Final Programmatic Environmental Impact Report

SAN FRANCISCO ESTUARY INVASIVE SPARTINA PROJECT: SPARTINA CONTROL PROGRAM

ADDENDUM

May 2005

Prepared for the
California State Coastal Conservancy

Coastal
Conservancy

Final Programmatic Environmental Impact Report

San Francisco Estuary Invasive *Spartina* Project: *Spartina* Control Program

State Clearinghouse #2001042058

ADDENDUM

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EXECUTIVE SUMMARY

The California State Coastal Conservancy (Conservancy) has prepared this Addendum to the 2003 *Invasive Spartina Project, Spartina Control Program* Final Programmatic Environmental Impact Report (2003 FPEIR) to incorporate the use of a new aquatic herbicide, imazapyr, into the Invasive Spartina Project's (ISP) Spartina Control Program (SCP). The SCP is a control program for several species of non-native, invasive cordgrasses (*Spartina* spp.) in the San Francisco Estuary (Estuary). This Addendum includes an overview of the herbicide imazapyr, its use in the SCP, and discusses to what degree its use on the currently anticipated acreage of infested cordgrass will have the potential to cause new significant environmental impacts in the Estuary or to cause a substantial increase in the severity of significant impacts previously identified in the 2003 FPEIR.

This Addendum is based on a detailed assessment of the risks of imazapyr herbicides, including surfactants, on water quality, biological resources, and human health and safety. That assessment concludes that the addition of imazapyr herbicides as a control tool under the SCP would not increase, and in many areas would reduce, the impacts on water quality and ecological and human health risks compared to glyphosate, the currently approved SCP herbicide, as described in the 2003 FPEIR. The assessment also confirmed that the SCP, as revised by the incorporation of imazapyr, would have no [different effects than those described in the 2003 FPEIR on other physical environmental impacts including geomorphology and hydrology, land use, aesthetics, air quality, noise, cultural resources, and cumulative impacts.

Based on the analysis in this Addendum, no revisions are needed to the 2003 FPEIR because no substantial changes in the proposed action relevant to environmental concerns have occurred, no new significant impacts and no substantial increase in the severity of significant impacts previously identified in the 2003 FPEIR would result from the proposed changes included in the Project, no substantial changes to environmental circumstances have occurred since the 2003 FPEIR was certified in September 2003, and because no new information relevant to environmental concerns bearing on the proposed action has come to light that would indicate the potential for new significant impacts not discussed in the 2003 FPEIR.

1.0 Introduction

The California State Coastal Conservancy (Conservancy) prepared this Addendum to the 2003 *Invasive Spartina Project*, *Spartina Control Program* Final Programmatic Environmental Impact Report[1] (2003 FPEIR) pursuant to the California Environmental Quality Act (CEQA) to incorporate the use of a new aquatic herbicide, imazapyr, into the Invasive Spartina Project's (ISP) Spartina Control Program (SCP or Project). The SCP is a control program for several species of non-native, invasive cordgrasses in the San Francisco Estuary (Estuary). This Addendum includes an overview of the herbicide imazapyr and its use in the SCP, and discusses to what degree its use will have the potential to cause new significant environmental impacts on the Estuary.

1.1 Environmental Impact Report Background

The following subsections provide the background and timing of the 2003 FPEIR.

1.1.1 Notice of Preparation, Initial Study, and Scoping

Pursuant to the requirements of CEQA, the Conservancy issued a Notice of Preparation for a Draft Programmatic Environmental Impact Report (DPEIR) for the Spartina Control Program on April 6, 2001. This Notice of Preparation was sent to the State Clearinghouse in the State of California Office of Planning and Research, which distributed it to applicable State agencies. An Initial Study also was prepared and a scoping meeting to solicit input on the proposed action and alternatives was held on April 24, 2001.

1.1.2 Draft Environmental Impact Report

The Conservancy submitted the Draft PEIR (DPEIR) to the State Clearinghouse in May 2003. The DPEIR was released at that time for a 47-day public review and comment period ending June 4, 2003. The State Clearinghouse circulated the DPEIR to all potentially interested state regulatory agencies and departments. Other organizations also received copies of the DPEIR directly from the Conservancy. The Conservancy held four public meetings in May and June 2003 to explain and solicit public input on the Project and DPEIR.

