Appendices

Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan/ Environmental Assessment

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Draft Compatibility Determinations

A-1 Wildlife Observation, Interpretation, and Environmental Education

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Compatibility Determination
(Draft, March 2011)

Use: Wildlife Observation, Interpretation, and Environmental Education

Refuge Name: Seal Beach National Wildlife Refuge (Orange County, California)

Establishing and Acquisition Authorities:
The Seal Beach National Wildlife Refuge (NWR or Refuge) was established under the authority of the National Wildlife Refuge System Administration Act of 1966, as amended (80 Stat. 927; 16 U.S.C. 668dd-668ee). Public Law 92-408, authorizing the establishment of the Seal Beach National Wildlife Refuge (NWR or Refuge), was signed by President Nixon on August 29, 1972. The law states that "The Secretary of the Interior shall administer the Refuge in accordance with the National Wildlife Refuge System Administration Act of 1966, as amended, and pursuant to plans which are mutually acceptable to the Secretary of the Interior and the Secretary of the Navy."

Refuge Purposes:
Seal Beach NWR purposes include:

> Preserve and manage the habitat necessary for the perpetuation of two endangered species, the light-footed clapper rail and California least tern, and preserve habitat used by migratory waterfowl, shorebirds, and other waterbirds (1974 Management Plan for Seal Beach National Wildlife Refuge, prepared pursuant to Public Law 92-408).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended).

Descriptions of Use:
Public access onto the Refuge is restricted in accordance with the military mission of Naval Weapons Station Seal Beach (NWSSB) and at all times is controlled at the discretion of the NWSSB Security Department. Public tours of the Refuge, which facilitate wildlife observation and interpretation, are currently offered once a month and special tours are periodically conducted to support the Refuge's objective of providing opportunities for wildlife observation, environmental education, and interpretation.

A three-hour public walking tour of the Refuge is currently offered on the last Saturday of each month. Reservations must be made in advance and attendance is generally limited to 50 people. These tours, which are led by Refuge staff and the Friends of the Seal Beach NWR, are conducted in cooperation with NWSSB. Visitors are introduced to the Refuge and the National Wildlife Refuge System at the Refuge Headquarters and are then lead on a guided tour of a portion of the Refuge. The tour includes a visit to the native plant garden and a walk along a six to eight-foot-

wide pedestrian pathway that provides access from the Refuge Headquarters east along Bolsa Avenue to an existing observation deck, located about one half mile to the east. Spotting scopes and binoculars are provided on the observation deck to enhance the public's wildlife viewing experience. In addition, several temporary information stations are set up along the pathway to provide opportunities for visitors to learn about the range of wildlife species found on the Refuge. Signs identifying salt marsh plants and birds have been installed along the pathway, while other signs along the pathway and in the native plant garden interpret the natural and cultural history of the Refuge's salt marsh complex and associated upland and open water areas.

Periodic special tours of the Refuge also provide the public with opportunities to observe wildlife, gain an understanding of the importance of protecting wetlands along the Pacific Flyway, and learn about the natural history of the area in and around the Refuge. Requests to conduct these tours are submitted by the Refuge Manager to the Navy command office for approval in advance. Special tours may accommodate birding groups, youth service groups, school groups, or other interested parties. A special tour may also be a component of a larger off-site environmental education program that is implemented annually by the Friends of the Seal Beach NWR for local school students. The special guided tours can focus on a variety of topics including but not limited to the native plant garden, habitat restoration, tracking wildlife, endangered species management, walking along Bolsa Avenue to observe marsh habitat and the associated wildlife, or visiting specific birding spots around the Refuge.

The CCP also includes proposals to expand opportunities for wildlife observation and environmental education by increasing the number of tours conducted on the Refuge and seeking funds to design and build a two-level, 20-foot-high observation tower/bird blind along the east side of Kitts Highway across from the Refuge Headquarters.

The Refuge, together with NWSSB, would also promote opportunities for environmental education and connecting people with nature on the Refuge by supporting requests for visits to the Refuge by educational institutions, non-governmental organizations, and archaeological/historical societies. Expanded visitation to the Refuge would continue to utilize the pathways currently available for public access; no new trails are proposed.

Availability of Resources:
Due to the restrictions on public access imposed by NWSSB, it is necessary to have Service personnel present during all public use activities on the Refuge. In addition, to ensure that large groups are adequately supervised, assistance from additional personnel, usually consisting of volunteers from the Friends of the Seal Beach NWR, is needed. Refuge staff currently consists of a Refuge Manager and a part time maintenance worker; therefore, Refuge personnel from elsewhere within the San Diego NWR Complex occasionally assist with public tours and events. Direct costs to provide opportunities for wildlife observation, interpretation, and environmental education are primarily in the form of staff time and maintenance. Table 1 describes the level of involvement by Refuge staff that is required annually to manage and maintain opportunities for public access on to the Refuge. Maintenance costs included in the table are based on FY 2010 costs.

Funding for new construction projects (i.e., elevated observation platform [$100,000], installation of video cameras [$14,000]) is not included in the current Refuge budget. Therefore, these projects

will not be implemented until adequate funding is secured. Potential sources for funding include Federal cost share grants, interagency partnerships, state and private grants, and contributions from Friends groups.

Table 1 Annual Staff Involvement and Maintenance Costs Associated with Managing Wildlife Observation, Interpretation, and Environmental Education Opportunities on the Refuge	
Staff Responsibilities	**Estimated Annual Administrative Time and Maintenance Costs**
Refuge Manager (GS 11) – Coordinate public tours, interface with NWSSB regarding public access, public outreach, Friends group coordination, conduct tours, permit/NEPA compliance, and construction management	(0.25 FTE*)
Maintenance Worker (WG 5) – Maintain refuge headquarters, native plant garden, pathway along Bolsa Avenue, interpretive and information signs, information kiosk, observation platform and observation deck	(0.1 FTE)
Other Refuge Complex Staff (GS varies) – Assist with public tours and occasional special events	(0.05 FTE)
Maintenance supplies and materials	$5,000

*FTE (full time equivalent)

Anticipated Impacts of the Use:
A number of studies have been conducted to evaluate the effects of wildlife observation and trail use on wildlife, including effects of disturbance on shorebirds and other avian species. Some of these studies are summarized in a literature review prepared for the Stillwater National Wildlife Refuge (*DeLong and Schmidt 2000*). In summarizing the findings of these studies, DeLong and Schmidt state that wildlife observation can "negatively impact wildlife by altering wildlife behavior, reproduction, distribution, and habitat." Huffman (*1999*) in observing waterbird disturbance in South San Diego Bay documented disturbance to migratory birds as a result of pedestrian activity along the shoreline. This disturbance was greatest during low tides when pedestrians left designated access ways to explore the mudflats. Trulio and Sokale (*2008*) while conducting studies along the San Francisco Bay Trail found that the number of birds decreased at trail sites as trail use increased on higher use over lower use days. Their results also seemed to support the proposal that disturbance to waterbirds may be less when trail users are not directly approaching foraging areas, such as when they are traveling along a trail that is parallel to foraging areas rather than extending through foraging areas.

Fernández-Juricic et al. (*2009*) found that overall tolerance of the State listed endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) to human disturbance varies depending upon the level of disturbance occurring in a given area, as well as between seasons. In areas where there is little if any public use activities, alert and flight responses to human approaches were observed to be greater than those observed in higher use areas. A trend for greater alert distance and flight distance was also observed in the non-breeding season (*Fernández-Juricic et al. 2009*).

Regularly scheduled monthly public tours of the Refuge are conducted along an established route that extends along Bolsa Avenue. The trail parallels much of the marsh habitat and tends to be setback from tidal mudflat areas where the greatest concentrations of foraging shorebirds are observed. As a result, disturbance to foraging avian species is relatively low. In addition, the frequency of these tours would continue to be relatively low (less than once a week) even if the number of tours permitted on the Refuge were to increase over current conditions. Most other special tours, if walking tours, would follow the same route as the monthly tours, so the affects to migratory and resident birds would be the same as described above. Refuge visits associated with the local schools' environmental education programs are also conducted on the Refuge and normally use the existing pedestrian pathway along Bolsa Avenue and/or Refuge Headquarters. These facilities are located an adequate distance from sensitive marsh habitat. Occasionally during walking tours the group is led off an established pathway to take advantage of interpretive opportunities. Under these circumstances, Refuge staff would be present to ensure that there are no negative impacts to wildlife or vegetation. This type of tour activity would only be conducted outside the breeding season if it is in close proximity to salt marsh habitat.

Special birding tours generally involve driving a group of 15 to 20 people to specific locations on the Refuge, including the existing observation platform, a roadside location near Perimeter Pond, the south end of 7th Street Pond, and Hog Island, to observe the various bird species present on the Refuge. Additional stops may also be included. These stops are generally made along the edge of existing roadways, some distance from shorebird foraging habitat. Entry into the marsh habitat is not permitted and is controlled by guides who accompany the visitors during the tours.

The proposed elevated observation platform would be installed in a disturbed area adjacent to marsh habitat. Construction would occur outside the avian breeding season and future access to the facility would be via a trail through disturbed habitat. This facility would improve opportunities for wildlife observation, while minimizing the potential for disturbance to distance foraging birds.

Disturbance associated with the installation of video cameras at NASA Island and in the salt marsh would be minimized by conducting these activities outside the breeding season. Once installed, the cameras would provide the public with up-close views of bird nesting and foraging activities without the potential for disturbance.

No adverse effects to sensitive tidal, intertidal, or restored native upland habitat and the wildlife species supported by these habitats are anticipated as a result of the wildlife observation, interpretation, and environmental education activities proposed or currently occurring on the Refuge.

Endangered and Threatened Species: Human activity can have adverse impacts on endangered and threatened species, particularly when it disrupts bird nesting or foraging activities. NASA Island supports nesting habitat for the Federally-listed endangered California least tern (*Sternula antillarum*) and the adjacent open water areas in the Refuge's marsh complex provide foraging habitat for the breeding terns and their young. The marsh complex also provides year-round foraging habitat, as well as nesting habitat, for the Federally-listed endangered light-footed clapper rail (*Rallus longirostris levipes*).

No public uses are permitted in the vicinity of NASA Island during the breeding season to avoid any potential for disturbance to nesting terns. In addition, public access around potential clapper rail nesting habitat is avoided during the breeding season. The potential for human intrusion into clapper rail habitat is limited due to the nature of the Refuge's public use program and the Navy's security program, which requires that all visitors be accompanied by a guide.

No adverse effects to listed species are anticipated from the current proposals to provide opportunities for wildlife observation, interpretation, and environmental education on the Refuge.

Public Review and Comment:
Opportunities for wildlife observation, interpretation, and environmental education on the Seal Beach NWR were discussed at the scoping meetings held on April 3, 2007 to initiate the Comprehensive Conservation Plan (CCP) process. A Notice of Intent was published in the Federal Register on April 16, 2007 (72 FR 19016). At that time, written comments were solicited. At the scoping meetings, the public was encouraged to provide verbal comments or to send us written comments following the meetings. A CCP web page was established to provide the public with specific information regarding the CCP process and the comments provided during public scoping. Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process.

This draft Compatibility Determination is being made available for public review and comment as Appendix A of the Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (*USFWS 2011*).

Determination:

__Use is Not Compatible

_X_ Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

1. Prior to constructing the proposed observation platform, construction plans and design specifications will be reviewed to ensure that the facility is sighted in a manner that avoids impacts to sensitive habitat and minimizes the potential for disturbance to wildlife.

2. All public activities on the Refuge will continue to be facilitated by Refuge staff, members of the Friends of the Seal Beach NWR, and/or Navy personnel and these activities will occur outside of sensitive habitat areas including areas with ground nesting birds during the breeding season.

Justification:
Providing opportunities for wildlife observation, interpretation, and environmental education on the Seal Beach NWR will enhance the public's appreciation of the wildlife resources supported within this Refuge and will support the Service's initiative for connecting people, particularly children, with nature. Through these activities, the Refuge has the opportunity to introduce the public to the importance of protecting coastal wetland habitats not only because these habitats support Federally listed species, but because of the role these habitat play in supporting migratory

birds, as well as fish and other marine organisms. All of these outcomes are consistent with the Refuge purposes of protecting listed species.

A review of the environmental consequences of implementing these uses is provided in Chapter 5 of the Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (*USFWS 2011*). This analysis demonstrates that these uses would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission, provided the stipulations to ensure compatibility are followed. Further, wildlife observation, interpretation, and environmental education are three of the six priority public uses of the System, as defined by the Act. Therefore, implementation of these programs would contribute to the fulfillment of the Refuge System mission, and the achievement of the goals established for the Refuge, particularly the goal to enhance public appreciation, understanding, and enjoyment of the Refuge's biological and cultural resources through outreach opportunities and quality wildlife-dependent recreation, including wildlife observation, environmental education, and interpretation.

Mandatory Re-Evaluation Date:

_X_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

__ Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

_Categorical Exclusion without Environmental Action Statement

__Categorical Exclusion and Environmental Action Statement

_X_ Environmental Assessment and Finding of No Significant Impact

_ Environmental Impact Statement and Record of Decision

References Cited:

DeLong, Anita and Janet Schmidt. 2000. Literature Review: Effects of Human Disturbance on Wildlife with Emphasis on Wildlife-Dependent Recreation Relevant to Stillwater National Wildlife Refuge (Draft).

Fernández-Juricic, E., E. F. Zahn, T. Parker, and T. Stankowich. 2009. California's endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*): tolerance of pedestrian disturbance. *Avian Conservation and Ecology - Écologie et conservation des oiseaux* 4(2): 1. [online] URL: http://www.ace-eco.org/vol4/iss2/art1/.

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

Trulio, Lynne and Jana Sokale. 2008. Foraging Shorebird Response to Trail Use around San Francisco Bay. *Journal of Wildlife Management* 72(8):1775-1780.

U.S. Fish and Wildlife Service. 2011. Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment.

Refuge Determination:

Prepared by: _____ _____
(Signature) (Date)

Project Leader
Approval: _____ _____
(Signature) (Date)

Concurrence:

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Regional
Director, Refuges: _____ _____
(Signature) (Date)

Compatibility Determination
(Draft, March 2011)

Use: Scientific Research

Refuge Name: Seal Beach National Wildlife Refuge (Orange County, California)

Establishing and Acquisition Authorities:
The Seal Beach National Wildlife Refuge (NWR or Refuge) was established under the authority of the National Wildlife Refuge System Administration Act of 1966, as amended (80 Stat. 927; 16 U.S.C. 668dd-668ee). Public Law 92-408, authorizing the establishment of the Seal Beach National Wildlife Refuge (NWR or Refuge), was signed by President Nixon on August 29, 1972. The law states that "The Secretary of the Interior shall administer the Refuge in accordance with the National Wildlife Refuge System Administration Act of 1966, as amended, and pursuant to plans which are mutually acceptable to the Secretary of the Interior and the Secretary of the Navy."

Refuge Purposes:
Seal Beach NWR purposes include:

> Preserve and manage the habitat necessary for the perpetuation of two endangered species, the light-footed clapper rail and California least tern, and preserve habitat used by migratory waterfowl, shorebirds, and other waterbirds (1974 Management Plan for Seal Beach National Wildlife Refuge, prepared pursuant to Public Law 92-408).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended).

Descriptions of Use:
The Seal Beach NWR receives periodic requests to conduct scientific research on the Refuge. Although research is not identified as a wildlife-dependent recreational use by the National Wildlife Refuge System Improvement Act of 1997, scientific research can benefit Refuge resources and facilitate informed management decisions. In so doing, scientific research conducted on the Refuge would support Refuge purposes and the mission of the National Wildlife Refuge System. Based on the Refuge proposes, priority would be given to scientific research that contributes to the enhancement, protection, and management of listed species and their habitats.

Research applicants would be required to submit a proposal summarizing:
1) objectives of the study;
2) justification for the study;
3) detailed study methodology and schedule;

4) potential impacts to Refuge wildlife and/or habitats, including short- and long-term disturbance, injury, and mortality;
5) research personnel required and their qualifications/experience;
6) status of necessary permits (i.e., scientific collecting permits, endangered species permit);
7) costs to Refuge and Refuge staff time requested, if any; and
8) anticipated end products (i.e., reports, publications).

Research proposals would be reviewed by Refuge staff or others, as appropriate. The criteria listed below, and others as necessary, would be used to assess research proposals.

1) Research that would contribute to the enhancement, protection, and management of listed species and their habitats and research that could provide insight into current or future Refuge management would have higher priority than other requests.
2) Research that would conflict with other ongoing research, monitoring, or management programs would not be approved.
3) Research that is not Refuge-specific and can be conducted elsewhere is less likely to be approved.
4) Research that causes undue disturbance or is intrusive would likely not be approved. The degree and type of disturbance would be carefully weighed when evaluating a research request.
5) Research requests would be evaluated to determine if the study design adequately addresses the need to minimize disturbance to sensitive habitat and wildlife (for example, has consideration been given to location, timing, and/or scope of the study, the need to minimize the number of participants, study methods, the number of study sites, etc.).
6) If Refuge staffing limitations or logistical constraints make the monitoring of research activities difficult, requests to conduct research on the Refuge may be denied or postponed, depending on the circumstances.
7) The duration of a proposed research project would be evaluated to determine the full effect of the proposal on Refuge trust resources, as well as on Refuge staff time.

Open-ended research projects would not be approved. All projects would be reviewed annually to assess whether they continue to meet these criteria (and others as necessary), continue to operate as originally proposed, and are contributing to the objectives of the study.

Approved research projects would be conducted under a Refuge-issued Special Use Permit with case-specific stipulations.

Availability of Resources:
Adequate funding and staff exist to manage some level of scientific research at the Seal Beach NWR. As always, discretionary use of staff time would be weighed through a cost-benefit analysis. Direct costs to administer research activities are primarily in the form of staff time. Table 1 describes the level of involvement by Refuge staff that will be required annually to manage and monitor research activities on the Refuge, as well as the associated funding/annual costs (based on FY 2010 costs).

Table 1 Annual Staff Involvement Associated with Managing Scientific Research Uses on the Refuge	
Staff Responsibilities	**Annual Administrative/Management Costs (approximate) and Time**
Deputy Project Leader (GS 13) – Review research proposals	(0.02 FTE*)
Refuge Manager (GS 11) – Review and oversight of research proposals; preparation of SUP; monitoring to ensure compatibility; report review; coordination of researcher access	(0.04 FTE)
TOTAL COST AND FTE	(0.06 FTE)

*FTE (full time equivalent)

Anticipated Impacts of the Use:
Through the Special Use Permit process, project specific conditions can be placed on individual research proposals to ensure that the potential for impacts to Refuge resources are minimized. Some level of disturbance is expected with all research activities since most researchers will be entering areas that are normally closed to the public and may be collecting samples or handling wildlife. Many shorebird and marshbird species are sensitive to disturbance (*Huffman 1999, Trulio and Sokale 2008, Fernández-Juricic et al. 2009*); salt marsh habitats that support light-footed clapper rails (*Rallus longirostris levipes*) and Belding's savannah sparrows (*Passerculus sandwichensis beldingi*) are prone to degradation by foot traffic; and disturbance around California least tern (*Sternula antillarum*) nesting and foraging sites can have an adverse effect on reproductive success (*Carney and Sydeman 1999*). These and other impacts related to the implementation of scientific research on the Refuge are summarized below and discussed in greater detail in Chapter 5 of the Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (*USFWS 2011*).

Endangered and Threatened Species. Human activity can have adverse impacts on endangered and threatened species, particularly when it disrupts bird nesting or foraging activities (*Carney and Sydeman 1999*). NASA Island supports nesting habitat for the Federally-listed endangered California least tern and the adjacent open water areas in the Refuge's marsh complex provide foraging habitat for the breeding terns and their young. The marsh complex also provides year-round foraging habitat, as well as nesting habitat, for the Federally-listed endangered light-footed clapper rail.

To minimize disturbance to nesting and foraging terns, research activities in the vicinity of NASA Island during the breeding season would be scrutinized and appropriate restrictions would be imposed on research activities to ensure that no adverse effects to the nesting colony would occur. In addition, access around potential clapper rail nesting habitat would be avoided during the nesting season for all research projects that are not related to clapper rail management, and any research related to clapper rails would be evaluated to ensure that no adverse effects to the species or its habitat would occur as a result of the study design and/or implementation.

Including appropriate conditions in Special Uses Permits for scientific research projects would ensure that no adverse effects to listed species would result from the implementation of research projects on the Refuge.

Migratory and Resident Water-Dependent Birds. Human activity associated with scientific research projects may result in disturbance to the variety of bird species that utilize the Refuge's intertidal and subtidal habitats for foraging. Human disturbance occurring near mudflats and salt marsh habitats could disturb feeding and nesting birds, including Belding's savannah sparrows. Some level of disturbance is expected with all research activities, because most researchers would be entering areas that are normally closed to the public. However, the conditions to be included in the Special Use Permits that will be issued prior to allowing a specific research project to begin on the Refuge will ensure that impacts on wildlife and the habitats they depend on are reduced as much as possible.

Public Review and Comment:
Opportunities for scientific research on the Seal Beach NWR were discussed at the scoping meetings held on April 3, 2007 to initiate the Comprehensive Conservation Plan (CCP) process. A Notice of Intent was published in the Federal Register on April 16, 2007 (72 FR 19016). At that time, written comments were solicited. At the scoping meetings, the public was encouraged to provide verbal comments or to send us written comments following the meetings. A CCP web page was established to provide the public with specific information regarding the CCP process and the comments provided during public scoping. Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process.

The draft Compatibility Determination for scientific research is being made available for public review and comment as Appendix A of the Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment (*USFWS 2011*).

Determination:
__Use is Not Compatible

X Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:
Concerns about protecting listed species and the overall integrity of the open water and salt marsh habitat on the Refuge require that Refuge staff closely review proposed research projects and that research activities and impacts be monitored. To minimize the potential for adverse effects to Refuge resources as a result of scientific research, the following measurers would be implemented:

1) All research requests must include a detailed description of the study proposal. At a minimum, the description should address the purpose of the research, the potential benefits to Refuge management and/or Refuge resources, the number of participants, the times of the year in which field studies and/or date collection would occur, how the studies or data collection will be implemented, the areas on the Refuge that would be accessed, any potential impacts to Refuge resources that could occur and the measures that would be

implemented to minimize such impacts, and when study results would be made available to the Refuge Manager.

2) Highly intrusive or manipulative research will generally not be permitted in order to protect Refuge resources.

3) Proposed research methods that have the potential to adversely affect Refuge resources will generally not be permitted. However, if the researcher can adequately demonstrate the need for the research and the overall benefits in terms of achieving Refuge purposes despite the potential for some adverse effects, the Refuge Manager has the discretion to permit such research provided the researcher can identify potential impacts in advance of their occurrence. The researcher will also be required to develop mitigation measures to minimize potential impacts. Mitigation measures will be listed as conditions on the Special Use Permit.

4) Approval of research projects on the Refuge will be permitted at the discretion of the Refuge Manager who will consider the compatibility of the proposed research with Refuge purposes, the proximity of research activities to sensitive habitat and known nesting areas, the potential for impacts to Refuge resources, and the availability of Refuge staff to manage and monitor the research activities.

5) All research projects will be conducted under a Special Use Permit which will have additional project-specific stipulations.

6) Special Use Permits will be valid for one year only. Renewals will be subject to review and approval by the Refuge Manager, who will consider the current status of the study, the researcher's compliance with the conditions outlined in the Special Use Permit, and the extent of anticipated or unanticipated impacts, if any, that occurred as a result of the specific research project.

7) Refuge staff may accompany researchers at any time to assess study methods and the potential for impacts to Refuge resources.

8) The Refuge Manager can suspend or modify conditions or terminate on-refuge research that is already permitted and in progress, should unacceptable impacts or issues arise or be noted.

9) Researchers will be responsible for acquiring and/or renewing any necessary State and Federal permits prior to beginning or continuing their project.

10) Research must adhere to current species protocols for data collection.

11) Research that does not involve birds will generally be conducted outside of the breeding season of the avian species using the Refuge.

Because the Naval Weapons Station Seal Beach Security Department is responsible for regulating all access onto NWSSB and thus onto the Refuge which is located within the base, Security Department approval must be obtained for all researcher access requests. Approval to access the Refuge is at the discretion of Security Department personnel.

Justification:
To be permitted on the Refuge, scientific research projects would be required to contribute to the enhancement, protection, use, preservation, and/or management of Refuge resources. The anticipated level of research to be conducted on the Refuge at any given time would be compatible because the Refuge would ensure that research proposals support the purpose of the Refuge and mission of the System. In view of the impacts research activities may have on the Service's ability to achieve the Refuge purpose, sufficient restrictions will be placed on the researcher to ensure that disturbance is kept to a minimum. This program as described is determined to be compatible.

Mandatory Re-Evaluation Date:

_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

X Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

_ Categorical Exclusion without Environmental Action Statement

_ Categorical Exclusion and Environmental Action Statement

X Environmental Assessment and Finding of No Significant Impact

_ Environmental Impact Statement and Record of Decision

References Cited:

Carney, Karen M. and William J. Sydeman. 1999. A Review of Human Disturbance Effects on Nesting Colonial Waterbirds. *Waterbirds: The International Journal of Waterbird Biology* 22(1):68-79.

Fernández-Juricic, E., E. F. Zahn, T. Parker, and T. Stankowich. 2009. California's endangered Belding's savannah sparrow (*Passerculus sandwichensis beldingi*): tolerance of pedestrian disturbance. *Avian Conservation and Ecology - Écologie et conservation des oiseaux* 4(2):1. [online] URL: http://www.ace-eco.org/vol4/iss2/art1/.

Huffman, Kathy. 1999. San Diego South Bay Survey Report – Effects of Human Activity and Water Craft on Wintering Birds in the South San Diego Bay.

Trulio, Lynne and Jana Sokale. 2008. Foraging Shorebird Response to Trail Use around San Francisco Bay. *Journal of Wildlife Management* 72(8):1775-1780.

U.S. Fish and Wildlife Service. 2011. Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan and Environmental Assessment.

Refuge Determination:

Prepared by: _____ _____
(Signature) (Date)

Project Leader Approval: _____ _____
(Signature) (Date)

Concurrence:

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Regional Director, Refuges: _____ _____
(Signature) (Date)

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Seal Beach National Wildlife Refuge

Use: Scientific Research

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ **Appropriate** ✓

Refuge Manager:_____ Date:_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Written Justification

Refuge Name: Seal Beach National Wildlife Refuge

Use: Scientific Research

Justification for Determining that this Use is an Appropriate Use for the Refuge:

Although scientific research is not identified as a wildlife-dependent recreational use, the information provided as a result of selectively permitting such use on the Refuge can benefit Refuge resources and facilitate informed management decisions. Based on the Refuge proposes, priority would be given to scientific research that contributes to the enhancement, protection, and management of listed species and their habitats. All research applications would be reviewed to ensure that the research objectives and justification, study methodology, schedule, and anticipated end products would provide useful information to assist with resource management on the Refuge. Additionally, all proposal would be reviewed to ensure that implementation of the research proposal would not result in significant disturbance or other impacts to Refuge resources. Because sufficient restrictions can be placed on the researcher to ensure that disturbance and other potential impacts are kept to a minimum, in my professional judgment scientific research is an appropriate use on the Refuge.

Refuge Manager:_____ Date:_____

Refuge Supervisor:_____ Date:_____

Compatibility Determination
(Draft, March 2011)

Use: Mosquito Management

Refuge Name: Seal Beach National Wildlife Refuge (Orange County, California)

Establishing and Acquisition Authorities:
The Seal Beach National Wildlife Refuge (NWR or Refuge) was established under the authority of the National Wildlife Refuge System Administration Act of 1966, as amended (80 Stat. 927; 16 U.S.C. 668dd-668ee). Public Law 92-408, authorizing the establishment of the Seal Beach National Wildlife Refuge (NWR or Refuge), was signed by President Nixon on August 29, 1972. The law states that "The Secretary of the Interior shall administer the Refuge in accordance with the National Wildlife Refuge System Administration Act of 1966, as amended, and pursuant to plans which are mutually acceptable to the Secretary of the Interior and the Secretary of the Navy."

Refuge Purposes:
Seal Beach NWR purposes include:

> Preserve and manage the habitat necessary for the perpetuation of two endangered species, the light-footed clapper rail and California least tern, and preserve habitat used by migratory waterfowl, shorebirds, and other waterbirds (1974 Management Plan for Seal Beach National Wildlife Refuge, prepared pursuant to Public Law 92-408).

National Wildlife Refuge System Mission:
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (National Wildlife Refuge System Administration Act of 1966, as amended).

Description of Use:
The Orange County Vector Control District (OCVCD) proposes to monitor and control mosquito populations on the Seal Beach NWR. Mosquito monitoring and control is not a wildlife-dependent recreational use, as defined in the National Wildlife Refuge System Improvement Act of 1997 (Act). The Act states that no use will be allowed on a Refuge unless it is first determined to be compatible with the purposes of the Refuge and mission of the National Wildlife Refuge System. This Act also mandates that a Comprehensive Conservation Plan (CCP) be prepared for all refuges. As part of the development of the CCP, we are required to develop new compatibility determinations, and where necessary conduct a determination of whether or not a proposed use is appropriate for implementation on the Refuge. In making these determinations, the Refuge Manager is required to use sound professional judgment based on many factors, including experience, knowledge, the best science available, and adherence to all applicable laws, regulations, and policies. This compatibility determination supersedes the compatibility determination for mosquito control on Seal Beach NWR prepared in September 1994.

The OCVCD currently conducts mosquito monitoring and control on the Refuge as part of their mandate to protect the public within their jurisdictional boundaries from mosquito-borne diseases. While mosquitoes are considered a nuisance because of their biting, some species are known vectors of serious diseases in California. Public concern over human health issues related to mosquito-borne disease has intensified on the west coast with the advance of West Nile Virus across the United States, and its detection in California in 2003. In Orange County, California, the mosquito-borne diseases of primary concern are West Nile Virus, St. Louis encephalitis, and western equine encephalitis.

OCVCD is issued a Special Use Permit (SUP) annually for the monitoring and control of mosquitoes on the Refuge. The pesticides permitted for use on the Refuge by the SUP must first be approved by the Service in accordance with Section 569 FW 1 of the Service Manual. This involves the preparation and approval of a pesticide use proposal (PUP). PUP records will provide a detailed, time-, site-, and target-specific description of the proposed use of the pesticide on the Refuge. The SUP then identifies which pesticides are approved for use on the Refuge and describes how and where they can be used. The SUP also describes how OCVCD is to notify the Refuge Manger prior to conducting any mosquito monitoring or control activities on the Refuge, identifies specific locations on the Refuge where these activities can occur, and outlines OCVCD's monitoring and data reporting requirements. The SUP also requires that OCVCD field staff meet with Refuge management and Navy Environmental staff prior to each year's nesting season (March 1 – September 15) to go over field protocols for avoidance and minimization of take to any trust resources, including listed species and their habitats and migratory birds.

Because the U.S. Fish and Wildlife Service (Service) uses insecticides, herbicides, and fungicides on refuges, a formal pesticide use review process is employed to ensure that all chemical pesticides approved for use have been reviewed for their potential impacts to groundwater, surface water and terrestrial and aquatic non-target vegetation and wildlife, including threatened and endangered species. PUP records identify specific pesticides, including mosquito control products, approved for use on each Refuge, as well as details on target pests, products applied, application dates, rates, methods, number of applications, site description, sensitive habitats, and best management practices employed to avoid impacts to Refuge resources. Pesticides approved for use must be shown to pose the lowest toxicity-related threat to non-target terrestrial and aquatic ecosystems, while addressing the specific pest control objectives. Depending on the product, PUPs are reviewed and approved at the Refuge Manager, Regional Office, or Washington Office level.

Until now, mosquito management on the Refuge by OCVCD has been conducted in accordance with an annually approved SUP and the Compatibility Determination approved in 1994. However, future mosquito management on the Refuge will be subject to the conditions included in annually issued SUPs, the stipulations provided in this Compatibility Determination, and the guidance and procedures provided in the Mosquito Management Plan (*USFWS 2011a*) prepared for the Refuge in association with the development of the Seal Beach NWR Comprehensive Conservation Plan (CCP). The Mosquito Management Plan, which is provided as Appendix D of the Seal Beach NWR CCP, describes the phased approach to mosquito management that will be implemented on the Refuge. It also outlines the procedures for when and how mosquito monitoring, management, and control will occur on the Refuge.

The Refuge and OCVCD both advocate for an integrated approach to mosquito management that includes a range of tools to improve habitat conditions for estuarine wildlife while reducing threats to public health from mosquito species capable of transmitting disease to humans. It is the intent of the Mosquito Management Plan to further define this approach to mosquito surveillance and control on the Seal Beach NWR.

Consistent with current practices, the Refuge and the Navy will continue to work with OCVCD on an annual basis to develop procedures for how surveillance, monitoring, and control activities shall be implemented on the Refuge in a given year. However, in future years, these procedures and any associated measures imposed to ensure the protection of Refuge trust resources will be consistent with the procedures outlined in the Mosquito Management Plan. The details of this work on the Refuge will be outlined in the annual SUP issued to the OCVCD prior to the commencement of mosquito season. This coordination will ensure that permits are current, communication is continuous, and concerns related to mosquito populations and other biological resources of the Refuge are addressed. It is vital to the mission of the respective agencies that a positive and productive working relationship is maintained. PUPs for the mosquito control products to be used on the Refuge must be approved annually. In addition, Pesticide Use Reports will be prepared annually by the Refuge with data support from OCVCD. Mosquito management and control proposals by the OCVCD will be reviewed annually as part of the SUP process to determine if there are any proposed changes in mosquito management that are not addressed in the Mosquito Management Plan and this Compatibility Determination. Any proposals that differ from these documents must comply with requirements of NEPA and Section 7 of the Endangered Species Act (ESA). Existing NEPA and Section 7 compliance documents will be reviewed to determine if additional compliance is necessary to address proposed changes.

Because of the nature of mosquito-borne diseases, as well as the limited information available regarding the effects of these diseases on wildlife of the Refuge, the phasing approach presented in the Mosquito Management Plan focuses on the implementation of a mosquito management program to protect human health. The plan presents four different mosquito scenarios for the Refuge, from a condition in which there are relatively low numbers of mosquito larvae present on the Refuge to a situation in which there are significant numbers of adult mosquitoes present on the Refuge during a declared public health emergency related to mosquito-borne disease. Each successive phase includes an expanded approach to addressing the threat to human health associated with specific mosquito conditions on the Refuge. The four phases are summarized below and presented in detailed in the Mosquito Management Plan.

> **Phase 1**. In Phase 1, mosquitoes are known to breed on the Refuge, but mosquito threshold treatment levels on the Refuge have not been exceeded during the current breeding season. Under these conditions, mosquito monitoring would be implemented throughout the breeding season.
>
> Consistent mosquito monitoring is necessary to establish baseline information regarding mosquito production and locations of mosquito breeding areas on the Refuge. On the Seal Beach NWR, monitoring is conducted annually during the breeding season by OCVCD to: 1) establish baseline data on species and abundance; 2) identify and map known mosquito breeding and/or harboring habitats; and 3) estimate relative changes in population sizes over time. Mosquito monitoring on the Refuge is to be conducted on foot and OCVCD

personnel are asked to access monitoring areas on foot and to the maximum extent possible confine activities to disturbed or sparsely vegetated areas in an effort to avoid impacts to sensitive habitat and minimize the potential for impacts to nesting birds, such as Belding's savannah sparrow. The SUP identifies those areas on the Refuge where access for mosquito management is permitted. Monitoring to determine the presence or abundance of mosquito larvae in these areas involves evaluating current site conditions, taking dip samples from areas of ponded water, and checking mosquito traps. To ensure that accurate and up-to-date information is available to the Refuge Manager, OCVCD provides monitoring results to the Refuge Manager on a weekly basis during the breeding season. The need for control is determined based on the results of dip sampling.

Annual meetings, involving the Refuge, NWSSB, and OCVCD, are held to assess the previous seasons monitoring and control efforts, if any. These meetings enable all participants to consider the need for adapting current management activities to better achieve the goal of effective mosquito management with minimal adverse effects to Refuge resources in subsequent years. The details of the monitoring program are described in the SUP, which includes conditions related to how and where access for mosquito monitoring can occur, scheduling of monitoring activities, reporting monitoring results, and when the implementation of control methods (discussed under Phase 2) would be considered appropriate. Over the past few years, mosquito management has only been permitted in six pre-approved locations on the Refuge (see Figure 1) and all access into these areas is limited to walking. Proposals by OCVCD to monitor and/or control other areas of the Refuge are reviewed by the Refuge Manager on a case by case basis, and if approved, such activities can only occur when the Refuge Manager or a representative designated by the Refuge Manager is present on the site to ensure the protection of listed species and sensitive habitat. In addition, all OCVCD personnel who will be present on the Refuge in a given year are required to meet with the Refuge Manager prior to the beginning of the mosquito monitoring season. At this meeting, OCVCD is provided with information on how to conduct mosquito monitoring in sensitive marsh habitat in a manner that will avoid disturbance to listed species and other wildlife and minimize trampling of marsh vegetation.

The Mosquito Management Plan for the Seal Beach NWR proposes an integrated approach to mosquito management, therefore all phases of this plan emphasize design, restoration/enhancement (refer to Chapter 3 of the CCP for details related to habitat restoration/enhancement), and management of wetlands in a manner that will benefit wildlife and minimize mosquito production. Refuge staff will confer with OCVCD during the development of wetland restoration and enhancement plans for the Refuge to ensure that the design addresses the need to minimize the creation of areas that could support mosquito breeding.

Phase 2. This phase addresses the need to control mosquito larvae on the Refuge. To implement Phase 2, mosquito breeding must be documented on the Refuge and the numbers of mosquito larvae present must exceed OCVCD's mosquito larvae threshold treatment levels. The criteria used by OCVCD (*2010*) to determine when treatment to control mosquito larvae should be considered are presented in Table 1.

Table 1 OCVCD Criteria for Considering Pesticide Application to Control Immature Mosquito Populations	
Mosquito Species	**Criteria for Considering Treatment**
Anopheles spp.	≥ 2 immatures/40 dips
Culex spp.	≥ 2 immatures/20 dips
Aedes spp.[1]	≥ 2 immatures/10 dips
Culiseta spp.	≥ 2 immatures/10 dips

Source: (*Orange County Vector Control District 2010*)

[1] *Aedes* is currently the only genus of mosquito known to breed on the Refuge.

In Phase 2, mosquito monitoring would be implemented throughout the breeding season, actions to reduce potential mosquito breeding habitat on the Refuge would be conducted per available funding, and the Refuge Manager may allow compatible mosquito larvae control when the numbers of immature mosquitoes present in an area exceed the threshold criteria presented in Table 1. In addition, mosquito monitoring on the Refuge would be expanded to include an evaluation of the effectiveness of the mosquito control measures being implemented to control mosquito larvae populations on the Refuge.

If threshold treatment levels for mosquito larvae are exceeded, OCVCD would request approval to apply specific larvicides on the Refuge. The pesticides to be applied must be approved through the PUPs process, listed in the SUP, considered in a Compatibility Determination, and evaluated as part of the NEPA and ESA Section 7 the compliance process. The following larvicides are currently approved for use on the Refuge: *Bacillus thuringiensis* var. *israelensis* (Bti), *Bacillus sphaericus* (Bs), and Altosid®. The use of these products is reviewed annually through the PUPs process. Bti and Bs, both naturally occurring soil bacteria, are used to control mosquitoes in wetlands prior to their emergence as adults. Recently, OCVCD requested that an additional larvicide, Natular™, be considered for use on the Refuge to control mosquito larvae. This larvicide has the active ingredient spinosad, a product of bacterial fermentation that attacks the nervous system of the mosquito larvae causing paralysis and death. The potential effects of these larvicides on Refuge resources are summarized in this Compatibility Determination under "Anticipated Impacts of the Use" and discussed in greater detail in Chapter 5 of the draft Seal Beach NWR CCP/Environmental Assessment (EA) (*USFWS 2011*).

Within one week of implementing any mosquito controls involving pesticide use on the Refuge, OCVCD is required to provide the Refuge Manager and the Navy Biologist with a report detailing the site number(s) treated, the date(s) of treatment, the mosquito species present at each treated site, mosquito abundance at each treated site, and the type and amount of pesticide applied at each treated site. All pesticide application must be conducted consistent with the Best Management Practices (BMPs) outlined in the Mosquito Management Plan.

Phase 3. In Phase 3, mosquitoes are known to breed on the Refuge; the numbers of mosquito larvae in the later instar stages and/or pupae present on the Refuge have exceeded established mosquito threshold treatment levels; and the species of mosquitoes

breeding on the Refuge pose an immediate threat to human health. The criteria for considering treatment of pupae are the same as those for larvae, as presented in Table 1, however, treatment would only be considered if the mosquitoes present were also considered a threat to human health. Based on these criteria, the actions that would occur under Phase 3 include: mosquito monitoring throughout the breeding season; actions to reduce potential mosquito breeding habitat on the Refuge per available funding; and treatment of mosquito larvae and pupae that is compatible with Refuge purposes.

Larvicides (e.g., Bti, Bs, methoprene) are only effective on mosquitoes during early instar stages (up to the fourth instar stage) and do not control pupae. If developing mosquitoes have reached the last instar stages or have pupated, then the application of site-specific pupacides in infested areas (determined through monitoring) would be considered. When the appropriate conditions are present to warrant the use of a pupacide, monomolecular biodegradable film (e.g., Agnique MMF) is currently the only pupacide that would be considered for use on the Refuge. Because pupacides can negatively affect all aquatic invertebrates that require surface air, this type of mosquito control treatment requires careful consideration. The potential effects of monomolecular biodegradable film on Refuge resources are summarized in this Compatibility Determination under "Anticipated Impacts of the Use" and discussed in greater detail in Chapter 5 of the draft Seal Beach NWR CCP/EA (*USFWS 2011*).

Phase 4. Phase 4 of the Mosquito Management Plan would include the use of an adulticide to control mosquito populations on the Refuge. The following conditions must be met before an adulticide can be applied on the Refuge:

- A public health emergency has been declared by the Orange County Health Care Agency (OCHCA) or the California Department of Public Health for an area that includes the Refuge;
- Infected mosquitoes have been identified on the Refuge or infected mosquitoes of the species known to breed on the Refuge have been identified within the published flight range of mosquito breeding areas on the Refuge;
- The criteria established in the OCVCD's Integrated Vector Management and Response Plan (*OCVCD 2010*) for determining when treatment of adult populations of mosquitoes should be considered has been exceeded on the Refuge for the mosquito species of concern;
- The FWS Integrated Pest Management Coordinator has approved the adulticide proposed for use through the PUPs review process; and
- The SUP issued to OCVCD has been modified by Refuge Manager to address adulticide application.
- OCVCD has coordinated with the Refuge Manager and Navy Environmental Office staff on how, when, and where an adulticide would be applied on the Refuge.

OCVCD is responsible for implementing a surveillance program to detect the presence of mosquito populations county-wide. The information gathered from this program is used by OCVCD and OCHCA to determine if and to what extent a health threat exits in the County. This surveillance program also collects data from the region to track mosquito-borne disease and the presences of pathogens in mosquito pool(s), wild birds, sentinel

chicken flock(s), horses, or humans. These conditions in combination with adult mosquito population sizes that exceed criteria established by OCVCD would be considered when determining if more aggressive mosquito treatment strategy, including the use of adulticides, is warranted. Currently, OCVCD maintains three carbon dioxide traps on or in the immediate vicinity of the Refuge. The data gathered from these traps provides information for the regional surveillance program, but also informs OCVCD of the current conditions on or near the Refuge. Table 2 presents OCVCD's criteria for when treatment of adult mosquitoes should be considered.

Table 2
OCVCD Criteria for Considering Adulticide Application

Mosquito Species	Criteria for Considering Treatment
Culex spp.	25 or more females per collection per trap night
Anopheles spp.	25 or more females per collection per trap night
Aedes spp.[1]	5 or more females per collection per trap night[2]
Culiseta spp.	10 or more females per collection per trap night
Multiple species	25 or more total female mosquitoes per collection per trap night

Source: (*Orange County Vector Control District 2010*)

[1] *Aedes* is currently the only genus of mosquito known to breed on the Refuge.

[2] The total number of trapped females is lower for Aedes spp. than other species of mosquitoes because Aedes spp. demonstrated a limited attraction to CO_2 traps. New types of traps are currently being considered by OCVCD to more accurately establish populations of Aedes spp. in Orange County (Jim Green pers. comm.).

Adulticides are pesticides used to kill adult mosquitoes. There are three general classes of adulticides: organophosphates, pyrethrins, and pyrethroids, and all tend to be much broader-spectrum insecticides than are larvicides and pupacides. If the appropriate conditions are present to warrant the use of an adulticide, products with the active ingredient sumithrin (e.g., AquaAnvil and Anvil 10 + 10 ULV) are currently the only adulticides that would be considered for use on the Refuge. The potential effects of these adulticides on Refuge resources are summarized in this Compatibility Determination under "Anticipated Impacts of the Use" and discussed in greater detail in Chapter 5 of the draft Seal Beach NWR CCP/EA (*USFWS 2011*).

