Point Reyes National Seashore

National Park Service
U.S. Department of the Interior

Abbotts Lagoon Area Dune Restoration Plan Environmental Assessment

Point Reyes National Seashore
National Park Service
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EXECUTIVE SUMMARY

Point Reyes National Seashore is proposing to restore 300 acres of coastal dune habitat south of Abbotts Lagoon to benefit species listed as threatened or endangered under the Endangered Species Act (e.g., federally listed species). Habitat would be restored by removing highly invasive, nonnative plant species which have greatly altered sand movement, dune structure and habitat function for native plants and animals uniquely adapted to this coastal environment. This environmental assessment (EA) has been prepared in compliance with the National Environmental Policy Act (NEPA) to assess impacts of alternative means of accomplishing this restoration.

PURPOSE AND NEED

Restoration is ***needed*** because the coastal dunes at the Abbotts Lagoon project site provide critical habitat for four federally listed species and several rare or unique species of plants and animals. This is the park's best remaining intact dune habitat, and includes some of the largest expanses of rare native plant communities remaining in the Seashore. These sensitive habitats and the species that inhabit them are imminently threatened by the presence and continued spread of two aggressive nonnative species: European beachgrass (or "*Ammophila*") and ice plant.

The ***purpose*** of the action is to improve and restore coastal dune habitat in the Point Reyes National Seashore.

Objectives

Objectives are specific statements of purpose. Alternatives are not considered reasonable unless they are able to meet primary objectives to a large degree, as well as meet the purpose and resolve the need for action.

The primary objectives related to dune restoration at Point Reyes National Seashore include:

Remove nonnative, invasive plant species from dune habitat where they interfere with natural physical processes such as sand movement and hydrology.

Remove nonnative, invasive plant species from dunes to create conditions under which native species can flourish.

Minimize potential for nonnative species reinvasion of restored habitat.

Increase potential coastal dune habitat for target threatened and endangered species affected by nonnative, invasive plant species.

Secondary objectives are goals that the park would like to achieve in taking action, but that do not define whether an alternative is reasonable. In other words, fulfilling these goals is desirable but not required.

Secondary objectives:

Increase visitor understanding of natural dune processes.

Use adaptive management to inform and improve subsequent dune restoration efforts.

Increase opportunities for research into understanding the restoration of coastal California dunes.

ALTERNATIVES

Three alternatives, including the No Action alternative, are analyzed in the EA. In addition to the description of treatment activities, staging and access below, each alternative includes a multitude of environmental protection and management measures.

The No Action Alternative

The No Action alternative in this case would mean that the proposed activity (dune restoration of 300 acres near Abbotts Lagoon) would not take place and that existing conditions and management activities would continue as they are currently. The No Action alternative includes continuing the current small-scale incremental restoration at a pace determined by staffing, funding opportunities and management priorities (see figure 4).

Restoration Activities

The park has been restoring small areas of dune habitat near Abbotts Lagoon since 2001. In total about 50 acres of dunes have been cleared of European beachgrass and other nonnative, invasive plants in increments of a few acres each. These removals have focused on areas where beachgrass is either rapidly expanding or has the potential to do so. Although removal initially took place with hand tools, heavy equipment was used beginning in early 2004 to dig more deeply and prevent or minimize resprouting. The No Action alternative would likely continue these small-scale removals using heavy equipment, although a combination of prescribed burns and herbicides could also be tested over small areas. The details of how heavy equipment would be used are the same as for the action alternatives, although the scale of treatment is much smaller under the No Action alternative.

Staging and Access

Equipment is currently driven down a gravel road and then along a two-track road that crosses grasslands and intersects the project site boundary along the southeastern edge. Secondary access roads run north and south along the reardune area. Fuel storage is at an abandoned parking lot at the end of the gravel road known locally as the former AT&T site. Another primary access route exits the North District Operations Center driveway and continues westward along a two-track ranch road. Use of either the AT&T route or the North District route is based on reducing travel time to the work area.

Alternative B

Each of the action alternatives (Alternative B or C) would treat an area along the coastline in the proximity of Abbotts Lagoon that covers approximately 300 acres (see figure 3). Alternative B would result in 93 acres of reardunes treated with prescribed burning and herbicides, 27 acres of foredunes treated by excavation and 13 acres near wetlands treated by manual removal. Iceplant removal totaling about one acre would take place in several locations.

Restoration Activities

In Alternative B, European beachgrass and/or iceplant would be removed using a variety of tools and techniques including prescribed fire, herbicide, heavy equipment deep burial and hand removal. In the foredune portion of the project, dunes are dominated by patches of high density, deep-rooted beachgrass interspersed with patches of open sand, native dune mat and dune grass, and small pockets of wetlands. Heading inland, foredunes transition into reardunes, eventually grading into mixed shrub and grassland plant communities.

Reardunes also have patches of dense beachgrass intermixed with perennial shrubs (mostly coyote brush). Reardunes have greater ground biomass and vegetative cover than foredunes, but beachgrass roots are more shallow.

This alternative proposes initial treatment in the foredunes with deep burial using heavy equipment, and hand removal in sensitive areas (wetlands, native dune mat) including 25-foot buffers around wetlands (see figure 6). After initial treatment, resprouting of invasive vegetation would be removed to the extent possible using hand removal or herbicide sprayed from targeted backpack sprayers or applied by hand (wicking). The initial removal work would be followed by up to five maintenance treatments to remove resprouting exotic vegetation.

In the reardunes, initial treatment would consist of a single prescribed burn followed by herbicide spraying of regrowth. The burn would be started using drip torch fuel distributed by hand crews or people on ATVs. The purpose of the burn would be to remove above ground biomass (beachgrass thatch) and encourage vigorous new growth of beachgrass. New growth would provide a sufficient leaf surface area to absorb herbicide, and ultimately would reduce the amount of herbicide necessary for treatment.

Staging and Access

The North District Operations Center (NDOC) facility would be the preferred point of access with the AT&T driveway a second choice for accessing the southern end of the project site. The NDOC access route (figure 5) would be improved (graded and graveled) at the beginning of the implementation period to improve access by heavy equipment. Where the road intersects the project site boundary, a parking area would be developed for overnight parking and refueling of heavy equipment, temporary equipment or tool storage, and daily parking by restoration crews. Jobsite trailers, offices, additional parking and storage would be located at the NDOC facility. Minor improvements to the AT&T route may be required; this would include adding gravel the current roadbed.

Within the project boundary, three proposed unimproved secondary access routes (figure 5) would provide designated access to restoration sites by heavy equipment. These routes would be flagged to avoid sensitive resources.

Alternative C (Preferred Alternative)

Restoration Activities

Alternative C is the park's preferred alternative. It would rely primarily on excavation and deep burial to remove European beachgrass from the project area. Iceplant would also be removed by physical means. Mechanical removal techniques use heavy equipment to dig up European beachgrass roots and rhizomes and completely remove all of the standing biomass. To prevent resprouting, the excavated biomass is buried beneath a cap of clean sand at least three feet deep. Excavators equipped with a large bucket and thumb are used to perform the digging and burial of biomass. Bulldozers may be used to support the excavators in transporting and/or burying excavated biomass. Bulldozers may also be used to re-contour treatment sites after burial is completed.

Hand removal would be used to remove beachgrass or iceplant from sensitive areas (in native dune mat or wetland, as well as in wetland buffers).

The use of herbicides would primarily be restricted to treating resprouts in Alternative C, especially in areas where hand removal proves difficult or ineffective, such as within existing shrubs or in dense foredune areas where complete excavation of European beachgrass roots proves difficult.

Excavation would take place on 126 acres and hand removal would be used on 7 acres (figure 7).

Staging and Access

Staging and access would be the same as in Alternative B, although secondary routes in the reardunes would be used by heavy equipment in Alternative C. In Alternative B, these routes would be used for equipment and staff access only.

ENVIRONMENTAL CONSEQUENCES

Vegetation

Continuing the current pace of restoration (e.g., implementing the No Action alternative) would likely allow continued expansion of nonnative invasive dune vegetation, and in particular *Ammophila*. The impact to native vegetative communities would be long-term, adverse and vary from minor (grasslands) to moderate (dune mat).

Staging and access activities may crush or otherwise have short-term minor adverse effects on grassland and coastal scrub in either of the action alternatives (B or C). The use of herbicides in Alternative B (and to a far lesser extent in other alternatives if used for maintenance of resprouts) could have adverse effects on non-target vegetation. Measures to avoid drift associated with spraying, such as the use of targeted backpack spraying, shields, spraying in the dry season and during low wind speeds, and designating buffers where herbicides would not be used would generally keep impacts becoming more than minor. If herbicides are applied in small areas where rare or native plant species are intermixed with *Ammophila*, overspray could have a localized, minor to moderate adverse effect on individuals of these populations. Runoff and windblown soils where spraying has occurred could also have negligible or minor impacts on non-target plant species. Negligible adverse impacts on macrophytic aquatic vegetation, and minor or possibly minor to moderate short-term adverse effects on algae from herbicide drift or runoff are possible.

Prescribed burns in Alternative B would likely have beneficial impacts on coastal scrub and grassland vegetation at the study area; dune mat and wetlands would be protected from impacts of prescribed burning with fire lines.

Excavation with mechanical or hand equipment would have minor, short-term adverse effects on native foredune vegetation, which would be kept to no more than minor by using hand shovels in native dune mat or wetlands to remove *Ammophila*. Although the extent of excavation would be greater in Alternative C, hand removal, flagging and avoidance of dune mat, wetlands and other patches of sensitive or unique native vegetation would keep impacts to native vegetation from excavation from becoming more than minor.

In the long-run under either action alternative, increases in sand movement are likely to result in the complete or partial fill of some wetland features, although returning natural processes would also result in the creating of additional dune slacks at the site. The net acreage of wetlands lost is expected to be about one acre, which the park would mitigate by expanding wetlands on a nearby marine terrace south of the site. Because it is somewhat unknown whether additional net wetland acreage would be lost to increased sand movement and fill, the park would also monitor the treatment area and mitigate additional losses by further expanding this same marine terrace wetland.

Minor to major long-term benefits to native dune vegetation from increases in diversity, coverage, restoration of open sand conditions and the elimination of *Ammophila*'s use of soil moisture and nutrients would result from treatment under either Alternative B or C.

Species of Special Concern

No Action Alternative

Continuing the current pace of restoration under the No Action alternative would provide minor benefits in slowing the loss of endangered Tidestrom's lupine, but would also continue minor or moderate localized adverse effects to this species at the site. Minor benefits for endangered beach layia compared to continuing to leave the site untreated would occur, but encroachment from *Ammophila* would have minor or moderate localized adverse effects where it is left untreated. Continuing current management would not "jeopardize the continued existence" of these species as defined by regulations for implementing the Endangered Species Act (ESA).

Small-scale treatment activities under the No Action alternative, such as experimental herbicide or fire use or small areas of excavation may have negligible impacts on endangered Myrtle's silverspot butterflies. In the long term, encroachment of *Ammophila* into dune mat or grassland habitat where it is left untreated would continue impacts on adult and larval habitat for this species, but compared to leaving the site untreated, implementing the No Action alternative would have minor benefits by removing *Ammophila* at some locations. Standard routes would be used if access is required by heavy equipment, including avoidance of sensitive areas which would keep impacts to no more than minor. This alternative "may affect, but would not be likely to adversely affect" the butterfly as this term is defined by the ESA.

The threatened red-legged frog would not be affected as biological monitors would ensure they are not present along access routes, would monitor the construction, and would train heavy equipment operators to recognize frogs. The scale of treatment would be very small compared to the action alternatives, would have negligible impacts, and would be unlikely to have any adverse effects as defined by the ESA.

Excavation in the foredune, which may occur on a small scale under the No Action alternative, would not take place within 500 feet of any active Western snowy plover (threatened) nest. This would prevent any contact with equipment and prevent the bulk of impacts to nesting plovers. Noise from machinery or the presence of human activity may have negligible impacts on wintering plovers. In the long term, small-scale treatment would provide minor benefits for plovers compared to taking no action by slowing the encroachment of *Ammophila*. However, an existing moderate or even major localized threat to plovers at the site would continue. No proposed actions under this alternative would be likely to result in a "take," and so although continuing current management may affect plovers, it is not likely to adversely affect them as defined by the ESA.

Negligible or minor short-term effects from the noise of excavation may affect roosting endangered California brown pelicans if treatment takes place near Abbotts Lagoon. Similar but less likely impacts to endangered willow flycatchers resting in wetland scrub could also occur. There is a remote chance that an endangered California least tern would be disturbed by noise at the site, but the impact is considered negligible because this species is considered highly unlikely to visit the site.

Rare unlisted plant species at the site may experience some minor benefit in the long term from small-scale treatment at the site by slowing the invasion of *Ammophila* or iceplant. However, minor to localized major adverse impacts from encroachment where it is not treated would continue or worsen.

Although it is possible that vehicles accessing the site or excavators digging in grasslands or scrub could crush nests of some rare birds (Northern harriers, short-eared owls, Allen's hummingbirds), the small scale of treatment means such an impact is unlikely and

considered negligible or minor. Noise from excavators could also have temporary minor adverse impacts on rare birds using tidal flats adjacent to Abbotts Lagoon. Several migratory species use this site each fall and/or spring, and may be disturbed by excavator noise or the presence of humans in reardunes close to this location. These same impacts could cause the rare Point Reyes jumping mouse to temporarily relocate, a negligible short-term effect.

Action Alternatives

Impacts from staging and access common to both action alternatives (B or C) would not affect listed plant species because these species do not occur along routes or in areas proposed for staging. Seasonal restrictions, speed limits and other mitigation would prevent most impacts from driving vehicles and heavy equipment to and from the site to Myrtle's silverspot butterflies, but collisions with adults and inadvertent crushing of larvae or pupae are possible, a moderate short-term localized effect and possible adverse effect under the Endangered Species Act. Red-legged frogs would not be affected because they do not occur along the access routes or staging locations, and because biologists would monitor these areas and equipment operators trained to recognize them and stop work. Nesting western snowy plovers would not be affected by access or staging, but wintering plovers may experience negligible or minor short-term impacts from disturbance by heavy equipment moving along access routes along the foredune. No or negligible impacts to California brown pelicans, least terns and willow flycatchers from access or staging would occur. Although access routes would be flagged, access could inadvertently crush and kill individuals or small patches of rare unlisted plants, a minor to moderate localized impact. Rare invertebrates could also be crushed, or collisions with other rare beetles could occur, with unknown but likely negligible to moderate impacts. Rare birds nesting in scrub or other open country may be at risk from inadvertent impacts, with only minor to moderate adverse localized impacts possible.

Localized inadvertent minor impacts to a few individuals of *Sonoma alopecurus* (endangered) from prescribed burning are possible in Alternative B. Mitigation to minimize impacts from burning, herbicide spraying and/or excavation in action alternative would keep impacts from treatment activities to no more than minor for beach layia and Tidestrom's lupine. In the long term, both species would experience major benefits from removal of *Ammophila*. Increases in sand movement following removal of *Ammophila* in either Alternative B or C may cause temporary adverse impacts to Tidestrom's lupine.

Seasonal and geographic restrictions and a speed limit during the period when adults emerge would help minimize impacts of excavation to Myrtle's silverspot butterfly from either Alternative B or C. Still, even a single collision or destruction of a caterpillar from restoration activities means the impact would be moderate and possibly an "adverse effect" under the ESA. Prescribed burning in Alternative B could also kill an occasional larva, pupae, adult or larval host plant. The use of herbicides is not expected to have more than minor short-term impacts, which at the highest exposure would be one-third of that shown to be statistically indistinguishable from the no effect level. In the long term, removal of *Ammophila* and iceplant would have moderate or even major localized and minor to moderate regional benefits for silverspots by increasing the abundance of native dune mat nectar species.

Although excavation in either action alternative would be unlikely to directly affect red-legged frogs given the mitigation included in this proposal, noise could disrupt communication temporarily, a negligible or minor short-term impact with no potential for adverse effect as defined by the Endangered Species Act. Impacts from noise are anticipated to be closer to frog habitat and therefore potentially more intense in Alternative C. Negligible to minor impacts from prescribed burning, and negligible short-term impacts

from herbicide use may occur in Alternative B. Some negligible or minor impacts from increased filling of wetland habitat with more mobile sand following the removal of *Ammophila* is possible in the long term under either action alternative.

Wintering Western Snowy Plovers would be disturbed by the noise and presence of ATVs, fire engines or other human activity that may be associated with prescribed fire in Alternative B. Energetic losses as well as possible abandonment of the area for the season may result, although impacts to the population at the site would remain minor or moderate and short term because nesting would be unaffected. Although human activity (manual removal, spraying herbicides, preparing the site for a prescribed burn) in the reardunes could disturb plovers and cause them to leave the area in Alternative B, it may also protect them (especially chicks) by minimizing the chance of inadvertently ingesting herbicide or being burned. Negligible to minor short-term impacts to plovers from ingesting sprayed insect prey are a possibility. Smoke or flames from fires in the reardunes could disturb nesting or wintering birds temporarily, with minor impacts depending on the season *Ammophila* is burned. While excavators would only affect wintering plovers in either action alternative, noise levels could be high and continuous along the foredune with minor or even moderate localized impacts to non-breeding birds. No adverse effect to plovers from any treatment activities as defined by the Endangered Species Act would occur. Removal of *Ammophila* would provide major long-term parkwide and moderate regional benefits for plover breeding and rearing success.

California brown pelicans would be disturbed by the noise of excavation in either action alternative, as well as by smoke or flames from prescribed burning or ATVs distributing flames in Alternative B. Minor to moderate short-term or long-term impacts could occur. Noise in Alternative C would be more intense and closer to California brown pelican wintering habitat than in Alternative B, and the number of pelicans abandoning the site for at least a season is likely to be larger than in Alternative B, a moderate short-term localized effect. No adverse effect under the Endangered Species Act is expected under either action alternative.

Impacts to the California least tern and willow flycatcher from human activity and noise would be negligible and short term in either action alternative and not likely to adversely affect either species as defined by the ESA.

A few individuals of rare plants would be so heavily intermixed with *Ammophila* that they would be impossible to hand treat and would be killed by excavation. This is a minor to moderate, short-term localized impact associated with excavation in both Alternatives B and C. In addition, rare plants could experience minor to moderate adverse short-term impacts from the loss of a few individuals or small patches during prescribed burning or from herbicide drift in Alternative B. In the long term, they would experience minor to moderate benefits from reducing competition for soil moisture and nutrients and creating bare sand for them to colonize.

Rare animals, and in particular invertebrates and birds, may experience impacts directly, or birds may experience impacts to their eggs or nests from crushing or collisions with excavators. Rare birds, particularly some waterfowl, are likely to make repeated flights away from noisy equipment in either action alternative, and they and other species may abandon the site for the season. Some species may pass by rather than land at the site when migrating, resulting in possible moderate adverse effects on energetics. Noise or fire may result in nesting birds abandoning eggs or chicks, as well as in physiological stress and increased expenditures of energy. Impacts would range from negligible for those species or individuals that can habituate to moderate for more sensitive species or nesting species. If it is present, the rare Point Reyes jumping mouse may experience minor, short-term adverse effects from the noise and presence of excavators in either action alternative, as well as

additional minor temporary impacts from smoke in Alternative B. If biological monitors are used to scan for rare species in the vicinity and alter treatment accordingly, these impacts could be minor; without this mitigation they would be localized, short term and moderate.

Wildlife

If the existing pace of restoration continues (e.g., the No Action alternative is adopted), the monospecific dense vegetation of *Ammophila* at the site would continue to keep native species diversity of wildlife lower than in surrounding areas. Some species that thrive in *Ammophila*, such as deer mice, would potentially increase in number, but overall, No Action would continue a moderate adverse impact to most small mammals. Predators would also be adversely affected by this scarcity of prey as well as the dense cover *Ammophila* provides. Native birds, including shorebirds, would have less native plant habitat for seeds, vegetation and nesting materials; shorebirds may be additionally adversely affected by the concentration of human activity into a smaller beach area (because *Ammophila* has colonized existing foredunes), with minor to moderate adverse impacts likely. Small-scale treatment activities could kill some small mammals, invertebrates or other slow moving animals or scare mammals or birds away, with negligible to minor short-term localized effects.

Impacts to wildlife from staging or access in any alternative, but especially the action alternatives include crushing, particularly for grassland species or slower moving animals, or noise. These would be minor, short term and localized. These same effects would also be likely to occur from excavation in either alternative, and would be wider-ranging and longer-lasting in Alternative C than Alternative B. The noise of excavators would particularly affect waterfowl or shorebirds at the site, which would be repeatedly disturbed and even displaced from habitat at the site in some cases. Amphibians, reptiles and mammals could experience minor short-term localized impacts. Migrating birds, or marine mammals that occasionally use the area to haul out may avoid it during treatment, a moderate adverse localized short-term impact. Although smaller or less mobile species may also experience impacts from noise, they are also more likely to be killed from crushing or digging by excavators, a minor to moderate localized impact.

Blowing sand from stockpiled supplies could increase sedimentation in wetlands and have minor short impacts to fish and amphibians in either action alternative; this could increase following removal of *Ammophila* as sand movement is remobilized until native vegetation recolonize the site, a possible moderate and longer-term effect.

Alternative B would have additional short- and long-term impacts on wildlife from burning and the use of herbicides. Prescribed fire could kill slower moving animals as well or species that occupy *Ammophila* as habitat, such as deer mice. Larger mammals and birds would be less affected. Short-term impacts from prescribed burning would be adverse and minor to moderate for most species. Long-term benefits from stimulating growth by prescribed burning in most native vegetative communities would result for many wildlife species.

The use of herbicides would generally not adversely affect wildlife directly, as exposures would be lower than those known to cause any adverse effects. Surfactants in the herbicide formulation could harm aquatic animals and inadvertent spraying may kill some insects or invertebrates with minor to moderate short-term impacts. Ingestion of contaminated vegetation or insects may have minor impacts on some birds or mammals.

Either action alternative would result in minor to moderate long-term benefits to wildlife from restoring habitat.

Soils and Sand Movement

Small-scale removal of *Ammophila* under the No Action alternative would loosen sand and restore some movement at the site. However, most of the *Ammophila* dominated foredune would remain in place, with continued moderate to major localized long-term adverse impacts on the natural movement of sand.

Grading to prepare staging areas under either action alternative would remove soils and use of access routes would increase compaction and possibly runoff or erosion. Heavy equipment may leak or spill fuel with some very localized contamination, although mitigation would keep these impacts to negligible or minor.

Soil at the site could experience short-term impacts from prescribed fire, herbicide use and excavation. Prescribed fire may have negligible to minor short-term effects to the surface layer of soil where *Ammophila* is burned and negligible to minor short-term benefits to soils by increasing nutrient levels. No impacts to the biological properties of soil from fire are expected. The impact of herbicide spraying to the biological and nutrient properties of soil are expected to be negligible to minor, may be beneficial or adverse, and would be short-term. Excavation in either Alternative B or C could have minor short-term impacts from eroding stockpiled supplies or redistributing sand. Recontouring would keep long-term impacts from excavation to negligible.

Restoring sand movement at the site would be a moderate to major localized benefit for soils, topography and the natural ecology of the area.

Water Resources

Relative long-term negligible to moderate benefits to water resources from the stabilization of soils at the site may have occurred and would continue if *Ammophila* is removed slowly as it would be in the No Action alternative.

Storing equipment, chemicals and fuel at the staging site in any of the alternatives would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed.

Fire breaks and mowed buffers would keep direct impacts to wetlands from becoming more than negligible or minor if Alternative B is selected. Ash from prescribed burns could add nutrients to soils and water, with possible negligible benefits. Impacts to water quality from herbicide spraying would be short-term and no more than minor; algae production may be stimulated if low levels of herbicide enter dune hollows or slacks. The exposure of stockpiled sand to wind and water erosion may increase sedimentation in the short-term, a negligible or minor localized effect of either action alternative to water resources related to excavation. In the long-term, remobilizing sand movement could fill in small wetlands completely and reduce the size or period the dune slack stays wet, a minor to moderate, localized adverse effect that would be long term. Burial of the site's unique fen-like sedge wetlands may be a minor to moderate adverse impact.

Cultural Resources

No above ground cultural resources are present at the site, but buried resources may exist. Implementation of any of the alternatives would result in no greater than minor, localized adverse effects to cultural resources related to ground disturbance. However, both Alternatives B and C have greater potential to affect cultural resources than the No Action alternative because of excavation and the use of hand tools to dig up *Ammophila*.

Visitor Experience

Implementation of the No Action alternative would result in no greater than minor, short-term, localized adverse effects to the visitor experience related to the use of heavy equipment (noise, blowing sand, odors).

Under either action alternative, visitors to the project vicinity could experience minor to possibly moderate, short-term adverse impacts from visual intrusions associated with new staging and vehicular access areas. In addition, the exposure to noise from heavy equipment as well as their related odors and associated blowing sands have the potential to result in minor, short-term, adverse effects in Alternative B and possibly moderate adverse effects in Alternative C. Smoke, odors and possible ATV noise from prescribed burning activities in Alternative B and potential visitor restrictions during restoration activities in either action alternative may result in additional minor impacts to visitors. Minor, long-term benefits to the visitor experience in either action alternative are expected as a result of the restoration of this dune area to a more naturally functioning state and the provision of educational materials related to the restoration efforts.

Neighboring Land Use

Small-scale restoration efforts under the No Action alternative would have negligible to minor, adverse, localized effects on wilderness uses of adjacent park lands.

The implementation of Alternative B or C would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to minor adverse effects to those using wilderness lands to the west and north of the project site from smoke, odors, herbicide use and noise are also expected.

Health and Safety

Only negligible, adverse effects to worker health and safety are anticipated as a result of the use of heavy equipment as needed in the continuation of current restoration (the No Action alternative).

Access and staging of vehicles used for restoration activities would result in negligible, short-term adverse effects related to travel along primary and secondary access routes and the storage of potentially hazardous (e.g., fuel, herbicide) materials at staging areas in either action alternative. The use of heavy equipment to treat the steep foredune would require proper equipment, training and a safety plan to keep the chance of accidents and impacts to negligible or minor. Potential safety related impacts related to excavation are higher in Alternative C because this treatment technique is used more extensively than in Alternative B.

In Alternative B, potential for injury from exposure to fire, smoke or herbicides exists. A burn plan and closure of the area during prescribed fire would keep the risk of fire and smoke injuries to park staff and the public to minor, adverse, short-term and localized. Workers applying herbicide would be exposed to a dose of glyphosate that is 12 times lower than the EPA reference value where no adverse effects are expected. The most likely herbicide exposure scenario for the public, given that the area would be closed for 48 hours following spraying, is contact with sprayed vegetation which would expose a visitor to a dose hundreds to thousands of times lower than the reference dose. These are negligible impacts.

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PURPOSE AND NEED FOR ACTION

INTRODUCTION

Point Reyes National Seashore is proposing to restore 300 acres of coastal dune habitat south of Abbotts Lagoon to benefit federally listed species (see figure 1). Habitat would be restored by removing highly invasive, nonnative plant species which have greatly altered sand movement, dune structure and habitat function for native plants and animals uniquely adapted to this coastal environment.

Purpose and Need

The purpose and need "statements" for this project as developed by a team of park staff and contractors are as follows:

Restoration is ***needed*** because the coastal dunes at the Abbotts Lagoon project site provide critical habitat for four federally listed species and several rare or unique species of plants and animals. This is the park's best remaining intact dune habitat, and includes some of the largest expanses of two rare native plant communities remaining in the Seashore. These sensitive habitats and the species that inhabit them are imminently threatened by the presence and continued spread of two aggressive nonnative species: European beachgrass and ice plant.

The ***purpose*** of the action is to improve and restore coastal dune habitat in the Point Reyes National Seashore.

More detail on purpose and need is presented below.

Point Reyes National Seashore ("park" or "Seashore") preserves some of the last remaining high quality coastal dune habitat in the United States. However, this habitat is seriously threatened by the rapid encroachment of two invasive, nonnative plant species, European beachgrass and iceplant. Over 70% (1,000 acres) of the park's dune habitat is dominated by these species, and they are rapidly spreading to other areas.

