ATTACHMENT G

Implementation Plan

For The

Vector Habitat Remediation Program

County of San Diego
Department of Environmental Health
Vector Control Program

March 24, 2010

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EXECUTIVE SUMMARY

The County of San Diego Department of Environmental Health's (DEH) Vector Surveillance and Control Program was created to protect and promote public health, safety, and welfare by preventing vector-borne diseases and minimizing vector-caused discomfort by suppressing mosquitoes, flies, domestic rodents and other vectors. In recent years, the need to control mosquitoes has intensified as land development has brought large human populations into close contact with major mosquito breeding areas, increasing the risk of vector-borne diseases. Outbreaks of malaria and encephalitis in San Diego County during the 1980's and the recent introduction of West Nile Virus to the County in 2004 has focused attention on the ever-increasing need for enhanced vector surveillance and control activities.

Twenty years ago it was common practice to drain wetlands to prevent mosquito breeding, and as recently as several years ago it was common practice to reduce vegetation at mosquito breeding sites using herbicides. The use of herbicides was discontinued by DEH in response to new requirements of the Clean Water Act and County-wide initiation of Integrated Pest Management practices. Problem mosquito breeding sites deteriorated further, so DEH began an aerial larvicide application program at sites where surface application of larvicides was infeasible or ineffective. That program was initially successful but has become less effective over time, in part because heavy vegetation at many sites does not allow larvicides to enter the water in areas where mosquito larvae are present.

In 2005, a ballot measure was presented to property owners to decide whether DEH should receive additional funding to support mosquito, vector, and disease control services. Property owners were advised that a portion of the money raised by this measure would be used for a Vector Habitat Remediation Program (Program) that would implement long-term solutions for controlling mosquito breeding habitat and providing better protection to the public from vector-borne diseases. Under this Program, grant funding will be offered to landowners and managers, including public sector entities, to physically alter chronic mosquito breeding sites in ways that will reduce mosquito breeding habitat and improve the effectiveness of mosquito breeding control measures in a more environmentally friendly way. The Program provides a strong focus on designing, modifying, and maintaining wetlands and stormwater facilities to function in a way that would reduce or eliminate mosquito breeding habitat while balancing the water quality, biologic, aesthetic, and hydrologic values of wetlands. These changes will make the use of environmentally benign short-term measures, such as biological larvicides, more effective.

County staff completed a draft Program Environmental Impact Report (Program EIR) in

accordance with the statutes and guidelines of the California Environmental Quality Act (CEQA) to examine the potential impacts that projects implemented under the Program could have on the environment. All future projects under the Program will be required to implement the applicable avoidance and minimization measures included in the Program EIR. Future projects will be examined in the light of the Program EIR to determine if subsequent CEQA review is required.

Project Selection and Funding

Much of the funding for this program will be awarded through the Department of Purchasing and Contracting's (P&C) Request for Proposal process and administered by DEH and P&C. The County, with the assistance of designated independent technical experts, will evaluate grant proposals using established criteria. Awards will be based on ranking by criteria, project feasibility, and financial requirements to ensure a competitive process and the best use of public funds to reduce risks to public health.

In addition to these competitive grants, DEH will award some direct grants to address acute breeding habitat problems identified by Vector Surveillance and Control Program staff. This component of the program will be limited to projects that can be implemented at a low cost without affecting sensitive environmental resources.

Project Monitoring

The Vector Habitat Remediation Program will be coordinated with other vector control program activities. DEH will monitor habitat remediation sites, to ensure that grant recipients perform as agreed both by completing grant-funded initial work, and by conducting follow-on maintenance, including long-term maintenance, monitoring and reporting of wetland mitigation sites as required by permits issued by regulatory agencies. DEH will take corrective action if project oversight and continuing surveillance reveals this is necessary for a project site.

Applicants who receive grant funding will be required to submit quarterly progress reports and a final summary report detailing project actions and assessing the project's effects on mosquito production. DEH shall prepare a Program progress report and reevaluation of funding levels and project selection procedures will be completed once a year and addressed in the annual Vector Benefit Assessment Budget Engineers' Report to the Board of Supervisors.

1 INTRODUCTION

1.1 Background

The County of San Diego's (County's) Vector Control Program (VCP) is an existing public health program that is implemented to monitor and control mosquitoes and other disease-carrying insects and rodents in San Diego County. The VCP also includes regularly testing for diseases that are spread by mosquitoes, other insects, and rodents. The VCP has provided mosquito and vector control services for over 30 years, and is managed by the County Department of Environmental Health (DEH) and governed by the County Board of Supervisors (Board).

Until recently, the VCP was primarily funded by an assessment charged to all property owners within San Diego County. This assessment was established in 1989 and was decreased in the 1990s when reserves had accumulated. However, those reserves were subsequently depleted due to inflation and an increase in the costs of protecting people and animals/wildlife from the West Nile virus, a disease spread by mosquitoes. Additional funding resources were needed to restore basic VCP services, and to continue mosquito and West Nile virus prevention efforts at the necessary enhanced level of protection.

Also, during the 1990s, effective maintenance and restoration of mosquito breeding habitat (such as wetlands, un-maintained stormwater BMPs, or other areas containing habitat for protected species) became more difficult to manage due to increased concerns regarding the protection of sensitive habitats and protected species. In addition, decreased water flows and increased vegetation in these areas made other mosquito-abatement techniques less effective.

In 2005, a ballot measure was presented to the public allowing property owners to decide whether the VCP should receive additional funding to support mosquito, vector, and disease control services. This measure was approved by property owners. The revenues from the measure now help to fund year-round mosquito control and enhanced disease prevention services, including year-round testing for, and response to, diseases that are carried by mosquitoes, other insects, and rodents. One of these diseases is the West Nile virus.

When mosquito breeding sources cannot be removed due to lack of access or potential for impacts on sensitive resources, the VCP uses mosquito larvicides found to be environmentally safe and endorsed by the United States Environmental Protection Agency (EPA), the University of California, and the Centers for Disease Control and Prevention (CDC). For mosquito breeding habitat such as ponds and marshes, the VCP uses natural bacteria that target the mosquito larvae before they mature. However,

surface application of larvicides can become infeasible or ineffective where heavy vegetation does not allow larvicides to enter the water. DEH began an aerial larvicide application program at these problem sites several years ago. That program was initially successful but has become less effective over time, due to vegetation growth and accumulated siltation. The continued effectiveness of the Vector Control program requires new, direct solutions to managing chronic mosquito breeding habitat.

The planned Program will be a primary VCP tool to address these situations. Under the proposed Program, a portion of funds from the Vector Control Program assessments would be used to implement mosquito breeding habitat remediation projects throughout San Diego County, within both developed and natural areas. Within wetlands, a primary goal of the Program is to eliminate or reduce breeding habitat in a manner that balances the water quality, biologic, aesthetic, and hydrologic values of wetlands with the need to protect human populations and animals from mosquito-borne disease. In many settings, management and design measures that bring the ecology of the wetland back into balance will also help to eliminate or reduce mosquito breeding habitat.

Under this Program, DEH will provide funding to government and private entities to implement vegetation removal, wetland enhancement, and other related projects that will reduce or remove mosquito breeding habitat. Projects implemented under the proposed Program will be funded or partially funded by DEH through either (1) a competitive grant program with an annual or more frequent award cycle for larger projects or (2) direct agreements with landowners as needs are identified for smaller projects. Projects that provide the most significant reductions in risks from mosquito-borne disease per dollar spent will be favored in making funding decisions for competitive proposals. All projects will be required to meet the objectives discussed above and described in more detail below.

Because this is a new program, implementation and management of the Program, including measures described in this document, are expected to evolve over time based on experience gained and changes in circumstances. To ensure that the potential environmental impacts of an evolving program have been identified and addressed to the greatest extent feasible, the Program is described and examined in broad terms in the supporting Program EIR and in this document.

1.2 Rationale

West Nile virus, a mosquito-borne disease, has become a growing concern in San Diego County. The disease was first introduced to the United States in New York City during 1999 and rapidly spread throughout the country. According to the California Department of Public Health, a total of 2,765 cases of West Nile virus have been documented within the state between 2003 and 2008. During that same 5-year time period, 76 human deaths

occurred statewide due to the disease. Within San Diego County, 2 human cases of West Nile virus occurred in 2004, 1 human case in 2006, 16 in 2007, and 34 from January 1 to December 19, 2008.

Mosquito-borne diseases, such as West Nile virus, pose a growing public health threat as mosquitoes establish and spread into new locations. The Vector Control Program is tasked with controlling mosquito populations to reduce disease transmission and has historically used larvicides, and herbicides as the primary means of reducing mosquito populations and controlling vegetation growth.

In response to environmental concerns, the VCP suspended routinely using herbicides several years ago. However, without vegetation control measures, plant growth can impede water flow and create ideal conditions for mosquito breeding.

DEH has developed the proposed Program to provide longer-term solutions at mosquito breeding sites. The Program is expected to make VCP ongoing control efforts more effective and environmentally friendly. The Program provides a strong focus on designing, modifying, and maintaining wetlands and stormwater facilities to function in a way that would reduce or eliminate mosquito breeding habitat while balancing the water quality, biologic, aesthetic, and hydrologic values of wetlands with the need to protect human populations and animals from mosquito-borne diseases. These changes will make the use of environmentally benign short-term measures, such as biological larvicides, more effective.

