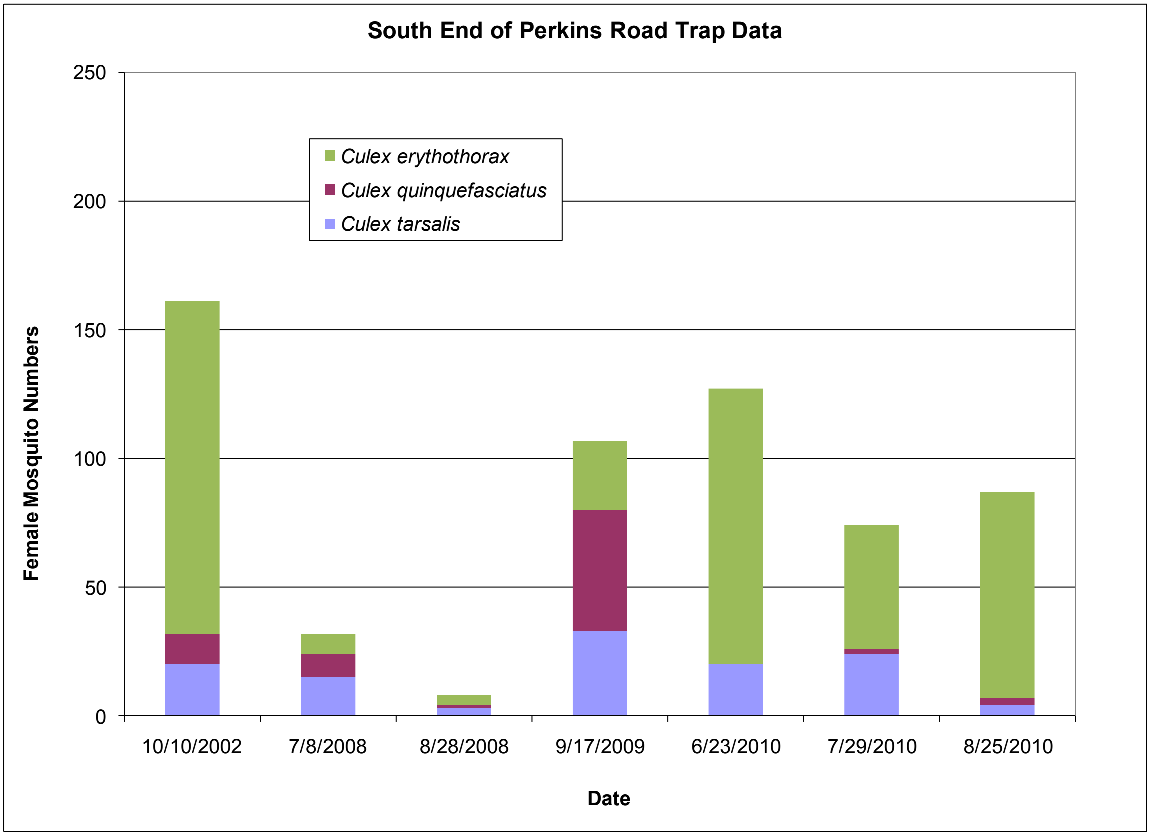

Figure 6. Adult Mosquito Trap Data, South End of Perkins Road

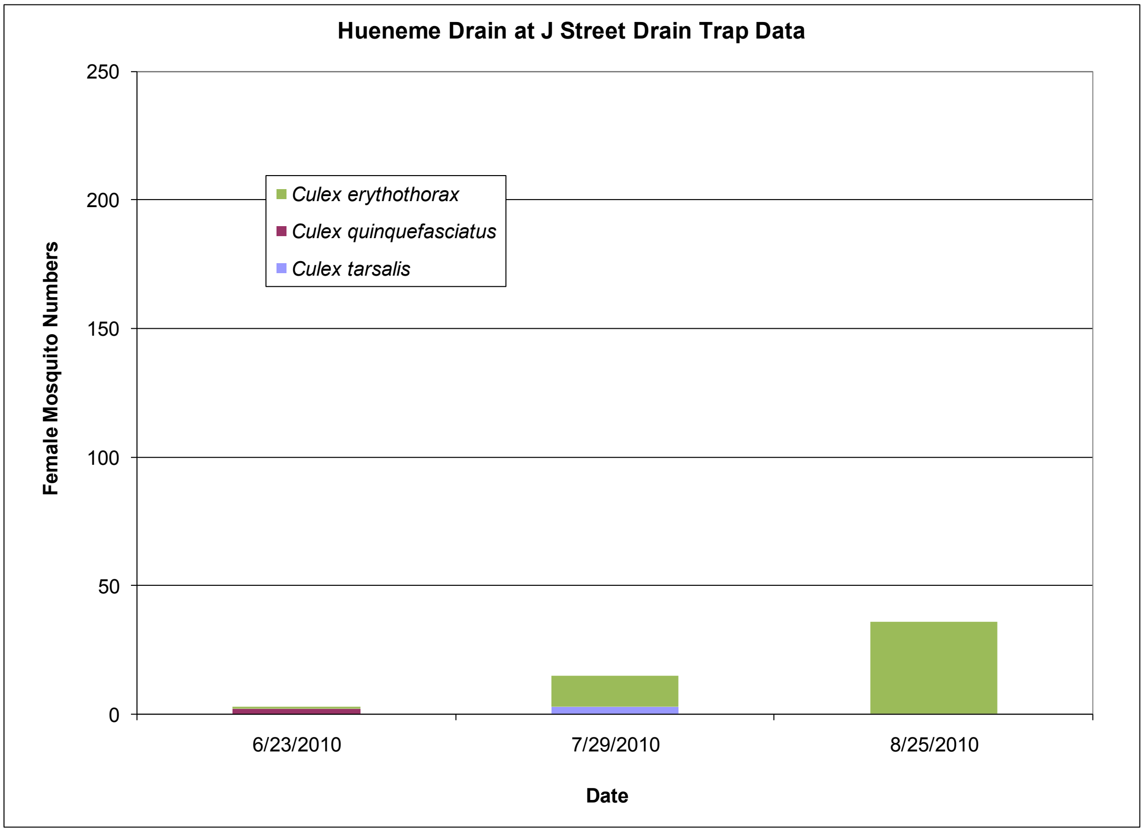

Figure 7. Adult Mosquito Trap Data, Hueneme Drain at J Street Drain (Terminus of J Street Drain)

3.3 DATA ANALYSIS: UNDEVELOPED FLOODPLAIN OF THE OXNARD INDUSTRIAL DRAIN

The VCVCP has periodically deployed an adult mosquito trap at the west end of McWane Blvd. since 1999. This large undeveloped area is subject to seasonal flooding that, under the right conditions, may produce large numbers of mosquitoes. The trap routinely captures large numbers of mosquitoes, most of which are *Culex tarsalis*, making this site the most mosquito-productive in the greater J Street Drain area (Figure 8). *Culex tarsalis* will breed in a variety of non-polluted waters, but have a strong affinity for wetland habitats (Bohart and Washino, 1978). Although *Culex tarsalis* may share some habitats with *Culex erythrothorax*, it has a preference for less densely vegetated habitats. The undeveloped floodplain of the Oxnard Industrial Drain provides such habitat, and the trap data show the difference in species composition between this location and the two sites in the Ormond Beach Lagoon area. Although *Culex tarsalis* often migrate relatively long distances from their point-of-origin, the trap data from Hueneme Drain at J Street Drain (Figure 7, above) provide little support to suggest that mosquitoes originating in the undeveloped floodplain were moving in any great numbers to the terminus of J Street Drain area during 2010. The mosquito trap data indicate that, compared to the undeveloped floodplain of the Oxnard Industrial Drain, the developed area surrounding the J Street Drain produces low numbers of mosquitoes.