Prior to considering the use of an adulticide on the Refuge, it should first be determined if increased intensity and frequency of larvicides or pupacides would be effective in reducing the abundance of mosquitoes present on the Refuge. Water quality and other environmental factors (e.g., water depth, vegetation) should be examined to determine if different formulations and treatment strategies of larvicides or pupacides could be more effective. If large numbers of pupae are present, increasing the use of pupacides in infested areas should be considered.

Because the efficacy and effects of adulticides are variable, conditions related to location and form of application would be included within an amended SUP. This would ensure that adult mosquitoes are effectively treated while minimizing non-target effects. If the criteria described above for allowing the use of an adulticide on the Refuge have been met, OCVCD

must request revisions to the SUP to include the use of an adulticide. This request shall include specific information regarding the adulticide proposed for use, the proposed treatment quantities and methods, and the locations where application is proposed to occur. Adulticides with the active ingredient sumithrin has been evaluated as part of this Compatibility Determination. Proposals for use of an adulticide not covered in this document would require evaluation in accordance with NEPA, Section 7 of the EAS, and Refuge policy. All pesticides proposed for use on the Refuge must be approved through the PUPs review process.

To reduce the potential for additional applications of adulticide within a season, all adulticide application shall occur in conjunction with the application of larvicides and pupacides. In addition, adulticides shall only be applied using vehicle mounted or backpack fitted ultra-low volume spray equipment. No aerial spraying over the Refuge would be permitted. In addition, to reduce the potential for impacts to the endangered California least tern and light-footed clapper rail, adulticide applications shall only occur on those roads that extend along the northern, eastern, and western perimeter of the Refuge and only when meteorological conditions are stable and favorable with a consistent wind greater than three miles per hour from the south or southwest. OCVCD shall also coordinate with the Refuge Manager and NWSSB in the monitoring and evaluation of the effectiveness of the treatment in eliminating the threat to human health.

Availability of Resources:
Adequate funding and staff exist to manage mosquito monitoring and control at the Seal Beach NWR provided the majority of this activity occurs within pre-approved locations on the Refuge. Direct costs to administer these activities are primarily in the form of staff time. Table 3 describes the level of involvement by Refuge staff that is currently required annually to manage and monitor mosquito monitoring and control on the Refuge (based on FY 2010 costs). If management were to advance to Phase 4, additional staff involvement would likely be required.

Table 3
Annual Staff Involvement in Managing Mosquito Monitoring and Control on the Refuge

Staff Responsibilities	Annual Administrative/Management Costs (approximate) and Time
Deputy Project Leader (GS 13) – Review research proposals	(0.02 FTE*)
Refuge Manager (GS 11) – Review and oversight of OCVCD activities; preparation of SUP; monitoring to ensure compatibility; report review	(0.02 FTE)
TOTAL COST AND FTE	(0.04 FTE)

*FTE (full time equivalent)

Anticipated Impacts of the Use:

Introduction

In our evaluation of potential impacts related to mosquito monitoring and control, we considered the discussion and direction provided in the Service's "Draft Mosquito and Mosquito-Borne Disease Management Policy" (Federal Register, Vol. 72, No. 198, 10/15/07). The proposed mosquito management policy of the National Wildlife Refuge System is described in this draft as allowing populations of native mosquito species to exist unimpeded unless they pose a specific wildlife and/or human health threat. According to the draft policy, pesticide treatments for mosquito population control on Refuge lands should only occur when local, current mosquito population monitoring data have been collected and indicate that refuge-based mosquito populations are contributing to a human or wildlife health threat. When these conditions are confirmed, management of mosquito populations on Refuge lands should employ effective means that pose the lowest risk to wildlife and habitats.

Our impact evaluation also took into account the direction provided in the Service's Biological Integrity, Diversity, and Environmental Health Policy (Service Manual Section 601 FW 3). This policy provides for the consideration and protection of the broad spectrum of fish, wildlife, and habitat resources found on Refuges. It also provides refuge managers with an evaluation process to analyze their refuge and recommend the best management direction to prevent further degradation of environmental conditions.

Overview of Impacts

Mosquito monitoring and control on the Seal Beach NWR has the potential to impact Refuge resources in a number of ways, including habitat degradation associated with required access into sensitive salt marsh habitat; wildlife disturbance, during monitoring and pesticide application; and direct and indirect impacts of pesticide use on mosquitoes and other Refuge species. Effective mosquito control results in the removal of a high percentage of one or more target species at least temporarily; however, there is the potential, depending upon the product being used, to adversely affect one or more non-target species. Any alteration of the ecological communities on the Refuge as a result of these activities could impact biological integrity and diversity through disruptions in food webs and other ecological functions.

Habitat Degradation/Wildlife Disturbance

Monitoring and control of mosquitoes requires OCVCD staff to enter sensitive salt marsh habitat areas to observe current site conditions; conduct dip samples in ponded water to identify the presence of mosquito larvae and/or pupae; examine traps for adult mosquitoes; and apply pesticides as needed. The result of this activity is some degree of vegetation trampling and soil compaction, which can impact habitat quality. Further, mosquito breeding season generally occurs at the same time as bird nesting season. As a result, access into vegetated areas can result in the inadvertent destruction of active bird nests and/or disturbance that causes nesting bird to temporarily abandon their nests making chicks or eggs vulnerable to predation. The Federally listed endangered light footed clapper rail and the state listed Belding's savannah sparrow, both of which nest on the Refuge, are particularly vulnerable to such disturbance since they nest on or near the ground.

To minimize the potential for disturbance and habitat degradation to the Federally endangered light-footed clapper rail, mosquito monitoring and control on the Seal Beach NWR is limited to six specific areas on the Refuge (see Figure 1). These areas, which have been identified by OCVCD as being mosquito problem areas, are generally unsuitable as nesting habitat for the light-footed clapper rail. For the most part, these areas are located around the perimeter of the salt marsh complex, and can only be accessed via foot traffic. Access into the main portion of the salt marsh complex requires prior approval by the Refuge Manager and any permitted access requires that Service personnel accompany OCVCD staff onto the site.

Direct and Indirect Effects of Pesticides Currently Approved for Use on the Refuge. The pesticides currently being used on the Refuge include Bti and methoprene. Bs has also been approved for use, but has not been used on the Refuge in several years. Both Bti and methoprene are widely used throughout the country to control mosquitoes, and are considered relatively safe in terms of non-target species; however, very few studies have been conducted to evaluate the long-term effects on non-target species, particularly short-lived aquatic insects and zooplankton.

Bti, which is applied in granular form on the Refuge, is specific to certain primitive dipterans (flies), particularly mosquitoes, black flies, and some chironomid midges. Bti is not known to be directly toxic to non-dipteran insects. The concentrations of Bti in water necessary to kill mosquito larvae vary with environmental conditions, but are generally 0.05-0.10 parts per million (ppm). The label recommended range of application rates under most conditions varies by a factor of 4 for most formulations (e.g., for granular formulations, 2.72-11.12 kg/ha (2.5-10 lb/acre)). For older larvae and water with a high organic content, higher application rates are recommended that may reach eight times the lowest rate (e.g., for granular formulations, the higher rate is 10-20 lb/acre). Mosquito control agencies use the recommended label rates, along with previous experience, to administer an effective dose. Efficacy is monitored by post-application reductions in mosquito larval density, but the actual concentration of Bti following an application is not measured. Thus, an insufficient concentration of Bti can be detected by low mortality of mosquito larvae, but an overdose (i.e., a concentration greater than necessary to kill mosquito larvae) of the pesticide will likely not be detected.

Bs, like Bti, a naturally occurring soil bacterium that can effectively kill mosquito larvae present in water. Bs is very effective in the control of mosquito larvae that occur in water rich in organic matter. It is effective against *Culex spp.* but is less effective against other mosquito species. Depending on the formulation and environmental conditions, Bs is generally effective from one to four weeks after application and there are very few environmental risks associated with its use. When used according to label rates, these products are not considered toxic to mammals, birds, fish, and most non-target invertebrates (insects and worms) (*Davis and Peterson 2008*). Indirect effects on the ecosystem as a result of multiple applications of these products have been documented in a few studies. These effects relate to disruptions in the invertebrate food web that can affect non-target wetland fauna (*Hershey et al. 1998, Poulin et al. 2010*).

Methoprene, which is occasionally used on the Refuge, is a synthetic mimic of a naturally produced insect hormone, juvenile hormone, which is active against a variety of insect species including horn flies, mosquitoes, beetles, tobacco moths, sciarid flies, fleas (eggs and larvae),

fire ants, pharaoh ants, midge flies, and Indian meal moths. When an insect is exposed to methoprene, a hormonal imbalance in the development of the insect results, and it fails to properly mature into an adult. The insect eventually dies in the pupal stage. The most susceptible stages of development to methoprene are the later instars (for mosquitoes, third and fourth instars). In mosquito control applications, methoprene is applied directly to the larval breeding habitat. Larvae will continue to feed and may reach the pupal stage, but they will not emerge as adults. Methoprene is completely ineffective on mosquito pupae and adults. It is available in several formulations: liquid, granular, pellet, and briquette. OCVCD uses Altosid briquets and pellets on the Seal Beach NWR.

Various studies have been conducted to determine the effects of methoprene on non-target species. Although results appear to vary, the general conclusion is that methoprene applied at levels recommended on the label are not likely to be toxic to non-target species. For example, methoprene was found to have an effect on copepods, crabs, and shrimp, although these effects were generally observed at concentrations higher than those of operational rates (*Bircher and Ruber 1988, Marten et al. 1993, Hershey et al. 1998*). According to the latest U.S. Environmental Protection Agency (USEPA) R.E.D. fact sheet for methoprene (*USEPA 2001*), data generated under laboratory and field conditions indicate that methoprene mosquito product formulations, including slow release briquette formulations, have a maximal rate of release of ≤ 4 parts per billion (ppb). The typical amount of methoprene necessary for mosquito control is < 1.0 ppb. The initial concentrations of methoprene when applied to aquatic habitats may reach 4 to 10 ppb, but residual concentrations are approximately 0.2 ppb (*Ross et al. 1994*). Most non-target organisms support margins of safety of >200 ppb, therefore, exposure to methoprene would not be expected to reach levels which are toxic to aquatic non-target species either after acute or chronic exposure. Once methoprene is released into the aquatic environment, it is non-persistent with a half-life of about 30-40 hours. Studies have been conducted that indicate the sensitivity of some species in the order Coleoptera to methoprene (*Marten et al. 1993*). This is of concern on the Refuge because at least two of the areas currently being treated for mosquitoes support one or more species of tiger beetles (in the order Coleoptera). A search of the existing literature did not find any studies that evaluated the effect of methoprene on tiger beetles; therefore, the risk of using this product in areas where these organisms occur is unknown.

There are a number of studies that have focused on the short and long term effects of pesticides, such as Bti and methoprene, on non-target species and long-term non-target species diversity. The general conclusion of these studies is that an integrated approach to mosquito control is necessary to avoid long term detrimental effects on the environment that appear to be occurring as a result of the continuous (year after year) application of these types of pesticides within a given area (*Hershey et al. 1998, Walker et al. 2005, Tilquin et al. 2008, Poulin et al. 2010*).

Direct and Indirect Effects of Pesticides Requested for Use on the Refuge

The OCVCD has requested that the pesticides Agnique®, Natular™, and Anvil™ (AquaAnvil and Anvil 10+10 ULV) be considered for use on the Refuge.

Agnique. As an invisible monomolecular biodegradable film (MMF) made from renewable plant oils, this product reduces surface tension on standing water. The presence of the film

makes it difficult for mosquito larvae and pupae to attach to the surface of the water and ultimate leads to drowning. Agnique®, which employs a physical, as opposed to toxic, mode of action to control mosquito and midge larvae and pupae, is persistent for up to 22 days and is effective on all species of mosquitoes and chronomid midges that breed in standing water. This product can be applied using a backpack sprayer. Higher doses are required in areas with multidirectional winds in excess of ten miles per hour.

The USEPA considers this product to be "practically nontoxic." Acute toxicological tests were conducted to determine the effects of up to a 100 fold excess of a monomolecular film on the various life stages of long-nose killifish, fiddler crab, snail, and other species, and no acute effects on any life stage of these species were observed. In addition, no adverse effects to saltwort or cordgrass were observed as a result of exposure over a four-week period. This product does have the potential to adversely affect non-target species such as marsh boatman (*Trichocorixa reticulate*) that live on the water surface or other aquatic insects that require periodic contact with the air-water interface to obtain oxygen. No information is currently available regarding potential effects to these types of non-target species.

Natular. This product includes the active ingredient spinosad, a product of bacterial fermentation. Spinosad, classified as a "reduced-risk" compound by the EPA, triggers continuous involuntary nervous stimulus in mosquito larvae that leads to paralysis and death. It has low impact on human health, low potential for groundwater contamination, low pest resistance potential, and is nonpersistent. It is a broad-spectrum pesticide but is only active if ingested or contacted while in liquid form. The label for Natular ™ states that this product is toxic to aquatic organisms and non-target aquatic invertebrates may be killed in waters where this pesticide is applied. Spinosad shows slight toxicity to birds and moderate toxicity to fish. The liquid form of spinosad is highly toxic to marine mollusks on an acute basis (*Material Safety Data Sheet May 2002*) and the EPA categorizes this product as highly toxic to bees, with topical acute activity of less than 1 microgram per bee. It also impacts species in the orders Lepidoptera and Coleoptera (*Thompson et al. no date*). Some spinosad products are used to kill fire ants, a soil dwelling species. The potential effect of spinosad-based products on native ants or other soil fauna is not known.

Anvil. The adulticides AquaAnvil™, a water-based formulation, and Anvil 10 +10 ULV, mineral oil-based formulation, both include the active ingredient sumithrin (a combination of phenothrin [a synthetic pyrethrin] and piperonyl butoxide). Phenothrin is a synthetic pyrethroid made to mimic the insecticidal properties of pyrethrins. It works upon physical contact with an insect or after ingestion as a nerve stimulant that affects the nerve channels of insects and ultimately leads to paralysis (*USEPA 2008*). These Anvil products also include piperonyl butoxide, a synergist, which increases the effectiveness of phenothrin. Both AquaAnvil and Anvil 10 + 10 ULV can be applied with all ultra-low volume (ULV) spray equipment, including non-thermal ULV portable backpack sprayers and suitable truck-mounted thermal fogging equipment.

The marine, estuarine, and terrestrial habitats on the Refuge are potentially at risk from spray drift and runoff following a ULV application of products containing sumithrin. The USEPA reports that there are currently no acceptable data available evaluating the

toxicity of phenothrin to algae or aquatic macrophytes; therefore, risks to aquatic plants from phenothrin exposure cannot be fully assessed, and remain an uncertainty (*USEPA 2008*). There are, however, no documented accounts of aquatic plant toxicity from phenothrin and because this compound acts as a neural toxin, phytotoxic effects are unlikely (*USEPA 2008*). The fact that phenothrin is applied at very low application rates and the Mosquito Management Plan does not allow the application of adulticides over the Refuge's coastal wetland habitat, no direct effects to aquatic plants from the application of phenothrin on the Refuge are anticipated.

USEPA (*2006*, *2008*) classifies piperonyl butoxide and phenothrin as practically non-toxic to avian species. The application of AquaAnvil and Anvil 10+10 ULV on the Refuge could however pose a threat to non-target species, such as birds, due to disturbance associated with the application of these products, and to a reduction in the prey upon which birds may forage that could result from pesticide drift.

The active ingredients in AquaAnvil™ and Anvil 10 +10 ULV are moderately toxic to estuarine and marine fish and highly toxic to estuarine invertebrates (*USEPA 2006*). The Material Safety Data Sheet (*August 2006*) for AquaAnvil™ states that this product is toxic to aquatic organisms, including fish and aquatic invertebrates, and according to the product label should not be applied to "bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body." The marine organisms supported in the Refuge's estuarine habitats would likely be adversely affected if this product is applied in a manner that would result in measurable drift of the product over sensitive wetland areas.

The Mosquito Management Plan (Appendix D) includes Best Management Practices (BMPs) that address proper handling and application of pesticides to minimize impacts to non-target species. These BMPs and specific recommendations related to where, when, and how approved adulticides could be applied on the Refuge would be incorporated in a SUP issued to the OCVCD, therefore, ensuring that the potential for adverse effects to non-target species and sensitive habitats would be minimized.

Effects to Endangered and Threatened Species. Human activity, such as that associated with mosquito monitoring and control, can have adverse impacts on endangered and threatened species, particularly when it disrupts bird nesting or foraging activities (*Carney and Sydeman 1999*). NASA Island supports nesting habitat for the Federally-listed endangered California least tern and the adjacent open water areas in the Refuge's marsh complex provide foraging habitat for the breeding terns and their young. The marsh complex also provides year-round foraging habitat, as well as nesting habitat, for the Federally-listed endangered light-footed clapper rail. To minimize disturbance to nesting and foraging terns and rails, mosquito monitoring and control is limited to specific locations on the Refuge (Figure 1) and within those locations, all activity must be conducted on foot. Specifics regarding where and how access can occur in and around the marsh is provided in detail in the SUP that is prepared annually for this use. No adverse effects to the listed species supported on the Refuge are anticipated as a result of continuing the current mosquito control practices on the Refuge, nor would any

adverse effects be anticipated as a result of adding Agnique to the list of mosquito control products permitted for use on the Refuge. Natular is described as having a slight toxicity to birds. Because it would be applied in areas where the light-footed clapper rail has the potential to forage, the direct effects of this product on this species are unknown.

If the use of AquaAnvil and Anvil 10+10 ULV is deemed necessary, its application would be restricted to those roads that extend along the northern, eastern, and western perimeter of the Refuge and only when meteorological conditions are stable and favorable with a consistent wind greater than three miles per hour from the south or southwest. These restrictions would minimize the potential for adulticide drift over the open water areas of the Refuge, avoiding any adverse effects to California least terns, east Pacific green turtles, or the prey on which these species forage.

Light-footed clapper rails and Belding's savannah sparrow could be affected by disturbance and possible insecticide drift as the habitats that support these species would be much closer to potential application sites. The adulticides that could be used on the Refuge would be applied as ultra-low volume sprays meant to target adult mosquitoes as they fly. Drift of the pesticide over the shallow tidal waters of the Refuge's marsh habitat could adversely affect estuarine invertebrates in these areas, resulting in a temporary decrease in the availability of prey species for birds including rails and sparrows, in some portions of the Refuge. The effects of pesticide drift and disturbance would be reduced through restrictions on when and where adulticides can be applied on the Refuge and strict adherence to all BMPs and label requirements.

Migratory and Resident Water-Dependent Birds. Mosquito monitoring and control activities may result in disturbance to a variety of bird species that utilize the Refuge's intertidal and subtidal habitats for nesting and/or foraging. Some level of disturbance (e.g., trampling of habitat, flushing a bird off an active nest) is expected with these activities, because access into portions of the marsh is necessary to monitor and implement appropriate mosquito control methods. However, actions such as prenesting season field orientation with OCVCD staff to discuss habitat sensitivity and precautions needed while walking through the salt marsh habitat and limiting the areas in which mosquito monitoring and control activities can occur, will help to minimize these potential impacts. To avoid harm to wildlife and habitats, access to traps and sampling stations will comply with the stipulations presented below and the conditions included in SUPs that are prepared annually for the OCVCD.

Direct effects to birds from the larvicides and pupacides proposed for use on the site are not anticipated as toxicity to birds from these products is generally considered slight to practically non-toxic. Indirect effects associated with these products include reducing mosquito populations and other non-target species that serve as the base of food chains for wildlife species. These effects are expected to be temporary and limited to the edges of the marsh. The potential for adverse effects to birds from the use of adulticides with the active ingredient sumithrin would be reduced through restrictions on when and where adulticides can be applied on the Refuge and strict adherence to all BMPs and label requirements.

Pesticide Toxicity and Other Effects to Non-target Organisms. For the most part, the areas on the Refuge where mosquito monitoring and control is permitted are located at the outer

edges of the marsh complex, minimizing the negative effects of mosquito monitoring and control to the majority of the Refuge. These areas do however provide habitat for a variety of species, including birds, invertebrates, and small mammals. As described above, Bti and Bs are not expected to impact mammals, birds, most invertebrates, and plants. There is however the potential for this products to kill midge larvae (family chironomidae). Chironomid (non-biting midge) larvae can be abundant in wetlands and provide a significant contribution to the food base of wildlife, including birds (*Batzer et al. 1993, Cooper and Anderson 1996, Cox et al. 1998*).

When applied as recommended on product labels, the presence of methoprene in the environment would not be expected to reach levels which are toxic to aquatic non-target species and methoprene is considered practically non-toxic to birds. Studies do however indicate the sensitivity of some species in the order Coleoptera to methoprene (*Marten et al. 1993*). No studies have been conducted to determine if this sensitivity includes species of the genus *Cicindela* (tiger beetles), therefore, the risk of using this product in areas that support these organisms is unknown. As a result, the use of this product in areas believed to support tiger beetle should only be permitted in association with mosquito control conducted when conditions are consistent with those described for Phase 4 of the Refuge mosquito management plan. Similar to Bti and Bs, there is a concern that the use of methoprene could impact the availability chironomid larvae and other non-target invertebrates that contribute to the food base for birds and other wildlife.

Agnique is considered to be "practically nontoxic." Studies show no effects on the various life stages of long-nose killifish, fiddler crab, snail, or plants, and this monomolecular film is not known to cause direct chronic or acute avian toxicological effects to birds. This product is potentially lethal to any aquatic insect that lives on the water surface or requires contact with the air-water interface. As a result, its use on the Refuge could have adverse indirect effects on the avian food base, but these effects are considered minimal.

Spinosads, such as Natular, are identified as toxic to aquatic organisms and the liquid form of spinosad is highly toxic to marine mollusks on an acute basis. Intertidal habitat extends almost to the edges of the Refuge; therefore, the use of this product even in the areas currently designated for mosquito control could adversely affect the marine organisms present in these estuarine habitats. Additionally, studies indicate that Natular is toxic to bees and can adversely affect species in the orders Lepidoptera and Coleoptera. One of the objectives of the Refuge habitat enhancement proposals is to improve native pollinator abundance and diversity on the Refuge. In addition, the Refuge supports several native salt marsh butterfly species. The effect of this product on these organisms is unknown.

As described above, adulticides with the active ingredients phenothrin and piperonyl butoxide are much broader-spectrum insecticides than the other pesticides considered for use on the Refuge to control mosquitoes. Therefore, the potential for impacts to non-target species including estuarine and marine fish and estuarine and terrestrial invertebrates would be higher should such products be used on the Refuge. Such effects would be reduced through restrictions on when, where, and how adulticides can be applied on the Refuge and through strict adherence to all BMPs and label requirements.

Public Review and Comment:
A Notice of Intent to prepare the CCP was published in the Federal Register on April 16, 2007 (72 FR 19016). At that time, written comments were solicited regarding management of the Refuge. Public scoping meetings were also held to solicit public comment. A CCP web page was established to provide the public with specific information regarding the CCP process and the comments provided during public scoping. Planning Updates have also been prepared to summarize the progress of the CCP and to discuss specific issues related to the planning process.

This draft Compatibility Determination is being made available for public review and comment as Appendix A of the Seal Beach NWR Draft Comprehensive Conservation Plan and Environmental Assessment (*USFWS 2011*).

Determination:

__Use is Not Compatible

X Use is Compatible with the Following Stipulations

Stipulations Necessary to Ensure Compatibility:

Integrated Pest Management

- Mosquito control techniques will stress the use of physical and biological control as much as practicable prior to the use of chemical control.
- Future restoration proposals will be designed to minimize the potential for ponding of tidal waters and areas currently subject to ponding will be targeted for restoration and/or enhancement to eliminate habitat favorable to mosquito production.

Coordination of Mosquito Management Activities

- OCVCD will coordinate all activities with the Refuge Manager.
- OCVCD will meet annually with Refuge and Navy Environmental Office staff to review the activities and results of the previous year and discuss the monitoring and possible control plans for the upcoming year.
- A Refuge SUP will be prepared annually for the OCVCD that will include all appropriate BMPs presented in the Mosquito Management Plan, as well as special conditions related to location, timing, extent of mosquito monitoring, and stipulations for carrying out all mosquito control under the guidance of the approved PUPs.
- Prior to each year's mosquito breeding season, OCVCD field staff will meet with Refuge Management and the Navy Environmental Office staff to go over field protocols for avoidance and minimization of take to any trust resources including migratory birds and listed species and their habitats.
- At the beginning of the mosquito breeding season, OCVCD will provide a firm schedule of seasonal activities to the Refuge Manager. If activities are proposed that differ from the schedule, OCVCD will call the Refuge Manager at least two business days prior accessing the Refuge.
- Motorized access into habitat areas will be prohibited; all access must be on foot.

- Access for mosquito monitoring and control will be limited to specific locations on the Refuge, as described in the annually issued SUP in order to avoid adverse effects to listed and other trust species and their habitats.
- Access into any areas other than those pre-approved in the annually issued SUP must be approved by the Refuge Manager, and the Refuge Manager or a representative designated by the Refuge Manager must be present while OCVCD staff is in the area to insure that no adults, nests, eggs, or young of listed species will be negatively affected by the monitoring or control activity.
- Within one week of any pesticide application, OCVCD will provide a written record to the Refuge Manager and Navy Biologist documenting the dates of mosquito sampling and treatment, the treatment site number, mosquito species present, abundance per species, and name and amount of product applied.
- OCVCD shall coordinate with the Refuge Manager and NWSSB in the monitoring and evaluation of the effectiveness of any adulticide treatment in eliminating the threat to human health.
- OCVCD will review the past year's pesticide proposals and submit any changes in the pesticides or formulations of pesticide that they expect to use in the upcoming year. This information should be made available at or before the time of the annual meeting.
- Mosquito monitoring and control on the Seal Beach NWR must comply with the description of use and activities and all conditions included in the ESA Section 7(a) (2) evaluation prepared to accompany the final CCP (*USFWS 2011*) for the Refuge.

<u>Pesticides Considered for Application on the Refuge</u>

- The use of the larvicides Bti, Bs, and Altosid will be permitted for use when OCVCD criteria for treatment are exceeded (refer to Table 1).
- Altosid can only be used in its solid form (e.g., briquets, pellets) and use of this product will be restricted in areas known or expected to support high numbers of tiger beetles.
- Natular will not be permitted for use on the Refuge due to potential adverse effects to nontarget species including marine and estuarine organisms and native pollinators.
- If larviciding actions are ineffective and late instar non-feeding larvae or pupae are present at densities that exceed OCVCD criteria for treatment and these density represent a public health threat to nearby human populations, then Agnique will be permitted for use on the Refuge.
- AquaAnvil and Anvil 10+10 ULV will be permitted for use on the Refuge only if the conditions identified under Phase 4 of the Mosquito Management Plan have been met and even when adulticide use is warranted, it will be used on a limited and site specific basis.
- Other formulations or compounds may also be approved for use on the Refuge in the future provided that: 1) there is adequate information to determine that no adverse effect to sensitive Refuge resources would occur; 2) the formulations has been approved through the PUPs review process; 3) the SUP is revised to include all BMPs and other measures necessary to ensure compatibility; and 4) compliance with the requirements of NEPA, Section 7 of the ESA, and Refuge policies has been met.

Pesticide Application on the Refuge

- OCVCD staff will apply all approved mosquito control products in accordance with approved PUPs and the product label. Where specific BMPs developed as part of the PUP approval are more restrictive than the label, the PUP requirements shall apply.
- OCVCD will be required to minimize the use of pesticides and continually investigate formulations and compounds that are least damaging to fish and wildlife populations.
- The BMPs included in the SUP shall be implemented at all times on the Refuge.
- The application of an approved adulticide shall occur in conjunction with concurrent applications of larvicides and pupacides in appropriate locations on the Refuge.
- Approved adulticides shall only be applied using vehicle mounted or backpack fitted ultra-low volume spray equipment. Aerial spraying over the Refuge is not permitted.
- All applications of adulticide shall take place from existing roads and under meteorological conditions that are stable and favorable with a consistent wind greater than three miles per hour from the south or southwest.
- Application of an adulticide shall only occur along the roads that extend along the northern, western, and eastern perimeter of the Refuge.

Justification:

Mosquitoes are a natural component of most wetland ecosystems; however, we also recognize they may represent a threat to human and/or wildlife health. Management of mosquito populations on the Refuge may therefore be permitted when mosquito populations pose a threat to the health and safety of the public or a wildlife population. The manner in which we manage mosquito populations on the Refuge must meet the Service's statutory obligations to protect the biological integrity of the Refuge while also meeting our policy obligations and our social obligation to protect the health and well-being of the human communities surrounding the Refuge. These obligations affect the decisions we make regarding when and how mosquito control can be implemented on the Refuge.

OCVCD has been monitoring and controlling mosquitoes on the Refuge and surrounding Naval Weapons Station for several decades. In the past, control was as much a response to complaints from surrounding residents as it was to reducing the threat of certain vector-borne diseases. Public complaints still drive some control effects, however, the association between mosquitoes and diseases have heighten the concern of vector control districts with respect to mosquito control. The result is increased pressure to actively manage mosquito populations on refuge lands, particularly those Refuges that are located in urban areas.

To more thoroughly address mosquito management on the Refuge, a Mosquito Management Plan for the Seal Beach NWR has been prepared that is consistent with the Service's draft Mosquito and Mosquito-Borne Disease Management Policy, published in Federal Register in October 2007. As proposed in the draft Policy, the Mosquito Management Plan provides guidance for when and how to monitor and control mosquitoes and mosquito-borne disease on the Seal Beach NWR. The Plan addresses the need for mosquito control management and documentation of management actions on the Refuge to protect listed plants, fish, and wildlife and to ensure the health and welfare of surrounding human populations. Adherence to the stipulations provided above will ensure that the proposed use is compatible and will not materially interfere with or detract from fulfilling the Refuge purposes and the Refuge System mission.

Mandatory Re-Evaluation Date:

_ Mandatory 15-year Re-Evaluation Date (for priority public uses)

X Mandatory 10-year Re-Evaluation Date (for all uses other than priority public uses)

NEPA Compliance for Refuge Use Decision:

_ Categorical Exclusion without Environmental Action Statement

_ Categorical Exclusion and Environmental Action Statement

X Environmental Assessment and Finding of No Significant Impact

_ Environmental Impact Statement and Record of Decision

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Refuge Determination:

Prepared by: _____ _____
(Signature) (Date)

Project Leader Approval: _____ _____
(Signature) (Date)

Concurrence:

Refuge Supervisor: _____ _____
(Signature) (Date)

Assistant Regional Director, Refuges: _____ _____
(Signature) (Date)

FINDING OF APPROPRIATENESS OF A REFUGE USE

Refuge Name: Seal Beach National Wildlife Refuge

Use: Mosquito Management

This form is not required for wildlife-dependent recreational uses, take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	✓	
(b) Does the use comply with applicable laws and regulations (Federal, State, tribal, and local)?	✓	
(c) Is the use consistent with applicable Executive orders and Department and Service policies?	✓	
(d) Is the use consistent with public safety?	✓	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	✓	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	✓	
(g) Is the use manageable within available budget and staff?	✓	
(h) Will this be manageable in the future within existing resources?	✓	
(i) Does the use contribute to the public's understanding and appreciation of the refuge's natural or cultural resources, or is the use beneficial to the refuge's natural or cultural resources?	✓	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D, 603 FW 1, for description), compatible, wildlife-dependent recreation into the future?	✓	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will **generally** not allow the use.

If indicated, the refuge manager has consulted with State fish and wildlife agencies. Yes ✓ No ___

When the refuge manager finds the use appropriate based on sound professional judgment, the refuge manager must justify the use in writing on an attached sheet and obtain the refuge supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate_____ **Appropriate** ✓

Refuge Manager:_____ Date:_____

If found to be **Not Appropriate**, the refuge supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found **Not Appropriate** outside the CCP process, the refuge supervisor must sign concurrence.

If found to be **Appropriate**, the refuge supervisor must sign concurrence.

Refuge Supervisor:_____ Date:_____

A compatibility determination is required before the use may be allowed.

FWS Form 3-2319
02/06

FINDING OF APPROPRIATENESS OF A REFUGE USE

Written Justification

Refuge Name: Seal Beach National Wildlife Refuge

Use: Mosquito Management

Justification for Determining that this Use is an Appropriate Use for the Refuge:

Mosquitoes are a natural component of most wetland ecosystems; however, we also recognize they may represent a threat to human and/or wildlife health. Management of mosquito populations on the Seal Beach NWR is considered appropriate when mosquito populations pose a threat to the health and safety of the public or a wildlife population.

The Orange County Vector Control District has been monitoring and controlling mosquitoes on the Refuge and surrounding Naval Weapons Station Seal Beach (NWSSB) for several decades. In the past, this control was as much a response to complaints from surrounding residents and personnel on NWSSB as it was to reducing the threat of certain vector-borne diseases. Public complaints still drive some control effects, however, the association between mosquitoes and diseases have heighten the concern of OCVCD with respect to mosquito control.

To more thoroughly address mosquito management on the Refuge, a Mosquito Management Plan for the Seal Beach NWR has been prepared that is consistent with the Service's draft Mosquito and Mosquito-Borne Disease Management Policy, published in Federal Register in October 2007. As proposed in the draft Policy, the Mosquito Management Plan provides guidance for when and how to monitor and control mosquitoes and mosquito-borne disease on the Seal Beach NWR. The Plan addresses the need for mosquito control management and documentation of management actions on the Refuge to protect listed plants, fish, and wildlife and to ensure the health and welfare of surrounding human populations. Adherence to the phasing requirements of the plan, as well as the implementation of Best Management Practices and detailed protection measures related to coordination, communication, access, and reporting will ensure that the implementation of mosquito monitoring and control on the Refuge will not materially interfere with or detract from fulfilling the Refuge purposes and the Refuge System mission.

Based on the guidance provided in the Mosquito Management Plan for implementing mosquito monitoring and control on the Seal Beach NWR, in my professional judgment this use is an appropriate use on the Refuge.

Refuge Manager:_____ Date:_____

Refuge Supervisor:_____ Date:_____

Appendix B:

List of Preparers, Planning Team Members, and Persons/Agencies Consulted

Appendix B - List of Preparers, Planning Team Members, and Persons/Agencies Consulted

Document Preparation

U.S. Fish and Wildlife Service Preparers:

Victoria Aires Touchstone	Refuge Planner/Principal Writer/Planning Team Coordinator
Kirk Gilligan	Refuge Manager/Writer/Reviewer
Slader Buck	Deputy Project Leader/Reviewer
Tony McKinney	GIS Coordinator/Graphics
Randy Nagel	GIS Technician/Graphics
Pek Pum	GIS Technician/Graphics
Lou Ann Speulda-Drews	Regional Historian/Historical Archaeologist/Cultural Resource Review

Consultant:

Leon Kolankiewicz	Mangi Environmental Group/Writer/Editor
Mark Blevins	Mangi Environmental Group/Graphics
Carmen Zepeda-Herman	RECON/Cultural Resource Review
David Cannon	Everest International Consultants, Inc./Hydrology
Seamus Innes	Everest International Consultants, Inc./Hydrology

CCP Planning Team

Andrew Yuen	USFWS, Project Leader
Slader Buck	USFWS, Deputy Project Leader
Kirk Gilligan	USFWS, Refuge Manager
Victoria Touchstone	USFWS, Refuge Planner
Jack Fancher	USFWS, Coastal Program (since retired)
Mark Pelz	USFWS, Region 8 Refuge Planning Chief
David Baillie	NWSSB, Installation Environmental Program Manager
Bob Schallmann	NWSSB, Conservation Program Manager

Persons/Agencies Consulted

Marco Buske	USFWS, Region 8 IPM Coordinator
Brian Collins	USFWS, Refuge Wildlife Biologist
Patricia Roberson	USFWS, Region 8 NEPA Coordinator
Erinn Wilson	California Department of Fish and Game
Kelly O'Reilly	California Department of Fish and Game
Robert Hoffman	NOAA, National Marine Fisheries Service
Eric Chavez	NOAA, National Marine Fisheries Service
Jim Green	Orange County Vector Control District
Dr. Bruno Pernet	Department of Biological Sciences, California State University, Long Beach
Erica Cunningham	Tierra Data

Naval Weapons Station Seal Beach
City of Seal Beach, Planning Department
County of Orange, Planning
Tim Anderson
Charlie Collins
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Appendix C:

Draft Integrated Pest Management Plan for the Seal Beach National Wildlife Refuge

Draft Integrated Pest Management Plan
for the
Seal Beach National Wildlife Refuge

(March 2011)

Prepared by: _____ Date: _____
Victoria Touchstone
Refuge Planner

Concurrence: _____ Date: _____
Regional Integrated Pest
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1.0 Introduction

This document explains the concept of integrated pest management (IPM) and its application to the Seal Beach National Wildlife Refuge (Refuge or NWR). It provides guidance for controlling or managing pests on the Refuge in a manner that will provide the most benefit to Refuge trust species and their habitats. IPM is also addressed in the objectives and strategies developed for the Seal Beach NWR in the Refuge's Comprehensive Conservation Plan (CCP).

In August 2010, the U.S. Fish and Wildlife Service (Service) approved an IPM policy for pest management activities on and off Service lands. This IPM policy (Part 569, FW1 of the Service Manual), which is consistent with the Department of the Interior (Department) IPM policy (517 DM 1) and other applicable authorities, establishes procedures and responsibilities for pest management activities, adopts IPM as the Service's method for making pest management decisions; and provides guidance to employees on how to implement IPM for all pest management activities. Although the IPM policy does not require each Refuge to prepare a separate IPM plan, it does encourage a Refuge with employees engaging in pest management practices to include a separate pest management plan or incorporate IPM strategies into other resource planning documents, such as a CCP. Further, preparation of an IPM plan benefits Refuge operations because it provides the opportunity for the Refuge to receive multi-year approvals of certain proposed pesticide uses that would normally require regional or national level review.

IPM is an interdisciplinary approach utilizing methods to prevent, eliminate, contain, and/or control pest species in concert with other management activities on refuge lands and waters to achieve wildlife and habitat management goals and objectives. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. Examples of tools listed in the IPM definition include, but are not limited to:

- Biological tools (e.g., predators, parasites, and pathogens);
- Cultural tools (e.g., crop rotation, alterations in planting dates, and sanitation);
- Physical tools (e.g., barriers, traps, hand-pulling, hoeing, mowing, and tilling); and
- Chemical tools (e.g., pesticides, such as herbicides, insecticides, or fungicides).

IPM is also a scientifically based, adaptive management process where available scientific information and best professional judgment of the Refuge staff, as well as other resource experts, is used to identify and implement appropriate management strategies that can be modified and/or changed over time to ensure effective, site-specific management of pest species to achieve desired outcomes. In accordance with 43 CFR 46.145, adaptive management is particularly relevant where long-term impacts may be uncertain and future monitoring will be needed to make adjustments in subsequent implementation decisions. After a tolerable pest population (threshold) is determined considering achievement of refuge resource objectives and the ecology of pest species, one or more methods, or combinations thereof, will be selected that are feasible, efficacious, and most protective of non-target resources, including native species (e.g., fish, wildlife, and plants), and Service personnel, Service authorized agents, volunteers, and the public. Staff time and available funding will be considered when determining feasibility/practicality of various treatments.

IPM techniques to address pests are presented as CCP strategies (Section 6.2 of the CCP for the Seal Beach NWR) in an adaptive management context to achieve refuge objectives. In order to satisfy requirements for IPM planning as identified in the Director's Memo (dated September 9, 2004) entitled *Integrated Pest Management Plans and Pesticide Use Proposals: Updates,*

Guidance, and an Online Database, the following elements of an IPM program have been incorporated into this CCP:

- Habitat and/or wildlife objectives that identify pest species and appropriate thresholds to indicate the need for and successful implementation of IPM techniques; and

- Monitoring before and/or after treatment to assess progress toward achieving objectives including pest thresholds.

Where pesticides would be necessary to address pests, this Appendix provides a structured procedure to evaluate potential effects of proposed uses involving ground-based applications to refuge biological resources and environmental quality in accordance with effects analyses presented in Chapter 5 (Environmental Consequences) of the CCP/EA. The pesticide uses that will be allowed for use within the National Wildlife Refuge System (NWRS), including the Seal Beach NWR, are those that are likely to only cause minor, temporary, or localized effects to Refuge biological resources and environmental quality. Pesticide use on the Refuge will also include the implementation of appropriate best management practices (BMPs) to further minimize or avoid adverse effects.

This Appendix does not describe the more detailed process to evaluate potential effects associated with aerial applications of pesticides, as they are not permitted on the Seal Beach NWR. Moreover, it does not address the effects of pesticide use (i.e., larvicide, pupacide, adulticide applications) to control mosquitoes. However, the basic framework to assess potential effects to Refuge biological resources and environmental quality from the use of insecticides for mosquito management would be similar to the process described in this Appendix for other pesticides.

2.0 Pest Management Laws and Policies

In accordance with Service Policy 569 FW 1 (Integrated Pest Management), plant, invertebrate, and vertebrate pests on units of the National Wildlife Refuge System can be controlled to assure balanced wildlife and fish populations in support of refuge-specific wildlife and habitat management objectives. Pest control on federal (refuge) lands and waters is also authorized under the following legal mandates:

- National Wildlife Refuge System Administration Act of 1966, as amended (16 USC 668dd-668ee);
- Plant Protection Act of 2000 (7 USC 7701 *et seq*.);
- Noxious Weed Control and Eradication Act of 2004 (7 USC 7781-7786, Subtitle E);
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996 (7 USC 136-136y);
- National Invasive Species Act of 1996 (16 USC 4701);
- Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 USC 4701);
- Food Quality Protection Act of 1996 (7 USC 136);
- Executive Order 13148, Section 601(a);
- Executive Order 13112; and
- Animal Damage Control Act of 1931 (7 USC 426-426c, 46 Stat. 1468).

Pests are defined as "…living organisms that may interfere with the site-specific purposes, operations, or management objectives or that jeopardize human health or safety" from Department Policy 517 DM 1 (Integrated Pest Management Policy). Similarly, 569 FW 1 defines

pests as "…invasive plants and introduced or native organisms, that may interfere with achieving our management goals and objectives on or off our lands, or that jeopardize human health or safety." 517 DM 1 also defines an invasive species as "a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health." Throughout the remainder of this document, the terms pest and invasive species are used interchangeably because both can prevent/impede achievement of refuge wildlife and habitat objectives and/or degrade environmental quality.

In general, control of pests on the Seal Beach NWR would conserve and protect the fish, wildlife, and plant resources on the Refuge, as well as maintain environmental quality. The IPM Policy states that animal or plant species, which are considered pests, may be managed if the following criteria are met:

- The pest is causing a threat to human health and well being or private property, the acceptable level of damage by the pest has been exceeded, or State or local government has designated the pest as noxious;
- The pest is detrimental to resource objectives as specified in a refuge resource management plan (e.g., CCP, habitat management plan); and
- The planned pest management actions will not interfere with attainment of resource objectives or the purposes for which a refuge was established.

The specific justifications for pest management activities on the Seal Beach NWR include:

- Protecting human health and safety;
- Preventing substantial damage to important refuge resources;
- Protecting newly introduced or re-establish native species;
- Controlling non-native (exotic) species in order to support existence for populations of native species; and
- Providing the public with quality, compatible wildlife-dependent recreational opportunities.

Service Policy 620 FW 1 (Habitat Management Plans) provides additional management directives regarding invasive species found on refuge lands and waters. Specifically, the Service is "prohibited by Executive Order, law, and policy from authorizing, funding, or carrying out actions that are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere." The Habitat Management Plan Policy requires that we: "Manage invasive species to improve or stabilize biotic communities to minimize unacceptable change to ecosystem structure and function and prevent new and expanded infestations of invasive species," and to conduct "refuge habitat management activities to prevent, control, or eradicate invasive species..."

Animal species identified as damaging or destroying federal property and/or considered detrimental to the management program of a refuge may be controlled as described in 50 CFR 31.14 (Official Animal Control Operations) and generally do not require a pesticide use proposal. For example, the trapping and/or shooting of crows that prey on California least tern eggs or chicks may be conducted without a pest control proposal. Additionally, ground squirrels, whose burrowing activities in the Refuge's dikes and levees can affect the integrity of these structures, can be controlled, if necessary, using the most effective techniques considering site-specific factors without a pest control proposal.

Trespass and feral animals also may be controlled on refuge lands. Based upon 50 CFR 28.43 (Destruction of Dogs and Cats), dogs and cats running at large on a national wildlife refuge and observed in the act of killing, injuring, harassing or molesting humans or wildlife may be disposed of in the interest of public safety and protection of the wildlife. Feral animals should be disposed by the most humane method(s) available and in accordance with relevant Service directives (including Executive Order 11643). Disposed wildlife specimens may be donated or loaned to public institutions. Donation or loans of resident wildlife species will only be made after securing State approval (50 CFR 30.11 [Donation and Loan of Wildlife Specimens]).