Numerous examples exist of how physical design and management strategies have been used to reduce mosquito populations in various types of wetland systems. Near Hemet, California, studies have demonstrated that reducing vegetation and increasing the extent of open water areas within wetlands can effectively reduce mosquito populations (Thullen et al. 2002 and Walton and Workman 1998). Furthermore, in Los Angeles and San Diego Counties research has demonstrated that placing sealed covers on certain types of wet stormwater treatment systems can effectively control mosquito reproduction (Metzger et al. 2008). Finally, past experience has shown that managing hydrology such that wetlands are quickly flooded and maintained at a maximum depth can help reduce the number of mosquitoes in a given area (Batzer and Resh 1992, Garcia and Rochers 1983, and Kwasny et al. 2004). It is important to note that successful projects involve design and management practices selected and tailored to the specific wetland resource or mosquito habitat being managed, and such site-specific planning is crucial for sustained success.

1.3 Program Goals and Objectives

The overarching goal of the Program is to protect public health and safety. This will be accomplished by funding projects that reduce or eliminate mosquito breeding habitat through physical modification and habitat management of mosquito breeding areas. The Program objectives, and a rationale for each, are detailed as follows.

Program Objective No. 1: To protect public health and safety by reducing or eliminating the presence of mosquitoes that transmit vector-borne diseases such as West Nile virus.

Rationale: As mentioned above, the West Nile virus is a growing public health threat in San Diego County. Illnesses caused by mosquito-borne pathogens that were comparatively rare throughout the recent past are reemerging as changing land use patterns and modern human activities facilitate the interaction between disease-causing agents and susceptible human populations.

Program Objective No. 2: To eliminate or reduce mosquito breeding habitat (such as areas of shallow standing water) in a manner that balances the water quality, biologic, aesthetic, and hydrologic values of wetlands with the need to protect human populations and animals from mosquito-borne diseases.

Rationale: The maintenance of a healthy ecosystem by preserving the biological resources, water quality, hydrologic, and aesthetic values, should be accorded as much importance as reducing and eliminating mosquito breeding habitat, so long as this does not prevent actions that are both necessary to protect public health and consistent with applicable law.

Program Objective No. 3: To implement a selective process that distributes funds to projects within natural and developed areas that would reduce or eliminate mosquito breeding habitat using methods that provide long-term solutions (e.g., through proper design of facilities, modification of physical features affecting water flow and retention, and vegetation removal and maintenance).

Rationale: The public approved a ballot measure and funding for the protection from West Nile virus, including creation of a Program to implement long-term solutions for controlling mosquito breeding habitat. Intergovernmental cooperation and cooperation with land owners and other interested parties is necessary for any such program to be effective. It is important to implement a process for the distribution funds that makes the

best use of the funds and also provides the most cost-effective protection against mosquito-borne disease. The Program must include natural, modified, and man-made environments because conditions conducive to mosquito breeding can be created in a variety of settings, such as when flood control channels that are poorly designed or maintained, when stormwater detention or infiltration facilities do not work properly, and when vegetated areas are not maintained.

Program Objective No. 4: To implement a directed process to allow for the implementation of an urgent public health mosquito-abatement project that would result in limited to no impacts on sensitive environmental resources and do not require additional regulatory review.

Rationale: The benefits to public health will be significantly enhanced if the proposed Program allows for a quick mosquito-abatement process for projects that would result in limited to no impacts on sensitive environmental resources. DEH staff has detailed knowledge of sites and situations wherein landowners would readily cooperate in abating mosquito habitats but they are unable to do so due to funding constraints.

1.4 Compliance with Regulations/Permitting

County staff completed a draft Program Environmental Impact Report (Program EIR) in accordance with the statutes and guidelines of the California Environmental Quality Act (CEQA) to examine the potential impacts that projects implemented under the Program could have on the environment. Preparation of a Program EIR was required because the series of projects that could be implemented under the Program can be considered as one large project of related actions. The Program EIR describes the project objectives, setting and characteristics, analyzes potential environmental effects of the proposed project, addresses project alternatives, and describes mitigation measures and environmental design considerations. All future projects under the Program will be required to implement applicable avoidance and minimization measures included in the Program EIR. Future projects will be examined in the light of the Program EIR to determine if subsequent CEQA review is required. Section 1.5 of the Program EIR describes the process that applicants must adhere to in order to ensure that adequate CEQA review is performed for each project implemented under the Program.

Projects funded under the Program will be carried out in a manner that complies with land use regulations and applicable local, state, and federal wetland and endangered species regulations, and that minimizes adverse effects on protected species and habitats. Projects will be screened on the basis of whether they would: (1) comply with environmental and land use regulations; (2) result in a net loss of wetland functions and values; (3) result in significant impacts on sensitive habitat; and (4) establish optimal

performance to reduce mosquito breeding habitat. Project applicants will be responsible for obtaining the necessary permits applicable to their own project(s).

Table 1 below includes a list of potential future discretionary actions/permits that will be required for some of the projects implemented under the Program.

Table 1. Matrix of Programmatic Approvals/Permits

Permit Type/Action	Agency
Project Approval/Certification of PEIR	County of San Diego
Minor Grading Permit	County of San Diego, or applicable land use authority for the specific project location.
Clearing Permit	County of San Diego, or applicable land use authority for the specific project location.
Regional General Permit	ACOE
1602 Streambed Alteration Agreement	CDFG
404 Permit Federal Clean Water Act—Dredge and Fill	ACOE
401 Water Quality Certification	RWQCB/SWRCB
Coastal Development Permit	CCC
Section 7 Consultation or Section 10a Incidental Take Permit	USFWS
General Construction Stormwater Permit	RWQCB
Local Jurisdictional Permits	All local jurisdictions
National Pollutant Discharge Elimination System (NPDES) Permit	RWQCB
Notes: ACOE = U.S. Army Corps of Engineers RWQCB = Regional Water Quality Control Board CDFG = California Department of Fish and Game USFWS = U.S. Fish and Wildlife Service CCC = California Coastal Commission SWRCB = State Water Resource Control Board	

Umbrella permits or master/programmatic permits are permits that would be issued to the County but upon authorization could be used by individual project applicants provided their project meets all the parameters outlined in the final permits. The County is pursuing an umbrella permit from the ACOE, or regional general permit (RGP), from the ACOE to authorize certain types of activities under Section 404 of the Federal Clean Water Act. All projects implemented under the Program that would qualify for the RGP would be required to implement measures provided by the USFWS to ensure all potential impacts to threatened/endangered species are avoided. In addition, the County plans to pursue acquisition of associated umbrella permits from the SWRCB and CDFG to cover certain types of activities resulting in impacts to resources under the jurisdiction of those agencies. It is anticipated that the umbrella permits will facilitate implementation of vector control projects with relatively minor impacts to jurisdictional waters and no impacts to federally listed threatened/endangered species. However, any project with proposed impacts to jurisdictional waters and/or threatened/endangered species above

and beyond the parameters defined in the umbrella permits would not qualify under the umbrella permits and would need to obtain separate project-specific permits from the resource agencies.

Program staff will be available to assist applicants to determine whether or not the work they plan to propose can be covered under the umbrella permits or would require project-specific permits from the resource agencies. Furthermore, applicants are encouraged to assess the impact limitations of the umbrella permits and design their projects to fit within those constraints if possible.

2 WETLAND DESIGN AND MANAGEMENT

The following outlines basic concepts and guidelines for wetland design and management that can be implemented to reduce mosquito breeding habitat. DEH will evaluate proposals to determine consistency with the concepts described below. However, it should be noted that reduction of mosquito breeding habitat via design and management strategies often requires creativity and adaptive management. Therefore, activities funded under the Program will not be limited to the concepts covered in this document.

Mosquito reproduction is largely dependent on areas where still, shallow water persists for more than a few days. This is due to the fact that mosquito larvae typically hang suspended beneath the water surface by a breathing tube after hatching. Rough water and wave action can physically damage the small, fragile larvae or drown them by filling their breathing tubes. In addition, stagnant, shallow pools of water that are choked with vegetation thatch often offer the larvae protection from mosquito-eating fish and other predators. Therefore, wetland and treatment pond design and management practices that eliminate or substantially reduce the extent of calm, shallow pools choked with vegetation thatch can be used to reduce mosquito populations.

In broad terms, practices that have been shown to affect mosquito reproduction in wetlands and treatment ponds include design strategies, water management activities, and vegetation manipulation (Table 1, page 9)). These management practices can be used independently or in combination, and they can be implemented within natural wetlands, constructed effluent treatment ponds, and stormwater facilities. These concepts are described briefly below and a more detailed assessment can be found in Appendix A.

The overall objective of wetland and treatment pond design projects will generally be to restore water conveyance by reduce or eliminate areas of shallow, standing water where

mosquitoes successfully reproduce. Such projects will typically involve changes in an aquatic system's physical characteristics to provide steep edges, maximize the area of deep open water pools, create surface connections between pools, encourage wave action and circulation, and provide habitat for mosquito-eating fish. This design will also limit the area around a still pond that is susceptible to vegetative thatch, as most water plants cannot survive in depths greater than five (5) feet and will give greater access for the use of mosquito larvicides, when required. Water management activities aimed at elimination or reduction of mosquito breeding habitat often involve rapid flooding and drawdown, reduced residence time for shallow water, and increased water agitation and wave action. Vegetation management activities for mosquito control generally involve removal of dense vegetation such that only narrow strips remain along wetland margins and within wetland pools. In addition, maintenance and monitoring contribute to providing long-term solutions and ensuring that these aquatic systems maintain desired levels of flow and circulation.