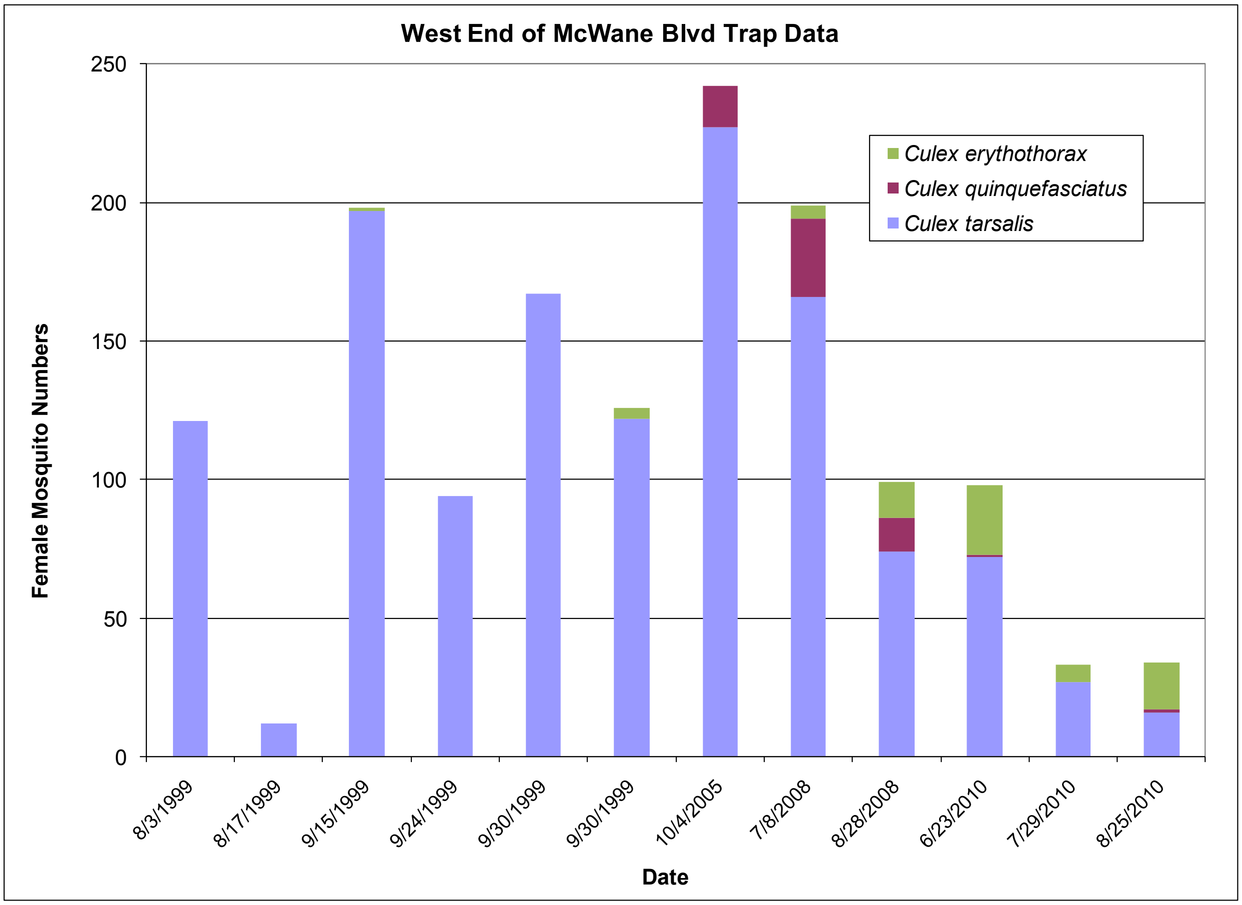

Figure 8. Adult Mosquito Trap Data, West End of McWane Blvd

3.4 DATA ANALYSIS: GREATER J STREET DRAIN AREA

In total, VCVCP deployed adult mosquito traps in nine locations in the greater J Street Drain area in 2005, 2008, 2009, and 2010 (Figure 5, above). For reasons explained in Section 3.1, traps were not necessarily deployed at the same locations on each available date; therefore, not all of the data are directly comparable. However, the following data summary does provide some insight into past and present mosquito production in the greater J Street Drain area, as well as providing evidence of where certain species are most plentiful and which areas have the greatest mosquito-producing potential (Figure 9 through Figure 13). As shown in the graphs, all deployed traps captured mosquitoes. It is rare for CO_2-baited traps not to capture at least some mosquitoes in developed areas. As previously discussed, it is impossible to eradicate mosquitoes completely in the urban environment due to the ability of mosquitoes to exploit a multitude of urban water sources for reproduction, many of which are difficult to identify or locate.

In locations where traps were placed more than once, data vary widely from one deployment to the next. For example, the trap site at J Street Drain near Hueneme Rd. captured numbers ranging from less than 25 to greater than 200 with equally variable species composition. A multitude of factors can influence the flight of adult mosquitoes and associated overnight trap captures including natural factors (e.g., temperature, wind, and rain) and artificial factors (e.g., street lights and vehicle traffic). However, adult populations also fluctuate in response to seasons, habitat availability, and control efforts. As expected, the more urban trap sites located to the north and west of Ormond Beach Lagoon, and even the trap site located in the undeveloped floodplain of the Oxnard Industrial Drain, captured a substantial percentage of *Culex quinquefasciatus*. This species thrives in disturbed and nutrient-rich habitats, including belowground stormwater infrastructure (Schreiber et al., 1988). Its opportunistic use of nearly any small source of urban water (e.g., neglected pools, ornamental ponds, clogged rain gutters, flower pots) as well as belowground sources for breeding make it challenging to control. These same traps also captured a large percentage of *Culex tarsalis*, which also thrives in urban areas, but almost never breeds belowground.