1.1.3 Final Environmental Impact Report

The Conservancy received comments on the DPEIR from 16 entities by the close of the public comment period. The Conservancy prepared responses to comments and distributed them to the various entities. The Project's FPEIR was completed in September 2003 and includes the following two volumes:

- Volume I – Final Programmatic Environmental Impact Report/Environmental Impact Statement (including revised DPEIR and Comments and Responses)
- Volume II – Appendices (including Notice of Preparation, Initial Study, technical appendices, and Mitigation Monitoring and Reporting Program)

[1] The full document title is: *San Francisco Estuary Invasive Spartina Project, Spartina Control Program, Final Programmatic Environmental Impact Statement/Environmental Impact Report*, September 2003. This Addendum to the Environmental Impact Report was prepared pursuant to the California Environmental Quality Act. The Environmental Impact Statement prepared pursuant to the National Environmental Policy Act has been determined by the federal Lead Agency (U.S. Fish and Wildlife Service) to be adequate as written.

This two-volume document is available under separate cover and is located on the web at *www.spartina.org*. A complete administrative record of the EIR process is located at Conservancy offices at 1330 Broadway, Suite 1100, Oakland, California, 94612.

1.1.4 Certification

The State Coastal Conservancy, as the lead agency under CEQA, read and considered the information contained in the 2003 FPEIR. The Conservancy certified the 2003 FPEIR on September 25, 2003. The Conservancy filed a Notice of Determination with the State of California Office of Planning and Research on September 26, 2003.

1.2 CEQA Guidelines for Preparing an Addendum

The CEQA Guidelines identify the decision making process the Conservancy should use to determine the type of CEQA document appropriate for this modification to the 2003 FPEIR (§15164(a) and §15162). The CEQA Guidelines (§15164(a)) specify that the lead agency shall prepare an addendum to a previously certified EIR if some changes or additions are necessary, but none of the conditions described in Section 15162 calling for preparation of a subsequent EIR have occurred. According to Section 15162, a subsequent EIR **shall not** be prepared for the Project unless the Conservancy determines, based on substantial evidence in light of the whole record, that one or more of the following conditions are met:

- Substantial changes are proposed to the Project which will require major revisions to the 2003 FPEIR due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects;
- Substantial changes occur with respect to the circumstances under which the Project is undertaken which will require major revisions to the 2003 FPEIR due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or
- New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the 2003 FPEIR was certified as complete, shows any of the following:
  - The Project will have one or more significant effects not discussed in the 2003 FPEIR;
  - Significant impacts previously examined in the 2003 FPEIR will be substantially more severe than shown in that FPEIR;
  - Mitigation measures or Project alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant impacts on the environment, but the Conservancy declined to adopt the mitigation measure or alternative; or
  - Mitigation measures or Project alternatives which are considerably different from those analyzed in the 2003 FPEIR would substantially reduce one or more significant impacts on the environment, but the Conservancy declined to adopt the mitigation measure or alternative.

Additionally, should the Conservancy determine that one or more of the conditions noted above apply; the Conservancy may also elect to prepare a supplemental EIR. Specifically, CEQA Guidelines, Section 15163, specifies that the lead agency shall prepare a supplemental EIR rather than a subsequent EIR if:

- Any of the conditions described in Section 15162 above would require the preparation of a subsequent EIR, and

- Only minor additions or changes would be necessary to make the previous EIR adequately apply to the ISP's Spartina Control Program in the changed situation.

1.3 Tiering: CEQA Review for Site-specific Invasive Spartina Control Projects

The 2003 FPEIR, as augmented by this Addendum, will be used as the basis for site-specific CEQA analyses that will be prepared by the ISP for each proposed treatment site. Once detailed treatment plans are developed for each proposed treatment site, including specific herbicide treatment plans, CEQA assessments will be conducted to determine if the impact analysis and mitigations in the 2003 FPEIR, as augmented by this Addendum, adequately address and mitigate the site-specific impacts. Additional mitigation measures may be developed if appropriate to specific treatment sites and plans. In such cases, appropriate subsequent CEQA documentation and findings will be prepared.

2.0 Project Description

The Invasive Spartina Project (ISP), Spartina Control Program (SCP or Project) is a program for controlling the four species of non-native invasive cordgrasses (*Spartina* spp.) in the San Francisco Estuary (Estuary). The California State Coastal Conservancy (Conservancy) is the lead agency under the California Environmental Quality Act (CEQA) for this program and has certified the Final Programmatic Environmental Impact Report in 2003 (2003 FPEIR). Existing treatment methods for invasive *Spartina* species analyzed in the 2003 FPEIR include:

- Hand pulling and manual excavation
- Mechanical excavation and dredging
- Mowing, burning, pruning, and flaming
- Crushing and mechanical smothering
- Covering/blanketing
- Flooding and draining
- Herbicide application

The change to the Project is the addition of a new aquatic herbicide, imazapyr, and associated adjuvants, *i.e.* surfactants and colorants, to the invasive *Spartina* control methods available to the ISP. The purpose of this Addendum is to evaluate the potential impacts of adding this new control method to the SCP.