European beachgrass (*Ammophila arenaria*) is particularly problematic at the Seashore. It is a native perennial grass of Europe and North Africa introduced to California in the late 1800s to help stabilize blowing sand dunes. European beachgrass has spread to inhabit areas from Santa Barbara County, California in the south to Canada in the north. European beachgrass spreads vegetatively by rhizomes; as plants are buried by blowing sand, their shoots continue grow up to 2 meters in six months (NPS 2003). About 132 acres of Ammophila would be removed at the Abbotts Lagoon area site where treatment is proposed.

Iceplant (*Carpobrotus edulis*), a native of South Africa, was introduced to California in the late 1800s also to stabilize dunes. This succulent spreads both vegetatively and by seed and now is found growing along the entire coast of California (NPS 2003). Only about one acre of iceplant grows at the Abbotts Lagoon area site where treatment is proposed.

The Seashore's dunes provide habitat for 11 federally listed species; those at the project site include the threatened Western snowy plover (*Charadrius alexandrinus nivosus*), the endangered Myrtle's silverspot butterfly (*Spyeria zerene myrtleae*), and the endangered plants beach layia (*Layia carnosa*) and Tidestrom's lupine (*Lupinus tidestromii*). Additionally, the Seashore's dunes contain the largest remaining expanses of two rare native foredune habitat types--American dune grass (*Leymus mollis*) and beach pea (*Lathyrus littoralis*).

Figure 1. Location of Abbotts Lagoon Dune Restoration Area

These rare species and habitat types are imminently threatened by both environmental changes and displacement resulting from the presence and spread of European beachgrass and iceplant. The primary effect comes from the dense, monotypic mats produced by both species. These mats preclude native plants from becoming established and alter sand dune structure and function by slowing sand movement and changing deposition patterns. Rather than the natural pattern of free-moving dunes that form perpendicular to the beach, dunes dominated by European beachgrass or iceplant mats are large, stable and form ridges parallel to the beach. This configuration prohibits sand movement and movement of animal species or seeds of native plants between fore and reardunes, reducing the amount and quality of habitat available for native plants, dune beetles, plovers, and other native species. Altered foredunes effectively restrict breeding snowy plovers to a narrow strip of habitat between the high tide line and the lower edge of the dunes, the same narrow area of the beach used by visitors and dogs. Besides making nesting and chick rearing difficult, these densely vegetated dunes provide cover for predatory species that feed on plover eggs and chicks. Removal of European beachgrass and iceplant from dune habitat in Point Reyes National Seashore is part of the recovery plan for federally listed species occurring in these areas (U.S. Fish and Wildlife Service 1998a).

Point Reyes National Seashore has targeted the Abbotts Lagoon area as a site that offers both the chance to try different methods of removing European beachgrass and iceplant, and one that has the largest acreage of high quality dune habitat. In addition, an infestation of beachgrass from the south is encroaching upon the southern end of the site, and action in these 300 acres would allow the park to halt the infestation and provide a future opportunity to continue treatment southward. The treatment area is also unique in that it is not part of a designated wilderness that stretches along much of the west coast of the park.

The Seashore staff has completed several seasons of small-scale removal and follow-up projects, and has used data from these projects to narrow the range of management tools, to identify the specific sites in the area where the best chance of success exists, and to predict the degree of success in restoring habitat for native species. These pilot projects have shown that resprouting of the invasive plants is a likely outcome of any treatment project that does not completely remove all rhizomes or root structures. Removing large number of resprouts is a difficult and expensive maintenance effort that, if not done, negates to a large degree the initial restoration of dune habitat. However, complete removal is also difficult and potentially expensive. Mechanical removal, for example, requires digging out beachgrass to depths greater than even 10 or 12 feet. The combination of vegetation and sand is then buried and covered with a thick cap of clean sand. This removal method has been found by the park and other researchers to be effective in preventing aggressive resprouting. However, where small patches of European beachgrass or iceplant are interspersed with native plant species, or when removal by machine threatens native, unique or sensitive animal species, hand removal is often required. Because it is impossible to dig 10 to 12 feet deep using hand removal techniques, resprouting in these mixed areas is more likely to occur. The combination of prescribed burning to remove beachgrass thatch followed by herbicides applied to new growth has also proved effective in both removal and minimizing resprouting (Hyland and Holloran 2005).

Treatment of iceplant is less complex or difficult because its roots do not grow as deep. Hand removal and burial are the tools the park would be mostly likely to use to remove the one acre of this invasive species at the site.

The Planning Process

After several seasons of experimentation on smaller plots, the Seashore has received approval to receive funds to continue restoration in the Abbotts Lagoon area over a much larger area. Before restoration can be implemented, the environmental planning process

required by NEPA (the National Environmental Policy Act), including this EA, must be complete. After evaluating the feasibility of several approaches, the official planning process to treat the 300 acre project area (see figures 1, 2 and 3) south of Abbotts Lagoon began with an internal scoping session August 9-10, 2005.

The goals of this session were to:

Review and refine work completed to date by the NPS on the purpose, need, objectives and constraints of the dune restoration effort,

Identify issues and concerns associated with the current encroachment of European beachgrass and iceplant on the park's dune ecosystem, and

Identify preliminary alternatives.

This environmental planning process and EA follow certain prescribed rules and regulations the NPS has developed to implement NEPA. These regulations are contained in the NPS Director's Order 12 (DO-12; NPS 2001), as well as the NEPA regulations governing all federal agencies (40 CFR 1500 et seq.). They advise including a full range of alternatives and require that the No Action, or continuation with existing conditions, be analyzed as a baseline for comparison. DO-12 also includes a requirement that an environmental assessment be available for public review for 30 days, and provides guidance for public meetings if "large-scale interest" in the proposal exists.

The review deadline for this EA is available by accessing the park's website (NPS.gov/PORE) or the NPS planning and environmental compliance website, PEPC (parkplanning.nps.gov). The commenting procedure is described on these two websites. The NPS may modify its EA following public comment if new information or concerns are raised, and the combination of this finalized EA, public comments and other information (such as cost, logistics, etc.) will be used to make a final decision on how to proceed. It is anticipated that this decision will be recorded and made available on-line in a Finding of No Significant Impact or FONSI. However, if any information found or received during the review period indicates the potential for significant environmental impacts, the NPS would either mitigate impacts so they are no longer significant or begin preparation of an environmental impact statement and more extensive planning process under NEPA.

Objectives

Objectives are specific statements of purpose. Alternatives are not considered reasonable unless they are able to meet primary objectives to a large degree and resolve purpose and need for action.

The primary objectives related to dune restoration at Point Reyes National Seashore include:

Remove nonnative, invasive plant species from dune habitat where they interfere with natural physical processes such as sand movement and hydrology.

Remove nonnative, invasive plant species from dunes to create conditions under which native species can flourish.

Minimize potential for nonnative species reinvasion of restored habitat.

Increase potential coastal dune habitat for target threatened and endangered species affected by nonnative, invasive plant species.

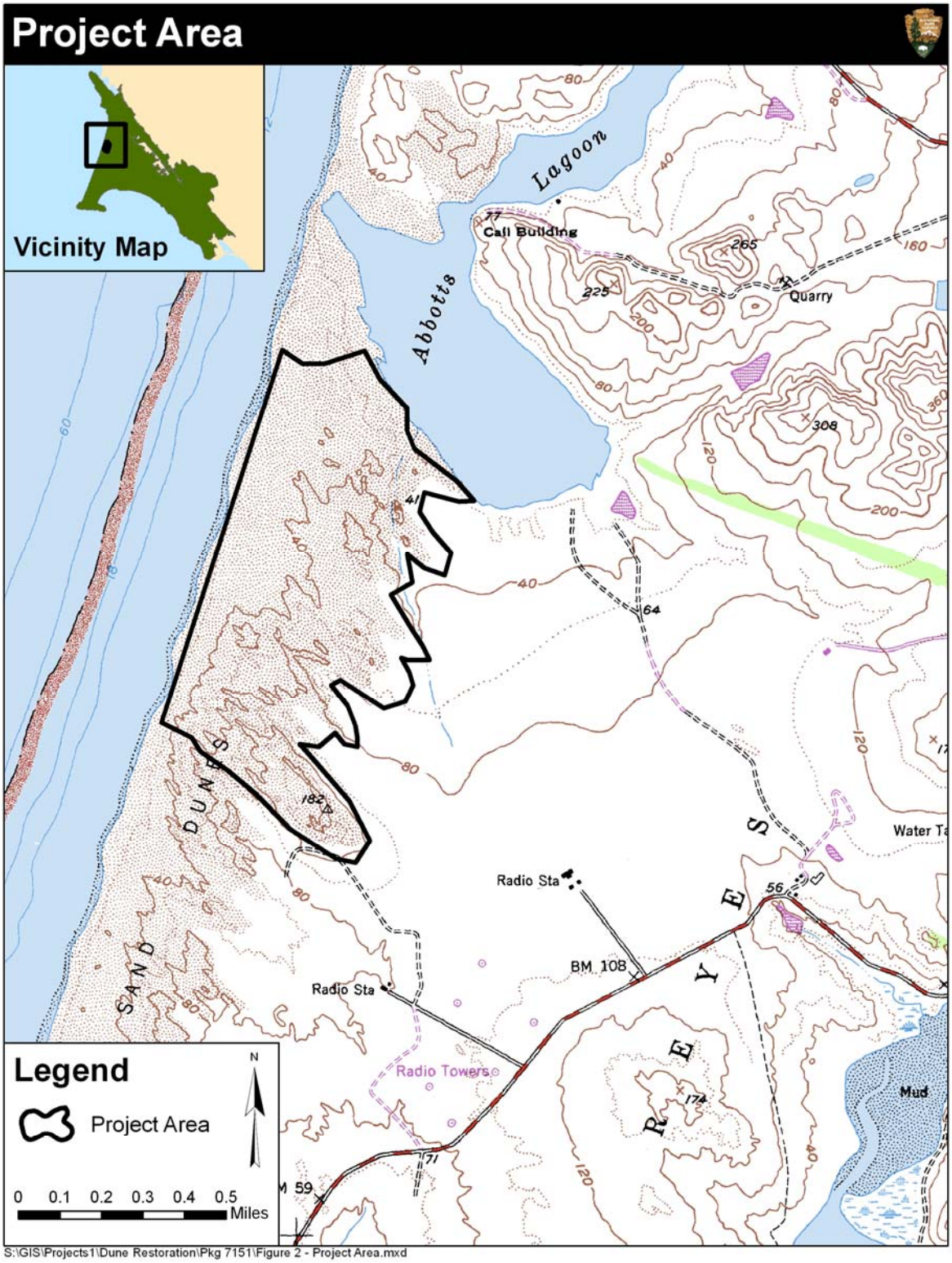

Figure 2. Location of Study Area

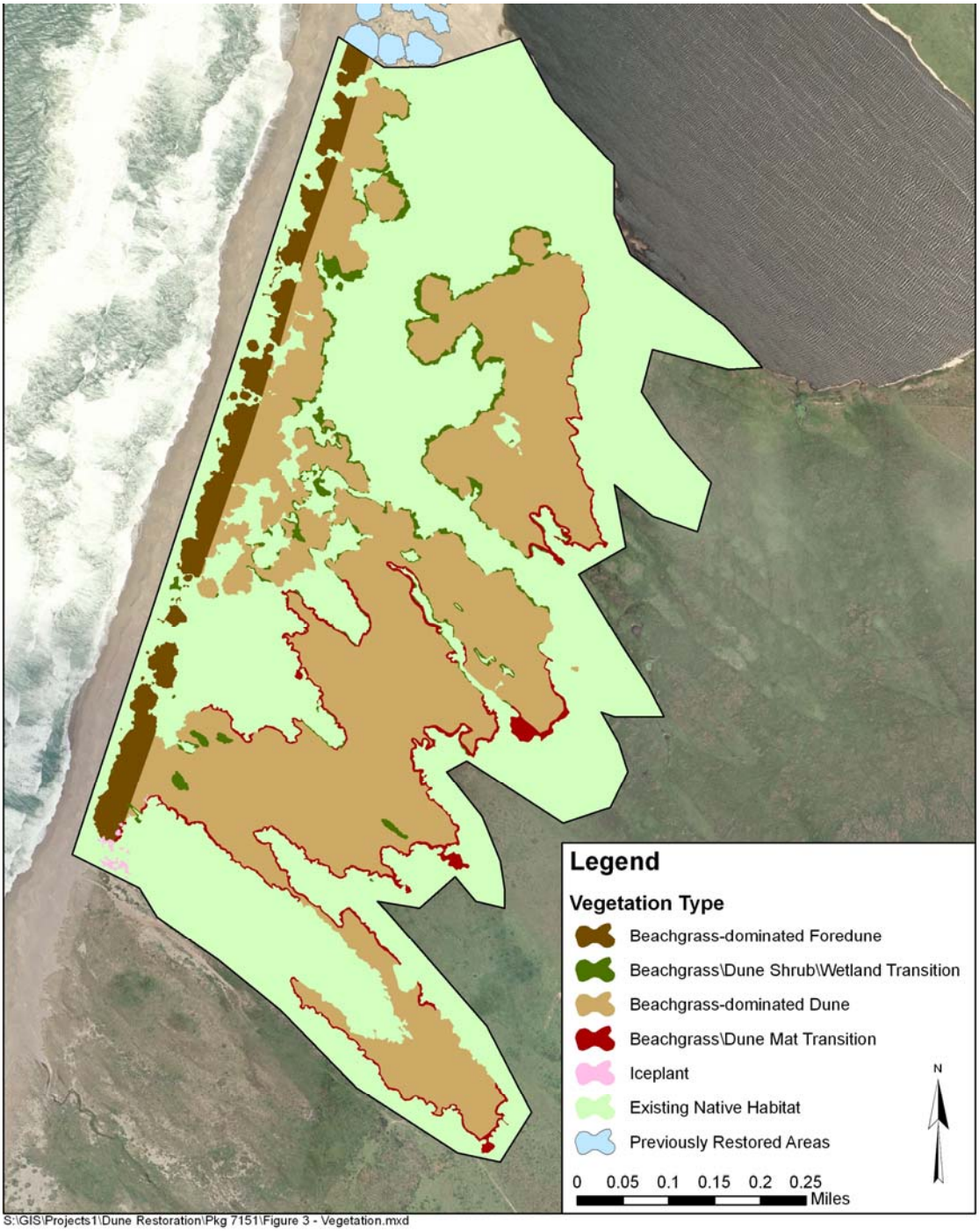

Figure 3. Vegetation in 300-acre Study Area where Restoration is Proposed

(Abbotts Lagoon appears in the upper part of the photograph.)

Secondary objectives are goals that the park would like to achieve in taking action, but that do not define whether an alternative is reasonable. In other words, fulfilling these goals is desirable but not required.

Secondary objectives:

Increase visitor understanding of natural dune processes.

Use adaptive management to inform and improve subsequent dune restoration efforts.

Increase opportunities for research into understanding the restoration of coastal California dunes.

PLANNING CRITERIA (CONSTRAINTS)

Planning criteria or constraints can be laws, policies, logistical or other factors that prevent or limit the Seashore in taking certain actions or implementing certain alternatives. In the case of dune restoration, some of these include:

The Organic Act and NPS Management Policies, which prohibit impairment of any park resources (see discussion of Organic Act below for more information).

The presence and sensitivity of native plant or animal species, which can limit the range of removal methods, access routes, the locations where removal can take place and the time of year when work can be completed.

Environmental laws and their requirements, including the Endangered Species Act, Marine Mammal Protection Act, and Wilderness Act which impose restrictions on location and/or method of removal. Responses to these restrictions take the form of protective mitigation measures described in the Alternatives section.

The “no net loss of wetlands” policy that is part of Executive Order 11990, as well as the legal requirements of the Clean Water Act surrounding fill in wetlands. These requirements may limit location of treatment, access roads or staging areas, or require mitigation if wetlands must be disturbed, degraded or filled

The California Coastal Zone Management Plan, as all federal actions must be consistent with this plan as decided by the California Coastal Commission.

Neighboring land use, land ownership or lease agreements, as these may limit access or treatment sites.

Weather conditions, which may keep the park from using heavy equipment, prescribed burning or herbicides for a period of time.

The requirement to spend funds made available through the line item construction process in a timely fashion before they expire.

BACKGROUND

Dune Management in Park to Date

Since 2001, Point Reyes National Seashore has been working to restore coastal dune habitat north and south of Abbotts Lagoon. In total about 50 acres of dunes have been treated to remove European beachgrass and other nonnative, invasive plants to improve habitat for federally listed plants and animals and restore natural dune processes.

As noted above, contract crews and volunteer groups initially used hand removal techniques to eradicate European beachgrass at Abbotts Lagoon. Removal of beachgrass at Abbotts

lagoon during the first year of the project focused on small, rapidly expanding patches of this species adjacent to high quality native dune vegetation. In addition, new satellite populations (which have the potential for the most rapid expansion) were removed from the beachfront and from stands of native vegetation throughout the project area. Work crews typically dug to a depth of one meter to remove as many rhizomes as possible; pulled vegetation was mounded and left to compost on site. European beachgrass began resprouting within one month of initial removal, and increased markedly following heavy rains in December 2001. Resprouts for this effort continue to be pulled one to six times per year.

Treatment continued into a second year where beachgrass was pulled both north and south of the lagoon mouth (see figure 4). All FY 2001 and FY 2002 dense removal areas were re-treated at least twice. Resprouts continued to occur but with less vigor. Removal efforts in FY 2003 focused on primarily colonizers in the fore and back dunes. After three years of hand removal, the park recognized that this method had limited success in heavily infested dunes and was costly at a large scale.

Beginning in February 2004 heavy equipment was used as an initial treatment to dig up and bury beachgrass on site south of Abbotts Lagoon with funds from the Cape Mohican oil spill settlement. Excavators dug to a depth of up to three meters to remove roots and rhizomes. Vegetation was piled, the hole was dug deeper and "clean" sand stockpiled. Beachgrass was then placed back in the pit and covered with clean, weed-free sand. To date, approximately eight acres within a 20-acre area have been treated using this method. Deep burial has resulted in many fewer resprouts to date than more shallow burials and is considered a preferred method of removal because of this.

Other agencies, including the U.S. Forest Service and California Parks Department, have successfully used less expensive methods of treatment that involve a combination of tools, including prescribed burning, herbicides and hand removal.

Research and Monitoring

Vegetation and Geomorphic Processes

Park staff has monitored vegetation in the pilot removal projects to document reduction of nonnative cover and subsequent colonization by native dune plants. In addition, park staff is monitoring populations of several rare native species, including both the federally endangered Tidestrom's lupine and beach layia for expansion into removal areas.

Fifteen vegetation monitoring plots were installed by park staff in 2001 within European beachgrass-removal areas. Vegetative cover and European beachgrass stem counts were recorded annually to determine trends in beachgrass cover, native plant cover and open sand after removal. In 2003, park staff installed seven control plots in native foredune plant communities. Monitoring will continue to compare these native dune communities to those of the European beachgrass removal areas.

Sand movement was monitored by measuring the height of sand along one-meter-tall posts marking a corner of each permanent vegetation plot. Measurements were collected in the first and second years in order to (1) estimate the rates of sand movement in stabilized European beachgrass infested dunes and (2) monitor changes to dune topography before and after beachgrass removal.

Endangered Plants

The boundaries of Tidestrom's lupine and beach layia populations were mapped in the early stages of the project in 2001. Tidestrom's lupine boundaries were mapped again in 2002

and in early 2004. In 2005, researchers from Washington University, St. Louis, Missouri, began studying Tidestrom's lupine at the Seashore. In addition to results regarding the success of treatment, Washington University researchers found that European beachgrass harbors elevated numbers of rodents resulting in higher predation rates on lupine seed pods. Ecological models, based on this and additional demographic information, predict that, without management, Tidestrom's lupine is on a pathway to extinction in the Point Reyes dunes. This research is continuing under a National Science Foundation grant with the university. Park staff will continue this monitoring as a part of the Seashore's rare plant monitoring program.

Endangered and Threatened Animals

Since 1995, PRBO Conservation Science (PRBO) personnel have been recording locations of threatened Western snowy plover nesting sites, as well as recording the success of each nest. PRBO has also monitored the health and success of these threatened birds. Physical exclosures and public education have both been used by PRBO and the park to protect nesting sites following removal of beachgrass and iceplant. The park plans on continuing monitoring and management for plovers following guidance from the Western Snowy Plover Recovery Plan (USFWS 2007).

Seashore staff have also counted and monitored the population of the endangered Myrtle's silverspot butterfly during the adult flight seasons from July to mid September.

LEGISLATIVE AND PLANNING DOCUMENTS

NPS Organic Act and NPS Management Policies

By enacting the National Park Service Organic Act of 1916 (Organic Act), Congress directed the U.S. Department of Interior and the NPS to manage units "to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC § 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC § 1a-1).

Despite these mandates, the Organic Act and its amendments afford the National Park Service latitude when making resource decisions that balance visitor recreation and resource preservation. By these acts Congress "empowered [the National Park Service] with the authority to determine what uses of park resources are proper and what proportion of the parks resources are available for each use" (*Bicycle Trails Council of Marin v. Babbitt,* 82 F.3d 1445, 1453 [9th Cir. 1996]).

Because conservation remains its predominant mandate, the National Park Service seeks to avoid or to minimize adverse impacts on park resources and values. Yet, the National Park Service has discretion to allow negative impacts when necessary (NPS *Management Policies 2006*, sec. 1.4.3 [NPS 2006a]); however, while some actions and activities cause impacts, the National Park Service cannot allow an adverse impact that constitutes resource impairment (NPS *Management Policies 2006,* sec. 1.4.3 [NPS 2006a]). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the acts (16 USC 1a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS *Management Policies 2006,* sec. 1.4.5 [NPS 2006a]). To determine impairment, the National

Park Service must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS *Management Policies 2006,* sec. 1.4.5 [NPS 2006a]). The Management Policies require that these determinations, and all planning decisions in the Service, be based on current scientific and scholarly understanding of park resources and ecosystems (sec. 2.3.1.4).

Park units vary based on their enabling legislation, natural resources, cultural resources, and missions. Management activities appropriate for each unit and for areas within each unit vary as well. An action appropriate in one unit could impair resources in another unit. Thus, this environmental assessment will analyze the context, duration, and intensity of impacts related to dune restoration within Point Reyes National Seashore, as well as the potential for resource impairment, as required by *Director's Order 12: Conservation Planning, Environmental Impact Analysis and Decision-making* (NPS 2001).

Point Reyes National Seashore Enabling Legislation

Point Reyes National Seashore was established September 13, 1962 "to save preserve, for purposes of public recreation, benefit and inspiration, a portion of the diminishing seashore of the United States that remains undeveloped (Public Law 87-657)." The Seashore is comprised of 70,046 acres of beaches, coastal headlands, extensive freshwater and estuarine wetlands, marine terraces and forests. The park is a coastal sanctuary with an exceptionally diverse variety of habitat types – roughly 20% of California's plant species and 45% of North America's bird species have been recorded within its boundaries. Amendments in 1976 (PL 94-544 and 94-567) state that the Seashore is to be administered without impairment of its natural values and establish the Point Reyes Wilderness Area.

Other Federal Laws, Policies, Regulations and Plans

The National Park Service is governed by laws, regulations, and management plans before, during, and following any management action related to this environmental assessment.

National Environmental Policy Act, 1969, as Amended

The National Environmental Policy Act requires all federal agencies to consider the potential environmental impacts of their decisions or proposals before they implement them. NEPA is the law that has given rise to this environmental assessment.

National Parks Omnibus Management Act of 1998 (NPOMA)

NPOMA (16 USC 5901 et seq.) underscores NEPA in that both are fundamental to National Park Service park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts using appropriate technical and scientific information. The explanation of research and monitoring ongoing in the parks, the resulting science and resource-based need for action and the literature and report-based analysis of impacts in this EA are examples of how NPOMA has been carried out in this particular planning process.

Coastal Zone Management Act

Under section 307(c)(3)(A) of the Coastal Zone Management Act (CZMA), 16 USC Section 1456(c)(3)(A), federal agency activities that affect any land or water use or natural resource of the coastal zone are required to be consistence with the state's coastal zone management program. Prior invasive plant removal efforts in the Abbotts Lagoon area were found to be consistent with the program by the California Coastal Commission. The

Commission will also decide whether the selected alternative is consistent with program in this project.

National Historic Preservation Act

The National Historic Preservation Act (NHPA), as amended, is the principal legislative authority for management of cultural resources located within national parks. Section 106 of the NHPA requires all federal agencies to consider the effects of their actions on cultural resources determined eligible for inclusion in the National Register of Historic Places. This includes archeological (buried) resources that may be affected by excavation of *Ammophila*, for example.

Executive Order 13112 – Invasive Species

This executive order requires the National Park Service to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

National Park Management Policies, 2006

Parks are guided in their management by the NPS *Management Policies 2006* and a series of more specific Director's Orders. Many sections of the Management Policies direct or support the proposal to restore dune habitat at Point Reyes National Seashore. The following excerpts are examples:

The Service will seek to return human-disturbed areas to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated. The Service will use the best available technology…to restore the biological and physical components of these systems, accelerating both their recovery and the recovery of landscape and biological-community structure and function. Efforts may include, for example, removal of exotic species (sec. 4.1.5).

All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed up to and including eradication if control is prudent and feasible, and the exotic species interferes with natural processes and the perpetuation of native features, native species or natural habitats (sec. 4.4.4.2).

The Service will survey for, protect, and strive to recover all species native to national park system units that are listed under the Endangered Species Act. The Service will undertake active management programs to inventory, monitor, restore and maintain listed species' habitats, control detrimental nonnative species…as necessary to maintain the species and the habitats upon which they depend (sec. 4.4.2.3).

The Service will protect geologic features, including sand dunes, from the unacceptable impacts of human activity, while allowing natural processes to continue (sec. 4.8.2).

Endangered Species Act of 1973, as Amended

The Purpose of the Endangered Species Act (7 USC 136; 16 USC 460 et seq. (1973)) is to conserve the "ecosystem upon which endangered and threatened species depend" and to conserve and recover listed species (USFWS). This act requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals having potential adverse impact on federally endangered and threatened plants and animals. Point Reyes National Seashore currently ranks fifth in the nation of parks with the highest numbers of federally listed species. Guidance on the management of federally listed species is also provided by USFWS Recovery Plans.

USFWS Recovery Plans

In 1998, the US Fish and Wildlife Service completed a recovery plan titled "Recovery Plan for Seven Coastal Plants and the Myrtle's Silverspot Butterfly." This plan outlined steps required to recover eight federally threatened and endangered species. Four of the species in this plan occur at Point Reyes National Seashore: Tidestrom's lupine, beach layia, Sonoma spineflower, and the Myrtle's silverspot butterfly. All but Sonoma spineflower exist at the treatment site (and spineflower grows close to the site). The USFWS identified seven actions to accomplish species recovery, and prioritized these tasks as 1, 2, or 3. Priority 1 is an action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future. Priority 2 is an action that must be taken to prevent a significant decline in the species population/habitat quality or some other significant negative impact short of extinction. Priority 3 includes all other actions necessary to meet the recovery objective (USFWS 1998). Of the seven actions outlined in the plan, those which are Priority 1 are: (1) Protect existing populations and habitats, and (2) Establish active management for the reduction of nonnative invasive plant species. These two Priority 1 tasks are addressed by this dune restoration project and represent one of the largest recovery efforts towards fulfilling them.

A recovery plan has also been prepared for the Western snowy plover, whose habitat is now constrained by nonnative invasive plants. A primary reason this restoration effort is being proposed is to create plover breeding and rearing habitat in the park.

ISSUES AND IMPACT TOPICS

Issues are potential environmental problems or opportunities that might result from implementing one of the alternatives. The relative impact of each of these problems or opportunities is examined in the *Environmental Consequences* section of this environmental assessment. The following issues were developed primarily by NPS staff and contractors, although public scoping comments were also integrated.

Vegetation

Removal of invasive plants would involve manual removal, the use of heavy equipment, staging areas, road use, and/or prescribed fire and application of herbicide. These actions could result in accidental trampling of native vegetation, or the deliberate removal to create roads, staging areas or store equipment and supplies. Herbicide spraying would need to be carefully controlled to avoid killing non-target vegetation, including aquatic (i.e., wetland) vegetation. Because wetlands include unique soils, vegetation and hydrology, these aspects are discussed under several impact topics.