The relatively high number of adult mosquitoes captured in traps in September 2009 (Figure 12), combined with numerous complaints from residents of the Surfside III Condominium Complex, prompted the VCVCP to investigate the OWWTP as a possible source of increased mosquito production. The VCVCP routinely monitors several areas within the OWWTP, including the pond and inactive treatment cells, which would be likely mosquito breeding sources. In response to the resident complaints and increase in *Culex quinquefasciatus* mosquitoes captured in traps, the VCVCP requested authorization to more broadly examine the OWWTP for new mosquito breeding sources and OWWTRP staff cooperated with this request. The investigation led to the detection of a large belowground flooded basement that was actively producing *Culex quinquefasciatus* mosquitoes. The flooded basement was considered a new mosquito source in the area. The VCVCP has since routinely addressed this source and other newly added smaller potential sources on the OWWTP property, in addition to the sites within the OWWTP previously monitored and treated. Trap data collected in 2010 (Figure 13) show far fewer mosquitoes in the greater J Street Drain area, reflecting the increased control efforts at new source locations by the VCVCP. Overall, these data suggest that mosquito production is widespread within the developed areas surrounding the J Street Drain, with no evidence of sharp rises in mosquito numbers in traps located near the J Street Drain that would implicate this conveyance channel as a major source of mosquitoes.