3.0 Strategies

To fully embrace IPM as identified in 569 FW 1, the following strategies, where applicable, would be carefully considered on the Seal Beach NWR for each pest species:

Prevention

Prevention is the most effective and least expensive long-term management option for pests. It encompasses methods to prevent new introductions or the spread of established pests to un-infested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Hazard Analysis and Critical Control Points (HACCP) planning can be used to determine if current management activities on a refuge may introduce and/or spread invasive species in order to identify appropriate BMPs for prevention. See http://www.haccp-nrm.org/ for more information about HACCP planning.

Prevention may include source reduction, using pathogen-free or weed-free seeds or fill; exclusion methods (e.g., barriers) and/or sanitation methods (e.g., wash stations) to prevent introductions by various mechanisms including Service vehicles, construction equipment, or boats. Because invasive species are frequently the first to establish newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations. Prevention would require consideration of the scale and scope of land management activities that may promote pest establishment within un-infested areas or promote reproduction and spread of existing populations. Along with preventing initial introduction, prevention would involve halting the spread of existing infestations to new sites (*Mullin et al. 2000*). The primary reason for prevention is to keep pest-free lands or waters from becoming infested. Executive Order 11312 emphasizes the priority for prevention with respect to managing pests.

The following methods will be implemented, as appropriate, to prevent the introduction and/or spread of pests on the Seal Beach NWR:

- Before beginning ground-disturbing activities (e.g., disking, grading), inventory and prioritize pest infestations in project operating areas and along access routes. Refuge staff will identify pest species on site and/or in areas adjacent to the work site. Where possible, project activities will begin in un-infested areas before working in pest-infested areas.
- Refuge staff will attempt to locate and, to the extent possible, use pest-free project staging areas. Travel through pest-infested areas will be avoided or minimized, and where this is not possible, travel will be restricted to those periods when spread of seed or propagules of invasive plants is least likely.

- Refuge staff will determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned of pests. Where possible, refuge staff will clean equipment before entering lands at on-refuge approved cleaning site(s). This practice does not pertain to vehicles traveling frequently in and out of the project area that will remain on roadways. Seeds and plant parts of pest plants will need to be collected, where practical. Refuge staff will remove mud, dirt, and plant parts from project equipment before moving it into a project area.
- Refuge staff will clean all equipment, before leaving the project site, if operating in areas infested with pests, and determine the need for, and when appropriate, identify sanitation sites where equipment can be cleaned.
- Refuge staff, authorized agents, and refuge volunteers will, where possible, inspect, remove, and properly dispose of seed and parts of invasive plants found on their clothing and equipment. Proper disposal means bagging the seeds and plant parts and then properly discarding of them.
- Refuge staff will revegetate disturbed soil (except travel ways on surfaced projects) to optimize plant establishment for each specific site. Revegetation may include weed free topsoil replacement, planting, seeding, and weed-free mulching as necessary. Refuge staff will use native species appropriate to the specific site. If needed, refuge staff will use certified weed-free or weed-seed-free hay or straw where certified materials are reasonably available.
- Refuge staff will provide information, training, and appropriate pest identification materials to refuge staff, permit holders, and recreational visitors. The refuge staff will educate them about pest identification, biology, impacts, and effective prevention measures.
- Refuge staff will inspect borrow material for invasive plants prior to use and transport onto and/or within refuge lands.
- Refuge staff will restrict off road travel to designated routes to the maximum extent practicable.
- Refuge staff will coordinate with the Navy to ensure that all projects located within or adjacent to the Refuge utilize sediment that is free of invasive plant seed.

The following methods will be implemented, as appropriate, to prevent the introduction and/or spread of pests within the tidal and intertidal habitats that dominate this Refuge:

- Before allowing contact with Refuge waters, all boats, downriggers, anchors, nets, floors of boats, propellers, axles, trailers, and other boating equipment used by Refuge staff, volunteers, or researchers working in Refuge waters will be inspected for the presence of pests and all visible plants, animals, or mud present on the equipment will be removed.
- Where construction equipment is to be used in wetland areas, Refuge staff will inspect and clean equipment, if necessary, before allowing the equipment to enter the wetland.

These prevention methods to minimize/eliminate the introduction and/or spread of pests were developed from information provided in Appendix E of "Preventing and Managing Invasive Plants Final Environmental Impact Statement" (*U.S. Forest Service 2005*).

Mechanical/Physical Methods

Mechanical and physical methods will be used as appropriate to remove and destroy, disrupt the growth of, or interfere with the reproduction of pest species. For plants species, these treatments can be accomplished by hand, hand tool (manual), or power tools (mechanical) and can include pulling, grubbing, digging, tilling/disking, cutting, swathing, grinding, sheering, girdling, mowing, or mulching of the pest plants.

For animal species, Service employees or their authorized agents may use mechanical/physical methods (including trapping) to control pests as a refuge management activity. As described in the CCP, the Seal Beach NWR has an approved predator management plan that permits trapping to control species that prey on nesting endangered birds, including California least terns and light-footed clapper rails. Trapping is permitted on Refuges in accordance with 50 CFR 31.2, which allows trapping to reduce surplus wildlife populations for a "balanced conservation program" in accordance with federal or state laws and regulations. In some cases, non-lethally trapped animals would be relocated to off-refuge sites with prior approval from the California Department of Fish and Game.

Depending upon the circumstances, each of these methods provides variable degrees of success and is generally applicable to a specific situation. If timed correctly, mechanical controls can effectively suppress most annual and biennial pest plants. To control perennial plants, the root system has to be destroyed or it will resprout and continue to grow and develop. Mechanical controls are typically not capable of destroying a perennial plants root system. Although some mechanical tools (e.g., disking, plowing) may damage root systems, they may stimulate regrowth producing a denser plant population that may aid in the spread of the plant depending upon the target species (e.g., giant cane [*Arundo donax*], perennial pepperweed [*Lepidium latifolium*]). In addition, proximity to salt marsh habitat and existing soil conditions are factors that can limit the use of many mechanical control methods.

Combining mechanical control methods (e.g., mowing, stump cutting) with the use of herbicides can be a very effective technique for controlling perennial species. For example, cutting perennial plants followed sequentially by treating the cut stump with a systemic herbicide often improves the efficacy of the herbicide compared to herbicide treatment only. The combination of mechanical and herbicide control will be used from time to time on the Refuge to control invasive plants such as Brazilian peppertree (*Schinus terebinthifolius*), Peruvian peppertree (*Schinus molle*), tree tobacco (*Nicotiana glauca*), and tree-of-heaven (*Ailanthus altissima*).

Cultural Methods

Cultural methods involve manipulating habitat to increase pest mortality by reducing its suitability to the pest. Cultural methods could include water-level manipulation, mulching, moisture management, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to out-compete invasive plants, and other habitat alterations. On the NASA Island least tern nesting site, various cultural methods have been used in an effort to reduce the invasive of the nesting area by weedy species. These include the addition of salt to some areas of the site to make the soils unsuitable for plant growth and the placement of additional sand on areas prone to supporting weedy species to minimize exposure of soils suitable for weed establishment.

Biological Control Agents

Classical biological control involves the deliberate introduction and management of natural enemies (e.g., parasites, predators, or pathogens) to reduce pest populations. The Service strongly supports the development, and legal and responsible use of appropriate, safe, and effective biological control agents for nuisance and non-indigenous or pest species. To date, the intentional use of biological control agents has not been implemented on the Seal Beach NWR, but it is an option that could be employed in the future for species such as Russian thistle (*Salsola tragus*).

Many of the most ecologically or economically damaging pest species in the United States originated in foreign countries. These newly introduced pests, which are free from natural enemies found in their country or region of origin, may have a competitive advantage over cultivated and native species. This competitive advantage often allows introduced species to flourish, potentially causing widespread economic damage to crops, or to out compete and displace native vegetation. Once the introduced pest species population reaches a certain level, traditional methods of pest management may be cost prohibitive or impractical. It is typically when a pest populations has become so widespread that eradication or effective control would be difficult or no longer practical that biological controls are implemented.

Biological control has advantages as well as disadvantages. Benefits include reducing pesticide usage, host specificity for target pests, long-term self-perpetuating control, low cost/acre, capacity for searching and locating hosts, synchronizing biological control agents to hosts' life cycles, and the unlikelihood that hosts will develop resistance to agents. Disadvantages include limited availability of agents from their native lands, the dependence of control on target species density, slow rate at which control occurs, biotype matching, the difficulty and expense of conflicts over control of the target pest, and host specificity when host populations are low.

A reduction in target species populations from biological controls is typically a slow process, and efficacy can be highly variable. It may not work well in a particular area although it does work well in other areas. Biological control agents would require specific environmental conditions to survive over time. Some of these conditions are understood; whereas, others are only partially or not at all understood.

The use of biological control agents would not eradicate a target pest, rather when using biological control agents, residual levels of the target pest typically are expected. The agent population level or survival would be dependent upon the density of its host. After the pest population decreases, the population of the biological control agent would decrease correspondingly. This is a natural cycle. Some pest populations (e.g., invasive plants) would tend to persist for several years after a biological control agent becomes established due to seed reserves in the soil, inefficiencies in the agents search behavior, and the natural lag in population buildup of the agent.

The full range of pest groups potentially found on refuge lands and waters would include diseases, invertebrates (e.g., insects, mollusks), vertebrates, and invasive plants (the most common group). Often it is assumed that biological control would address many if not most of these pest problems. There are several well-documented success stories of biological control of invasive weed species in the Pacific Northwest including Mediterranean sage, St. Johnswort (Klamath weed) and tansy ragwort. Emerging success stories include Dalmatian toadflax, diffuse knapweed, leafy spurge, purple loosestrife, and yellow star thistle. However,

historically, each new introduction of a biological control agent in the United States has only about a 30% success rate (*Coombs et al. 2004*).

Before a natural enemy of an invasive species can be released in the United States for biological control, the potential agent must undergo rigorous testing to ensure that it will not harm other organisms. If a biological control agent is proposed for release on the Refuge, Refuge staff will ensure that the particular agent has been approved by the applicable authorities.

Except for a small number of formulated biological control products registered by U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide and Rodenticide Act of 1996 (FIFRA), most biological control agents are regulated by the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service, Plant Protection and Quarantine unit (APHIS-PPQ). APHIS-PPQ review includes independent analysis by the Technical Advisory Group for Biological Control Agents of Weeds (TAG), an independent voluntary committee, that is responsible for reviewing release petitions and providing an exchange of views, information and advice to researchers. In addition, the State of California has additional approval authority. The statuary authority of the State program is provided in the State's Food and Agricultural Code. Section 403 of the Code states that the Department of Food and Agriculture "shall prevent the introduction and spread of injurious insect or animal pests, plant diseases, and noxious weeds;" and Section 405(a) states that "with the prior approval of the Department of Fish and Game and the Office of Environmental Health Hazard Assessment, the Department of Food and Agriculture and the Department of Pesticide Regulation may reproduce or distribute biological control organisms that are not detrimental to the public health and safety which are known to be useful in reducing or preventing plant or animal damage due to pests or diseases." The Orange County Agricultural Commissioner may have additional approval authority; therefore, contact will be made with the Agricultural Commissioner prior to implementing any proposal to release a biological control agent on the Refuge.

Federal permits (USDA-APHIS-PPQ Form 526) are required to import biological control agents from another state. Form 526 may be obtained by writing: USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, Maryland 20737; or through the internet at URL address: http://www.aphis.usda.gov/ppq/permits/biological/weedbio.html.

The State of California Department of Food and Agriculture and the Orange County Agricultural Commissioner may also be sources for biological control agents or they may have information about where biological control agents may be obtained. Commercial sources should have an Application and Permit to Move Live Plant Pests and Noxious Weeds (USDA-PPQ Form 226 USDA-APHIS-PPQ, Biological Assessment and Taxonomic Support, 4700 River Road, Unit 113, Riverdale, MD 20737) to release specific biological control agents in a state and/or county. Furthermore, certification regarding the biological control agent's identity (genus, specific epithet, sub-species and variety) and purity (e.g., parasite free, pathogen free, and biotic and abiotic contaminants) should be specified in purchase orders. Biological control agents are subject to 7 RM 8 (Exotic Species Introduction and Management). In addition, Refuge staff must follow the International Code of Best Practice for Classical Biological Control of Weeds (http://sric.ucdavis.edu/exotic/exotic.htm) as ratified

by delegates to the X International Symposium on Biological Control of Weeds, Bozeman, Montana, July 9, 1999. This code states the following:

- Release only approved biological control agents;
- Use the most effective agents;
- Document releases; and
- Monitor for impacts to the target pest, non-target species, and the environment.

Biological control agents formulated as pesticide products and registered by the USEPA (e.g., *Bti*) are also subject to PUP review and approval (see below).

A record of any releases will be maintained by the Refuge staff with date(s), location(s), and environmental conditions of the release site(s); the identity, quantity, and condition of the biological control agents released; and other relevant data and comments such as weather conditions. Systematic monitoring to determine the establishment and effectiveness of the release is also recommended.

Prior to using any biological control agents, the Service would prepare a National Environmental Policy Act (NEPA) document (e.g., environmental assessment, environmental impact statement) that addresses the potential biological and other environmental effects of using the proposed biological control agent. The Service would also review, and where appropriate, incorporate by reference information included in NEPA documents prepared by another federal agency, where the scope is relevant to evaluation of releases on refuge lands. Possible source agencies for such NEPA documents include the Bureau of Land Management, U.S. Forest Service, National Park Service, U.S. Department of Agriculture Animal and Plant Health Inspection Service, and the military services. It might be appropriate to incorporate by reference parts or all of existing document(s) from the review. Incorporating by reference (43 CFR 46.135) is a technique used to avoid redundancies in analysis. It also can reduce the bulk of a Service NEPA document, which only must identify the documents that are incorporated by reference. In addition, relevant portions must be summarized in the Service NEPA document to the extent necessary to provide the decision maker and public with an understanding of relevance of the referenced material to the current analysis.

Pesticides

The selective use of pesticides on the Refuge will be based upon pest ecology (including mode of reproduction), the size and distribution of its populations, site-specific conditions (e.g., soils, topography), known efficacy under similar site conditions, and the capability to utilize BMPs to reduce and/or eliminate potential effects to non-target species, sensitive habitats, and the potential to contaminate surface and groundwater. All pesticide usage, including the type of product used, target species, application rate, and method of application, will comply with the applicable federal (FIFRA) and state regulations pertaining to pesticide use, safety, storage, disposal, and reporting. Before pesticides can be used to eradicate, control, or contain pests on refuge lands and waters, pesticide use proposals (PUPs) must be prepared and approved in accordance with section 569 FW 1 of the Service Manual. PUP records will provide a detailed, time-, site-, and target-specific description of the proposed use of pesticides on the Refuge. All PUPs will be created, approved or disapproved, and stored in the Pesticide Use Proposal System (PUPS), which is a centralized database only accessible on the Service's intranet (https://systems.fws.gov/pups). Only Service employees would be authorized to access PUP records in this database. As of 2010, the pesticides approved for the use on the Refuge include

the herbicides Aquamaster®, Glyphosate Pro™ 4, Surflan® A S, and Habitat®. Aquamaster and Glyphosate Pro 4 contain the active ingredient glyphoste; Surflan A S contains the active ingredient oryzalin, and Habitat contains the active ingredient isopropylamine salt of imazapyr. More information about these products can be found in the Chemical Profiles provided in Attachment B, and information about how these products are used on the Refuge can be found in Chapter 3 of the Comprehensive Conservation Plan.

Pesticide application equipment is selected to provide site-specific delivery to target pests while minimizing or eliminating direct or indirect (e.g., drift) exposure to non-target areas and degradation of surface and groundwater quality. Where possible, target-specific equipment (e.g., backpack sprayer, wiper) will be used to treat target pests. Other target-specific equipment to apply pesticides could include use of a hand wand attached to an ATV sprayer, soaked wicks or paint brushes for wiping vegetation and lances, hatchets, or syringes for direct injection into stems. If used, granular pesticides would be applied using seeders or other specialized dispensers. No aerial spraying (e.g., fixed wing or helicopter) is proposed on this Refuge.

Because repeated use of one pesticide may allow resistant organisms to survive and reproduce, multiple pesticides with variable modes of action will be considered for treatments on refuge lands and waters. This is especially important if multiple applications within years and/or over a growing season are necessary for habitat maintenance and restoration activities to achieve resource objectives. Integrated chemical and non-chemical controls also are highly effective, where practical, because pesticide resistant organisms can be removed from the site.

Cost may not be the primary factor in selecting a pesticide for use on a refuge. If the least expensive pesticide could result in harm to natural resources or people, then a different product will be selected. The most efficacious pesticide available with the least potential to degrade environment quality (e.g., soils, surface water, and groundwater), as well as the least potential effect to native species and communities of fish, wildlife, plants, and their habitats would be acceptable for use on the Refuge in the context of an IPM approach.

Habitat Restoration and/or Maintenance

Restoration and/or proper maintenance of refuge habitats associated with achieving wildlife and habitat objectives is the most important step that can be taken to ensure the long-term prevention, eradication, or control (at or below threshold levels) of pests. Promoting desirable plant communities through the manipulation of species composition, plant density, and growth rate is an essential component of invasive plant management (*Masters et al. 1996, Masters and Shelly 2001, Brooks et al. 2004*). Although herbicide treatment may eliminate or suppress pest species in the short term, the resulting gaps and bare soil create niches that are conducive to further invasion by the species and/or other invasive plants. On degraded sites where desirable species are absent or in low abundance, revegetation with site-appropriate native plant species is necessary to direct and accelerate plant community recovery, and achieve site-specific objectives in a reasonable time frame. The selection of appropriate species for revegetation would be dependent on a number of factors including resource objectives and site-specific, abiotic factors (e.g., soil texture, precipitation/ temperature regimes, and shade conditions). Seed or plant availability and cost, ease of establishment, seed production, and competitive ability are also important considerations.

The CCP for the Seal Beach NWR includes objectives and associated strategies for managing existing habitats to maximize habitat quality. The strategies proposed for implementation to achieve this objective include: monitoring and maintaining native plant restoration areas near Hog Island, along Kitts Highway and Bolsa Avenue, and to the north of Case Street Pond to ensure that these areas are not reinvaded with invasive non-native plants; and revegetate with appropriate native plant species those areas of the Refuge where chemical or mechanical control of invasive plant species has occurred to reduce the potential for reinvasive of the treated sites. Additionally, the CCP includes objectives for restoring native wetland and upland habitat in upland areas that are currently dominated by non-native weedy species. The implementation of these various strategies will reduce the numbers of plant pests on the Refuge, as well as reduce the need for continued chemical and mechanical control of infested sites.

4.0 Priorities for Treatments

For many refuges, the magnitude (number, distribution, and sizes of infestations) of pest problems is too extensive and beyond the available capital resources to effectively address during any single field season. To manage pests on the Seal Beach NWR, it is essential that treatment of infestations be prioritized. Highest priority treatments would be focused on early detection and rapid response to eliminate infestations of new pests, if possible. This is especially important for aggressive pests potentially impacting species, species groups, communities, and/or habitats of species associated with refuge purpose(s); NWRS resources of concern (e.g., federally listed species, migratory birds, and selected marine mammals); and native species needed to maintain and/or restore biological integrity, diversity, and environmental health on the Refuge.

The next priority would be treating established pests that appear in one or more previously un-infested areas. Moody and Mack (*1988*) demonstrated through modeling that small, new outbreaks of invasive plants eventually would infest an area larger than the established, source population. They also found that control efforts focusing on the large, main infestation rather than the new, small satellites reduced the chances of overall success. The lowest priority would be treating large infestations (sometimes monotypic stands) of well established pests. In this case, initial efforts would focus on containment of the perimeter followed by work to control/eradicate the established infested area. If containment or control of a large infestation is not effective, then efforts would focus on halting pest reproduction or managing source populations. Maxwell et al. (*2009*) found treating fewer populations that are sources represents an effective long-term strategy for reducing the total number of invasive populations and decreasing meta population growth rates.

Although state listed noxious weeds are always of high priority for management, other pest species known to cause substantial ecological impact will also be considered. Pest control would likely require a multi-year commitment from Refuge staff. Essential to the long-term success of pest management would be pre- and post-treatment monitoring, assessment of the successes and failures of treatments, and the development of new approaches when proposed methods do not achieve desired outcomes.

5.0 Best Management Practices (BMPs)

BMPs can minimize or eliminate possible effects associated with pesticide usage to non-target species and/or sensitive habitats, as well as degradation of water quality from drift, surface runoff, or leaching. Based upon the Department of Interior Pesticide Use Policy (517 DM 1) and the

Service Pest Management Policy and Responsibilities (30 AM 12), the use of applicable BMPs (where feasible) during the application of pesticides will minimize the potential for adverse effects to federally listed species and/or their critical habitats.

Presented below are the BMPs pertaining to the mixing, handling, and application of all ground-based treatments of pesticide that will considered and utilized, as appropriate, based upon target- and site-specific factors and time-specific environmental conditions on the Seal Beach NWR. Although not listed below, the most important BMP to eliminate and/or reduce potential impacts to non-target resources would be an IPM approach to prevent, control, eradicate, and contain pests.

Pesticide Handling and Mixing

- As a precaution against spilling, spray tanks will not be left unattended during filling.
- All pesticide spray equipment will be properly cleaned. Where possible, rinsate will be used as part of the makeup water in the sprayer tank and applied to treatment areas.
- All pesticide containers will be triple rinsed and the rinsate will be used as water in the sprayer tank and applied to treatment areas.
- When a pesticide container is marked as recyclable, Refuge staff will deliver the triple rinsed pesticide containers to the appropriate herbicide container collection site.
- All unused pesticides will be properly discarded at a local "safe send" collection.
- Pesticides and pesticide containers will be lawfully stored, handled, and disposed of in accordance with the label and in a manner that will safeguard human, fish, and wildlife health and prevent soil and water contaminant.
- Refuge staff will consider the water quality parameters (e.g., pH, hardness) that are important to ensure the greatest efficacy, when specified on the pesticide label.
- All pesticide spills will be addressed immediately using procedures identified in the Refuge's spill response plan.

Applying Pesticides

- Pesticide treatments will only be conducted by or under the supervision of Service personnel and non-Service applicators with the appropriate, state or BLM certification to safely and effectively conduct these activities on refuge lands and waters.
- Refuge staff will comply with all federal, state, and local pesticide use laws and regulations, as well as Departmental, Service, and NWRS pesticide-related policies. For example, Refuge staff will use application equipment and apply rates for the specific pest(s) identified on the pesticide label as required under FIFRA.
- Before each treatment season and prior to mixing or applying any product for the first time each season, all applicators will review the product label, Material Safety Data Sheet (MSDS), and PUP for each pesticide, determining the target pest, appropriate mix rate(s), personal protective equipment (PPE), and other requirements listed on the pesticide label.
- A one-foot no-spray buffer from the water's edge will be used, where applicable, and when it does not detrimentally influence effective control of pest species.
- Refuge staff will use low impact herbicide application techniques (e.g., spot treatment, cut stump, oil basal, Thinvert system applications) rather than broadcast foliar applications (e.g., boom sprayer, other larger tank wand applications), where practical.
- Refuge staff will use low volume rather than high volume foliar applications when the low impact methods described above are not feasible or practical, to maximize herbicide effectiveness and ensure correct and uniform application rates.

- Applicators will use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators will use the largest droplet size that results in uniform coverage.
- Applicators will use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying will occur during low (average<7mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <85 °F).
- Where possible, applicators will avoid spraying during inversion conditions (often associated with calm and very low wind conditions) that can cause large-scale herbicide drift to non-target areas.
- Equipment will be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- Spray applications will be made at the lowest height for uniform coverage of target pests to minimize or eliminate potential drift.
- If windy conditions frequently occur during afternoons, spraying (especially boom treatments) will typically be conducted during early morning hours.
- Spray applications will not be conducted on days with >30% forecast for rain within six hours, except for pesticides that are rapidly rain fast (e.g., glyphosate in 1 hour) or pesticides that need rain to activate the product (e.g., oryzalin) so as to minimize or eliminate potential runoff.
- Where possible, applicators will use drift retardant adjuvants during spray applications, especially adjacent to sensitive areas.
- Where possible, applicators will use a non-toxic dye to aid in identifying treated target areas, as well as any areas of over spray or drift. A dye can also aid in detecting equipment leaks. If a leak is discovered, the application will be stopped until repairs can be made to the sprayer.
- When drift cannot be sufficiently reduced through altering equipment set up and application techniques, buffer zones may be identified to protect sensitive areas downwind of applications. When an application is required adjacent to a sensitive habitat area, it will only occur when the wind is blowing away from the habitat area.
- To eliminate unnecessary pesticide applications, Refuge staff will examine the target area for the presence of expected pests prior to applying a pesticide product.
- Refuge staff will consider the timing of a pesticide application to ensure that native plants are protected (e.g., senescence) while effectively treating invasive plants.
- Application equipment (e.g., backpack sprayer, transport vehicles) will be thoroughly cleaned and PPEs removed and properly disposed of on-site after treatments.

6.0 Safety

6.1 Personal Protective Equipment (PPE)

All applicators will wear the specific PPE identified on the pesticide label and the appropriate PPE will be worn at all times during handling, mixing, and applying of the pesticide. PPEs can include disposable (e.g., Tyvek) or laundered coveralls, gloves (e.g., latex, rubber, or nitrile), rubber boots, eye protective wear, and/or an NIOSH-approved respirator. Because exposure to concentrated product is usually greatest during mixing, extra care will be taken while preparing pesticide solutions. Persons mixing these solutions can be best protected if they wear long gloves, an apron, appropriate footwear, and a face shield.

Coveralls and other protective clothing used during an application will be laundered separately from other laundry items. Transporting, storing, handling, mixing and disposing of pesticide containers will be consistent with label requirements, USEPA and OSHA requirements, and Service policy.

If a respirator is necessary for a pesticide use, the respirator will be used in accordance with the Service's Respiratory Protection policy (242 FW 14). Use of respirator in accordance with this policy requires that there be a written, site-specific respiratory protection plan for each work area where employees are required to wear respirators, a sufficiently trained Respiratory Protection Program Administrator to conduct and coordinate the respiratory protection plan at each facility requiring it, the availability of appropriate respirators and accessories for those who must wear them, and a clean storage area for respirators and their accessories at the work site. Respirators will only be issued to individuals who complete a Request for Respirator Clearance, pass a medical evaluation documenting that the individual is medically qualified for respirator use, complete the required respirator training, and successfully pass respirator fit testing. Respirators must be fit tested at least once a year. The policy also includes specific requirements for maintaining, cleaning, inspecting, and storing Service respirators.

6.2 Notification

The restricted entry interval (REI) is the time period required after the application at which point someone may safely enter a treated area without PPE. Refuge staff, authorized management agents of the Service, volunteers, and members of the public who could be in or near a pesticide treated area within the stated re-entry time period on the label will be notified about treatment areas. Posting will occur at any site where individuals might inadvertently become exposed to a pesticide during other activities on the refuge. Where required by the label and/or state-specific regulations, sites will also be posted on its perimeter and at other likely locations of entry. Refuge staff will also notify appropriate Navy personnel of an application.

6.3 Medical Surveillance

Medical surveillance may be required for Service personnel and approved volunteers who mix, apply, and/or monitor the use of pesticides (see 242 FW 7 [Pesticide Users] and 242 FW 4 [Medical Surveillance]). In accordance with 242 FW 7.12A, Service personnel will be medically monitored if one or more of the following criteria is met: exposed or may be exposed to concentrations at or above the published permissible exposure limits or threshold limit values (see 242 FW 4); use pesticides in a manner considered "frequent pesticide use;" or use pesticides in a manner that requires a respirator (see 242 FW 14 for respirator use requirements). In 242 FW7.7A, "Frequent Pesticide Use means when a person applying pesticide handles, mixes, or applies pesticides, with a Health Hazard rating of 3 or higher, for 8 or more hours in any week or 16 or more hours in any 30-day period." Under some circumstances, individuals may be medically monitored who use pesticides infrequently (see section 7.7), experience an acute exposure (sudden, short term), or use pesticides with a health hazard ranking of 1 or 2. This decision will consider the individual's health and fitness level, the pesticide's specific health risks, and the potential risks from other pesticide-related activities. Other authorized agents (e.g., state and county employees) will be responsible for their own medical monitoring needs and costs. Standard examinations (at the Refuge's expense) of appropriate Refuge staff will be provided by the nearest certified occupational health and safety physician as determined by Federal Occupational Health.

6.4 Certification and Supervision of Pesticide Applicators

Appropriate Refuge staff or approved volunteers handling, mixing, and/or applying or directly supervising others engaged in pesticide use activities will be trained and state or federally (BLM) licensed to apply pesticides on the Seal Beach NWR. In accordance with 242 FW7.18A and 569 FW 1.10B, certification is required to apply restricted use pesticides based upon USEPA regulations. For safety reasons, all individuals participating in pest management activities with general use pesticides also are encouraged to attend appropriate training or acquire pesticide applicator certification. A Qualified Applicator Certificate, as required by the State of California, will be obtained by any person on the Refuge who applies or supervises the application of federally restricted use pesticides or state restricted materials. New staff unfamiliar with proper procedures for storing, mixing, handling, applying, and disposing of pesticides and containers will receive orientation and training before handling or using any products. Documentation of training will be kept in the files at the Refuge office.

6.5 Recordkeeping

Labels and Material Safety Data Sheets (MSDS)

Approved PUPs stored in the PUPS database typically contain website links (URLs) to pesticide labels and MSDSs. Pesticide labels and MSDSs for all products approved for use on the Seal Beach NWR are maintained in a binder adjacent to the hazardous material and pesticide storage cabinets. These documents are also be carried by field applicators, where possible. A written reference (e.g., note pad, chalk board, dry erase board) for each tank to be mixed will also be kept in the mixing area for quick reference while mixing is in progress.

Pesticide Use Proposals (PUPs)

A PUP is prepared for each proposed pesticide use associated with annual pest management on refuge lands and waters. A PUP includes specific information about the proposed pesticide use including the common and chemical names of the pesticide(s), target pest species, size and location of treatment site(s), application rate(s) and method(s), and federally listed species determinations, where applicable.

In accordance with Service guidelines (Director's memo [December 12, 2007]), Refuge staff may receive up to 5-year approvals for Washington Office and field reviewed proposed pesticide uses based upon meeting identified criteria including an approved IPM plan, where necessary (see http://www.fws.gov/contaminants/Issues/IPM.cfm). This IPM plan for the Seal Beach NWR has been completed in association with a CCP and the environmental effects of implementing the plan, as required by NEPA, are addressed in Chapter 5 of the draft CCP/EA (*USFWS 2011*).

Pesticide Usage. In accordance with 569 FW 1, the Refuge Project Leader is required to maintain records of all pesticides annually applied on lands or waters under refuge jurisdiction. This would encompass pesticides applied by other federal agencies, state and county governments, non-government applicators including cooperators and their pest management service providers with Service permission. For clarification, pesticide means all insecticides, insect and plant growth regulators, dessicants, herbicides, fungicides, rodenticides, acaricides, nematicides, fumigants, avicides, and piscicides.

The following usage information is reported for approved PUPs in the PUPS database: pesticide trade name(s), active ingredient(s), total acres treated, total amount of pesticides used (lbs or gallons), total amount of active ingredient(s) used (lbs), target pest(s), and

efficacy (% control). To determine whether treatments are efficacious (i.e., eradicating, controlling, or containing the target pest) and achieving resource objectives, habitat and/or wildlife response is monitored both pre- and post-treatment, where possible. Considering available annual funding and staffing, appropriate monitoring data regarding characteristics (attributes) of pest infestations (e.g., area, perimeter, degree of infestation-density, % cover, density), as well as habitat and/or wildlife response to treatments may be collected and stored in a relational database (e.g., Refuge Habitat Management Database), preferably a geo-referenced data management system (e.g., Refuge Lands GIS [RLGIS]) to facilitate data analyses and subsequent reporting. In accordance with adaptive management, data analysis and interpretation would allow treatments to be modified or changed over time, as necessary, to achieve resource objectives considering site-specific conditions in conjunction with habitat and/or wildlife responses. Monitoring could also identify short- and long-term impacts to natural resources and environmental quality associated with IPM treatments in accordance with adaptive management principles identified in 43 CFR 46.145.

7.0 Evaluating Pesticide Use Proposals

Pesticides will only be used on the Seal Beach NWR for habitat management and facilities maintenance after approval of a PUP. Approval of a PUP generally is issued where there would likely be only minor, temporary, or localized effects to fish and wildlife species, minimal potential to degrade environmental quality, and pesticide application is proposed to be implemented with appropriate BMPs (see Section 4.0). Potential effects to listed and non-listed species are evaluated with quantitative ecological risk assessments and other screening measures. Potential effects to environmental quality are determined based upon pesticide characteristics of environmental fate (e.g., water solubility, soil mobility, soil persistence, and volatilization) and other quantitative screening tools. Ecological risk assessments, characteristics of environmental fate, and potential to degrade environmental quality are all documented in Chemical Profiles (see Section 7.5). These profiles are to include threshold values for quantitative measures of ecological risk assessments and screening tools for environmental fate that represent minimal potential effects to species and environmental quality.

7.1 Overview of Ecological Risk Assessment

An ecological risk assessment process would be used to evaluate potential adverse effects to biological resources as a result of a pesticide(s) proposed for use on the Refuge. This process is an established quantitative and qualitative methodology for comparing and prioritizing risks of pesticides and conveying an estimate of the potential risk for an adverse effect. This quantitative methodology provides an efficient mechanism to integrate best available scientific information regarding hazard, patterns of use (exposure), and dose-response relationships in a manner that is useful for ecological risk decision-making. It provides an effective way to evaluate potential effects where there is missing or unavailable scientific information (data gaps) to address reasonable, foreseeable adverse effects in the field as required under 40 CFR Part 1502.22. Protocols for ecological risk assessment of pesticide uses on refuge lands and waters were developed through research and established by the USEPA (*2004*). Assumptions for these risk assessments are presented in Section 6.2.3.

The toxicological data used in ecological risk assessments are typically results of standardized laboratory studies provided by pesticide registrants to the USEPA to meet regulatory requirements under FIFRA. These studies assess the acute (lethality) and chronic (reproductive)

effects associated with short- and long-term exposure to pesticides on representative species of birds, mammals, freshwater fish, aquatic invertebrates, and terrestrial and aquatic plants. Other effects data publicly available would also be utilized for risk assessment protocols. Toxicity endpoint and environmental fate data are available from a variety of resources. Some of the more useful resources can be found in Section 7.5.

7.2 Determining Ecological Risk to Fish and Wildlife

The potential for pesticides used on the Seal Beach NWR to cause direct adverse effects to fish and wildlife would be evaluated using USEPA's Ecological Risk Assessment Process (*USEPA 2004*). The risks poses to the trust resources protected on the Seal Beach NWR are particularly important because the Refuge provides nesting and foraging habitat for several listed species including the endangered California least tern (*Sternula antillarum browni*), light-footed clapper rail (*Rallus longirostris levipes*), and Pacific green sea turtle (*Chelonia myda*).

The Ecological Risk Assessment Process, which is based upon a two-phase process involving estimation of environmental concentrations and then characterization of risk, integrates exposure estimates (estimated environmental concentration [EEC] and toxicological endpoints [e.g., LC_{50} and oral LD_{50}]) to evaluate the potential for adverse effects to species groups (birds, mammals, and fish) representative of legal mandates for managing units of the NWRS. This integration is achieved through risk quotients (RQs) calculated by dividing the EEC by acute and chronic toxicity values selected from standardized toxicological endpoints or published effect (Table 1).

$$RQ = EEC/Toxicological\ Endpoint$$

Table 1
Ecotoxicity Tests Used to Evaluate Potential Effects to Birds, Fish, and Mammals to Establish Toxicity Endpoints for Risk Quotient Calculations

Species Group	Exposure	Measurement Endpoint
Bird	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[1]
Fish	Acute	Median Lethal Concentration (LC_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[2]
Mammal	Acute	Oral Lethal Dose (LD_{50})
	Chronic	No Observed Effect Concentration (NOEC) or No Observed Adverse Effect Concentration (NOAEC)[3]

[1]Measurement endpoints typically include a variety of reproductive parameters (e.g., number of eggs, number of offspring, eggshell thickness, and number of cracked eggs).

[2]Measurement endpoints for early life stage/life cycle typically include embryo hatch rates, time to hatch, growth, and time to swim-up.

[3]Measurement endpoints include maternal toxicity, teratogenic effects or developmental anomalies, evidence of mutagenicity or genotoxicity, and interference with cellular mechanisms such as DNA synthesis and DNA repair.

The level of risk associated with direct effects of pesticide use are characterized by comparing calculated RQs to the appropriate Level of Concern (LOC) established by USEPA (*1998* [Table 2]). The LOC represents a quantitative threshold value for screening potential adverse effects to fish

and wildlife resources associated with pesticide use. The following are four exposure-species group scenarios that would be used to characterize ecological risk to fish and wildlife on a NWR: acute listed species, acute non-listed species, chronic listed species, and chronic non-listed species.

Acute risk indicates the potential for mortality associated with short-term dietary exposure to pesticides immediately after an application. For characterization of acute risks, median values from LC_{50} and LD_{50} tests are used as toxicological endpoints for RQ calculations. In contrast, chronic risks indicate the potential for adverse effects associated with long-term dietary exposure to pesticides from a single application or multiple applications over time (within a season and over years). For characterization of chronic risks, the no observed concentration (NOAEC) or no observed effect concentration (NOEC) for reproduction are used as toxicological endpoints for RQ calculations. Where available, the NOAEC is preferred over a NOEC value.

Listed species are those federally designated as threatened, endangered, or proposed in accordance with the Endangered Species Act of 1973 (16 USC 1531-1544, 87 Stat. 884, as amended-Public Law 93-205). For listed species, potential adverse effects are assessed at the individual level because loss of individuals from a population could detrimentally impact a species. In contrast, risks to non-listed species are considered effects at the population level. A RQ<LOC indicates the proposed pesticide use "may affect, not likely to adversely affect" individuals (listed species) and it would not pose an unacceptable risk for adverse effects to populations (non-listed species) for each taxonomic group (Table 2). In contrast, a RQ>LOC indicates a "may affect, likely to adversely affect" for listed species and it would also pose unacceptable ecological risk for adverse effects to non-listed species.

Table 2
Presumption of Unacceptable Risk for Birds, Fish, and Mammals

Risk Presumption		Level of Concern	
		Listed Species	Non-listed Species
Acute	Birds	0.1	0.5
	Fish	0.05	0.5
	Mammals	0.1	0.5
Chronic	Birds	1.0	1.0
	Fish	1.0	1.0
	Mammals	1.0	1.0

Source: (*USEPA 1998*)

Environmental Exposure

Following release into the environment through application, pesticides experience several different routes of environmental fate. Pesticides that are sprayed can move through the air (e.g., particle or vapor drift) and may eventually end up in other parts of the environment such as non-target vegetation, soil, or water. Pesticides applied directly to the soil may be washed off the soil into nearby bodies of surface water (e.g., surface runoff) or may percolate through the soil to lower soil layers and groundwater (e.g., leaching) (*Baker and Miller 1999, Pope et. al. 1999, Butler et. al. 1998, Ramsay et. al. 1995, EXTOXNET 1993a*). Pesticides that are injected into the soil may also be subject to the latter two fates. The aforementioned possibilities are by no means complete, but it does indicate that movement of pesticides in the environment is very complex with transfers occurring continually among different environmental compartments. In some cases, these

exchanges occur not only between areas that are close together, but may also involve transportation of pesticides over long distances (*Barry 2004, Woods 2004*).

Terrestrial Exposure. The EEC for exposure to terrestrial wildlife is quantified using a USEPA screening-level approach (*USEPA 2004*). This screening-level approach is not affected by product formulation, because it evaluates pesticide active ingredient(s). This approach would vary depending upon the proposed pesticide and method of application to be used.

For spray applications, exposure is determined by using the Kanaga nomogram method (*Pfleeger et al. 1996, USEPA 2004, USEPA 2005a*) through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3 (*USEPA 2005b*). To estimate the maximum (initial) pesticide residue on short grass (<20 cm tall) as a general food item category for terrestrial vertebrate species, T-REX input variables include the following from the pesticide label: maximum pesticide application rate (pounds active ingredient [acid equivalent]/acre) and pesticide half-life (days) in soil. Although there are other food item categories (tall grasses; broadleaf plants and small insects; and fruits, pods, seeds and large insects), short grass was selected because it would yield maximum EECs (240 ppm per lb ai/acre) for worse-case risk assessments. Short grass is not representative of forage for carnivorous species (e.g., raptors), but it would characterize the maximum potential exposure through the diet of avian and mammalian prey items. Consequently, this approach provides a conservative screening tool for pesticides that do not biomagnify.

For RQ calculations in T-REX, the model requires the weight of surrogate species and Mineau scaling factors (*Mineau et al. 1996*). Body weights of bobwhite quail and mallard are included in T-REX by default, but body weights of other organisms (Table 3) can be entered manually. The Mineau scaling factor accounts for small-bodied bird species that may be more sensitive to pesticide exposure than would be predicted only by body weight. Mineau scaling factors are entered manually with values, which are unique to a particular pesticide or group of pesticides, ranging from 1 to 1.55. If specific information to select a scaling factor is not available, then a value of 1.15 is used as a default. Alternatively, zero is entered if it is known that body weight does not influence toxicity of the pesticide(s) being assessed. The upper bound estimate output from the T-REX Kanaga nomogram is used as an EEC for calculation of RQs. This approach yields a conservative estimate of ecological risk.

Granular pesticide formulations and pesticide-treated seed pose a unique route of exposure for avian and mammalian species. In these cases, the pesticide is applied in discrete units that birds or mammals might accidentally ingest with food items or intentionally ingest when actively seeking and picking up seed to eat or gravel or grit to aid digestion. Granules may also be consumed by wildlife foraging on earthworms, slugs, or other soft-bodied soil organisms to which the granules may adhere.

Terrestrial wildlife RQs for granular formulations or seed treatments are calculated by dividing the maximum milligrams of active ingredient (ai) exposed (e.g., EEC) on the surface of an area equal to one square foot by the appropriate LD_{50} value multiplied by the surrogate's body weight (refer to Table 3). An adjustment to surface area calculations is made for broadcast, banded, and in-furrow applications. An adjustment

is also made for applications with and without incorporation of the granules. Without incorporation, assumes that 100% of the granules remain on the soil surface available to foraging birds and mammals. Press wheels push granules flat with the soil surface, but they are not incorporated into the soil. If granules are incorporated in the soil during band or T-band applications or after broadcast applications, it is assumed that only 15% of the applied granules remain available to wildlife. Following in-furrow applications, it is assumed that only 1% of the granules are available on the soil surface.

Table 3
Average Body Weight of Selected Terrestrial Wildlife Species Frequently Used in Research to Establish Toxicological Endpoints

Species	Body Weight (kg)
Mammal (15 g)	0.015
House sparrow	0.0277
Mammal (35 g)	0.035
Starling	0.0823
Red-winged blackbird	0.0526
Common grackle	0.114
Japanese quail	0.178
Bobwhite quail	0.178
Rat	0.200
Rock dove (aka pigeon)	0.542
Mammal (1000 g)	1.000
Mallard	1.082
Ring-necked pheasant	1.135

Source: (*Dunning 1984*)

EECs for pesticides applied in granular form and as seed treatments are calculated based on potential ingestion rates of avian or mammalian species (e.g., 10-30% body weight/day). This provides an estimate of maximum exposure that may occur as a result of granule or seed treatment spills, which commonly occur at end rows during application and planting. The availability of granules and seed treatments to terrestrial vertebrates is also considered by calculating the loading per unit area (LD_{50}/ft^2) for comparison to USEPA LOCs (*USEPA 1998*). The T-REX version 1.2.3 (*USEPA 2005b*) contains a submodel which automates Kanaga exposure calculations for granular pesticides and treated seed.