Opportunities include the restoration of a 300-acre site to one primarily populated by native vegetation. When nonnative invasive species are removed, native plants, including several rare, unique or listed species and two rare foredune habitat types, are expected to expand their range. Previous restoration work in the Abbotts area demonstrated that even without active seeding or planting, native plants are able to regenerate in weed-free areas, germinating from viable seed churned up in the sand.

Species of Special Concern

Trampling of listed plants or habitat for listed animal species would be avoided through biological monitoring and use of more precise hand tools or seasonal restrictions where these species are found. Opportunities for improving species of special concern include removal of nonnative European beachgrass, which currently impedes breeding by the threatened Western snowy plover and competes with listed plant species for light and

nutrients. Expansion of at least four listed species is expected following removal of nonnative invasive vegetation. Additional state and CNPS listed species are expected to benefit from this project.

Wildlife

Treatment activities including excavation, hand removal, prescribed burning and application of herbicide could disturb wildlife on or near the site. Wildlife could be frightened of human activity, of the noise excavators generate or of smoke from prescribed fires. Burning may also entail the use of ATVs, which would be additional disturbances to wildlife. Herbicide spraying may result in drift, which could be a health hazard for invertebrates or the birds or other wildlife that eat them. Herbivorous wildlife could also ingest herbicides.

Soil and Sand Movement

Removing beachgrass and iceplant would increase slope instability and change site topography. These species were originally planted to stabilize the dunes, but have eliminated natural forces such as wind erosion, which creates open space and blow-out areas needed by plovers for foraging. The use of heavy equipment would also result in changed topography and sand movement during removal. Dunes would shift from unnaturally high, parallel dune topography to a more natural topography in which dunes are perpendicular to the ocean front allowing for movement by wildlife from fore to back dune habitat.

Water Resources

Heavy equipment, fuel and herbicides would be stored on paved or other impervious surfaces with berms or other constructed mitigation and spill containment equipment in close reach to prevent the spread of any spills or leaks. However, equipment would operate in the vicinity of Abbotts Lagoon and may be as close as five feet from its shore. In addition, wet swales where wetland vegetation grows are relatively common in the reardunes, both adjacent to European beachgrass and interspersed within it. Leaks, as well as inadvertent overspray of herbicides, ash from prescribed burning, and sand migration in the long term may also change the character of water resources in the lagoon or intermittent wet areas on site. Excavation of dunes to remove *Ammophila* could also result in temporary movement of water from swales to the excavated dune.

Visitor Experience

Visitors used to quiet or solitude would be disturbed by humans removing nonnative plants and by the use of heavy and noisy equipment. The equipment would release pollutants and stir up sand and dust. Equipment would use diesel fuel, known for both odors and visible smoke emissions. Staging areas, where temporary office space, fuel storage and personnel parking takes place, may also be in areas where visitors now experience a low level of human presence. Areas would be closed during prescribed burns or herbicide spraying.

In the long-term, views would be more natural and open following restoration of the area. Species diversity of plant life is likely to increase, and native animal life would be more abundant.

Cultural Resources

The use of heavy equipment to dig up beachgrass and iceplant, and even manual removal or the traveling by excavators along double track paths and roads could unearth or partially uncover subsurface historic resources. No prehistoric or historic resources were identified

during the reconnaissance survey of the Area of Potential Effect (APE) however paleosols (buried ground surfaces) were identified indicating a potential subsurface location for buried archaeological resources. These paleosol locations were recommended for archaeological monitoring during the dune restoration project.

Neighboring Land Use

Transportation of construction crews, the use of heavy equipment, staging areas, and access roads could have a temporary and adverse effect on neighboring ranchers, cattle or land use itself. In the long run, the area may be more attractive to those who wish to view wildlife and to those seeking to visit a dune area where thick vegetation has previously prevented access, increasing traffic to the site.

Health and Safety

Diesel fuel and gasoline, as well as herbicides can spill and contaminate soils and vegetation. Prescribed fire and/or herbicides can be dangerous for those staff or contractors conducting fires or spraying herbicide as well as for the public in the area during or following (herbicide) treatment. The use of heavy equipment can also be dangerous for the operators, and for staff and volunteers conducting manual removal or other operations where they cannot be well seen.

Issues and Impact Topics that Will Not Be Analyzed

The following issues were dismissed because either no impact would occur, or impacts would be negligible and/or undetectable:

- Impacts to above ground historic resources, museum collections, cultural landscapes
- Impacts to groundwater –Because equipment, fuel and supplies would be stored on sites where the surface is paved, covered in plastic or otherwise made impervious to fluid absorption, no impact to groundwater from these storage or staging areas would occur. Leaks may contaminate sand or soils on access roads, but equipment would be inspected regularly to prevent them. If a leak does occur, it would be temporary and very small scale; the equipment would be returned to a staging area and fixed (or replaced if needed) before continuing to use on site. Fuel, oil or other leaking fluid would be very unlikely to have reached groundwater if this type of small leak occurs, therefore impacts to groundwater are considered negligible and are dismissed from further analysis.
- Impacts to socioeconomics, including gateway communities or employment
- Impacts to minority or low-income communities
- Impacts to fuel resources
- Impacts to the night sky
- Impacts to visitor accessibility with special needs
- Impacts from the attraction of animal (including insect) pests
- Impacts to park operations- Park staff would need to be involved in the completion of the restoration effort. For example, rangers may be needed to help in traffic control, maintain public safety and/or provide security for equipment at the staging area. Natural resource staff may function as biological monitors, and cultural resource staff as trainers, observers or monitors of subsurface excavation. Pulling and coordinating volunteer efforts to pull resprouts would also require staff time. However, each of these is either already part of the staff person's job description or a temporary duty requiring a few hours of time and no or only negligible impact to park operating budget or day to day staff duties is expected. The cost of treatment is reported in the description of each alternative. Although costs may be substantial, the project

would not be completed unless additional line item budget funds from the National Park Service were allocated for them, so no or only negligible impact to the park's operating budget is expected. Therefore this issue is not analyzed further in the document.

- Impacts to wilderness areas- the site is not in a designated or proposed wilderness area. Impacts to neighboring wilderness from noise and human activities are part of the *Neighboring Land Use* analysis.
- Impacts from climate change- The U.S. Geological Survey (USGS) has identified Point Reyes National Seashore as particularly at risk among American shorelines for impacts related to global sea level increases (http://coastalmap.marine.usgs.gov/GISdata/nps-cvi/pore/pore_shore.zip), and especially beaches on the west side of the park including the project area. Restoring the project area so that it is vegetated with native species would help in minimizing the impact of global climate change and rising sea levels on dune natural resources by creating reardune habitat for these species; thereby making the overall park population more resilient to unstable climate conditions.
- Impacts to Air Quality- The use of cars and trucks to transport crews, as well as heavy equipment on site will result in the emission of criteria pollutants. Prescribed burning would emit smoke, which is a combination of pollutants, including large and small particulates, volatile organic compounds, carbon monoxide and nitrogen oxides. However, the degree of impact for all air quality emissions would be negligible and short-term. Negligible impacts are defined by the NPS as fewer than 50 tons per year of any pollutant emitted. Both alternatives would include the use of excavators. In Alternative B, driving each excavator (the analysis assumes up to two excavators or other pieces of heavy equipment working simultaneously) one hour per day to and from the refueling location would generate 0.06 tons hydrocarbons (HC), 0.3 tons carbon monoxide (CO), 0.2 tons nitrogen oxides (NOx) and 0.04 tons particulates over the life of the project. In this same alternative, excavators removing *Ammophila* (used for about 65 days) may generate up to 0.5 tons of hydrocarbons, 2.3 tons of carbon monoxide, 1.6 tons of NOx and 0.3 tons of particulates over the life of the project. This would increase in Alternative C as excavators would be used for an estimated 160 days. In Alternative C, emissions from heavy equipment would be 0.2 tons hydrocarbons, 5.6 tons CO, 0.7 tons particulates and 3.84 tons NOx over the life of the project. The emissions from refueling would also increase in Alternative C and are estimated to be 0.15 tons HC, 0.7 tons CO, 0.5 tons NOx and 0.09 tons particulates over the life of the project.

Smoke from prescribed burning in Alternative B would have an additional impact from particulates and other volatilized substances. Although emissions from burning were not modeled for this project, using those for the park's Fire Management Plan (NPS 2004) indicate the following emissions would occur for 90 acres of prescribed burning: 7 tons of particulates, 8.2 tons of carbon monoxide, one ton of hydrocarbons, and 0.23 tons of NOx. These numbers assume the burning of grasslands and coastal scrub vegetation similar to that on site. The total emissions of Alternative B would be 1.56 tons hydrocarbons, 10.8 tons carbon monoxide, 2.03 tons NOx, and 7.34 tons particulates. Total emissions from Alternative C are: 0.35 tons hydrocarbons, 6.3 tons CO, 0.79 tons particulates and 4.34 tons NOx. Each of these is well below the definition of negligible impacts for air emissions and so air quality is not discussed further in this environmental assessment.

ALTERNATIVES

ALTERNATIVES DEVELOPMENT PROCESS

Options for treating different subsets of the 300 acre project area now slated for *Ammophila* removal were initially developed and refined using value analysis. Value analysis is an organized team effort directed at analyzing the functions of facilities, processes, systems, equipment, services, and supplies for the purpose of achieving essential functions at the lowest life-cycle cost consistent with required performance, reliability, quality, safety, and achievement of NPS mission priorities such as resource protection, sustainability and quality visitor experience. The value analysis and other internal scoping eventually helped the park decide that the entire 300-acre project area should be treated. Two options for treating the 300 acres, one that focused on restoration of native habitat and the other that took a more generalist restoration approach were proposed during public scoping. Excavation was the tool that would be used, as this method had been used both at the park and in other northern California locations with success.

Funding limitations put the restoration project on hold for three years, and in this intervening time, other options were investigated. The park conferred with at least one other agency management team (Hyland and Holloran 2005) that had successfully used a combination of pre-burning and herbicide application to remove *Ammophila*. Fire was used to remove beachgrass thatch and stimulate regrowth; herbicides were applied a year later when new growth was green and uptake was maximized. The authors found that treatment was effective and costs were lower than those associated with mechanical treatment.

Final alternatives were modified to remove the alternative that would primarily treat plover habitat and keep the general restoration alternative using excavation (now Alternative C) and to add a second alternative (now Alternative B) that would treat all 300 acres and make use of diverse treatment methods similar to those reported in Hyland and Holloran (2005).

ALTERNATIVE A - NO ACTION

According to Director's Order 12 (sec. 5.2), EAs must fully describe and analyze the No Action alternative. The analysis of the No Action alternative "sets a baseline of existing impacts continued into the future against which to compare impacts of action alternatives" (Director's Order 12, sec. 2.7).

The No Action alternative in this case would mean that the proposed activity (dune restoration of 300 acres near Abbotts Lagoon) would not take place and that existing conditions and management activities would continue as they currently do. No Action includes continuing the current small-scale incremental restoration at a pace determined by staffing, funding and management priorities (see figure 4).

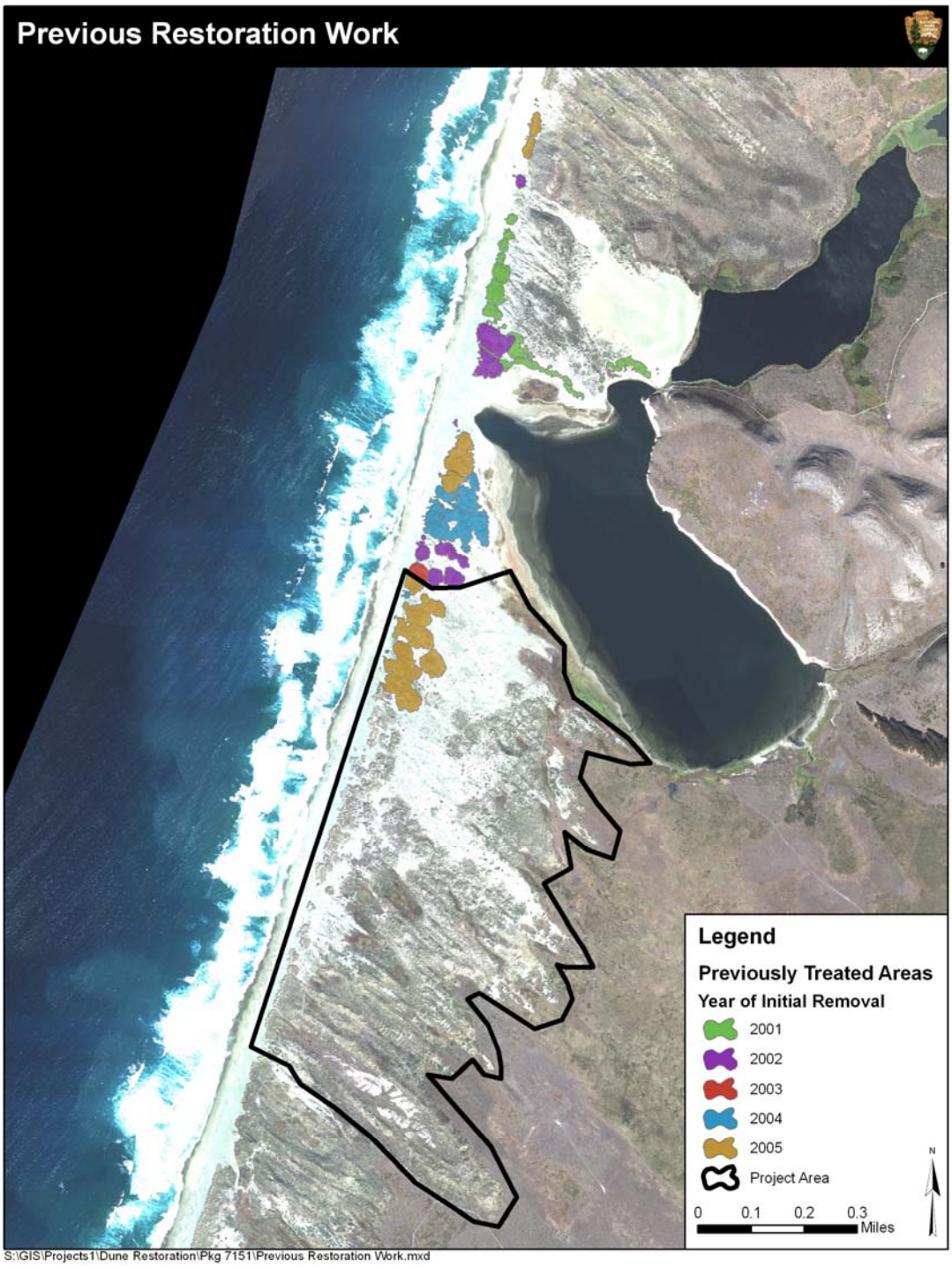

Figure 4. Alternative A

(Illustrates likely pace of restoration in Alternative A based on prior restoration activities at and near the site.)

Restoration Activities

As noted above, the park has been restoring small areas of dune habitat near Abbotts Lagoon since 2001 and has cleared a total of about 50 acres of dunes of European beachgrass and other nonnative, invasive plants in increments of a few acres each. These removals have focused on areas where beachgrass is either rapidly expanding or has the potential to do so. Although removal initially took place with hand tools, heavy equipment was used beginning in early 2004 to dig more deeply and prevent or minimize resprouting. The No Action alternative would likely continue these small-scale removals using heavy equipment, although a combination of prescribed burns and herbicides could also be tested over small areas. The details of how heavy equipment would be used are the same as for the action alternatives, although the scale of treatment is much smaller under No Action.

Staging and Access

Equipment is currently driven down a gravel road then along a two-track road that crosses grasslands and intersects the project site boundary along the southeastern edge. Secondary access roads run north and south along the reardune area. Fuel storage is at an abandoned parking lot at the end of the gravel road known locally as the former AT&T site. Another primary access route exits the park's North District Operations Center driveway and continues westward along a two-track ranch road. Use of either the AT&T route or the North District route is based on reducing travel time to the work area. Additional detail regarding staging and access for this alternative is supplied in the description of actions common to Alternatives B and C. The frequency of use and scale of staging needed are larger in the action alternatives than under No Action, but details are otherwise the same for all three alternatives.

Monitoring

Monitoring of small removal projects would continue to determine the success in preventing resprouting and extent of expansion by native dune plants, including those that are listed or rare, into restored areas. Efforts to track the number of Western snowy plover nesting sites, nesting success and health of each plover, as well as the extent of the Myrtle's silverspot butterfly population would continue. Sand movement and expansion of beachgrass would also continue to be monitored.

Resource Protection

Management of dune vegetation and wildlife would continue to protect existing rare communities and individuals or populations of threatened or endangered species. For example, signs indicating the general location of nesting plovers would be used to keep visitors and dogs away from these nests during the breeding and rearing seasons. Grassland habitat where larval and food plants for Myrtle's silverspot butterfly grow would be relatively free of disturbance as no new roads would be built, and efforts to fence cattle or cattle management activities (including the use of off-road vehicles) from these most coastal grasslands (1/4 mile strip along the coast) would continue. In addition, all relevant environmental protection measures imposed for work in the action alternatives would also be potentially used when small-scale sporadic treatment occurs under the No Action alternative.

ACTIONS COMMON TO BOTH ACTION ALTERNATIVES

In addition to some common restoration activities, staging and access, monitoring and environmental protection measures, the following actions would be common to both Alternative B and C:

- Management actions would consist of the most efficient, environmentally sensitive methods and implementation.
- Both alternatives would treat beachgrass and iceplant within the same 300-acre project area.
- Methods of operations, access and staging associated with areas of native species would be dependent on sensitive species.
- All work would be designed to avoid "take" under the Endangered Species Act.
- All work would be mitigated to assure no net loss of wetlands in the area.
- All restoration efforts would require long-term follow up to reduce invasive plant cover at less than 1%.

Restoration Activities

Each of the action alternatives would treat an area along the coastline in the proximity of Abbotts Lagoon that covers approximately 300 acres (see figure 3). The emphasis of the alternatives would be habitat enhancement for the four federally listed species located within the area through the removal of European beachgrass and iceplant. European beachgrass removal and iceplant would take place on about 90 acres of reardunes and 43 acres of foredunes within the 300-acre project area. Within the 133 acres, iceplant removal would take place in several locations totaling about one acre.

The project boundaries were designed to isolate the recently restored areas from neighboring patches of European beachgrass. The northern boundary is adjacent to Abbotts Lagoon and a previous restoration (European beachgrass eradication) project site. The Pacific Ocean and beachfront forms the western boundary. The eastern boundary is adjacent to grasslands (pasture) and seasonally wet areas, and the southern perimeter is bounded by a buffer of native dune habitat an average of 450 ft. wide. As such, there are no European beachgrass populations abutting the perimeter of the project area.

Each of the action alternatives include implementation of mechanical removal and hand removal in areas where sensitive resources are identified.

Mechanical Removal techniques

Mechanical removal techniques use heavy equipment to dig up European beachgrass roots and rhizomes and completely remove all of the standing biomass. Excavators equipped with a large bucket and thumb are used to perform the digging and burial of biomass. Bulldozers may be used to support the excavators in transporting and/or burying excavated biomass. Bulldozers may also be used to re-contour treatment sites after burial is completed.

To prevent resprouting, the excavated biomass is buried beneath a cap of clean sand at least three feet deep. First, a section of European beachgrass is dug to the depth of the root mass (typically 3-4.5 feet, occasionally as deep as 6 feet) and piled on top of an adjacent stand of beachgrass. Any large woody debris (driftwood) encountered during the excavation would be removed and stockpiled for later use. The excavated biomass would be mixed with a significant amount of sand, and is referred to as "dirty sand." Second, the "clean sand" at the bottom of the pit is excavated and stockpiled in an adjacent clean sand area. The pit is dug as deeply as possible (at least 9 feet deep) to maximize the yield of clean sand and to ensure subsequent deep burial of excavated biomass. Next, the pit is filled with the recently excavated biomass and dirty sand. The pit is filled to within 3 to 4.5 feet of the top (existing

grade elevation). Finally, the pit is backfilled using the stockpiled clean sand to create a cap between 3 to 4.5 feet deep on top of the “dirty sand.” The clean sand cap is then smoothed to match the surrounding grade.

This method requires the complete excavation of standing vegetation and overturning of soils (dune sands), and is therefore suitable only in areas where sensitive plant species do not currently exist. No mechanical equipment will be used within five feet of an identified wetland area.

Hand Removal techniques

In sensitive habitat areas, such as areas where beachgrass is interspersed with native plants, wetland areas, in transition zones between areas identified for removal and adjacent native habitats to be preserved, hand removal techniques would be employed. Biomass removed by hand is either is piled on site to decompose or transported to a nearby mechanical removal area and buried. Because hand tools cannot reach as deep as mechanical equipment, a greater frequency of resprouting of beachgrass and consequently more aggressive maintenance is likely.

Narrow-bladed shovels (such as a trenching shovel) would be used when hand removal is needed in areas dominated by shrubs or in native shrub/beachgrass transition areas. The use of a narrow blade will minimize impacts to the roots of adjacent shrubs and make it easier to insert the blade deeply into the soil to sever beachgrass roots. Ideally, the tool would have a short handle with a “D-shaped” grip to allow one-handed digging, while the beachgrass is held and pulled with the other hand. Regular spade shovels, scalping tools, rakes, and short trenching shovels may be used in open sand buffer areas, where the low-density of native vegetation to be preserved would provide more working space and allow for a more complete excavation of beachgrass roots, rhizomes and biomass. Newly-dug beachgrass would be stockpiled on site in small, manageable piles or carried to a nearby area where they would be buried.

In open sand/ beachgrass transition areas, where beachgrass may be found in higher densities growing adjacent to native dune habitat, the techniques used to excavate and remove beachgrass would depend upon the density of the stand targeted, and the presence of native plants to be preserved. Where individual clumps of beachgrass are found growing in low-densities among native dune plants, narrow-bladed shovels would be used to sever beachgrass. Where beachgrass is found growing in dense stands, and existing native plants are fewer, a more complete excavation of beachgrass roots may be possible. In these cases, shovels would be used to completely excavate the rootmass, either by digging a trench or pit around the beachgrass clump to be removed. The trench or pit would be dug as deeply as necessary (typically 3-4 feet) and all biomass removed by hand and the site raked.

These same tools and techniques would be used to remove any resprouting beachgrass. To be effective, resprout removal must be regularly scheduled and thorough. The current restoration strategy includes five follow-up resprout removal treatments to achieve complete eradication and control. The level of effort required for each follow-up treatment is expected to diminish with time as resprouting rhizomes are completely removed from treated areas. The final result of such treatments would be the creation of open sand habitat and subsequent re-colonization by native dune mat and dune grass vegetation.

Iceplant is more shallow-rooted and excavation to no more than about 6 inches to completely remove the root structure is required. Because hand removal is effective for iceplant, it may be used for some larger patches as well. These larger clonal mats of iceplant can be removed by excavating the roots beneath one edge and rolling the mat up onto itself. As the mat is rolled up, the roots may be severed just below the soil surface, freeing the mat and allowing it to be rolled further. Once a mat is completely liberated from

the soil surface, the iceplant would be buried. Herbicide is also an effective treatment method, and larger patches could be sprayed.

Staging and Access

As noted above under No Action, the NDOC facility is the preferred point of access to the project site with the AT&T driveway a second choice for accessing the southern end of the project site. The NDOC access route (figure 5) would be improved (graded and graveled) at the beginning of the implementation period to improve access by heavy equipment. The road intersects the project site boundary along the southeastern edge. At this intersection, a parking area would be developed for overnight parking and refueling of heavy equipment, temporary equipment or tool storage, and daily parking by restoration crews. Minor improvements to the AT&T route may be required; this would include adding gravel the current roadbed.

The parking area would be approximately 1/4 acre in size, and would be fenced to provide security for refueling equipment, storage containers, and parked vehicles. Upon completion of this project, both the road and the parking area would be reclaimed to their former condition and all building materials removed from the site.

Jobsite trailers, offices, additional parking and storage would be located at the NDOC facility, where there is access to power, water, septic and telephone utilities. This facility is currently used as office and shop space by NPS staff on a daily basis, and is secured with a locked gate. The facility has paved parking areas, secure storage and workspaces, open areas suitable for temporary trailers, and is expected to require minimal improvements or retrofitting.

Within the project boundary, three proposed secondary access routes (figure 5) would provide designated access to restoration sites by heavy equipment. Two routes traverse the project area running north to south along the reardune area. These routes would provide access to restoration sites during plover nesting season, when beach areas are closed to heavy equipment.

The third route crosses the project site from east to west, from the primary access road and parking area to the beachfront. From this point, heavy equipment would access restoration sites to the north and the south by driving along the beach. This route would be used primarily for work in foredune sites.

These secondary routes would not be improved; they would simply be delineated with flagging until repeated use has made them obvious. The following criteria would be used to select the preferred routes for these secondary roads: avoid existing dune mat and wetland vegetation types, direct travel to European beachgrass-dominated sites, and avoid steep slopes. During the route selection and flagging process, any unavoidable sensitive plants found on the right-of-way would be salvaged and relocated to appropriate sites. Upon completion of the project, these routes would be reclaimed to match surrounding conditions. Figure 5 shows wetlands and how secondary routes would avoid them.

Use of these routes would differ in each alternative. For example, only light use would be made of access routes and even staging areas in the No Action alternative, as sporadic small-scale restoration efforts would continue as funding allows. In Alternative B, the access routes along the eastern perimeter of the site would not be as heavily used as in Alternative C, as reardunes would be treated with herbicides and fire. The herbicides would be delivered by personnel on foot with backpack sprayers, requiring only drop off and pickup of staff and equipment via the reardune access routes. These routes may also be used by ATVs or fire engines when the prescribed burn is conducted. In Alternative C, the reardune routes would

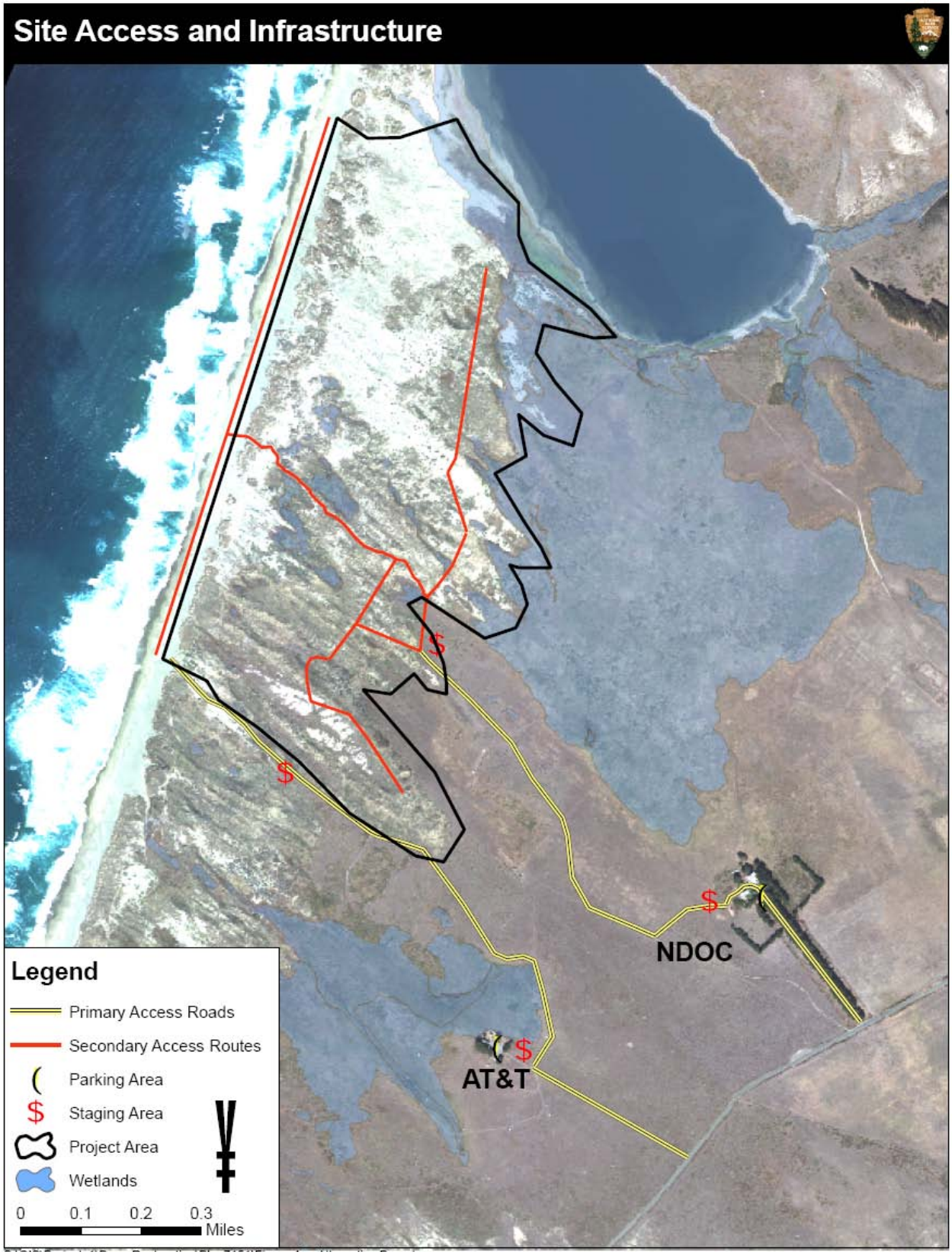

Figure 5. Staging, Access and Parking Areas

be used by excavators and other heavy equipment as needed to treat these acres. Both action alternatives would make equal use of the foredune access routes.