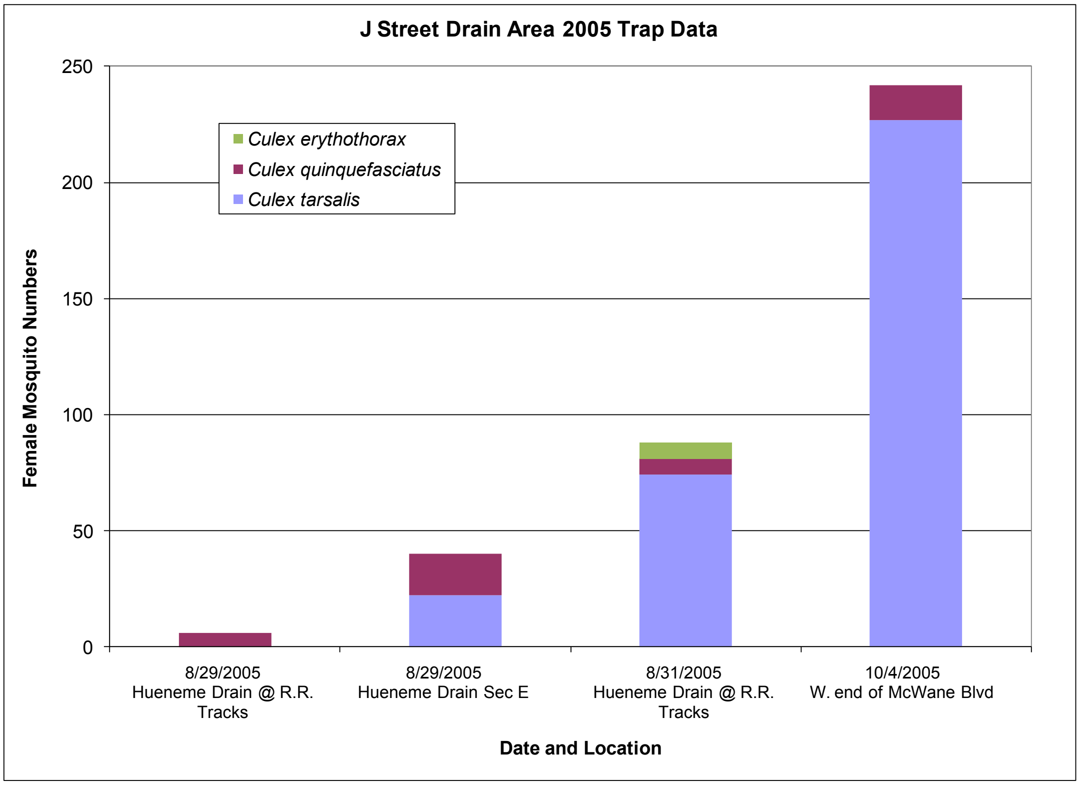

Figure 9. Greater J Street Drain Area 2005 Adult Mosquito Trap Data

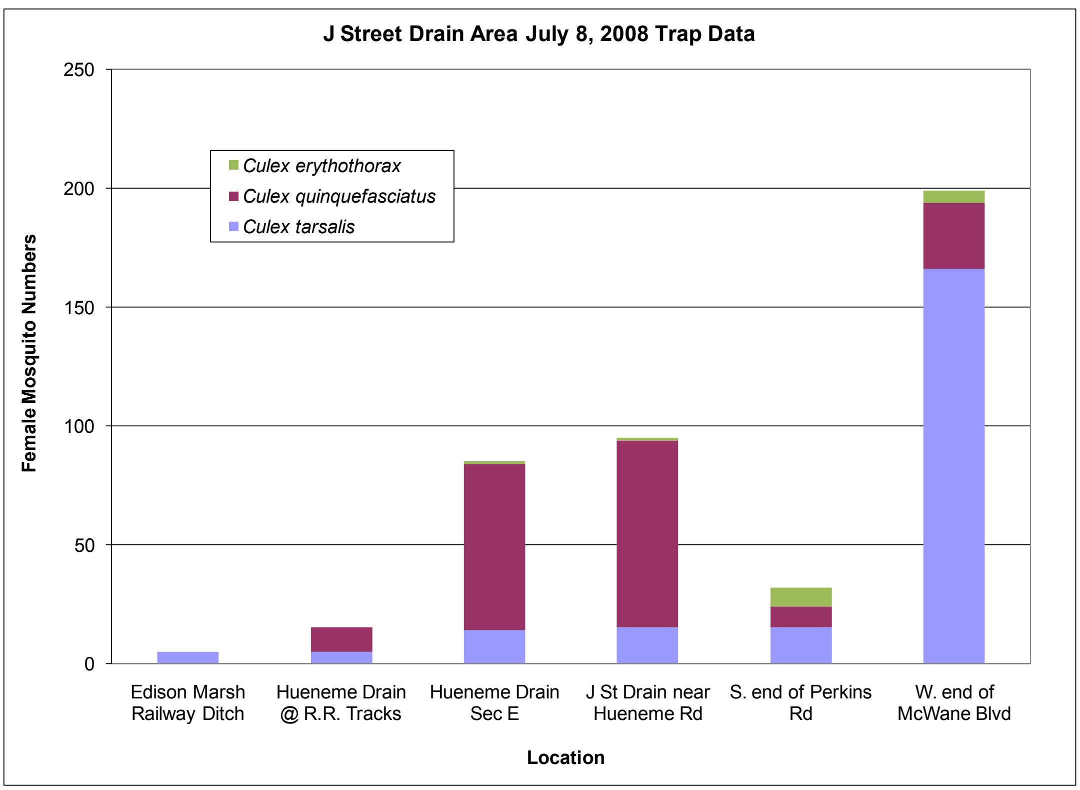

Figure 10. Greater J Street Drain Area July 8, 2008 Adult Mosquito Trap Data

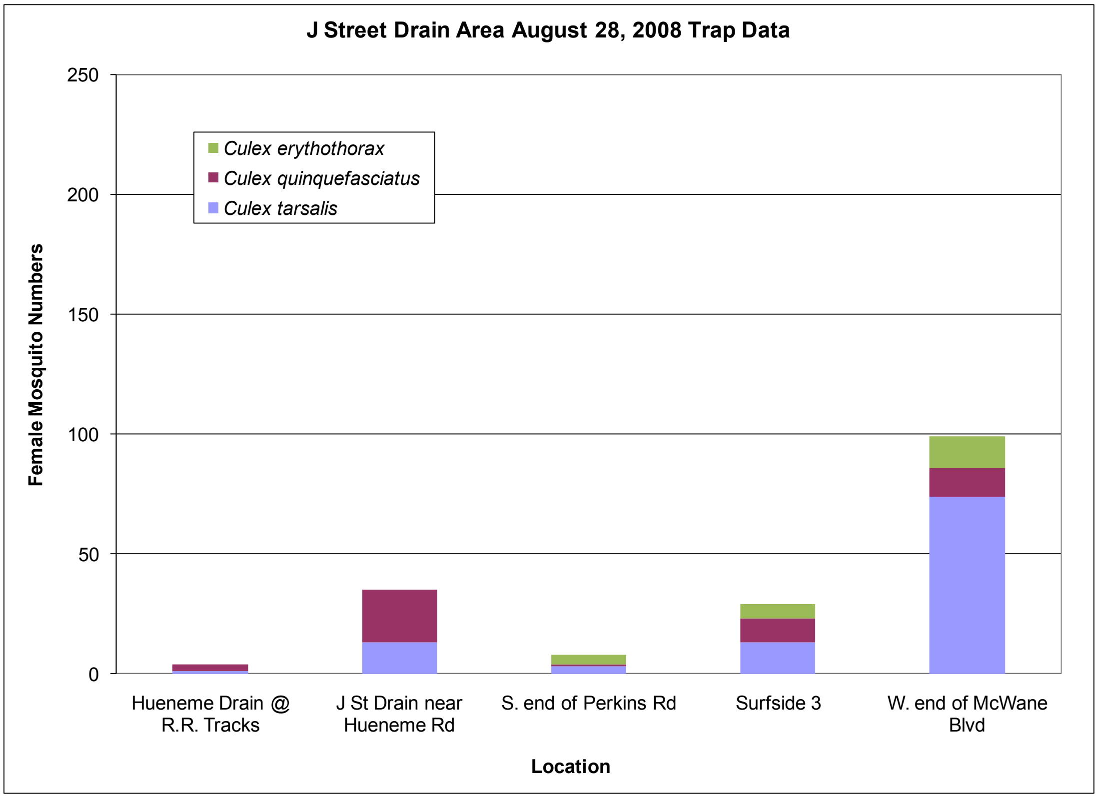

Figure 11. Greater J Street Drain Area August 28, 2008 Adult Mosquito Trap Data

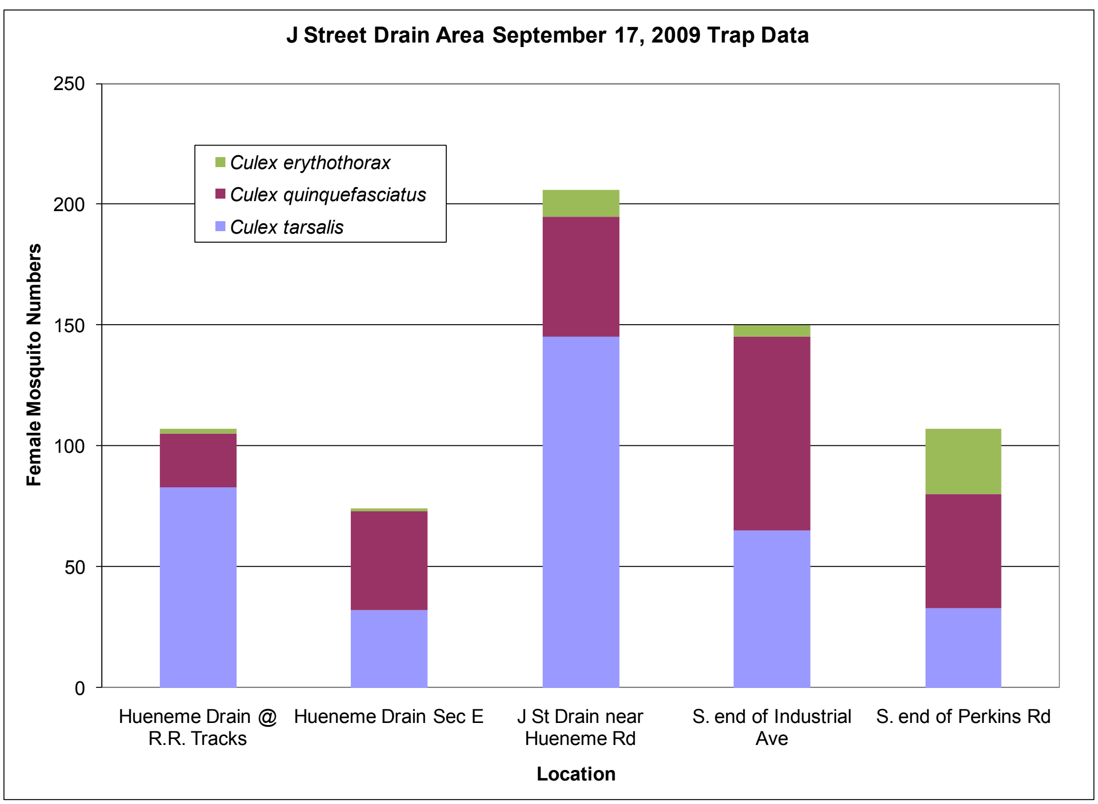

Figure 12. Greater J Street Drain Area September 17, 2009 Adult Mosquito Trap Data