At the time the 2003 FPEIR was certified, the only herbicides registered by the California Environmental Protection Agency (CalEPA) for use in estuarine habitats were glyphosate-based Aquamaster® and Rodeo®. Imazapyr was unavailable as a treatment method at the time because it had not yet been registered for aquatic use in California. However, "Habitat®, an aquatic imazapyr formulation, was submitted to CalEPA's Department of Pesticide Regulation (DPR) in February, and it is expected to be approved for estuarine use in early summer 2005. The ISP would like to add imazapyr to the SCP's treatment options because it has been demonstrated to have several benefits over the use of glyphosate, such as increased efficacy and fewer limitations on timing of application, and, as described in this document, it has been found to have very minor potential adverse effects on the environment.

When it becomes available for use, the ISP intends to use imazapyr in addition to other measures already approved for use in the Project as described in Sections 2.1-2.3, below. Additionally, because of the extremely rapid spread of invasive cordgrasses since the 2003 approval of the Project, imazapyr may be used on a cumulatively larger area than that originally envisioned in the 2003 FPEIR. That EIR assumed a net area of invasive cordgrasses in the Estuary of approximately 500 acres. Current estimates of net areas infested with invasive cordgrasses have doubled to approximately 1,000 acres (despite treatment of about 450 acres in 2004). The revised Project could involve the application of imazapyr herbicides to as many as 1,500 acres of tidal wetlands annually for up to four consecutive years.

2.1 Treating Sites with Imazapyr and Imazapyr/Glyphosate Mixtures

As described above, the revised Project would involve treating some or all of the sites currently scheduled for treatment with glyphosate herbicides with imazapyr herbicide or glyphosate/imazapyr herbicide mixtures. Site-specific selection of control measures would continue to follow the approach described on page 2-19 of the 2003 FPEIR, and summarized in Table 2-1.

As described in the 2003 FPEIR, treatment methods with herbicides may include manual spraying (directed or broadcast), and aerial spraying from helicopters. Herbicide mixtures will be sprayed onto target plant surfaces, either manually with backpack sprayers or with spray equipment mounted on trucks, amphibious tracked vehicles, boats, or helicopters (broadcast sprayers or directed spray apparatus; 2003 FPEIR, p. 2-13). In certain situations, pastes may be applied to cut stems or solutions wiped or painted on foliage.

Imazapyr. Depending on the application method, Habitat® tank mixes will be applied with varying concentrations at 1 to 1.5 pounds of the active ingredient imazapyr (as acid equivalent) per acre (lb imazapyr a.e. /acre). High-volume handheld sprayers will typically use a spray volume of 100 gallons per acre (gal/acre). Low-volume directed sprayers will use about 20 gal/acre. The aerial application with helicopters uses a low-volume tank mix of 10 to 30 gal/acre of a 2.5-7.5% solution of Habitat®. The low spray volumes are necessitated by the relatively small helicopter tank volume (~50 gallons), which would otherwise require frequent refilling. Helicopter applications are controlled via global positioning systems ("GPS") and are therefore quite precise. Applications via helicopter result in a uniform, vertical deposition onto the plants. Application of imazapyr herbicide would follow the same guidelines and precautions set forth in the Mitigation Monitoring and Reporting Plan (MMRP) for the application of glyphosate herbicides.

Glyphosate. Compared to imazapyr, application of glyphosate requires considerably higher concentrations of the active ingredient to achieve high levels of efficacy. Depending on the application method, the herbicide is applied at a rate of up to ~11 pound of the active ingredient glyphosate (as acid equivalent) per acre (lb glyphosate a.e. /acre). Application methods, timing, quantities, and mixtures of glyphosate herbicides evaluated in the 2003 FPEIR are described on pages 2-12 through 2-18. Glyphosate herbicide mixture components, including surfactants and colorants proposed for use in the Project, are described on pages 3.2-12 through 3.2-15 of the 2003 FPEIR

Imazapyr/Glyphosate Mixtures. According the product labels for Aquamaster® and Habitat®, both products may be combined with other herbicides. The SCP may combine Aquamaster® and Habitat® to achieve certain objectives. For example, because imazapyr is much slower acting than glyphosate, it takes several weeks to months for damage to plants to become visible, potentially precluding timely follow-up applications on spots that were missed. Research in Washington State has found that glyphosate, which acts much faster, can be added to imazapyr mixtures to serve as a brown-down[2] indicator.