The following formulas are used to calculate EECs depending upon the type of granular pesticide application:

For in-furrow applications, assume a typical value of 1% granules, bait, or seed remain unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}580\ mg/lbs)(1\%\ exposed))] / \{[(43{,}560\ ft.^2/acre)/(row\ spacing\ (ft.))] / (row\ spacing\ (ft.)\}$$

or

$$mg\ a.i./ft^2 = [(lbs\ product/1000\ ft.\ row)(\%\ a.i.)(1000\ ft\ row)(453{,}580\ mg/lb.)(1\%\ exposed)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

For incorporated banded treatments, assume that 15% of granules, bait, seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/1000\ row\ ft.)(\%\ a.i.)(453{,}580\ mg/lb.)(1\text{-}\%\ incorporated)] / (1{,}000\ ft.)(band\ width\ (ft.))$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

For broadcast treatment without incorporation, assume 100% of granules, bait, seeds are unincorporated.

$$mg\ a.i./ft.^2 = [(lbs.\ product/acre)(\%\ a.i.)(453{,}590\ mg/lb.)] / (43{,}560\ ft.^2/acre)$$

$$EEC = [(mg\ a.i./ft.^2)(\%\ of\ pesticide\ biologically\ available)]$$

Note:

- *% of pesticide biologically available = 100% without species specific ingestion rates*

- *Conversion for calculating mg a.i./ft.^{2} using ounces: 453,580 mg/lb. /16 = 28,349 mg/oz.*

The following equation is used to calculate a RQ based on the EEC calculated by one of the above equations. The EEC is divided by the surrogate LD_{50} toxicological endpoint multiplied by the body weight (Table 3) of the surrogate.

$$RQ = EEC / [LD_{50}(mg/kg) * body\ weight\ (kg)]$$

As with other risk assessments, a RQ>LOC is presumed an unacceptable ecological risk. A RQ<LOC is considered an acceptable risk with only minor, temporary, or localized effects to species.

Aquatic Exposure. Exposures to aquatic habitats (e.g., wetlands, meadows, ephemeral pools, water delivery ditches) are evaluated separately for ground-based pesticide treatments. The primary exposure pathway for aquatic organisms from any ground-based treatments likely would be particle drift during the pesticide application. However, different exposure scenarios must be considered as a result of contrasting application equipment and techniques. In addition, the type of pesticides used to control pests as part of facilities maintenance (e.g., roadsides, parking lots, trails) may vary from those used to manage habitats on the refuge. Further, pesticide applications may be done <25 feet from the high water mark of aquatic habitats for habitat management treatments; whereas, no-spray buffers (≥25 feet) would be used for facilities maintenance treatments.

For the worst-case exposure scenario to non-target aquatic habitats EECs (Table 4) are derived from Urban and Cook (*1986*) that assumes an intentional overspray to an entire, non-target water body (1-foot depth) from a treatment <25 feet from the high

water mark using the maximum application rate (acid basis [see above]). However, use of BMPs for applying pesticides (see Section 4.2) would likely minimize/eliminate potential drift to non-target aquatic habitats during actual treatments. An unacceptable (acute or chronic) risk to fish and wildlife with the simulated 100% overspray (RQ>LOC) would likely result in a proposed pesticide being disapproved or the pesticide proposal being approved at a lower application rate to minimize/eliminate unacceptable risk to aquatic organisms (RQ=LOC).

Table 4
Estimated Environmental Concentrations of Pesticides in Aquatic Habitats (1 foot depth) Immediately after Direct Application

Lbs/acre	EEC (ppb)
0.10	36.7
0.20	73.5
0.25	91.9
0.30	110.2
0.40	147.0
0.50	183.7
0.75	275.6
1.00	367.5
1.25	459.7
1.50	551.6
1.75	643.5
2.00	735.7
2.25	827.6
2.50	919.4
3.00	1103.5
4.00	1471.4
5.00	1839
6.00	2207
7.00	2575
8.00	2943
9.00	3311
10.00	3678

Source: (*Urban and Cook 1986*)

Field drift studies conducted by the Spray Drift Task Force, which is a joint project of several agricultural chemical businesses, were used to develop a generic spray drift database. From this database, the AgDRIFT computer model was created to satisfy USEPA pesticide registration spray drift data requirements and as a scientific basis to evaluate off-target movement of pesticides from particle drift and assess potential effects of exposure to wildlife. Several versions of the computer model have been developed (i.e., v2.01 through v2.10). The Spray Drift Task Force AgDRIFT® model version 2.01 (*AgDRIFT 2001, SDTF 2003*) would be used to derive EECs resulting from drift of pesticides to refuge aquatic resources from ground-based pesticide

applications >25 feet from the high water mark. The Spray Drift Task Force AgDRIFT model is publicly available at http://www.agdrift.com. At this website, click "AgDRIFT 2.0" and then click "Download Now" and follow the instructions to obtain the computer model.

The AgDRIFT model is composed of submodels called tiers. Tier I Ground submodel is used to assess ground-based applications of pesticides. Tier outputs (EECs) are calculated with AgDRIFT using the following input variables: maximum application rate (acid basis [see above]), low boom (20 inches), fine to medium droplet size, EPA-defined wetland, and a ≥25-foot distance (buffer) from treated area to water.

Use of Information on the Effects of Specific IPM Practices

Where the scope of a NEPA document prepared by another federal agency is relevant to the evaluation of the effects of pesticide uses on refuge lands, that document may, in accordance with 43 CRF 46.120(d), be incorporated by reference into Service NEPA documents that address the impacts of pesticides on Refuge resources. As such, is may be appropriate to incorporate through reference ecological risk assessments prepared by the U.S. Forest Service (http://www.fs.fed.us/r6/invasiveplant-eis/Risk-Assessments/Herbicides-Analyzed-InvPlant-EIS.htm) and Bureau of Land Management (http://www.blm.gov/wo/st/en/prog/more/veg_eis.html). These risk assessments and the associated documentation are available in total with the administrative record for the Final Environmental Impact Statement entitled *Pacific Northwest Region Invasive Plant Program – Preventing and Managing Invasive Plants* (*U.S. Forest Service 2005*) and *Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic EIS (PEIS)* (*Bureau of Land Management 2007*).

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicide and adjuvant uses prepared by the U.S. Forest Service are incorporated by reference:

- 2,4-D
- Chlorosulfuron
- Clopyralid
- Dicamba
- Glyphosate
- Imazapic
- Imazapyr
- Metsulfuron methyl
- Picloram
- Sethoxydim
- Sulfometuron methyl
- Triclopyr
- Nonylphenol polyethylate (NPE) based surfactants

As a basis for completing "Chemical Profiles" for approving or disapproving refuge PUPs, ecological risk assessments for the following herbicides and pesticide degradates and adjuvants, prepared by the Bureau of Land Management, are incorporated by reference:

- Bromacil
- Chlorsulfuron
- Diflufenzopyr

- Diquat
- Diuron
- Fluridone
- Imazapic
- Overdrive (diflufenzopyr and dicamba)
- Sulfometuron methyl
- Tebuthiuron
- Pesticide degradates and adjuvants (Appendix D)

Assumptions for Ecological Risk Assessments

There are a number of assumptions involved with the ecological risk assessment process for terrestrial and aquatic organisms associated with utilization of the USEPA (*2004*) process. These assumptions may be risk neutral or may lead to an over- or under-estimation of risk from pesticide exposure depending upon site-specific conditions. The following describes these assumptions, their application to the conditions typically encountered, and whether or not they may lead to recommendations that are risk neutral, underestimate, or overestimate ecological risk from potential pesticide exposure.

1. Indirect effects would not be evaluated by ecological risk assessments. These effects include the mechanisms of indirect exposure to pesticides: consuming prey items (fish, birds, or small mammals), reductions in the availability of prey items, and disturbance associated with pesticide application activities.

2. Exposure to a pesticide product can be assessed based upon the active ingredient; however, exposure to a chemical mixture (pesticide formulation) may result in effects that are similar or substantially different compared to only the active ingredient. Non-target organisms may be exposed directly to the pesticide formulation or only various constituents of the formulation as they dissipate and partition in the environment. If toxicological information for both the active ingredient and formulated product are available, then data representing the greatest potential toxicity would be selected for use in the risk assessment process (*USEPA 2004*). This conservative approach may lead to an overestimation of risk characterization from pesticide exposure.

3. Because toxicity tests with listed or candidate species or closely related species are not available, data for surrogate species would most often be used for risk assessments. Specifically, bobwhite quail and mallard duck are the most frequently used surrogates for evaluating potential toxicity to federally listed avian species. Bluegill sunfish, rainbow trout, and fathead minnow are the most common surrogates for evaluating toxicity for freshwater fishes. Sheep's head minnow can be an appropriate surrogate marine species for coastal environments. Rats and mice are the most common surrogates for evaluating toxicity for mammals. Interspecies sensitivity is a major source of uncertainty in pesticide assessments. As a result of this uncertainty, data is selected for the most sensitive species tested within a taxonomic group (birds, fish, and mammals) assuming the quality of the data is acceptable. If additional toxicity data for more species of organisms in a particular group are available, the selected data will not be limited to the species previously listed as common surrogates.

4. The Kanaga nomogram outputs maximum EEC values that may be used to calculate an average daily concentration over a specified interval of time, which is referred to as a time-weighted-average (TWA). The maximum EEC would be selected as the exposure input for both acute and chronic risk assessments in the screening-level evaluations. The initial or maximum EEC derived from the Kanaga nomogram represents the maximum expected instantaneous or acute exposure to a pesticide. Acute toxicity endpoints are determined using a single exposure to a known pesticide concentration typically for 48 to 96 hours. This value is assumed to represent ecological risk from acute exposure to a pesticide.

5. An organism's response to chronic pesticide exposure may result from either the concentration of the pesticide, length of exposure, or some combination of both factors. Standardized tests for chronic toxicity typically involve exposing an organism to several different pesticide concentrations for a specified length of time (days, weeks, months, years or generations). However, when a test is limited to a single length of time, the time response data is usually not available for inclusion into risk assessments, and without time response data, it is difficult to determine the concentration that elicited a toxicological response.

6. Using maximum EECs for chronic risk estimates may result in an overestimate of risk, particularly for compounds that dissipate rapidly. Conversely, using TWAs for chronic risk estimates may underestimate risk if it is the concentration rather than the duration of exposure that is primarily responsible for the observed adverse effect. The maximum EEC is used for chronic risk assessments although it may result in an overestimate of risk. TWAs may be used for chronic risk assessments, but they will be applied judiciously considering the potential for an underestimate or overestimate of risk. For example, the number of days exposure exceeds the LOC may influence the suitability of a pesticide use. The greater the number of days the EEC exceeds the LOC translates into greater the ecological risk. This is a qualitative assessment, and is subject to reviewer's expertise in ecological risk assessment and tolerance for risk.

7. The length of time used to calculate the TWA can have a substantial effect on the exposure estimates and there is no standard method for determining the appropriate duration for this estimate. The T-REX model assumes a 21-week exposure period, which is equivalent to avian reproductive studies designed to establish a steady-state concentration for bioaccumulative compounds. However, this does not necessarily define the true exposure duration needed to elicit a toxicological response. Pesticides, which do not bioaccumulate, may achieve a steady-state concentration earlier than 21 weeks. The duration of time for calculating TWAs will require justification and it will not exceed the duration of exposure in the chronic toxicity test (approximately 70 days for the standard avian reproduction study). An alternative to using the duration of the chronic toxicity study is to base the TWA on the application interval. In this case, increasing the application interval would suppress both the estimated peak pesticide concentration and the TWA. Another alternative to using TWAs would be to consider the number of days that a chemical is predicted to exceed the LOC.

8. Pesticide dissipation is assumed to be first-order in the absence of data suggesting alternative dissipation patterns such as bi-phasic. Field dissipation data would generally be the most pertinent for assessing exposure in terrestrial species that forage on vegetation. However, this data is often not available and it can be misleading particularly

if the compound is prone to "wash-off". Soil half-life is the most common degradation data available. Dissipation or degradation data that would reflect the environmental conditions typical of refuge lands would be utilized, if available.

9. For species found in the water column, it is assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column.

10. Actual habitat requirements for any particular terrestrial species are not considered, and it is assumed that species exclusively and permanently occupy the treated area, or adjacent areas receiving pesticide at rates commensurate with the treatment rate. This assumption produces a maximum estimate of exposure for risk characterization and will likely lead to an overestimation of exposure for species that do not permanently and exclusively occupy the treated area (*USEPA 2004*).

11. Exposure through incidental ingestion of pesticide contaminated soil is not considered in the USEPA risk assessment protocols. Research suggests <15% of the diet can consist of incidentally ingested soil depending upon species and feeding strategy (*Beyer et al. 1994*). An assessment of pesticide concentrations in soil compared to food item categories in the Kanaga nomogram indicates incidental soil ingestion will not likely increase dietary exposure to pesticides. Inclusion of soil into the diet would effectively reduce the overall dietary concentration compared to the present assumption that the entire diet consists of a contaminated food source (*Fletcher et al. 1994*). An exception to this may be soil-applied pesticides in which exposure from incidental ingestion of soil may increase. Potential for pesticide exposure under this assumption may be underestimated for soil-applied pesticides and overestimated for foliar-applied pesticides. The concentration of a pesticide in soil would likely be less than predicted on food items.

12. Exposure through inhalation of pesticides is not considered in the USEPA risk assessment protocols. Such exposure may occur through three potential sources: spray material in droplet form at the time of application, vapor phase with the pesticide volatilizing from treated surfaces, and airborne particulates (soil, vegetative matter, and pesticide dusts). The USEPA (*1990*) reported exposure from inhaling spray droplets at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size (particles reaching the lung) in birds is limited to maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application scenarios indicate that less than 1% of the applied material is within the respirable particle size. This route of exposure is further limited because the permissible spray drop size distribution for ground pesticide applications is restricted to ASAE medium or coarser drop size distribution.

13. Inhalation of a pesticide in the vapor phase may be another source of exposure for some pesticides under certain conditions. This mechanism of exposure to pesticides occurs post application and would pertain to those pesticides with a high vapor pressure. The USEPA is currently evaluating protocols for modeling inhalation exposure from pesticides including near-field and near-ground air concentrations based upon equilibrium and kinetics-based models. Risk characterization for exposure with this mechanism is unavailable.

14. The effect from exposure to dusts contaminated with a pesticide cannot be assessed generically as partitioning issues related to application site, soils, and chemical properties of the applied pesticides render the exposure potential from this route highly situation specific.

15. Dermal exposure may occur through three potential sources: direct application of spray to terrestrial wildlife in the treated area or within the drift footprint; incidental contact with contaminated vegetation; or contact with contaminated water or soil. Interception of spray and incidental contact with treated substrates may pose risk to avian wildlife (*Driver et al. 1991*); however, research related to wildlife dermal contact with pesticides is extremely limited. Dermal toxicity values are common for some mammals used as human surrogates, particularly rats and mice. The USEPA is currently evaluating protocols for modeling dermal exposure. Risk characterization may be underestimated for this route of exposure, particularly with high risk pesticides such as some organophosphates or carbamate insecticides, which act by a similar mechanism to organophosphate pesticides. If protocols are established by the USEPA for assessing dermal exposure to pesticides, they will be considered for incorporation into pesticide assessment protocols.

16. Exposure to a pesticide may occur from consuming surface water, dew, or other water on treated surfaces. Water soluble pesticides have the potential to dissolve in surface runoff and puddles in a treated area may contain pesticide residues. Similarly, pesticides with lower organic carbon partitioning characteristics and higher solubility in water have a greater potential to dissolve in dew and other water associated with plant surfaces. Estimating the extent to which such pesticide loadings to drinking water occurs is complex and would depend upon the partitioning characteristics of the active ingredient, as well as the soils types and meteorology of the treatment area. In addition, the use of various water sources by wildlife is highly species-specific. Currently, risk characterization for this exposure mechanism is not available. The USEPA is actively developing protocols to quantify drinking water exposures from puddles and dew. If and when such protocols are formally established by the USEPA, these protocols will be incorporated into pesticide risk assessment protocols.

17. Risk assessments are based upon the assumption that the entire treatment area will be subject to pesticide application at the rates specified on the label. In most cases however, there is potential for uneven application of pesticides through such plausible incidents as changes in calibration of application equipment, spillage, and localized releases at specific areas in or near the treated field that are associated with mixing and handling, application equipment, and applicator skill. Inappropriate use of pesticides and the occurrence of spills represent a potential underestimate of risk; however, this is generally a minor factor for risk characterization. All pesticide applicators are required to be certified by the state in which they apply pesticides. Certification training, which requires yearly updates, includes the safe storage, transport, handling, and mixing of pesticides, appropriate equipment calibration, and proper application.

18. The USEPA relies on Fletcher (*1994*) for setting the assumed pesticide residues in wildlife dietary items. The USEPA (*2004*) "believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify." Fletcher's (*1994*) research suggests that the pesticide active ingredient residue assumptions used by the USEPA

represent a 95th percentile estimate. However, research conducted by Pfleeger et al. (*1996*) indicates USEPA residue assumptions for short grass was not exceeded. Baehr and Habig (*2000*) compared USEPA residue assumptions with distributions of measured pesticide residues for the USEPA's Uptake, Translocation, Accumulation, and Biotransformation (UTAB) database. Overall residue selection level will tend to overestimate risk characterization. This is particularly evident when wildlife individuals are likely to have selected a variety of food items acquired from multiple locations. Some food items may be contaminated with pesticide residues whereas others are not contaminated. However, it is important to recognize differences in species feeding behavior. Some species may consume whole above-ground plant material, while others will preferentially select different plant structures. Species may also preferentially select a specific food item despite the presence of multiple food items. Without species specific knowledge regarding foraging behavior, characterizing ecological risk other than in general terms is not possible.

19. Acute and chronic risk assessments rely on comparisons of wildlife dietary residues with LC_{50} or "no observed effect concentration" (NOEC) values expressed as concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods are not accounting for a potentially important aspect of food requirements.

20. It is assumed that aquatic species exclusively and permanently occupy the water body being assessed. Actual habitat requirements of aquatic species are not considered. With the possible exception of scenarios where pesticides are directly applied to water, it is assumed that no habitat use considerations specific for any species would place the organisms in closer proximity to pesticide use sites. This assumption produces a maximum estimate of exposure or risk characterization. It would likely be realistic for many aquatic species that may be found in aquatic habitats within or in close proximity to treated terrestrial habitats. However, the spatial distribution of wildlife is usually not random, because wildlife distributions are often related to habitat requirements of the species. Clumped distributions of wildlife may result in an under- or over-estimation of risk depending upon where the initial pesticide concentration occurs relative to the species or species habitat.

21. For species found in the water column, it is assumed that the greatest bioavailable fraction of the pesticide active ingredient in surface waters is freely dissolved in the water column. Additional chemical exposure from materials associated with suspended solids or food items is not considered, because partitioning onto sediments is considered minimal. Adsorption and bioconcentration occurs at lower levels for many newer pesticides compared with older more persistent bioaccumulative compounds. For pesticides with RQs close to listed species' LOC, the potential for additional exposure from these routes may be a limitation of risk assessments, because potential pesticide exposure or risk may be underestimated.

22. Mass transport losses of pesticide from a water body (except for losses by volatilization, degradation, and sediment partitioning) are not considered in ecological risk assessments. The water body would be assumed to capture all pesticide active ingredients entering as runoff, drift, and adsorbed to eroded soil particles. It would also be assumed that the pesticide active ingredient is not lost from the water body by overtopping or flow-through, nor is its concentration reduced by dilution. In total, these assumptions would lead to a near maximum possible water-borne concentration. However, this assumption would not account for the potential to concentrate pesticide through evaporative loss. This limitation may have the greatest impact on water bodies with high surface-to-volume ratios such as ephemeral wetlands, where evaporative losses are accentuated and applied pesticides have low rates of degradation and volatilization.

23. For acute risk assessments, there would be no averaging time for exposure. An instantaneous peak concentration would be assumed, where instantaneous exposure is sufficient in duration to elicit acute effects comparable to those observed over more protracted exposure periods (typically 48 to 96 hours) tested in the laboratory. In the absence of data regarding time-to-toxic event, analyses and latent responses to instantaneous exposure, risk would likely be overestimated.

24. For chronic exposure risk assessments, the averaging times considered for exposure are commensurate with the duration of invertebrate life-cycle or fish-early life stage tests (e.g., 21-28 days and 56-60 days, respectively). Response profiles (time to effect and latency of effect) to pesticides likely vary widely with mode of action and species and should be evaluated on a case-by-case basis as available data allow. Nevertheless, because the USEPA relies on chronic exposure toxicity endpoints based on a finding of no observed effect, the potential for any latent toxicity effects or averaging time assumptions to alter the results of an acceptable chronic risk assessment prediction is limited. The extent to which duration of exposure from water-borne concentrations overestimate or underestimate actual exposure depends on several factors including: localized meteorological conditions; runoff characteristics of the watershed (e.g., soils, topography); hydrological characteristics of receiving waters; environmental fate of the pesticide active ingredient; and the method of pesticide application. It should also be understood that chronic effects studies are performed using a method that holds water concentration in a steady state. This method is not likely to reflect conditions associated with pesticide runoff. Pesticide concentrations in the field increase and decrease in surface water on a cycle influenced by rainfall, pesticide use patterns, and degradation rates. As a result of the dependency of this assumption on several undefined variables, risk associated with chronic exposure may in some situations underestimate risk and overestimate risk in others.

There are several other assumptions that can affect non-target species that are not considered in the risk assessment process. These include possible additive or synergistic effects from applying two or more pesticides or additives in a single application, co-location of pesticides in the environment, cumulative effects from pesticides with the same mode of action, effects of multiple stressors (e.g., combination of pesticide exposure, adverse abiotic and biotic factors), and behavioral changes induced by exposure to a pesticide. These factors may exist at some level contributing to adverse affects to non-target species, but they are usually characterized in the published literature in only a general manner limiting their value in the risk assessment

process. As this type of information becomes available, it would be included, either quantitatively or qualitatively, in this risk assessment process.

USEPA is required by the Food Quality Protection Act to assess the cumulative risks of pesticides that share common mechanisms of toxicity, or act the same within an organism. Currently, USEPA has identified four groups of pesticides that have a common mechanism of toxicity requiring cumulative risk assessments. These four groups are: the organophosphate insecticides, N-methyl carbamate insecticides, triazine herbicides, and chloroacetanilide herbicides.

7.3 Pesticide Mixtures and Degradates

Pesticide products are usually a formulation of several components generally categorized as active ingredients and inert or other ingredients. The term active ingredient is defined by FIFRA as preventing, destroying, repelling, or mitigating the effects of a pest, or it is a plant regulator, defoliant, desiccant, or nitrogen stabilizer. In accordance with FIFRA, the active ingredient(s) must be identified by name(s) on the pesticide label along with its relative composition expressed in percentage(s) by weight. In contrast, inert ingredient(s) are not intended to affect a target pest. Their role in the pesticide formulation is to act as a solvent (keep the active ingredient is a liquid phase), an emulsifying or suspending agent (keep the active ingredient from separating out of solution), or a carrier such as clay in which the active ingredient is impregnated on the clay particle in dry formulations. For example, if isopropyl alcohol would be used as a solvent in a pesticide formulation, it would be considered an inert ingredient. FIFRA only requires that inert ingredients be identified if they pose a hazard to man or the environment. Inert ingredients that are not classified as hazardous are not required to be identified. The only other requirement is to state on the product label the percentage by weight of all inert ingredients.

The USEPA (*September 1997*) issued Pesticide Regulation Notice 97-6 which encouraged manufacturers, formulators, producers, and registrants of pesticide products to voluntarily substitute the term “other ingredients” for “inert ingredients” in the ingredient statement. This change recognized that all components in a pesticide formulation potentially could elicit or contribute to an adverse effect on non-target organisms and, therefore, are not necessarily inert. Whether referred to as “inerts” or “other ingredients,” these constituents within a pesticide product have the potential to affect species or environmental quality. The USEPA categorizes regulated inert ingredients as follows (http://www.epa.gov/opprd001/inerts/index.html):

- List 1 – Inert Ingredients of Toxicological Concern
- List 2 – Potentially Toxic Inert Ingredients
- List 3 – Inerts of Unknown Toxicity
- List 4 – Inerts of Minimal Toxicity

Several of the List 4 compounds are naturally-occurring earthen materials (e.g., clay materials, simple salts) that would not elicit toxicological response at applied concentrations. However, some of the inerts (particularly the List 3 compounds and unlisted compounds) may have moderate to high potential toxicity to aquatic species based on MSDSs or published data.

Comprehensively assessing potential effects to non-target fish, wildlife, plants, and/or their habitats from pesticide use is a complex task. It would be preferable to assess the cumulative effects from exposure to the active ingredient, its degradates, and inert ingredients, as well as other active ingredients in the spray mixture. However, it would only be feasible to conduct

deterministic risk assessments for each component in the spray mixture individually. Limited scientific information is available regarding ecological effects (additive or synergistic) from chemical mixtures that typically rely upon broadly encompassing assumptions. For example, the U.S. Forest Service (*2005*) found that mixtures of pesticides used in land (forest) management were not likely to cause additive or synergistic effects to non-target species based upon a review of scientific literature regarding toxicological effects and interactions of agricultural chemicals (*ATSDR 2004*). Moreover, information on inert ingredients, adjuvants, and degradates is often limited by the availability of and access to reliable toxicological data for these constituents.

Toxicological information regarding "other ingredients" may be available from sources, including:

- TOMES (a proprietary toxicological database including USEPA's IRIS, the Hazardous Substance Data Bank, the Registry of Toxic Effects of Chemical Substances [RTECS]);
- USEPA's ECOTOX database, which includes AQUIRE (a database containing scientific papers published on the toxic effects of chemicals to aquatic organisms);
- TOXLINE (a literature searching tool);
- Material Safety Data Sheets (MSDSs) from pesticide suppliers; and
- Sources such as the Farm Chemicals Handbook.

Because there is a lack of specific inert toxicological data, inert(s) in a pesticide may cause adverse ecological effects. However, inert ingredients typically represent only a small percentage of the pesticide spray mixture, and it would be assumed that negligible effects would be expected to result from inert ingredient(s).

Although the potential effects of degradates should be considered when selecting a pesticide, it is beyond the scope of this assessment process to consider all possible breakdown chemicals of the various product formulations containing an active ingredient. Degradates may be more or less mobile and more or less hazardous in the environment than their parent pesticides (*Battaglin et al. 2003*). Differences in environmental behavior (e.g., mobility) and toxicity between parent pesticides and degradates would make assessing potential degradate effects extremely difficult. For example, a less toxic and more mobile, bioaccumulative, or persistent degradate may have potentially greater effects on species and/or degrade environmental quality. The lack of data on the toxicity of degradates for many pesticides would represent a source of uncertainty for assessing risk.

USEPA-approved labels specify whether a product can be mixed with one or more pesticides. Without product-specific toxicological data, it would not possible to quantify the potential effects of these mixtures. In addition, a quantitative analysis could only be conducted if reliable scientific information allowed a determination of whether the joint action of a mixture would be additive, synergistic, or antagonistic. Such information would not likely exist unless the mode of action would be common among the chemicals and receptors. Moreover, the composition of and exposure to mixtures would be highly site- and/or time-specific and, therefore, it would be nearly impossible to assess potential effects to species and environmental quality.

To minimize or eliminate potential negative effects associated with applying two or more pesticides as a mixture, the use would be conducted in accordance with the labeling requirements. Labels for two or more pesticides applied as a mixture should be completely reviewed, where products with the least potential for negative effects would be selected for use on the refuge. This is especially relevant when a mixture would be applied in a manner that may already have the potential for an

effect(s) associated with an individual pesticide (e.g., runoff to ponds in sandy watersheds). Use of a tank mix under these conditions would increase the level of uncertainty in terms of risk to species or potential to degrade environmental quality.

Adjuvants generally function to enhance or prolong the activity of pesticide. For terrestrial herbicides, adjuvants aid in the absorption into plant tissue. Adjuvant is a broad term that generally applies to surfactants, selected oils, anti-foaming agents, buffering compounds, drift control agents, compatibility agents, stickers, and spreaders. Adjuvants are not under the same registration requirements as pesticides and the USEPA does not register or approve the labeling of spray adjuvants. Individual pesticide labels identify types of adjuvants approved for use with it. In general, adjuvants compose a relatively small portion of the volume of pesticides applied. Selection of adjuvants with limited toxicity and low volumes would be recommended to reduce the potential for the adjuvant to influence the toxicity of the pesticide.

7.4 Determining Effects to Soil and Water Quality

The approval process for pesticide use considers the potential to degrade water quality on and off refuge lands. After application, pesticide mobilization can be characterized by one or more of the following (*Kerle et al. 1996*):

- Attach (sorb) to soil, vegetation, or other surfaces and remain at or near the treated area;
- Attach to soil and move off-site through erosion from run-off or wind; and/or
- Dissolve in water subjected to run-off or leaching.

As an initial screening tool, selected chemical characteristics and rating criteria for a pesticide can be evaluated to assess the potential for the product to enter ground and/or surface waters. These would include the following: persistence, sorption coefficient (K_{oc}), groundwater ubiquity score (GUS), and solubility. Persistence, which is expressed as half-life ($t_{½}$), represents the length of time required for 50% of the deposited pesticide to degrade (completely or partially). Persistence in the soil can be categorized as the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (*Kerle et al. 1996*). Half-life data is usually available for aquatic and terrestrial environments.

Another measure of pesticide persistence is dissipation time (DT_{50}). This represents the time required for 50% of the deposited pesticide to degrade and move from a treated site; whereas, half-life describes the rate for degradation only. Similar to half-life, units of dissipation time are usually expressed in days. Field or foliar dissipation time is the preferred data for use to estimate pesticide concentrations in the environment; however, soil half-life is the most common persistence data cited in published literature. If field or foliar dissipation data is not available, soil half-life data may be used. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments.

Mobility of a pesticide is a function of how strongly it is adsorbed to soil particles and organic matter, its solubility in water, and its persistence in the environment. Pesticides strongly adsorbed to soil particles, relatively insoluble in water, and not environmentally persistent would be less likely to move across the soil surface into surface waters or to leach through the soil profile and contaminate groundwater. Conversely, pesticides that are not strongly adsorbed to soil particles, are highly water soluble, and are persistent in the environment would have greater potential to move from the application site (off-site movement). The degree of pesticide adsorption to soil particles and organic matter (*Kerle et al. 1996*) is expressed as the soil adsorption coefficient (K_{oc}).

The soil adsorption coefficient is measured as micrograms of pesticide per gram of soil (μg/g) that can range from near zero to the thousands. Pesticides with higher K_{oc} values are strongly sorbed to soil and, therefore, would be less subject to movement.

The Groundwater Ubiquity Score (GUS) is a quantitative screening tool to estimate a pesticide's potential to move in the environment. It utilizes soil persistence and adsorption coefficients in the following formula: $GUS = \log_{10}(t_{½}) \times [4 - \log_{10}(K_{oc})]$. The potential pesticide movement rating would be based upon its GUS value. Pesticides with a GUS <0.1 would considered to have an extremely low potential to move toward groundwater. Values of 1.0-2.0 would be low, 2.0-3.0 would be moderate, 3.0-4.0 would be high, and >4.0 would have a very high potential to move toward groundwater.

Water solubility describes the amount of pesticide dissolving in a specific quantity of water, where it is usually measured as milligrams of pesticide dissolved per liter of water (mg/l) or parts per million (ppm). Solubility is useful as a comparative measure because pesticides with higher values are more likely to move by run-off or leaching. For example, pesticides with solubility <0.1 ppm are virtually insoluble in water, 100-1000 ppm are moderately soluble, and >10,000 ppm highly soluble (*U.S. Geological Survey 2000*). As pesticide solubility increases, there is greater potential for off-site movement.

GUS, water solubility, $t_{½}$, and K_{oc} values are available for selected pesticides from the OSU Extension Pesticide Properties Database at http://npic.orst.edu/ppdmove.htm. Many of the values in this database were derived from the SCS/ARS/CES Pesticide Properties Database for Environmental Decision Making (*Wauchope et al. 1992*).

Soil properties influence the fate of pesticides in the environment. The following six properties are most likely to affect pesticide degradation and the potential for pesticides to move off-site by leaching (vertical movement through the soil) or runoff (lateral movement across the soil surface).

> Permeability. This is the rate at which water moves vertically through the soil. It is affected by soil texture and structure. Coarse textured soils (e.g., high sand content) have a larger pore size and are generally more permeable than fine textured soils (i.e., high clay content). The potential for pesticides to move vertically down through the soil profile is greater the more permeable the soils are within the treatment area. Soil permeability rates (inches/hour) are usually available in county soil survey reports. In the case of the Seal Beach NWR, the majority of the soils on site consist of stratified clay and sand deposits that are poorly drained (*USDA 1978*).
>
> Soil Texture. Soil texture is defined by the relative percentage of sand, silt, and clay present in the soil. In general, greater clay content would lower the likelihood and rate at which water would move through the soil profile. Clay also serves to adsorb (bind) pesticides to soil particles. Soils with high clay content would adsorb more pesticide than soils with relatively low clay content. In contrast, sandy soils with coarser texture and lower water holding capacity would have a greater potential for water to leach through them.

Soil Structure. Soil structure describes soil aggregation. Soils with a well developed soil structure have looser, more aggregated, structure that would be less likely to be compacted. Both characteristics would allow for less restricted flow of water through the soil profile resulting in greater infiltration.

Organic Matter Content. This is the single most important factor affecting pesticide adsorption in soils. Many pesticides are adsorbed to organic matter, reducing their rate of downward movement through the soil profile. Also, soils high in organic matter tend to hold more water, which may make less water available for leaching.

Soil Moisture Content. Soil moisture content affects how the velocity at which water moves through the soil. If soils are already wet or saturated before rainfall or irrigation, excess moisture would runoff rather than infiltrate into the soil profile. Soil moisture also influences microbial and chemical activity in soil, which effects pesticide degradation.

Soil pH. Soil pH influences the chemical reactions that occur in the soil. This in turn determines whether or not a pesticide will degrade, as well as the rate of degradation, and, in some instances, the types of degradation products that are produced.

Based upon the aforementioned properties, soils most vulnerable to groundwater contamination are sandy soils with low organic matter. In contrast, the least vulnerable soils are well-drained, clayey soils with high organic matter. Consequently, pesticides with the lowest potential for movement in conjunction with appropriate BMPs will be used in an IPM framework to treat pests while minimizing effects to non-target biota and protecting environmental quality.

Along with soil properties, the potential for a pesticide to affect water quality through run-off and leaching would also be affected by site-specific environmental and abiotic conditions including rainfall, water table conditions, and topography (*Huddleston 1996*). Water is necessary to separate pesticides from soil. This can occur in two basic ways: 1) pesticides that are soluble would move easily with runoff water, and 2) pesticide-laden soil particles could be dislodged and transported from the application site in runoff. The concentration of pesticides in the surface runoff would be greatest for the first runoff event following treatment. The rainfall intensity and route of water infiltration into the soil, to a large extent, determine pesticide concentrations in surface runoff. The timing of the rainfall after application would also have an influence on the total pesticide concentrations in surface runoff. Rainfall interacts with pesticides at a shallow soil depth (¼ to ½ inch), which is called the mixing zone (*Baker and Miller 1999*). The pesticide/water mixture in the mixing zone would tend to leach down into the soil or runoff depending upon how quickly the soil surface becomes saturated and how rapidly water can infiltrate into the soil. Leaching would decrease the amount of pesticide available near the soil surface (mixing zone) reducing total runoff during the initial rainfall event following application, as well as subsequent rainfall events. Terrain slope would also affect the potential for surface runoff and the intensity of the runoff. Steeper slopes would have greater potential for runoff following a rainfall event. In contrast, soils that are relatively flat would have little potential for runoff, except during intense rainfall events. In addition, soils in lower areas would be more susceptible to leaching as a result of receiving excessive water from surrounding higher elevations.

Depth to groundwater is also an important factor affecting the potential for pesticides to leach into groundwater. If the distance from the soil surface to the top of the water table is shallow, pesticides would be more likely to influence groundwater quality. Soil survey reports, available for

individual counties, provide data regarding the water table depths. In some situations, a hard pan may exist above the water table, preventing the pesticide from leaching into the groundwater.

7.5 Determining Effects to Air Quality

Pesticides may volatilize from soil and plant surfaces and move from the treated area into the atmosphere. The potential for a pesticide to volatilize is determined by the pesticide's vapor pressure. The extent to which a pesticide may volatilize is influenced by temperature, sorption, soil moisture, and the pesticide's solubility. Vapor pressure is often expressed in mm Hg. To make these numbers easier to compare, vapor pressure may be expressed in exponent form ($I \times 10^{-7}$), where "I" represents a vapor pressure index. In general, pesticides with $I<10$ would have a low potential to volatilize; whereas, pesticides with $I>1{,}000$ would have a high potential to volatilize (*Oregon State University 1996*). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database.

7.6 Preparing a Chemical Profile

The following instructions will be used by Service personnel to complete Chemical Profiles for pesticides. Specifically, profiles will be prepared for pesticide active ingredients (e.g., glyphosate, oryzalin) that would be contained in one or more trade name products, registered and labeled with USEPA. A blank Chemical Profile form is provided as Attachment A. All fields under each category (e.g., Toxicological Endpoints, Environmental Fate) on the Chemical Profile must be filled in. If no information is available for a specific field, then "No data is available in references" would be recorded in the profile. Available scientific information would be used to complete Chemical Profiles. Each entry of scientific information would be shown with applicable references.

Completed Chemical Profiles will provide a structured decision-making process utilizing quantitative assessment/screening tools with threshold values, where appropriate, that would be used to evaluate potential biological and other environmental effects to refuge resources. For ecological risk assessments presented in these profiles, the "worst-case scenario" would be evaluated to determine whether a pesticide could be approved for use considering the maximum single application rate specified on pesticide labels for Refuge habitat management and facilities maintenance. Where the "worst-case scenario" is likely to result in only minor, temporary, and localized effects to listed and non-listed species (when appropriate BMPs [see Section 5.0] are implemented), the proposed pesticide's use would have a scientific basis for approval under any application rate specified on the label that is at or below rates evaluated in a Chemical Profile. In some cases, the Chemical Profile will include a lower application rate than the maximum labeled rate in order to protect refuge resources. As necessary, Chemical Profiles will be periodically updated to include new scientific information or include a new pesticide proposed for use on the Refuge through the PUPs process that possesses the same active ingredient described in the Chemical Profile.

Currently, three Chemical Profiles have been prepared for the Seal Beach NWR: one for the active ingredient glyphosate; one for the active ingredient oryzalin; and one for the active ingredient imazapyr (Attachments B-1, B-2, and B-3). These Chemical Profiles address the active ingredients used in Aquamaster, Glyphosate Pro 4, Surflan A S, and Habitat, all of which have been approved for use on the Refuge through the PUPs process.

The Chemical Profile will clearly identify threshold values in order to prevent or minimize potential biological and environmental effects. Comparison of these threshold values provides an explicit scientific basis to approve or disapprove PUPs for habitat management and facilities

maintenance on the Seal Beach NWR. In general, PUPs will be approved for pesticides with Chemical Profiles where there would be no exceedances of threshold values. However, BMPs are identified for some screening tools that would minimize and/or eliminate potential effects (exceedance of the threshold value) as a basis for approving PUPs.

The following information will be recorded for each Chemical Profile that is completed or updated.

General Information

Date. Service personnel will record the date when the Chemical Profile is completed or updated. Chemical Profiles (e.g., currently approved pesticide use patterns) will be periodically reviewed and updated, as necessary. The most recent review date will be recorded on a profile to document when it was last updated.

Trade Name(s). Service personnel will accurately and completely record the trade name(s) from the pesticide label, which includes a suffix that describes the formulation (e.g., WP, DG, EC, L, SP, I, II or 64). The suffix often distinguishes a specific product among several pesticides with the same active ingredient. Service personnel will record a trade name for each pesticide product with the same active ingredient.

Common Chemical Name(s). Service personnel will record the common name(s) listed on the pesticide label or MSDS for an active ingredient. The common name of a pesticide is listed as the active ingredient on the title page of the product label immediately following the trade name, and on the MSDS, Section 2: Composition/Information on Ingredients. A Chemical Profile is completed for each active ingredient.

Pesticide Type. Service personnel will record the type of pesticide for an active ingredient as one of the following: herbicide, dessicant, fungicide, fumigant, growth regulator, insecticide, pisicide, or rodenticide.

EPA Registration Number(s). This number (EPA Reg. No.) appears on the title page of the label and MSDS, Section 1: Chemical Product and Company Description. It is not the EPA Establishment Number that is usually located near it. Service personnel will record the EPA Reg. No. for each trade name product with an active ingredient based upon PUPs.

Pesticide Class. Service personnel will list the general chemical class for the pesticide (active ingredient). For example, malathion is an organophosphate and carbaryl is a carbamate.

CAS (Chemical Abstract Service) Number. Service personnel will record this number, which is often located in the second section (Composition/Information on Ingredients) of the MSDS, in the Chemical Profile. The MSDS table listing components usually contains this number immediately prior to or following the % composition.

Other Ingredients. From the most recent MSDS for the proposed pesticide product(s), Service personnel will include any chemicals in the pesticide formulation not listed as an active ingredient that are described as toxic or hazardous, or regulated under the Superfund Amendments and Reauthorization Act (SARA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Toxic Substances Control Act

(TSCA), Occupational Safety and Health Administration (OSHA), State Right-to-Know, or other listed authorities. These are usually found in MSDS sections titled "Hazardous Identifications", "Exposure Control/Personal Protection", and "Regulatory Information". If concentrations of other ingredients are available for any compounds identified as toxic or hazardous, then Service personnel will record this information in the Chemical Profile by trade name. MSDS(s) may be obtained from the manufacturer, manufacturer's website or from an on-line database maintained by Crop Data Management Systems, Inc. (see list below).

Toxicological Endpoints

Toxicological endpoint data is collected for acute and chronic tests with mammals, birds, and fish. This data will be recorded in the Chemical Profiles as available in the scientific literature. If no data are found for a particular taxonomic group, then "No data available is references" will be recorded as the data entry. Throughout the Chemical Profile, references (including toxicological endpoint data) will be cited using parentheses (#) following the recorded data.

Mammalian LD_{50}. For test species in the scientific literature, Service personnel will record available data for oral lethal dose (LD_{50}) in mg/kg-bw (body weight) or ppm-bw. The most common test species in scientific literature are the rat and mouse. The lowest LD_{50} value found for a rat will be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk to mammals (see Table 1 in Section 7.1).

Mammalian LC_{50}. For test species in the scientific literature, Service personnel will record available data for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species in scientific literature are the rat and mouse. The lowest LC_{50} value found for a rat will be used as a toxicological endpoint for diet-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Mammalian Reproduction. For test species listed in the scientific literature, Service personnel will record the test results (e.g., Lowest Observed Effect Concentration [LOEC], Lowest Observed Effect Level [LOEL], No Observed Adverse Effect Level [NOAEL], No Observed Adverse Effect Concentration [NOAEC]) in mg/kg-bw or mg/kg-diet for reproductive test procedure(s) (e.g., generational studies [preferred], fertility, new born weight). The most common test species available in scientific literature are rats and mice. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for a rat will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Avian LD_{50}. For test species available in the scientific literature, Service personnel will record values for oral lethal dose (LD_{50}) in mg/kg-bw or ppm-bw. The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LD_{50} value found for an avian species will be used as a toxicological endpoint for dose-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Avian LC_{50}. For test species available in the scientific literature, Service personnel will record values for dietary lethal concentration (LC_{50}) as reported (e.g., mg/kg-diet or ppm-diet). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest LC_{50} value found for an avian species will be used as a

toxicological endpoint for dietary-based RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Avian Reproduction. For test species available in the scientific literature, Service personnel will record test results (e.g., LOEC, LOEL, NOAEC, NOAEL) in mg/kg-bw or mg/kg-diet consumed for reproductive test procedure(s) (e.g., early life cycle, reproductive). The most common test species available in scientific literature are the bobwhite quail and mallard. The lowest NOEC, NOAEC, NOEL, or NOAEL test results found for an avian species will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Fish LC_{50}. For test freshwater or marine species listed in the scientific literature, Service personnel will record a LC_{50} in ppm or mg/L. The most common test species available in the scientific literature are the bluegill, rainbow trout, and fathead minnow (marine). Test results for many game species may also be available. The lowest LC_{50} value found for a freshwater fish species will be used as a toxicological endpoint for RQ calculations to assess acute risk (see Table 1 in Section 7.1).

Fish Early Life Stage (ELS)/Life Cycle. For test freshwater or marine species available in the scientific literature, Service personnel will record test results (e.g., LOEC, NOAEL, NOAEC, LOAEC) in ppm for test procedure(s) (e.g., early life cycle, life cycle). The most common test species available in the scientific literature are bluegill, rainbow trout, and fathead minnow. Test results for other game species may also be available. The lowest test value found for a fish species (preferably freshwater) will be used as a toxicological endpoint for RQ calculations to assess chronic risk (see Table 1 in Section 7.1).

Other. For test invertebrate, as well as non-vascular and vascular plant species, available in the scientific literature, Service personnel will record $LC_{50,}$ $LD_{50,}$ LOEC, LOEL, NOAEC, NOAEL, or EC_{50} (environmental concentration) values in ppm or mg/L. The most common test invertebrate species available in scientific literature are the honey bee and the water flea (*Daphnia magna*). Green algae (*Selenastrum capricornutum*) and pondweed (*Lemna minor*) are frequently available test species for aquatic non-vascular and vascular plants, respectively.