Monitoring

Monitoring of treated acres to identify whether and the degree to which treatment is successful would take place in both action alternatives. Success would be determined by counting the number of resprouts, the number of native dune plants, and the recolonization by listed plants and animals the proposal is intended to restore. Maintaining the site so that nonnative vegetation does not constitute more than one percent ground cover would be considered successful restoration; if *Ammophila* resprouts cover a greater area than this, control efforts would be conducted. Efforts to track the number of Western snowy plover nesting sites, nesting success and health of each plover, as well as the extent of the Myrtle's silverspot butterfly population would continue. Sand movement and expansion of beachgrass would also be monitored.

Environmental Protection

The ecological restoration work in each of the action alternatives would take place on a large area of extreme environmental sensitivity, where the avoidance of adverse impacts to species of special concern, rare vegetation communities, and wetlands is important. Actions taken to protect these and other resources from impacts of removal are described in detail below to help in understanding their need or how they would be implemented.

Measures to Protect Western Snowy Plover

Snowy plovers over-winter in Point Reyes along Point Reyes Beach, Limantour Beach, and at Drakes Beach and Estero, and breed at some of these sites, including along the foredune at the 300-acre study area. The seasonal presence of the breeding Western snowy plovers (*Charadrius alexandrinus* var. *nivosus*) in the project area is expected to present the longest lasting time constraint on when and where removal can take place. The plover nesting and foraging zone is almost exclusively in the foredunes, although chicks are precocious and both they and adults can sometimes forage through blowouts inland from the foredune. Western snowy plovers may begin the breeding season as early as the beginning of March, and can lay more than one clutch to extend breeding, nesting and rearing into mid-September. During this time (March 1 to September 15), no work within 500 feet of a nesting plover would take place to work to avoid disturbing or displacing this sensitive population.

Since the mid-1990's, PRBO Conservation Science has provided a biologist to monitor the beaches of Point Reyes National Seashore recording information on breeding pairs and fledgling success. A similar biological monitor on-site during plover season would be used to guide restoration crews in conducting work in the vicinity to avoid impacts to specific nesting birds. In foredune sites or habitat suitable for plovers that are known to have no nesting birds in the vicinity, the monitor may allow crews to conduct hand removal work, or even to continue mechanical removal.

Before any work takes place in the reardunes during the plover nesting season, the biological monitors trained to identify snowy plovers would survey it. If a nest is spotted in the reardunes, no mechanical equipment would operate within 500 feet of the nest for the remainder of the breeding season.

As noted, chicks and adults can use both foredune and reardune habitat, and if the foredune is restored, blowouts will facilitate their travel to and from these portions of the site. This may increase the number of adults, chicks or even nests in the reardune and put plovers at

increased risk. Therefore, the reardune would be treated first in both action alternatives and the foredune maintained in its current stable condition until treatment in the reardune is complete.

Measures to Protect Myrtle's Silverspot Butterfly

Myrtle's silverspot butterflies may be observed on the project site between mid-June and early October. During this period adults take flight in search of nectar sources in grasslands and dunes. As noted above, several native dune mat plant species are known to provide nectar for the butterflies, and the Western dog violet (*Viola adunca*), a grassland species, is used by larvae as the butterflies' sole source of food prior to pupating. The primary butterfly population on the site is at its south end in an area of native dune mat vegetation adjacent to grasslands. To protect feeding butterflies, removal work would be restricted by ensuring vehicles and heavy equipment move less than 10 mph on the southern portion of the site when adult butterflies are active (at least from June 15 through August 31). This would help protect adults foraging in grasslands or away from dune mat vegetation, as no treatment of dune mat itself would be required and no heavy equipment or vehicles would be allowed to travel through dune mat vegetation. Both alternatives would make use of hand removal at the edges of dune mat habitat on the site where it transitions into beachgrass. Surveys of the entire site to find any additional butterfly locations and avoid impact would also take place.

Vehicles or heavy equipment would access the site along secondary access routes that have been flagged by biological monitors. The monitors would be trained to recognize dog violets and Myrtle's silverspot butterflies and the routes selected to avoid impact to either. As noted above, vehicles would move no more than 10 mph along access routes in the southern portion of the site during the time adult butterflies are active. If butterflies are found elsewhere on the site, similar restrictions to the use of other secondary access routes would apply (e.g., vehicles would move no faster than 10 mph). Foot traffic would be similarly restricted, e.g., all dog violets would be flagged and avoided by those engaging in hand removal.

No treatment within 500 feet of a nest would take place in the foredunes between March 1 and September 15 to protect snowy plovers (unless it is approved by a USFWS permitted biological monitor)—this may offer some secondary benefit to foraging butterflies.

Measures to Protect California Red-legged Frog

Red-legged frogs do not exist on the 300-acre site, but do occupy grassland and other wet habitat directly north and east of the site. NPS staff and contractors would be trained to identify red-legged frogs and would stop work if a frog is seen in the project area. A qualified biological monitor would be contacted to remove any frog seen on the site unless it moves of its own accord.

Measures to Protect Rare, Listed or Sensitive Plants

The Seashore has monitored federal, state and locally listed rare plants in coastal dune habitat for over 20 years. Inventory and monitoring data provides both information on species abundance and distribution. All inventory and monitoring data are submitted to the California Natural Diversity Database (CNDDB).

Fourteen rare plant species are known to occur within the project area (see Affected Environment for Species of Special Concern). Prior to initiating work in any given area, a biological monitor would use existing maps and CNDDB data to survey the restoration area for sensitive plant species and clearly mark or flag their locations. Depending upon the specific situation and the activity planned for that area, such discoveries may result in

designating areas as off-limits, or may require special considerations or mitigation measures. However, given the sheer numbers of rare plants at the site, it is likely that some individuals would be unavoidably damaged by access or treatment activities.

Measures to Protect Dune Mat Habitat

Dune mat habitats are a highly sensitive and rare plant community found in the project area. Some of these habitats contain listed threatened or endangered species and some carry only unlisted, but nonetheless unique native plants. Dune mat areas that are known to contain listed species would be considered off-limits to heavy equipment throughout the entire construction period. Limited foot traffic may be allowed through these areas with the concurrence of a biological monitor. However, restoration crews would first be trained to identify sensitive species, and the biological monitor would affirm that access would not adversely affect the reproductive success (flowering, seed set, and/or germination) of the populations.

Dune mat areas that are not known to contain listed species would also be generally considered off-limits to heavy equipment throughout the construction period, although some limited access may be possible with the concurrence of a Biological Monitor. Access by heavy equipment would require the absence of any known resources of concern and only allowed when no other route is available.

Measures to Protect Water Resources

Herbicides would only be sprayed according to package directions, which include working in the dry season and on days when no precipitation is expected for at least 24 hours. Spring, summer and fall are the dry time of the year at the park, and this is when spraying would occur. This would minimize runoff and contamination of water and soil and allow for maximum degradation of herbicide before wet weather begins.

A spill plan would also be in effect and all staff and contractors aware of spill response procedures (see below).

Measures to Protect Wetlands

Prior to initiating work in the vicinity of wetlands, a biological monitor would clearly mark or flag the perimeter of the wetlands and clearly identify the limits of heavy equipment access. To remove European beachgrass from this transition zone (between mechanical treatment areas and the wetland perimeter), hand crews would work around the wetlands from the edges, and generally avoid traversing these sites, especially during the wet season. Only hand pulling would be allowing in a wetland. In addition, within five feet of known wetlands where excavation would otherwise be used, vegetation would be removed by hand.

Measures to Avoid Hazardous Spill/ Fuel Containment

The use of heavy equipment on the project site would require the development of a plan and strategy to address the prevention, containment, and disposal of hazardous substances, particularly hydraulic fluid, gasoline, and oil. Spill prevention measures would include ensuring that equipment is parked or staged on top of an impermeable surface. This may include the use of tarps or pans while the equipment is parked on the project site, or paved parking areas in an off-site staging area. Staging or parking areas would be located away from water bodies or other sensitive areas. Daily inspections of machinery would be required to detect leaks and identify preventive maintenance needs.

In the event of a spill or leak, each piece of equipment would have the proper containment equipment readily at hand, and the operator would be trained in the proper protocol and use. NPS staff and/or biological monitors would be notified and the disposal procedures

outlined in the prevention plan initiated. Spill response kits would be kept with the heavy equipment and stored in the on-site staging areas. Kits would likely contain spill berms, hazardous materials drums, drip pans, and absorbent materials.

Measures to Protect Cultural Resources

A cultural resource monitoring plan would be prepared to ensure that ground-disturbing activities within the areas of two identified buried soil levels result in no adverse effects to buried resources. Archaeological monitoring of paleosols or buried ground surfaces would be periodically conducted during dune restoration activities by a qualified cultural resource specialist. The monitoring program would include oversight of project schedules and excavation depths to insure that important opportunities for archaeological discovery are realized, and that potentially buried archaeological deposits are recognized in the course of active excavation and restoration. Archaeological monitoring of paleosols or buried ground surfaces would be conducted during dune restoration activities.

In areas where ground disturbance related to equipment/vehicular access is expected, staging and parking, monitoring by a qualified cultural resources specialist would be routinely conducted during site preparation and, in the case of access routes, throughout the life of the project.

Heavy equipment operators would undergo training for the identification of cultural resources that may be encountered during excavation, as well as what to do if they are encountered.

If previously unidentified cultural resources are encountered during restoration activities, the NPS would ensure that appropriate actions (e.g., cease work, evaluation) for Section 106 (NHPA) compliance are taken.

Measures to Protect Recreational Use

Construction dates/times, planned closures of portions of the project site and adjacent areas, and suggestions for alternative recreational opportunities would be provided to visitors via docents, rangers, park website, Visitor Center, parking lots/trailheads, etc., and posted at the project site in advance.

To minimize the effects of treatment-related noise on the natural quiet of the project area, heavy equipment would be required to have sound-control devices at least as effective as those originally provided by the manufacturer, and no equipment would be operated with an unmuffled exhaust. Signs in the project vicinity and on the park website would provide information on the NPS contact person for any noise concerns. This staff person would record and monitor construction-related noise complaints to determine if adverse effects can be mitigated further.

Measures to Protect Health and Safety

All tasks associated with project implementation would be conducted with the highest priority being the health and safety of staff, contractors and the public. Where appropriate for specific project tasks, adequate training and/or certifications would be required for staff and/or contractors.

Herbicides would be used in accordance with a Pesticide Use Proposal approved by the Pacific West Regional Integrated Pest Management Coordinator. Approvals require tracking of herbicide quantities and locations of applications. All herbicide applications would be conducted by state-certified applicators. All herbicide application would be in compliance with manufactures' labels and would occur only under prescribed weather conditions. Calibrated backpack sprayers with adjustable single-wand nozzles would be used to avoid overspraying onto non-target vegetation and open sand areas. Where appropriate, the

application area (project site) and a prescribed area downwind from it would be closed to the public during and after herbicide application.

ALTERNATIVE B. RESTORATION ON 300+ ACRES, EMPHASIS ON DIVERSE CONTROL METHODS

Restoration in this alternative would use an integrated pest management approach (IPM); 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 and maximizes the potential for successful treatment of the target pest. Specifically, prescribed fire, herbicide, heavy equipment deep burial and hand removal would be combined to control nonnative beachgrass and iceplant.

Restoration Activities

In addition to common staging and access, monitoring and environmental protection measures described above, Alternative B includes the following actions:

- 27 acres of excavation with heavy equipment (all in foredunes)
- A single prescribed burn and subsequent herbicide treatment using targeted backpack sprayers or hand wipes (wicking) on 93 acres of reardunes
- 13 acres of hand removal in sensitive areas (dune mat, wetland, etc.)
- Control of resprouts using only herbicides (wicking or targeted backpack spraying) and hand removal to the extent possible

Dune Restoration Approach

- Management actions would consist of the most efficient, environmentally sensitive methods and implementation.
- Alternative B would treat beachgrass and iceplant within the project area.
- Methods of operations, access and staging associated with areas of native species would be dependent on sensitive species.
- All work would be designed to avoid “take” under the Endangered Species Act.
- All work would be mitigated to assure no net loss of wetlands in the area.
- All restoration efforts would require long-term follow up to reduce invasive plant cover at less than 1%.

This alternative takes advantage of ecological variation within the landscape of the project area. For example, in the foredune portion of the project, dunes are dominated by patches of high density, deep-rooted beachgrass interspersed with patches of open sand, native dune mat and dune grass, and small pockets of wetlands. Heading inland, foredunes transition into reardunes, eventually grading into mixed shrub and grassland plant communities. Reardunes are characterized in some spots by perennial shrubs (mostly coyote brush) intermixed with beachgrass. These reardunes are more heavily vegetated than foredunes with increased cover and decreased bare ground. Beachgrass here is shallow rooted.

Because beachgrass is deeply rooted in the foredunes, Alternative B proposes to use excavation and deep burial to remove it on a total of 27 acres using mechanical removal techniques as described above (see *Mechanical Removal* section in *Actions Common to Both Action Alternatives*). In the reardunes the more shallow-rooted beachgrass can be effectively removed with a combination of fire and herbicide (described below). Buffers

around wetlands (25 feet) where only hand-pulling is used would protect this sensitive vegetative community from any impacts of herbicide drift. Imposing this buffer would result in 13 acres of the site being treated with manual removal (see figure 6). After initial treatment, resprouting of invasive vegetation would be removed/controlled to the extent

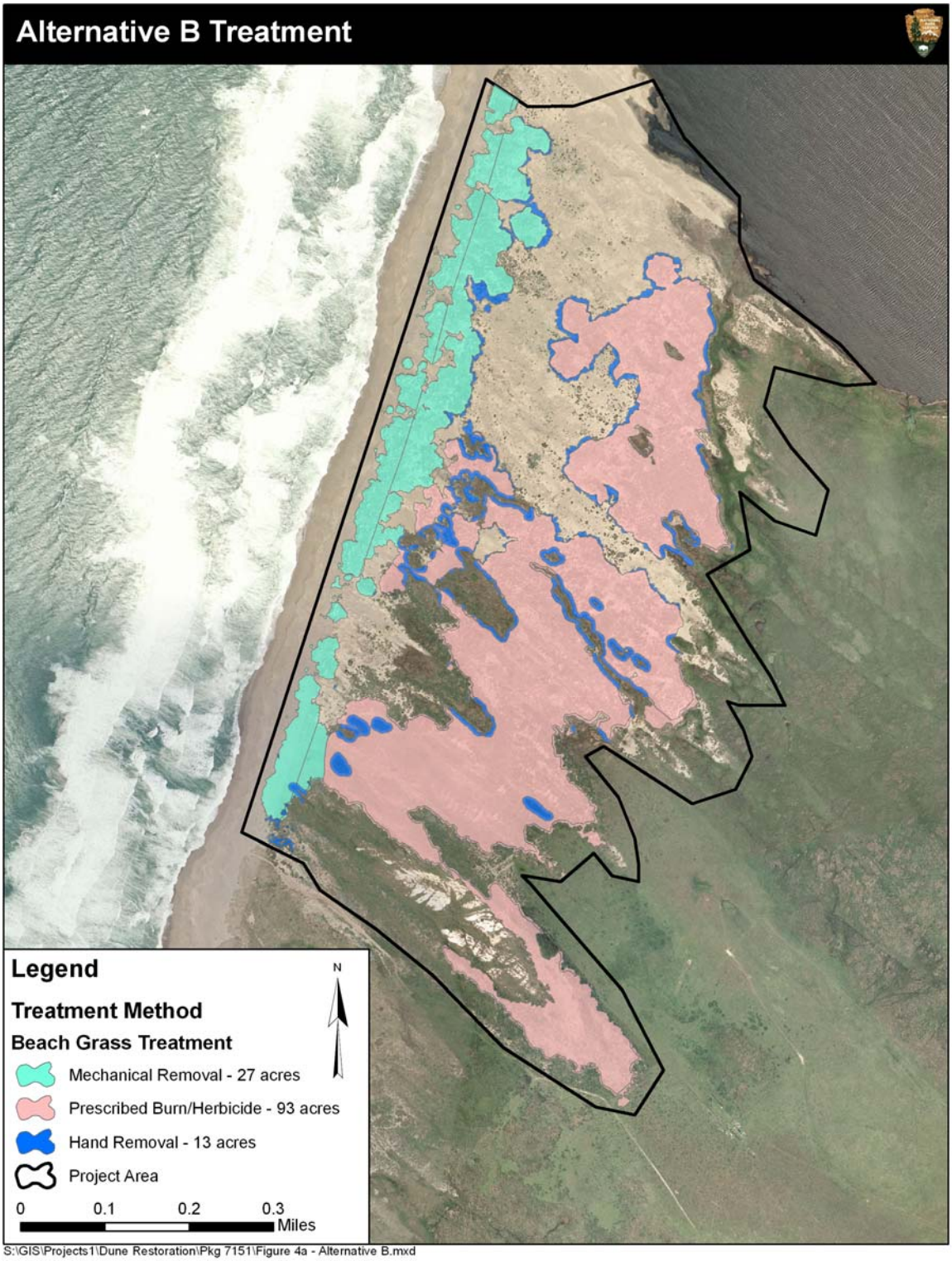

Figure 6. Alternative B Treatment

possible using herbicide and/or hand removal only. The initial removal work would be followed by up to five (possibly more) maintenance treatments to remove resprouting exotic vegetation. Long-term maintenance is expected to require minimal effort and would likely be necessary only along the perimeter of the project, adjacent to untreated stands of exotic vegetation.

Treatment of the reardunes would consist of a single prescribed burn followed by herbicide spraying of regrowth over 93 acres. The burn would be started using drip torch fuel distributed by hand crews or by people on ATVs. The purpose of the burn is to remove above ground biomass (beachgrass thatch) and encourage vigorous new growth of beachgrass. New growth would provide a sufficient leaf surface area to absorb herbicide, and ultimately would reduce the amount of herbicide necessary for treatment.

As an environmental mitigation and protection measure for the threatened Western snowy plover, both action alternatives would treat reardunes before the foredunes. This is to keep plover chicks from entering the reardunes through naturally occurring blowouts in the foredunes, which could occur if the foredunes were restored first.

Beach Grass Removal

The herbicide glyphosate (part of the commercial formulation known as Roundup®) would be used to kill *Ammophila* when it begins to grow in the spring. Glyphosate would be applied at up to 7-8% concentration using backpack sprayers or through direct contact by wicking, the latter a technique where herbicide is applied via a wand with a tip wetted by glyphosate. The herbicide would flow to the wand from a backpack and would not be subject to drift from wind. Backpack sprayers could emit some overspray during higher wind conditions, but this would be minimized through the use of calibrated nozzles; in addition, glyphosate is a minimally volatile chemical. To further minimize the chance of inadvertent contamination by drift, it would be applied only when wind speed is below 10 miles per hour and shields would be employed if needed. Broadcast applications would not be used anywhere within the project area.

Glyphosate is made by a number of different manufacturers; for example there are currently 35 commercial formulations of glyphosate registered for forestry applications (USDA Forest Service 2003). The exact product the park would use is not yet known, but is likely to be Rodeo® or some similar formulation with the lowest possible toxicity that is still effective. Roundup® is another familiar formulation of glyphosate which contains a toxic surfactant (chemical to help in the absorption of glyphosate); Roundup® would not be the formulation chosen by the park because of this surfactant.

Herbicide use on lands managed by the National Park Service requires initiation and approval of a Pesticide Use Proposal. Approvals are provided by the Pacific West Regional Integrated Pest Management Coordinator. Approvals require tracking of quantities and areas where pesticides are used. All herbicide application would be in compliance with manufacture's labels and would occur only under specific weather conditions.

The results of treatment are discussed in the Environmental Consequences section of this EA. However, in summary, it is anticipated that newly restored open sand habitats would return to their pre-disturbance condition. Foredune sand would be unrestrained by plant biomass and allowed to migrate and form the perpendicular dune ridge typically found in undisturbed dune ecosystems. This perpendicular orientation would form migration corridors providing access between foredune and reardune areas, increasing amount/variety of wildlife habitat available.

Vegetative recovery in areas formerly dominated by invasive vegetation would proceed naturally as native plants from existing populations within and immediately adjacent to the project area are allowed to re-colonize. Use of the area by both breeding and wintering populations of Western snowy plover would be expected to increase within the project area due to improved habitat as areas formerly dominated by exotic vegetation are converted to native dune structure and vegetative composition.

Time and Cost

It is estimated that treatment would take approximately 90-95 days to complete. Treatment of the 43 infested acres of foredunes with heavy equipment and manual removal would require about 65 days. Burning in the reardunes could take up to five days. Herbicide treatment of these same 93 acres of reardunes would average 5 acres/day and would involve about 20 days. These are estimates only, as burning may take place on a single day when weather conditions are appropriate for example, or herbicide spraying may be spread out over a longer period of time to avoid the windiest conditions when control would be more difficult.

The average cost of restoration under this alternative is $5546 per acre, including initial treatment and five follow-up treatments. The total cost for this alternative is currently estimated at $1,664,000.

Staging and Access

Staging and access operations would be as described above for *Actions Common to Both Action Alternatives*. These include the use of the NDOC facility as the preferred point of access to the project site and a graded and graveled primary access road at the AT&T site. A secondary staging area in the form of a ¼ acre fenced parking lot would be created where the primary road intersections the project site boundary. Within the project boundary, three proposed secondary access routes (figure 5) would provide designated access to restoration sites by heavy equipment. Two routes traverse the project area running north to south along the reardune area would provide access to restoration sites during plover nesting season, when beach areas are closed to heavy equipment. The third route crosses the project site from east to west, from the primary access road and parking area to the beachfront and would be used primarily for work in foredune sites.

Monitoring

Monitoring of treated acres to identify whether and the degree to which treatment is successful would take place in both action alternatives. Success would be determined by counting the number of resprouts, the number of native dune plants, and the recolonization by listed plants and animals the restoration proposal is intended to restore. Efforts to track the number of Western snowy plover nesting sites, nesting success and health of each plover, as well as the extent of the Myrtle's silverspot butterfly population would continue. Sand movement and expansion of beachgrass would also be monitored.

Environmental Protection

In addition to the environmental protection measures identified above (*Actions Common to Both Action Alternatives*), the following environmental protection measures would apply to Alternative B:

Measures to Protect Western Snowy Plover

As noted above, the Western snowy plover primarily occupies open beach habitat windward of the foredune in the project area. For the most part, the foredune would not be treated during the period of March 1 through September 15; however if no nesting plovers are found on a certain section of foredune at the site by trained biologists, and no impact from treating a section of foredune would therefore occur, hand or mechanical treatment may take place during this period. A 500-foot buffer from any nesting plover would be observed in both this and Alternative C.

Treatment would occur in the reardunes before the foredunes are treated as noted in the *Actions Common to Both Action Alternatives* section indicates. Burning would take place in the fall, both when vegetation is the most desiccated and available for burning, and after the plovers have completed their nesting and rearing cycle. The application of herbicide must take place in the spring or summer when the flush of new growth maximizes the uptake of the chemical. This would likely coincide with some part of the nesting season for plovers. However, spraying would not take place in vegetation that is any closer than 500 feet from an active nest (plovers generally nest in the foredunes where herbicides would not be used).

Leaving the foredune untreated until reardune removal operations are complete would help in keeping plovers away from herbicide spraying and prescribed burning. As noted above, plover adults and chicks may take advantage of blowouts to access reardunes for feeding, but the beachgrass-stabilized foredune would minimize the chance for blowouts. Even so, a biological monitor on-site during plover nesting season would be able to guide restoration crews in conducting work in the vicinity to avoid impacts to specific nesting or feeding birds or known feeding areas.

Measures to Protect Myrtle's Silverspot Butterfly

In addition to the environmental protection measures identified above for both action alternatives, the following would apply to Alternative B:

To protect Myrtle's silverspot butterflies, treatment activities would be restricted during the period when adults are known to occur. No prescribed burning or application of herbicides would occur during June 15 and August 31 in the southern portion of the project to protect adult butterflies. If butterflies are found in the northern portion of the site, these same restrictions would apply.

As noted above, all dog violets would be avoided by vehicles, heavy equipment and people using hand tools to remove *Ammophila*. In Alternative B, this also includes backpack spraying and prescribed burning.

Measures to Protect Red-legged Frogs

In addition to the environmental protection measures identified above for action alternatives, the following would apply specifically to this alternative:

No herbicide spraying within a 200-foot buffer of the east side of the site where frogs have been sighted or are known to have occurred would take place.

Measures to Protect Rare, Listed or Sensitive Plants

In addition to the environmental protection measures identified above for action alternatives, the following would apply specifically to this alternative:

Burning in the fall would allow sensitive plants to complete their life cycle or complete seed set. Backpack sprayers used in accordance with manufacturer and NPS regulations with

highly focused and directed nozzles would minimize any impact from herbicide application. If vegetation adjacent to known populations of listed or large patches of rare plants is being sprayed, a buffer and/or shielding would be observed to protect these plants from impacts of inadvertent drift. Compliance with package directions, weather and wind restrictions would also minimize impacts to rare, listed or sensitive plants.

Measures to Protect Dune Mat Habitat

The same measures as identified above for rare plants would be used to protect dune mat habitat. In other words, burning in the fall would allow dune mat species to complete their life cycle and set seed, and using backpack sprayers in accordance with manufacturer regulations would keep drift to a minimum. In addition, a buffer and/or shielding from the edge of any dune mat habitat to prevent inadvertent drift from affected dune mat species may be observed for spraying adjacent vegetation. If vegetation in a patch of dune mat or other important native vegetative communities (including dune slacks or hollows) is dense enough to carry a fire, an unvegetated ring around it would be created by manual removal or mowing to keep fire from burning the native vegetation.

Measures to Protect Wetlands

In addition to the environmental protection measures identified above for action alternatives, the following would apply specifically to this alternative:

Herbicide spraying would be restricted to within a 25-foot buffer of any known wetland to ensure no impacts from inadvertent spraying of herbicides to sensitive vegetation.

Measures to Avoid Hazardous Spill/ Fuel Containment

In addition to the environmental protection measures identified above for action alternatives, the following would apply to this alternative. If herbicides are used to treat resprouts in Alternative C, these same measures would apply:

A material storage and spill-response strategy would be developed that is specific to the herbicides and application methods to be used. Such a strategy would address the proper storage, mixing, and disposal methods for herbicides to be used.

In addition, the NPS and its contractors would follow all guidelines in applying any herbicide to prevent impacts to staff, contractors or visitors, including wearing face masks and closing the area to visitors during and following spraying for the recommended period of time for any residue to dissipate adequately to protect public health and safety.