The concentrations and application rates for mixtures of imazapyr, surfactant, and colorant proposed to be used by the Project are shown in Table 1. Table 2, shows the concentrations and application rates for mixtures of glyphosate, surfactants, and colorants currently used by the Project. For glyphosate/imazapyr mixtures, the herbicide concentrations and application rates shown in

[2] The term brown-down, or burn-down, refers to the visible effect of browning of leaves or the entire plant after application of an herbicide.

Tables 1 and 2 represent the maxima for each herbicide product. The exact herbicide solution concentration, the choice of surfactants and colorants, and the determination of application rates will be based on site-specific conditions and will be described in the Site-specific Plans ("SSPs"), which are developed annually by the ISP.

Treatment Window. Similar to glyphosate application, imazapyr herbicides would be applied mid-May through mid-November, to accommodate constraints described in the 2003 FPEIR, pp. 2-17 through 2-21. No changes are proposed to treatment windows or timing for imazapyr.

3.0 Environmental Setting

As described in the 2003 FPEIR, the areas to be treated are located in the tidal wetlands along the margins of the San Francisco Estuary. The control program would be carried out within the nearly 40,000 acres of tidal marsh and 29,000 acres of tidal flats that comprise the shoreline areas of Alameda, Contra Costa, Marin, Napa, San Mateo, San Francisco, Santa Clara, Solano, Sonoma, and Sacramento Counties.

Of the approximately 70,000 acres of tidal wetlands and flats in the Estuary, invasive *Spartina* species currently occupy approximately 1,000 acres (as of 2005), mostly in the Central and South Bay subregions. Invasive *Spartina* species, primarily Atlantic cordgrass (*S. alterniflora*) and its hybrids with the native cordgrass (*S. foliosa*) are spreading rapidly, and the ISP anticipates the possible need to treat up to 1,500 acres annually for up to four consecutive years. The baseline physical conditions in the Estuary are described in detail in Chapter 3 of the 2003 FPEIR.

4.0 Analysis of Environmental Impacts

In order to evaluate the potential impacts of use of imazapyr herbicides, the Conservancy reviewed the 2003 FPEIR to identify resource areas that might be affected by this change in the Project. Because the overall scope of the Project has not changed, and the primary change is the addition of another herbicide to the already permitted herbicide, the Conservancy determined that this change would not have the possibility to alter the Project's impacts on air quality, noise, land use, visual quality, and cultural resources as presented for glyphosate in the 2003 FPEIR.

In order to determine if there were any possibility for imazapyr to result in increased or new significant impacts to water quality, biological resources, and human health and safety that were not previously identified in the 2003 FPEIR for the use of glyphosate, the Conservancy commissioned a detailed evaluation of the use of this herbicide in the San Francisco Estuary (Leson & Associates, May 2005). The evaluation presented in the Leson & Associates report regarding the use of an imazapyr herbicide for control of non-native *Spartina* in the San Francisco Estuary was based on the data, procedures, and findings of a standard ecological risk assessment for use of imazapyr for control of non-native *Spartina* in an estuarine setting in Washington State and a standard human health risk assessment for the use of imazapyr in forestry applications. In addition, the Leson & Associates report incorporated information from a comprehensive literature search and review of publications on ecological impacts, toxicity, and fate and transport of imazapyr and its formulations including adjuvants that could potentially be used with imazapyr. Additional unpublished information was obtained from the ISP, industry representatives, researchers, and government.

The following discussion of environmental effects is summarized from that report, which is included as Appendix D to this Addendum.

Table 1: Imazapyr herbicide mixture component concentrations and application rates for treatment of non-native *Spartina* in the San Francisco Estuary

Application Method	Spray Volume	Habitat®	Active Ingredient Imazapyr*	Surfactant**	Colorant
High volume hand-held sprayer	100 gal/acre	0.52-0.75% solution 4-6 pints/100 gal	1-1.5 lb a.e./acre	1 qt/100 gal NIS with ≥70% a.i.; ~1% MSO or VOC; SBS according to label	3 qt/100 gal
Low-volume directed sprayer	20 gal/acre	0.75-1.5% solution 1.2-2.4 pints/20 gal	0.3-0.6 lb a.e./acre	1 qt/100 gal NIS with ≥70% a.i.; ~1% MSO or VOC; SBS according to label	3 qt/100 gal
Broadcast sprayer/ Aerial application	10-30 gal/acre	2.5-7.5% solution 6 pints/10-30 gal	0.5-1.5 lb a.e./acre	1 qt/100 gal NIS with ≥70% a.i.; ~1% MSO or VOC; SBS according to label	0.5-1.5 qt/acre

* Active ingredient in Habitat® is imazapyr isopropylamine salt; values expressed as imazapyr acid equivalent (a.e.) ** a.i. = active ingredient; NIS = non-ionic surfactant; MSO = methylated seed oil; VOC = vegetable oil concentrate, SBS = silicone-based surfactant