Ecological Incident Reports

After a site has been treated with pesticide(s), wildlife may be exposed to these chemical(s). When exposure is high relative to the toxicity of the pesticides, wildlife may be killed or visibly harmed (incapacitated). Such events are called ecological incidents. The USEPA maintains a database (Ecological Incident Information System) of ecological incidents. This database stores information extracted from incident reports submitted by various federal and state agencies and non-government organizations. Information provided in an incident report includes date and location of the incident, type and magnitude of affects observed in various species, type(s) of pesticides known or suspected of contributing to the incident, and results of any chemical residue and cholinesterase activity analyses conducted during the investigation.

Ecological Incident Reports. Incident reports can play an important role in evaluating the effects of pesticides by supplementing quantitative risk assessments. All incident reports pertaining to the active ingredient addressed in a Chemical Profile and the

associated information related to the reported incident will be recorded. If no reports are available this too will be noted.

Environmental Fate

Water Solubility. Service personnel will record values for water solubility (S_w), which describes the amount of pesticide that dissolves in a known quantity of water. S_w is expressed as mg/L (ppm). Pesticide S_w values would be categorized as one of the following: insoluble <0.1 ppm, moderately soluble = 100 to 1000 ppm, highly soluble >10,000 ppm (US Geological Survey 2000). As pesticide S_w increases, there is a greater potential for water quality to be degraded through run-off and leaching. S_w will be used to evaluate potential for bioaccumulation in aquatic species (see Octanol-Water Partition Coefficient (K_{ow}) below).

Soil Mobility. Service personnel will record available values for soil adsorption coefficient (K_{oc} [µg/g]), which provides a measure of a chemical's mobility and leaching potential in soil. K_{oc} values are directly proportional to organic content, clay content, and surface area of the soil. K_{oc} data for a pesticide may be available for a variety of soil types (e.g., clay, loam, sand). K_{oc} values will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below).

Soil Persistence. Service personnel will record values for soil half-life ($t_{½}$), which represents the length of time (days) required for 50% of the deposited pesticide to degrade (completely or partially) in the soil. Based upon the $t_{½}$ value, soil persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (Kerle et. al. 1996). Along with K_{oc}, soil $t_{½}$ values will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below).

The following threshold has been established for approving PUPs:

> Where soil $t_{½}$ is ≤100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where soil $t_{½}$ is>100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices (BMPs) section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year.
- Do not use on coarse-textured soils where the groundwater table is <10 feet and average annual precipitation >12 inches.
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Soil Dissipation. Dissipation time (DT_{50}) represents the time required for 50% of the deposited pesticide to degrade and move from a treated site; whereas, soil $t_{½}$ describes the

rate for degradation only. As for $t_{½}$, units of dissipation time are usually expressed in days. Field dissipation time will be the preferred data for use to estimate pesticide concentrations in the environment, because it is based upon field studies as compared to soil $t_{½}$, which is derived in a laboratory. However, soil $t_{½}$ is the most common persistence data available in the published literature. If field dissipation data is not available, soil $t_{½}$ data will be used in a Chemical Profile. The average or representative half-life value of the most important degradation mechanism will be selected for quantitative analysis for both terrestrial and aquatic environments. Along with K_{oc}, soil DT_{50} values (preferred over soil $t_{½}$) will be used in evaluating the potential to degrade groundwater by leaching (see Potential to Move to Groundwater below), if available.

Based upon the DT_{50} value, environmental persistence in the soil will also be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

The following threshold has been established for approving PUPs:

> Where soil DT_{50} is ≤100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where soil DT_{50} is >100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year.
- Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Aquatic Persistence. Service personnel will record values for aquatic $t_{½}$, which represents the length of time required for 50% of the deposited pesticide to degrade (completely or partially) in water. Based upon the $t_{½}$ value, aquatic persistence would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days (*Kerle et al. 1996*).

The following threshold has been established for approving PUPs:

> Where aquatic $t_{½}$ is ≤100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where aquatic $t_{½}$ is >100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year.
- Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Aquatic Dissipation. Dissipation time (DT_{50}) represents the time required for 50% of the deposited pesticide to degrade or move (dissipate); whereas, aquatic $t_{½}$ describes the rate for degradation only. As for $t_{½}$, units of dissipation time are usually expressed in days. Based upon the DT_{50} value, environmental persistence in aquatic habitats also would be categorized as one of the following: non-persistent <30 days, moderately persistent = 30 to 100 days, and persistent >100 days.

The following threshold has been established for approving PUPs:

> Where aquatic DT_{50} is ≤100 days, a PUP will be approved without additional BMPs to protect water quality.
>
> Where aquatic DT_{50} is >100 days, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year.
- Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Potential to Move to Groundwater. The Groundwater Ubiquity Score (GUS) = $\log_{10}$(soil $t_{½}$) x [4 – $\log_{10}(K_{oc})$]. If a DT_{50} value is available, it will be used rather than a $t_{½}$ value to calculate a GUS score. Based upon the GUS value, the potential to move toward groundwater will be recorded as one of the following categories: extremely low potential<1.0, low - 1.0 to 2.0, moderate - 2.0 to 3.0, high - 3.0 to 4.0, or very high>4.0.

The following threshold has been established for approving PUPs:

> Where GUS is ≤4.0, a PUP will be approved without additional BMPs to protect water quality.

Where GUS is>4.0, a PUP will only be approved with additional BMPs implemented specifically to protect water quality.

When BMPs are required to protect water quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to minimize potential surface run-off and leaching that can degrade water quality:

- Do not exceed one application per site per year.
- Do not use on coarse-textured soils where the ground water table is <10 feet and average annual precipitation >12 inches.
- Do not use on steep slopes if substantial rainfall is expected within 24 hours or the ground is already saturated.

Volatilization. Pesticides may volatilize (evaporate) from soil and plant surfaces and move off-target into the atmosphere. In general, pesticides with I<10 would have low potential to volatilize; whereas, pesticides with I >1,000 would have a high potential to volatilize (*Oregon State University 1996*). Vapor pressure values for pesticides are usually available in the pesticide product MSDS or the USDA Agricultural Research Service (ARS) pesticide database (see References).

The following threshold has been established for approving PUPs:

Where I is ≤1000, a PUP will be approved without additional BMPs to minimize drift and protect air quality.

Where I is >1000, a PUP will only be approved with additional BMPs implemented specifically to minimize drift and protect air quality.

When BMPs are required to protect air quality, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile and will be implemented during the application of the specific pesticide to reduce volatilization and drift:

- Do not treat when wind velocities are <2 or >10 mph with existing or potential inversion conditions.
- Apply the largest-diameter droplets possible for spray treatments.
- Avoid spraying when air temperatures >85°F.
- Use the lowest spray height possible above target canopy.
- Where identified on the pesticide label, soil incorporate the pesticide as soon as possible during or after application.

Octanol-Water Partition Coefficient (K_{ow}). The octanol-water partition coefficient (K_{ow}) is the concentration of a pesticide in octanol and water at equilibrium at a specific temperature. Because octanol is an organic solvent, it is considered a surrogate for natural organic matter. Therefore, K_{ow} will be used to assess the potential for a pesticide to bioaccumulate in tissues of aquatic species (e.g., fish). If K_{ow} >1000 or S_w<1 mg/L and soil $t_{½}$>30 days, then there is a high potential for a pesticide to bioaccumulate in aquatic species such as fish (*U.S. Geological Survey 2000*).

The following threshold has been established for approving PUPs:

> If there is not a high potential for a pesticide to bioaccumulate in aquatic species, then the PUP would be approved.
> If there is a high potential to bioaccumulate in aquatic species (K_{ow}>1000 or S_w<1 mg/L and soil $t_{½}$>30 days), then the PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Bioaccumulation/Bioconcentration. This is the physiological process whereby pesticide concentrations in tissue would increase in biota because they are taken and stored at a faster rate than they are metabolized or excreted. The potential for bioaccumulation will be evaluated through bioaccumulation factors (BAFs) or bioconcentration factors (BCFs). Based upon BAF or BCF values, the potential to bioaccumulate will be recorded as one of the following: low – 0 to 300, moderate – 300 to 1000, or high >1000 (*Calabrese and Baldwin 1993*).

The following threshold has been established for approving PUPs:

> If BAF or BCF is ≤1000, then a PUP would be approved without additional BMPs.
>
> If BAF or BCF is >1000, then a PUP would not approved, except under unusual circumstances where approval would only be granted by the Washington Office.

Worst-Case Ecological Risk Assessment

Max Application Rates (acid equivalent). Service personnel will record the highest application rate of an active ingredient (ae basis) for habitat management and facilities maintenance treatments in this data field of a Chemical Profile. These rates can be found in Table CP.1 of Attachment A under the column heading "Max Product Rate – Single Application (lbs/acre – AI on acid equiv basis)." This table is to be filled out prior to completing the Chemical Profile to provide the basic information needed to complete the Chemical Profile. The information included on this table can be found on the product labels for trade name products identified in PUPs. If these data are not available in pesticide labels, then write "NS" for "not specified on label" in this table.

EECs. EECs represent potential exposure of fish and wildlife (birds and mammals) to a pesticide applied on the Refuge. EECs would be derived by Service personnel using an USEPA screening-level approach (*USEPA 2004*). For each max application rate (see description under Max Application Rates [acid equivalent]), Service personnel will record two EEC values in a Chemical Profile; these will represent the worst-case terrestrial and aquatic exposures for habitat management and facilities maintenance treatments. For terrestrial and aquatic EEC calculations, see description for data entry under Presumption of Unacceptable Risk/Risk Quotients, which is the next field for a Chemical Profile.

Presumption of Unacceptable Risk/Risk Quotients. Service personnel will calculate and record acute and chronic risk quotients (RQs) for birds, mammals, and fish using the provided tabular formats for habitat management and/or facilities maintenance treatments. RQs recorded in a Chemical Profile will represent the worst-case assessment for ecological risk. See Section 7.2 for discussion regarding the calculations of RQs.

For aquatic assessments associated with habitat management treatments, RQ calculations will be based upon selected acute and chronic toxicological endpoints for fish and the EEC will be derived from Urban and Cook (*1986*) assuming 100% overspray to an entire 1-foot deep water body using the max application rate (ae basis [see above]).

For aquatic assessments associated with facilities maintenance treatments, RQ calculations will be calculated by Service personnel based upon selected acute and chronic toxicological endpoints for fish and an EEC will be derived from the aquatic assessment in AgDRIFT® model version 2.01 under Tier I ground-based application with the following input variables: max application rate (acid basis [see above]), low boom (20 inches), fine to medium/coarse droplet size, 20 swaths, EPA-defined wetland, and 25-foot distance (buffer) from treated area to water. See the section above entitled "Aquatic Exposure" for more details regarding the calculation of EECs for aquatic habitats for habitat management and facilities maintenance treatments.

For terrestrial avian and mammalian assessments, RQ calculations will be calculated by Service personnel based upon dietary exposure, where the "short grass" food item category will represent the worst-case scenario. For terrestrial spray applications associated with habitat management and facilities maintenance treatments, exposure (EECs and RQs) will be determined using the Kanaga nomogram method through the USEPA's Terrestrial Residue Exposure model (T-REX) version 1.2.3. T-REX input variables will include the following: max application rate (acid basis [see above]) and pesticide half-life (days) in soil to estimate the initial, maximum pesticide residue concentration on food items for terrestrial vertebrate species in short (<20 cm tall) grass. For granular pesticide formulations and pesticide-treated seed with a unique route of exposure for terrestrial avian and mammalian wildlife, see the section above entitled "Terrestrial Exposure" for the procedure that would be used to calculate RQs.

All calculated RQs in both tables would be compared with LOCs established by USEPA (see Table 2 in Section 7.2). If a calculated RQ exceeds an established LOC value (in brackets inside the table), then there would be a potential for an acute or chronic effect (unacceptable risk) to federally listed (T&E) species and non-listed species. See Section 7.2 for detailed descriptions of acute and chronic RQ calculations and comparison to LOCs to assess risk.

The following threshold has been established for approving PUPs:

> If RQs is ≤LOCs, then a PUP would be approved without additional BMPs.
>
> If RQs is >LOCs, then a PUP would only be approved with additional BMPs implemented specifically to minimize exposure (ecological risk) to bird, mammal, and/or fish species.

When BMPs are required to reduce the potential risk to listed or non-listed species, one or more of the following measures will be included in the Specific Best Management Practices section of the Chemical Profile:

- The application rate will be lowered and/or fewer number of applications will be conducted so RQs≤LOCs.

- For aquatic assessments (fish) associated with facilities maintenance, the buffer distance will be increased beyond 25 feet so RQs≤LOCs.

Justification for Use. Service personnel will describe the reason(s) for using the pesticide to control specific pests or groups of pests. In most cases, the pesticide label provides the appropriate information regarding control of pests, which can be included in the section.

Specific Best Management Practices (BMPs). Service personnel will record specific BMPs necessary to minimize or eliminate potential effects to non-target species and/or to minimize or eliminate degradation of environmental quality related to drift, surface runoff, or leaching. These BMPs will be based upon scientific information documented in previous data fields of a Chemical Profile. Where necessary and feasible, these specific practices will be included in PUPs as a basis for approval.

If there are no specific BMPs that are appropriate, Service personnel will describe why the potential effects to refuge resources and/or degradation of environmental quality is outweighed by the overall resource benefit(s) from the proposed pesticide use in the BMP section of the PUP. See Section 4.0 of this document for a complete list of BMPs associated with mixing and applying pesticides appropriate for all PUPs with ground-based treatments that would be additive to any necessary, chemical-specific BMPs.

References. Service personnel will record scientific resources used to provide data/information for a Chemical Profile. Use the number sequence to uniquely reference data in a chemical profile.

The following on-line data resources are readily available for toxicological endpoint and environmental fate data for pesticides:

1. California Product/Label Database. Department of Pesticide Regulation, California Environmental Protection Agency. (http://www.cdpr.ca.gov/docs/label/labelque.htm#regprods)

2. ECOTOX database. Office of Pesticide Programs, US Environmental Protection Agency, Washington, DC. (http://cfpub.epa.gov/ecotox/)

3. Extension Toxicology Network (EXTOXNET) Pesticide Information Profiles. Cooperative effort of University of California-Davis, Oregon State University, Michigan State University, Cornell University and University of Idaho through Oregon State University, Corvallis, Oregon. (http://extoxnet.orst.edu/pips/ghindex.html)

4. FAO specifications and evaluations for plant protection products. Pesticide Management Unit, Plant Protection Services, Food and Agriculture Organization, United Nations. (http://www.fao.org/WAICENT/FAOINFO/AGRICULT/AGP/AGPP/Pesticid/)

5. Human health and ecological risk assessments. Pesticide Management and Coordination, Forest Health Protection, US Department of Agriculture, US Forest Service. (http://www.fs.fed.us/foresthealth/pesticide/risk.htm)

6. Pesticide Chemical Fact Sheets. Clemson University Pesticide Information Center. (http://entweb.clemson.edu/pesticid/Document/Labels/factshee.htm)

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Attachment A - Blank Chemical Profile Form

Date:			
Trade Name(s):		**Common Chemical Name(s):**	
Pesticide Type:		**EPA Registration Number:**	
Pesticide Class:		**CAS Number:**	
Other Ingredients:			

Toxicological Endpoints

Mammalian LD_{50}:	
Mammalian LC_{50}:	
Mammalian Reproduction:	
Avian LD_{50}:	
Avian LC_{50}:	
Avian Reproduction:	
Fish LC_{50}:	
Fish ELS/Life Cycle:	
Other:	

Ecological Incident Reports

Environmental Fate

Water solubility (S_w):	
Soil Mobility (K_{oc}):	
Soil Persistence ($t_{½}$):	
Soil Dissipation (DT_{50}):	
Aquatic Persistence ($t_{½}$):	
Aquatic Dissipation (DT_{50}):	
Potential to Move to Groundwater (GUS score):	
Volatilization (mm Hg):	
Octanol-Water Partition Coefficient (K_{ow}):	
Bioaccumulation/Biocentration:	**BAF:`** **BCF:**

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** **Croplands/Facilities Maintenance:**
EECs	**Terrestrial (Habitat Management):** **Terrestrial (Croplands/Facilities Maintenance):** **Aquatic (Habitat Management):** **Aquatic (Croplands/Facilities Maintenance):**

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	[0.1]	[0.5]
	Mammals	[0.1]	[0.5]
	Fish	[0.05]	[0.5]
Chronic	Birds	[1]	[1]
	Mammals	[1]	[1]
	Fish	[1]	[1]

Justification for Use:	
Specific Best Management Practices (BMPs):	
References:	

Attachment A (continued)

Table CP.1 (Accompanies the Chemical Profile) Pesticide Name						
Trade Name[a]	Treatment Type[b]	Max Product Rate – Single Application (lbs/acre or gal/acre)	Max Product Rate - Single Application (lbs/acre - AI on acid equiv basis)	Max Number of Applications Per Season	Max Product Rate Per Season (lbs/acre/season or gal/acre/season)	Minimum Time Between Applications (Days)

[a]From each label for a pesticide identified in pesticide use proposals (PUPs), Service personnel would record application information associated with possible/known uses on Service lands.

[b]Treatment type: H – habitat management or CF – cropland/facilities maintenance. If a pesticide is labeled for both types of treatments (uses), then record separate data for H and CF applications.

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Attachment B - Completed Chemical Profiles for the Seal Beach NWR

B-1 Aquamaster, AquaNeat and Rodeo Chemical Profile (Glyphosate)

B-2 Oryzalin Chemical Profile

B-3 Imazapyr Formulations Chemical Profile

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B1- Aquamaster, AquaNeat and Rodeo Chemical Profile

Date:			
Trade Name(s):	Aquamaster, AquaNeat, Rodeo	**Common Chemical Name(s):**	glyphosate
Pesticide Type:	Herbicide, Grp 9	**EPA Registration Number:**	524-343, 228-365 62719-324
Pesticide Class:	EPSP synthase inhibitor	**CAS Number:**	1071-83-6
Other Ingredients:	**Aquamaster:** 46.2% water (1). **AquaNeat:** Other ingredients (46.2%) not listed and no regulatory advisories listed in MSDS. **Rodeo:** Other ingredients (46.2%) not listed and no regulatory advisories listed in MSDS (2).		

Toxicological Endpoints

Mammalian LD_{50}:	**Tech:** Oral: Rat, =5600 mg/kg (3); >5000 mg/kg (8); >4320 mg/kg (6). Mice: >10,000 mg/kg (3). Rabbit: >10,000 mg/kg (3). Goat: >10,000 mg/kg (3). **Aquamaster:** Oral: Rat, >5000 mg/kg (1,7); Mouse, >5000 mg/kg (1). **Rodeo:** Oral, Rat, >5000 mg/kg (7).
Mammalian LC_{50}:	No information in references.
Mammalian Reproduction:	**Tech:** Rat: 3-generation NOEL >=30mg/kg/day (diet); focal tubular dilation only effect and considered spurious rather than glyphosate-related effect by EPA as it was not observed in 2-generation study using higher doses (6); 2-generation NOEL=30000 ppm (6), =1500 mg/kg/day (6). **Aquamaster :** Oral, Rat: 3-generation NOAEL >30 mg/kg (1).
Avian LD_{50}:	**Tech:** Bobwhite >3851 mg/kg (4,8,10), >2000 mg/kg (2,6,10). Chicken: >2500 mg/kg (8). **Aquamaster:** Bobwhite >3851 mg/kg (1,7). **Rodeo:** Bobwhite >2000 mg/kg (7).
Avian LC_{50}:	**Tech:** Bobwhite: >4640 ppm (4,5,6,8,10); >4500 ppm (3); >5200 ppm (10). Mallard: >4640 ppm (4,6,8,10); >4500 ppm (3); >5200 ppm (10). **Aquamaster:** Bobwhite: >4640 ppm (1,7). Mallard: >4640 ppm (1,7).
Avian Reproduction:	**Tech:** Bobwhite: (17 wk) LOEL>1000 ppm (4,6), NOEL >1000 ppm (4,6,8). Mallard: 1-generation LOEL >30 ppm, NOEL >30 ppm (4,6); 17-wk LOEL >1000 ppm (4,6), NOEL >1000 ppm (4,6,8). **Aquamaster:** Bobwhite: (17 wk) NOEC >1000mg/kg (1,7). Mallard: 16-wk NOEC >1000 mg/kg (1).
Fish LC_{50}:	**Tech:** 96 hr: Bluegill: =120 ppm (4,6), NOEL = 100 ppm (4); =140 ppm (4,6); =120 ppm (3,5,6); <24 ppm (6); =2.4 – 240 ppm (9); =5.8-34 ppm (8). Channel catfish: =130 ppm (4,6); =3.3 – 130 ppm (9); =39 ppm (8). Fathead minnow: =97 ppm (4,6); =84.9 ppm (6); =2.3-97 ppm (9). Rainbow: =86 ppm (4,6), NOEL = 42 ppm (4); =86 ppm (3,5,6); =140 ppm (4,6); =1.4-240 ppm (9); =8.2-26 ppm (8). Carp: =3.1-620 ppm (9); =19.0 ppm (8). Coho: =1.3-210 ppm (9); =22 ppm (8). Fathead minnow: =2.3-97 ppm (9); =23 ppm (8); =84.9 ppm (6); =97 ppm (6). Brown trout: =4.5-5.4 ppm (9). **Aquamaster:** Bluegill: >1000 ppm (1,6,7). Rainbow: >1000 ppm (1,6,7). **Rodeo:** Rainbow: =60 ppm (2); =1100 ppm (7); TL_{50} >1000 ppm (7). Carp: TL_{50}>10,000 ppm (7). Bluegill: TL_{50} >1000 ppm (7).
Fish ELS/Life Cycle:	**Tech:** Fathead minnow: (ErlyLf, 255 da), LOEL > 25.7 ppm (6), NOEL > 25.7 ppm (4,6).

Other:	**Tech:** 48 hr EC_{50}: *Daphnia:* 780 ppm (3,4,6), NOEL = 560 ppm (4); =13-37 ppm (8); =5.3– 96 ppm (9). ErlyLf (21 da): =96 ppm (4,6), NOEL =50 ppm (4,6);. Duckweed: =21.5 ppm (6). Green algae: =12.5 ppm (6). American toad: LC_{50}=2.52 ppm (9); LOEC=5.0 ppm (9), NOEC=1.0 ppm (9). Bullfrog: LC_{50}=2.07 ppm (9); LOEC=5.0 ppm (9), NOEC=1.0 ppm (9). Leopard frog: LC_{50}=2.46 ppm (9); LOEC=5.0 ppm (9), NOEC=1.0 ppm (9). **Aquamaster:** *Daphnia*: LC_{50} =930 ppm (1,7). **Rodeo:** *Daphnia*, LC_{50}=218 ppm (7).

Ecological Incident Reports

No reports in references.

Environmental Fate

Water solubility (S_w):	Water solubility =900,000 ppm (5), =12,000 ppm (3).
Soil Mobility (K_{oc}):	Koc = 884-60,000 (1), 24,000 (3).
Soil Persistence ($t_{½}$):	Soil photolysis = stable (6). Aerobic soil metabolism ½ life = 2.1 days (6).
Soil Dissipation (DT_{50}):	Field dissipation half-life (vegetation) = 10.4 to 26.6 days (5).
Aquatic Persistence ($t_{½}$):	Hydrolysis = stable @ pH 3, 6 & 9 (6). Aqueous photolysis = stable @ pH 5, 7 & 9 (6). Anaerobic aquatic metabolism ½ life = 8.1 days (6). Water DT_{50} < 7 days (1), 12 - 70 days (3).
Aquatic Dissipation (DT_{50}):	Aquatic field dissipation ½ life = 7.5-120 days (6).
Potential to Move to Groundwater (GUS score):	Low (13)
Volatilization (mm Hg):	Negligible (3)
Octanol-Water Partition Coefficient (K_{ow}):	No information in references.
Bioaccumulation/Biocentration:	**BAF:** **BCF:** <1 (6, 11)

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 2.0 **Croplands/Facilities Maintenance:** 2.0
EECs	**Terrestrial (Habitat Management):** 480 ppm **Terrestrial (Croplands/Facilities Maintenance):** 480 ppm **Aquatic (Habitat Management):** 0.74 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.0067 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.11 [0.1]	=0.11 [0.5]
	Mammals	=0.11 [0.1]	=0.11 [0.5]
	Fish	=0.01 [0.05]	=0.01 [0.5]
Chronic	Birds	=0.48 [1]	=0.48 [1]
	Mammals	=0.32 [1]	=0.32 [1]
	Fish	=0.03 [1]	=0.03 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.11 [0.1]	=0.11 [0.5]
	Mammals	=0.11 [0.1]	=0.11 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.48 [1]	=0.48 [1]
	Mammals	=0.32 [1]	=0.32 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:

Specific Best Management Practices (BMPs):

References:

[1]___. 2001. Aquamaster MSDS. Monsanto Co., 800 N. Lindbergh Blvd. St. Louis, MO. 8 pp.

[2]___. 2000. Rodeo MSDS. Dow AgroSciences, 9330 Zionsville Road, Indianapolis, IN. 3 pp.

[3]___. 1996. Glyphosate. Extension toxicology network (EXTOXNET) pesticide information profiles. Oregon State University, Corvallis, OR 4 pp.

[4]___. 2000. USEPA one-liner database.

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[6]____. 1993. Glyphosate reregistration eligibility decision EPA 738-R-93-14. Office of Prevention, Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Washington, D.D. 291 pp.

[7]____. 1999. Glyphosate - human health and ecological risk assessment final report. Prepared for USDA-Forest Service by Syracuse Environmental Research Associates, Inc. Fayetteville, NY to USDA-APHIS, Biotechnology, Biologics and Environmental Protection, Environmental Analysis and Documentation, Riverdale, MD. pp.

[8]_____. 2001. FAO specifications and evaluations for plant protection products – Glyphosate. Food and Agriculture Organization, United Nations, New York, NY. 33 pp.

[9]Office of Pesticide Programs. 2000. ECOTOX: aquatic report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, U.S. Environmental Protection Agency, Washington, D.C.

[10]Office of Pesticide Programs. 2000. ECOTOX: terrestrial report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, U.S. Environmental Protection Agency, Washington, D.C.

[11]Office of Pesticide Programs. 2000. Active ingredient fate studies: glyphosate. Pesticide Fate Database, Environmental Fate and Effects Division, U.S. Environmental Protection Agency, Washington, D.C.

[12]_____. 1999. AquaNeat MSDS. Nufarm Americas, Inc., Burr Ridge, IL. 4 pp.

[13]Natural Resource Conservation Service. 2006. Pesticide properties database – AIData spreadsheet. USDA, Washington, D.C.

B2 - Oryzalin Chemical Profile

Date:	12/22/10		
Trade Name(s):	Surflan AS Surflan WDG	**Common Chemical Name(s):**	oryzalin
Pesticide Type:	Herbicide/Grp 3	**EPA Registration Number:**	70506-44 70506-50
Pesticide Class:	dinitroaniline	**CAS Number:**	19044-88-3
Other Ingredients:	Surflan AS: <40% by wt. glycerin, <40% by wt. propylene glycol (1). Surflan WDG: 15% by wt. kaolin (2).		

Toxicological Endpoints

Mammalian LD_{50}:	Rats: >5000 mg/kg (1,2,3,7). Mice: >5000 mg/kg (3). Dog: >1000 mg/kg (3). Chicken: >1000 mg/kg (3).
Mammalian LC_{50}:	Dietary NOEL >300 ppm (7).
Mammalian Reproduction:	No adverse effects on reproduction in a three-generation study fed dietary concentrations up to 112.5 mg/kg/day (3,9).
Avian LD_{50}:	Bobwhite: =1046 mg/kg (1,2); >500 mg/kg (3); =506.7 mg/kg (4,9). Mallard: >500 mg/kg (3); =427 mg/kg (7). Chicken: =1000 mg/kg (3).
Avian LC_{50}:	Bobwhite: >5000 ppm (3,4,9,10). Mallard: >5000 ppm (3,4,9,10).
Avian Reproduction:	Bobwhite: LOEL =1000 ppm (10), NOEL =1000 (10). Mallard: LOEL =1000 ppm (10), NOEL =1000 ppm (9,10).
Fish LC_{50}:	Bluegill: =2.88 ppm (3,5,8,9,10). Rainbow trout: =2.86 ppm (7); =3.26 ppm (3,5,9,10); =3.355 ppm (8); =3.45 ppm (5,10). Goldfish: =1.4 ppm (3).
Fish ELS/Life Cycle:	Rainbow trout: 21-day chronic NOEC =0.46 ppm (7,9,10). Fathead minnow: MATC =0.22 ppm (9); LOEL =0.43 ppm (10), NOEL =0.22 ppm (10).
Other:	Water flea: EC_{50} =1.5 ppm (5,10); =1.02 ppm (7); =1.4 ppm (9); 21-day chronic NOEC =0.36 ppm (7). Aquatic sowbug: =0.4 ppm (5); =0.7 ppm (8). Scud: =0.19 ppm (5); =0.495 ppm (8). Red Swamp crayfish: =400-10,000 ppm (5). Midge: 28-day chronic NOEC =1.0 ppm (7). Honeybee: oral >100 ug (1,2); =>11ug (3,9,10); =32 ug/bee (7). Blue-green algae: EC_{50} =0.0181 ppm (7); =0.024 ppm (8,10). Green algae: =0.042 ppm (8,9,10). Duckweed: EC_{50} =0.0154 ppm (5,7,8,9,10). Earthworm: LC_{50} >500 mg/kg (7).

Ecological Incident Reports

No reports in references.

Environmental Fate

Water solubility (S_w):	=1.13 mg/L (7); =3.0 mg/L (8).
Soil Mobility (K_{oc}):	=949 ml/g (7); =807 ml/g (8).
Soil Persistence ($t_{½}$):	=20 days (3). Soil photolysis =0.933 days (6,9). Aerobic soil metabolism =63 days (6,8,9). Anaerobic soil metabolism =10 days (6,8,9).
Soil Dissipation (DT_{50}):	=20-120 days (3). Aerobic soil degradation =20 days (7). Field dissipation =68 days in sand soil FL (9); biphasic degradation in silty clay loam soil in MI 77 days and 146 days, and in loam soil in CA 58 days and 138 days (9).

Aquatic Persistence ($t_{½}$):	Hydrolysis =Stable @ pH 5-9 (6,9); =28 days (8) =stable (7). Aquatic photolysis =0.0958 days @ pH 5 (6); =0.21 days @ pH 5 (9); =0.08 days (7).
Aquatic Dissipation (DT_{50}):	Water-sediment =32.7 days (7); water phase only =5.9 days (7).
Potential to Move to Groundwater (GUS score):	=1.33
Volatilization (mm Hg):	=7.5x10^{-07} mm Hg (7).
Octanol-Water Partition Coefficient (K_{ow}):	Kow =5.37x10^{-3} (7).
Bioaccumulation/Biocentration:	**BAF:** Low (7). **BCF:** Edible tissue =37.5; viscera =122; whole body =75.8 (6), =66.1 (7). Bluegill =32.2 edible tissue; =105.7 viscera; =66.1 whole fish (9), >75% depuration within 24 hrs.

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 2.0 lbs. a.i./acre **Croplands/Facilities Maintenance:** 2.0 lbs. a.i./acre
EECs	**Terrestrial (Habitat Management):** 480 ppm **Terrestrial (Croplands/Facilities Maintenance):** 480 ppm **Aquatic (Habitat Management):** 0.552 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00503 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.10 [0.1]	=0.10 [0.5]
	Mammals	=0.04 [0.1]	=0.04 [0.5]
	Fish	=0.39 [0.05]	=0.39 [0.5]
Chronic	Birds	=0.48 [1]	=0.48 [1]
	Mammals	=0.21 [1]	=0.21 [1]
	Fish	=1.20 [1]	=1.20 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.10 [0.1]	=0.10 [0.5]
	Mammals	=0.04 [0.1]	=0.04 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.48 [1]	=0.48 [1]
	Mammals	=0.21 [1]	=0.21 [1]
	Fish	=0.01 [1]	=0.01 [1]

Justification for Use:	
Specific Best Management Practices (BMPs):	1 application @ 1.5 lbs. a.i./acre/year. Maintain a minimum 25-foot buffer zone between all upland treatment site(s) and the high water mark of the nearest surface water resource(s). Do not apply oryzalin to sites upslope to surface water resources with >10° slope.

References:

[1]_____. 2009. Surflan AS specimen label & MSDS. United Phosphorus, Inc., King of Prussia, PA. 12 and 8 pp., respectively.

[2]_____. 2006 & 2009, respectively. Surflan WDG specimen label & MSDS. United Phosphorus, Inc., King of Prussia, PA. 6 & 8 pp., respectively.

[3]_____. 1996. EXTOXNET – Pesticide Information Profile, Oryzalin. Web database maintained by Oregon State Univ., Corvallis, OR.

[4]Office of Pesticide Programs. 2000. ECOTOX: terrestrial report, pesticide ecotoxicity database. Environmental Fate and Effects Division, USEPA, Washington, D.C.

[5]Office of Pesticide Programs. 2000. ECOTOX: aquatic report, pesticide ecotoxicity database. Environmental Fate and Effects Division, USEPA, Washington, D.C.

[6]Office of Pesticide Programs. 2000. Pesticide fate database: active Ingredient fate studies. Environmental Fate and Effects Division, USEPA, Washington, D.C.

[7]_____. 2009. Pesticide properties database. Agricultural & Environmental Research Unit, Science and Technology Research Institute, University of Hertfordshire, Hatfield, UK.

[8]____. 2000. Pesticide database – oryzalin. Pesticide Action Network, San Francisco, CA.

[9]Special Review and Reregistration Division. 1994. Reregistration eligibility decision (RED) – oryzalin EPA 738-R-94-016. Office of Prevention, Pesticides and Toxic Substances, U.S. EPA, Washington, D.C. 223 pp.

[10]_____. 2000. U.S. EPA one-liner database. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, D.C.

B3 - Imazapyr Formulations Chemical Profile

Date:	1/6/11		
Trade Name(s):	Habitat, Arsenal, Stalker, Ecomazapyr 2 SL	**Common Chemical Name(s):**	imazapyr
Pesticide Type:	Herbicide Group 9	**EPA Registration Number:**	241-426, 241-346, 241-398, 74477-6
Pesticide Class:	imidazolinone	**CAS Number:**	81510-83-0
Other Ingredients:	**Habitat:** 71.3% proprietary ingredients (1a). **Arsenal:** 71.3% proprietary ingredients (1b). **Stalker:** 72.4% proprietary ingredients (1c). **Ecomazapyr 2 SL:** 72.2% proprietary ingredients (1d).		

Toxicological Endpoints

Mammalian LD_{50}:	**Amine Salt:** Rat, oral: >5000 mg/kg (combined sexes) (1a,5,6); >2,000 mg/kg (7).
Mammalian LC_{50}:	Rat, dietary: **Acid:** NOEL=10,000 ppm (7).
Mammalian Reproduction:	Chronic studies in three mammalian species (dogs, rats, and mice) and several reproduction studies in two mammalian species (rats and rabbits) indicate that imazapyr is not likely to be associated with adverse effects at relatively high dose levels (6).
Avian LD_{50}:	**Acid:** Bobwhite: >2150 mg/kg (2,5,6,8), NOEL=2150 mg/kg (2). Mallard: >2150 mg/kg (2,5,6,7,8), NOEL>2150 mg/kg (2).
Avian LC_{50}:	**Acid:** Bobwhite: >5000 ppm (2,6,8), NOEL>5000 ppm (2). Mallard: >5000 ppm (2,6,8), >5000 ppm (2). **Amine Salt:** Bobwhite: >5000 ppm (2), NOEL=5000 ppm (2).
Avian Reproduction:	**Acid:** ErlyLf: Bobwhite: LOEL<2000 ppm (2), NOEL=1000 ppm (2); NOEC=2000 ppm (6). Mallard: LOEL>1890 ppm, NOEL=1890 ppm (2); NOEC=2000 ppm (6).
Fish LC_{50}:	**Acid:** Bluegill: >100 ppm (2,5,6,9), NOEL=100 ppm (2); =100 ppm (3); 1000 ppm (3,6); =180 ppm (6); =24 ppm (9); =75 ppm (9). Rainbow: >100 ppm (2,5,6,7,9), NOEL=100 ppm (2); =100 ppm (3); =110 ppm (6); =6.7 ppm (9). Channel catfish: >100 ppm (2,5,6), NOEL=100 ppm (2); =100 ppm (3). **Amine Salt:** Bluegill: >1000 ppm (2), NOEL=1000 ppm (2).
Fish ELS/Life Cycle:	**Acid:** Rainbow: LOEC=92 ppm (2), NOEC=43.1 ppm (2), investigators reported nearly significant results, but discount the significance of the results due to a lack of correlation to test concentration and lack of corresponding reductions in wet and dry weights (6). Fathead minnow: LOEC>120 ppm (6), NOEC=120 ppm (6); LOEC>118 ppm (6), NOEC>118 ppm (6).
Other:	**Acid:** *Daphnia*: EC_{50}>100 ppm (2,5,6,9), =100 ppm (3,7); LOEC=350 ppm (6), NOEC=180 ppm (6). ErlyLf: LOEC>97.1 (2,6), NOEC>97.1 ppm (2,6). Green algae: EC_{50}=71 ppm (2,3,6,9). Bluegreen alage: EC_{50}=12.2 ppm (2,3); =11.7 ppm (6). Duckweed: EC_{50}=0.024 ppm (2,3,6,7). Honeybee: =25 ug/bee (7). Earthworms: =133 mg/kg (7). **Amine Salt:** *Daphnia*: EC_{50}=750 ppm (2,3), NOEL=560 ppm (2); =6.6 ppm (3).

Ecological Incident Reports

USEPA EIIS has records of 12 incidents related to the use of Imazapyr. Four incidents involved aquatic resources including fish kills. One report agricultural runoff to a pond resulting in a possible fish kill from Imazapyr, but could not definitively determine mortalities were directly related to Imazapyr exposure. Two other reports involved a mixture of herbicides, one of which was imzapyr. Because a mixture was involved it could not be definitively determined the mortalities were due to Imazapyr exposure. A fourth report involved a goldfish kill from suspected runoff following aerial application of Imazapyr.

Environmental Fate

Water solubility (S_w):	**Acid:** =15,000 ppm (4); =9740 ppm (7). **Amine salt:** 650,000 ppm (4).
Soil Mobility (K_{oc}):	**Acid:** Koc =125 ml/g (7). Adsorption to soil particles is generally weak, but can vary depending on soil properties. Adsorption is reversible, and desorption occurs readily. Because the chemical form is determined by pH, the adsorption capacity of imazapyr changes with soil pH. A decline in pH below 5 increases adsorption to soil particles. Above pH 5, imazapyr becomes ionized, increasing its negative charge, and limiting its ability to bind with soils. (5)
Soil Persistence ($t_{½}$):	**Acid:** Microbial degradation is the primary mechanism in the soil. Average soil ½ life =69 to 155 days (5). Aerobic soil ½ life =4.5 days (4); =11 days (7). Aerobic and anaerobic soil degradation = stable (10).
Soil Dissipation (DT_{50}):	**Acid:** Field dissipation ½ life = 90 days (4). **Amine salt:** Field dissipation ½ life =90 days (4).
Aquatic Persistence ($t_{½}$):	**Acid:** Aqueous photolysis ½ life =2 days (5); =3 to 5 days (10). Hydrolysis =stable (10). Aerobic and anaerobic aquatic metabolism =stable (10).
Aquatic Dissipation (DT_{50}):	No data in references.
Potential to Move to Groundwater (GUS score):	=1.98 (7).
Volatilization (mm Hg):	=9.75x10^{-8} (7).
Octanol-Water Partition Coefficient (K_{ow}):	Log Kow=0.11 (7).
Bioaccumulation/Biocentration:	**BAF:** Low – calculated (7). **BCF:** =2.54 (7).

Worst Case Ecological Risk Assessment

Max Application Rate (ai lbs/acre – ae basis)	**Habitat Management:** 1.5 lbs. a.e./acre **Croplands/Facilities Maintenance:** 1.5 lbs. a.e./acre
EECs	**Terrestrial (Habitat Management):** 360 ppm **Terrestrial (Croplands/Facilities Maintenance):** 360 ppm **Aquatic (Habitat Management):** 0.552 ppm **Aquatic (Croplands/Facilities Maintenance):** 0.00503 ppm

Habitat Management Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.07 [0.1]	=0.07 [0.5]
	Mammals	=0.04 [0.1]	=0.04 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]

Chronic	Birds	=0.07 [1]	=0.07 [1]
	Mammals	=0.04 [1]	=0.04 [1]
	Fish	<0.01 [1]	<0.01 [1]

Cropland/Facilities Maintenance Treatments:

Presumption of Unacceptable Risk		**Risk Quotient (RQ)**	
		Listed (T&E) Species	**Nonlisted Species**
Acute	Birds	=0.07 [0.1]	=0.07 [0.5]
	Mammals	=0.04 [0.1]	0.04 [0.5]
	Fish	<0.01 [0.05]	<0.01 [0.5]
Chronic	Birds	=0.07 [1]	=0.07 [1]
	Mammals	=0.04 [1]	=0.04 [1]
	Fish	<0.01 [1]	<0.01 [1]

Justification for Use:	Reduced risk herbicide active ingredient that may be used in upland, riparian and aquatic habitats.
Specific Best Management Practices (BMPs):	No specific BMPs associated with this active ingredient.
References:	[1a]_____. 2004 & 2002, respectively. Habitat specimen label & MSDS. BASF Corp., Agricultural Products Group, Research Triangle Park. 13 & 4 pp., respectively. [1b]_____. 2004 & 2002, respectively. Habitat specimen label & MSDS. BASF Corp., Agricultural Products Group, Research Triangle Park. 13 & 4 pp., respectively. [1c]_____. 2004 & 2002, respectively. Habitat specimen label & MSDS. BASF Corp., Agricultural Products Group, Research Triangle Park. 13 & 4 pp., respectively. [1d]_____. 2004 & 2002, respectively. Habitat specimen label & MSDS. BASF Corp., Agricultural Products Group, Research Triangle Park. 13 & 4 pp., respectively. [2]_____. 2000. USEPA one-liner database. [3]_____. 2000. Pesticide database. Pesticide Action Network, San Francisco, CA. [4]_____. 1995. ARS pesticide properties database. USDA-ARS, Washington, D.C. [5]Tu, et al. 2001. Imazapyr. Weed Control Handbook, The Nature Conservancy. 7 pp. [6]Syracuse Environmental Research Associates, Inc. 2004. Imazapyr – human health and ecological risk assessment – final report. Prepared for USDA, Forest Service (GSA Contract No. GS-10F-0082F), Washington, D.C. 149 pp. [7]_____. 2009. Pesticide properties database. Agricultural & Environmental Research Unit, Science and Technology Research Institute, University of Hertfordshire, Hatfield, UK. [8]Office of Pesticide Programs. 2000. ECOTOX: terrestrial report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, USEPA, Washington, D.C. [9]Office of Pesticide Programs. 2000. ECOTOX: aquatic report. Pesticide Ecotoxicity Database, Environmental Fate and Effects Division, USEPA, Washington, D.C. [10]_____. 2006. Reregistration eligibility decision (RED) document for imazapyr, List C, Case Number 3078. Office of Pesticide Programs, Prevention, Pesticides and Toxic Substances, USEPA, Washington, D.C. 100 pp.

Appendix D:

Draft Mosquito Management Plan for the Seal Beach National Wildlife Refuge

Draft Mosquito Management Plan
for the
Seal Beach National Wildlife Refuge

(March 2011)

Prepared by: _____ Date: _____
Victoria Touchstone
Refuge Planner

Concurrence: _____ Date: _____
Regional Integrated Pest
Management Coordinator

Concurred: _____ Date: _____
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Assistant Regional Director, Refuges
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1.0 Introduction

This Mosquito Management Plan has been prepared to provide guidance for when and how mosquito monitoring, management, and control should be implemented on the Seal Beach National Wildlife Refuge (NWR or Refuge). Mosquito management is particularly important on this Refuge because of the proximity of the Refuge's coastal wetlands to urban development in both Orange County and Los Angeles County, California. The U.S. Fish and Wildlife Service (Service) has and will continue to work with the Orange County Vector Control District (OCVCD), the agency responsible for mosquito management in and around the Refuge, to ensure that management of mosquitoes on the Refuge will support OCVCD's efforts to protect public health and safety as it relates to mosquito-borne diseases. Because the Refuge is located within the boundaries of Naval Weapons Station Seal Beach (NWSSB), mosquito management on the Refuge will also involve coordination with the Navy.