Fire Prevention and Control

NPS and cooperating fire crews are expected to conduct any necessary burns, and they would be responsible for preparing a burn plan and developing the criteria for determining the conditions under which burning is appropriate (season, time of day, prevailing winds, relative humidity, etc.). The restoration crew would consult with the fire crew prior to scheduling all other treatments, including herbicide application, hand removal, and heavy equipment burial to ensure worker safety and appropriate scheduling for controlling beachgrass.

ALTERNATIVE C. EMPHASIS ON MECHANICAL CONTROL METHODS (PREFERRED ALTERNATIVE)

Alternative C would restore dune habitat by using mechanical and hand removal treatments to eradicate European beachgrass and iceplant. The initial removal work would be followed

by five maintenance treatments or more using hand labor and other treatments to remove resprouting exotic vegetation. This is the current NPS preferred alternative.

Restoration Activities

In addition to common staging and access, monitoring and environmental protection measures described above, Alternative C includes the following actions:

- Heavy equipment to excavate and bury *Ammophila* would be used on 126 acres and to recontour the site following removal
- Hand removal would be used to protect sensitive vegetation on 7 acres
- Control of resprouts using herbicides (wicking or targeted backpack spraying) and hand removal only to the extent possible

Dune Restoration Approach

- Management actions would consist of the most efficient, environmentally sensitive methods and implementation.
- Alternative C would treat beachgrass and iceplant within the project area.
- Methods of operations, access and staging associated with areas of native species would be dependent on sensitive species.
- All work would be designed to avoid “take” under the Endangered Species Act.
- All work would be mitigated to assure no net loss of wetlands in the area.
- All restoration efforts would require long-term follow up to reduce invasive plant cover at less than 1%.

Alternative C would rely only on the systematic removal and burial using heavy equipment and manual removal to initially remove beachgrass and iceplant. After initial treatment, resprouting of invasive vegetation would be removed/controlled to the extent possible using herbicide and/or hand removal only. Ongoing maintenance is expected to require minimal effort (compared to hand treated areas) and would likely be necessary only along the perimeter of the project, adjacent to untreated stands of exotic vegetation.

Mechanical removal techniques use heavy equipment to dig up European beachgrass roots and rhizomes and completely remove all of the standing biomass. To prevent resprouting, the excavated biomass is buried beneath a cap of clean sand at least three feet deep. This method requires the complete excavation of standing vegetation and overturning of soils (dune sands), and is therefore suitable only in areas where sensitive plant species do not currently exist.

Excavators equipped with a large bucket and thumb are used to perform the digging and burial of biomass. Bulldozers may be used to support the excavators in transporting and/or burying excavated biomass. Bulldozers may also be used to re-contour treatment sites after burial is completed.

First, a section of European beachgrass is dug to the depth of the root mass (typically 3-4.5 feet, occasionally as deep as 6 feet) and piled on top of an adjacent stand of beachgrass. Any large woody debris (driftwood) encountered during the excavation would be removed and stockpiled for later use. The excavated biomass would be mixed with a significant amount of sand, and is referred to as “dirty sand.” Second, the “clean sand” at the bottom of the pit is excavated and stockpiled in an adjacent clean sand area. The pit is dug as deeply as possible (at least 9 feet deep) to maximize the yield of clean sand and to ensure subsequent deep burial of excavated biomass. Next, the pit is filled with the recently excavated biomass and dirty sand. The pit is filled to within 3 to 4.5 feet of the top (existing grade elevation). Finally, the pit is backfilled using the stockpiled clean sand to create a cap between 3 to 4.5 feet deep on top of the “dirty sand.” The clean sand cap is then smoothed to match the surrounding grade.

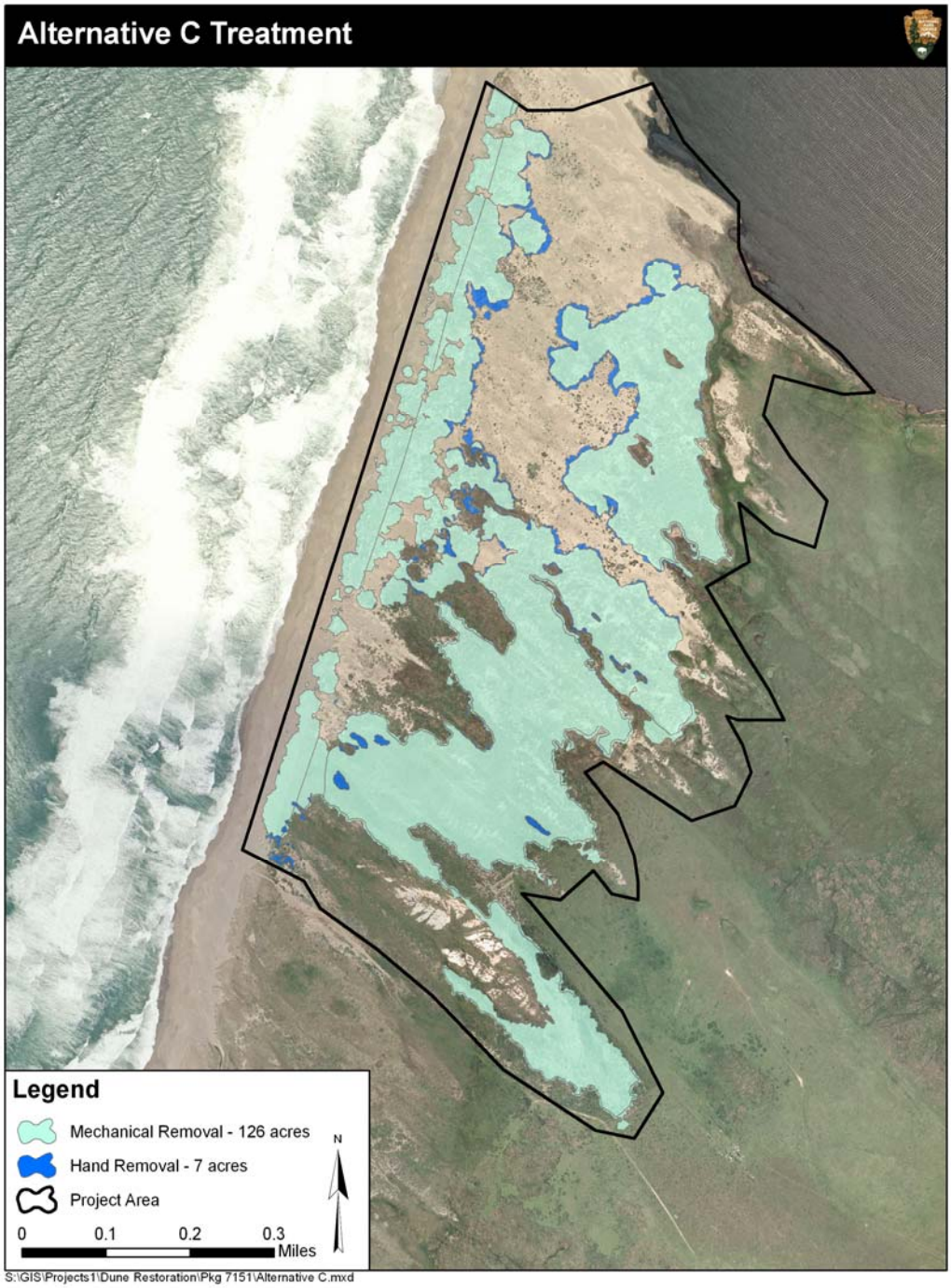

Figure 7. Alternative C Treatment

As noted above, European beachgrass growing in the foredune area tends to be more aggressive and deep-rooted. In addition, sand is more likely to be blown off buried vegetation in the foredune, and so excavated biomass must be buried deeper to prevent resprouting. A clean sand cap of 6 feet is likely to be required in these areas.

Hand removal for sensitive areas or for maintenance would be conducted as described above for *Actions Common to Both Action Alternatives*.

The use of herbicides would primarily be restricted to treating resprouts in Alternative C, especially in areas where hand removal proves difficult or ineffective, such as within existing shrubs or in dense foredune areas where complete excavation of European beachgrass roots proves difficult.

If the use of herbicides is to be considered for any larger areas, the same techniques and constraints as described above for Alternative B would apply.

The same degree of restoration as described above for Alternative B would occur in this alternative. The approximately 300 acres of newly restored open sand habitats would be encouraged to return to their pre-disturbance condition. Dune sands would be allowed to migrate and form the perpendicular dune ridge typically found in undisturbed dune ecosystems. This perpendicular orientation would form migration corridors providing access between foredune and reardune areas, increasing amount/variety of wildlife habitat available.

Vegetative recovery in areas formerly dominated by invasive vegetation would proceed naturally as native plants from existing populations within and immediately adjacent to the project area are allowed to re-colonize. Use of the area by both breeding and wintering populations of Western snowy plover would be expected to increase within the project area due to improved habitat as areas formerly dominated by exotic vegetation are converted to native dune structure and vegetative composition.

Time and Cost

It is estimated that treatment would take approximately 160 days to complete. As in Alternative B, treatment of the foredunes with heavy equipment would require about 65 days to treat 43 acres. Treatment of the more shallow-rooted reardunes could proceed more quickly, at a pace of about 0.95 acres/day or a total of 95 working days. Weather considerations that constrain burning or herbicide application would not apply to this alternative, and work is likely to continue 5 days a week throughout October to March until the project is complete.

The average cost of restoration under this alternative is $6,869 per acre, including initial treatment and five follow-up treatments. The total cost for this alternative is currently estimated at $2,002,000.

Staging and Access

Staging and access operations would be as described above for *Actions Common to Both Action Alternatives*. These include the use of the NDOC facility and the AT&T road as the preferred points of access to the project site. A secondary staging area in the form of a ¼ acre fenced parking lot would be created where the primary road intersections the project site boundary. Within the project boundary, three proposed secondary access routes (figure 5) would provide designated access to restoration sites by heavy equipment. Two routes traverse the project area running north to south along the reardune area would provide access to restoration sites during plover nesting season, when beach areas are closed to heavy equipment. The third route crosses the project site from east to west, from the

primary access road and parking area to the beachfront and would be used primarily for work in foredune sites.

Monitoring

Monitoring of treated acres to identify whether and the degree to which treatment is successful would take place in both action alternatives. Success would be determined by counting the number of resprouts, the number of native dune plants, and the recolonization by listed plants and animals the restoration proposal is intended to restore. Efforts to track the number of Western snowy plover nesting sites, nesting success and health of each plover, as well as the extent of the Myrtle's silverspot butterfly population would continue. Sand movement and expansion of beachgrass would also be monitored.

Environmental Protection

The environmental protection measures for all resources described above under *Actions Common to Action Alternatives* (including Western snowy plover, Myrtle's silverspot butterfly, red-legged frog, rare plants, dune mat habitat, wetlands, and hazardous waste/fuel spills) would apply to this alternative. Measures to protect wetlands and other resources from contamination by herbicides described under Alternative B may apply if herbicides are used to treat resprouts. No additional protection measures are anticipated.

PREFERRED ALTERNATIVE

The preferred alternative is Alternative C. The preferred alternative was selected after initial assessment and comparison of the potential impacts associated with four alternatives. A decision-making process known as "Choosing by Advantages" (CBA) was used to bring maximum value to the process while making cost-effective decisions that would benefit the parks and the nation.

Part of the CBA process involved selecting a paramount advantage. All other factor advantages were ranked proportionally against the paramount advantage benchmark. The factor selected as providing the paramount advantage in relation to the park's mission was "prevent loss of resources/maintain and improve condition of resources." Both Alternatives B and C would equally improve the condition of resources in the long term, but Alternative C would have fewer adverse impacts and therefore result in less loss of park natural resources during implementation. Cost was considered as well, but was secondary to the alternative's ability to meet the primary objective. In other words, costs and benefits were weighed and compared in selecting the preferred alternative.

ENVIRONMENTALLY PREFERABLE ALTERNATIVE

Alternative C is also the environmentally preferable alternative. The environmentally preferable alternative is defined by the Council on Environmental Quality (CEQ) as the one which "causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves and enhances historic, cultural and natural resources."

The No Action alternative has several long-term adverse impacts to park resources that both Alternatives B and C would alleviate in the long term by removing *Ammophila*, making the action alternatives environmentally preferable to the No Action alternative. These include continued minor to major adverse impacts on listed animal and plant species, minor to moderate adverse impacts on vegetation and wildlife and moderate to major long-term adverse effects on natural sand movement at the site. The two action alternatives (B and C) offer the same long-term advantages to these resources through *Ammophila* removal and

differ primarily in impacts during implementation; therefore, it is these short-term impacts that determined the environmentally preferable option. Both Alternative B and C would use excavators, although the noise and disturbance to wildlife would be greater in Alternative C from this source. This would be outweighed by the relative adverse impacts of herbicide and burning in Alternative B.

The use of herbicide would have additional adverse effects beyond those in Alternative C on wetlands and other native vegetation, rare plants, red-legged frogs, Western snowy plovers, Myrtle's silverspot butterfly, birds (from ingesting contaminated insects or vegetation), invertebrates, soils, wetlands, visitor experience and worker safety. Although it could have some benefits for fire-adapted vegetation, burning could also adversely affects air quality, rare plants, wildlife, visitor experience, adjacent land use and worker safety. Even though a multitude of environmental protection measures to minimize impacts would be applied, some typically minor or moderate short-term effect from herbicides or burning would remain. The additive effect of these remaining impacts would be substantially greater in Alternative B than C.

ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

The National Park Service NEPA regulations (Director's Order 12) indicate that a range of alternatives must be developed with environmental resources as the primary determinant (section 2.7a). In other words, alternatives are to propose different means of accomplishing objectives while at the same time minimizing adverse impacts or maximizing beneficial impacts to some or all resources. Alternatives are also to be environmentally distinct, with issues "sharply defined" to provide a clear basis for choice among options (40 CFR 1502.14).

Several different approaches to creating an appropriate range of alternatives were reviewed by the interdisciplinary team during internal scoping. These included a programmatic approach applied to all areas at the Seashore where European beachgrass or iceplant dominate the dunes; alternatives that focused on different methods of removal at the Abbotts Lagoon site; alternatives that treated differing numbers of acres; and alternatives that varied in the degree to which various objectives would be met or impacts would occur.

A programmatic NEPA document evaluating all of the park's 1,000 acres of dunes infested with nonnative invasive species was considered but eliminated. Reasons for eliminating this option including unavailable funding to treat the entire park and that the area of Abbotts Lagoon offers several benefits other locations do not. This conclusion regarding benefits was reached through a "Value Analysis" process used to rank 36 options among dune areas of the park. Variables evaluated included difficulty, feasibility, and overall benefit. The area south of Abbotts Lagoon scored highest with regard to restoration potential for plovers nesting habitat and potential for positive impact on Myrtle's silverspot butterfly (Jones and Stokes 2004), and was relatively accessible and feasible to treat.

The park then developed four versions of treatment in this area, which differed in the amount of land they treated and ranged from 200 to 300 acres. These variations would prioritize different spots on the 300-acre site, and would either focus on complete removal up front, or less intense initial treatment and more complete resprout removal and follow-up. Because these options would vary little in their environmental impacts, the team agreed they would not meet the requirement that alternatives be environmentally distinct.

The team developed another approach, where each alternative would treat the same number of acres in the same general area, but one would focus on foredune restoration and the other would treat a combination of fore and reardune habitat. The foredune restoration would have maximized restoration of snowy plover nesting habitat, whereas the

combination would have also restored habitat for Myrtle's silverspot butterfly, beach layia, Tidestrom's lupine and other rare vegetative communities.

Because the foredune alternative would not also restore habitat for other listed or important rare species, this approach was also dismissed. In addition, demonstrated success with the use of prescribed burning and herbicide application (now Alternative B in this EA) for significantly less money than mechanical removal and deep burial suggested that this combination of tools be evaluated more closely.

Table 1. Comparison of the Elements of Alternatives

	No Action	Alternative B	Alternative C
Restoration Activities	Small-scale removal using a variety of techniques; primarily excavation	Combination of manual removal, excavation on the foredune; prescribed burning and herbicide application to reardunes	Combination of manual removal and excavation to remove *Ammophila* across site
Staging and Access	Use existing staging at NDOC and AT&T and associated access routes	Create new staging area closer to dunes at NDOC; flag three secondary access routes	Same as Alternative B, although heavier use of reardune access by excavators, heavy equipment than in Alternative B
Monitoring	Monitor resprouting in treated areas; use of areas by plovers; Extent of Myrtle's silverspot butterfly; sand movement	Same as Alternative A	Same as Alternative A
Resource Protection	Seasonal, geographic, timing and logistic means used	Seasonal, geographic, timing and logistic means used. Burn and safety plans prepared	Same as Alternative A
Snowy plovers	No excavation within 500 feet of nests. Treat reardune first to prevent chicks entering area during treatment; Biological monitor surveys area to be treated, flags access routes	Same as Alternative A	Same as Alternative A
Myrtle's silverspot butterfly	No work in southern butterfly habitat during June 15-Aug 31; 10 MPH speed limit for vehicles, heavy equipment during June 15-Aug 31; Flag access routes to avoid larvae	No work in southern butterfly habitat during June 15-Aug 31; 10 MPH speed limit for vehicles, heavy equipment during June 15-Aug 31; Flag access routes to avoid larvae; Mow or foam buffer around dune mat to avoid burning habitat; Spray no closer than 25 feet from dune mat	Same as Alternative A
Red-legged frogs	Biological monitor would survey prior to treatment in areas where frogs may be found; equipment operators trained to recognize red-legged frogs and stop work	Same as Alternative A	Same as Alternative A

	No Action	Alternative B	Alternative C
Rare, listed or sensitive plants	Biological monitor would survey prior to treatment and flag individuals and the extent of patches of listed, rare or sensitive plants or vegetative communities	Biological monitor would survey prior to treatment and flag individuals and the extent of patches of listed, rare or sensitive plants or vegetative communities; a fuel break would keep fires from burning most rare or listed plants	Same as Alternative A
Wetlands	Perimeter would be flagged and a hand pulled buffer created to prevent inadvertent excavation. No excavation, spraying within 25 feet of a wetland	Perimeter would be flagged and a hand pulled buffer created to prevent inadvertent excavation; no excavation, spraying within 25 feet of a wetland; 20 foot fuel break enforced for burning	Same as Alternative A
Dune mat	Excavation not allowed, some hand removal if no listed species affected. Boundaries flagged, hand pull vegetation in a 10-foot buffer around dune mat	Excavation not allowed, some hand removal if no listed species affected; boundaries flagged, hand pull vegetation in a 10-foot buffer around dune mat; 20-foot fuel break enforced for burning; no excavation, spraying within 10 feet of dune mat	Same as Alternative A
Hazardous spill/fuel containment	Staging area covered with impervious material and bermed; equipment checked for leaks daily; fuel/hazardous spill plan; all materials to clean or stop spill on site	Same as Alternative A	Same as Alternative A
Cultural Resources	Archaeological monitoring of paleosols or buried ground surfaces would be conducted during dune restoration activities	Same as Alternative A	Same as Alternative A

Table 2. Impacts of Alternatives

	No Action	Alternative B	Alternative C
Vegetation			
Dune mat	Moderate adverse long-term impact	No impact anticipated from staging or access as routes would avoid dune mat; Negligible to minor short-term adverse impacts from treatment activities; moderate to major long-term benefit from removing *Ammophila*.	Same as Alternative B
Grasslands	Minor adverse long-term impact	Minor short-term adverse impacts from staging, access routes; long-term benefit from prescribed burn; minor to major adverse long-term localized impact from sand movement possible; long-term minor to moderate benefit from treatment.	Minor short-term adverse impacts from staging, access routes; Minor to major adverse long-term localized impact from sand movement possible; long-term minor to moderate benefit from treatment.
Wetlands	Moderate adverse long-term impact	No impact from access as routes would avoid wetlands; Negligible to moderate short-term to algae, macrophytes from herbicide drift; minor to major adverse long-term localized impact from sand movement.	No impact from access as routes would avoid wetlands; Minor to major adverse long-term localized impact from sand movement.
Shrub/scrub	Minor adverse long-term impact	Minor short and/or long-term adverse impact from access possible; long-term benefit from prescribed burn; minor to moderate long-term benefit from treatment.	Minor short and/or long-term adverse impact from access possible; Minor to moderate long-term benefit from treatment.
Species diversity		Minor to major long-term benefits from treatment.	Same as Alternative B.

	No Action	Alternative B	Alternative C
Native vegetation		Minor to moderate short-term adverse impacts from herbicides, fire. Minor to major long-term benefits from treatment.	Negligible to minor short-term impacts from excavation. Minor to major long-term benefits from treatment.
Species of Special Concern			
Sonoma alopecurus	No effect.	No effect from staging or access routes; Possible minor short-term impacts from sand drift.	No effect from staging or access routes; possible minor short-term adverse impact from sand drift.
Beach layia	Minor benefits relative to no management, but would continue minor to moderate adverse effects.	No effect from staging or access routes; Minor short-term adverse effects from treatment; major long-term benefits.	No effect from staging or access routes; minor short-term adverse effects from treatment; major long-term benefits.
Tidestrom's lupine	Minor benefits relative to no management, but would continue minor to moderate adverse effects.	No effect from staging or access routes; Minor short-term adverse effects from treatment; major long-term benefits	No effect from staging or access routes; minor short-term adverse effects from treatment; major long-term benefits.
Jeopardy under ESA	No jeopardy for any listed plant species at or near site.	No jeopardy for any listed plant species at or near site.	No jeopardy for any listed plant species at or near site.
Myrtle's silverspot butterfly	Negligible to minor short-term effects from treatment; minor long-term benefits relative to no management.	Moderate short-term impact from vehicles, access by heavy equipment. May adversely affect through inadvertent collisions, crushing larvae; Moderate short-term impacts possible from excavation, prescribed burning, herbicide use. Moderate or major long-term benefits.	Moderate short-term impact from vehicles, access by heavy equipment. May adversely affect through inadvertent collisions, crushing larvae; Moderate short-term impacts possible from excavation. Moderate or major long-term benefits.
Red-legged frog	No effect.	No effect from access or staging with mitigation. Negligible to minor short-term adverse impacts from prescribed fire, herbicide use.	No effect from access or staging with mitigation. Negligible or minor short-term adverse effect from noise possible.

	No Action	Alternative B	Alternative C
Western snowy plover	Negligible short-term adverse impacts from noise; minor long-term benefit from treatment relative to no management, but would continue moderate or major negative localized or regional effect.	Minor short-term adverse effects from heavy equipment driving along foredune in winter disturbing wintering population; Negligible to minor short-term impacts from fire, herbicide use. Moderate short-term adverse effects from presence, noise of excavators in foredune for wintering plovers. Moderate regional, major localized benefits in long-term.	Minor short-term adverse effects from heavy equipment driving along foredune in winter disturbing wintering population; Minor to moderate short-term effects to wintering plovers from noise, presence of excavators; Moderate regional, major localized benefits in long-term.
California brown pelican	Negligible or minor short-term impacts from noise.	No effect from access or staging; Minor to moderate disturbance from noise of excavation.	No effect from access or staging; Moderate short-term disturbance from noise of excavation.
California elegant tern	Negligible impacts from noise.	No effect from access or staging; Negligible adverse ST effects from noise	Same as alternative B.
Willow flycatcher	Negligible to minor short-term impacts from noise.	No effect from access or staging; Negligible adverse ST effects from noise	Same as alternative B.
No effect under ESA	Red-legged frogs, California elegant terns.	Red-legged frogs, California brown pelican, California elegant tern, willow flycatcher.	Same as alternative B.
May affect under ESA	Myrtle's silverspot butterfly; Western snowy plover; California brown pelican; willow flycatcher.	Western snowy plover; red-legged frog; brown pelican, elegant tern, willow flycatcher.	Western snowy plover; red-legged frog; brown pelican, elegant tern, willow flycatcher.
Likely to adversely affect under ESA	None	Myrtle's silverspot butterfly.	Myrtle's silverspot butterfly
Rare plants	Minor benefits relative to no treatment but would continue localized minor to major adverse impacts.	Minor to moderate short-term effect from crushing by heavy equipment, vehicles accessing site; Minor to moderate short-term adverse impacts possible from fire, herbicide drift. Long-term minor to major benefits.	Minor to moderate short-term effect from crushing by heavy equipment, vehicles accessing site; long-term minor to major benefits.

	No Action	Alternative B	Alternative C
Rare animals	Negligible to minor short-term adverse impacts from noise, crushing injuries.	Negligible to moderate adverse impacts from crushing by heavy equipment, noise associated with access; Minor to moderate short-term adverse effects, especially on sensitive or nesting birds, from noise, excavation.	Negligible to moderate adverse impacts from crushing by heavy equipment, noise associated with access; Negligible to moderate adverse effects, with greater intensity for sensitive or nesting birds than Alternative B.
Wildlife			
Mammals	Continued moderate adverse impact to most small mammals; predatory mammals similarly adverse affected; possible negligible to minor localized short term adverse effects from small-scale treatment.	Noise of vehicles and excavators would temporarily frighten wildlife; minor, short-term and localized; Minor to moderate adverse short-term impacts from burning to small mammals; minor short term adverse effect from noise of excavation, possible minor to moderate adverse effects on marine mammals from noise; Long term moderate benefits from restoring habitat.	Noise of vehicles and excavators would temporarily frighten wildlife; minor, short-term and localized; Moderate short-term adverse effects to small mammals possible from crushing; moderate adverse effects during and possibly following treatment to large mammals from noise; Long term moderate benefits from restoring habitat.
Birds	Minor to moderate adverse effects from loss of habitat; possible negligible to minor localized short-term adverse effects from small-scale treatment.	Minor, short-term localized impacts from noise of vehicles and equipment accessing site; Ingestion of prey contaminated by herbicide may have minor adverse effect. Possible moderate adverse short-term effect from noise to migrating birds; long-term moderate benefits from restoring habitat.	Minor, short-term localized impacts from noise of vehicles and equipment accessing site; Moderate 1-2 season adverse effects on birds, particularly migrating species and perhaps nesting birds as well; long-term moderate benefits from restoring habitat.
Amphibians and Reptiles	Possible negligible to minor localized short-term adverse effects from small-scale treatment.	Crushing of slower moving amphibians and reptiles during access may occur- minor, short-term and localized adverse effect; possible minor impact of noise and vibration from excavators; smoke and fire possible minor to moderate adverse impacts.	Crushing of slower moving amphibians and reptiles during access may occur- minor, short-term and localized adverse effect; possible minor impact of noise and vibration from excavators.

	No Action	Alternative B	Alternative C
Fish	No impact from *Ammophila*, small-scale treatment.	Possible minor short-term adverse effect from noise of excavation; possible moderate adverse effect from restoring natural sand movement.	Same as Alternative B
Invertebrates	Minor to moderate adverse impact from habitat loss would continue.	Minor short-term localized adverse impacts from crushing or habitat loss possible; Prescribed burning, herbicide use could kill some individuals; minor to moderate short-term adverse impact; possible moderate short-term effect from noise; long-term moderate benefits from restoring habitat.	Minor short-term localized adverse impacts from crushing or habitat loss possible; Moderate adverse impacts from crushing, noise and vibrations during excavation; long-term moderate benefits from restoring habitat.
Native species diversity	Lower than in areas where no *Ammophila*; a minor to moderate long-term adverse impact.	Possible long-term minor to moderate benefits from habitat improvement resulting from burns; long-term moderate benefits from restoring habitat.	Same as Alternative B.
Soils and Sand Movement			
Natural sand movement	Moderate to major long-term adverse effects would continue; treatment may have negligible to minor localized benefits.	Negligible to minor short-term adverse impacts from redistribution of stockpiled soil; long-term moderate to major benefit from increased sand movement.	Minor short and/or long-term adverse impacts from redistributed stockpiled soils; long-term moderate to major benefit from increased sand movement.
Soils	No impacts anticipated.	Negligible or minor localized short-term impacts from compaction, contamination from fuel leaks possible during access; Negligible to minor localized adverse and possible beneficial (nutrient increase) short-term impact from prescribed burning; minor short-term adverse effects from herbicide contamination possible.	Negligible or minor localized short-term impacts from compaction, contamination from fuel leaks possible during access.