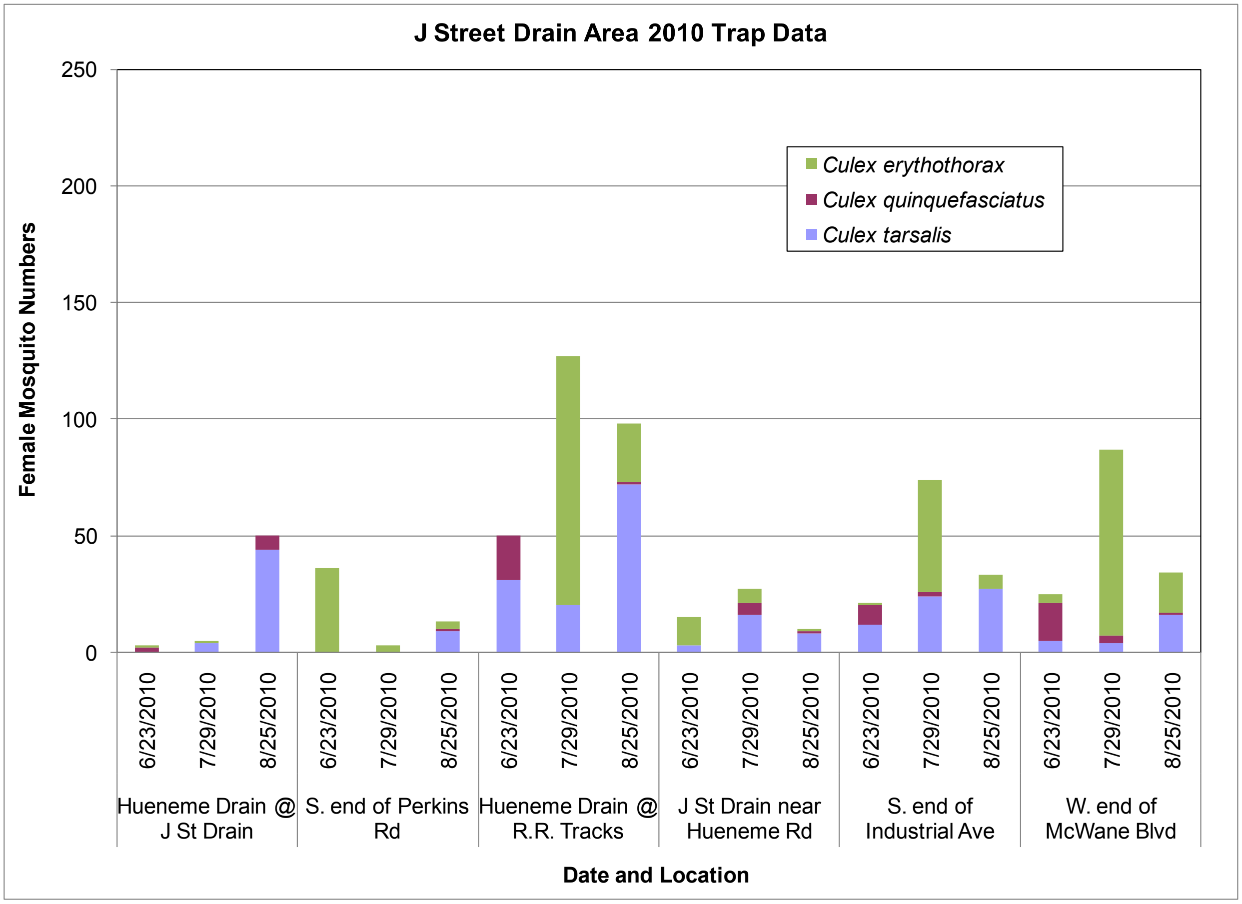

Figure 13. Greater J Street Drain Area 2010 Adult Mosquito Trap Data

4 Evaluation of Channel Design with Respect to Mosquitoes and Public Health

To achieve their intended goals, stormwater management structures can be built into a variety of shapes and sizes depending on local conditions such as slope, soil makeup, flow rates, geographic setting, and existing infrastructure. A consideration that is often overlooked by planners and developers is the potential for such structures to facilitate the attraction, harborage, or development of mosquitoes and options for abating these outcomes. To this end, studies of various structures have been conducted in California in order to determine the design characteristics found to best decrease mosquito production potential for use by the stormwater community (Harbison and Metzger, 2010; Metzger et al., 2008; Metzger, 2004; CDPH and MVCAC, 2010; CDPH, 2010; NCSU Cooperative Extension, 2005; CDHS, 2001). The most effective design characteristics are those that decrease or eliminate the amount of sheltered, stagnant water as discussed in Section 2. Shallow, sheltered standing water with vegetative cover is one of the most conducive mosquito breeding habitats, while deep or flowing unprotected water is unlikely mosquito breeding habitat. Belowground sources of standing water are almost always suitable mosquito breeding habitat. Additional effective design characteristics include:

- Steep sides to inhibit emergent vegetation growth;
- Flowing water;
- Deep-water areas where natural predators can live;
- Open-water areas exposed to wind, which results in surface disturbances (i.e., waves) that reduce the effectiveness of mosquito breathing siphons; and
- Proper access for mosquito treatment and vegetation management.

Additionally, the manual of Best Management Practices for Mosquito Control in California (CDPH and MVCAC, 2010) recommends that drains have a minimum four-foot wide bottom that is well maintained and receives periodic removal of accumulated sediment, trash, and debris. In stormwater structures with permanent standing water, the manual recommends that deep zones of four feet or more be maintained to limit the spread of vegetation such as cattails, and that edges below the water surface be steep and uniform to discourage plant growth that may provide mosquitoes with protection from predators. Use of a concrete bottom in shallow areas is also recommended to discourage plant growth. Finally, all stormwater structures should be easily and safely accessible for monitoring and potential treatment of mosquitoes. This includes minimizing confined-space entry and providing access roads close to shorelines for maintenance.

4.1 CURRENT J STREET DRAIN

The current J Street Drain is a trapezoidal, concrete flood control channel approximately 20-30 feet wide with 1.5:1 sloped walls and an average depth below grade near 4 feet (HDR, 2009). The J Street Drain discharges into Ormond Beach Lagoon, which usually does not have an outlet draining to the ocean (as described in Section 1). The effect of Ormond Beach Lagoon having no outlet is that water backs up into the J Street Drain nearly to Hueneme Road (HDR, 2009). While mosquito control best management practices (BMPs) largely advocate reducing or eliminating standing water in channels and drains as the primary strategy for mosquito control, the endangered species requirements in Ormond Beach Lagoon (discussed in Section 1) prevent such practices. Therefore, the current J Street Drain is evaluated as a standing water body rather than as a channel.

The simplest and most straightforward approach to mosquito control in stormwater structures is to create either flowing water or dry ground; however, as discussed in Section 2 and above, there are other factors that influence whether habitat is suitable for mosquito development. The current J Street Drain has a concrete substrate and relatively steep sides, both of which inhibit emergent vegetation growth along the bottom and margins of the channel. Lack of vegetation can prevent mosquito production as no sheltered areas for mosquito larvae to use as refuge are provided. As described above, the current J Street Drain is 20-30 feet wide. Because of this wide, open surface, the lack of vegetative cover, and the location near the Pacific Ocean, the water surface in the drain experiences substantial wind and wave action, especially near the beach. Wind and wave action on the surface of the water prevent the breathing siphons of mosquito larvae from maintaining a connection to the air, therefore effectively drowning the larvae. This makes the current J Street drain unlikely habitat for mosquito breeding. In addition, the greater water depth of the J Street Drain downstream of Hueneme Road allows it to support numerous fish species that will opportunistically prey on mosquito larvae.