Table 2: Glyphosate herbicide mixture component concentrations and application rates for treatment of non-native *Spartina* in the San Francisco Estuary

Application Method	Spray Volume	Aquamaster® or Rodeo®	Active Ingredient Glyphosate*	Surfactant**	Colorant
High volume hand-held sprayer	100 gal/acre	1-2% solution 1-2 gal/100 gal	4-8 lb a.e./acre	≥2 qt/100 gal NIS with ≥50% a.i.	3 qt/100 gal
Low-volume directed sprayer	25-200 gal/acre	1-8% solution 1-8 gal/100 gal	1.35-10.8 lbs a.e./acre	≥2 qt/100 gal NIS with ≥50% a.i.	3 qt/100 gal
Broadcast sprayer/ Aerial application	7-40 gal/acre/ 7-20 gal/acre	4.5-7.5 pints/acre	2.25-3.75 lb a.e./acre	≥2 qt/100 gal NIS with ≥50% a.i.	0.5-1.5 qt/acre

* The active ingredient in Rodeo® and Aquamaster® is glyphosate isopropylamine salt; values are expressed as glyphosate acid equivalent (a.e.)
** a.i. = active ingredient; NIS = non-ionic surfactant

4.1 Effects of Use of Imazapyr Herbicides on Water Quality

Using the various application methods, herbicide mixtures will be directly onto the foliage or stems of non-native *Spartina* during low tides when the sediment is exposed. Herbicide mixtures may be directly released to surface waters when the incoming tide washes the remaining herbicide mixture off the foliage and the exposed sediment. In the San Francisco Estuary rainfall is unlikely to occur during the planned application season. The concentrations in water will be determined by canopy interception of the applied herbicide, uptake into the plants, uptake into the root zone, and aerial drift. The Leson & Associates report evaluated the fate of the herbicide in water after application onto *Spartina* based on the herbicide's physical/chemical characteristics and the potential concentrations in water determined from theoretical models and results from field dissipation studies. (See sections 3.1.6, 3.1.7, 4.2.1, and 6.1.)

Under typical environmental conditions, imazapyr is highly soluble in water and does not adsorb to sediment particles. In aquatic systems, it is not expected to biodegrade, and volatilization from water or plant surfaces is insignificant. Residual imazapyr on the plants that has not completely dried or did not get absorbed by the plants will be inundated by the incoming tide and presumably solubilized. In water, imazapyr is subject to rapid photolysis with reported half-lives ranging from 3 to 5 days. In estuarine systems, dilution of imazapyr in the incoming tide will contribute to its rapid dissipation and removal from the area where it has been applied. Studies in Washington, which measured maximum concentrations after application of 1.5 lb imazapyr a.e./acre, the maximum application rate proposed by the ISP, onto a non-vegetated tidal mudflat, demonstrated complete dissipation of imazapyr from the area within 40 hours from the water column and within 400 hours from sediment.

One recent persistence study in Washington State investigated whether the herbicide would concentrate in the leading edge of the incoming tide as it moves over the treated site and continually dissolves herbicide from the sediment. Imazapyr herbicide was applied at the manufacturer-recommended rate of 1.5 lb a.e./acre directly onto a non-vegetated mudflat at the upper intertidal zone. The highest imazapyr concentration of 5.77 mg a.e./L, or 0.055 mg a.e./in^3 [3], was measured in 1-inch deep water at the upper tidal edge of the site. The average maximum concentration from three samples was 3.4 mg/L. (Patten 2003; Entrix 10/03, p. 61.) Thus, compared to the original application of 1.5 lb a.e./acre, or 0.11 mg a.e. onto a unit area of 1 square inch[4], the measured concentration in the first flush water was lower by a factor of about 2[5]. The concentration of imazapyr in water collected 6 and 60 meters outside the treatment area was 99% lower than the maximum water concentration collected at the edge of the treatment area. The highest measured imazapyr concentration in sediment was 5.4 mg a.e./kg. As mentioned above, no residues could be detected in water and sediment after 40 and 400 hours, respectively, with half-lives of <0.5 and 1.6 days, respectively, suggesting rapid dissipation of imazapyr from both water and sediment.

This information indicates that imazapyr is not environmentally persistent in the estuarine environment and will not degrade the water quality of the San Francisco Estuary. There are no water quality objectives for imazapyr in California; therefore, the water quality considerations for imazapyr are associated with toxicity, which is addressed in the following section.