	No Action	Alternative B	Alternative C
Water Resources			
Dune slacks and other wetlands	Negligible to moderate long-term benefits from artificially stabilized soils.	Negligible or minor adverse and beneficial short-term impacts from prescribed burning; herbicide use; exposure of stockpiled sand may have negligible adverse impacts on wetlands. Long-term minor to moderate adverse impacts from remobilized sand movement.	Minor adverse short-term impacts from exposure of stockpiled sand to wind and water erosion; Long-term minor to moderate adverse impact from remobilized sand movement.
Groundwater	No impact.	Negligible short-term adverse impacts possible from spills at staging site.	Same as alternative B.
Cultural Resources			
Archeological resources	Minor, localized effects from ground disturbance possible.	Preparation and use of staging areas may uncover resources; mitigation will keep impacts from this source to no more than minor; Use of excavators and hand tools to dig up *Ammophila* could have minor adverse effects assuming mitigation in place.	Preparation and use of staging areas may uncover resources; mitigation will keep impacts to from this source no more than minor; Minor adverse effects from excavation, digging assuming mitigation in place.
NHRP 106 finding	No adverse effect.	No adverse effect.	No adverse effect.

	No Action	Alternative B	Alternative C
Visitor Experience			
	Negligible to minor localized short-term adverse effects from noise, dust, odors from excavation during small-scale treatment.	Minor to moderate short-term localized adverse effect from visual intrusion of staging areas; minor, localized adverse effect possible from blowing sand, odors, and noise from excavators; negligible to minor short-term adverse effect from smoke and area-wide impact from noise (all-terrain vehicle [ATV]) during prescribed burn; minor short-term adverse impact from closures during and following herbicide application; Minor long-term benefit from returning natural conditions at site.	Minor to moderate short-term localized adverse effect from visual intrusion of staging areas; Minor to moderate short-term adverse effects from continuous work by excavators and associated noise, odors and blowing sand; Minor long-term benefit from returning natural conditions at site.
Neighboring Land Use			
Adjacent Wilderness	Small-scale treatment may have negligible to minor short-term adverse effects on wilderness character.	Smoke from prescribed burn, herbicide use and noise, visual appearance and odors from excavators would have negligible to minor adverse short-term impacts on character of adjacent wilderness.	Visual appearance, noise and odors from excavators would have negligible to moderate adverse short-term impacts on character of adjacent wilderness.
Adjacent ranching	No impact	Coordination with ranchers would keep impacts from access to no more than negligible and short term.	Same as alternative B

	No Action	Alternative B	Alternative C
Health and Safety			
Workers and staff	Negligible impacts from accidents possible from small-scale treatment.	Negligible short-term adverse effects possible from handling fuel, chemicals at staging area, driving heavy equipment to and from treatment site. Negligible to minor adverse impact to workers from excavation accidents possible; minor impact from use of fire; negligible to minor short-term adverse effects from irritants in herbicide possible.	Negligible short-term adverse effects possible from handling fuel, chemicals at staging area, driving heavy equipment to and from treatment site. Negligible to minor adverse impact to workers from excavation accidents possible.
Public	No impact.	No impact from excavation or burning (site would be closed during burn); no impact from direct herbicide spray; negligible short-term impacts possible from contact with sprayed vegetation.	No impact.

AFFECTED ENVIRONMENT

VEGETATION

Point Reyes National Seashore preserves some of the last remaining high quality coastal dune habitat in the United States. The coastal dunes at the project site provide habitat for federally listed plants as well as several rare or state-listed plants. These special status plant species inhabit some of the largest remaining expanses of two rare native plant communities at the project area-- native dunegrass and dune mat foredunes. Each is a unique habitat along the coast of the western United States from central California to Washington. Both communities have been reduced in size, structure, function and biodiversity through coastal development and the introduction of nonnative species. Relegated to small areas under conservation status, these communities have become a critical refuge for a variety of rare plant and animal species. Across Point Reyes National Seashore, dunes provide habitat for at least eight federally listed plant and animal species and several other species that are rare or otherwise of concern.

Native Vegetative Communities

Native dunegrass

This plant community is mostly restricted to the foredune area of a coastal dune system. Prior to development and the introduction of nonnative species, native dunegrass was common along the U.S. west coast from Monterey northward. Currently it can be found only at Point Reyes (near Abbotts Lagoon) and the Humboldt Bay dunes (Pickart and Sawyer 1998). This community is ranked by the Nature Conservancy as critically imperiled, which means five or fewer global occurrences of fewer than 2,000 acres remain. Vegetation in the native dunegrass community is sparse (25%-75% cover) and is dominated by American dunegrass (*Leymus mollis*). Other associated species include beach bursage (*Ambrosia chamissonis*), seashore bluegrass (*Poa douglasii*), beach morning glory (*Calystegia soldanella*), sand-verbena (*Abronia latifolia*), and beach evening primrose (*Camissonia cheiranthifolia*). At the site, small patches of native dunegrass are mixed into dune mat, described below.

Dune mat

Dune mat communities are comprised of mat-forming vegetation that is often variable and sparse. Species include beach bursage, dune sagebrush (*Artemesia pycnocephala*), dune buckwheat (*Eriogonum latifolium*), seashore bluegrass (*Poa douglasii*), sand-verbena (*Abronia latifolia*), beach pea (*Lathyrus littoralis*), beach strawberry (*Fragaria chiloensis*) and beach evening primrose (*Camissonia cheiranthifolia*). As with native dunegrass, this community is also restricted primarily to the foredune area. Dune mat habitat is considered rare, and has been severely impacted by European beachgrass (Pickart and Sawyer 1998). Many federal, state and locally listed species are restricted to dune mat communities, including the federally endangered beach layia (*Layia carnosa*) and Tidestrom's lupine (*Lupinus tidestromii*).

Native dune vegetative communities at the site exist both with and without Tidestrom's lupine or beach layia. About 100 non-contiguous acres of native dunes that are not infested with European beachgrass exist within the project site (see figure 8) (NPS 2005).

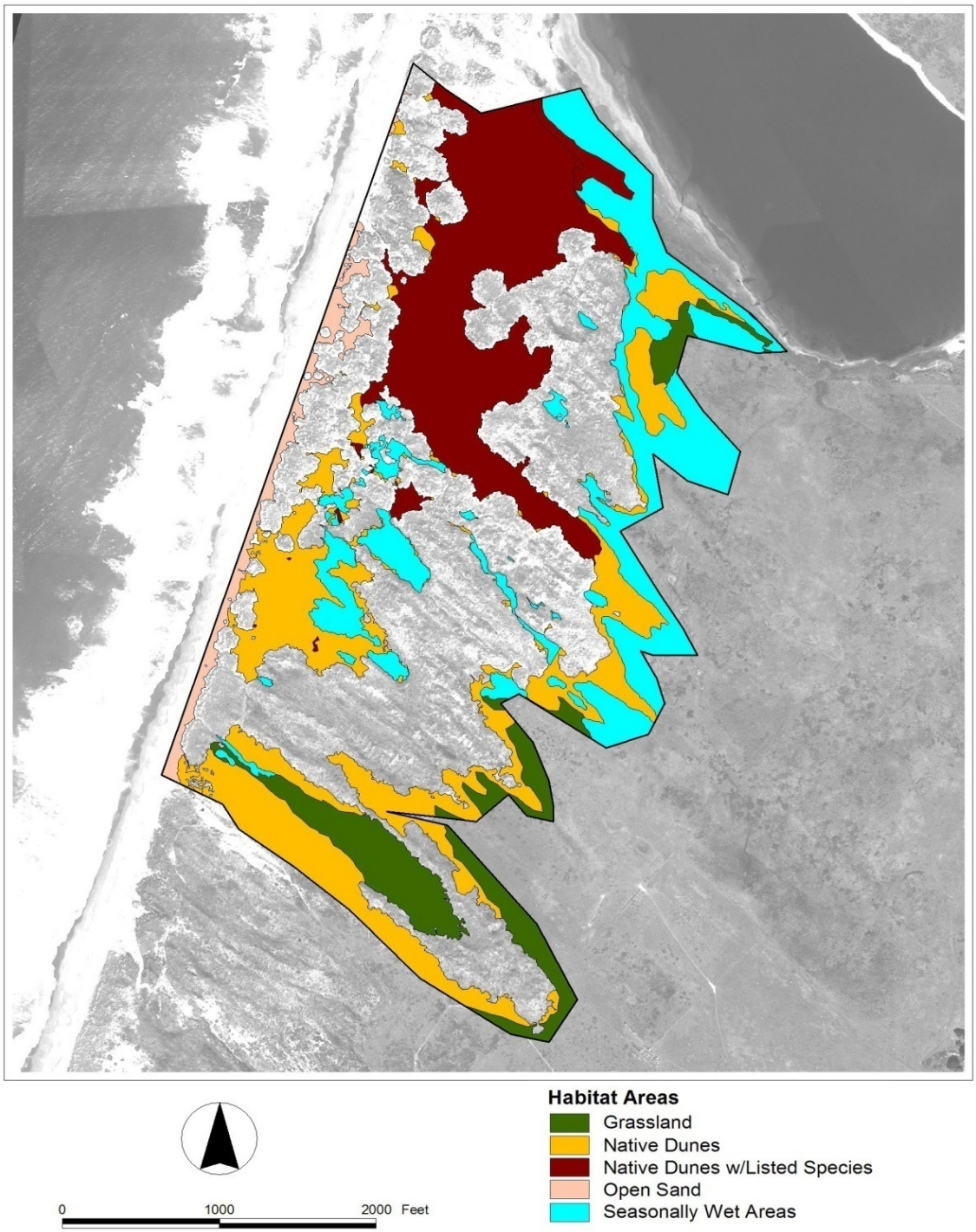

Figure 8. Native Vegetative Communities and Open Sand Areas at Project Site

Seasonally wet areas

In addition to rare foredune communities, the site has 41 acres of seasonally wet areas, also called coastal interdunal wetlands. Coastal interdunal wetlands are common

components of larger active and stabilized coastal dune fields, ranging from Coos Bay, Oregon, and south to San Luis Obispo County, California. They can be referred to as "slack dune ponds" when associated with larger and deeper water or "coastal dune swales" when water is shallow, and typically occur behind active foredunes, especially where the base of the dunes are at or near groundwater levels. They may result from active dune movement, either when dunes interrupt surface water flow, or where extensive dune "blowouts" remove sand down to the water table.

The vegetation at these sites typically falls into the sedge series. Slough sedge (*Carex obnupta*) and salt rush (*Juncus lescurii*) are the dominant species of the seasonally wet sedge series. Associated species include Pacific silverweed, springbank clover and California blackberry. Cover commonly approaches 100% (Pickart and Sawyer 1998).

At the treatment site, the dune slacks support wetland sedge meadows, which indicates perennial near-surface saturation or high moisture. The largest dune slack at the site is vegetated by an unusual association of species dominated by slough sedge (*Carex obnupta*) in association with marsh baccharis (*Baccharis douglasii*) and beach starwort (*Stellaria littoralis*). This assemblage grades into salt rush and a regionally rare dune sedge *Carex pansa*. The particular association is also unusual, and may be the only case in the central coast (Baye 2008). This large slack is also unique in that it includes thick peat soils and vegetation more typical for a freshwater fen (such as *Hypericum anagalloides*). The seaward edge of the slack grades to adjacent stabilized dunes, where vegetation indicates a more seasonal wetland covered by dense turf of *Carex pansa* and Pacific wildrye (*Leymus pacificus*).

Vegetation on the shore of Abbotts Lagoon (adjacent to the north end of the study area) includes wild heliotrope (*Heliotropium curassavicum*), salt grass (*Distichlis spicata*), New Zealand spinach (nonnative, *Tetragonia tragonioides*), marsh pennywort (*Hydrocotyle ranunculoides* and *H. verticillatum*), white smartweed (*Polygonum punctatum*), shoreline goosefoot (nonnative, *Chenopodium macrospermum* var. *halophilum*), three-square (*Schoenoplectus pungens*), nail-rod (*Eleocharis macrostachya*), water primrose (*Ludwigia peploides*), mudwort (*Limosella acaulis*), willow-leaved dock (*Rumex salicifolia crassus*), alkali-heath (*Frankenia salina*), Pacific silverweed (*Potentila anserina pacifica*), sand-lotus (*Lotus heermannii orbicularis*), wetland popcorn flower (*Plagiobothrys reticulatus rossianorum*), dune cryptantha (*Cryptantha leiocarpa*), lawn verbena (nonnative, *Phyla nodiflora*) and marsh cudweed (*Gnaphalium palustre*).

Grasslands

Twenty acres of coastal prairie and pasture grasslands fringe the reardunes of the project area. This vegetative community is common at the Seashore, and although pristine coastal prairie is dominated by perennial bunchgrasses, the majority of the grasslands in the Seashore are dominated by nonnative grasses. Pacific reedgrass (*Calamagrostis nutkaensis*) is the most common native grass in Seashore coastal prairie, along with tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*). Native grasses are often found in association with annual nonnative grasses, coyote brush, California blackberry and a variety of native and weedy herbs. Most common of the nonnative species is the invasive perennial purple velvet grass (*Holcus lanatus*), although annual Italian wild rye (*Lolium multiflorum*), farmer's foxtail (*Hordeum murinum*) and rattail fescue spp. (*Vulpia spp*.) also cover large acreage. Northern coastal grasslands are highly heterogeneous and species-rich, comprising numerous alliances and associations, and provide habitat for a wealth of animals and insects. In addition, populations of endangered plants, including Sonoma alopecurus (*Alopecurus aequalis var. sonomensis*) and Sonoma spineflower (*Chorizanthe valida*) grow in the grasslands and pastures east of the site.

Coastal scrub

Intermixed with grasslands and beachgrass in the reardunes are coastal scrub species. Coastal scrub is dominated by coyote brush (*Baccaris pilularis*), a small-leaved evergreen shrub. Coyote brush scrub is highly diverse and variable, ranging from fairly low open areas where coyote brush associates with grasses, to tall dense multi-species scrubs. In its more open variation, coyote brush commonly associates with nonnative and native grasses and California blackberry (*Rubus ursinus*). In its taller, denser variation, poison oak (*Toxicodendron diversilobum*) is the most commonly associating shrub, often in fairly high cover. Coffeeberry (*Rhamnus californica*), thimbleberry (*Rubus parviflorus*), California blackberry and California sagebrush (*Artemisia californica*) are common associates in dense coyote brush scrub.

Nonnative Vegetation

European beachgrass (*Ammophila arenaria*), native to Europe and North Africa, was introduced to California in the late 1800s (Bossard et al. 2000, Pickart and Sawyer 1998). The grass was primarily planted to stabilize blowing sand dunes. European beachgrass has spread to inhabit areas from Santa Barbara County, California in the south to Canada in the north (Pickart and Sawyer 1998). European beachgrass spreads vegetatively by rhizomes that can extend over 2 meters in six months (Bossard et al. 2000). Iceplant (*Carpobrotus edulis*), a native of South Africa, was introduced to California in the late 1800s (Pickart and Sawyer 1998) also to stabilize dunes. This succulent spreads both vegetatively and by seed and is now found growing along the entire coast of California (Bossard et al. 2000).

European beachgrass (or "*Ammophila*") is a perennial grass that grows primarily by way of rhizomes, underground horizontal stems that can send out roots and shoots to create and connect new plants. The plants also produce viable seeds, and seedlings have been found growing on the edge of dune hollows and on foredunes in California (Pickart and Sawyer 1998). *Ammophila* rhizome fragments are resistant to prolonged immersion in seawater and can travel and become established on coasts a long distance from where they were dispersed. Once established, European beachgrass develops vigorous vertical root and horizontal rhizome systems. Sand burial stimulates the production of vertical rhizomes and new shoots, which are the structures primarily responsible for the dune building and stabilizing ability of this species. *Ammophila* spreads both by steadily advancing in primary foredunes and by in-filling from dispersed populations on more inland dunes.

Iceplant is a common name describing both Hottentot fig (*Carpobrotus edulis*) and sea fig (*C. chilensis;* both formerly *Mesembryanthemum spp.).* These are perennial, mat-forming herbs with succulent, angled leaves. Hottentot fig was also widely planted in the United States beginning in the 1800s to stabilize dunes. It has also invaded a number of coastal plant communities throughout California. It can reproduce through seeds dispersed primarily by mammals including rabbits and deer, although clonal growth is its primary means of expansion once it is established. Clonal mats form on the seaward side of foredunes. Hybridization between *C. edulis* and *C. chilensis* has not only been documented,

but is believed to have occurred among most populations in California (Albert et al. 1997 in Pickart and Sawyer 1998).

C. edulis is from South Africa, but the origin of *C. chilensis* is debated. Although some researchers believe it is likely native to South Africa, evidence suggests that sea figs occurred in Monterey as early as the 1500s and likely were introduced in ships' ballast. Several authors now refer to the species as either native or naturalized.

The following subsections describe specific treatment areas at the project site (see figures 8 and 9):

European Beachgrass-dominated Foredune

These sites are identified by a steep foredune complex dominated by a high density of *Ammophila*. The foredune area extends approximately 50 meters inland from the beachfront and is classified separately because of the tendency to develop a much deeper and more dense root mass than in reardunes. About 12 acres of beachgrass-dominated foredune exist at the site.

European Beachgrass-dominated Dunes (>10% cover)

These sites are characterized by a high density of European beachgrass, but occur further inland than 50 meters from the beachfront. In some reardune areas, the vegetation cover includes a small percentage of native shrubs: coyotebrush (*Baccharis pilularis*), mock-heather (*Ericameria ericoides*) and yellow bush lupine (*Lupinus arboreus*). Nearly 108 acres of this vegetative association exists at the project site.

European Beachgrass/ Native Habitat Buffer

These sites are characterized by a low density of European beachgrass. They will require extra care during the restoration process because they either contain or are directly adjacent to known rare- or endangered-plant habitats, or they are adjacent to known wetlands. Native, rare or endangered plant species within these areas include: seaside daisy (*Erigeron glaucus*), beach layia (*Layia carnosa*), beach pea (*Lathyrus littoralis*), American dune-grass (*Leymus mollis*), and Tidestrom's lupine (*Lupinus tidestromii*). The areas adjacent to wetlands are mapped as a 2-meter buffer between dense European beachgrass areas and the sensitive wetland habitats to be preserved. About 7 acres of this vegetative association exists at the project site. Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*) occurs in wetlands near this habitat type.

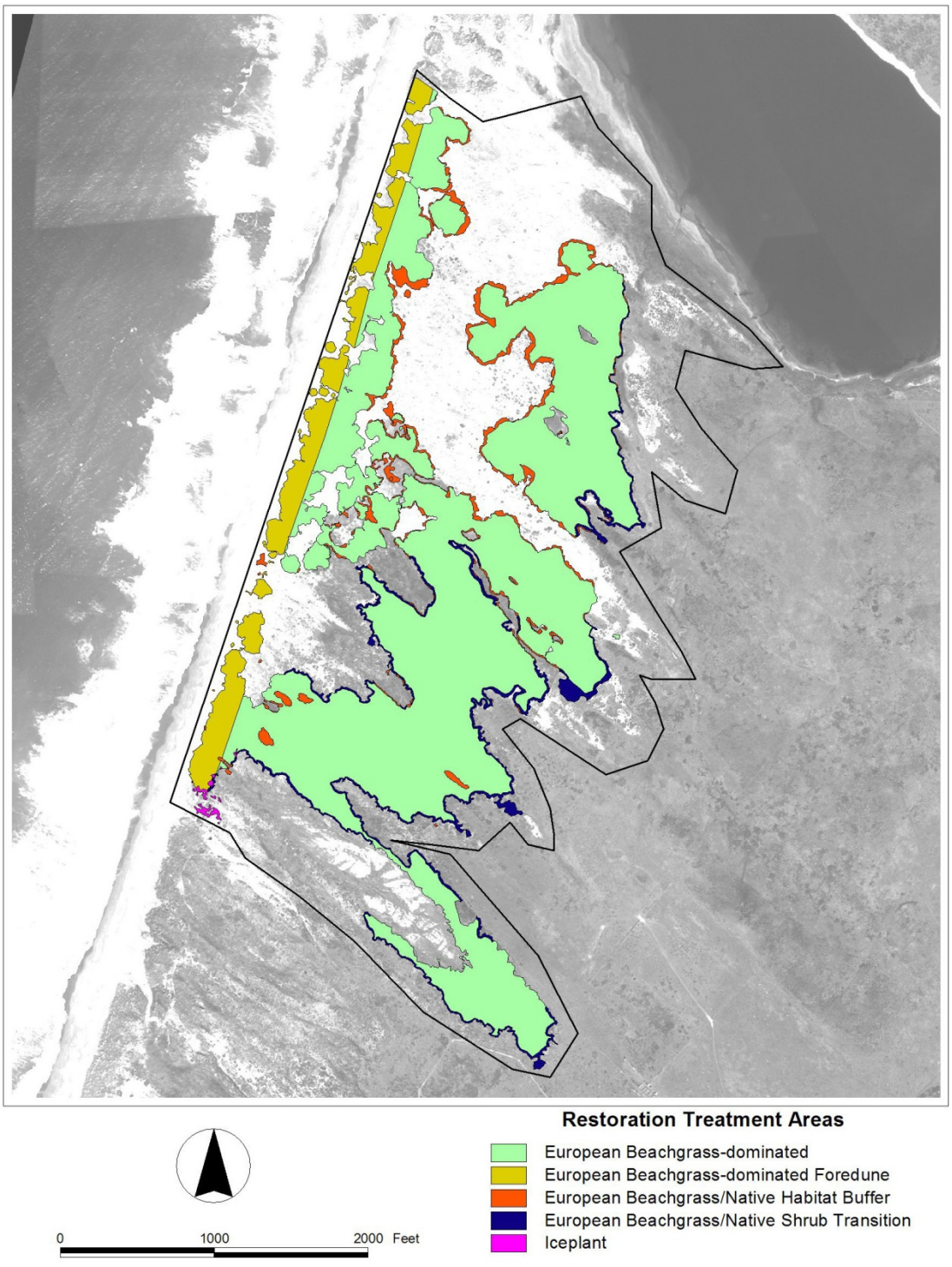

Figure 9. Nonnative Invasive Vegetative Communities at the Project Site

European Beachgrass/ Native Shrub Transition

These sites are mapped as a 3-meter buffer between dense European beachgrass areas and adjacent stands of native shrubs to be preserved. They are characterized as a transition zone where dense, monotypic stands of European beachgrass abut areas of dense native shrubs. European beachgrass within these sites typically consists of scattered individuals and clumps growing among native shrubs such as coyotebrush (*Baccharis pilularis*), mock-heather (*Ericameria ericoides*) and yellow bush lupine (*Lupinus arboreus*). European beachgrass removal methods in these areas must be precise to avoid disturbance to existing native shrubs. About 6 acres of this vegetative association exists at the project site.

Iceplant

Small isolated patches identified as distinct mats of iceplant occur on the site. These patches tend to include stands of American dune-grass (*Leymus mollis*), and restoration treatments would be conducted to avoid impacts to this native species. Less than one acre of iceplant exists at the site.

SPECIES OF SPECIAL CONCERN

Species of special concern include plants and animals on the list of threatened and endangered species at both the state and federal level and species that are not listed but are of concern to the state or park. Rare plant community associations are discussed in *Vegetation*. Table 3 below shows the listed species that are known to occur on or in the vicinity of the site.

Table 3. Species Listed on the Endangered Species List Known to Occur in or near the Project Area

Common Name	Scientific Name	Listing Status	Known To Occur Within Project Area	Known To Occur Adjacent To Project Area
Plants				
Beach layia	Layia carnosa	E	Yes	
Tidestrom's lupine	Lupinus tidestromii (var. layneae)	E	Yes	
Sonoma alopecurus	Alopecurus aequalis var. sonomensis	E	Yes	
Sonoma spineflower	Chorizanthe valida	E	No	Yes
Invertebrates				
Myrtle's silverspot butterfly	Speyeria zerene myrtleae	E	Yes	
Amphibians				

Common Name	Scientific Name	Listing Status	Known To Occur Within Project Area	Known To Occur Adjacent To Project Area
California red-legged frog	Rana aurora draytonii	T	No	Yes
Birds				
Western snowy plover	Charadrius alexandrinus nivosus	T	Yes	
California brown pelican	Pelecanus occidentalis californicus	E	No	Yes

E = federal endangered; T= federal threatened

Listed Plant Species

Layia carnosa (Beach layia) – Federal and state endangered

Beach layia is an annual, usually prostrate member of the Asteraceae family found in dune sites on the northern and central California coast from Humboldt to Santa Barbara counties (USFWS 1998). Fourteen colonies exist inside the park, including at the project site. Its habitat is the central foredune community characterized by some drifting sand and low growing herbaceous and perennial species. Generally it grows on sparsely vegetated open areas on semi-stabilized dunes. The cover of associated vegetation protects beach layia from sand dune movement and erosion. These associated species include coast buckwheat, beach peak, beach sagewort, dune bluegrass, dune goldenrod, sand verbena and beach-bur.

Beach layia germinates during the fall to mid-winter rainy season and blooms in the spring. Seeds are dispersed by wind in the late spring and summer. Beach layia can experience large fluctuations in plant numbers and local distribution associated with dune blowouts and restabilization. Such fluctuations have been observed in four of the five Point Reyes National Seashore occurrences for which counts have been made over multiple years. Twelve of the 14 occurrences in the park were considered to be threatened by the presence of the nonnative European beachgrass or iceplant nearby, as the monotypic stands of either virtually exclude less competitive native species. Nearly 50 acres of area containing individuals of this species have been mapped at the 300-acre treatment site.

Lupinus tidestromii (Tidestrom's lupine) – Federal and state endangered

Tidestrom's lupine is a creeping perennial herb and a member of the pea family. The flowers are blue to lavender and the fruits are pods containing 5-8 seeds. It is found on the Monterey Peninsula and in northwest Marin County to the Russian River in Sonoma County (7 Coastal Plants Recovery Plan). Tidestrom's lupine occurs on partially stabilized coastal dunes, in association with sand gilia, beach evening-primrose, beach-bur, beach sagewort and sand verbena.

Seven colonies grow at the park, and part of the largest colony at the park grows in the study site. At the 300-acre treatment site, 48.6 acres of area where individuals of Tidestrom's lupine grow have been mapped.

The seeds of Tidestrom's lupine are generally long lived, and degradation of the seed coat is needed for germination. However, scarifying by sandblasting from wind-blown sand is not effective. Rather, very slow microbial decomposition of the seed coat consistent with the more sheltered habitat of this species is likely to result in germination. Also, seeds are large and primarily fall in the vicinity of the plant base.

Six of the occurrences in the park are considered threatened by European beachgrass and ice plant.

Alopecurus aequalis var. sonomensis (Sonoma alopecurus) – Endangered

Sonoma alopecurus is a perennial grass 9-47 cm tall that has spike-like flowers. It is a variety of the species found in wet meadows and shorelines in California, the eastern U.S., and Eurasia. Because alopecurus is a clonal species, it is difficult to accurately estimate numbers of plants. The park counts individual flowers of known populations somewhat regularly, and has done so since 1983.

Of the five populations known on the Point Reyes peninsula, three (park populations 3, 4 and 5) occur in the vicinity of the study area. Even so, only a very small portion of the site has been found to contain Sonoma alopecurus, as mapping has indicated it occurs on about 0.4 acres. Individual plants also grow in permanently or seasonally flooded freshwater marshes within and adjacent to the study area, and careful hand removal around these individuals may be necessary to prevent damaging them.

Chorizanthe valida (Sonoma spineflower) – Endangered

Sonoma spineflower is a member of the Buckwheat family, and is an annual that grows 10-30 cm tall on sandy soils. It is thought to have originally been widespread in Marin and Sonoma counties, and was believed to be extinct as a result of agricultural and urban development. In 1976, the species was rediscovered in Point Reyes National Seashore south of Abbotts Lagoon in the same pasture on G Ranch in which Sonoma alopecurus is located. This population has been monitored by CNPS since 1983. These surveys provide only coarse estimates of plant numbers. Survey data show this population has ranged widely in size, from several hundred plants in 1983 to 30,000 plants in 1993 and 470,000 plants in 2005. Fluctuation in numbers may be related to sampling effort, detectability, and variations in area monitored.

One of the requirements for downlisting Sonoma spineflower is to establish and maintain two new populations (USFWS 1998). Between 1988 and 2002, the park planted seeds in

grazed pastures at Point Reyes National Seashore with mixed results. While some plantings have expanded, others eventually failed.