Recent inspections of the J Street Drain by California Department of Health, Vector-Borne Disease Section staff confirmed that the J Street Drain does not currently provide suitable habitat to support large mosquito populations (personal communication Marco Metzger, September 22, 2010). Additionally, the open channel facilitates maintenance, monitoring, and treatment activities. As a note, the current J Street Drain does, however, provide suitable habitat for midges, which resemble mosquitoes (although they do not bite or transmit disease) and can seasonally be a nuisance.

4.2 PROPOSED J STREET DRAIN PROJECT

The proposed J Street Drain project entails changing the existing open trapezoidal channel into an open rectangular channel with vertical rather than sloped walls. It also entails deepening the channel by four feet and widening it by approximately ten feet (HDR, 2009). The wider, deeper channel will increase the overall capacity of the channel and convey greater volumes of floodwater to prevent the channel from over-topping and causing damage to property and vital facilities. The change in channel geometry would increase the depth, surface area, and length of backed up water. When the water surface elevation in Ormond Beach Lagoon is at 6.5 feet, the additional surface water acreage of the J Street Drain would be one additional acre at the completion of Phase I and 2.6 additional acres at the completion of Phase II (HDR, 2009). However, neither the changes in channel configuration nor the resulting additional standing water volume is expected to increase the suitability of the drain habitat for mosquito breeding. The proposed changes to the channel are projected to maintain or possibly amplify the aforementioned negative effects on mosquito breeding. The greater volume of water would provide additional habitat for predator fish downstream of Hueneme Road, while the increased width would increase exposure to wind and wave action throughout the submerged reach. Vertical channel walls are considered the most desirable design choice to minimize vegetative or other cover along the channel margins and present the best scenario for preventing refuge for immature mosquitoes. The proposed channel geometry will not reduce the ease or safety of access for mosquito monitoring and treatment or channel maintenance.

Due to endangered species constraints, the deepening of the J Street Drain as part of the proposed project would not extend into Ormond Beach Lagoon. Following a breach event, this could result in a situation where the majority of the J Street Drain empties, while a section of standing water remains at the terminus of the drain where the elevation is lower than the lagoon. This scenario is not expected to increase the probability of mosquito production for the following reasons:

1) Vertical walls, lack of vegetation, and wind action would maintain poor mosquito habitat similar to pre-breach conditions
2) Fish living in coastal lagoons, such as the tidewater goby, are adapted to tolerate fluctuations in water level and should remain in the channel providing predation.
3) Breach events usually take place during the colder winter months. In the event that a breach resulted in the temporary formation of isolated pools, mosquito production would be unlikely.

The transition area between flowing water and backed-up water would be expected to have the most potential for mosquito production. However, this area would be accessible to VCVCP staff for monitoring and treatment. The transition area would not be expected to be a substantial source of mosquitoes when treated. It should also be noted that breaches close relatively quickly, and the continuous flow in the channel would refill the drain, preventing this condition from persisting. Furthermore, it is expected that the depth of the drain and the lagoon would equalize over time such that standing water may not remain in the drain during future breaches.

4.3 J STREET DRAIN CHANNEL ALTERNATIVES

The Draft EIR presented project alternatives to the proposed J Street Drain Project and determined the environmental impacts of the alternatives. The alternative projects were:

- Alternative A: Buried box culverts
- Alternative B (the Proposed Project): Open rectangular channel
- Alternative C: Open rectangular channel with step
- Alternative D: Two separated buried box culverts
- Alternative E: Natural channel

Analyses of all four of the project alternatives with regard to mosquito breeding potential are presented below. It should be noted that only Alternative A and B are feasible options for the project between the beach and Hueneme Rd due to the size of the right-of-way and existing structures.

4.3.1 Alternative A: Buried Box Culverts

This project alternative involves the construction of buried box culverts rather than an open channel from Hueneme Road north to Pleasant Valley Road. The J Street Drain channel would remain open from Hueneme Road south to Ormond Beach Lagoon to avoid impacts to endangered species in the lagoon (HDR, 2009). The use of buried box culverts for the channel would most likely have a negative impact on mosquito control because of four main factors. First, buried box culverts would be closed at the surface, providing cover and decreasing/eliminating wind disturbance of the water that prevents mosquito larvae from surviving. Second, dark, belowground habitats are unsuitable for fish that may otherwise be predators. Third, the use of buried box culverts would shift the dominant mosquito species expected to occupy this area of the channel from *Culex tarsalis*, which tend to stay out of underground habitats (Reisen and Lothrop, 1995; Walton et al., 1990), to *Culex quinquefasciatus,* which are strongly attracted to underground habitats (Schreiber et al., 1988). While this change in species composition does not inherently cause a greater risk to public health (both are vectors of West Nile virus), the buried box culvert design provides a protected breeding habitat for *Culex quinquefasciatus,* increasing its mosquito production potential. Lastly, the buried box culvert design would reduce the accessibility of the channel for mosquito monitoring and treatment by the VCVCP and maintenance by the District, both of which are important factors in mosquito control.

4.3.2 Alternative C: Open Rectangular Channel with Step

This project alternative consists of a main concrete channel with vertical walls and a landscaped step on either side of the main channel. The main channel would be wider and shallower than the proposed project and have suitable capacity for most stormwater flows, but as flow increased above the main channel's capacity it would spread out onto the step (HDR, 2009). Under this alternative, the main channel would be wider than the current J Street Drain. This alternative would likely have similar mosquito breeding potential to the current and proposed J Street Drain, with a similar amount of wind disturbance and fish predation compared to the existing J Street Drain. The change to vertical walls in the main channel is considered a more desirable design choice to reduce potential for vegetative or other cover along the channel margins, as for the proposed project. This alternative would also provide adequate access for mosquito treatment and emergent vegetation management, similar to both the current and proposed J Street Drain, though may require additional maintenance for the vegetated step.

4.3.3 Alternative D: Two Separated Buried Box Culverts

This project alternative is very similar to Alternative A, except that the buried box culvert would be separated by a vegetated swale that could be used to treat stormwater before it enters the culverts (HDR, 2009). The same applies here as discussed for Alternative A: reduced wind disturbance, reduced or eliminated fish presence, change in mosquito species composition, and reduced access for monitoring, treatment, and maintenance.