Mosquitoes are a natural component of most of the world's wetland habitats, including freshwater wetlands, brackish marshes, and coastal salt marshes, and various species of mosquitoes are found throughout the United States. In California, more than 50 species of mosquitoes have been documented. Most these species are relatively uncommon and seldom pose a threat to public health (*University of California 2009*). Others, such as species in the genera *Culex, Aedes*, and *Anopheles*, represent a significant public health concern because they are known to transmit microbial organisms that cause human diseases. Although 12 mosquito-borne viruses, including malaria, are known to occur in California, today only West Nile encephalitis virus (WNV), western equine encephalomyelitis virus, and St. Louis encephalitis virus are significant causes of human disease. This is also true in Orange County, California, where some 22 species of mosquitoes are known to be present.

The first efforts to control mosquito production in California began in the early 1900s in the diked reclaimed salt marshes along San Francisco Bay (*San Mateo County Mosquito and Vector Control District no date*). In 1915, the State passed the Mosquito Abatement Act, which established publicly funded special districts to control mosquitoes (*Sutter-Yuba Mosquito Vector Control District no date*). More than 70 mosquito and vector control agencies have been established in California since 1915. In Orange County, California, mosquito surveillance and control is implemented by OCVCD. OCVCD currently conducts mosquito monitoring and implements limited mosquito control on the Seal Beach NWR in accordance with the conditions outlined in a Refuge Special Use Permit (SUP) that is issued annually to the District. The pesticides currently used on the Refuge, which will be addressed in greater detail below, have been approved through the Service's Pesticide Use Proposal (PUP) process.

Nationally, mosquito management on National Wildlife Refuges has been a controversial issue with some segments of the public for many years. In response to requests by local residents and/or political officials, mosquito control agencies have routinely sought permission to access refuges for mosquito control. Permission has been readily granted in those rare cases where a mosquito-borne disease has resulted in a documented public health emergency. However, requests for control solely to address annoyance mosquitoes have raised a myriad of concerns and, as a result, access for mosquito control on refuges has varied across the National Wildlife Refuge System (NWRS). Refuge managers are concerned about introducing toxic substances onto refuges, including direct effects of mosquito management techniques on non-target invertebrates and other species and indirect effects associated with reductions in mosquito populations and other non-target species that form the base of food chains.

In an effort to address concerns related to mosquito control on refuges and to provide a process for determining if and how to manage mosquito populations within the NWRS, the Service has drafted a Mosquito and Mosquito-Borne Disease Management Policy. The draft policy, published in the Federal Register on October 15, 2007 (72FR58321), states that a mosquito management plan is to be prepared for Refuges with current mosquito control or mosquito monitoring programs. Although the Service's mosquito policy has not yet been approved, a Mosquito Management Plan for the Seal Beach NWR has been prepared because mosquito management is already taking place on the Refuge.

This Mosquito Management Plan, which represents a "step-down plan" for the Refuge, has been prepared concurrent with the development of the Comprehensive Conservation Plan (CCP) for the Refuge. The CCP provides a general discussion of mosquito management on the Refuge, while the Management Plan provides specific details about the mosquito management actions proposed for the Refuge. The Management Plan also provides guidance for how current mosquito management could be expanded under certain conditions. The potential effects on the environment of current and future mosquito management activities are addressed in the CCP/Environmental Assessment (EA). This Mosquito Management Plan also complements the pest management practices to be implemented under the Refuge's Integrated Pest Management Plan (Appendix C), another step-down plan prepared for the Refuge concurrent with the CCP.

2.0 Refuge Location and Establishment

Seal Beach NWR encompasses approximately 965 acres of coastal salt marsh, tidal channels, mudflats, open bay, restored open water areas, and uplands in northwestern Orange County, California (Figure 1). The Refuge, which is managed by the Service as part of the NWRS, is located entirely within the boundaries of NWSSB. The Refuge was established in 1974 under authority of the National Wildlife Refuge System Administration Act of 1966, as amended (80 Stat. 927; 16 U.S.C. 668dd-668ee) for the purpose of preserving and managing habitat "necessary for the perpetuation of two endangered species, the light-footed clapper rail and California least tern, and preserving habitat used by migrant waterfowl, shorebirds, and other water birds."

3.0 Purpose of the Plan

The purpose of this Mosquito Management Plan is to ensure that activities associated with surveying and controlling mosquito populations on the Seal Beach NWR are compatible with the establishing purposes of the Refuge. Under this plan, mosquito management would be implemented through a phased approach that is consistent with the principles of integrated pest management. The Plan includes ongoing coordination with the OCVCD and incorporates the recommendation of the Service's draft Mosquito and Mosquito-Borne Disease Management Policy. This draft policy provides a standard process for refuges to follow and criteria to consider when making decisions regarding management of mosquitoes and mosquito-borne disease. Mosquito control management plans and documentation of management actions on refuges are necessary to protect threatened and endangered plants, fish, and wildlife and to ensure the health and welfare of surrounding human populations.

Figure 1. Location Map – Seal Beach National Wildlife Refuge

With the spread of WNV and the potential for spread of other mosquito-borne disease, there is increasing pressure to manage mosquito populations that occur on lands of the NWRS, especially in urban areas such as coastal southern California. The Refuge considers some mosquitoes a natural component of tidal wetlands, but also recognizes that mosquitoes may pose a threat to human and/or wildlife health.

4.0 Need for the Plan

It is well known that mosquitoes (members of the Phylum Arthropoda) can be vectors of disease to both humans and wildlife and in some cases can cause death. Arthropod-borne viruses (termed "arboviruses") are viruses that are maintained in nature through biological transmission between susceptible vertebrate hosts by blood-feeding arthropods (e.g., mosquitoes, sand flies, ticks). Vertebrates can become infected when an infected arthropod bites them to take a blood meal (*CDC 2009*). Recently, the arbovirus, WNV, has been of particular concern. With the swift westward advance of WNV across the U.S., concern by the public and the Service over mosquito management and disease prevention has intensified. As a result, Service personnel across the refuge system have undertaken a number of actions, including: stepping-up coordination and communication with mosquito experts in regional and local mosquito control districts, universities, and elsewhere; increasing communication with public health officials; participating in mosquito management seminars and workshops; initiating mosquito management-oriented research on refuges; and conducting restoration that benefits natural resources and reduces the need for mosquito management.

The implementation of measures to control mosquitoes in wetlands has a long history dating back to the 1900s. One of the first mosquito control projects was not implemented for disease control, but to abate severe nuisance infestations of salt-marsh mosquitoes in the San Francisco Bay Area (*Peters 1966, Fontaine 1980*). When 112 people died in California in 1909 as a result of contracting the mosquito-borne disease, malaria, significant attention was directed towards controlling mosquito populations throughout the state. In 1915, the Mosquito Abatement Act was passed, giving local governments the power to obtain revenues and form special districts for the purpose of protecting the public from mosquitoes and mosquito-borne diseases.

Historic measures for reducing mosquitoes included draining or filling wetlands and spreading oil over the surface of open water areas. Today, a suite of measures are implemented to control mosquitoes from restoration of degraded wetland areas to improve tidal flow to the application of various forms of pesticides. The OCVCD and the Refuge both advocate for an integrated approach to mosquito management that includes a range of tools to improve habitat conditions for estuarine wildlife while reducing threats to public health from mosquito species capable of transmitting disease to humans. It is the intent of this Mosquito Management Plan to further define this approach to mosquito surveillance and control on the Seal Beach NWR.

5.0 Mosquitoes and Mosquito-borne Disease

5.1 West Nile Virus

In the United States, WNV is transmitted by infected mosquitoes, primarily members of the *Culex* and *Aedes* species, although 64 mosquito species have been identified in WNV positive mosquito pools in the U.S. since 1999 (*CDC 2009*). Ten California species of mosquito that are known vectors of arboviruses or as major pests were evaluated for WNV transmission in 2002. Individuals from all ten species were found to be infected with WNV and were able to transmit the

disease at some level (*Goddard et al. 2002*). *Culex tarsalis* is considered one of the most efficient laboratory vectors of WNV tested from North America. This species is abundant in California and much of western North America, where it is involved in the maintenance and amplification of western equine encephalomyelitis virus and Saint Louis encephalitis virus (*Goddard et al. 2002*). *Culex tarsalis* larvae are typically found in irrigation ditches, ponds, and storm sewers, and other areas that usually contain abundant organic material. It is not known to breed on the Seal Beach NWR.

OCVCD is responsible for mosquito monitoring and control throughout Orange County, California, as well as for tracing current and future vector threats. The District maintains a website that provides updated information on the issues related to WNV and other mosquito-borne diseases. According to the OCVCD website (http://www.ocvcd.org/wnv1.php), between January 1 to October 13, 2010, 19 sites in Orange County were found to have mosquitoes infected with WNV. All of these sites were located in northern Orange County, but none were located on or near the Refuge. To date in 2010, 12 dead birds (all crows) have tested positive for WNV, with the majority of these infected birds found in northern Orange County. None of these birds were recovered in proximity to the Refuge. One person residing in Huntington Beach, located to the south of the Refuge, was reported to have contracted WNV in 2010. There have been no reports in Orange County in 2010 of horse infections, but one squirrel has tested positive for WNV. No reported infections of St. Louis or western equine encephalitis have occurred in the County to date in 2010 (*Rob Velten, OCVCD, pers. comm.*).

5.2 Mosquito Populations on the Refuge

Only two mosquito species are known to breed on the Refuge: *Ochlerotatus* (*Aedes*) *taeniorhynchus*, black salt marsh mosquito, and *Ochlerotatus* (*Aedes*) *squamiger*, California salt marsh mosquito. No freshwater wetland areas that would support breeding habitat for freshwater mosquitoes are present on the Refuge, but adult *Culex tarsalis*, the western encephalitis mosquitoes, have been trapped on the Refuge, indicating that appropriate breeding habitat is present in the general vicinity of the Refuge.

Ochlerotatus (*Aedes*) *taeniorhynchus* appears to be the species most often present on the Refuge during mosquito monitoring. The larvae of this species develop in the higher elevation pickleweed flats on the Refuge that experience periodic flooding during higher high tides. This species is an aggressive biter during the day and at dusk, and can be troublesome to coastal residents living near breeding sources. Females are known to fly long distances (up to 20 miles) for a blood meal. The Centers for Disease Control and Prevention (CDC) (*2009*) reports that this species has been found in WNV positive mosquito pools in the U.S. in all years between 2001 and 2008, except in 2004.

Ochlerotatus (*Aedes*) *squamiger*, present less often on the Refuge based on monitoring conducted over the past few years, is an extremely aggressive day and dusk biter with the capacity to disperse long distances (up to 15 miles) to obtain a blood meal. Research on this species indicates that it may be a public health concern (*Lang 2003*). Bolsa Chica populations have been found naturally infected with a California-group encephalitis (Morro Bay) virus. The potential impact of this virus on residents inhabiting coastal areas is unknown (OCVCD Website no date). Between 2001 and 2008, this species was only found in WNV positive mosquito pools in the U.S. in 2004.

Culex tarsalis, which does not appear to breed on the Refuge, is the main vector identified in the transmission of WNV, St. Louis encephalitis, and western equine encephalitis within Orange

County. It is more common in the rural areas of Orange County, but can be found breeding throughout the county in association with clean, standing freshwater sources.

5.3 Historical Mosquito Production Areas of the Refuge

The areas most prone to mosquito production on the Refuge are the upper edges of the marsh complex where the highest high tides (spring tides) of each month leave behind small pools of stagnant bay water, which salt marsh mosquitoes quickly populate. Another area that is subject to mosquito breeding, particularly following a higher high tide, is the eastern end of the Bolsa Cell. An area near NASA Island was also identified as supporting salt marsh mosquitoes following high tides; however, management actions have been implemented by the Refuge to ensure that adequate drainage is occurring in this area to avoid the future development of stagnant ponds following high tide events. No freshwater ponding occurs on the Refuge; therefore, appropriate conditions for breeding by freshwater mosquitoes, such as *Culex tarsalis*, are not present on the Refuge.

6.0 History of Mosquito Surveillance and Control on the Refuge

6.1 Mosquito Surveillance

OCVCD begins mosquito surveillance on the Refuge in the spring, generally around the end of April, and continues at intervals of about once a week through October of each year. Communication between the Refuge and OCVCD occurs periodically throughout the year, but the primary planning for mosquito monitoring occurs annually when the agencies meet to evaluate past and proposed mosquito management activities and coordinate all necessary permitting and implementation planning for the upcoming year. A SUP is issued to OCVCD prior to the beginning of each mosquito season. The current SUP, issued for the 2010 mosquito season, includes six pre-approved monitoring and control sites (Figure 2). Monitoring and control in other areas of the Refuge is permitted on a case by case basis, following review and consideration by the Refuge Manager, and such activities can only occur when the Refuge Manager or a representative designated by the Refuge Manager is present on the site to ensure the protection of listed species and sensitive habitat.

Mosquito monitoring in natural areas on the Refuge is to be conducted on foot and OCVCD personnel are asked to walk in disturbed or sparsely vegetated portions of designated control areas to the maximum extent possible in an effort to avoid impacts to sensitive habitat, as well as to minimize the potential for disturbance to nesting birds, such as Belding's savannah sparrow. Monitoring to determine the presence or abundance of mosquito larvae in these areas involves evaluating current site conditions, taking dip samples from areas of ponded water, and checking mosquito traps.

The primary technique for determining the extent of the larval population within a specific area on the Refuge is the dip count. The dip count technique involves the use of a 16 ounce dipper that is dipped into a pool of water. The water is then examined for the presence of mosquito larvae. The numbers of larvae in each dip, as well as the species of the larvae present, are recorded. The dipping technique is difficult to standardize, but on the Refuge, dips are generally taken once a week during the breeding season. Dip samples, which are often timed to be taken after higher high tides, are obtained around the eastern edges of the salt marsh habitat from pools of water left behind by the higher high tides. Dip samples are also taken from the eastern end of the Bolsa Cell where monthly higher high tides also leave behind stagnant pools of salt water. Dip samples are taken randomly throughout the site with up to twenty dip samples per site unless the count for

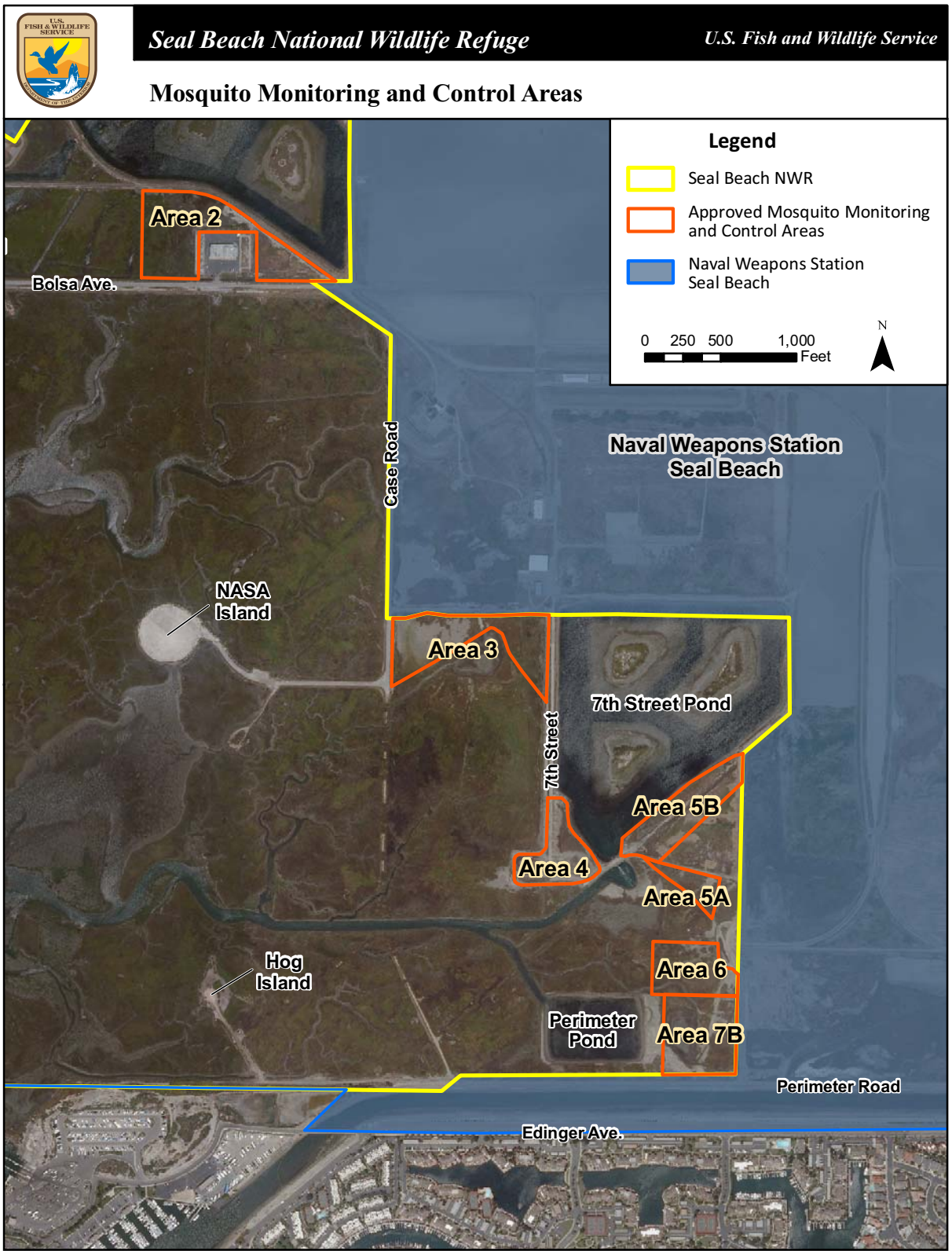

Figure 2. Areas Approved for Mosquito Monitoring and Control on the Seal Beach National Wildlife Refuge

treatment (e.g., generally around one larvae per ten dip samples) is achieved in a smaller number of dip samples.

The OCVCD monitors the presence of adult mosquitoes on the Refuge by using carbon dioxide traps. These traps, which emit carbon dioxide, mimic a potential blood-meal to the mosquito. Carbon dioxide traps have been installed both on and adjacent to the Refuge. One trap is located just off the Refuge near the Refuge office building and another is located off the Refuge just to the north of Case Road Pond. A third carbon dioxide trap has been installed on the Refuge at the drop tower, to the southwest of 7th Street Pond.

The results of monitoring, including field observations, dip sample count data, and/or mosquitoes found in carbon dioxide traps are to be reported to the Refuge Manager on a weekly basis.

6.2 Mosquito Control

Under current management practices, when monitoring indicates the need to control breeding mosquitoes on the Refuge, OCVCD is permitted to apply the larvicides *Bacillus thuringiensis israelensis* (Bti) and *Bacillus sphaericus* (Bs) and Altosid®, a biochemical pesticide with the active ingredient methoprene. Bti is a naturally occurring bacterium used to kill mosquitoes and black flies in the larval form. It can also be toxic to certain other dipterans (including midges). When eaten by mosquito larvae, Bti spores release toxins that cause the larvae to stop eating and die. Bti is only effective against actively feeding larvae; it does not affect mosquito pupae or adults. The mosquito control product most often used on the Refuge is VectoBac® G (EPA Registration No. 73049-10), a granular solid form of Bti that is applied using a backpack air applicator. VectoBac® 12AS (EPA Registration No. 73049-38), an aqueous suspension of Bti, is also permitted for use on the Refuge.

Bs is also a naturally occurring soil bacterium. OCVCD has approval to use this product under the trade name Vectolex® WDG (EPA Registration No. 73049-57). This granular product is mixed with water prior to application and on this Refuge would be applied using a backpack sprayer. Similar to Bti, Bs is only effective when active feeding mosquito larvae are present; and has no effect on mosquito pupae or adults.

Methoprene is a chemical insect growth regulator that retards the completion of the life cycle of the mosquito by preventing the larva from transforming to the pupa (stage between the larva and adult) and/or the adult from emerging from the pupae. The forms of methoprene approved for use on the Refuge include Altosid® XR Briquets (EPA Registration No. 2724-421) and Altosid® Pellets WSP (EPA Registration No. 2724-448). Although methoprene is not used very often on the Refuge, when needed, it is generally applied as Altosid® XR Briquets, which provide up to 150 days of control. This product is generally applied to an area prior to inundation by extreme high tides. Methoprene is to be used on the Refuge only as a second line of defense.

When mosquito control activities are implemented on the Refuge, OCVCD is required to provide the Refuge Manager and Navy Environmental Office staff with a report within one week of pesticide application. The report is to include the site number treated, the species found, mosquito abundance on the site, and the type and amount of pesticide applied. Only pesticides permitted for use in the current year's SUP can be applied on the Refuge.

7.0 Mosquito Management Plan

The Mosquito Management Plan for the Seal Beach NWR is one of several step-down management plans to be develop concurrent with or after the completion of the Seal Beach NWR CCP. Under this plan, a phased approach to mosquito management would be implemented and mosquito surveillance, monitoring, and control would be conducted consistent with Service, other national, and regional guidance and California public health and safety guidelines. A draft Compatibility Determination for mosquito management is included in Appendix A of the CCP/EA for the Seal Beach NWR. The Refuge Manager is recommending that mosquito management implemented in accordance with this plan is appropriate and compatible with the Refuge purposes.

Consistent with current practices, the Refuge and the Navy will continue to work with the OCVCD on an annual basis to develop guidance for how surveillance, monitoring, and control activities shall be implemented on the Refuge in a given year. The details of this work on the Refuge will be outlined in the annual SUP issued to the OCVCD prior to the commencement of mosquito season. This coordination will ensure that permits are current, communication is continuous, and concerns related to mosquito populations and other biological resources of the Refuge are addressed. It is vital to the mission of the respective agencies that a positive and productive working relationship is maintained. PUPs and Pesticide Use Reports will be prepared annually by the Refuge with data support from OCVCD. In addition, prior to issuing the annual SUP, we will review the guidance provided in this plan, the Section 7 compliance document, the Compatibility Determination, and the EA prepared for the CCP to determine if any additional documentation will be necessary.

7.1 Plan Objectives

The objectives of the Mosquito Management Plan include:

- Protect public health and safety;
- Protect endangered species, migratory birds, and other wildlife and their habitats;
- Allow compatible surveillance of mosquito populations on the Refuge;
- Develop refuge-based control activity thresholds: mosquito population levels and/or levels of disease activity that, once reached, indicate an increased health risk and possibly require a more aggressive response to mosquito control;
- Where mosquito control is needed, use the most effective means that pose the lowest risk to wildlife and associated habitats;
- Allow the use of adulticides only when there are no practical and effective alternatives to reduce a public health threat; and,
- Identify priority areas for enhancement or restoration to reduce the need for mosquito management and improve habitat for native wildlife, fisheries and plants.

7.2 Issues and Concerns

Public Participation

Public participation is provided through the CCP public review process. The draft CCP/EA, accompanying step-down plans, including the Mosquito Management Plan, and Compatibility Determination for Mosquito Control are all provided for public review and comment. This document will be provided OCVCD, NWSSB, neighboring land management agencies, State resource and water quality agencies, and other concerned parties for comment. Comments will be incorporated into the final document as appropriate. The final plan will be provided to involved and interested parties upon request.

Issues Related to the Plan

Specific issues associated with mosquito management on the Refuge include:

- Understanding how Refuge-based mosquito populations contribute to or pose a public health threat to surrounding human developments;
- Determining the effects of mosquito population monitoring, disease surveillance, and control activities on endangered species, migratory birds, and other wildlife and associated habitats;
- Ensuring adequate interagency communication between the Refuge, NWSSB and OCVCD regarding mosquito management activities;
- Planning and implementing wetland enhancement and restoration projects that reduce the persistence of above normal mosquito populations; and,
- Facilitating reliable, consistent management of mosquitoes on the Refuge.

7.3 Laws, Policies, and Executive Orders Relevant to the Mosquito Management Plan

Legislative Acts

Activities of the Service are governed by Acts of Congress. The proposed action must comply with the legislative acts presented below.

- **National Wildlife Refuge System Administration Act of 1966, as amended**
  The most important Federal statute guiding management of the NWRS and its units is the National Wildlife Refuge System Administration Act of 1966, as amended (16 U.S.C. 668dd-668ee). This law was significantly amended in 1997 with passage of the National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act). The law makes clear that the NWRS is to be managed first and foremost for wildlife conservation. Several substantive and procedural requirements associated with Compatibility Determinations form a major feature of the law. This is because all public uses must first be determined compatible with the purpose(s) of the refuge and the NWRS mission before they are allowed on a refuge. The law also requires monitoring of the status and trends of refuge fish, wildlife, and plants; as well as maintenance of the NWRS' biological integrity, diversity, and environmental health.

- **Endangered Species Act (ESA) of 1973, as amended**
  The Endangered Species Act (16 U.S.C.1531-1544) provides for the identification, protection, and recovery of species approaching extinction. One of the means used to protect such species is found in Section 7 of the EAS. This section requires Federal agencies to consult with the Service's Ecological Services (ES) Program or the U.S. Department of Commerce's National Marine Fisheries Service (NMFS) whenever an action is proposed which may affect a threatened or endangered species or its critical habitat.

  All mosquito management activities conducted on the Refuge will be in compliance with the ESA. The Refuge will determine whether Section 7 consultation is required for specific wetland restoration or enhancement projects. Consultation with NMFS for marine species, including most marine mammals and sea turtles, will be implemented as necessary to address specific actions.

- **National Environmental Policy Act (NEPA)**
  The National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321-4347) requires that Federal agencies "Utilize a systematic, interdisciplinary approach…in

planning and decision-making…" and "...insure that presently unquantified environmental amenities and values... [are]...given appropriate consideration in decisionmaking along with economic and technical considerations...." Prior to making a decision to undertake a proposed action, agencies are to consider a range of reasonable alternatives and the effects of their implementation.

An EA has been prepared in compliance with NEPA that evaluates the potential effects to the environment of implementing the CCP and its accompanying step-down plans, including this Mosquito Management Plan. Following public review of the EA, we will make a decision whether or not to sign a finding of no significant impact.

- **Federal Water Pollution Control Act as amended in the Clean Water Act of 1977** The Clean Water Act (33 U.S.C. 1251-1387) provides for the restoration and maintenance of the Nation's water quality. Several sections of the Clean Water Act are applicable to this proposal. Section 404 regulates the placement of fill or the dredging of wetlands under the jurisdiction of the U.S. Army Corps of Engineers or the U.S. Environmental Protection Agency (USEPA). Section 401 of the Clean Water Act requires a water quality certification from the State for all Section 404 Permit activities. Compliance with these aspects of the Clean Water Act will be required for future restoration and enhancement actions on the Refuge.

  Section 402 of the Clean Water Act established the National Pollutant Discharge Elimination System (NPDES). In response to a recent court decision which held that NPDES permits are required for the discharge of pesticides into waters of the U.S., even if the pesticides are applied consistent with label requirements (Headwaters, Inc. v. Talent Irrigation District, 9th Cir. 2001, 243 F.3d 526), the state of California has adopted a statewide general NPDES Permit (No. CAG990004) for the application of aquatic pesticides to surface waters. Each discharger seeking coverage under this General Permit is required to submit a Monitoring Plan for approval by the appropriate Regional Water Quality Control Board and must implement the monitoring plan as approved. The OCVCD has coverage under this General Permit.

- **Federal Insecticide, Fungicide, and Rodenticide Act of 1947 (FIFRA), as amended** FIFRA (7 U.S.C. 135 *et seq.*) regulates all activities related to pesticides, including development, registration and classification, production, storage and transport, and applications. Section 18, as amended, provides for exemption of State or Federal agencies from all requirements in cases where the Governor or head of that agency requests and secures such an exemption. This constitutes declaration of official emergency conditions (such as an imminent human health hazard).

Policies

The proposed action must comply with the Service policies presented below.

- **Biological Integrity, Diversity, and Environmental Health Policy**
  The Service has developed guidance, in the form of policies, for implementing some of the key provisions of the 1997 amendments to the Refuge Administration Act. One such policy is the Biological Integrity, Diversity, and Environmental Health Policy (601 FW 3). Consistent with the Refuge purpose(s), this policy provides for maintenance and restoration of healthy, functioning biological communities composed of native species and

habitats comparable with historic conditions. The policy favors refuge management which restores or mimics natural ecosystem processes or functions and generally discourages the use of chemical pesticides and the removal of native species. At the same time, the Policy acknowledges that these actions may at times be necessary and appropriate. A key to proper implementation of this policy is evaluating how proposed actions would affect achievement of the Refuge purpose(s).

- **Appropriate Refuge Uses and Compatibility Policies**
  The policies on Appropriate Refuge Uses (603 FW1) and Compatibility (603 FW2) were also developed in response to the Refuge Improvement Act. The Appropriate Refuge Uses Policy provides procedures for the Refuge Manager to follow when deciding if uses are appropriate on a refuge. This policy also clarifies and expands on the Compatibility Policy, which describes when Refuge Managers should deny a proposed use without determining compatibility. When a use is found to be appropriate, it must then be determined if the use is compatible before it is allowed to occur on a refuge. For a use to be compatible, it cannot materially interfere with or detract from the fulfillment of the NWRS mission or the purposes for which a particular Refuge was established. For mosquito control to be implemented on a refuge, it must first be found appropriate and then compatible. Specifically, conducting mosquito management activities on a refuge must be consistent with the purposes of the Refuge and the mission of the NWRS.

  A Compatibility Determination and accompanying Appropriate Use Determination for mosquito management on the Seal Beach NWR are provided in Appendix A of the draft Seal Beach NWR CCP and are available for public review and comment as part of the CCP public review process.

- **Department of Interior, Pesticide Use Policy and FWS Pest Management Policy**
  Both the Department of the Interior and the Service have policies which address management of pests and application of pesticides on National Wildlife Refuges. These policies can be found at 517 DM 1, 30 AM 12, and 7 RM 14. These policies are based on integrated pest management principles and allow use of pesticides only after evaluation of a range of alternatives (including physical and cultural methods, biological controls, and no action); and full consideration of safety, environmental effects, efficacy, specificity, and costs. Under these policies, Refuge Project Leaders are required to develop and submit PUPs for all pesticides proposed for use on the Refuge. Only after the PUPs have been approved can the specific pesticides be used on the Refuge. This requirement includes pesticides that mosquito control districts or other permittees propose for use as part of a refuge mosquito management program. Depending on the pesticide proposed for use and the proposed application method(s), approval of the PUP could reside with the Refuge Project Leader, Regional Office, or Headquarters Office.

Executive Orders

The proposed action must comply with the Executive Orders presented below.

- **Protection of Wetlands (EO 11990)**
  This order directs Federal agencies to minimize the destruction, loss or degradation of wetlands and preserve and enhance the natural beneficial value of wetlands in the conduct of the agency. With respect to mosquito management on the Seal Beach NWR, control of mosquito populations would likely include restoration and enhancement of disturbed

coastal wetlands in an effort to facilitate better drainage through the marsh following inundation by higher high tides.

- **Intergovernmental Review of Federal Programs (EO 12372)**
  A Notice of Availability for this EA will be sent to local county and city governments, regional and state agencies, other Federal agencies and interested parties.

USFWS Missions and Refuge Purposes

The proposed action must consist with the following:

- **Mission of the U.S. Fish and Wildlife Service**
  "...to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people." (1 RM 4.3)

- **Mission of the National Wildlife Refuge System**
  "To preserve a national network of lands and waters for the conservation and management of the fish, wildlife and plants of the United States for the benefit of present and future generations." (EO 12996)

- **Goals of the National Wildlife Refuge System**
  A. To preserve, restore and enhance in their natural ecosystems (when practicable) all species of animals and plants that are endangered or threatened with becoming endangered. (2 RM 1)
  B. To perpetuate the migratory bird resource.
  C. To preserve a natural diversity and abundance of fauna and flora on refuge lands.
  D. To provide an understanding and appreciation of fish and wildlife ecology and man's role in his environment, and to provide refuge visitors with high quality, safe, wholesome, and enjoyable recreational experiences oriented toward wildlife to the extent these activities are compatible with the purposes for which the refuge was established.

- **Purpose of the Seal Beach National Wildlife Refuge**
  "Preserve and manage the habitat necessary for the perpetuation of two endangered species, the light-footed clapper rail and California least tern, and preserve habitat used by migrant waterfowl, shore birds, and other water birds" (Management Plan for Seal Beach National Wildlife Refuge, prepared in 1974 pursuant to Public Law 92-408).

7.4 Decision to be Made

The Service must decide whether implementing the Mosquito Management Plan would have a significant impact to the human environment. This evaluation is provided in Chapter 5 of the CCP/EA for the Seal Beach NWR. If we conclude that these actions do not have a significant impact to the human environment then we will sign a finding of no significant impact (FONSI).

7.5 Alternatives Evaluated in the CCP/EA

The CCP/EA includes two alternatives for mosquito management on the Refuge: 1) continuation of the current mosquito monitoring and control program being implemented on the Refuge by OCVCD, as described in Refuge Management Alternative A of the CCP/EA (see Chapter 3 of the CCP/EA); and 2) implementation of a phased approach to mosquito management, as described in this Mosquito Management Plan and summarized in Refuge

Management Alternatives B and C (see Chapter 3 of the CCP/EA). An alternative that involves no mosquito management on the Refuge has been deemed infeasible due to the proximity of the Seal Beach NWR to the highly urbanized areas of Orange County and adjacent Los Angeles County.

7.6 Phased Implementation of Mosquito Management

Overview

This Mosquito Management Plan presents the process to be followed in making determinations regarding to what extent mosquito management should occur on the Seal Beach NWR and how and when specific mosquito management activities should be undertaken. Effective mosquito control results in the removal of a high percentage of one or more target species, although usually temporarily. Such control efforts can also result in direct and indirect adverse effects to one or more non-target species. The altered ecological communities that may result from mosquito control activities can impact biological integrity and diversity through disruptions in food webs and other ecological functions. Therefore, the decision to control mosquitoes and at what level requires careful evaluation.

As proposed, mosquito management on the Seal Beach NWR will be consistent with an integrated pest management (IPM) approach to mosquito control. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks. When practical, the approach may include compatible actions that reduce mosquito production and do not involve pesticides.

In some locations, mosquito production may be influenced by current site conditions. For example, historical human activities along the upper edges of a salt marsh complex may have altered the natural drainage patterns, creating areas where ponding now occurs during higher spring tides or after a significant rain event. In these situations, an integrated approach to mosquito management involving habitat manipulation and/or restoration and enhancement could provide benefits related to reducing the area available on the refuge for mosquito production.

While the emphasis of this plan is restoring wetlands, it also includes mosquito monitoring, disease surveillance, and the potential application of pesticides. Application of pesticides would be approved based on the phased approach outlined below. The principle goal of a phased approach to mosquito management is to minimize adverse effects to Refuge resources while addressing legitimate human and fish and wildlife health concerns and complying with Service regulations and policies. The Plan proposes a phased-response to mosquito management and control that is consistent with Service and California guidelines. Because the occurrence of arboviruses and other human health issues resulting from mosquitoes are sporadic, the phases of mosquito management to be implemented on the Refuge would vary through time.

Except during high risk disease situations where there is a need to take action quickly, full consideration must be given to the integrity of non-target populations and communities when considering compatible habitat management and pesticide uses for mosquito control. Mosquito control procedures must also be consistent with IPM strategies and existing pest management policies of the Department of the Interior and the Service (517 DM 1 and 30 AM 12). Even during high risk disease situations, mosquito population monitoring data are required that indicate substantial intervention (e.g., the use of adulticides) is necessary. Additionally, appropriate pesticide review (i.e., approval of the use of a pesticide through the PUPs process)

must be completed, although this review will be expedited so that any necessary intervention measures will not be delayed. Such pesticide treatments for adult mosquito population control on Refuge lands will only be allowed when local, current mosquito population monitoring data have been collected and indicate that refuge-based mosquito populations are contributing to a human or wildlife health threat.

The proposed phased approach to mosquito management is dependent upon continued communication and cooperation among the Service, NWSSB, OCVCD, and the appropriate state and local public health agencies. The following coordination actions would be implemented under any phase of the mosquito management plan:

- OCVCD will coordinate all activities with the Refuge Manager.
- OCVCD will meet annually with Refuge and Navy Environmental Office staff to review the activities and results of the previous year and discuss the monitoring and possible control plans for the upcoming year.
- A Refuge SUP will be prepared annually for the OCVCD that will include all appropriate BMPs presented in the Mosquito Management Plan, as well as special conditions related to location, timing, extent of mosquito monitoring, and stipulations for carrying out mosquito control, should it be warranted, under the guidance of the approved PUPs.
- Prior to each year's mosquito breeding season, OCVCD field staff will meet with Refuge Management and the Navy Environmental Office staff to go over field protocols for avoidance and minimization of take to any trust resources including migratory birds and listed species and their habitats.
- At the beginning of the mosquito breeding season, OCVCD will provide a firm schedule of seasonal activities to the Refuge Manager. If activities are proposed that differ from the schedule, OCVCD will call the Refuge Manager at least two business days prior accessing the Refuge.
- Motorized access into habitat areas will be prohibited; all access must be on foot.

Although OCVCD would have the lead for monitoring, disease surveillance, and pesticide applications, evaluation of monitoring data and approval for each management action would be the responsibility of the Refuge. This approach, which requires the Refuge Manager to oversee the mosquito management program, process PUPs, prepare annual SUPs, and comply with legal mandates (e.g., NEPA, Refuge Improvement Act) and Service policies (e.g., Compatibility, Appropriate Use), is necessary to ensure that the conditions for compatibility are met and the program is implemented so as to avoid or minimize effects on Refuge resources.

Because of the nature of mosquito-borne diseases, as well as the limited information available regarding the effects of these diseases on wildlife of the Refuge, this approach focuses on the implementation of a mosquito management program to protect human health. A detailed description of each of the four phases of the mosquito management plan is provided below.

Phase 1. In Phase 1, mosquitoes are known to breed on the Refuge, but mosquito threshold treatment levels on the Refuge have not been exceeded during the current breeding season. Under these conditions, mosquito monitoring would be implemented throughout the breeding season.

Consistent mosquito monitoring is necessary to establish baseline information regarding mosquito production and locations of mosquito breeding areas on the Refuge. On the Seal Beach NWR, monitoring is conducted annually during the breeding season by OCVCD to: 1) establish baseline data on species and abundance; 2) identify and map known mosquito breeding and/or harboring habitats; and 3) estimate relative changes in population sizes over time. The dip sampling process described in Section 6.1 would be implemented as part of this mosquito monitoring process. Provided the number of larvae documented during this part of the monitoring process do not exceed the criteria used by OCVCD (*2010*) to determine when treatment to control mosquito larvae should be considered. The criteria recommended by OCVCD are presented in Table 1.

Table 1
OCVCD Criteria for Considering Pesticide Application to Control Immature Mosquito Populations

Mosquito Species	Criteria for Considering Treatment
Anopheles spp.	≥ 2 immatures/40 dips
Culex spp.	≥ 2 immatures/20 dips
Aedes spp.[1]	≥ 2 immatures/10 dips
Culiseta spp.	≥ 2 immatures/10 dips

Source: (*Orange County Vector Control District 2010*)
[1] *Aedes* is currently the only genus of mosquito known to breed on the Refuge.

To ensure that accurate and up-to-date information is available to the Refuge Manager, OCVCD provides monitoring results to the Refuge Manager within one week of any monitoring activity during the breeding season.

OCVCD is also responsible for implementing a surveillance program to detect the presence of mosquito populations county-wide. The information gathered from this program would be used by the appropriate public health authority to determine if and to what extent a health threat exits in the County. The OCVCD county-wide surveillance program involves placing more than 100 mosquito traps, including carbon dioxide traps and gravid traps, throughout the county. The mosquitoes collected in these traps provide information regarding species presence and general population estimates for a given area. Trapped mosquitoes are also tested for diseases (i.e., WNV, St. Louis and Western Equine Encephalitis). A statewide mosquito-borne encephalitis virus surveillance program is also conducted by the California Department of Health Services (DHS). DHS, OCVCD, and other agencies implement various programs to detect mosquito-borne viruses, particularly WNV. These include testing trapped mosquitoes, implementing a protocol for reporting and testing dead birds, and monitoring sentinel chickens. The only aspect of this program that occurs on the Refuge is the maintenance of a carbon dioxide trap near the existing drop tower. This trap can easily be accessed by an existing roadway and a short walk to the site; therefore, no adverse effects to Refuge resources occur as a result of allowing the placement of this trap on the Refuge. Additional traps are maintained just beyond the Refuge boundary on NWSSB.

Communication and cooperation are the essential elements needed to develop a reliable understanding of how best to address mosquito management on the Refuge. OCVCD would have the lead for mosquito monitoring, but all decisions related to how mosquito management would be implemented on the Refuge must be made in consultation with the

Refuge Manager using monitoring data collected on and within the vicinity of the Refuge. Annual meetings, involving the Refuge, NWSSB, and OCVCD, are held to assess the previous seasons monitoring and control efforts, if any. These meetings enable all participants to consider the need for adapting current management activities to better achieve the goal of effective mosquito management with minimal adverse effects to Refuge resources in subsequent years.

Mosquito monitoring is conducted in accordance with an annually issued Refuge SUP, as described in Section 6. This SUP includes conditions related to how and where access for mosquito monitoring can occur, scheduling of monitoring activities, reporting monitoring results, and when the implementation of control methods (discussed under Phase 2) would be considered appropriate. Over the past few years, mosquito management has only been permitted in six pre-approved locations on the Refuge (see Figure 2) and all access into these areas is limited to walking. Any proposal to enter and monitor other areas of the Refuge requires review and approval by the Refuge Manager. In addition, all OCVCD personnel who will be present on the Refuge in a given year are required to meet with the Refuge Manager prior to the beginning of the mosquito monitoring season. At this meeting, OCVCD is provided with information on how to conduct mosquito monitoring in sensitive marsh habitat in a manner that will avoid disturbance to listed species and other wildlife and minimize trampling of marsh vegetation.

Because the Mosquito Management Plan for the Seal Beach NWR proposes an integrated approach to mosquito management, all phases of this plan emphasize design, restoration/ enhancement, and management of wetlands in a manner that will benefit wildlife and minimize mosquito production. Proposed actions include the control of artificial mosquito breeding habitat (e.g., old tires, open containers, other equipment or objects that collect water where mosquitoes can breed) and the restoration or enhancement of disturbed wetland habitat. Surveys for artificial mosquito breeding habitat would be conducted following periods of higher high tides, such as the spring tides that occur during the summer months, or after a rainfall event.

Proposals in the CCP related to habitat enhancement or restoration include culvert replacement to improve tidal circulation in the Bolsa Cell, habitat restoration in the disturbed marsh areas to the south and west of 7th Street Pond, and restoration of the area to the north of Case Road Pond. The focus of these restoration and enhancement projects would be on improving tidal circulation within the upper edges of the marsh and restoring habitat for native wildlife and plants, while at the same time decreasing the areas available on the Refuge to support mosquito production. These restoration and enhancement projects would be implemented as funding becomes available.

Projects to restore or enhance habitat quality around the edges of the marsh or to improve tidal circulation in portions of the marsh to reduce the potential for mosquito production would be implemented as funding permits. These restoration and enhancement projects are described in detail in Chapter 3 of the draft CCP/EA. When these restoration or enhancement projects are being planned for the Refuge, the Refuge Manager will consult with OCVCD to ensure that the project design takes into consideration potential issues or opportunities related to mosquito production and management.

Phase 2. In Phase 2, mosquitoes are known to breed on the Refuge and the numbers of mosquito larvae counted during sampling exceed the criteria presented in Table 1, a condition that is not uncommon on the Refuge in the spring and summer months. Under these conditions, mosquito monitoring would continue throughout the mosquito breeding season; actions to reduce potential mosquito breeding habitat on the Refuge would be implemented per available funding; and control of larvae would be conducted as warranted by sampling counts with the approval of the Refuge Manager and in accordance with the conditions outlined in the SUP.

Surveillance to identify potential or documented vectors of mosquito-borne diseases in the County that represent a potential human health would continue as presented in Phase 1. Mosquito monitoring on the Refuge would be expanded to include an evaluation of the effectiveness of the mosquito larvae control measures approved for implemented on the Refuge.

Before the Refuge Manager can approve a larvicide for use on the Refuge, the larvicide must be approved for use on the Refuge through the PUPs review process, included in the current SUP, considered in the Compatibility Determination for Mosquito Management, and evaluated in compliance with NEPA, Section 7 of the ESA, and all applicable Refuge policies. The PUPs process is a formal pesticide use review process employed to ensure that all chemical pesticides approved for use on a Refuge have been reviewed for their potential impacts to groundwater, surface water and terrestrial and aquatic non-target vegetation and wildlife, including threatened and endangered species. The PUPs identify specific pesticides, including mosquito control products, approved for use on each Refuge, as well as details on target pests, products applied, application dates, rates, methods, number of applications, site description, sensitive habitats, and best management practices employed to avoid impacts to Refuge resources. Pesticides approved for use must be shown to pose the lowest toxicity-related threat to non-target terrestrial and aquatic ecosystems, while addressing the specific pest control objectives. Depending on the product, PUPs are reviewed and approved at the Project Leader, Regional Office, or Washington Office level.