[3] $(3.4 \text{ mg/L}) / (61 \text{ in}^3\text{/L}) = 0.055 \text{ mg/in}^3$

[4] $(1.5 \text{ lb/acre}) \times (453{,}592 \text{ mg/lb}) / (6{,}272{,}640 \text{ in}^2\text{/acre}) = 0.108 \text{ mg/in}^2$

[5] $(0.055 \text{ mg/in}^3) / (0.11 \text{ mg/in}^2) = 1.94\text{/in}$

4.2 Effects of Use of Imazapyr Herbicides on Biological Resources

The San Francisco Estuary provides a number of different salt marsh habitats, including tidal brackish marsh, estuarine beaches, brackish lagoons, and tidal salt marsh pans and ponds. These habitats support diverse, species-rich intertidal and subtidal ecological communities, including several species of concern, some listed as threatened or endangered (T&E) under the Federal Endangered Species Act (ESA). (For a detailed description of the biological communities and a listing of the species of concern, consult the 2003 FPEIR, Section 3.3.1 and Appendix F.) Estuarine plants, algae, animals, and bacteria are all potential receptors for exposure to herbicides. Humans are also potential receptors, particularly herbicide applicators, but also people who live or work close to marshland or who use treated marshland for recreation.

Application of imazapyr would be executed in the same way as glyphosate applications, *i.e.* with ground-, boat- or helicopter-based spray applications. Therefore, the ecological receptors and species of concern occurring in the marshes in the San Francisco Estuary where imazapyr would be used to control non-native *Spartina* are identical to those identified for the application of glyphosate in Section 3.3.1 of the 2003 FPEIR. The Leson & Associates report evaluated realistic exposure scenarios for all ecological receptors following application of an imazapyr herbicide onto non-native *Spartina* in the San Francisco Estuary ecosystem, taking into account local conditions and species of concern. The report evaluated the potential risks based on levels of concern for not-endangered as well as endangered species specified in the U.S. Environmental Protection Agency's guidelines for ecological risk assessment. (Section 4.5.1 through 4.5.7.)

Mammalian wildlife could be exposed to imazapyr through dermal, oral (ingestion) or inhalation routes. The dietary route is considered the most likely. The oral and dermal toxicity of imazapyr to mammals is categorized as practically non-toxic. Based on the evaluated exposure scenario, the only potentially significant risk was identified for a spill scenario that assumed ingestion of undiluted spray solution by mammalian wildlife. This risk scenario is highly unlikely because best management practices set forth in the MMRP would ensure immediate clean-up of the spill and because the disturbance created by the cleanup efforts would discourage wildlife use of the area. Risks to mammals from exposure to imazapyr following treatment of *Spartina* are therefore considered insignificant.

Exposure to birds may occur via ingestion, contact, and inhalation. None of the acute or chronic exposure scenarios was significant to birds with the exception of the drinking water spill scenario. Again, the spill scenario modeled is unlikely to be realized in the field. Risks to birds from exposure to imazapyr following treatment of *Spartina* are therefore considered insignificant.

Based on exposure calculations for a worst-case exposure scenario (spraying tank mix directly onto insects) and the reported toxicity to bees (practically non-toxic), the risk to insects from exposure to imazapyr following treatment of *Spartina* is considered insignificant.

No studies regarding the toxicity of imazapyr to reptiles and amphibians were found in the literature and a formal risk calculation could not be conducted. However, amphibians can not tolerate the salinity levels found in areas where non-native *Spartina* occurs and are therefore not at risk. The life history of those reptiles that might occur in the Estuary suggests that their exposure is unlikely. The risks to reptiles and amphibians following treatment of non-native *Spartina* with imazapyr herbicides are therefore considered insignificant.

Imazapyr is practically non-toxic to fish; however, the use of surfactants in the tank mixture may greatly increase the toxicity of the formulation to aquatic organisms as evidenced by a number of studies. The Leson & Associates report evaluated the toxicity of tested imazapyr herbicide/ surfactant mixes to fish based on a very conservative exposure scenario that assumed the highest potential concentration of imazapyr in water potentially found in the leading edge of the incoming tide. Levels of concern for acute exposure of fish were not exceeded for any of the surfactant/formulation mixtures tested. However, levels of concern for endangered fish could potentially be marginally exceeded for the highest measured and modeled concentrations in water. However, the presence of fish in the leading edge of an incoming tide, where these concentrations might occur, is highly unlikely. Further, the basis for the highest measured exposure value was extremely conservative in that the pesticide was applied directly to sediment with no interception by vegetation and collection of the sample only three hours later. The Project intends to apply pesticides with the outgoing tide, leaving a much longer window of time before the tide washes off any remaining herbicide from the sediment and foliage. Some degradation and uptake of the herbicide will occur, which will further reduce the concentration in water. Due to the tidal exchange of waters, which results in dilution of the compound with each tide, imazapyr would quickly dissipate beyond detection. This conclusion is supported by dissipation experiments in Washington State, which demonstrated that imazapyr effectively dissipated in water within about four to five tidal exchanges. Therefore, the acute and chronic risk to fish due to application of imazapyr herbicides for control of non-native *Spartina* is considered insignificant.