4.3.4 Alternative E: Natural Channel

This project alternative consists of a natural channel with no concrete sides or bottoms. This alternative would require a much wider channel than currently exists and might increase the area of water backed up compared to the proposed project (HDR, 2009). This project alternative would greatly increase the potential for mosquito production within the J Street Drain as compared to the current or proposed configuration and provide habitat suitable for additional species. The natural channel would have gently sloping sides that would be vegetated to control erosion. This vegetation would provide shallow, protected mosquito habitat along the margins of the channel. Dense vegetation along channel margins also makes monitoring and treatment by the VCVCP more difficult and dense vegetation can make treatment less effective. Without substantial maintenance, the natural channel would also likely develop side channels with intermittent flow that could similarly provide for mosquito habitat (Williams and Swanson, 1989). Conversely, the additional width of the natural channel will increase wind action on the surface of the water where vegetation is not present and the use of a natural channel may increase habitat for mosquito predators. However, these benefits are unlikely to compensate for the factors that would increase mosquito populations.

4.3.5 Additional Alternatives

The Surfside III Condominium Owner's Association suggested an additional alternative for the J Street Drain (Loewenthal, Hillshafer & Rosen LLP, 2010). The additional alternative is to pump out the standing water in the J Street Drain, the reasoning being that without standing water no mosquito breeding would occur within the J Street Drain. This additional alternative, however, would not solve the original problem and impetus of the J Street Drain Project, which is the need for 100-year storm flow capacity. The dimensions of the current J Street Drain are not sufficient to convey the flow volume of a 100-year storm, with no relationship to the volume of water present in the channel. In other words, the current J Street Drain would flood during a 100-year storm even if the outlet to the Pacific Ocean was open at the time and the channel was initially empty.

This additional alternative assumes that (1) it is feasible to pump the water out of the J Street Drain and (2) such pumping would not violate the Endangered Species Act. It should be noted that it is unlikely either of these assumptions are correct. Pumping water out of J Street Drain would reduce the size of Ormond Beach Lagoon, resulting in a reduction of foraging habitat for endangered California least terns and critical habitat for the endangered tidewater goby.

While generally it is considered good to reduce or eliminate standing water to minimize mosquito production, it is unlikely that a pump would be capable of removing all water in the drain, especially the small volumes of non-storm urban runoff. Remaining wet areas in depressions and debris would provide excellent mosquito breeding habitat. Additionally, pumps may require a sump, which would hold water in a sheltered space that is good mosquito habitat. This option would require substantial additional maintenance to keep the channel and sump free of trash and debris. Also, additional monitoring and treatment would be necessary by the VCVCP. This condition contrasts with the current J Street Drain, where, as discussed above, though standing water is present, the standing water is not good mosquito breeding habitat. Therefore, implementing a pump would essentially remove water that is not good mosquito habitat (current water in J Street Drain) and replace it with water that is good mosquito habitat (small pools of water that remain in the channel or in a sump).

4.3.6 Summary of Alternatives

The impacts on mosquito production of each alternative as compared to the proposed project are presented in Table 1.

Table 1. Impacts of Alternatives on Mosquito Production Compared with Proposed Project

Alternative	Effect on Habitat	Effect on Maintenance & Chemical Applications	Overall Impact
A: Buried box culverts	• Reduced disturbance to water surface • Reduced fish habitat • Altered mosquito species	• Difficult to access	Negative
C: Open rectangular channel with step	• Similar surface water disturbance and fish habitat	• Increased maintenance required	Similar
D: Two separated buried box culverts	• Reduced disturbance to water surface • Reduced fish habitat • Altered mosquito species	• Difficult to access	Negative
E: Natural Channel	• Increased disturbance to water surface • Increased fish habitat • Creation of mosquito habitat at margins	• Increased maintenance required • Reduced accessibility • Reduced effectiveness of treatment	Negative
Additional Alternative	• Creation of stagnant puddles • Creation of habitat in sump	• Increased maintenance required • Increased treatment required	Negative

5 Narrative Review of Potential Mosquito Sources

In addition to the J Street Drain there are other potential mosquito breeding sites in the surrounding area. This section evaluates the potential of additional sites as mosquito breeding habitat.

5.1 ORMOND BEACH LAGOON

According to the manual of Best Management Practices for Mosquito Control in California (CDPH and MVCAC, 2010), wetlands can be an important source of mosquito production. This is also supported by the VCVCP trap data presented in Section 3 (Figure 6 and Figure 7, above). Ormond Beach Lagoon has grown in area since the District ceased breaching the lagoon's berm to maintain an ocean outlet. When the lagoon had an outlet, the wetland area was fairly small compared to the current condition. Ormond Beach Lagoon is an open, natural substrate waterbody with vegetated margins and also vegetated interior in some portions. Water depth varies. The open, interior portions of the lagoon are not good habitat for mosquito breeding due to wind action and fish predation, as discussed above. However, the many densely vegetated areas of the lagoon, some with merely inches of water, provide optimal habitat for mosquito breeding. Emergent vegetation such as cattails, which are plentiful and dense in the lagoon, protects immature mosquitoes from wind and predators.

Many regions of the lagoon are difficult to access by VCVCP staff for monitoring and treatment. Furthermore, the dense vegetation makes treatment difficult and less effective – the presence of emergent vegetation can prevent applied substances from reaching the water in adequate quantities to control mosquitoes. Additionally, many wetlands, and/or the species that live in them, are protected by state and federal laws, which may limit the management strategies permitted. For these many reasons, Ormond Beach Lagoon is considered to be a potential and substantial source of mosquito breeding. Given the close proximity of portions of the lagoon to residential areas, it may be a source of mosquitoes experienced by the public. This is also supported by the VCVCP trap data discussed in Section 3.

5.2 OXNARD WASTEWATER TREATMENT PLANT

The OWWTP borders the J Street Drain across from the Surfside III Condominiums and occupies the majority of the space between the J Street Drain to the west, Perkins Rd. to the east, the railroad tracks to the north, and approximately McWane Blvd. to the south. This facility collects and treats approximately 31 million gallons of wastewater per day from the City of Oxnard, the City of Port Hueneme, the US Naval Base, and some unincorporated areas of Ventura County. Treated wastewater is discharged to the Pacific Ocean. The OWWTP contains a large pond, may contain inactive treatment cells, and many sumps for pumping wastewater throughout various stages of the treatment process as well as on-site ditches and other locations that contain standing water. These sources of standing water do not contain natural predators and can become suitable mosquito breeding habitat under certain conditions. The VCVCP currently treats many locations within the OWWTP and the OWWTP cooperates in the monitoring and treatment of mosquito sources. Several new sources within the OWWTP were identified during 2009, including a flooded basement actively breeding mosquitoes. This suggests that these locations may have been producing mosquitoes prior to their identification and treatment. Monitoring and treatment of identified sources should keep mosquito production from the

OWWTP to a minimum; therefore, certain areas within the OWWTP are considered potential sources for substantial mosquito production without treatment (as was the case prior to identification of new sources) but a minor source with regular monitoring and treatment hereafter.