While Sonoma spineflower occurs near the project area, it is outside the footprint of project activities.

Listed Animal Species

Speyeria zerene myrtleae (Myrtle's Silverspot Butterfly) – Endangered

Myrtle's silverspot is a medium-sized butterfly with a wingspan averaging 2.1 - 2.3 inches. This species inhabits coastal dune, coastal prairie, and coastal scrub habitats at elevations ranging from sea level to 300 meters, and ranges as far inward as 5 kilometers (Launer et al. 1992 as cited in USFWS 1998). Adult butterflies prefer areas protected from onshore winds, but can be observed in exposed areas when winds are calm.

A critical factor in the distribution of Myrtle's silverspot larvae is the presence of the larval host plant, western dog violet (*Viola adunca*). It is possible that, like other subspecies of *Speyeria zerene* and other species of silverspots, Myrtle's silverspot use other violet species as larval hosts, although this has not been observed. Western dog violet is found on open grassy slopes, sandy flats behind dunes, and on the edge of brush under pines (Howell 1970 as cited in NPS 2008). While it is rather common near the coast, including the Point Reyes dunes, distribution of the species is patchy. At the site, dog violet may occur in the grasslands and along ranch roads or in areas where a secondary road may be needed. Abundance of western dog violet alone is not a good predictor of silverspot presence.

Those plant species that are known to be nectar sources for the Myrtle's silverspot and which have been found on the project site include: yellow sand verbena (*Abronia latifolia*), yarrow (*Achillea millefolium*), beach evening primrose (*Camissonia cheiranthifolia* ssp. *cheiranthifolia*), seaside daisy (*Erigeron glaucus*), Pacific gumplant (*Grindelia stricta*), and particularly curly-leaved monardella (*Monardella undulata*) (Adams 2004). The emergence of adult butterflies from the larval stage typically occurs from mid-June to mid-July. Although Myrtle's silverspot adults only live for about two to five weeks, because of individual variation in emergence time the species has a 2- to 3-month flight period, ranging from mid-June to early October with the bulk of flight taking place during the period from June 15 to August 31. Eggs are laid singly by the female on dog violet and within a few weeks of the eggs being laid, the larvae (caterpillars) emerge. These caterpillars crawl a short distance into the surrounding foliage or litter and spin a silk pad on which they spend the fall and winter. In the spring, it finds a nearby violet and begins feeding for 7-10 weeks, after which the larvae form pupae. The adult butterfly emerges from the pupa after about two weeks.

Speyeria butterflies experience large population fluctuations, and increases of tenfold or more in a single year have been observed. The population which exists in part on the study area is centered on North Beach and extends from Abbotts Lagoon to South Beach and east to Drakes Estero and Drakes Beach. Although this population was estimated to number in the low thousands in 1993, survey work in 1998 indicated it had dropped to 50-200 individuals, with no silverspots found in portions of the 1993 range. Very wet winters in both 1994/95 and 1997/98 may have been partially or wholly responsible for the low numbers. Surveys of both the North Beach and Tomales Point populations in the park in 2002 and 2003 indicated 534 and 558 individuals (USFWS 2008).

At the treatment site, it is believed that the silverspot butterfly resides in grassland habitats surrounding the project area during the larval stage (September through early June). Surveys conducted in 2003 revealed concentrations of butterflies within dune mat and dune shrub vegetation types in the project area.

Rana aurora draytonii (California Red-legged Frog) – Threatened

Point Reyes National Seashore supports one of the largest known populations of California red-legged frogs in the world. This frog frequents marshes, slow parts of streams, lakes, stock ponds, and other usually permanent waters. The frog is generally found near water but disperses during rain events and after breeding season to non-breeding habitat adjacent to water bodies. The non-breeding habitat is usually a moist area with some cover such as a willow or blackberry thicket. Breeding requires ponds that retain water at least 20" deep well into the summer, and occurs in numerous stockponds and other bodies of water in the park, including at Abbotts Lagoon in the study area.

Creation of stock ponds and other small impoundments on ranches over the past 100 years has likely resulted in increased numbers and an expansion in range for red-legged frogs in the Point Reyes National Seashore area. Frogs appear to move readily between these ponds during periods when the ground is moist, which are prolonged on the foggy Point Reyes National Seashore peninsula. Numerous wet swales, seasonal springs, and ephemeral pools provide dispersed travel and feeding habitats.

Surveys in the vicinity of the study area show they occur nearby but are limited in any habitat on the 300 acres designated for treatment. Rather, it is pasture and lagoon tributary habitat east and north of the study area where frogs have been observed. This may include a northern access area road, which is not slated for use in the alternatives but which may be an alternate in the event of an emergency or inability to access the site via southern roads. As noted in the discussion of actions common to alternatives, NPS staff and contractors would be trained to identify red-legged frogs, and if one is seen in the project area work would stop until the US Fish and Wildlife Service is able to move it from the area or the frog leaves of its own accord.

Charadrius alexandrinus nivosus (Western snowy plover) – Threatened

Western snowy plovers use the Point Reyes peninsula as both wintering and nesting habitat. In addition to the study site and further south along the Great Beach, wintering birds occur around Drakes Beach and Estero and along Limantour Spit. During the 1980s nesting took place along the entire Great Beach, Drakes Beach, and Limantour Spit. In recent years, erosion along the southern portion of the Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting still occurs on the northern portion of this beach, between the North Beach parking lot and Kehoe Beach, including the study area. Snowy plovers also nest along the western edge of Abbotts Lagoon. Between 2001 and 2005, all snowy plover nests observed were located on this northern portion of the Great Beach.

Snowy plover monitoring data between 1977 and 1996 showed a decline in the number of nesting birds. This was followed by a gradual rebound in recent years (table 4). In 1995, a program to increase snowy plover nesting success was initiated, and this program continues to the present. For example, Point Reyes National Seashore ropes off sensitive habitat and posts signs to divert visitor traffic. Visitors are advised to avoid walking on upper beach

areas used by plovers, and dogs are prohibited within the nesting area (500 feet south of Kehoe Beach and ¼ mile north of the North Beach Parking Lot) (NPS 2007). Despite this prohibition, illegal dog walking still takes place and observers found a higher rate of snowy plover chick loss in these areas on weekends, when disturbance by humans and dogs is more likely (NPS 2000).

Table 4. Western Snowy Plover Nesting at Point Reyes National Seashore

Year	Number of nests	Number of nesting birds	Number of chicks fledged	Percent chicks fledged per egg laid
1986	41	41-44	8	7
1987	75	50-54	15	7
1988	65	40-42	5	3
1989	61	34-37	1	1
1995	20	12	4	7
1996	9	10-11	15	56
1997	25	25	25	40
1998	14	16	23	55
1999	21	20	24	39
2000	28	31-37	14	17
2001	34	27-36	10	12
2002	30	34-37	17	22
2003	22	23-25	19	30
2004	37	34-36	19	18
2005	19	19-21	17	32
2006	24	30-32	23	33
2007	28	30-32	24	29

Starting in 1996, exclosures were placed over plover nests to reduce avian and mammalian predation. Since the use of exclosures in 1995, the rate of chicks fledged per egg has increased from between 1% and 7% before 1996 to 20%-58% (Ruhlen and Abbott 2000 as cited in NPS 2008), and between one and three chicks per female have fledged. In 2000, although egg laying remained high, fledging rate started to decline. Causes for the decline likely included predation by ravens, raptors, and disturbance by visitors.

Western snowy plovers breed primarily above the high tide line on coastal beaches, sand spits, dune-backed beaches, salt pond levees and river bars. In winter, they are found on many of the beaches used for nesting as well as on beaches where they do not nest, in man-made salt ponds, and on estuarine sand and mud flats. Roosting plovers usually site in small depressions in the sand, or in the lee of kelp, other debris or small dunes. When they are disturbed in winter, they typically run a few meters to a new location and may displace other birds. They tend to be social rather than territorial in the winter, and a flock may fly to a different location together when disturbed (USFWS 2007).

Snowy plovers forage on invertebrates in wet sand and surf-cast kelp within the intertidal zone, in dry sand areas above the high tide and along the edges of salt marshes and lagoons. They can probe sand for prey and pick insects of low-growing vegetation.

Pelecanus occidentalis californicus (California brown pelican) Endangered

The California brown pelican is one of six recognized subspecies of brown pelican.

The brown pelican is found in estuarine, marine subtidal, and marine pelagic waters along the California coast. This species is present in the summer, fall and winter on Abbotts Lagoon where it roosts, feeds and bathes, but is not likely to occupy any habitat on the project site itself.

Sternula antillarum (=***Sterna***, = ***albifrons***) ***browni*** (California least tern) Endangered

The California least tern has been sited on or near the area proposed for treatment, but is considered an extremely rare fall migrant. The least tern uses tidal flats like those on the southern end of the lowest lobe of Abbotts Lagoon (bordering the northern corner of the treatment area) for roosting and forages over open water.

Empidonax traillii (Willow flycatcher) - all subspecies state endangered; ***extimus*** subspecies also federal endangered.

This is a rare migrant to the area and is present primarily in August at or near the site. The willow flycatcher is an open brush, coastal scrub species that finds habitat at or near the coast. It rests in brush and forages over open areas.

Plant Species of Concern

Plants species that are not on the federal threatened and endangered species list, but are considered rare or are state or locally listed are also monitored in the park. Inventory and monitoring data is submitted to the CNDDB using the CNDDB data format.

In addition to the listed plants described above, eleven rare plant species are known to occur within the project area (table 5). Most individuals or patches of these plants at the site occur in native dune mat or dune grass habitat (see *Vegetation*).

Agrostis blasdalei (Blasdale's bent grass) is considered "fairly endangered" in California by the California Native Plant Society (CNPS) (CNPS 2008). It grows in several central and northern California coastal locations, with Point Reyes being near or at its Southern extension. It is a coastal bluff, dune or grassland species and blooms in late spring and early summer. A combination of agricultural, recreation and competition from nonnative plants has adversely affected this species, and fewer than 15 occurrences are known in the state (ibid.).

Gilia capitata spp. chamissonis (blue coast gilia) is considered seriously endangered in California by the CNPS, although the species does not have federal or state listing status. It found at several spots in and around Point Reyes, as well as other locations in Marin, San Francisco and Sonoma counties (CNPS 2008). It grows on coastal dunes and in coastal

scrub and is considered threatened by urbanization, recreational development and nonnative plants.

Table 5. Rare Plants Mapped at the Site

Species	Acres Mapped at Site	# polygons	# points[1]
Agrostis blasdalei	9.121	1	1
Gilia capitata ssp. chamissonis	2.753	1	2
Gilia millefoliata	2.756	2	0
Hesperevax sparsiflora var. brevifolia	2.691	1	1
Horkelia marinensis	1.099	1	0
Leptosiphon rosaceus	5.357	1	3
Monardella undulata	57.681	3	8
Perideridia gairdneri ssp. gairdneri	6.102	1	
Sidalcea calycosa ssp. rhizomata	n/a	0	1
Stellaria littoralis	n/a	0	2
Chorizanthe cuspidata	n/a	0	1

Gilia millefoliata (dark-eyed gilia or yarrowleaf gilia) is ranked as 1B.2 by the CNPS, which means it is “fairly endangered” in the state. It is one of a host of coastal dune plant species that has undergone significant declines in distribution and abundance within north-central and central coast dune systems (USFWS 1998). It occurs along the coast from San Francisco County north to the state line and is a coastal dune species. It is listed as endangered in Oregon, and is adversely affected by development, vehicles, foot traffic, grazing and nonnative plants (CNPS 2008).

[1] Point refers to the centroid of an occurrence and may represent a single or multiple individuals.

Hesperevax sparsiflora var. brevifolia (short-leaved evax) occurs from Santa Cruz County north to Del Norte County in coastal bluff scrub and coastal dune habitat. It is also considered "fairly endangered" in California by the CNPS, although it is more common elsewhere. Actions such as logging, development, foot traffic and competition with nonnative plants have contributed to its scarcity (CNPS 2008).

Horkelia marinensis (Point Reyes horkelia) is a perennial herb considered "fairly endangered" in California by CNPS. It occurs in Santa Cruz County north to Mendocino County in coastal dune, scrub and prairie and blooms from May to September. It is known from fewer than twenty occurrences and is affected by nonnative plants and residential development (CNPS 2008).

Leptosiphon rosaceus (rose leptosiphon) formerly known as *Linanthus rosaceus*, is an annual herb that grows in coastal bluff scrub in Marin and surrounding counties. Is it considered "seriously endangered" in California by CNPS and possibly threatened by competition with native and nonnative plants (CNPS 2008).

Monardella undulata (curly-leaved monardella) has both limited distribution and is considered fairly endangered in the state by CNPS (2008). It can occur in a variety of habitats, including coniferous forest, coastal dune, coastal prairie and coastal scrub. It is one of several species considered by the USFWS to have experienced "significant declines" and agencies are instructed to incorporate it into restoration and management plans (USFWS 1998). More than 57 acres of the site include this species.

Perideridia gairdneri spp. gairdneri (Gairdner's yampah) is a perennial herb that is considered "fairly endangered" in California by the CNPS. Occurrences have been found in several coastal and near coastal counties from San Diego to Del Norte County. It occupies chaparral and grassland habitat, including coastal prairie. It can be relatively common in some locales, although it is rarer in the southern portion of its range. Agriculture, grazing, urbanization, habitat alteration and nonnative plants threaten this species (CNPS 2008).

One or two individuals of *Sidalcea calycosa ssp. rhizomata*, *Stellaria littoralis* and *Chorizanthe cuspidate* also occur on the site. *Chorizanthe cuspidata* is a spineflower with only one point occurrence noted in the study area. It is one of several coastal dune plant species in north-central or central California dune systems that has undergone significant declines but is not listed (USFWS 1998). Like other Chorizanthe species, cuspidate occurs on sandy substrates. *Sidalcea calycosa ssp. rhizomata*, the Point Reyes checkerbloom, grows in freshwater swales near the coast and is threatened by nonnative plants. It is considered "fairly endangered" by the CNPS and occurs in Mendocino, Marin and Sonoma counties. *Stellaria littoralis*, the beach starwort, is also considered "fairly endangered" and is on the CNPS limited distribution watchlist. It ranges from San Francisco to Humboldt counties in California and is threatened by grazing, trampling and nonnative plants (CNPS 2008).

Animal Species of Concern

Animal species that are not listed, but are rare, sensitive or otherwise of concern that may be present at the site include mostly invertebrates and birds. The Point Reyes jumping mouse (*Zapus trinotatus orarius*) occurs in coastal meadow bordered by redwood, spruce or hemlock forests and may occupy habitat in the vicinity of Abbotts Lagoon. Bird species of concern are noted in table 6 below.

Several insects and other invertebrates are found in dune habitats in the area. Rare species include globos dune beetle (*Coelus glubosus*), sandy tiger beetles (*Cicindela hirticollis gravida*) and bumblebee scarab beetles (*Lichnanthe ursine*), as well as possibly the Point Reyes blue butterfly (*Icaricia icarioides parapheres*).

Coelus glubosus (globos dune beetle) is a primarily subterranean beetle that inhabits California's coastal dune systems. The adults, which lack functional wings, tunnel through the sand underneath dune vegetation, usually in foredunes within 100 feet of the wave wash zone. The dune beetles leave a distinct track on the beach that resembles a labyrinth.

Cicindela spp. (tiger beetles) are winged as adults and run and fly rapidly. They have distinct, sharp mandibles which they use to prey on other beetles, flies, caterpillars, ants, grasshopper nymphs, and spiders. Adults escape predation by other tiger beetles, birds, and small vertebrates by running, flying, the use of their sharp mandibles, and secreting a foul odor.

Lichnanthe ursine (bumblebee scarab). The life history of the bumblebee scarab beetle has been poorly documented. In general, adults are often brightly colored, bristly, diurnal, and strong fliers. Many resemble bumble bees or metallic bees due to colored bands on the abdomen, and have been observed visiting flowers. The larvae live in sandy areas such as riparian and coastal dunes, feeding on decaying leaf litter and detritus in the sand.

Icaricia icarioides parapheres (Point Reyes blue butterfly, subspecies *parapheres*) is found only on the Point Reyes Peninsula. Its habitat is stabilized sand dunes with *Lupinus arboreus* and *Lupinus variicolor*, the probable hostplants. The adult flight period is from mid-April to mid-July. Although they were not seen in a 1995 survey at Abbotts Lagoon, they have been reported there in the past.

Table 6. Rare Birds that have been Observed at or near the Treatment Site and that may be Affected by *Ammophila* Removal Activities

Common name	*Latin name*	Status	Occurrence at or near site	Habitat
American White Pelican	*Pelecanus erythrorhynchos*	BSSC	Uncommon but regular year round	Forage and rest on lagoon, tidal flat
Tule Greater White-fronted Goose	*Anser albifrons elgasi*	DFG:SSC	Rare; fall/winter	Lagoon (tidal) flat or on lagoon
White-tailed Kite	*Elanus leucurus*	DFG:FP	Uncommon; mid winter to mid summer; nest around lagoon in upper bay area	Roost, breed in shrubbery surrounding lagoon, open country; follow vole outbreaks
Merlin	*Falco columbarius*	DFG:WL; IUCN:LC	Uncommon; Oct-April	Roost, feed on small shorebirds on or near tidal flat
Ferruginous Hawk	*Buteo regalis*	DFG:WL	Uncommon; Oct-April	Roost; flush small mammals from shrubs at lagoon
Short-eared Owl	*Asio flammeus*	DFG:SSC	Uncommon, sporadic; possible nesters May to mid-June	Follow rodent outbreaks, forage in shrubs around lagoon; may nest
Northern Harrier	*Circus cyaneus*	DFG:SSC	Breeds late March to June	Ground nester in grasslands, swales, shrubs near or on site.
Burrowing Owl	*Athene cuniculata*	DFG:SSC	Uncommon, sporadic Sept-March	Roost and forage in dunes on insects

Common name	*Latin name*	Status	Occurrence at or near site	Habitat
Allen's hummingbird	*Selasphorus sasin*	IUCN:LC	Fairly common, spring nesting possible through June	Roost, nest in understory, shrubs, berry patches.
California Horned Lark	*Eremophila alpestris ctia*	DFG:WL; ICUN:LC	Uncommon migrant	Tidal flat, open ground
Saltmarsh Common yellowthroat	*Geothlypis sinuosa*	DFG:SSC	Fairly common; winter, possible nesting	Tidal flat, coastal strand
Black brant	*Brant bernicla*	DFG:SSC	Rare in winter; more common in spring migration	Roosts on, near lagoon
Elegant Tern	*Thalasseus elegans*	USFWS:BCC	Sporadic, may be common if anchovy run near site.	Roosts on tidal flats, forage over open water
Buff-breasted Sandpiper	*Tryngites subruficollis*	Local concern	Rare migrant in fall	Tidal flats
Pacific Golden Plover	*Pluvialis fulva*	Local concern	Rare migrant Aug to mid-Oct	Tidal flats
Marbled Godwit	*Limosa fedoa*	Local concern	Common in winter	Large numbers may roost on tidal flats at high tide
Western Sandpiper	*Calidris mauri*	Local concern	Migrant in fall	Tidal flats
Pectoral Sandpiper	*Calidris melanotos*	Local concern	Migrant in fall	Tidal flats
Baird's Sandpiper	*Calidris bairdii*	Local concern	Rare migrant in fall	Tidal flats
Peregrine falcon	*Falco peregrines anatum*	Federal delisted; State candidate for delisting	Nests at Kehoe and Pt. Reyes Headlands	Feeds on shorebirds and waterbirds

Sources: California Department of Fish and Game, Special Animals List (Feb 2008); pers comm. J. Evans, K. Peterlein. BSSC: Bird species of conservation concern (USFWS); SSC: California species of special concern; IUCN: World Conservation Union listed; FP: fully protected (Calif. Fish and Game)

Zapus trinotatus. (Point Reyes jumping mouse) is a state species of concern. It feeds on grasses and forbs and prefers moist meadow habitat near the coast usually bordered by forest. The isolated population at the park is a race of a more widely spread Pacific jumping mouse and is at the far southern end of its range. An individual mouse was found dead on Abbotts Lagoon Trail in the late 1990's; none have been seen since. (Allen 2008). The larger population extends north to southwest British Columbia.

WILDLIFE

No systematic inventory of wildlife at the site has been performed, although information on fish at Abbotts Lagoon, mammals and some lizards and snakes at a similar dune site south of the study area exists. Anecdotal observations of wildlife at or near the site or for similar sites were also used to compile this description.

Mammals at the site are likely to be somewhat similar to those reported by Fellers and Pratt (2002) for a similar dune site vegetated with nonnative iceplant south of the study area. Based on trapping of small mammals and photographs of mid and larger-sized mammals, the site is likely to have a few small mammal species including a low number of trowbridge shrews, western harvest mice and vagrant shrews. An earlier study of a site in the same vicinity as the study area (Pitts and Barbour 1979) and the 2002 study both found evidence of a high number of deer mice, including in areas vegetated with European beach grass.

Larger mammals that may inhabit the dunes, nearby dune slacks or the Abbotts Lagoon area include mule deer, striped skunk, bobcat, raccoon and black-tailed jackrabbit (Fellers and Pratt 2002; SFgate website). The lagoon may also harbor grey fox and badger (SFGate n.d.).

The Fellers and Pratt inventory indicated that the number of mammals in the dune plot was among the lowest of any habitat type in the park. The average number of mammals captured per trap check was 0.233 at the dune site, whereas parkwide it averaged 0.878. The total number of animals trapped or photographed at the dune site during the study period was 52, whereas it averaged 468 parkwide.

Bird species that have been observed in the vicinity include California quail, Northern harrier, blue herons, osprey, brown pelicans, white pelicans, red-winged blackbird and a variety of ducks, geese, grebes and other shore and waterbirds (SF Gate n.d.). Several sensitive or rare species of birds occupy habitat either on Abbotts Lagoon or in vegetation or on tidal flats along its shoreline. Most of these are fall and/or spring migrants, but some winter at the site or even nest in grasslands, riparian scrub and/or the dunes themselves. These are described in the *Animal Species of Concern* Section above.

The Fellers and Pratt inventory did find one reptile on the site they investigated, the alligator lizard, at very low densities. It is likely that garter snakes and frogs occupy wetter habitat on the site as well.

A 2001 published survey of fish in Abbotts Lagoon found 8 species, with Sacramento perch and Pacific herring the most often captured (gill nets). Sacramento perch was found most commonly near the shores of the lagoon, an area that would be more likely to experience any impact from the dune restoration alternatives than would deeper water sites. However, Pacific herring were more common in the lower lagoon than were Sacramento perch. Silver surfperch, longfin smelt and striped bass also were found in the lower lagoon. Other nearshore species include largemouth bass. Prickly sculpin and threespine stickleback were captured in minnow traps, with stickleback caught in larger numbers in the lower lagoon.

Several insects and other invertebrates are found in dune habitats in the area. In addition to the rare species identified above in the *Animal Species of Concern* section, San Francisco forktail damselflies, isopods, and other beetles and insects are likely to inhabit any perennial dune slacks or ponds or be nearby in and around Abbotts Lagoon.

SOILS AND SAND MOVEMENT

Coastal dune sands tend to be nutrient limited, especially for the essential nutrients nitrogen, phosphorus and potassium. Plants in these systems can obtain nitrogen from fog,

inputs of detritus and nitrogen fixing bacteria, as one study at Point Reyes has indicated (Pickart and Sawyer 1998). Dune slack soils have higher levels of nitrogen than beach sands. Phosphorus level in dune plants is enhanced by a symbiotic relationship with arbuscular mycorrhizal (AM) fungi near the roots. AM fungi have also been shown to be beneficial by promoting sand aggradation and improving nitrogen fixation in legumes (ibid.).

Natural dune morphology in California coastal areas includes foredunes, ridges and hollows in the reardunes and a deflation plain. The primary foredune is a ridge of sand that forms parallel with the coast above the mean high tide line. It is buffeted by onshore winds, and so is vegetated by plants that are tolerant of sand burial. Under normal circumstances (e.g., without invasion by nonnative species), the foredune is sparsely vegetated by native dune grass allowing periodic blowouts of sand. The wind pushes sand inland through the blowouts forming crests and valleys or U-shaped dunes perpendicular to the coast.

These longitudinal ridges and valleys behind the foredune are also sparsely vegetated, and move slowly inland by the forces of wind and slumping along the lee face as slopes exceed the angle of repose. The spaces between the ridges may be seasonally flooded by a rising water table, forming dune slacks or dune hollows. Wetland vegetation grows and stabilizes the dune hollows. The inland margins of dune hollows migrate southeast behind the trailing edge of moving sand. The ridges and troughs or series of U-shaped dunes are also referred to as the reardunes (or as the foredune "complex" in Pickart and Sawyer 1998).

Parabolic dunes are larger influxes of sand and sand movement that periodically occur. These can merge into a large sand plain or sand sheet, which can be nearly devoid of vegetation. As the sheet moves inland, a large "deflation plain" is left behind. Where sand is blown sufficiently to reveal the groundwater table in a deflation plain, wetlands form either seasonally or permanently.

European beachgrass has altered the natural morphology of dunes at the study site. The details of how it has been altered are discussed in the impacts of the No Action alternative, which examines the effects of continuing to leave dunes untreated. In brief, the primary foredune topography has changed to a steep continuous slope without blowouts, and the orientation of the ridges and troughs in the reardunes are parallel rather than perpendicular to the coast. This has prevented large-scale sand movement or fresh supplies of sand to the area inland of the primary foredune. In the study area and in many shorelines of northern California and Oregon, foredunes are stabilized and steeper because they are colonized and stabilized by European beachgrass.

WATER RESOURCES

In addition to the marine environment and dune slacks discussed above under *Vegetation*, the primary water resource at the study site is the lower lobe of Abbotts Lagoon. The northern border of the study site abuts the far southwest corner of this lobe of the lagoon (see figure 10). The lower lagoon is brackish, and is periodically open to the Pacific Ocean for short periods of time during high flow in the winter or early spring (Saiki and Martin 2001). As spring progresses into the dry summer and fall, water levels in the lagoon drop and beaches or other features on the shores of the lagoon submerged during the winter are exposed. Between winter and late summer, water levels can drop by as much as 4-6 meters and flow into the lower lagoon is either very low or stopped altogether. Low water conditions persist into the fall.

Most water quality variables are similar across the lagoon. Water temperature averages about 15-16º C, dissolved oxygen concentrations average 7.0-8.8 mg/L, pH averages 6.7-7.6 and turbidity averages 4.4 to 10.7 NTUs (nephelometric units) (Saiki and Martin 2001). However, salinity, water depth and total ammonia levels do vary from upper to lower lagoon. Salinity is much higher in the lower lagoon, in the neighborhood of 0.47 to 0.5%, where brackish is 0.05 to 3%, saline is 3-5% and fresh water is less than 0.05% salinity. In the upper and middle lagoons, it is 0.02 to 0.05%. Total ammonia is highest in the upper lagoon, but decreases to 0.06 to 0.09 mg/L in the lower lagoon. Water depth is greater in the lower lagoon, averaging 4-6 meters. A mixture of sand and silt predominates in the bottom substrates.

Dune hollows or dune slacks are additional water resources at the site. As noted in other sections, dune hollows form at the trailing edge of parabolic dunes as the capillary fringe of the groundwater table is exposed, and are primarily present on the site in the deflation (i.e., formed by active sand erosion) plain behind the primary foredune (Baye 2005). Dune slacks at the treatment site are shown on figure 8. The depth to groundwater and the movement of dunes to expose it varies seasonally and between years; however vegetation established in the wet periods can persist to a more limited extent in drier times to stabilize sand. These perennial wetlands tend to be long and narrow and aligned with the site's northwest winds. Dunes can also obstruct seasonal drainages and impound hillslope runoff in gulches and ravines forming ponds or wetlands.

The effect of European beachgrass at the site has very likely been to capture most of the fresh sand deposited in the primary foredune, amplifying the development of a wide dune deflation zone downwind with extensive sand-starved dune slacks. At Tomales dunes north of the site, a similar dune slack forms a continuous plain with little topographic relief, containing a mixture of native marsh and nonnative pasture grasses. In some years, ponds can be perennial and up to 1.5 meters deep when flooded, drawing down to groundwater seasonally in late summer (Baye and Wright 2004).