Imazapyr is practically non-toxic to both freshwater and marine invertebrates. The acute risk to aquatic invertebrates from exposure to imazapyr in water was determined to be insignificant. Any potential impact from a spill would be short-term only because epibenthic and pelagic invertebrate communities will likely recover within a few tidal cycles. Therefore, the acute and chronic risk to aquatic invertebrates due to application of imazapyr herbicides for control of non-native *Spartina* is considered insignificant.

In sum, the maximum proposed application rate of 1.5 lb imazapyr a.e./acre for control of *Spartina* in the Estuary did not result in aquatic concentrations or terrestrial doses that would pose significant risks to aquatic or terrestrial wildlife, even under the extremely conservative conditions modeled.

Because imazapyr is an effective herbicide, non-target plants that are inadvertently directly sprayed are likely to be severely damaged. These risks are particularly acute for vascular plants. Algae appear to be less sensitive to imazapyr than aquatic macrophytes. Off-site drift from the application site after ground-broadcast or aerial applications if terrestrial imazapyr formulations in forestry applications were found to cause damage to sensitive plant species at distances of up to 500 feet. Peak concentrations of imazapyr with the incoming tide could also result in adverse effects on aquatic macrophytes and non-target vegetation. However, the tidal exchange of water would rapidly dilute these concentrations to levels that do not cause acute damage to plants. Rapid dissipation and lack of persistence of imazapyr in the estuarine environment preclude long-term adverse effects to non-target vegetation. Best management practices as identified in the FPEIR and adopted by the Conservancy as conditions of approval of the Project, will reduce the likelihood of effects on non-target vegetation.

4.3 Effects of Imazapyr Herbicides on Human Health and Safety

The potential human health and safety effects of the addition of imazapyr to the Project treatment methods are addressed in detail in the Leson & Associates report, Sections 5 and 6.1.

That report concludes that typical exposures to imazapyr would not lead to estimated doses that exceed a level of concern for either workers or members of the general public at the maximum application rate of imazapyr proposed for control of Spartina in the San Francisco Estuary. Based on the available information and under the foreseeable conditions of application, it can be reasonably concluded that workers or members of the general public will not be at any substantial risk from acute or longer-term exposure to imazapyr at the proposed application rate on non-native *Spartina*.

Mild irritation to the eyes can result from accidental splashing. This effect will be minimized or avoided by exercising care to reduce splashing and wearing goggles during the handling of the compound identified in the FPEIR and adopted by the Conservancy as a condition of approval of the Project.

4.4 Comparison of Relative Ecological and Human Health Effects of Imazapyr versus Glyphosate and Associated Adjuvants

The 2003 FPEIR evaluated the ecological and human health effects of the use of glyphosate for control of non-native *Spartina* in the San Francisco Estuary and concluded that the use of glyphosate presents limited risks to some ecological receptors. The following paragraphs provide a summary of conclusions presented in the Leson & Associates report.

Imazapyr has been demonstrated to be less toxic to aquatic organisms than glyphosate. For example, a direct comparison test with rainbow trout established an inherent acute toxicity of glyphosate to fish at more than 25-fold higher than for imazapyr. Given that the relationship between fish and aquatic invertebrate toxicity for a given chemical rarely differs by more than an order of magnitude, it is reasonable to expect a similar relationship to exist for aquatic invertebrates for the toxicity of glyphosate compared to imazapyr. On a unit-compound basis, imazapyr is more effective than glyphosate for control of *Spartina* and is consequently applied at considerably lower application rates. The resulting risk from imazapyr to aquatic organisms is therefore considerably lower than that for glyphosate.

The aquatic formulations of both herbicides must be mixed with surfactants for use on post-emergent vegetation such as *Spartina*. The inherent risks of using either herbicide have been shown to increase significantly when mixed with surfactants. Risks associated with glyphosate/surfactant mixtures increase more drastically than those for imazapyr/surfactant mixtures for a number of reasons. First, most non-ionic surfactants that must be used with glyphosate are inherently more toxic to aquatic organisms than the methylated or esterified seed oils or silicone-based surfactants that can be used with imazapyr herbicides. (For example, the non-ionic surfactants R-11® and LI-700® were determined to be five times as toxic as the esterified seed oil Competitor®.) Second, glyphosate requires considerably higher spray volumes than imazapyr and surfactants are mixed proportionally to the spray volume, resulting in about twice as high surfactant concentrations for glyphosate tank mixes compared to imazapyr tank mixes. Surfactants to be used with imazapyr are described in detail in Appendix D to this Addendum, the Leson & Associates Report, Section 4.4. As shown in that report, a number of less toxic surfactants are available for use with imazapyr and have been demonstrated to be effective on *Spartina*.