5.3 HUENEME DRAIN/BUBBLING SPRINGS

Hueneme Drain, also known as Bubbling Springs, runs south along Surfside Drive toward the ocean and then southeast parallel to the beach to end at the Hueneme Drain Pump Station at J Street Drain. Hueneme Drain has many similarities to J Street Drain: it is wide with wind action on the surface, many fish live in the channel, and has very little protected habitat along the margins. Hueneme Drain has some shoreline vegetation along the margins in contrast to the vegetation-free J Street Drain, but it is limited to small clusters. Therefore, Hueneme Drain is considered to be at worst a minor source of mosquitoes. Hueneme Drain does, however, provide suitable habitat for midges, which resemble mosquitoes (although they do not bite or transmit disease) and can seasonally be a nuisance.

5.4 HUENEME DRAIN PUMP STATION

As discussed in the Introduction, the Hueneme Drain Pump Station transfers water from the Hueneme Drain to the J Street Drain. The Hueneme Drain Pump Station was created in the 1960s because the Hueneme Drain, fed by the naturally occurring Bubbling Springs, was bisected by the J Street Drain, which effectively cut off the Hueneme Drain from its outlet (HDR, 2009). A forebay is included as part of the Hueneme Drain Pump Station that acts as the sump for the pumps. The Hueneme Drain Pump Station was reconstructed in 2005-2007 to provide pumping capacity for the 100-year storm event. There was no hydrologic change (e.g., additional standing water) to the Hueneme Drain, Hueneme Drain Pump Station, or J Street Drain after the reconstruction as daily flow volumes passing through the pump station are similar to pre-project conditions, and the pump forebay continues to exist in its original condition. Flow volumes are based on the natural output of Bubbling Springs and urban runoff generated by City of Port Hueneme residents and businesses. Residents of the area have commented (Kelemen, 2009) that an increase in the mosquito population coincided with the reconstruction of the pump station; therefore, this section includes an evaluation of the previous and current pump station for mosquito breeding potential.

Because Hueneme Drain ends at the J Street Drain with no outlet, there is standing water in the channel. Water is removed from the channel via the Hueneme Drain Pump Station. The potential of the Hueneme Drain Pump Station to produce mosquitoes prior to the reconstruction was not considered to be different than the potential of the channel itself, which, as described above, is considered a minor or non-source. There was no change in the hydrologic conditions found in the Hueneme Drain or the Hueneme Drain Pump Station, including the forebay that continues to exist in its original size, following the reconstruction (i.e., no additional standing water). The additions to the pump station following the reconstruction would not have increased the suitability for mosquito production. Therefore, the current Hueneme Drain Pump Station is also considered to be at worst a minor source of mosquitoes.

5.5 OTHER URBAN SOURCES

Many potential sources of mosquito production can exist in the urban environment, including residential properties, industrial properties, parks and recreational areas, and urban infrastructure. Some examples of potential sources include unmaintained swimming pools where debris and algae provide refuge, over-watered lawns, garbage cans or other containers filled with water by sprinklers, ditches or ruts, rain gutters or down spouts, and bird baths (CDPH, 2008a). Mosquitoes arising from private property are the legal responsibility of the landowner in California, according to the California Health and Safety Code Sections 2001 - 4(d), 2002, and 2060 (b) (CDPH and MVCAC, 2010); however, it is difficult to assess the amount of actual mosquito production that may be taking place given the variety of potential sources that could exist in the area. This variety is a common struggle for vector control agencies throughout the state, as it is impossible for any program to identify or quantify all urban sources, especially as the sources are constantly changing. In particular, the sources arising from unmaintained swimming pools and properties due to home foreclosures may be substantial.

5.6 OTHER OPEN SPACE SOURCES

Besides Ormond Beach Lagoon discussed above, there are other wetlands and ponds in the vicinity of the J Street Drain. Areas within undeveloped floodplains may be seasonally flooded, which varies from year to year. Depending on the size, amount of vegetation, and access, these additional waterbodies may also be sources of mosquito production. As discussed above, wetlands can be an important source of mosquito production (CDPH and MVCAC, 2010). Additionally, many wetlands, and/or the species that live in them, are protected by state and federal laws, which may limit the management strategies permitted. The VCVCP currently monitors and treats several marshes, wetlands, and ponds in the area, indicating the potential for these waterbodies to be mosquito sources. Additionally, wetlands and seasonally flooded areas may be very difficult to access. However, identified waterbodies are monitored and treated by the VCVCP to control mosquito production. Additional waterbodies that may not have been identified as sources may be substantial sources of mosquito production. This is supported by the VCVCP trap data from McWane Blvd. that captures mosquitoes from the undeveloped floodplains and marshes adjacent to the Oxnard Industrial Drain. The data indicate that this undeveloped area is the most mosquito-productive in the greater J Street Drain area.

6 Overall Evaluation and Conclusions

The purpose of this report is to provide an analysis of the mosquito production potential of the proposed J Street Drain Project compared with the current J Street Drain and the proposed project alternatives. The assessment took into account the known biology and ecology of mosquito species present in the greater J Street Drain area, adult mosquito trap data provided by the VCVCP from the surrounding developed and undeveloped environments, design and maintenance considerations known to affect mosquito breeding, local environmental concerns and limitations, and empirical observations. The underlying objective was to determine if construction of the proposed J Street Drain Project would result in the creation of additional habitat conducive to mosquito production that could have negative public health consequences (i.e., transmission of disease and/or nuisance) to local residents.

The analysis found no evidence to suggest that the current configurations of the J Street Drain, Hueneme Drain Pump Station, or Hueneme Drain provide high-quality habitat for—or produce large numbers of—mosquitoes. Adult mosquito trap data from this area implicate Ormond Beach Lagoon as the primary source of mosquitoes in the immediate area (i.e., in the area adjacent to Ormond Beach Lagoon). However, the evaluation of the greater J Street Drain area revealed that the OWWTP, the undeveloped floodplain of the Oxnard Industrial Drain, and urban areas may also produce substantial numbers of mosquitoes. In fact, trap data indicate that the undeveloped floodplains of the Oxnard Industrial Drain are the most mosquito-productive habitat in the greater J Street Drain area. Overall, the trap data suggest that mosquito production is widespread within the developed areas surrounding the J Street Drain, with no evidence of sharp rises in mosquito numbers in traps located near the J Street Drain that would implicate this conveyance channel as a major source of mosquitoes. The current J Street Drain, Hueneme Drain Pump Station, and Hueneme Drain do, however, provide suitable habitat for midges, which resemble mosquitoes (although they do not bite or transmit disease) and can seasonally be a nuisance by massing in and around human-occupied structures.

The evaluation of the proposed J Street Drain Project found the proposed channel configuration to have similar or less mosquito breeding potential than the current J Street Drain channel. The proposed changes would likely amplify the channel's negative effects on mosquito breeding and is not expected to have significant impact on public health due to mosquito production. The alternatives presented in the Draft EIR, as well as the additional proposed alternative, would be expected to have similar or greater mosquito breeding potential, as compared to the proposed project.

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