Table 2: Summary of Key Concepts that Reduce Mosquito Production

WETLAND AND WATER QUALITY TREATMENT SYSTEM DESIGN

General Concepts

- Incorporate steep edges to minimize vegetation along wetland margins
- Maximize deep, open water areas to provide predator habitat, water circulation, and wave action
- Ensure surface connection and multiple flow paths among wetland cells and pools
- Minimize still, isolated, shallow areas
- Facilitate access for surveillance, maintenance, and mosquito control activities

Created Wetlands and Effluent Treatment Ponds

- Design to achieve a hydrological regime unfavorable for mosquito production (e.g. avoid isolated pools or repeated drying/inundation cycles during periods of peak mosquito activity; incorporate water conveyance to facilitate relatively rapid changes in water level)
- Include permanent, open water pools with a depth of 1.5 meters or more
- Ensure connections (multiple flow paths) between wetland cells and pools
- Incorporate mosquito-eating fish

Stormwater Treatment Facilities

- Design to limit water retention time to less than 72 hours
- Where feasible, cap open water structures that hold water longer than 72 hours
- Include trash racks, debris screens, or similar components to prevent clogging
- Where feasible, install curtains, valves, or similar components to prevent mosquito access
- Avoid use of loose riprap or other materials that can create standing water
- Incorporate on-going maintenance

WATER MANAGEMENT

General Concepts

- Water delivery systems, drainage systems, levees, and other water control structures should be designed and maintained to minimize mosquito production (e.g. promote rapid flooding and quick drawdown, enhance populations of naturally occurring predators of mosquitoes, etc.)
- Where feasible, limit the presence of standing, shallow water (< 30 cm depth) to less than 72 hours
- Provide circulation and wave action

Created Wetlands and Effluent Treatment Ponds

- Adequately size and maintain water control structures and pumps
- Use sprayers, spinning wheels or other systems to promote agitation and wave action
- Use of recirculating water sprinkler systems to prevent mosquito activity

Stormwater Treatment Facilities

- Ensure water retention time is less than 72 hours
- Ensure active maintenance to avoid clogging of drains, pipes, and outfalls

VEGETATION MANIPULATION

General Concepts

- When possible, limit vegetation to narrow strips (< 5 m wide)
- Remove dense emergent vegetation and sediment that limits wave action and predator access
- Provide access for mosquito surveillance and control activities

Created Wetlands and Effluent Treatment Ponds

- Remove vegetation and sediment as part of ongoing maintenance

Stormwater Treatment Facilities

- Remove vegetation and sediment as part of ongoing maintenance

3 METHODS FOR DISTRIBUTING FUNDS

DEH is expecting to fund projects proposed by a variety of grant applicants that will address various vector control needs. The proposed VHRP will facilitate both directed and competitive funding processes. Competitive funds will generally be directed to comprehensive habitat modification/restoration projects of varying scales and complexity that will be evaluated and awarded using a competitive bid process. Directed funds will generally be granted to relatively small discretionary projects focused on activities identified by DEH staff.

3.1 Competitive Projects

Competitive projects will generally focus on comprehensive solutions for source reduction of mosquito breeding habitat through physical modification in mosquito breeding problem areas. These projects may involve a variety of activities, such as modifying tidal flow in lagoons, management of stream discharge, manipulation of stormwater retention time, vegetation removal, and wetland restoration/redesign. Within the competitive projects category, projects will be funded under three subcategories: (1) turnkey projects, (2) study projects, and (3) assistance projects.

3.1.1 Turnkey Projects

Turnkey projects will be ready to go as soon as they are funded. For a project to qualify as a turnkey project, the vector habitat remediation activity must be fully planned, environmental reviews in accordance with CEQA must be completed, and permits must be obtained prior to submitting the application. Turnkey projects will vary in scope and complexity.

3.1.2 Study Projects

Study projects will include planning and permitting activities necessary prior to project implementation. These projects will be aimed at developing specific vector habitat remediation plans, consulting with pertinent regulatory agencies, and obtaining permits required prior to project implementation. Activities may include site planning, engineering design work, preparation of environmental documents, and permit application. The goal of the study projects is to complete all background planning and permitting work so that they can be considered turnkey projects in a subsequent funding cycle.

3.1.3 Assistance Projects

Assistance projects are those in which the project applicant request County involvement for any aspect of implementation, including but not limited to, permitting, mediation in discussion with regulatory agencies, developing project plans, vegetation removal and other related activities. Typically, this type of project will occur when an entity needs the

County to function as the lead agency for CEQA review. For assistance projects, a portion of the allocated funding would be used to cover the costs of the County's role.

3.2 Directed Projects

Directed projects will generally focus on smaller needs identified by DEH staff during surveillance or through customer requests. These projects will focus on immediate actions, such as clean-up of detention basins and maintenance of storm drains and ditches.

3.3 Process for Reviewing Proposed Projects

The County will accept proposals only for sites within San Diego County, including within incorporated cities. Federal and Tribal lands are excluded, because those lands do not pay the assessments that fund this program. Proposals may be submitted by property owners, designated land managers, or other entities or individuals authorized by the owner or land manager.

Owners should submit documentary evidence of ownership. Land Managers should submit a copy of the conservation easement or other document showing their authority and responsibility to manage the land. Other applicants should submit documents to establish the identity of the land owner or the identity and authority of the land managers, and to show authorization by that owner or land manager to conduct work of the kind proposed on the property at issue. In addition, documentation must be provided that any individual signing a proposal on behalf of a legal entity has been authorized by the relevant entity to enter into a contract with the County to perform the proposed work if a grant is awarded. The County shall be the sole judge of whether submitted documentation is sufficient, and may request that additional documentation be provided at any time during the grant award process.

Competitive Projects – The County will issue a Request for Proposals (RFP) once a year through the County Department of Purchasing and Contracting. RFPs will be posted on the County's Buynet website. Proposals under the Competitive Grant Program will be evaluated and selected using the following steps (see Figure 1):

1. **Basic eligibility requirements** - The County will conduct an initial screening of the Proposals to determine if the proposed project meets the basic eligibility requirements of the Program including (1) is the project site within San Diego County but outside Federal and Tribal lands; (2) does the project address reduction of mosquito breeding habitat; and (3) has applicant provided documentation to establish the identity of the land owner or the identity and authority of the land managers to complete project.

2. **Presentation** - If a proposed project meets the eligibility requirements, the Project Applicant will be invited to make a presentation to the Source Selection Committee (SSC). The SSC will consist of County staff and outside experts.

3. **Detailed Costs and Schedule** – The SSC may request Project Applicants to prepare more detailed approach, costs and schedule. A format for the more detailed information will be provided.

4. **Proposal Ranking and Selection** – DEH staff will collect and create additional information needed to help evaluate each proposal including level urbanization surrounding project site, proximity to known breeding sites, and level of mosquito production from project site. The SSC will evaluate and rank each proposal based on the Evaluation Criteria (see Appendix B). Projects will be selected based on the evaluation results, financial requirements, project feasibility, and the best use of public funds. Selected applicants will be invited to enter into a contract with the County for grant funding. Applicants who receive grant funding will be required to submit quarterly progress reports and a final summary report detailing project actions and assessing the project's effects on mosquito reproduction.

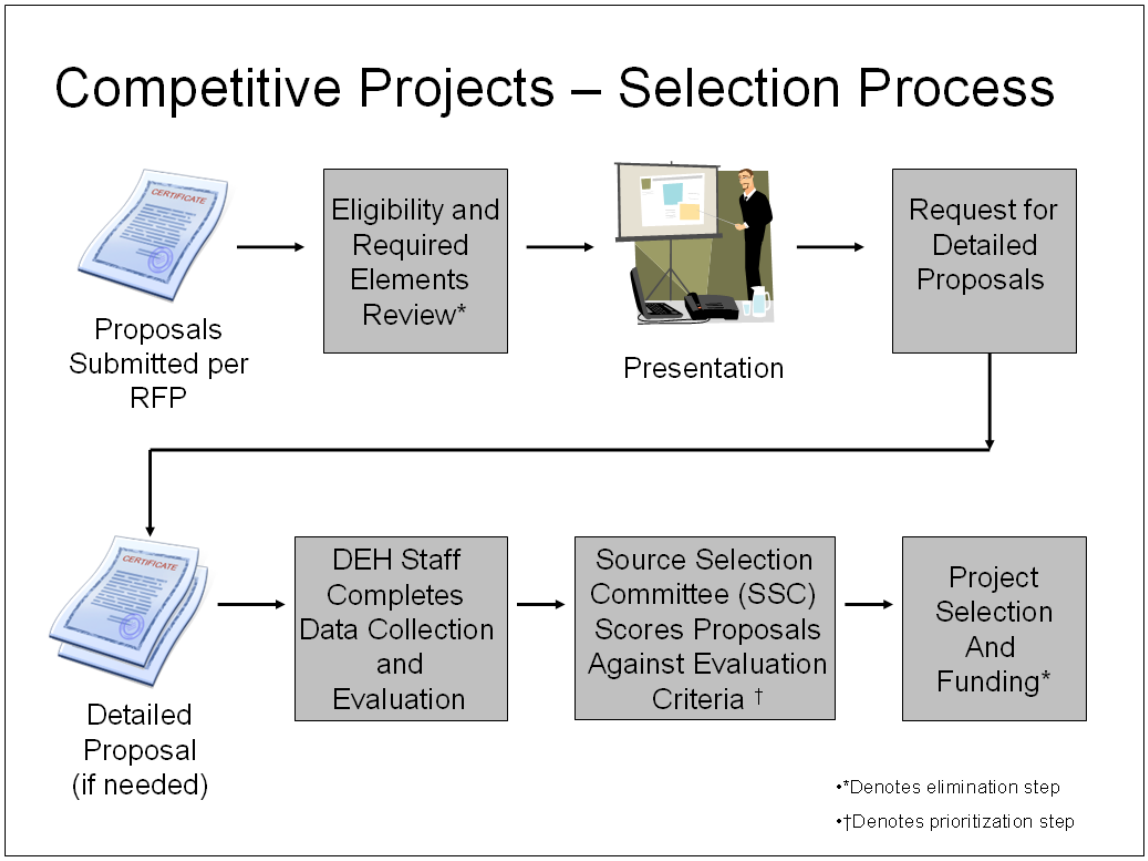

Figure 1: Competitive Projects Selection Process

Directed Projects - Directed projects will be identified by DEH staff during surveillance or through customer requests. Annual funding for directed projects will be based on annual budgetary constraints, DEH Vector Control Program priorities, and a desire to fund projects located throughout San Diego County. The amount of money available each year for directed projects will be specified in the annual budget.