The larvicides most recently approved for use on the Refuge include *Bacillus thuringiensis* var. *israelensis* (Bti), *Bacillus sphaericus* (Bs), and Altosid®. *Bti and Bs*, both naturally occurring soil bacteria, are used to control mosquitoes in wetlands prior to their emergence as adults. Altosid® is a trade name for methoprene, an insect development regulator used in the control of mosquitoes. Methoprene mimics a growth hormone found in mosquitoes and interferes with the mosquito's normal adult development. Methoprene is to be used on the Refuge only as a second line of defense. For more information regarding these larvicides, refer to Section 8.1 below.

Within one week of any pesticide application, OCVCD is required to provide the Refuge Manager with a report detailing the location of the application, the numbers of larvae per dip sample obtained at each control site, the species present, and the types and amount of pesticide applied. All pesticides must be applied in accordance with the product label. In addition, the following Best Management Practices (BMPs), which will be included as conditions of the SUP, must be implemented during larvicide applications:

Pesticide Handling and Mixing

- If OCVCD fills pesticide spray tanks on the Refuge, the tanks shall not be left unattended during filling.
- Cleaning of mosquito spray equipment will not be permitted on the Refuge.
- The Refuge Manager shall be notified immediately if a pesticide spill occurs on the Refuge during mosquito control and the spill shall be addressed immediately using procedures identified in the Refuge's spill response plan.

Applying Pesticides

- Pesticide treatments shall only be conducted by applicators with the appropriate, state certification to safely and effectively conduct these activities.
- Mosquito control shall comply with all federal, state, and local pesticide use laws and regulations, as well as Departmental, Service, and NWRS pesticide-related policies.
- All applicators shall be familiar with requirements of the product label and Material Safety Data Sheet (MSDS).
- Applicators will use and adjust spray equipment to apply the coarsest droplet size spectrum with optimal coverage of the target species while reducing drift.
- Applicators will use the largest droplet size that results in uniform coverage.
- Applicators will use drift reduction technologies such as low-drift nozzles, where possible.
- Where possible, spraying will occur during low (average<7mph and preferably 3 to 5 mph) and consistent direction wind conditions with moderate temperatures (typically <85 °F).
- Equipment will be calibrated regularly to ensure that the proper rate of pesticide is applied to the target area or species.
- If windy conditions frequently occur during afternoons, spraying will typically be conducted during early morning hours.

Phase 3. In Phase 3, mosquitoes are known to breed on the Refuge; the numbers of mosquito larvae in the later instar stages and/or pupae present on the Refuge have exceeded established mosquito threshold treatment levels; and the species of mosquitoes that exceed the threshold levels pose an immediate threat to human health. OCVCD uses the same criteria for considering the need to treat pupae as they use for larvae (refer to Table 1). Under Phase 3, mosquito monitoring would be implemented throughout the breeding season; actions to reduce potential mosquito breeding habitat on the Refuge would be conducted per available funding; and the Refuge Manager would consider the use of a monomolecular biodegradable film on the Refuge to control late-stage mosquito larvae and pupae provided it is conducted in accordance with the conditions outlined in the SUP.

Larvicides (i.e., Bti or Bs and methoprene) are only effective on mosquitoes during early instar stages (up to the fourth instar stage) and do not control pupae. If developing mosquitoes have reached the last instar stages or have pupated, then the application of site-specific pupacides in infested areas (determined through monitoring) would be considered. Because pupacides can negatively affect all invertebrates that require surface air (e.g., act as surfactants), the use of these pesticides should be carefully considered. For this reason, pupacides would only be used if the numbers of mosquito pupae present on the Refuge exceed established criteria and the lack of control could pose a threat to human health.

Although not currently used on the Refuge, monomolecular biodegradable film (e.g., Agnique® MMF) products are available for use in controlling pupae and later stage larvae. Agnique MMF is a biodegradable, alcohol ethoxylated surfactant, made from renewable plant oils. This product, which is applied using conventional spraying methods, forms an invisible monomolecular film that spreads over the surface of standing water. (Additional information regarding Agnique MMF is provided in Section 8.2 below.)

The potential effects to the environment of using monomolecular biodegradable film to control mosquitoes on the Refuge have been evaluated in the draft CCP/EA for the Seal Beach NWR and in the Compatibility Determination for Mosquito Management. This product will also be evaluated through the PUPs process, and assuming this product is approved for use on the Refuge, it could be used to control pupae under the conditions described above. Use of this product would require adherence to the conditions described in the SUP and implementation of BMPs to minimize potential adverse effects to Refuge resources.

Within one week of any pesticide application, OCVCD is required to provide the Refuge Manager with a report detailing the location of the application, the numbers of pupae per dip sample obtained at each control site, the species present, and the types and amount of pesticide applied. All pesticides must be applied in accordance with the product label. In addition, implementation of the BMPs described in Phase 2 would also be required during pupacide applications. Enforcement of these BMPs would be assured through their inclusion in OCVCD's SUP.

Phase 4. Phase 4 involves the use of adulticides to control mosquitoes on the Refuge. All of the following conditions must be met before an adulticide can be applied on the Refuge:

- A public health emergency has been declared by the Orange County Health Care Agency (OCHCA) or the California Department of Public Health for an area that includes the Refuge;
- Infected mosquitoes have been identified on the Refuge or infected mosquitoes of the species known to breed on the Refuge have been identified within the published flight range of mosquito breeding areas on the Refuge;
- The criteria established in the OCVCD's Integrated Vector Management and Response Plan (*OCVCD 2010*) for determining when treatment of adult populations of mosquitoes should be considered has been exceeded on the Refuge for the mosquito species of concern;
- The FWS Integrated Pest Management Coordinator has approved the adulticide proposed for use through the PUPs review process; and
- The SUP issued to OCVCD has been modified by Refuge Manager to address adulticide application.
- OCVCD has coordinated with the Refuge Manger and Navy Environmental Office staff on how, when, and where an adulticide would be applied on the Refuge.

When disease surveillance conducted by OCVCD indicates a high risk for mosquito-borne disease in the vicinity of the Refuge, and/or a pathogen is present in mosquito pool(s) on the Refuge and/or in wild birds, sentinel chicken flock(s), horses, or humans in the

immediate vicinity of the Refuge, a public health concern will likely be expressed. A public health emergency, as declared by OCHCA or the California Department of Public Health, in combination with adult mosquito population sizes on the Refuge that exceed criteria developed by OCVCD, could trigger consideration of a more aggressive treatment strategy, including the use of adulticides. The criteria used by OCVCD for determining when treatment of adult mosquitoes should be considered are presented in Table 2. These factors, as well as the other conditions presented above, would all be used to determine if and when the use of adulticides to control mosquitoes is warranted on the Refuge.

Table 2
OCVCD Criteria for Considering Adulticide Application

Mosquito Species	Criteria for Considering Treatment
Culex spp.	25 or more females per collection per trap night
Anopheles spp.	25 or more females per collection per trap night
Aedes spp.[1]	5 or more females per collection per trap night[2]
Culiseta spp.	10 or more females per collection per trap night
Multiple species	25 or more total female mosquitoes per collection per trap night

Source: (*Orange County Vector Control District 2010*)

[1] *Aedes* is currently the only genus of mosquito known to breed on the Refuge.

[2] The total number of trapped females is lower for Aedes spp. than other species of mosquitoes because Aedes spp. demonstrated a limited attraction to CO_2 traps. New types of traps are currently being considered by OCVCD to more accurately establish populations of Aedes spp. in Orange County (Jim Green pers. comm.).

Adulticides are pesticides used to kill adult mosquitoes. There are three general classes of adulticides: organophosphates, pyrethrins and pyrethroids, and all tend to be much broader-spectrum insecticides than are larvicides and pupacides. The adulticides considered for use on the Refuge under this Plan, when warranted by the conditions described above, would be limited to those products containing the active ingredient sumithrin (e.g., AquaAnvil™, a water-based formulation, and Anvil 10 +10 ULV, a mineral oil-based formulation). Sumithrin is a combination of phenothrin (a synthetic pyrethrin) and piperonyl butoxide. More information about sumithrin is provided in Section 8.3 below.

Prior to using an adulticide on the Refuge, it should first be determined if increased intensity and frequency of larvicides or pupacides would be effective in reducing the abundance of mosquitoes present on the Refuge. Water quality and other environmental factors (e.g., water depth, vegetation) should be examined to determine if different formulations and treatment strategies of larvicides or pupacides could be more effective. If large numbers of pupae are present, increasing the use of pupacides in infested areas should be considered. Because the efficacy and effects of adulticides are variable, the application of these products would be restricted to specific areas of the Refuge that can be effectively treated while minimizing non-target effects.

The potential effects to the environment of using pesticides with the active ingredient sumithrin to control adult mosquitoes on the Refuge have been evaluated in the draft CCP/EA for the Seal Beach NWR and in the Compatibility Determination for Mosquito Management. This product will also be evaluated through the PUPs process, which will could result in additional restrictions in terms of where, how, and when it could be applied

on the Refuge. The use of an adulticide on the Refuge would require adherence to the conditions described in the SUP, which will include the implementation of specific BMPs to minimize potential adverse effects to Refuge resources.

Within one week of application, OCVCD will be required to provide the Refuge Manager with a report detailing the location of the adulticide application, the numbers of mosquitoes documented on the Refuge through trapping, the species present, and the type and amount of pesticide applied. All pesticides must be applied in accordance with the product label. In addition, implementation of the BMPs described in Phase 2 would be required, as would the following additional measures:

Adulticide Application on the Refuge

- All approved mosquito control products shall be applied in accordance with approved PUPs and the product label. Where specific BMPs developed as part of the PUP approval are more restrictive than the label, the PUP requirements shall followed.
- The use of pesticides on the Refuge shall be minimized and new formulations and compounds that are the least damaging to fish and wildlife populations should be sought out.
- The BMPs included in the SUP shall be implemented at all times during the application of any pesticide on the Refuge.
- The application of an approved adulticide on the Refuge shall occur in conjunction with the concurrent application of larvicides and pupacides in appropriate locations on the Refuge.
- Approved adulticides shall only be applied using vehicle mounted or backpack fitted ultra-low volume spray equipment. No aerial spraying over the Refuge will be permitted.
- All applications of adulticides containing sumithrin shall take place from existing roads and under meteorological conditions that are stable and favorable with a consistent wind greater than three miles per hour from the south or southwest to ensure that the pesticide does not drift over the Refuge's sensitive wetland habitats.
- Application of sumithrin-based products shall only occur from roads that extend along the northern, western, and eastern perimeter of the Refuge.

SUPs that permit the application of adulticides containing sumithrin must outline the existing conditions that justify this use, identify the specific areas to be treated, and list any restrictions and all measures, including BMPs, that must be followed before, during, and after treatment.

8.0 Mosquito Control Pesticides

The range of mosquito control options that can be considered for use on the Seal Beach NWR increases as the risk for mosquito-borne disease in humans or wildlife also increases. Mosquito control pesticides can be categorized into three groups: larvicides, pupacides (surface films/ surfactants), and adulticides. Compared with other forms of pest control, there are relatively few pesticides available within each of these categories, and all differ with regard to efficacy and effects on non-target organisms.

The larvicides Bti (*Bacillus thuringiensis israelensis*), Bs (*Bacillus sphaericus*), and methoprene will be approved for use on the Refuge when sampling data indicates it is warranted. Approval is however subject to review by the Regional Office Integrated Pest Management Coordinator acting under the Service's Washington Office.

Before applying these pesticides on the Refuge in a non-emergency situation the Refuge must:

1. Use current monitoring data for larval, pupal, and adult mosquitoes which documents the need for mosquito management.
2. Determine the most appropriate pesticide treatment options based on monitoring data for the relevant mosquito life stage.
3. Consider whether use of pesticide would harm trust species.
4. Have an approved PUP in place.

Other pesticides considered for use on the Refuge when warranted by the conditions outlined under Phases 3 and 4, include monomolecular biodegradable films, such as Agnique MMF, and adulticides containing the active ingredient sumithrin, including AquaAnvil™ and Anvil 10 +10 ULV. Other formulations or compounds may also be approved for use on the Refuge in the future provided: 1) there is adequate data from various sources (e.g., scientific literature) to conclude that they will not adversely affect non-target Refuge resources; 2) approved through the PUPs review process is obtained; the SUP is revised to address the use and associated conditions for these new produces, and compliance with NEPA, Section 7 of the Endangered Species Act (ESA), and applicable Refuge policies has been met.

8.1 Larvicides

Larvicides are materials that affect the four larval stages of mosquitoes known as instars. Based on the existing conditions on the Seal Beach NWR, application of these materials is limited to hand application or backpack sprayers. The larvicides currently approved for use on the Refuge, when conditions warrant their application, include Bti (*Bacillus thuringiensis israelensis*), Bs (*Bacillus sphaericus*), and methoprene. Bti is currently the most commonly used larvicide on the Refuge.

Bti is a naturally occurring bacterium used to kill mosquitoes and black flies in the larval form. It can also be toxic to certain other dipterans (including midges). When eaten by mosquito larvae, Bti spores release toxins that cause the larvae to stop eating and die. Bti is not known to be directly toxic to non-dipteran insects. Because Bti must be ingested to kill mosquitoes, it is much more effective on first-, second-, and early third-instar larvae than on late third and fourth-instar larvae since the earlier instar phases feed at a faster rate (fourth-instar larvae feed very little). Bti is not effective on mosquito pupae or adults. The mosquito control product most often used on the Refuge is VectoBac® G (EPA Registration No. 73049-10), a granular solid that is applied using a backpack air applicator. VectoBac® 12AS (EPA Registration No. 73049-38), an aqueous suspension, is also permitted for use on the Refuge.

Formulated products of Bti can be granular or liquid, and potency is expressed in International Toxicity Units (ITU), usually ranging from 200-1200 ITU. The concentrations of Bti in water necessary to kill mosquito larvae vary with environmental conditions, but are generally 0.05-0.10 ppm. Higher concentrations (0.1->0.5 ppm) of Bti are necessary when there is a high amount of organic material in the water, late-third and early fourth-instar larvae predominate, larval mosquito density is high, or water temperature is low (*Nayar et al. 1999*).

Operationally, Bti is applied within a range of volume or weight of formulated product per acre as recommended on the pesticide label, with the goal to achieve an effective concentration. The label recommended range of application rates under most conditions varies by a factor of 4 for most formulations (e.g., for granular formulations, 2.72-11.12 kg/ha (2.5-10 lb/acre)). For later instar larvae and water with a high organic content, higher application rates are recommended that may reach 8 times the lowest rate (e.g., for granular formulations, the higher rate is 11.1-22.5 kg/ha (10-20 lb/acre)). Mosquito control agencies use the recommended label rates, along with previous experience, to administer an effective dose. Because water depths even within a single wetland can vary greatly, field concentrations of Bti can vary widely. Efficacy is monitored by post-application reductions in mosquito larval density, but the actual concentration of Bti following an application is not measured. Thus, an insufficient concentration of Bti can be detected by low mortality of mosquito larvae, but monitoring to detect an overdose (i.e., a concentration greater than necessary to kill mosquito larvae) of the pesticide is rarely conducted.

Bs is also a naturally occurring soil bacterium. The Refuge has approval for this product to be applied as Vectolex® WDG (EPA Registration No. 73049-57). This granular product is mixed with water prior to application and applied on the Refuge using a backpack sprayer. Similar to Bti, Bs is only effective when active feeding mosquito larvae are present; and has no effect on mosquito pupae or adults.

Methoprene (e.g., trade name Altocid ®) is a synthetic mimic of a naturally produced insect hormone, juvenile hormone (JH). All insects produce JH in the larval stages, with the highest levels occurring in the early developmental stages. As an insect reaches its final stage of larval development, the level of JH is very low. This low level of JH triggers the development of adult characteristics. When an insect is exposed to methoprene, a hormonal imbalance in the development of the insect results, and it fails to properly mature into an adult. The insect eventually dies in the pupal stage. The most susceptible stages of development to methoprene are the later instars (for mosquitoes, third and fourth instars). In mosquito control applications, methoprene is applied directly to the larval breeding habitat. Larvae will continue to feed and may reach the pupal stage, but they will not emerge as adults. Methoprene is completely ineffective on mosquito pupae and adults. It is available in several formulations: liquid, granular, pellet, and briquette. There are several micro-encapsulated and extended-release formulations that remain effective for up to 150 days.

The amount of methoprene necessary for mosquito control is < 1.0 part per billion (ppb). The initial concentrations of methoprene when applied to aquatic habitats may reach 4-10 ppb, but residual concentrations are approximately 0.2 ppb (*Ross et al. 1994*). Once released into the aquatic environment, it is non-persistent, with a half-life of about 30-40 hours. Micro-encapsulated and extended-release formulations will, of course, be present in the water longer as the pesticide is slowly released over time, 7-150 days, depending on the formulation. In field applications, efficacy is determined only by an observed inhibition of emergence of adults, since larvae are not directly killed by the pesticide.

8.2 Pupacides

Several surface oils and films are available that can be applied to mosquito breeding sites to kill late stage mosquito larvae and pupae. The products create a barrier to the air-water interface, causing insects that require at least periodic contact with the water surface for oxygen to suffocate. As a result, both these products are potentially lethal to any aquatic insect that lives on the water surface or requires periodic contact with the air-water interface to obtain oxygen.

Studies have demonstrated significant negative effects on water surface-dwelling insects from applications of oils (*Mulla and Darwazeh 1981; Lawler et al. 1998*). Surface oils may also adversely affect wildlife by wetting the feathers of young waterfowl. This may be of particular concern at low temperatures when the oil could affect thermoregulation (*Lawler et al. 1998*).

Monomolecular biodegradable films, such as Agnique MMF, are invisible films that make it difficult for mosquito larvae and pupae to attach to the surface of the water causing them to drown. Agnique, which employs a physical as opposed to toxic mode of action to control mosquito and midge larvae and pupae, is persistent for up to 22 days and is effective on all species of mosquitoes and chronomid midges that breed in standing water. This product can be applied using a backpack sprayer. Higher doses are required in areas with multidirectional winds in excess of ten miles per hour.

The EPA considers Agnique to be "practically nontoxic." Acute toxicological tests were conducted to determine the effects of up to a 100 fold excess of a monomolecular film (MMF) on the various life stages of long-nose killifish, fiddler crab, snail, and other species, and no acute effects on any life stage of these species were observed. In addition, no adverse effects to saltwort or cordgrass were observed as a result of exposure over a four-week period. This product does have the potential to adversely affect non-target species such as marsh boatman (*Trichocorixa reticulate)* that live on the water surface or other aquatic insects that require periodic contact with the air-water interface to obtain oxygen. No information is currently available regarding potential effects to these types of non-target species. Limited use of this product in small areas of ponded tidal waters could provide an additional tool for controlling mosquito larvae during periods when exceptionally high numbers of mosquito larvae are present on the Refuge.

8.3 Adulticides

Adulticides are pesticides used to kill adult mosquitoes. There are three general classes of adulticides: organophosphates, pyrethroids, and pyrethrins/pyrethroids. These pesticides work on the nervous system, although they have different modes of action. Organophosphates are cholinesterase inhibitors while pyrethroids and pyrethrins are sodium channel blockers. Organophosphates such as Malathion and Naled are the used in California to control mosquitoes, but use of these products is infrequent and generally limited to rural areas. They are not currently permitted, nor are they proposed, for use on the Refuge.

The products that will be permitted for use on the Refuge when conditions warrant their use are adulticides with the active ingredient sumithrin. These include AquaAnvil™ and Anvil 10 +10 ULV. Sumithrin is a combination of phenothrin (a synthetic pyrethrin) and piperonyl butoxide. Piperonyl butoxide is a synergist that which interferes with an insect's detoxifying mechanisms (*Tomlin 1994*). The combination of these ingredients works upon physical contact with an insect or after ingestion as a nerve stimulant that affects the nerve channels of insects and ultimately leads to paralysis (*USEPA 2008*). AquaAnvil, a water-based formulation, and Anvil 10 +10 ULV, a mineral oil-based formulation, are both applied with ultra-low volume (ULV) spray equipment, including non-thermal ULV portable backpack sprayers and suitable truck-mounted thermal fogging equipment. In the past, adulticides were not permitted for use on the Refuge under any conditions. OCVCD has used AquaAnvil and Anvil 10+10 ULV on occasion elsewhere is the District and in 2010, requested that these products be considered for use on the Refuge.

Most adulticides, including those with the active ingredient sumithrin, are applied as ultra-low volume (ULV) sprays and are sprayed as very fine droplets (aerial 30-50 microns; ground 8-30 microns). Small droplet size allows the spray to drift for a relatively longer period of time compared to larger droplets, and the small size delivers an appropriate dose of the pesticide to kill an adult mosquito. Drift is a necessary component of adulticiding because these sprays are most effective on flying insects. To maximize the effectiveness of these products, applications generally occur in the evening or early morning when mosquitoes are most active.

The Material Safety Data Sheet (August 2006) for AquaAnvil™ states that this product is toxic to aquatic organisms, including fish and aquatic invertebrates, and according to the label, this product is not to be applied to "bodies of water (lakes, rivers, permanent streams, natural ponds, commercial fish ponds, swamps, marshes or estuaries), except when necessary to target areas where adult mosquitoes are present, and weather conditions will facilitate movement of applied material away from the water in order to minimize incidental deposition into the water body." The label also states that this project is toxic to bees exposed to direct treatment on blooming crops or weeds. The active ingredient piperonyl butoxide is considered by the USEPA to be moderately toxic to estuarine and marine fish and highly toxic to estuarine invertebrates (*USEPA 2006*).

When conditions warrant the use of an adulticide on the Refuge (e.g., public health emergency, exceedance of thresholds for numbers of mosquitoes found in on or immediately adjacent to the Refuge), the sumithrin-based product would be applied using ultra-low volume truck-mounted or backpack sprayers. Applications would only be permitted from roads that extend along the northern, western, and eastern perimeter of the Refuge and under meteorological conditions that are stable and favorable with a consistent wind greater than three miles per hour from the south or southwest. Under these conditions, the potential for drift over sensitive wetland areas would be minimal.

9.0 Actions to Minimize Adverse Effects to Refuge Trust Resources

9.1 Coordination and Communication

Annual Meeting. Prior to each mosquito breeding season, a meeting shall be held involving representatives from the Refuge, NWSSB, and OCVCD. Topics to be addressed at these annual meetings include:

- Surveillance, monitoring, and control activities that took place the prior year;
- Effectiveness of prior year's actions, if any, to control mosquitoes on the Refuge;
- Any concerns related to habitat or species disturbance during the prior year that must be resolved during the upcoming season;
- Surveillance, monitoring, and control activities proposed on the Refuge during the upcoming mosquito breeding season, including any potential changes in monitoring or surveillance activities proposed by OCVCD;
- Approved access areas on the Refuge for the current year;
- Review of field protocols for avoidance and minimization of take of any trust resources, including listed species, migratory birds, and their habitats;
- Presentation of any new pesticides proposed by OCVCD for use on the Refuge and discussion of the required review and approval process; and
- Review of the conditions to be included in the SUP for the current year.

Additional Coordination. In the event that mosquito surveillance in the vicinity of the Refuge indicates a potential for a public health emergency that could require additional control on the Refuge, OCVCD shall meet with the Refuge and NWSSB as soon as possible to discuss potential changes in the current monitoring and control activities. This will enable the Refuge Manager to begin the PUPs process and prepare that other documentation required to ensure the protection of trust Refuge resources.

Prior Access Notification. OCVCD shall call the Refuge Office at least two business days prior to entering the Refuge to conduct mosquito monitoring and/or control or provide a schedule of seasonal activities to the Refuge Manager prior to the beginning of each mosquito breeding season.

9.2 Access Restrictions

All access for mosquito monitoring and control in salt marsh habitat shall be on foot; the use of motorized vehicles shall be limited to existing roadways. Access is only permitted within those areas specified in the annually issued SUP. Approval from the Refuge Manager must be obtained before OCVCD can enter any areas on the Refuge that have not been approved for access in the SUP, and the Refuge Manager or a representative designated by the Refuge Manager must be present while OCVCD staff is in such areas to insure that no adults, nests, eggs, or young of listed species will be negatively affected by the monitoring or control activity.

Access for mosquito monitoring and control must comply with the description of use and activities included in the ESA Section 7(a) (2) consultation that has been conducted to accompany the CCP (USFWS 2010) for the Seal Beach NWR.

9.3 Reporting Requirements

OCVCD shall provide written reports to the Refuge Manager and NWSSB Biologist within one week of any mosquito monitoring activity or pesticide application. When reporting pesticide applications, the report shall document the dates of mosquito sampling and treatment, the treatment site number, mosquito species present, abundance per species, and name and amount of product applied.

9.4 Integrated Pest Management

Mosquito control on the Refuge shall follow an integrated pest management approach, including the implementation of non-pesticide actions that may be taken to reduce mosquito production. Non-pesticide actions include restoring or enhancing degraded habitat to reduce the potential for pooling water following higher high tides and/or heavy rainfall. These actions would be taken by the Refuge per available funding.

OCVCD will minimize the use of pesticides on the Refuge and continually investigate formulations and compounds that are least damaging to fish and wildlife populations. Controlling mosquito larvae populations with larvicides should be the focus of the control effort if established population thresholds are exceeded. When Altosid is used, it shall only be used in its solid form (e.g., briquets, pellets) and its use restricted to areas of the Refuge that are not known or expected to support high numbers of tiger beetles, unless use is required to address a public health emergency, as described under Phase 4.

Prior to using any adulticides, it should first be determined if increased intensity and frequency of larvicides or pupacides would be effective in reducing the abundance of

mosquitoes present on the Refuge. Water quality and other environmental factors (e.g., water depth, vegetation) should be examined to determine if different formulations and treatment strategies of larvicides or pupacides could be more effective. If large numbers of pupae are present, increasing the use of pupacides in infested areas should be considered.

When conditions, as described in Phase 4, warrant the use of an adulticide, its use should be limited and site specific in an effort to minimize adverse effects to non-target species including native pollinators and marine and estuarine organisms. In all cases, the implementation of the BMPs and other conditions described in this Plan shall be required in the SUP for mosquito control.

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11.0 Glossary of Terms

Action Threshold. Mosquito population levels that trigger IPM actions to manipulate mosquito populations.

Adulticide. Killing adult mosquitoes or a pesticide that kills adult mosquitoes.

Arthropod-borne viruses (arboviruses). Viruses that are maintained in nature through biological transmission between susceptible vertebrate hosts by blood-feeding arthropods.

Biological Diversity. The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur. (See 601 FW 3 for more information on biological diversity.)

Biological Integrity. Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities. (See 601 FW 3 for more information on biological integrity.)

BMPs. Best Management Practices.

ESA. Endangered Species Act.

Environmental Health. Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment. (See 601 FW 3.)

Health Threat. An adverse impact to the health of human or wildlife populations from mosquitoes identified and documented by Federal, State, and/or local public health authorities.

Integrated Pest Management (IPM). A sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks.

Larvicide. Killing mosquito larvae, or a pesticide that kills mosquito larvae.

Monitoring (mosquito). Activities associated with collecting quantitative data to determine mosquito species composition and to estimate relative changes in mosquito population sizes over time.

Mosquito-Borne Disease. An illness produced by a pathogen that mosquitoes transmit to humans and other vertebrates. The major mosquito-borne pathogens presently known to occur in the United States that are capable of producing human illness are the viruses causing eastern equine encephalitis, western equine encephalitis, St. Louis encephalitis, West Nile encephalitis/fever, LaCrosse encephalitis, and dengue, as well as the protozoans causing malaria.

Mosquito-Borne Disease Surveillance. Activities associated with detecting pathogens causing mosquito-borne diseases, such as testing adult mosquitoes for pathogens or testing reservoir hosts for pathogens or antibodies.

Mosquito Management. Any activity designed to inhibit or reduce populations of flies in the family

Mosquito Population Monitoring. Activities associated with collecting quantitative data to determine mosquito species composition and to estimate relative changes in mosquito population sizes over time.

Non-target Organisms. Species or communities other than those designated for population control.

Public Health Authority. A Federal, State, and/or local agency that has health experts with training and expertise in mosquitoes and mosquito-borne diseases and that has the official capacity to identify health threats and determine when there is a high risk for serious human disease or death from mosquitoes.

Public Health Emergency. An imminent risk of serious human disease or death, or an imminent risk to populations of wildlife or domestic animals. A health emergency represents the highest level of mosquito-associated health threats, as documented and determined by Federal, State, and/or local public health authorities.

PUP. Pesticide Use Proposal.

Pupacide. A pesticide that kills the pupal stage of mosquitoes.

Refuge-Based Mosquitoes. Mosquitoes that are produced within, or occur on, a refuge.

Reservoir Host. A species in which a pathogen is maintained over time. Reservoir hosts are capable of transferring the pathogen to a vector.

Vector. An organism, such as an insect or tick, that is capable of acquiring and transmitting a disease-causing agent, or pathogen, from one vertebrate host to another, or the act of transmitting a pathogen in such a manner.

WNV. West Nile Virus.

Appendix E:

Federal and State Ambient Air Quality Standards

Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.075 ppm (147 µg/m^3)		
Respirable Particulate Matter (PM10)	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	15.0 µg/m^3		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m3)	Gas Phase Chemiluminescence	53 ppb (100 µg/m^3) (see footnote 8)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (339 µg/m^3)		100 ppb (188 µg/m^3) (see footnote 8)	None	
Sulfur Dioxide (SO_2)	24 Hour	0.04 ppm (105 µg/m^3)	Ultraviolet Fluorescence	—	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)[9]
	3 Hour	—		—	0.5 ppm (1300 µg/m^3) (see footnote 9)	
	1 Hour	0.25 ppm (655 µg/m^3)		75 ppb (196 µg/m^3) (see footnote 9)	—	
Lead[10]	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 µg/m^3	Same as Primary Standard	High Volume Sampler and Atomic Absorption
	Rolling 3-Month Average[11]	—		0.15 µg/m^3		
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

See footnotes on next page …

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An “equivalent method” of measurement may be used but must have a “consistent relationship to the reference method” and must be approved by the EPA.

8. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national standards to the California standards the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

9. On June 2, 2010, the U.S. EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. The EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010.
   The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

10. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

11. National lead standard, rolling 3-month average: final rule signed October 15, 2008.

Appendix F:

Species Lists

Appendix F: Species Lists

Bird Species List

The following list includes bird species that have been observed within the Seal Beach NWR and the adjacent Naval Weapons Station. The birds' common and scientific names are provided in accordance with the 7th edition (1998), tenth Supplement (2010) of the A. O. U. Checklist of North American Birds. (* Indicates bird species known to nest on the refuge and # indicates birds observed on the adjacent Naval Weapons Station that although not yet observed, may also occasionally occur on the Refuge.)

Common Name	Scientific Name
Red-throated Loon	*Gavia stellata*
Pacific Loon	*Gavia pacifica*
Common Loon	*Gavia immer*
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkia*
American White Pelican	*Pelecanus erythrorhynchos*
California Brown Pelican	*Pelecanus occidentalis californicus*
Brandt's Cormorant#	*Phalacrocorax penicillatus*
Double-crested Cormorant	*Phalacrocorax auritus*
Pelagic Cormorant#	*Phalacrocorax pelagicus*
American Bittern	*Botaurus lentiginosus*
Great Blue Heron*	*Ardea herodias*
Great Egret	*Ardea alba*
Snowy Egret	*Egretta thula*
Little Blue Heron	*Egretta caerulea*
Tricolored Heron	*Egretta tricolor*
Reddish Egret	*Egretta rufescens*
Green Heron	*Butorides virescens*
Cattle Egret	*Bubulcus ibis*
Black-crowned Night Heron	*Nycticorax nycticorax*
White-faced Ibis	*Plegadis chihi*
Turkey Vulture	*Cathartes aura*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Ross's Goose	*Chen rossii*
Canada Goose	*Branta canadensis*
Brant	*Branta bernicla*

Bird Species List (continued)

Common Name	Scientific Name
Cackling Goose	*Branta hutchinsii*
Mute Swan	*Cygnus olor*
Tundra Swan	*Cygnus columbianus*
Gadwall*	*Anas strepera*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Mallard*	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acute*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
Long-tailed Duck	*Clangula hyemalis*
Bufflehead	*Bucephala albeola*
Common Goldeneye	*Bucephala clangula*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Ruddy Duck	*Oxyura jamaicensis*
Osprey	*Pandion haliaetus*
White-tailed Kite	*Elanus leucurus*
Bald Eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Red-shouldered Hawk	*Buteo lineatus*
Swainson's Hawk#	*Buteo swainsoni*
Red-tailed Hawk*	*Buteo jamaicensis*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
American Kestrel*	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon	*Falco peregrinus*
Prairie Falcon	*Falco mexicanus*
Light-footed Clapper Rail*	*Rallus longirostris levipes*
Virginia Rail	*Rallus limicola*
Sora	*Porzana Carolina*

Bird Species List (continued)

Common Name	Scientific Name
American Coot	*Fulica americana*
Black-bellied Plover	*Pluvialis squatarola*
Pacific-golden Plover	*Pluvialis fulva*
Western Snowy Plover	*Charadrius alexandrinus nivosus*
Semipalmated Plover	*Charadrius semipalmatus*
Killdeer*	*Charadrius vociferous*
Mountain Plover#	*Charadrius montanus*
Black Oystercatcher#	*Haematopus bachmani*
Black-necked Stilt*	*Himantopus mexicanus*
American Avocet*	*Recurvirostra americana*
Spotted Sandpiper	*Actitis macularius*
Wandering Tattler#	*Tringa incana*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmatus*
Lesser Yellowlegs	*Tringa flavipes*
Whimbrel	*Numenius phaeopus*
Long-billed Curlew	*Numenius americanus*
Marbled Godwit	*Limosa fedoa*
Ruddy Turnstone	*Arenaria interpres*
Black Turnstone	*Arenaria melanocephala*
Surfbird	*Aphriza virgata*
Red Knot	Calidris canutus
Sanderling	*Calidris alba*
Western Sandpiper	*Calidris mauri*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Dunlin	*Calidris alpine*
Stilt Sandpiper	*Calidris himantopus*
Ruff	*Philomachus pugnax*
Short-billed Dowitcher	*Limnodromus griseus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Snipe	*Gallinago gallinago*
Wilson's Phalarope	*Phalaropus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicarius*
Bonaparte's Gull	*Chroicocephalus philadelphia*
Heermann's Gull	*Larus heermanni*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Western Gull	*Larus occidentalis*
Glaucous-winged Gull	*Larus glaucescens*

Bird Species List (continued)

Common Name	Scientific Name
Glaucous Gull	*Larus hyperboreus*
Black Skimmer*	*Rynchops niger*
California Least Tern*	*Sternula antillarum browni*
Gull-billed Tern	*Gelochelidon nilotica*
Caspian Tern	*Hydroprogne caspia*
Black Tern	*Chlidonias niger*
Common Tern	*Sterna hirundo*
Forster's Tern*	*Sterna forsteri*
Royal Tern	*Thalasseus maximus*
Elegant Tern	*Thalasseus elegans*
Rock Dove	*Columba livia*
Spotted Dove	*Streptopelia chinensis*
Mourning Dove*	*Zenaida macroura*
Common Ground-Dove#	*Columbina passerina*
Barn Owl*	*Tyto alba*
Great Horned Owl*	*Bubo virginianus*
Burrowing Owl*	*Athene cunicularia*
Short-eared Owl	*Asio flammeus*
Lesser Nighthawk	*Chordeiles acutipennis*
White-throated Swift	*Aeronautes saxatalis*
Black-chinned Hummingbird#	*Archilochus alexandri*
Anna's Hummingbird*	*Calypte anna*
Costa's Hummingbird#	*Calypte costae*
Rufous Hummingbird#	*Selasphoras rufus*
Allen's Hummingbird	*Selasphorus sasin*
Belted Kingfisher	*Megaceryle alcyon*
Red-breasted Sapsucker#	*Sphyrapicus ruber*
Downy Woodpecker#	*Picoides pubescens*
Northern Flicker	*Colaptes auratus*
Western Wood-Pewee	*Contopus sordidulus*
Hammond's Flycatcher	*Empidonax hammondii*
Pacific-slope Flycatcher	*Empidonax difficilis*
Black Phoebe*	*Sayornis nigricans*
Say's Phoebe*	*Sayornis saya*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Western Kingbird*	*Tyrannus verticalis*
Loggerhead Shrike*	*Lanius ludovicianus*
Warbling Vireo	*Vireo gilvus*
Western Scrub Jay#	Ap*helocoma californica*
American Crow	*Corvus brachyrhynchos*
Common Raven*	*Corvus corax*
Horned Lark*	*Eremophila alpestris*

Bird Species List (continued)

Common Name	Scientific Name
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Cliff Swallow*	*Petrochelidon pyrrhonota*
Barn Swallow*	*Hirundo rustica*
Bushtit*	*Psaltriparus minimus*
Rock Wren	*Salpinctes obsoletus*
Bewick's Wren#	*Thryomanes bewickii*
House Wren	*Troglodytes aedon*
Marsh Wren	*Cistothorus palustris*
Ruby-crowned Kinglet	*Regulus calendula*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Western Bluebird*	*Sialia mexicana*
Mountain Bluebird	*Sialia currucoides*
Hermit Thrush	*Catharus guttatus*
American Robin#	*Turdus migratorius*
Northern Mockingbird*	*Mimus polyglottos*
Sage Thrasher	*Oreoscoptes montanus*
European Starling*	*Sturnus vulgaris*
American Pipit	*Anthus rubescens*
Cedar Waxwing#	*Bombycilla cedrorum*
Orange-crowned Warbler	*Oreothlypis celata*
Nashville Warbler	*Oreothlypis ruficapilla*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Black-throated Gray Warbler	*Dendroica nigrescens*
Townsend's Warbler	*Dendroica townsendi*
Hermit Warbler	*Dendroica occidentalis*
Common Yellowthroat*	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*
Western Tanager	*Piranga ludoviciana*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee	*Pipilo maculatus*
California Towhee#	*Melozone crissalis*
Chipping Sparrow	*Spizella passerina*
Lark Sparrow	*Chondestes grammacus*
Savannah Sparrow	*Passerculus sandwichensis*
Belding's Savannah Sparrow*	*Passerculus sandwichensis beldingi*
Large-billed Savannah Sparrow	*Passerculus sandwichensis rostratus*
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*
Fox Sparrow	*Passerella iliaca*
Song Sparrow*	*Melospiza melodia*
Lincoln's Sparrow	*Melospiza lincolnii*

Bird Species List (continued)

Common Name	Scientific Name
White-crowned Sparrow	*Zonotrichia leucophrys*
Golden-crowned Sparrow	*Zonotrichia atricapilla*
Lapland Longspur#	*Calcarius lapponicus*
Black-headed Grosbeak	*Pheucticus melanocephalus*
Blue Grosbeak	*Passerina caerulea*
Lazuli Bunting#	*Passerina amoena*
Red-winged Blackbird*	*Agelaius phoeniceus*
Tricolored Blackbird#	*Agelaius tricolor*
Western Meadowlark*	*Sturnella neglecta*
Yellow-headed Blackbird#	*Xanthocephalus xanthocephalus*
Brewer's Blackbird#	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
Hooded Oriole*	*Icterus cucullatus*
Bullock's Oriole	*Icterus bullockii*
House Finch*	*Carpodacus mexicanus*
Lesser Goldfinch	*Spinus psaltria*
American Goldfinch	*Spinus tristis*
House Sparrow*	*Passerculus domesticus*

Salt Marsh Native Plant Species List

The plant species listed below are the more predominant plant species occurring within the salt marsh complex at the Seal Beach NWR.

Common Name	Scientific Name
Jaumea	*Jaumea carnosa*
Saltwort	*Batis maritima*
Annual pickleweed	*Salicornia bigelovii*
Glasswort	*Salicornia subterminalis*
Common Pickleweed	*Sarcocornia pacifica*
Sea-blite	*Suaeda esteroa*
Alkali weed	*Cressa truxillensis*
Alkali heath	*Frankenia salina*
Boxthorn	*Lycium californicum*
Sea-lavender	*Limonium californicum*
Arrow-grass	*Triglochin concinna*
Saltgrass	*Distichlis spicata*
Shoregrass	*Monanthochloe littoralis*
Cordgrass	*Spartina foliosa*

Terrestrial Invertebrates

Limited information is available regarding the terrestrial invertebrates present on the Refuge. The invertebrate species listed below are identified as focus management species for all of Naval Weapons Station Seal Beach, including the Refuge, in the IRNMP (*U.S. Navy 2011*). These species may or may not be present on the Refuge.

Common Name	Scientific Name
Globose dune beetle	*Coelus globosus*
Gabb's tiger beetle	*Cicindela gabbii*
Sandy beach tiger beetle	*Cicindela latesignata latesignata*
Frost's tiger beetle	*Cicindela senilis frosti*
Mudflat tiger beetle	*Cicindela trifasciata sigmoidea*
Wandering skipper	*Panoquina errans*

Reptiles and Amphibians

Presented below of reptile and amphibian species document on NSWSB (*U.S. Navy 2011*), some of these species have not been observed in recent years. These species may or may not be present on the Refuge.

Common Name	Scientific Name
Western fence lizard	*Scheloperus occidentalis*
Side-blotched lizard	*Uta stansburiana*
Southern alligator lizard	*Gerrhonotus multicarinatus*
Gopher snake	*Pituophis melanoleucus*
San Diego horned lizard	*Phrynosoma coronatum blainvillii*
Pacific tree frog	*Hyla regilla*

Mammal

This is a partial list of mammals that occur or historically occurred on Naval Weapons Seal Beach and are likely to be found on occasion on the Refuge (*U.S. Navy 2011*).

Common Name	Scientific Name
House mouse	*Mus musculus*
Western harvest mouse	*Reithrodontomys megalotis*
California vole	*Microtus californicus*
Botta pocket gopher	*Thomomys bottae*
California ground squirrel	*Spermophilus beecheyi*
Virginia opossum	*Didelphis virginiana*
Long-tailed weasel	*Mustela frenata*
Striped skunk	*Mephitis mephitis*
Black-tailed jackrabbit	*Lepus californicus*
Audubon's cottontail	*Sylvilagus audubonii*
North American badger*	*Taxidea taxus*
Gray fox*	*Urocyon cinereoargenteus*

* Historically occurred on NWSSB, but are now extirpated.

Appendix G:

Fire Management Plan Exemption

United States Department of the Interior
Fish and Wildlife Service
San Diego National Wildlife Refuge Complex
2722-D Loker Avenue West
Carlsbad, California 92008

Memorandum December 4, 2002

To: Acting Manager, California and Nevada Operations, Region 1, U.S. Fish and Wildlife Service, Sacramento, California

From: San Diego National Wildlife Refuge Complex, Carlsbad, California

Subject: Request for Fire Management Plan Exemption, Seal Beach National Wildlife Refuge

Seal Beach National Wildlife Refuge
Request for Fire Management Plan Exemption

When approved, this document will exempt Seal Beach National Wildlife Refuge from developing a Fire Management Plan. U.S. Fish and Wildlife Service policy requires that all refuges with burnable vegetation develop a Fire Management Plan (620 DM 1). The Project Leader/Refuge Manager believes that this refuge contains no burnable vegetation, or essentially no burnable vegetation due to fuels conditions that will prevent ignition and fire spread. Therefore, a Fire Management Plan for this refuge is not required.

Justification:
We believe that the Seal Beach NWR should be exempt from the requirement to write a Fire Management Plan for the following reasons:

- Virtual lack of burnable vegetation
- Lack of ignition sources
- No reason or plans to do prescribed burning
- A long history of having no wild fires
- Refuge incorporated into Naval Weapons Station Fire Management Program

The Seal Beach NWR consists of a salt water marsh located in the Anaheim Bay estuary along the southern California bight, approximately 3 miles south of the City of Long Beach. About 745 acres of the Refuge's 923 acres are subject to regular, unobstructed tidal influences, creating a

salt marsh environs that includes about 560 acres of salt marsh vegetation, 60 acres of mud flats regularly exposed at lower tides, and 115 acres of tidal channels and open water. The remaining 178 acres are mostly distributed over the Refuge as narrow swaths of vegetation and bare ground located immediately adjacent to the wetlands, above the mean high tide elevation. The narrowness and isolation of upland areas and marine-influenced weather have resulted in limited vegetative growth, mostly dominated by grasses and sparse annual forbs. The upland vegetation community along the edges of the salt marsh appear to be limited to the salt-laden clayey soil. Common plants found in these strips often include elements from the salt marsh, particularly pickleweed (*Salicornia virginica* and *S. subterminalis*) and the higher marsh grasses, along with *Bassia hyssopifolia*, *Gasoul nodiflorum*, *Gasoul crystallinum*, and Australian saltbush (*Atriplex semibaccata*). Further from the Refuge edge, regular perturbation of the land by discing and mowing has led to the proliferation of weedy introduced plants along the road edges, including tumbleweed (*Salsola iberica*), mustards (*Brassica* spp.), and, most abundant in terms of total cover and distribution, annual grasses. The grasses include ripgutgrass (*Bromus diandrus*), foxtail chess (*Bromus rubens*), soft chess (*Bromus mollis*), barleys (*Hordeum* spp.), fescues (*Festuca* spp.), and wild oats (*Avena* spp.). Additional species of regular occurrence include telegraph weed (*Heterotheca grandiflora*), sow-thistle (*Sonchus oleraceous*), sweet-clovers (*Melilotus indicus* and *M. albus*), filaree (*Erodium cicutarium*), wild radish (*Raphanus sativus*), milk thistle (*Silybum marianum*), pigweed (*Chenopodium album*), curly dock (*Rumex crispus*), and London-rocket (*Sysymbrium irio*). A small number of native species, other than the salt marsh elements, are conspicuous for their local abundance, stature, or color. These natives include mulefat (*Baccharis emoyri*), lupin (*Lupinus* spp.), and fiddleneck (*Amsinkia intermedia*).