Although glyphosate is highly soluble like imazapyr, it is not photolyzed in water and is readily adsorbed to suspended particles and sediment. Its fate in an estuarine environment is primarily determined by its strong adsorption to sediment particles and the rate of microbial degradation. Concentrations of glyphosate in rhizomes of treated *Spartina* have been shown to increase over several years after treatment. The residual biomass of *Spartina* could therefore slowly release glyphosate into the environment. Therefore, glyphosate is predicted to be more persistent than imazapyr in an estuarine environment.

In sum, due to the lower inherent toxicity of imazapyr to aquatic organisms, the ability to use less toxic surfactants, the lower application rates, and the more rapid dissipation from the environment, the use of imazapyr herbicides in the estuarine environment presents an improved risk scenario for aquatic and terrestrial animals over the use of glyphosate herbicides.

Adverse effects of imazapyr to directly sprayed non-target vegetation, particularly vascular plants, may be higher compared to glyphosate due to the herbicide's higher efficacy. However, despite its increased toxicity to the non-target plants, because of the lower spray volumes used with imazapyr, impacts due to drift would not be increased beyond those described in the 2003 FPEIR. 2003 FPEIR Mitigation BIO-2, adopted by the Conservancy as a condition of approval of the Project, would continue to reduce this impact to a less-than-significant level, as with the use of glyphosate herbicides.

4.5 Changes in Environmental Effects

As described in the Project description section of this Addendum, the imazapyr herbicide Habitat® is proposed be used on as many as 1,500 acres per year of tidal wetlands for as many as four consecutive years to facilitate eradication of non-native *Spartina*.

With the exception of potential impacts to non-target vegetation, fewer adverse effects are expected when using an imazapyr herbicide compared to a glyphosate herbicide. Potential adverse effects from their combined use are also less than those expected for the use of a glyphosate herbicide alone. In addition, effective non-native *Spartina* eradication, which requires little or no retreatment allows for recolonization of treated sites with native species sooner than if multiple treatments have to be used over a number of years. Even so, it can take a number of years for the ecosystem to restabilize itself after treatment with either herbicide.

In the long-term, the anticipated higher efficacy of imazapyr (as described in Appendix D, Leson & Associates Report) for control of non-native *Spartina* may result in decreased water quality, biological, and human health and safety impacts due to potential need for fewer applications over the years. Fewer applications also would result in fewer physical adverse impacts to the estuarine ecosystem due to trampling, compaction of sediment, and so forth.

Tables A-1, A-2, and A-3 in Appendix A provide a comparative summary of the potential impacts on water quality, biological resources, and human health and safety and the associated mitigation measures, as presented in the 2003 FPEIR for the use of glyphosate and imazapyr in the San Francisco Estuary.

5.0 Conclusions

Based on the above analysis and discussion, no revisions are needed to the 2003 FPEIR because no substantial changes in the proposed action relevant to environmental concerns have occurred, no new significant impacts and no substantial increase in the severity of significant impacts previously identified in the 2003 FPEIR would result from the proposed changes included in the Project, no substantial changes to environmental circumstances have occurred since the 2003 FPEIR was certified in September 2003, and because no new information relevant to environmental concerns bearing on the proposed action has come to light that would indicate the potential for new significant impacts not discussed in the 2003 FPEIR.

Accordingly, an addendum to the 2003 FPEIR is considered the appropriate CEQA document for the addition of imazapyr herbicide mixtures to the ISP Spartina Control Program. None of the conditions in the CEQA Guidelines Section 15162 (for a subsequent EIR) apply for the Project as currently proposed and, as a result, the conditions in Section 15163 (for a supplemental EIR) also do not apply.

While substitution of imazapyr herbicide mixtures for glyphosate herbicide mixtures will reduce some of the impacts of the Project, because glyphosate herbicides will continue to be an option for use (*i.e.*, the ISP is not proposing to remove glyphosate from the SCP), the potential for unavoidable significant impacts from the Project does not materially change from the original 2003 FPEIR. Nonetheless, incorporating imazapyr herbicide mixtures into the Project is expected to lead to fewer overall impacts than the Project approved in the 2003 FPEIR.