Directed projects will be identified and funded on an on-going basis throughout the year. These projects will generally be identified by DEH staff during routine surveillance. They may also be initiated in response to a customer request. Once a potential project has been identified, the property owner or manager will be required to submit a letter of interest. This letter will then be reviewed and a final decision regarding whether or not to proceed will be made by the DEH Director using Evaluation Criteria (see Appendix B) developed with input from an Advisory Panel of outside experts (Figure 2).

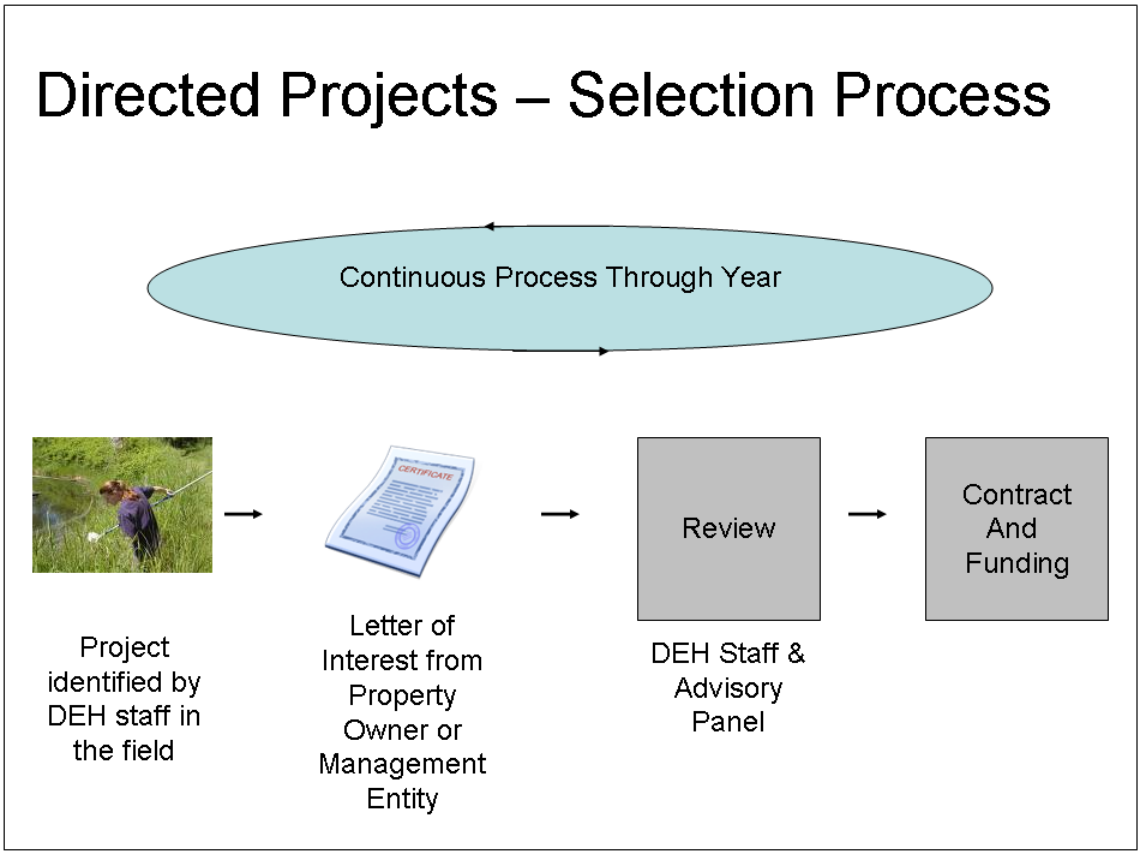

Figure 2: Directed Projects Selection Process

4 OUTREACH AND IMPLEMENTATION

4.1 Stakeholder Committee

A stakeholder committee was formed during the early stages of the Program development and consisted of representatives of local governments, regulatory agencies, land use planners, and community organizations. The committee provided input on Program goals and criteria for evaluating and ranking proposed projects.

4.2 Program Environmental Impact Report (Program EIR)

A Program Environmental Impact Report (Program EIR) was prepared and circulated to address potential environmental effects of the planned Program. As part of the Program EIR process, public outreach included the circulation of a Notice of Preparation (NOP) and Initial Study for comment, a public scoping meeting held in February 2009, and circulation of the Draft Program EIR in June 2009 for public comments.

The Program EIR addresses the Program in broad and general terms, to ensure that the potential environmental impacts of such a program would be identified and addressed to the greatest extent feasible. Because this is a new program, implementation and management of the Program are expected to evolve over time based on experience gained and changes in circumstances. All future Program changes will need to be within the scope of the Program EIR, unless additional environmental analysis of the Program is completed. The Program EIR describes the project objectives, setting and characteristics, analyzes potential environmental effects of the proposed project, addresses project alternatives, and describes mitigation measures and environmental design considerations. All future projects under the Program will be required to implement the applicable avoidance and minimization measures included in the Program EIR. Future projects will be examined in the light of the Program EIR to determine if subsequent CEQA review is required. Section 1.5 of the Program EIR describes the process that applicants must adhere to in order to ensure that adequate CEQA review is performed for each project implemented under the Program including adherence to the permit requirements outlined in Table 1. This Plan describes DEH's specific plans for the implementation of the Program. The descriptions in this Plan are not intended to limit future changes to the Vector Habitat Remediation Program.

4.3 Implementation

Once the Program is initiated, staff from DEH, other County departments, and consultants will be responsible for a series of activities to track individual projects and report on the overall program results. The overall implementation tasks will include:

- ***Outreach and Training*** - Program representatives will conduct outreach to property owners and agencies to educate them on the opportunities for funding under this program. Training will be provided to DEH staff to set clear expectations that all projects will be rigorously monitored and implemented in a manner that complies with all local, state, and federal regulatory requirements.

- ***Project Selection*** - DEH staff will identify, select and contract Directed Projects throughout the year. Competitive Projects will be solicited through an RFP process through the County Department of Purchasing and Contracting (P&C). Proposals will be reviewed and selected with a Source Selection Committee. Selected projects will be contracted in coordination with County P&C.

- ***Project Monitoring*** - Once projects have been selected, funded, and contracted, DEH will monitor to assess project progress, evaluate invoices, and evaluate effectiveness for reduction of mosquito breeding. Project applicants will be required to submit progress status information. DEH will administer a geographic information system (GIS) database of project locations and status to assist in project monitoring and overall program tracking.

- ***Project Remediation*** – If DEH monitoring reveals that corrective action is necessary for a project site due to unanticipated events, such as where wetland mitigation implementation and maintenance requirements have not been performed in accordance with the Program EIR, project CEQA documents, or the permits for the project issued by the regulatory agencies, DEH will take appropriate action to correct or to provide additional mitigation, subject to funding approvals by the Board of Supervisors. The recipient of grant funds is contractually bound to administer the vector remediation as approved in the project CEQA document and jurisdictional permits. If a grantee fails to implement a project as required in a grant agreement, DEH may instead take legal action to compel corrective action or mitigation by the grantee. The terms and applicability to a specific project or any regional general permits issued to DEH to support this program would govern how DEH responds to circumstances of this kind in a particular case.

- ***Program Reporting and Modifications*** - On an annual basis, a Program summary will be prepared by DEH to reevaluate funding requirements, project selection procedures, and other aspects of the Program that could/should be adjusted. An annual report will be prepared and submitted to the Board of Supervisors with the prepared assessments for the Mosquito, Vector and Disease Control Benefit Assessment accompanying the Engineer's Report. Dependant upon initial Board

of Supervisors' actions establishing this Program, changes to some aspects of the Program, e.g., project selection criteria, may be within the authority of the Director of DEH without further Board authorization. Annual funding will always require Board approval, and DEH anticipates that the Board will also retain control over the allocation of annual funding between competitive and directed projects, and over the maximum size of grants that can be awarded.

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Appendix A

Date: October 7, 2008

Subject: Wetland Design and Management Concepts for Vector Control

Introduction

A concerted effort has been underway for many years to restore, enhance, and protect wetlands to offset significant historic wetland losses and improve water quality and biological functions within existing aquatic ecosystems. Changes in land use and natural hydrological regimes associated with human development can have significant effects on the structure and function of natural wetlands that sometimes enhance the production of mosquitoes. Moreover, wetland areas constructed for mitigation, restoration, or water treatment purposes that are not properly designed and maintained can become breeding grounds for mosquitoes that serve as vectors – carriers – of a variety of potentially dangerous pathogens. Such pathogens can cause diseases such as West Nile Virus in humans, domestic animals, and wildlife. To facilitate reduction and/or elimination of mosquito breeding grounds in established wetlands, flood control facilities, effluent treatment ponds, and stormwater treatment facilities, the County Department of Environmental Health (DEH), Vector Control Program has initiated the development of a Vector Habitat Remediation Program (Program). The goal of the Program will be to eliminate or reduce mosquito-breeding habitat in a manner that balances the water quality, biological, aesthetic, and hydrologic values of wetlands with the need to protect human populations and animals from mosquito-borne diseases.