Fuels are non-continuous due to paved and dirt roads; temperatures are relatively low with an average daily temperature of 65 degrees F., and the Refuge is frequently bathed in fog throughout the year. Average annual rainfall is about 12 inches mostly occurring in the November to April time frame. Along the coast this period is characterized by fog and low clouds. Vegetation growth occurs primarily during this season, and during this time the annual plant growth on the upland strips is substantial, but too moist to be burnable. During the summer, fog and low clouds are a regular morning phenomenon, often persisting until mid-afternoon, and contribute to keeping the air temperature mild in summer. In May through July, the annual plants dry up with the lack of rainfall. This is the time when fuels would be most flammable; however, the prevailing weather conditions cause the fine and noncontinuous fuels to be very moist. The warmest, driest period of the year occurs August through early November when occasional strong, dry, gusty wind storms known locally as Santa Ana winds come from the inland deserts and are a regular autumn phenomenon. By this time most of the fuels have been mown as part of fuel control program on the Naval Weapons Station Seal Beach and blown away.

The Refuge is co-located on the 5000-acre Naval Weapons Station Seal Beach. The U.S. Fish and Wildlife Service administers the Refuge as a "management overlay." The Navy facility is responsible for storing and handling ordnance for the U.S. Navy's Pacific Fleet. Both structural and wildland fire management is administer by a civilian fire department which is located on the base. Fire prevention is a dominant safety concern on the Station. All ordnance storage and handling activity occurs on the eastern 4/5 of the Station; the western 1/5 is used for administrative and other miscellaneous functions. A major road separates the two portions of the Station. In order to reduce fire hazards to the minimum, the Navy administers agricultural leases covering much of the ordnance/handling areas. These leases result in maintaining the open space

lands on the Station in some stage of cultivation, significantly reducing fuels potential. The Station's Fire Department is strategically located on the Station, operates two 10,000 gallon tankers, and is manned 24 hours a day, 7 days a week. The Department conducts routine monthly fire prevention inspections, confines smoking to limited specified locations (off Refuge), maintains a water grid system of hydrants covering the entire base, and allows no open flames or "hot work" (eg. Bar-B-Q, welding) without prior inspections and permit. Ruderal vegetation along road sides, including on the Refuge, is cut by a contractor at regular intervals.

Public access to the Refuge is substantially curtailed by the Navy, limited to the last Saturday of each month and a few additional "clean-up" days during the year. There is virtually no trespass, so there is little chance of a human-ignited fire. There is no reason nor plans to conduct any prescribed fire.

Prepared: G. Mendel Stewart — 12/5/02
G. Mendel Stewart, Project Leader — Date
~~San Diego NWR Complex~~

Concurred: Pam Ensley — 1/6/03
Pam Ensley, Regional Fire Management Coordinator — Date
Pacific Region, U.S. Fish and Wildlife Service

Approved: for Dan Wabnitz Acting CNO Mgr — 1/15/03
Steve Thompson, Manager — Date
California and Nevada Operations
Pacific Region, U.S. Fish and Wildlife Service

Appendix H:

Wilderness Inventory

Appendix H: Wilderness Inventory

Introduction

A National Wilderness Preservation System composed of federally owned areas designated by Congress as "wilderness areas" has been created as a result of the passage of the Wilderness Act of 1964 (16 USC 1131-1136, 78 Stat. 890). The purpose of this Act is "to secure for the American people of present and future generations the benefits of an enduring resource of wilderness." Areas designated as wilderness are to be administered "for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness." No Federal lands are to be designated as "wilderness areas" except as provided for in the Act.

Consistent with the intent of the Wilderness Act, wilderness reviews are a required element of CCPs and are conducted in accordance with the refuge planning process outlined in Section 602 FW 1 and 3 of the Service Manual, including public involvement and NEPA compliance. The three phases of the wilderness review are: 1) inventory, 2) study; and 3) recommendation.

If through the inventory process a determination is made that a Refuge or area on a Refuge meets the criteria for wilderness, the area, referred to as a wilderness study area (WSA), is further evaluated as part of the study phase. In the study phase, all values (e.g., ecological, recreational, cultural, economic, symbolic), resources (e.g., wildlife, water, vegetation, minerals, soils), public uses, and refuge management activities within the area are analyzed. This analysis also includes an evaluation of whether the WSA can be effectively managed to preserve its wilderness character. These elements are analyzed through the refuge planning process to determine the most appropriate management direction for the WSA.

The recommendation phase consists of forwarding or reporting recommendations for wilderness designation from the Director through the Secretary of the Interior and the President to Congress in a wilderness study report.

If the inventory does not identify any areas that meet the WSA criteria, these findings are documented in the administrative record for the CCP, fulfilling the planning requirement for a wilderness review. We inventoried the lands and waters within the Seal Beach NWR and found no areas that meet the eligibility criteria for a WSA as defined by the Wilderness Act. This appendix summarizes the wilderness inventory for the Seal Beach NWR.

Inventory Criteria

The wilderness inventory is a broad look at the planning area to identify wilderness study areas (WSAs). WSAs are roadless areas that meet the minimum criteria for wilderness identified in Section 2(c) of the Wilderness Act.

> "*A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by*

> *man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions, and which: (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value.*"

A WSA must be a roadless area or island, meet the size criteria, appear natural, and provide outstanding opportunities for solitude or primitive recreation. The process for identification of roadless areas and islands in the Seal Beach NWR and application of the wilderness criteria are described in the following sections.

Identification of Roadless Areas and Roadless Islands

Identification of roadless areas and roadless islands required gathering and evaluating land status maps, land use and road inventory data, and aerial photographs for the Seal Beach NWR. "Roadless" refers to the absence of improved roads suitable and maintained for public travel by means of motorized vehicles primarily intended for highway use.

Evaluation of the Size Criteria

Roadless areas or roadless islands meet the size criteria if any one of the following standards applies:

- An area with over 5,000 contiguous acres. State and private lands are not included in making this acreage determination.
- A roadless island of any size. A roadless island is defined as an area surrounded by permanent waters or that is markedly distinguished from the surrounding lands by topographical or ecological features.
- An area of less than 5,000 contiguous Federal acres that is of sufficient size as to make practicable its preservation and use in an unimpaired condition, and of a size suitable for wilderness management.
- An area of less than 5,000 contiguous Federal acres that is contiguous with a designated wilderness, recommended wilderness, or area under wilderness review by another Federal wilderness managing agency such as the Forest Service, National Park Service, or Bureau of Land Management.

Evaluation of the Naturalness Criteria

In addition to being roadless, a WSA must meet the naturalness criteria. Section 2(c) defines wilderness as an area that "... generally appears to have been affected primarily by the forces of nature with the imprint of man's work substantially unnoticeable." The area must appear natural to the average visitor rather than "pristine." The presence of historic landscape conditions is not required. An area may include some human impacts provided they are substantially unnoticeable in the unit as a whole. Significant human-caused hazards, such as the presence of unexploded ordnance from military

activity, and the physical impacts of refuge management facilities and activities are also considered in evaluation of the naturalness criteria. An area may not be considered unnatural in appearance solely on the basis of the "sights and sounds" of human impacts and activities outside the boundary of the unit.

Evaluation of Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
In addition to meeting the size and naturalness criteria, a WSA must provide outstanding opportunities for solitude or primitive recreation. The area does not have to possess outstanding opportunities for both solitude and primitive and unconfined recreation, and does not need to have outstanding opportunities on every acre. Further, an area does not have to be open to public use and access to qualify under this criteria; Congress has designated a number of wilderness areas in the Refuge System that are closed to public access to protect resource values.

Opportunities for solitude refer to the ability of a visitor to be alone and secluded from other visitors in the area. Primitive and unconfined recreation means non-motorized, dispersed outdoor recreation activities that are compatible and do not require developed facilities or mechanical transport. These primitive recreation activities may provide opportunities to experience challenge and risk; self reliance; and adventure.

These two "opportunity elements" are not well defined by the Wilderness Act but, in most cases, can be expected to occur together. However, an outstanding opportunity for solitude may be present in an area offering only limited primitive recreation potential. Conversely, an area may be so attractive for recreation use that experiencing solitude is not an option.

Evaluation of Supplemental Values
Supplemental values are defined by the Wilderness Act as "...ecological, geological, or other features of scientific, educational, scenic, or historic value." These values are not required for wilderness but their presence should be documented.

Inventory Findings

As documented below, the lands and waters within the Seal Beach NWR do not meet the criteria for a WSA.

Roadless Areas and Roadless Islands
The majority of the Seal Beach NWR is owned by the U.S. Navy. The water areas not owned by the Navy are designated as public tidelands held in trust for the people of California by the California State Lands Commission and are leased to the Service for management as a NWR. Several paved and unpaved roads extent through the Refuge and are used by both the Refuge and the Navy. The lands and waters within the Refuge do not meet the criteria for roadless areas.

Size Criteria
The Seal Beach NWR consists of approximately 965 acres of land and water, which does not meet the size criteria for wilderness. No islands are included within the Seal Beach NWR.

Naturalness Criteria
The marsh complex within the Seal Beach NWR represents historic, nature coastal wetland habitat. However, other portion of the Refuge, including Forrestal Pond, Case Road Pond, 7th Street Pond, and Perimeter Pond, support subtidal habitats that were constructed as mitigation for wetland impacts at the Port of Long Beach. These restored wetlands are maintained through a system of culverts and constructed tidal channels, and do not represent the historic natural conditions of the area. In addition, evidence of past military and oil development are present in various locations throughout the Refuge.

Outstanding Opportunities for Solitude or Primitive and Unconfined Recreation
The Seal Beach NWR is located on a Naval Weapons Station, with a small weapons range located just off the Refuge to the northeast. Pacific Coast Highway borders the southwestern edge of the Refuge and military aircraft from Los Alamitos Army Airfield, located to the northeast of the Refuge, often fly over the site. Although the Refuge can provide opportunities for escape from the urban environment, the sights and sounds of urbanization are often apparent within the Refuge boundary.

Supplemental Values
The Seal Beach NWR protects was remains of the historic, natural coastal wetlands of Anaheim Bay, and these areas of the Refuge provide significant scenic value and provide significant ecological benefits to wildlife.

Conclusions
The lands and waters included within the Seal Beach NWR do not meet the minimum criteria for wilderness as identified in Section 2(c) of the Wilderness Act. No further analysis related to wilderness issues is therefore required.

Appendix I:

Request of Cultural Resource Compliance Form

REQUEST FOR CULTURAL RESOURCE COMPLIANCE
U.S. Fish and Wildlife Service, Region 1

Project Name:					**FWS Program:** (ES, Refuges, Fisheries, Fire…)	
					Funding Program: (Partners, Refuges, TEA-21, HCP, NAWCA…)	
State: CA, ID, HI, NV, OR, WA		**EcoRegion:** CBE, IPE,KCE, NCE			**FWS Unit: Org Code:**	
Project Location:	**County**	**Township**	**Range**	**Section**	**FWS Contact:** Name, Tel#, Address	
USGS Quad:					**Date of Request:**	**Proposed Project Start Date:**
Total project acres/ linear ft/m:		**APE Acres / linear ft/m** (if different)				

Have you consulted with Tribe(s)?				Have you consulted with other interested parties?				**Is there another federal agency involved with this project?**		No	If yes, provide name:
Yes		No		Yes		No				Yes	
MAPS Attached				**Check below**				**If yes, which agency is taking lead for Section 106 compliance?**		FWS	Other Agency
Copy of portion of USGS Quad with project area marked clearly **(required)**								Project (sketch) map showing Area of Potential Effect with locations of specific ground altering activities **(required)**			
Photocopy of aerial photo showing location **(if available)**								Any other project plans, photographs, or drawings that may help CRT in making determination **(if available)**			

Directions to Project: (if not obvious)	

Description of Undertaking:	Describe proposed project and means to facilitate (e.g., provide funds to revegetate 1 mile of riparian habitat, restore 250 acres of seasonal wetlands, and construct a 5-acre permanent pond). How is the project designed (e.g., install 2 miles of fence and create approximately 25' of 3' high check dam)?

Return Form and maps to: Virginia_parks@fws.gov
If unable to send digitally, mail or fax to USFWS Region 1 Cultural Resources Team, 20555 SW Gerda Lane, Sherwood, OR 97140
Questions: 503-625-4377 or fax 503-625-4887

Area of Potential Effects (APE):	Describe where disturbance of the ground will occur. What are the dimensions of the area to be disturbed? How deep will you excavate? How far apart are fenceposts? What method are you using to plant vegetation? Where will fill be obtained? Where will soil be dumped? What tools or equipment will be used? Are you replacing or repairing a structure? Will you be moving dirt in a relatively undisturbed area? Will the project reach below or beyond the limits of prior land disturbance? Differentiate between areas slated for earth movement vs. areas to be inundated only. Is the area to be inundated different from the area inundated today, in the recent past, or under natural conditions? Provide acres and/or linear ft/m for all elements of the project.
Environmental and Cultural Setting:	Briefly describe the environmental setting of the APE. **A)** What was the natural habitat prior to modifications, reclamation, agriculture, settlement? **B)** What is land-use history? When was it first settled, modified? How deep has it been cultivated, grazed, etc.? **C)** What is land use and habitat today? What natural agents (e.g., sedimentation, vegetation, inundation) or cultural agents (e.g., cultivation) might affect the ability to discover cultural resources? **D)** Do you (or does anybody else) know of cultural resources in or near the project area?
Please return this RCRC and map showing APE digitally, if possible, to virginia_parks@fws.gov. Questions, call 503-625-4377	

Return Form and maps to: Virginia_parks@fws.gov
If unable to send digitally, mail or fax to USFWS Region 1 Cultural Resources Team, 20555 SW Gerda Lane, Sherwood, OR 97140
Questions: 503-625-4377 or fax 503-625-4887

Appendix J:

Glossary of Terms

Appendix J: Glossary of Terms

1. Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ACOE	United States Army Corps of Engineers
ADA	Americans with Disabilities Act
ADT	average daily traffic volumes
AHPA	Archaeological and Historic Preservation Act
APE	Area of Potential Effect
AQMD	Air Quality Management District
ARB	California Air Resources Board
ARPA	Archaeological Resources Protection Act
Basin	South Coast Air Basin
BCC	Birds of Conservation Concern
BCR	Bird Conservation Regions
BMPs	Best Management Practices
BOD	biological oxygen demand
CAAQS	California Ambient Air Quality Standards
Caltrans	California Department of Transportation
CCP	Comprehensive Conservation Plan
CDFG	California Department of Fish and Game
CDPH	California Department of Public Health
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CFWO	Carlsbad Fish and Wildlife Office
cm	centimeter
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	Carbon monoxide
Code	California Fish and Game Code
Complex	San Diego National Wildlife Refuge Complex
CRMP	Cultural Resources Management Program
CWA	California Waterfowl Association
dB	decibel
dBA	A-weighted" noise scale
DDE	Dichloro-Diphenyl-Ethylene
DDT	Dichloro-diphenyl-trichloroethane
DMG	California Division of Mines and Geology
DOC	California Department of Conservation
DOI	Department of the Interior
EA	environmental assessment
EIS	Environmental Impact Statement
EO	Executive Order

EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESA	Endangered Species Act of 1973 as amended
FEMA	Federal Emergency Management Agency
FR	Federal Register
FTE	full-time equivalent
FY	Fiscal Year
GIS	Geographic Information System
gpm	gallons per minute
HMP	Habitat Management Plan
HUD	U.S. Department of Housing and Urban Development
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
INRMP	Naval Weapons Station Seal Beach Integrated Natural Resources Management Plan
IPM	Integrated Pest Management
IR	Installation Restoration
kV	kilovolt
LCP	Local Coastal Program
Ldn	Day/Night Average Sound Level
LOS	Level of Service
m^2	square meter
MBTA	Migratory Bird Treaty Act
MHHW	mean higher high water
MHW	mean high water
MLLW	mean low low water
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPAs	Marine Protected Areas
mph	miles per hour
MSCP	Multiple Species Conservation Program
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
Municipal Permit	Municipal Storm Water NPDES Permit
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NGDV	National Geodetic Vertical Datum
NGOs	non-government organizations
NHPA	National Historic Preservation Act
NIFZ	Newport-Inglewood Fault Zone
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOx	Oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System
NWSSB	Naval Weapons Station Seal Beach

O_3	Ozone
OEHHA	Office of Environmental Health Hazard Assessment
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PM_{10}	fugitive dust emissions or "inhalable particles" that are 10 microns (millionths of a meter) or less in diameter
$PM_{2.5}$	fine inhalable particles that are 2.5 microns and smaller
Port	Port of Long Beach
ppm	parts per million
ppt	parts per thousand
PUP	Pesticide Use Proposal
ROD	Record of Decision
RONS	Refuge Operating Needs System
RWQCB	Regional Water Quality Control Board
SAMMS	Service Asset Maintenance Management System
SCAQMD	South Coast Air Quality Management District
Service	U.S. Fish and Wildlife Service (also, USFWS)
SHC	Strategic Habitat Conservation
SHPO	State Historic Preservation Office
SO_4	Sulfates
SSC	California Species of Special Concern
State	California Department of Fish and Game
SUP	Special Use Permit
SWRCB	California State Water Resources Control Board
TBT	tributyltin
TOT	transit occupancy taxes
TRPH	total recoverable petroleum hydrocarbons
USC	United States Code
USDA APHIS	U.S. Department of Agriculture, Animal Plant Health Inspection Service
USDA	U.S. Department of Agriculture
USFWS	U.S. Department of the Interior, Fish and Wildlife Service (also, Service)
VOC	volatile organic compounds
WCB	Wildlife Conservation Board
WNV	West Nile Virus
WSA	wilderness study area

2. Glossary of Terms

Abiotic. The non-living parts of an ecosystem (e.g. light, temperature, water, oxygen, and other nutrients or gases).

Accessibility. The state or quality of being easily approached or entered, particularly as it relates to complying with the Americans with Disabilities Act.

Accumulation. The build-up of a chemical in an organism due to repeated exposure.

Action Threshold. Mosquito population levels that trigger IPM actions to manipulate mosquito populations.

Adaptive Management. The rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities. A process that uses feedback from refuge research and monitoring and evaluation of management actions to support or modify objectives and strategies at all planning levels. Analysis of results help managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Adulticide. Killing adult mosquitoes or a pesticide that kills adult mosquitoes.

Alluvial. Clay, silt, sand, gravel or other sedimentary matter transported and deposited in a delta or riverbed by flowing water.

Alternative. A reasonable way to resolve identified issues; a different set of objectives and strategies to achieve refuge goals and the desired future condition.

Aquatic. Pertaining to water, in contrast to land.

Arthropod-borne viruses (arboviruses). Viruses that are maintained in nature through biological transmission between susceptible vertebrate hosts by blood-feeding arthropods.

Artifact. An object used or made by humans, usually in reference to projectile points, tools, utensils, art, food remains, and other products of human activity.

Benthic. Refers to organisms associated with the bottom of the ocean, bay, lake, or river.

Biological Diversity. The variety of life and its processes, including the variety of living organisms, the genetic differences among them, and communities and ecosystems in which they occur. (See 601 FW 3 for more information on biological diversity.)

Biological Integrity. Biotic composition, structure, and functioning at the genetic, organism, and community levels consistent with natural conditions, including the natural biological processes that shape genomes, organisms, and communities.

Biota. The plant and animal life of a region.

Bivalve. Common term for pelecypods (members of Mollusca) in which the hard parts are composed of two sections fitting together to enclose a space that contains the soft part of the organism.

Categorical Exclusion. A category of actions that do not individually or cumulatively have a significant effect on the human environment and have been found to have no such effect in procedures adopted by a Federal agency pursuant to the National Environmental Policy Act.

Compatibility Determination. A written determination that a proposed or existing use of a National Wildlife Refuge is a compatible use or is not a compatible use.

Compatible Use. A proposed or existing wildlife-dependent recreational use or any other use of a National Wildlife Refuge that, based on sound professional judgment, will not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System Mission or the purposes of the Refuge on which the use would occur.

Comprehensive Conservation Plan (CCP). A document that describes the desired future conditions of the refuge or planning unit and provides long-range guidance and management direction to achieve the purposes of the refuge, helps fulfill the mission of the Refuge System; maintains and, where appropriate, restores the ecological integrity of each refuge and the Refuge System; helps achieve the goals of the National Wilderness Preservation System; and meets other mandates.

C**oncern.** See issue.

Critical Habitat. According to U.S. Federal law, the ecosystems upon which endangered and threatened species depend.

Cultural Resource Inventory. A professionally conducted study designed to locate and evaluate evidence of cultural resources present within a defined geographic area. Inventories may involve various levels, including background literature search, comprehensive field examination to identify all exposed physical manifestations of cultural resources, or sample inventory to project site distribution and density over a larger area. Evaluation of identified cultural resources to determine eligibility for the National Register follows the criteria found in 36 CFR 60.4.

Cultural Resource Overview. A comprehensive document prepared for a field office that discusses, among other things, its prehistory and cultural history, the nature and extent of known cultural resources, previous research, management objectives, resource management conflicts or issues, and a general statement on how program objectives should be met and conflicts resolved.

Cultural Resource. The physical remains of human activity (e.g., artifacts, ruins, historic sites, petroglyphs) and conceptual content or context of an area such as a traditional sacred site. It includes historically, archaeologically, and architecturally significant resources.

Detritus. An accumulation of decomposing plant and animal remains.

Dioxin. A family of toxic chemicals, including polychlorinated biphenyls (PCBs), that all share a similar chemical structure and a common mechanism of toxic action. Dioxin levels in the environment have been declining; however, current exposures levels still remain a concern.

Disturbance. Significant alteration of habitat structure or composition. May be natural (e.g., fire) or human-caused events (e.g., aircraft overflight). Also see wildlife disturbance.

Easement. A privilege or right that is held by one person or other entity in land owned by another.

Ecological Integrity. The integration of biological integrity, natural biological diversity, and environmental health; the replication of natural conditions.

Ecoregion. A territory defined by a combination of biological, social, and geographic criteria, rather than geopolitical considerations; generally, a system of related, interconnected ecosystems.

Ecosystem Approach. Protecting or restoring the natural function (processes), structure (physical and biological patterns), and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management. Management of an ecosystem that includes all ecological, social and economic components that makes up the whole of the system.

Ecosystem. A dynamic and interrelated complex of plant and animal communities and their associated non-living environment.

Effect. A change in a resource, caused by a variety of events including project attributes acting on a resource attribute (direct), not directly acting on a resource attribute (indirect), another project attributes acting on a resource attribute (cumulative), and those caused by natural events (e.g., seasonal change).

Endangered Species (Federal). A plant or animal species listed under the Endangered Species Act that is in danger of extinction throughout all or a significant portion of its range.

Endangered Species (State). A plant or animal species in danger of becoming extinct or extirpated in California within the near future if factors contributing to its decline continue.

Environment. The sum total of all biological, chemical, and physical factors to which organisms are exposed; the surroundings of a plant or animal.

Environmental Assessment (EA). A concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action, alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an Environmental Impact Statement or Finding of No Significant Impact.

Environmental Education. A process designed to develop a citizenry that has the awareness, concern, knowledge, attitudes, skills, motivation, and commitment to work toward solutions of current environmental problems and the prevention of new ones. Environmental education within the National Wildlife Refuge System incorporates materials, activities, programs, and products that address the citizen's course of study goals, the objectives of the refuge or unit, and the mission of the Refuge System.

Environmental Health. Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment. (See 601 FW 3.)

Environmental Impact Statement (EIS). A detailed written statement required by Section 102(2)(C) of the National Environmental Policy Act, analyzing the environmental impacts of a proposed action, adverse effects of the project that cannot be avoided, alternative courses of action, short-term uses of the environment versus the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitment of resources (40 CFR 1508.11).

Epibenthic. Pertaining to the environment and conditions of organisms living near the water bottom.

Estuarine. Deepwater tidal habitats and adjacent tidal wetlands that are usually partly enclosed by land but have some access to the open ocean and are diluted by freshwater.

Estuary. The wide lower course of a river into which the tides flow. The area where the tide meets a river current.

Euryhaline. Organisms that are tolerant of a wide range of salinity.

Exotic Species. Species that have been intentionally introduced to or have inadvertently infiltrated an area in which they are not natural found. Exotic species compete with native species for food or habitat.

Fallow. Allowing land that normally is used for crop production to lie idle.

Federal Trust Resources. A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States of America as a result of Federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by the Migratory Bird Treaty Act and other international treaties, and native plant or wildlife species found on the Refuge System.

Finding of No Significant Impact (FONSI). A document prepared in compliance with the National Environmental Policy Act, supported by an environmental assessment, that briefly presents why a Federal action will have no significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared (40 CFR 1508.13).

Fiscal Year. Federal Government budget year beginning October 1 and ending September 31.

Floodplain. The relatively flat area along the sides of a river which is naturally subjected to flooding.

Flyway. A route taken by migratory birds between their breeding grounds and their wintering grounds. Four primary migration routes have been identified for birds breeding in North America: the Pacific, Central, Mississippi, and Atlantic Flyways.

Foraging. The act of feeding; another word for feeding.

Forb. A broad-leaved, herbaceous plant.

Fragmentation. The process of reducing the size and connectivity of habitat patches.

Gastropod. Any of a large class of mollusks, usually with a univalve shell or no shell and a distinct head bearing sensory organs, such as snails and slugs.

Goal. Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units.

Habitat Restoration. Management emphasis designed to move ecosystems to desired conditions and processes, and/or to healthy ecosystems.

Habitat Type. See Vegetation Type.

Habitat. Suite of existing environmental conditions required by an organism for survival and reproduction. The place where an organism typically lives.

Health Threat. An adverse impact to the health of human or wildlife populations from mosquitoes identified and documented by Federal, State, and/or local public health authorities.

Hydrologic Regime. The local pattern and magnitude of water flow influenced by season.

Hydrology. The science dealing with the properties, distribution, and circulation of water on and below the earth's surface and in the atmosphere. The distribution and cycling of water in an area.

Impact. Refer to Effect.

Integrated Pest Management (IPM). A sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks.

Interpretation. Interpretation can be an educational and recreational activity that is aimed at revealing relationships, examining systems, and exploring how the natural world and human activities are interconnected.

Intertidal Mudflat. Expanses of mud contiguous to a water body often covered and exposed by tides.

Invasive Species. Refer to Exotic Species.

Inversion. A state in which the temperature of the air increases with increasing altitude and keeps the surface air and pollutants down.

Invertebrate. Animals that do not have backbones. Included are insects, spiders, mollusks (clams, snails, etc.), and crustaceans (shrimp, crayfish, etc.).

Issue. Any unsettled matter that requires a management decision (e.g., a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition).

Landbird. A category of birds that obtains at least part of their food from the land and nest in mainland areas (though some can also be found on islands). Landbirds include raptors and songbirds among others.

Landform. The physical shape of the land reflecting geologic structure and processes of geomorphology that have sculpted the structure.

Landowner: A person or entity indicated as the owner of property on the various ownership maps maintained by the Office of the County Assessor.

Larvicide. Killing mosquito larvae, or a pesticide that kills mosquito larvae.

Lease. A legal contract by which rights to use land or water are acquired for a specified period of time for a specified rent or compensation.

Macroinvertebrates. Invertebrates large enough to be seen with the naked eye (e.g., most aquatic insects, snails, and amphipods).

Management Alternative. A set of objectives and the strategies needed to accomplish each objective [FWS Manual 602 FW 1.4].

Management Concern. Refer to Issue.

Marsh Habitat. Habitat that is characterized by shallow water and emergent vegetation; unless otherwise specified, this term does not apply to similar habitat found in rivers, drains, or canals.

Marsh. A periodically wet or continually flooded area where the water is shallow enough to allow the growth of emergent vegetation; a marsh can be influenced by freshwater, tides, or both.

Migration. The seasonal movement from one area to another and back.

Migratory Bird. A bird that seasonally moves between geographic areas.

Mitigation. To avoid or minimize impacts of an action by limiting the degree or magnitude of the action; to rectify the impact by repairing, rehabilitating, or restoring the affected environment; to reduce or eliminate the impact by preservation and maintenance operations during the life of the action.

Model. A mathematical formula that expresses the actions and interactions of the elements of a system in such a manner that the system may be evaluated under any given set of conditions.

Monitoring. The process of collecting information to track changes of selected parameters over time. Monitoring is necessary to identify, track and analyze results of management actions at the Refuge so that future management actions may be adapted to obtain the best benefits to wildlife and habitat. See also Adaptive Management.

Mosquito Management. Any activity designed to inhibit or reduce populations of flies in the family

Mosquito Population Monitoring. Activities associated with collecting quantitative data to determine mosquito species composition and to estimate relative changes in mosquito population sizes over time.

Mosquito-Borne Disease Surveillance. Activities associated with detecting pathogens causing mosquito-borne diseases, such as testing adult mosquitoes for pathogens or testing reservoir hosts for pathogens or antibodies.

Mosquito-Borne Disease. An illness produced by a pathogen that mosquitoes transmit to humans and other vertebrates. The major mosquito-borne pathogens presently known to occur in the United States that are capable of producing human illness are the viruses causing eastern equine encephalitis, western equine encephalitis, St. Louis encephalitis, West Nile encephalitis/fever, LaCrosse encephalitis, and dengue, as well as the protozoans causing malaria.

National Environmental Policy Act (NEPA). An act which encourages productive and enjoyable harmony between humans and their environment, to promote efforts that will prevent or eliminate damage to the environment and atmosphere, to stimulate the health and welfare of humans. The act also established the Council on Environmental Quality. The Act requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and implementation of all actions. Federal agencies must integrate NEPA with other planning requirements, and prepare appropriate NEPA documents to facilitate better environmental decision making.

National Wildlife Refuge (Refuge or NWR). A designated area of land or water or an interest in land or water within the Refuge System, including National Wildlife Refuges, Wildlife Ranges, Wildlife Management Areas, Waterfowl Production Areas, and other areas (except Coordination Areas) under Service jurisdiction for the protection and conservation of fish and wildlife.

National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). Under the Refuge Improvement Act, the Service is required to develop 15-year Comprehensive Conservation Plans for all National Wildlife Refuges outside Alaska. The Act also describes the six public uses given priority status within the NWRS (i.e., hunting, fishing, wildlife observation, photography, environmental education, and interpretation).

National Wildlife Refuge System Mission. "The mission of the system is to administer a National network of lands and waters for the conservation, management, and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

National Wildlife Refuge System. Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife, including species threatened with extinction; all lands, waters, and interests therein administered by the Secretary as wildlife refuges; areas for the protection and conservation of fish and wildlife that are threatened with extinction; wildlife ranges; games ranges; wildlife management areas; or waterfowl production areas.

Native Species. Species that normally live and thrive in a particular ecosystem.

Natural Recruitment. Plant establishment through natural processes.

Neotropical Migratory Birds. Migratory birds that breed in North American and winter in Central and South America.

No Action Alternative. An alternative under which existing management would be continued.

Non-target Organisms. Species or communities other than those designated for population control.

Notice of Intent (NOI). A notice that is published in the Federal Register announcing that an Environmental Impact Statement will be prepared and considered for a specific action.

Objective. An objective is a concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work. Objectives are derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively.

Opportunities. Potential solutions to issues.

Ordinary High Water Mark. That line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Outreach. Two-way communication between the Service and the public to establish mutual understanding, promote involvement, and influence attitudes and actions, with goal of improving joint stewardship of our natural resources.

Passerine Bird. A songbird or other perching bird that is in the order Passeriformes (blackbirds, crows, warblers, sparrows, and wrens for example).

Perennial. In reference to a body of water, one that contains water year-to-year and that rarely goes dry.

Permeability. The property or capacity of porous rock, sediment, or soil to transmit water.

Phenology. The life cycle of particular species.

Planning Team. A team or group of persons working together to prepare a document. Planning teams are interdisciplinary in membership and function and generally consist of a planning team leader, refuge manager and staff biologists, a state natural resource agency representative, and other appropriate program specialists (e.g., social scientist, ecologist, recreation specialist).

Planning Unit or Unit. A single refuge, an ecologically or administratively related refuge complex, or distinct unit of a refuge. The planning unit also may include lands currently outside refuge boundaries.

Plant Association. A classification of plant communities based on the similarity in dominants of all layers of vascular species in a climax community.

Plant Community. An assemblage of plant species of a particular composition. The term can also be used in reference to a group of one or more populations of plants in a particular area at a particular point in time; the plant community of an area can change over time due to disturbance (e.g., fire) and succession.

Pollutant or Contaminant. Any introduced gas, liquid, or solid that makes a resource unfit for a specific purpose.

Polychaetes. Any of a class (Polychaeta) of chiefly marine annelid worms (such as clam worms), usually with paired segmental appendages, separate sexes, and a free-swimming trochophore larva.

Polychlorinated Biphenyls (PCBs). A mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment.

Polycyclic Aromatic Hydrocarbons (PAHs). A group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Population. All the members of a single species coexisting in one ecosystem at a given time. portion of its range, and published in the Federal Register.

Preferred Alternative. This is the alternative determined by the decision maker to best achieve the Refuge purpose, vision, and goals; contributes to the Refuge System mission, addresses the significant issues; and is consistent with principles of sound fish and wildlife management.

Prime Farmland. Farmland in an area or region that is considered to be the most ideal farmland based on several criteria; usually soil types and land productivity of the land are two of the most important criteria.

Priority Public Uses. Compatible wildlife-dependent recreation uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

Proposed Action. The management alternative that the Planning Team feels could best achieve Refuge purposes, vision, and goals while helping to fulfill the Refuge System mission.

Public Health Authority. A Federal, State, and/or local agency that has health experts with training and expertise in mosquitoes and mosquito-borne diseases and that has the official capacity to identify health threats and determine when there is a high risk for serious human disease or death from mosquitoes.

Public Health Emergency. An imminent risk of serious human disease or death, or an imminent risk to populations of wildlife or domestic animals. A health emergency represents the highest level of mosquito-associated health threats, as documented and determined by Federal, State, and/or local public health authorities.

Public Involvement. A process that offers impacted and interested individuals and organizations an opportunity to become informed about, and to express their opinions on Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge management.

Public Scoping: See Public Involvement.

Public. Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

Pupacide. A pesticide that kills the pupal stage of mosquitoes.

Purpose(s) of the Refuge. The purpose of a refuge is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing, authorization, or expanding a refuge, refuge unit, or refuge subunit.

Raptor. A category of carnivorous birds, most of which have heavy, sharp beaks, strong talons, and take live prey (e.g., peregrine falcon, northern harrier). Also referred to as a bird of prey.

Record of Decision (ROD). A concise public record of decision prepared by the Federal agency, pursuant to NEPA, that contains a statement of the decision, identification of all alternatives considered, identification of the environmentally preferable alternative, a statement as to whether all practical means to avoid or minimize environmental harm from the alternative selected have been adopted (and if not, why they were not), and a summary of monitoring and enforcement where applicable for any mitigation.

Recruitment. The annual increase in a population as determined by the proportion of surviving offspring produced during a specific period (usually expressed per year).

Refuge Goal. Refer to Goal.

Refuge Operating Needs System (RONS). A national database that contains the unfunded operational needs of each refuge. The Service includes projects required to implement approved plans and meet goals, objectives, and legal mandates.

Refuge Purposes. Refer to Purposes of a Refuge.

Refuge Revenue Sharing Program. Provides payments to counties in lieu of taxes using revenues derived from the sale of products from refuges.

Refuge Use. Any activity on a refuge, except administrative or law enforcement activity carried out by or under the direction of an authorized service employee.

Refuge Vision. A succinct statement of the unit's purpose and reason for being.

Restoration. The return of an ecosystem to an approximation of its former unimpaired condition.

Revetment. A facing of stone, concrete, or other material placed on a riverbank to protect it from erosion.

Rhizomes. Rootlike stem growing horizontally below the surface. The rhizome is used for food storage and can produce roots and shoots.

Scoping. A process for determining the range of issues to be addressed by a Comprehensive Conservation Plan and for identifying the significant issues that involves input from a range of government agencies, including Tribes, as well as private organizations, landowners, other interested parties, and the public.

Seabird. A group of birds that obtain at least some food from the ocean by traveling some distance over its surface. They also typically breed on islands and along coastal areas. Seabirds include gulls, terns, pelicans, and cormorants, among others.

Sediment. Any material, carried in suspension by water, which ultimately settles to the bottom of water courses. Sediments may also settle on stream banks or flood plains during high water flow.

Shorebirds. Long-legged birds, also known as waders, belonging to the order Charadriiformes, which use shallow wetlands and mud flats for foraging and nesting.

Soil Erosion. The wearing away of the land's surface by water, wind, ice, or other physical process.

Songbirds. A category of birds that are medium to small, perching landbirds. Most are territorial singers and migratory. (Refer also to Passerines.)

Sound Professional Judgment. A finding, determination, or decision that is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to the requirements of the Refuge Administration Act of 1966 (16 U.S.C. 668dd-668ee), and other applicable laws. Included in the finding, determination, or decision is a refuge manager's field experience and knowledge of the particular refuge's resources.

Southern California Bight. A curve in the southwestern California coastline that extends for Point Conception to just south of the Mexican border; the marine ecosystem and overall biodiversity in this area are influenced by the dramatic change in the angle of the coastline, which creates a significant backwater eddy. This backwater eddy results in the northern flow of equatorial waters along the nearshore and the southern flow of subarctic waters offshore, creating a biological transition zone between the warm and cold waters that supports approximately 500 marine fish species and more than 5,000 invertebrate species (*Southern California Coastal Water Research Project 1998*).

Species Composition. A group of species that inhabit a specific habitat type in its healthy state.

Species Diversity. Usually synonymous with "species richness," but may also include the proportional distribution of species.

Species. A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Step-down Management Plan. A plan that provides specific guidance on management subjects (e.g., habitat, public use, fire, safety) or groups of related subjects. It describes strategies and implementation schedules for meeting CCP goals and objectives.

Strategy. A specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives.

Study Area. The area reviewed in detail for wildlife, habitat, and public use potential. For purposes of this CCP/EIS the study area includes the land and water within the approved Refuge boundary.

Sublittoral. Relating to or describing an organism living immediately below low-tide level.

Submergent Vegetation. Plants that grows completely submerged except when flowering.

Subsidence. Movement to a lower level or elevation.

Surface Water. A body of water that has its upper surface exposed to the atmosphere.
the Endangered Species Act as being in danger of extinction throughout all or a significant

Threatened Species (Federal). A plant or animal species identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register, as likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Tiering. The coverage of general matters in broader environmental impact statements with subsequent narrower statements of environmental analysis, incorporating by reference, the general discussions and concentrating on specific issues.

Trace Elements. Metallic elements generally occurring in trace amounts in water, including iron, manganese, copper, chromium, arsenic, mercury, and vanadium.

Turbidity. Cloudiness of a water body caused by suspended silt, mud, pollutants, or algae.

U.S. Fish and Wildlife Service Mission. **"**Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

Understory. Shrubs and herbaceous plants that typically grow beneath larger trees or shrubs.

Upland. An area where water normally does not collect and where water does not flow on an extended basis. Uplands are non-wetland areas.

Vector. An organism, such as an insect or tick, that is capable of acquiring and transmitting a disease-causing agent, or pathogen, from one vertebrate host to another, or the act of transmitting a pathogen in such a manner.

Vegetation Community. Refer to Plant Community.

Vegetation Type or Habitat Type. A land classification system based upon the concept of distinct plant associations.

Vegetation. The composition of plant species, their frequency of occurrence, density, and age classes at a specified scale.

Waterfowl. A group of birds that include ducks, geese, and swans (belonging to the order Anseriformes).

Watershed. The entire land area that collects and drains water into a river or river system.

Wetland. Areas such as lakes, marshes, and streams that are inundated by surface or ground water for a long enough period of time each year to support, and that do support under natural conditions, plants and animals that require saturated or seasonally saturated soils.

Wildfire or Wildland Fire. A free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands.

Wildlife. All non-domesticated animal life; included are vertebrates and invertebrates.

Wildlife-Dependent Recreational Use. "A use of a refuge involving hunting, fishing, wildlife observation and photography, or environmental education and interpretation." These are the six priority public uses of the Refuge System as established in the National Wildlife Refuge System Administration Act, as amended.

Appendix K:

Distribution List

Appendix K: Distribution List

The following elected officials, Tribes, agencies, organizations, and interested individuals received notice of the availability of the Seal Beach National Wildlife Refuge Draft Comprehensive Conservation Plan/Environmental Assessment:

U.S. Elected Officials
Honorable Barbara Boxer, U.S. Senate
Honorable Dianne Feinstein, U.S. Senate
Congressman Ed Royce, District 40
Congressman Dana Rohrabacher, District 46
Congresswoman Loretta Sanchez, District 47

California State Legislature
State Senator Alan Lowenthal, District 27
State Senator Tom Harman, District 35
State Assemblywoman Bonnie Lowenthal, District 54
State Assemblyman Jim Silva, District 67

Federal Agencies
NOAA Marine Fisheries
U.S. Army Corps of Engineers
U.S. EPA, Region IX
U.S. Coast Guard
USFWS, Carlsbad Fish and Wildlife Office
USFWS, Pacific Southwest Regional Office
USFWS, Region 1 and 8 Cultural Resources Team
USFWS, Migratory Birds
U.S. Geological Survey, San Diego Field Station
U.S. Navy, Naval Weapons Station Seal Beach

California State Agencies
California State Clearinghouse
California Resources Agency
California Coastal Commission, Federal Consistency
California Office of Historic Preservation
California Department of Boating and Waterways
California Department of Conservation
California Department of Fish and Game, Los Alamitos Field Office
California Department of Fish and Game, Marine Region
Fish and Game Commission
Native American Heritage Commission
Santa Ana Regional Water Quality Control Board, Region 9, Executive Officer
State Lands Commission, Executive Officer
State Water Resources Control Board
Wetlands Recovery Project
Wildlife Conservation Board

Tribes
Cahuilla Band of Indians
Gabrieleno/Tongva Indians of California
Juaneno Band of Mission Indians

City Governments
City of Huntington Beach, Mayor and City Council
City of Huntington Beach, Planning Department
City of Los Alamitos, Mayor and City Council
City of Seal Beach, Mayor and City Council
City of Seal Beach, Manager and Planning Department
City of Westminster, Mayor and City Council

County Government
Orange County Board of Supervisor Janet Nguyen, District 1
Orange County Board of Supervisor John Moorlach, District 2
Orange County Watershed Program
Orange County Vector Control District
Orange County Resources and Development Management, Flood Control Division
Orange County Community Planning
Orange County Operations and Maintenance

Other Local Agencies
Orange County Fire Authority
South California Association of Governments
South Coastal Air Quality Management District

Local Libraries
Seal Beach Mary Wilson Public Library

Organizations
Amigos de Bolsa Chica
Animal Protection Institute
California Audubon
California Native Plant Society
California State University, Long Beach, Department of Biological Sciences
California State University, Fullerton, Department of Biological Sciences
Center for Biodiversity
Defenders of Wildlife
Ducks Unlimited
El Dorado Audubon
Endangered Habitats League
Friends of the Seal Beach National Wildlife Refuge
Laguna Hills Audubon Society
National Audubon Society
National Fish and Wildlife Foundation
National Wildlife Federation
National Wildlife Refuge Association
Orange County Conservation Corps
Palos Verdes/South Bay Audubon Society
Point Reyes Bird Observatory

San Diego Audubon
Sea and Sage Audubon Society
Sierra Club
Sunset Aquatic Regional Park
Sunset Beach Community Association
Surfrider Foundation
The Nature Conservancy
The Wilderness Society
Westchester Bay HOA
Wildlife Management Institute

Interested Public
Breitburn Energy
Tierra Data Inc.
Tim Anderson
Charlie Collins
Kristen Bender
Dick Zembal
Susan Hoffman
Pete Bloom
John Bradley

Media
Huntington Beach News
Huntington Beach Wave
Los Angeles Times, Orange County Addition
Orange County Register
Seal Beach News Enterprise
Seal Beach Sun
SBTV Channel 3
Westminster Herald