The Program is funded by a benefit assessment that was approved by voters in 2005. DEH will provide funding to local entities to carry out vegetation removal, wetland enhancement, and other related projects with the goal of implementing management and design measures that eliminate or reduce mosquito breeding habitat in areas known to sustain mosquito populations.

The purpose of this Technical Memorandum is to outline basic concepts and guidelines for wetland design and management that can be implemented to reduce mosquito breeding habitat. DEH will evaluate proposed projects to determine the consistency of each project with the concepts described below.

Background

Mosquito-borne diseases such as West Nile Virus pose a growing public health threat as they establish and spread in new locations. In addition to the establishment of new diseases, illnesses caused by mosquito-borne pathogens that were comparatively rare throughout the recent past are re-emerging as changing land use patterns and modern human activities facilitate the interaction between disease-causing agents and susceptible human populations. Policy officials, land managers, public health personnel, and other individuals face the complex task of controlling mosquito populations to reduce disease transmission while balancing mosquito control efforts with regulatory requirements and the ecological benefits of protecting the environments where mosquitoes breed. This paper has been prepared to introduce selected concepts for designing and managing wetlands and other habitats capable of harboring mosquitoes to reduce mosquito production. A summary of the Wetland Design and Management Concepts for Vector Control is included in Table 1.

Traditionally, chemical insecticides have served as the primary means of reducing mosquito populations, and this is still an effective strategy especially during public health emergencies. However, given that resource managers are faced with balancing numerous, and often conflicting social, environmental, and economic concerns, it is important to explore and develop alternative control strategies. To this end, researchers and land managers have explored design and management concepts aimed at reducing suitable mosquito breeding habitats within wetlands and treatment ponds. In short, best available science demonstrates that integrated vector management, including changes to wetland attributes, can significantly alter levels of mosquito reproduction (SWS 2008).

In broad terms, practices that have been shown to affect mosquito reproduction in wetlands include wetland design, water management, and vegetation manipulation. These management practices can be used independently or in combination, and they can be implemented within natural wetlands, constructed effluent treatment ponds, and stormwater facilities. Most importantly, these practices should be selected and tailored to the specific mosquito habitat being managed.

Numerous species of mosquito are capable of becoming infected with West Nile Virus (Goddard et al. 2002). According to data from the Center for Disease Control (CDC), 62 mosquito species have tested positive for West Nile Virus in the United States since the disease first arrived in the country in 1999 (CDC 2008). However, not all of these species are competent vectors of the disease (Turrell et al. 2005). Within the State of California, and throughout much of the rest of the United States, mosquitoes in the genus *Culex* appear to be the principal mosquito hosts of West Nile Virus. Furthermore, of the primary mosquito species known to occur in San Diego County, *Culex tarsalis*, *Culex quinquefasciatus*, *Culex erythrothorax*, and *Culex stigmatosoma* are believed to be the most important for transmission of West Nile Virus (Goddard et al. 2002, Goddard et al. 2003, County of San Diego 2007). A more detailed description of potential mosquito vectors and their breeding habitats can be found in the Attachment A of this document.

Wetland and Water Quality Treatment System Design

In this context, wetland design refers to the physical alteration or construction of wetlands and treatment ponds in a manner that reduces mosquito breeding habitat. A handful of general concepts are applicable, including: (1) incorporation of steep edges, (2) incorporation of relatively deep open water pools, (3) surface connection between pools, and (4) avoidance of calm, shallow areas.

In general terms, development of mosquito larvae is largely dependent on the presence of still, shallow water and shelter from predators and waves. Therefore, deliberate design and/or manipulation of wetland attributes such as topography, slope, and water depth can be used to eliminate or minimize areas suitable for the survival of mosquito larvae. For example, wetlands can be designed to maximize the ratio of open water to emergent vegetation to increase mortality of immature mosquitoes caused by wave action, to decrease shelter for mosquito larvae, and to provide habitat for mosquito-eating fish and other predators of mosquitoes.

Often, larval development of mosquitoes is dependent on wetland vegetation to provide protection from moving water and predators. Typically, wetlands that possess gently sloping margins often develop thick emergent vegetation across a relatively shallow bottom. While dense vegetation can provide important wetland functions and values (Kadlec and Knight 1996, Mitsch and Gosselink 2000) it can also provide shelter where mosquito larvae are able to survive to adulthood. On the other hand, wetlands with relatively steep edges provide less area for wetland vegetation to become established. Therefore, designing or altering wetlands such that steep edges drop quickly to relatively deep open water can reduce the area suitable for mosquito reproduction.

Larval development of mosquitoes is dependent on the presence of still water because wave action can damage or drown larval mosquitoes that hang suspended in the water column via a breathing tube. Therefore, wetland designs that promote wave action can drown larval mosquitoes and reduce reproduction (SWS 2008).

Finally, mosquito larvae can be preyed upon by fish and other aquatic animals. Therefore, creating conditions that provide fish habitat and allow access to mosquito larvae can be an effective means of controlling mosquito populations. Management actions that can achieve this objective include creating and maintaining water depth greater than 1.5 meters through dredging as well as maintaining permanent or seasonal surface connection between pools to enable fish distribution. Typically, wetlands that lack deep water zones and do not provide habitat for mosquito predators are more prone to mosquito production problems than those that contain permanent deep water habitats (SWS 2008).

Natural Wetlands

There is often less opportunity to apply design techniques in natural wetlands as opposed to created effluent treatment ponds and stormwater facilities. This is true because regulations designed to protect overall wetland functions and values often discourage extensive dredging, filling, or other manipulation of natural wetland systems. In addition, changing topography and vegetation communities within functioning natural wetlands can have unexpected consequences and reduce existing ecological benefits (SWS 2008). For example, a parallel-grid-ditching method for mosquito reduction frequently used in salt marsh habitats until about 30 years ago involved excavation of open, tidal ditches over vast acreages and had significant negative impacts on coastal marshes. The negative impacts included introduction of invasive species, loss of wetland area, and loss of habitat for waterbirds, estuarine fish, and invertebrates (SWS 2008). Furthermore, removing specific species from wetlands lowers overall biological diversity and such activities can adversely impact the ecological integrity of the ecosystem by changing food webs and other biological interactions (Gwin et al. 1999). Therefore, careful planning must be undertaken when attempting to remove mosquito breeding habitat from natural wetlands.

Well planned wetland modification can effectively reduce mosquito breeding habitat without creating notable adverse effects in some natural wetland ecosystems. For example, techniques known as “open marsh water management” (OMWM) and runnelling have been successfully used to reduce mosquito populations. These

techniques rely on construction of ponds and interconnecting channels in mosquito breeding habitat to increase water circulation and improve habitat quality for mosquito-eating fish (Meredith et al. 1985, Hulsman et al. 1989). The modern technique of OMWM, when properly employed, avoids almost all of the adverse impacts associated with parallel-grid-ditching. In fact, in marshes where parallel-grid-ditching was historically undertaken, the installation of OMWM systems is often viewed as a preferred habitat-restoration technique because it restores standing water to marsh surfaces that were historically dewatered by the parallel-grid-ditches (SWS 2008).

Created Wetlands and Effluent Treatment Ponds

Generally, created wetlands and effluent treatment ponds provide greater opportunity for use of design techniques for mosquito abatement than natural wetlands do. In general, created wetlands and effluent treatment ponds should be designed to ensure the following conditions: (1) stable water level and, if feasible, a water infrastructure system that facilitates rapid drainage during a public health emergency, (2) permanent open water pools with a depth of 1.5 meters or greater, (3) multiple flow paths among wetland cells, (4) presence of mosquito-eating fish and (5) access around and within the wetlands for mosquito surveillance and control activities.

Because these aquatic habitats are constructed systems, they can be designed to include features that reduce mosquito production such as relatively steep slopes along the periphery, open water zones, a controlled hydrological regime, reduced refuge areas for mosquito larvae, and enhancement of mosquito-eating predators. As mentioned previously, wetlands that lack deep water zones (water depth > 1.5 meters) and do not maintain sufficient mosquito predation are more likely to produce large populations of mosquitoes than wetlands that contain permanent deep water. This is true because areas of relatively deep open water provide habitat for mosquito-eating predators and allow for wave action and water circulation. In addition, wetlands that have gently sloping margins are prone to develop thick emergent vegetation throughout the shallow areas. As noted earlier, such areas of dense vegetation can create refuge areas where mosquito larvae can hatch and survive to adulthood (SWS 2008). Certainly, dredging may be appropriate in existing artificial wetlands and effluent treatment ponds to create steep banks, increase water depth, improve circulation, and favor mosquito predators.

Stormwater Treatment Facilities

Engineers, planners, and landscape architects can choose from a vast combination of stormwater treatment structures. Often, a combination of different structures is used to achieve the optimal treatment of stormwater. At the same time, these structures should

be designed to minimize creation of mosquito breeding habitats (Metzger 2004). Several key concepts should be considered, including: (1) limiting water retention time to 72 hours or less, (2) capping open structures that hold water for more than 72 hours where feasible, (3) installing trash racks or debris screens to prevent clogging, (4) installing curtains or valves where necessary to prevent mosquito access, (5) avoiding use of riprap or other materials that create standing water, and (6) incorporating ongoing maintenance.

While permanent, open detention and treatment systems are arguably the easiest stormwater treatment devices to design, construct, and maintain, they also create potential for development of mosquito habitat. These systems present vector control challenges similar to natural and effluent treatment wetlands. Therefore, design of open facilities should ensure access for maintenance activities, and maintenance crews should remove excess vegetation and debris regularly to eliminate mosquito habitat and encourage water flow. In addition, groundwater depth should be measured and accounted for in facility design to ensure that water can drain vertically if appropriate. Ideally, alternatives such as injection systems, infiltration trenches, biofiltration areas, vegetated filter strips, sand filters, or sump/vault systems should be considered as alternatives to open detention and treatment systems.

Water Management

Water management is an important tool for mosquito control efforts. Water management can be used in some wetlands to control the depth of standing water, the length of time that water is present, and the amount of water movement within the wetland system. A few general management concepts are applicable, including: (1) rapid flooding and drawdown of wetlands, (2) limiting residence time of shallow standing water to less than 72 hours, and (3) providing circulation and wave action.

Managing wetlands to provide flow and circulation enhances mosquito control by eliminating or reducing the accumulation of stagnant, organically-rich waters that attract certain types of mosquitoes. Flowing water also helps maintain good water quality with high oxygen levels and other characteristics that enhance the survival of mosquito-eating fish and other predators (SWS 2008).

Natural Wetlands

Use of water management to control mosquito populations is not practicable in all natural wetlands. However, mosquito breeding in some actively managed natural wetland ecosystems can be reduced through the control of water levels using structures such as weirs, dams, and tide gates. In such instances, management favoring relatively rapid

flooding and/or drawdown may be possible to limit the extent of floodwater mosquito habitat during peak reproductive periods. Generally, the primary objective when flooding is to maintain a water depth greater than 1.5 meters in known mosquito breeding areas. The primary objective in dewatering is to reduce the amount of standing water available for mosquito reproduction (Kwasny et al. 2004).

Water levels and flooding frequency can also be managed or controlled in tidal wetlands by installing and operating tide gates. Optimal management of tidal water levels for mosquito control in coastal lagoons and estuaries often involves increasing tidal circulation to flush otherwise isolated pools of accumulated rainwater (optimal vector breeding habitats) with saline or brackish tidal water on a daily basis. Fortunately, in Southern California rainfall during the peak mosquito breeding period (March-November) is limited. Therefore, isolated pools generated by rainwater are not as significant an issue as they are in other locations. However, depressions within the high marsh zone that are infrequently inundated by tides can hold standing water for extended periods.

Created Wetlands and Effluent Treatment Ponds

Water management for vector habitat control in created wetlands and effluent treatment ponds can occur in many ways. Ideally, such opportunities are built into the wetland during the design phase. Some effective means of reducing mosquito habitat in these types of created systems include: (1) use of water control structures and pumps to move water through the wetland and (2) use of sprayers, spinning wheels and other systems to promote agitation and wave action.

These types of water management activities prevent stagnation, minimize the spatial extent of potential mosquito habitat, and generate water movement to drown or damage mosquito larvae in open water zones. In general, water control structures should be designed, installed, operated, and maintained to minimize the production of isolated shallow pools and to achieve rapid flooding and drawdown of created wetlands.

Stormwater Facilities

Water management in stormwater facilities is critical to control mosquito vector habitat. Practical activities aimed at mosquito reduction in these types of systems should do the following: (1) ensure water is retained for less than 72 hours in open systems and (2) provide active maintenance to avoid clogging of drains, pipes, and outfalls. In general, the primary goal of water management in these types of systems is to avoid the presence of shallow, stagnant water (Metzger 2004).

Vegetation Manipulation

Vegetation manipulation is another important tool that can be used to control mosquito populations. General concepts include: (1) limiting vegetation to narrow strips along wetland margins and within the wetland and (2) removing dense emergent vegetation that limits wave action and predator access to mosquito larvae.

As stated earlier, wide expanses of dense vegetation provide shelter for mosquito larvae against predation, wave action, and water agitation. Therefore, limiting vegetation to narrow strips can be an effective means of reducing mosquito reproduction within a wetland system (SWS 2008). In addition, vegetation control can play an important role by allowing access to wetland areas where other types of management are required. For example, vegetation removal can allow access to areas where dredging is required to create relatively deep, open pools that allow greater levels of water circulation and provide habitat for mosquito-eating predators. Vegetation removal may also be required to allow access for mosquito control when necessary.

Vegetation removal for mosquito control within wetlands can be accomplished using a combination of methods including mowing, disking, burning, and herbicide application. However, care should be taken in planning and implementing vegetation management within wetland ecosystems because removal of existing vegetation can create undesirable consequences, such as opportunity for invasive species colonization and reduced usage by certain types of wildlife. Furthermore, if vegetation removal efforts are not executed carefully they can backfire. For example, if roots and other vegetative material are not adequately removed from the site the disturbance may result in prolific new growth within the disturbed area (SWS 2008).

As stated earlier, the need to protect people and animals from mosquito-borne diseases must be balanced against the importance of protecting key ecological services provided by wetlands. That said, some research has demonstrated that carefully executed vegetation manipulation can be beneficial to wildlife in certain situations (Payne 1992, Kwasny et al. 2004, Lawler et al. 2007). For example, mowing, disking, and grazing can sometimes achieve changes in plant species composition and abundance that enhance wildlife use. Similarly, vegetation removal can serve as an opportunity to remove invasive plant species from the system. In addition, removing vegetation to create open pool habitats can benefit certain species of birds that depend on open pools to complete their life cycle.

Ideally, vegetation removal in wetlands and stormwater structures would prioritize the removal of invasive exotic plant species first, advancing to the removal of native wetland vegetation only after exotic species are completely removed. Removal of the exotic vegetation, particularly floating emergent species such as water hyacinth, may be adequate to open waterways for increased circulation, wave action, and predatory fish access.

Natural Wetlands

Vegetation manipulation in natural wetlands can be difficult given regulatory requirements and the need to balance the importance of vector control with the equally important goal of protecting and enhancing wetland functions and values. Clearly, removal of organisms from ecological communities lowers biological diversity and may adversely impact ecological integrity by altering biological interactions and species composition (Gwin et al. 1999). Therefore, major alteration or modification of natural wetland ecosystems should be approached thoughtfully, avoiding activities that could detrimentally alter floral and faunal community assemblages.

In some natural wetlands, particularly those known to possess high levels of mosquito breeding, vegetation manipulation may be the most practical vector habitat control method. In such cases, vegetation manipulation for vector habitat control may be feasible if the management entity can reach a negotiated agreement with pertinent regulatory agencies to authorize certain vegetation control activities. This could involve removal of invasive species within the system or negotiated compensatory mitigation to accompany the vector control activity. If feasible, the overarching objective in such instances should be to limit vegetation to narrow strips within the wetland and along wetland margins.

Some vegetation manipulations may improve wildlife habitat. Carefully executed vegetation management has been used to promote wetland plants of higher food value for migratory birds, improve edge habitat, and increase the overall openness of wetland units to make them more attractive for shorebirds and waterfowl (Brown et al. 2006). One recent study assessed the effects of removing joint grass (*Paspalum distichum)* on mosquito populations in seasonal freshwater wetlands (Lawler et al. 2007). Joint grass is an emergent grass that grows in dense mats that can provide cover for mosquitoes and is considered poor habitat for waterfowl by some wildlife managers. Results demonstrate that untreated plots had seven times more larvae and 20 times more pupae than were found in plots where vegetation was removed. Similar densities of mosquitoes were found along edges and within fields. Furthermore, vegetation management in this instance was shown to enhance vegetation community structure and diversity, and the

removal of mat forming species provided open water habitat for waterfowl and shorebirds.

Within San Diego County, vegetation manipulation for vector habitat management could positively affect some resident southern California bird species such as northern pintail, green-winged teal, and sandhill crane. However, vegetation manipulation could have less desirable effects on other species such as clapper rail, least bittern, and least tern. In general, vegetation removal should not occur in close proximity to active or inhabited nests of sensitive bird species (particularly salt marsh species such as least tern, light-footed clapper rail, and least bittern). In addition, if native vegetation must be removed, it should be removed outside of the nesting season. Furthermore, if herbicide application is used for vegetation control, the applicator should use an herbicide approved for aquatic application. The herbicide should be applied in accordance with the product label instructions and all applicable State of California Department of Pesticide Regulation (DPR) requirements. Finally, cut biomass should be collected and disposed of off-site at an appropriate green waste facility to prevent the plant material from creating additional mosquito refuge areas or clogging water control structures and retarding water discharge.

Created Wetlands and Effluent Treatment Ponds

An ideal time to address vegetation community effects on mosquito populations in created systems is during the design phase. As described above, such man-made systems should be designed to maximize open water and to limit coverage by emergent plants to the minimum surface area required to achieve project goals. Furthermore, ongoing maintenance is necessary to ensure vegetation and debris do not clog structures and create shallow pools.

In existing created wetlands and effluent treatment ponds, similar efforts as those described for natural wetlands should be taken to avoid harming wildlife or intensifying vector problems. For example, vegetation should be removed outside of applicable bird nesting seasons, appropriate herbicides should be chosen and used with care, and cut vegetation should be disposed of appropriately.

Stormwater Facilities

As noted earlier, stormwater structures should be designed and managed to minimize vegetation around the perimeter of open water areas. In addition vegetation removal as part of ongoing maintenance within stormwater facilities is critical to prevent clogging of water control structures. The ponding effect of such clogging can create ideal breeding habitat for mosquitoes.

Conclusions

In summary, practices that have been shown to affect mosquito reproduction in wetlands and treatment ponds include wetland design, water management, and vegetation manipulation. Combinations of these management practices can be used to reduce or eliminate mosquito habitat within natural wetlands, constructed effluent treatment ponds, and stormwater facilities. If planned and implemented carefully, such strategies can reduce the significant public health threat posed by diseases such as West Nile Virus while also protecting or enhancing the important ecological functions and values of wetlands and other aquatic systems.

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Ecology of Important Mosquitoes in the San Diego Region

Numerous species of mosquito are capable of becoming infected with West Nile Virus at some level (Goddard et al. 2002). According to data from the Center for Disease Control (CDC), 62 mosquito species have tested positive for West Nile Virus in the United States since the disease first arrived in the country in 1999 (CDC 2008). However, not all of these species are competent vectors of the disease (Turrell et al. 2005).

The County of San Diego Vector Control Program has identified 13 species of mosquito as the primary species in the area. These include:

- *Culiseta incidens*
- *Culiseta inornata*
- *Culiseta particeps*
- *Culex tarsalis*
- *Culex quinquefasciatus*
- *Culex erythrothorax*
- *Culex stigmatosoma*
- *Aedes dorsalis*
- *Aedes squamiger*
- *Aedes taeniorhynchus*
- *Aedes increpitus*
- *Aedes sierrensis*
- *Anopheles hermsi*

Within the State of California, and throughout much of the rest of the United States, mosquitoes in the genus *Culex* appear to be the principal mosquito hosts of West Nile Virus (Goddard et al. 2002, Goddard et al. 2003). Therefore, *Culex tarsalis*, *Culex quinquefasciatus*, *Culex erythrothorax*, and *Culex stigmatosoma* are believed to be the most important species for transmission of West Nile Virus within San Diego County (County of San Diego 2007). In addition, *Anopheles hermsi* is capable of carrying malaria (Lawler and Lanzaro 2005). As a result, it is also considered a vector or concern within the San Diego Region.

Given that the local *Culex* species and *Anopheles hermsi* are considered to be the major mosquito vector threats within the San Diego region, projects aimed at mosquito abatement should focus on reducing the larval habitat associated with these species. Therefore, a brief description of these species and their larval habitats is included below (Reisen 1993, Alameda County 2008).

***Culex tarsalis* (western encephalitis mosquito)** – This widespread species is considered to be the most important mosquito vector of arboviruses in western North America.

Females deposit rafts of eggs in a wide variety of sunlit standing water pools. They can be found in agricultural systems, alkaline lake beds, fresh and saline wetlands, secondary treated sewage effluent, and other manmade or natural sources. Larvae do not do well in areas with excessive organic pollution.

Culex quinquefasciatus **(southern house mosquito)** – This species is widespread and occurs largely in polluted standing waters near residential and commercial sources. Its larvae are commonly found in stormdrains and treatment ponds.

Culex erythrothorax **(tule mosquito)** – This species occurs throughout the region and is commonly found in ponds, lakes, and marshes dominated by tules and cattails.

Culex stigmatosoma **(banded foul water mosquito)** – This species is common throughout much of California. Its larvae are typically found in polluted standing water in places such as dairy ponds, sewer ponds, catch basins, and some natural pools.

Anopheles hermsi **(southern California malaria mosquito)** – This species is often found in relatively large, sunlit pools with matted emergent vegetation. Their larvae can also be found in areas such as rice fields and roadside ditches with emergent vegetation.

Appendix B – Evaluation Criteria

Competitive Grant Funding - Evaluation Criteria

Proposals for competitive grants will be evaluated based on the following evaluation criteria:

- Known breeding location/aerial application site
- Mosquito abundance and type/threat permanence and recurrence
- Proximity to urbanized areas and sensitive receptors
- Consistency with Wetland Design Concepts for Vector Control
- Experience in related habitat management
- Matching funds/partnering
- Lack of habitat sensitivity
- Regulatory permitting feasibility and cost
- Improvement of larvicide treatment effectiveness
- Contribution to conservation
- Feasibility of maintenance plan

Projects will be selected based on the evaluation results, financial requirements, project feasibility, and the best use of public funds. Selected applicants will be invited to enter into a contract with DEH for grant funding. Applicants that receive grant funding will be required to commit to an ongoing maintenance program, and to submit periodic progress reports and a final summary report detailing project actions and assessing the project's effect on mosquito reproduction.

Known breeding location / aerial application site

The rationale behind this criterion is to ensure that funded projects target locations with a demonstrated mosquito population. In other words, it is important that projects implemented as part of the Vector Habitat Remediation Program (Program) focus on areas where there is a known vector problem with the potential to transmit disease to humans.

As part of ongoing monitoring activities, DEH has mapped over 2,000 known mosquito breeding locations, and these areas are treated using larvicide or other environmentally-friendly controls on a regular basis. In addition, DEH uses aerial applications techniques in several areas that present difficult access and coverage issues. Projects proposed to occur within these areas known to possess mosquito breeding habitat will be ranked higher than projects that will not occur in documented problem areas.

Project applicants must provide information on the project location, such as parcel numbers, coordinates, and a location map. Subsequently, DEH staff will be responsible for comparing the proposed project location with the known breeding locations to develop a score for this criterion.

Mosquito abundance and type / threat permanence and recurrence

There are 24 different types of mosquitoes in San Diego County. At least four types are known to carry diseases that can be passed to humans. The most common diseases carried by mosquitoes in San Diego County are encephalitis viruses and malaria. Encephalitis viruses like West Nile Virus affect the central nervous system. Malaria is a blood parasite that can cause chills, high fever, anemia, kidney damage, or brain damage

The rationale behind this criterion is to ensure that projects funded under this program control or eradicate mosquito species known to carry diseases that pose a threat to humans. Therefore, proposed project sites known to have a higher abundance of mosquito species known to represent a public health risk will receive a relatively high score in this category. In addition, sites that are consistently a threat and/or require a greater frequency of treatment by DEH will be ranked higher.

Project applicants will provide information on the project location and site characteristics. Subsequently, DEH staff will be responsible for comparing the project location against the surveillance database, conducting field data collections, and/or assessing species expected to be found on the site using their professional judgment.

Proximity to urbanized areas and sensitive receptors

The proximity of a mosquito breeding habitat to urbanized areas directly affects the likelihood that mosquitoes from that area could pose a public health threat. In short, the closer a given mosquito habitat is to populated areas to greater the opportunity for disease transmission to occur. In addition, it has been demonstrated that individuals over the age of 50, those with diabetes, those with high blood pressure, and those with compromised immune systems are at the highest risk of developing serious complications from West Nile Virus. Therefore, the Program will favor projects proposed to occur in relatively close proximity to homes and institutions used by significant numbers of people that are most sensitive to the disease.

The project site's proximity to urbanized areas will be assessed by overlaying a 2-mile buffer polygon around the project site on top of the SANDAG existing land use map. A relative score for the amount of urbanization within the buffer zone will be generated from GIS. In addition, the project applicant may provide information on sensitive receptors (parks, schools, outdoor theatres, etc.) located in the vicinity.

Consistency with Wetland Design Concepts for Vector Control

Projects will be evaluated on their ability to meet wetland design concepts, water management techniques, and vegetation manipulation that can be undertaken to reduce or eliminate mosquito breeding habitat within wetlands, effluent treatment ponds, and stormwater treatment infrastructure.

The techniques discussed include, but are not limited to: (1) reduction or elimination of shallow, standing water, (2) use of steep edges along pool margins, (3) creation of deep, open water pools, (4) creation of surface connections between pools, (5) promotion of wave action and circulation, (6) incorporation of habitat for mosquito-eating fish, (7) rapid flooding and drawdown, and (8) removal of dense vegetation within pools, leaving only narrow strips of vegetation along wetland margins.

The project applicant will provide a description of the proposed project actions and design. DEH staff will evaluate proposed projects for consistency with wetland design and management concepts known to facilitate vector control. It should be noted that this evaluation will apply to the project site and any off-site compensatory mitigation, if needed, associated with the project.

Experience in related habitat management

It is anticipated that project proponents with experience managing wetlands, effluent treatment ponds, and stormwater facilities will have a better chance of successfully implementing vector habitat remediation projects. This is especially true of individuals or groups that have a proven track record of managing such systems in a manner that reduces mosquito breeding habitat.

Project applicants will be required to provide a description of their experience (or their consultant's experience) in implementing the type of habitat management activities proposed in their project. Organizations with track record of successful implementation of projects will be ranked higher than those that do not have such a track record.

Matching funds / partnering

Projects that have additional funding sources will be looked upon favorably. If Program dollars are matched by money from outside sources it is anticipated that a heightened amount of work aimed at controlling mosquito populations can be carried out. Therefore, project proponents will be required to include the percentage of requested Program funding that will be matched by other public or private sources, including other 3rd party government funding, non-governmental organization (NGO) grants, and private funds.

Lack of habitat sensitivity

Projects in areas that possess sensitive habitats and species are expected to be more complicated and less cost-effective. These projects will require more environmental permits and entail more regulatory oversight than projects that avoid such impacts. Furthermore, projects that occur within sensitive habitats are more likely to result in adverse ecological effects and require substantial mitigation. Both of these issues can add substantial expenses and regulatory constraints to a project.

Therefore, projects involving rare or sensitive habitats will be given a lower score for this criterion. Projects involving modification of low quality or disturbed habitats, common upland habitats, and heavily managed artificial ponds and basins will be favored because of lesser resource sensitivity to management activities.

Regulatory permitting feasibility and cost

Regulatory permitting can add complexity, expense, and uncertainty to a project. Projects that require a number of environmental permits are subject to the review and discretion of multiple regulatory agencies. The need to address the concerns and constraints of each agency often adds complexity to a project. This in turn adds expense, because time and resources must be used to apply for permits, respond to agency concerns, and adapt plans if needed. In addition, the need to obtain permits adds a layer of uncertainty to projects, because often in the permitting process there is no guarantee that the proposed work will be approved by each regulatory agency involved.

Project applications will be evaluated for: (1) the expected time needed to complete the regulatory permitting process, (2) the expected permitting fees and other funds needed to acquire regulatory permits, and (3) the project's consistency with regulatory requirements and likelihood of obtaining approval.

Improvement of larvicide treatment effectiveness

Some types of projects have the potential to enhance the effectiveness of ongoing larvicide treatments. For example, projects that remove dense vegetation from shallow, stagnant waters can allow greater access for applicators and facilitate dispersion of treatment chemicals. Therefore, each proposed project will be evaluated to assess the extent to which it will increase efficiency or effectiveness of DEH's routine treatment activities.

Contribution to conservation

All projects funded under this Program will be required to comply with all regulatory requirements and result in no net loss of wetland functions and values. To the extent that

projects also contribute to conservation and are consistent with local habitat and watershed management plans will be assessed under this criterion. More specifically, each project will be judged to assess its consistency with the goals and objectives of local conservation plans, programs, and policies. Furthermore, each project's overall contribution to the amount and type of habitat protected via some form of conservation mechanism will be assessed.

Feasibility of maintenance plan

This Program seeks to promote projects that will be lasting in nature and result in sustained reduction in mosquito breeding. The long-term effectiveness of a project will depend on incorporation of a comprehensive maintenance plan. To this end, project applicants will be required to provide a description of the proposed long-term maintenance plan (including detailed descriptions of maintenance activities, schedule, and funding). Each project will be judged regarding the likelihood that the proposed long-term maintenance will ensure continued effectiveness of the vector habitat remediation activity.

Grant recipients who subsequently fail to conduct maintenance as required by the grant agreement or as required to prevent the recurrence of a mosquito breeding nuisance will be subject to enforcement or abatement action by the County.

Scoring and Weighting of Evaluation Criteria

Scoring and weighting of evaluation criteria will be completed by the Source Selection Committee. It is anticipated that this scoring and weighting system will be reevaluated and adjusted each year as new information and priorities arise. This score will not be the only factor used to determine grant awards. Financial requirements, project feasibility, and the best use of public funds will also be considered.

Competitive Grant - Project Evaluation Criteria	**Description / Metric**
1) Known breeding location / aerial application site	DEH has mapped over 2,000 known mosquito breeding locations that are treated on a regular basis. In addition, DEH has a number of sites treated through aerial applications due to access and coverage issues. To the extent that the proposed project reduces mosquito breeding at these known locations and can reduce the treatment requirements, these projects will be ranked higher. The project applicant will provide information on the project location (APN(s), coordinates, map) and DEH staff will be responsible for comparing the project location with the known breeding locations to develop a score for this criterion.
2) Mosquito abundance and type / threat permanence and recurrence	Project sites with a higher abundance and generate mosquitoes known to represent a public safety risk will be ranked higher. In addition, sites that are consistently a threat or require a greater frequency of treatment (and therefore cost) would be ranked higher. The project applicant will provide information on the project location and site characteristics and DEH staff will be responsible for comparing the project location with the database of surveillance data, conducting field data collections, and/or assessing the site using their professional judgment.
3) Proximity to urbanized areas and sensitive receptors	The project site will be measured for it's proximity to urbanized areas by overlaying a 2-mile buffer polygon around the project site on top of the SANDAG existing land use map. A relative score for the amount of urbanization within the buffer zone will be generated from GIS. In addition, the project applicant will provide information of sensitive receptors (parks, schools, outdoor theatres, etc.) in the vicinity.
4) Consistency with *Wetland Design Concepts for Vector Control*	The project applicant will provide a description of the proposed actions and wetland design. DEH staff will evaluate the proposed project for consistency with the wetland design concepts for vector control. Note: This evaluation will apply to the project site and any off-site compensatory mitigation associated with the project.
5) Experience in related habitat management	The project applicant will provide a description of their experience (or consultant's) in implementing the type of habitat management activities proposed in their project. Organizations with track record of successful implementation of projects will be ranked higher.

Competitive Grant - Project Evaluation Criteria	**Description / Metric**
6) Matching funds / partnering	What percentage of the requested funding will be matched through other public or private sources including other 3rd party government and NGO grants and private funds? 0% - 0, 1-25% - 1, 26-50% - 3, 51-75% - 5
7) Lack of habitat sensitivity	Projects involving rare or sensitive habitats will be given a lower score for this criterion. Projects involving modification of low quality or disturbed habitats, common upland habitats, and heavily managed artificial ponds and basins will be encouraged (scored higher) because of lesser resource sensitivity to management activities.
8) Regulatory permitting feasibility and cost	The project will be evaluated for the 1) expected time needed to complete the regulatory permitting process, 2) expected permitting fees and other funds needed to acquire regulatory permits, 3) project consistency with regulatory mandate / overall feasibility of authorization.
9) Improvement of larvicide treatment effectiveness	The project will be evaluated to what extent habitat management will increase efficiency or effectiveness of DEH's routine treatment on breeding sites via application of larvicides.
10) Contribution to conservation	The project will be judged to what degree the project is consistent with the goals and objects of local conservation plans, programs, and policies and overall contribution of the project in amount/type of habitat held in conservation through easement or other conservation mechanism?. Note: All projects must be consistent with state, federal, and local regulations.
11) Feasibility of maintenance plan	The project applicant will provide a description of their long-term maintenance plan (including detailed description of maintenance activities, schedule, and funding) and each project will be judged in regards to the feasibility of long-term maintenance of the proposed treatment site to ensure continued performance/ effectiveness of initial vector habitat remediation activities.

Directed Project Grant Funding - Evaluation Criteria

Directed projects will generally focus on smaller projects at sites known to the Department of Environmental Health Vector Surveillance and Control Program (DEH-VSCP) to be "problem sites" for mosquito species capable of transmitting disease to humans. This directed process will support the implementation of a mosquito abatement project that would result in limited to no impacts on sensitive environmental resources and would not require additional regulatory review. Ideally this kind of project would not require a resource agency permit, or could be covered under a County Regional General Permit or an existing permit(s) held by the project applicant.

DEH-VCP staff has detailed knowledge of sites and conditions that could be modified to restore water flow and conveyance using various methods such as the removal of silt, heavy vegetation and/or trash, thereby reducing mosquito breeding habitat and mosquito populations. Directed projects that remove dense vegetation from shallow, stagnant waters including culverts, roadside ditches and stormwater facilities can allow greater access for applications and facilitate dispersion of larvicide as well as restore water flow.

To ensure that funded projects target locations with a demonstrated mosquito population, the directed project selection process will evaluate:

- Known breeding location/application site
- Mosquito abundance and type/threat permanence and recurrence
- Proximity to urbanized areas and sensitive receptors
- Consistency with conditions identified in applicable permit(s) (e.g. RGP)
- Lack of habitat sensitivity such as existing artificial storm water BMP or conveyance systems with no established sensitive habitats

Projects will be selected based on the evaluation of the site and review of the funding request, which include:

- Proposed tasks
- Break down of costs by tasks (staff hours, consultant costs, equipment rentals, materials)
- Start and end dates
- Deliverables and dates of deliverables (milestones)
- Map of the proposed work
- Verified lack of habitat sensitivity
- Costs/funding requested
- Any regulatory permits required or already in place

- Maintenance plan for site

Selected applicants will be invited to enter into a contract with DEH for grant funding. Applicants that receive grant funding will be required to submit progress reports (milestones) and a final summary report detailing project actions and assessing the project's effect on mosquito reproduction. Payment will be based on progress and completion of milestones.

Directed Grant - Project Evaluation Criteria	**Description / Metric**
Known breeding location/treatment site	VSCP staff has information on known mosquito breeding locations that are treated on a regular basis. To the extent that the proposed directed project reduces mosquito breeding at the location and can reduce the treatment requirements, these projects will be judged favorably. The project applicant will be invited to apply by VSCP based on staff recommendations or may apply on their own. The project must be verified as a mosquito breeding location (VSCP trap data/or RFS information)
Mosquito Abundance and species type	Project sites with a higher abundance and species type that represent a public health risk will be prioritized. Sites that are known to be consistently a threat or require a greater frequency of treatment would also be prioritized.
Proximity to urbanized areas and sensitive receptors	The project site will be evaluated it terms of it's proximity to urbanized areas, residential communities, sensitive receptors such as schools, parks, outdoor theaters.
Consistency with the RGP or lack of habitat sensitivity	Projects that do not meet the RGP requirements and projects that have sensitive habitats will not, in most circumstances, be considered under the Directed Projects. Projects that do fall within the RGP or involve modification of low quality habitats such as drainage canals, artificial ponds, silted in BMP's or basins will be considered.
Regulatory Permitting	The project will be evaluated to determine if any required permits for resource regulatory agencies have already been obtained, or determination from the same that none are required
Improvement of larvicide treatment effectiveness	The project will be evaluated to what extent the habitat management will increase efficiency or effectiveness of VSCP routine larvicide treatment up to making treatment no longer necessary.