Water quality at dune slack sites would be similar or identical to groundwater quality. Although it has not been measured at the site, groundwater quality would likely be similar to that described above for upper Abbotts Lagoon for salinity and pH, with lower turbidity and total ammonium levels from the filtering action of the sandy subsoils and bedrock.

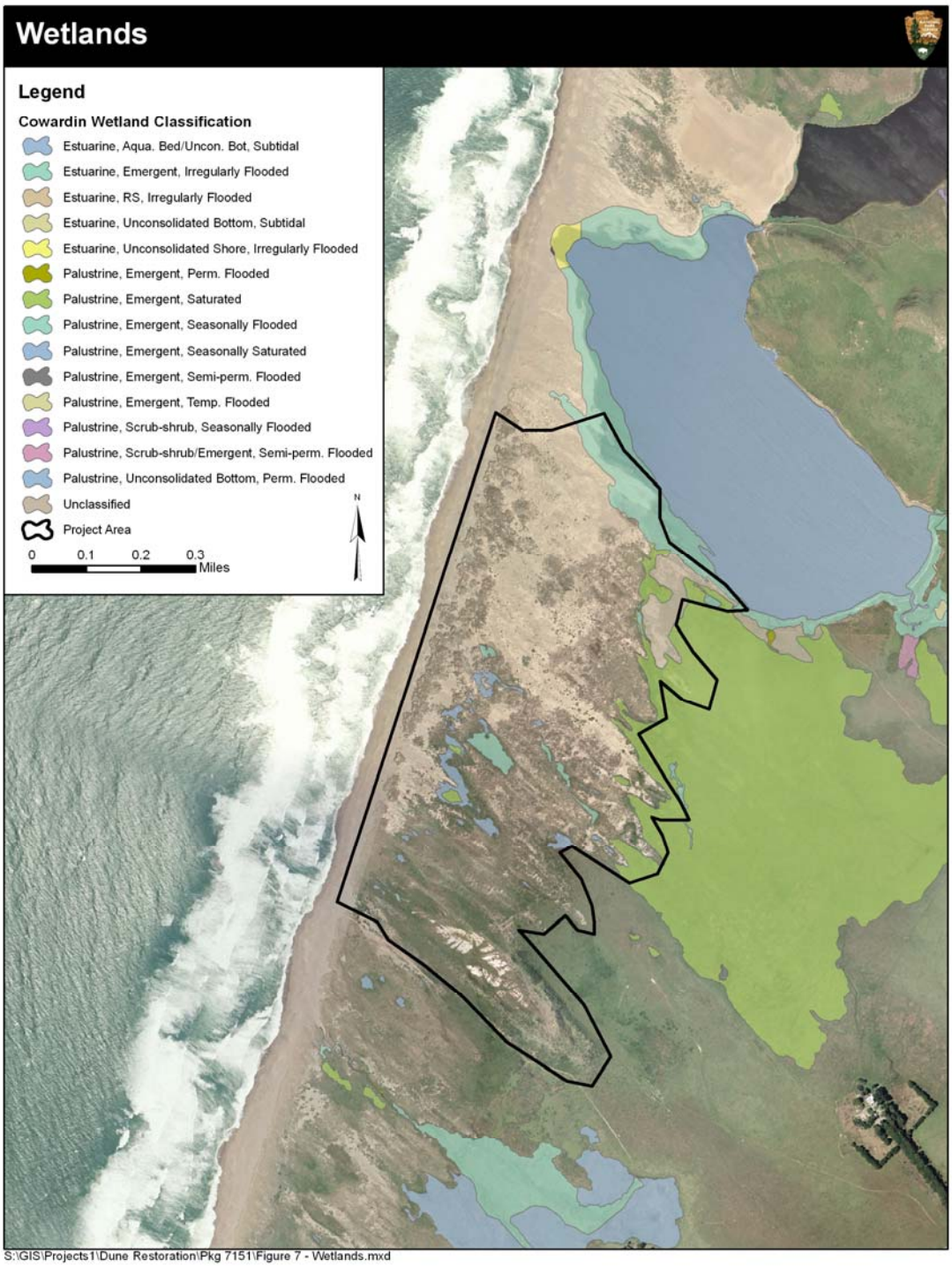

Figure 10. Study Site in Relation to Abbotts Lagoon

(Source: NPS unpublished information)

CULTURAL RESOURCES

Note: The majority of the information presented in this section has been compiled from Archaeological Survey and Geoarchaeological Trenching Results for Abbotts Lagoon Dune Restoration, Point Reyes National Seashore (Meyer and Dalldorf 2006).

The NPS manages the following cultural resources--archeological resources, historic and prehistoric structures, museum collections, cultural landscapes and ethnographic resources (NPS 1998). Dune restoration activities have the potential to affect prehistoric and historic archeological resources.

The project study area is referred to as the "Area of Potential Effect" (APE) for purposes of complying with the requirements of the National Historic Preservation Act (NHPA). The APE is the geographic area within which an agency's actions may alter the character or use of historic properties. The project APE is influenced by aeolian geomorphic processes which can result in buried archaeological resources related to migration and deposition of wind-blown dunes (figure 11).

Prehistoric Background

Early visitors to the Point Reyes peninsula recorded descriptions of Coastal Miwok culture. Much of what is known of the prehistoric use of the peninsula prior to that time is based on archaeological investigations conducted on several sites in 1940. These investigations revealed use of the area during the McClure, Mendoza, and Estero aspects, a range of from ca. 500 B.C. to the Historic period (ca. A.D. 1500). All sites were shell middens with later sites containing historic materials such as porcelain and iron spikes.

Other past investigations in the Abbotts Lagoon area resulted in descriptions of several sites containing areas of dark sand, obsidian artifacts, and projectile points. Most of these sites, including MRN-295 located in the general project area, can no longer be located and have possibly been buried by dune activity, damaged by road construction, or looted.

Historic Background

Historically, the Point Reyes peninsula is associated with the 16th-century voyages of Sir Francis Drake in 1579 and Sebastian Rodrigues Cermeño in 1595. Known outside contact with the Miwok was limited until the late 18th and early 19th centuries, with the founding of missions in San Francisco (1776), San Rafael (1817), and Sonoma (1823).

The advent of cattle grazing resulted in most of the native inhabitants leaving the area by the 1820s. Others remained as converts and supplied labor for the missions. In the 1830s, the peninsula was being divided into land grants and, around 1850, the cattle grazing pattern which continues today began. Many of the historic ranches are still being leased. The APE falls within the boundary of the ATT and Lunny Ranch parcels (also known as the G Ranch). No ranch structures are located within the APE.

Prior to 1875 and the construction of the railroad, transportation to the area was primarily by boat. Shipwrecks were always a risk with ocean transport. The project area is near the center of the Point Reyes peninsula's Pacific Ocean beach frontage. There have been numerous known shipwrecks in the vicinity and numerous wrecks of unknown location from which debris may have been scattered onto the beach and dunes. Due to prevailing currents, those wrecks north of the project are more likely to have debris within the project area.

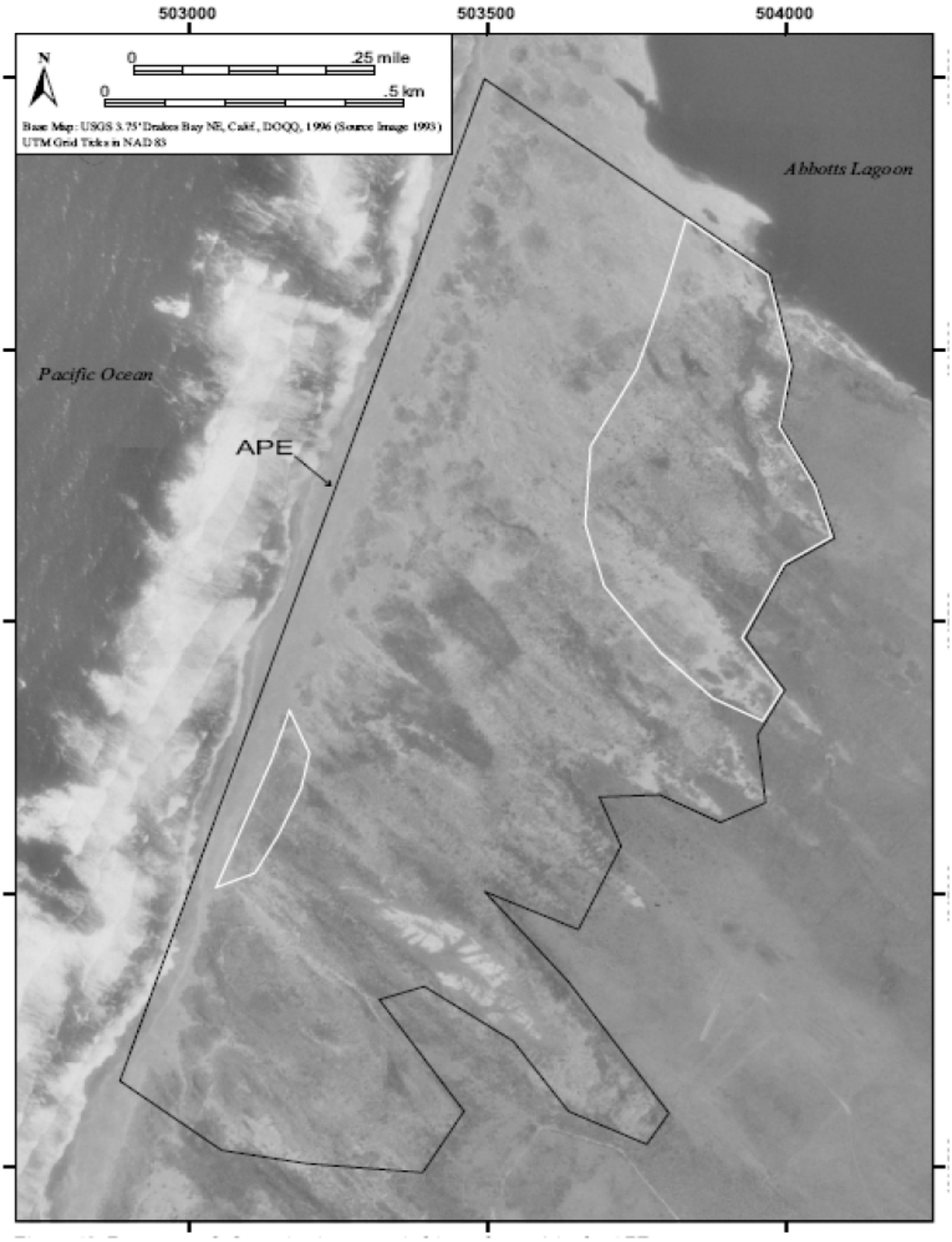

Figure 11. Area of Potential Effect (black line) with Areas Recommended for Monitoring during Excavation Indicated (white lines)

There are nine known shipwrecks dating prior to 1940 between the mouth of Tomales Bay and Abbotts Lagoon and an additional 20 shipwrecks of unknown location along the Point Reyes peninsula that may have contributed flotsam that washed up on the beach within the project area. The nature of this material's deposition makes its location within the dunes difficult to predict.

A large timber presumably from a shipwreck was found during prior dune-restoration efforts within the Seashore. The timber likely belonged to a ship that was constructed either on the East Coast or in Europe during the mid-19th century. Several associated bottles date from approximately 1933.

Cultural resources investigations in the general study area in 2006 indicated that there was the potential for historical, prehistoric, maritime and geoarcheological resources. These investigations included an intensive surface survey as well as geoarcheological (backhoe trenches) investigations.

No prehistoric cultural materials were identified by the pedestrian surface survey. Although some early- to mid-20th century refuse was identified, most of these materials were located in open dunes, not within areas of proposed restoration and excavation. A large scatter of historic debris (milled lumber, wire nails, bottle fragments, a cartridge casing, etc.) located in the general project area may have been associated with a shack or other shelter. It was not recorded as a cultural resource site. A large iron ship's line chock covered in beach grass was also found in the general project area.

Geoarchaeological field investigations (subsurface exploration trenches) within the APE were performed in 2005. A sequence of aeolian deposits spanning from the late Pleistocene to the historic period was identified. Though no archeological soils were located, two deposits of buried soils dating to the late Holocene were identified. These soils could potentially contain archeological deposits. In addition, the dynamic nature of the dune field could have also redeposited archeological materials within the upper dune sands. Consequently, it has been recommended that these buried soils areas be monitored during dune restoration activities (excavations, earth moving).

VISITOR EXPERIENCE

The current visitor experience in the area is generally remote and quiet. A single public trail leads to the beaches north of the project site and Abbotts Lagoon. This two-mile trail, Abbotts Lagoon Trail, begins off of Pierce Point Road from the Abbotts Trailhead Parking Lot. The trail passes the fresh water upper and lower brackish lobes of the lagoon, as well as pastures and dunes. Trail use is highest on weekends and holidays, with weekdays relegated to joggers, bird watchers, walkers, etc. Bikes and dogs are not allowed.

The entire stretch of beach associated with this project is open to visitors for recreating. Activities include hiking, beachcombing, swimming, horse-back riding, and fishing. Hiking and outdoor activity websites for Bay Area sites variously describe the area as "a day of discovery," "a unique blend of coastal prairie, ponds and lagoon," "a spot of breathtaking views where ocean currents and wind are fierce," and "an area of raw beauty" (Get Outside; Bay Area Hiker websites).

Noise-free Intervals (NFI) are currently high along the Great Beach of Point Reyes National Seashore, particularly in the vicinity of Abbotts Lagoon. NFI is defined as noise generated from an anthropogenic source. The only routine anthropogenic noise in this area comes from both high and low altitude aircraft and U.S. Coast Guard helicopters; however, ocean waves typically mask out this sound and provide for extended periods of NFI. Sound within and adjacent to the project area are typically associated with wave action, birdlife, cattle, weather, and to a much lesser extent visitors.

NEIGHBORING LAND USE

Adjacent to the site are lands zoned as wilderness and lands used for cattle ranching. Figures 12 and 13 show that the sites northern boundary comes very close to the wilderness boundary; however the study site was left out of wilderness designation, at least in part because ranches and former private property (owned by AT&T) occupied land in the vicinity. Now the Evans (former AT&T) and Lunny permitted ranching operations do overlap the eastern portion of the site. As noted in the Alternatives description, part of the former AT&T land would be used for access and staging. Most of the treatment area of the site is fenced so that cattle cannot access it; however, ranching vehicles do use the roads leading to the staging area.

HEALTH AND SAFETY

Currently, there are no health and safety concerns at the project site. However, small-scale restoration projects in the vicinity of Abbotts Lagoon (to the north of the project site) have involved the use of heavy equipment—a potential safety issues for workers and visitors. The use of heavy equipment, prescribed fire and herbicides under the action alternatives all have the potential to result in health and safety effects, primarily to workers.

Figure 12. Wilderness Boundary in Vicinity of Treatment Site

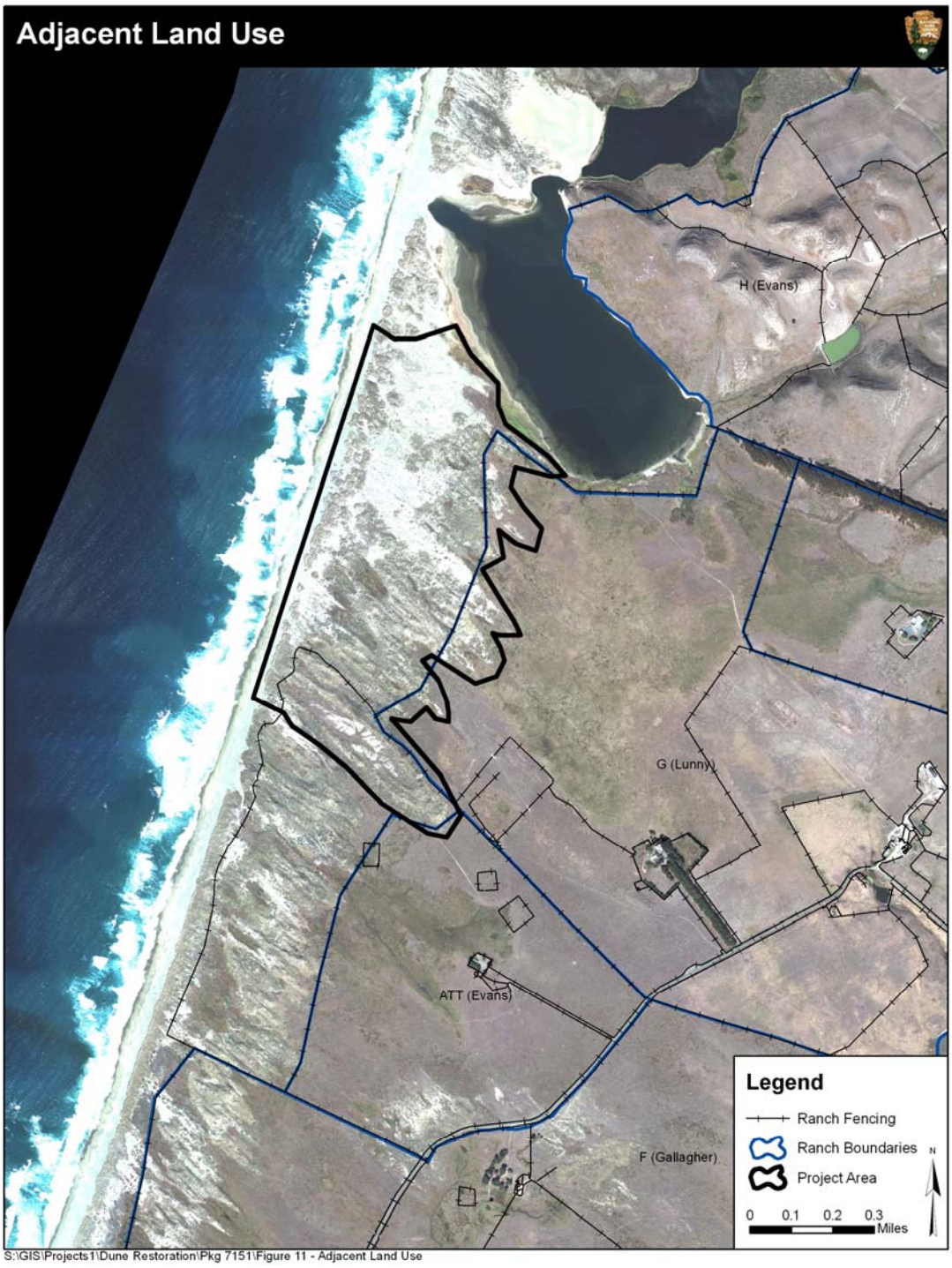

Figure 13. Adjacent Land Use Showing Project Area and Ranching Boundaries

ENVIRONMENTAL CONSEQUENCES

REGULATIONS, POLICIES AND METHODOLOGIES

The analysis of each resource is preceded by a short discussion of relevant laws, regulations and policies, a description of methods and sources, and definitions of context, intensity and duration if they differ from the standard definitions below. Cumulative impacts are also analyzed, and this is followed by a summary conclusion.

Generally, impacts of the action alternatives are analyzed *relative* to continuing existing management—that is they are compared to the impacts of No Action. It is the *incremental* change in the condition of a resource that would likely occur if an alternative is implemented that is reported in the impact analysis section.

Standard definitions of context, intensity, duration and type of impact, which are used unless a more specific or different definition is indicated, are:

Context describes the geographic setting within which an impact is analyzed. A localized impact is one that occurs on the 300-acre treatment site or in its immediate vicinity. An area-wide impact could take place both on the treatment site and in the area of Abbotts Lagoon south to the former ATT site and east to the general area of the trailhead to the lagoon. A regional impact is one that takes place over a wider area than this.

Duration is a measure of the time period over which the effects of an impact persist. The duration of the impacts evaluated in this EA is defined as short-term or long-term. Generally, short-term impacts occur during the time treatment takes place. These are also called direct impacts. Long-term impacts occur several weeks to years beyond the treatment period.

Intensity is a measure of the severity of an impact. The intensity of an impact may be negligible, minor, moderate, or major. Negligible impacts are those that are just at the level of detection or are assumed to occur despite being undetectable with current technology. Minor impacts are detectable but the resource is easily able to recover (assuming they are adverse impacts) or benefits are relatively unimportant to the resource (if impacts are beneficial). Moderate impacts are detectable and the resource may experience a noticeable change, either in a positive (beneficial impact) or negative (adverse impact) direction. Without mitigation or interference, moderate adverse impacts may become major over time. Major impacts are obvious, and may be extensive and/or long-lasting although this is not always the case. Further detail on how each of these thresholds is defined for specific resources is included as needed before the resources are analyzed in this chapter.

Cumulative Impacts

CEQ regulations implementing NEPA defines a cumulative impact as "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (CEQ Section 1508.7). In other words, cumulative impacts are the impacts of actions independent of those in this proposal. They are impacts that are already occurring or expected to occur in the reasonable future on the same resources as would be affected by the proposed dune restoration.

Impairment of Park Resources

In addition to the requirements of NEPA, the National Park Service uses its environmental impact statements and environmental assessments as a base to determine whether a proposed action may violate the precepts of the Organic Act as amended. Any action that may "impair" park resources or values is not allowed under this Act.

An impairment is "an impact that … in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2006a sec. 1.4.5). In general, an impact is more likely to constitute an impairment if it affects a resource or value whose conservation is necessary to specific purposes identified in the legislation or proclamation that created the park unit; one that is essential to the park's natural or cultural integrity, or to the public's opportunities to enjoy a park; or one that is specifically identified as a goal in the park's General Management Plan or other relevant NPS planning documents.

Park resources and values include natural and cultural resources as well as physical or ecological processes. Visitor experience, economics, land use, park operations, etc. are not park resources or park values which necessitate impairment findings.

VEGETATION

Policies and Regulations

NPS *Management Policies 2006* regarding the eradication of nonnative plant species and the restoration of native plant and animal species to return the dune ecosystem to a more natural state are part of the motivation for taking action as noted in chapter one of this environmental assessment (in the section *Other federal laws, regulations, policies and plans*). Because they are fully discussed as part of that chapter, they are summarized here: if exotic species can be eliminated and control is "prudent and feasible" the NPS is required to manage up to the level of eradication if the exotic species interferes with natural processes or native species (sections 4.1.5, 4.4.4.2). In addition, the NPS is required to maintain all plants (and animals) native to park ecosystems by preserving habitat, restoring populations and minimizing human impacts (sec. 4.4.1).

Wetlands are addressed separately from other vegetation types in this vegetation impact analysis as they are protected by a specific set of laws and regulations. Section 4.6.5 of the NPS *Management Policies 2006* addresses the management of wetlands on NPS lands and requires parks to prevent the destruction, loss or degradation of this unique vegetative community (NPS 2006a). NPS also supports a policy of no net loss of wetlands, a goal outlined by the White House Office on Environmental Policy in 1993 and Executive Order 11990. The NPS generally requires mitigation for any projects that may impact > 0.25 acres of "natural" wetlands except for those related to recreational facilities (e.g., overlooks, bike/foot trails, and signs) and minor stream crossings that completely span channel and wetlands (i.e., no pilings, fill, or other support structures).

Assessment Methodology

Vegetative communities in the treatment area have been mapped and are noted in figures 3, 8 and 9. The assessment of impacts of treatment assumed the mandatory mitigation described in the *Alternatives* section of this EA and projected the effect treatment with different methods might have on neighboring native vegetation when they methods were applied to *Ammophila*. The analysis is qualitative in nature.

Context and Duration

Short-term: Short-term impacts are those that last one or two growing seasons.

Long-term: impacts would extend beyond two growing seasons.

Impact Thresholds

Negligible: There would be no measurable or perceptible adverse or beneficial changes in the geographic extent of any native vegetative plant community, its continuity, integrity or species richness. No detectable changes to sensitive plant communities (including wetlands) would occur and no individuals of any rare or unique plant species would be disturbed. Key environmental conditions influencing plant communities (such as soils and water quality) would not be affected.

Minor*:* Measurable adverse or beneficial changes in the geographic extent of a native vegetative plant community, its continuity, integrity or species richness may occur, but its viability would be unaffected. Slight changes to sensitive plant communities (including wetlands) may occur, with one or a few individuals of rare or unique plant species more or less growing in the treatment area. Changes in environmental conditions influencing plant communities (such as soils and water quality) would be at the lower levels of detection. The potential for beneficial or adverse changes in the abundance of nonnative species would be detectable but minimal.

Moderate: Noticeable adverse or beneficial changes in the geographic extent of a native vegetative plant community, its continuity, integrity or species richness may occur, but if changes are adverse, the viability of the community would remain. Moderate beneficial changes may make a small or degraded population noticeably more likely to be viable. Detectable changes to sensitive plant communities (including wetlands) may occur, with some individuals of rare or unique plant species either disturbed or the community experiencing a noticeable increase in number of individuals of these species. Changes in environmental conditions influencing plant communities (such as soils and water quality) would be measurable. The potential for changes in the abundance of nonnative species would be noticeable.

Major: Substantial changes in the geographic extent of a native vegetative plant community, its continuity, integrity or species richness may occur. Although the communities would remain viable regionally, small populations may be eradicated if the impact is adverse. Beneficial impacts to the community may include making small populations viable or improving the viability of the area-wide or regional population. Noticeable changes to sensitive plant communities (including wetlands) may occur, with small populations of rare or unique plant species disturbed or conditions dramatically improved. Changes in environmental conditions influencing plant communities (such as soils and water quality) would be obvious. The potential for changes in the abundance of nonnative species would be substantial.

Impact of No Action

Analysis

Under the No Action alternative, the 300 acre project site would largely be left untreated, although some very small-scale treatment may take place as funding is available like it has north of Abbotts Lagoon in the past few years. Although these small-scale removals would chip away at *Ammophila* at the site, European beachgrass would also spread in sections where the site is untreated.

Ammophila dominated dunes tend to be both densely populated and have high percent ground cover. At one beach in Northern California (Lanphere-Christensen Dune Preserve in Humboldt County) *Ammophila* increased in cover nearly 600% and bare sand reduced by the same amount over a four year period. Near the study site north of Abbotts Lagoon, pre-treatment sites had cover approaching 100% (Peterson et al. 2003). This is in contrast to native dunegrass (dominated by *Leymus mollis*, American dunegrass) communities where cover is sparse. At the park, for example, examination of sites north of Abbotts Lagoon found that those with native vegetation averaged 76% open sand.

Where native dunegrass is sparse and dispersed, *Ammophila* is a tussock forming species. Both native dunegrass and European beachgrass spread primarily by rhizomes from an original parent plant. The rhizomes travel both horizontally and vertically as stems or tillers. However, particularly under low soil nitrogen conditions such as exist in a dune environment; the two species employ different and telling strategies. *Ammophila* puts its effort into aboveground biomass (2-3 times that of native dunegrass) in the form of buds and vertical rhizomes (Pavlik 1983), whereas native dunegrass extends its horizontal rhizomes, “searching” for pockets of nitrogen rich soil. The bulk of buds on *Ammophila* rhizomes are located near the parent plant and primarily sprout into vertical stems or tillers, creating the tussock appearance. This allows it to photosynthesize and produce additional biomass more effectively, and the creation of additional buds gives it a reproductive advantage. Following an initial juvenile phase where it produces above-ground shoots and buds, *Ammophila* begins to spread extensively. This high density of above-ground foliage is effective in covering bare ground and squeezing out other species, giving rise to the monoculture or near monoculture typical of the primary foredune at the Point Reyes treatment site.

Ammophila also appears to outcompete native dunegrass by using water and nitrogen more efficiently, and by being able to tolerate and even thrive when buried by sand. Barbour (1977 as cited in The Nature Conservancy n.d.) found that *Ammophila* had twice the root density as Leymus at every depth measured up to 5 meters. Leaves of *Ammophila* tend to inroll during dry periods. Each of these differences gives *Ammophila* an advantage in both using existing moisture and in surviving drought conditions typical of the summer and fall at the treatment site. While *Leymus* can withstand some sand burial, *Ammophila* is able to survive and thrive much more, up to one meter per year (Pickart and Sawyer 1998). In fact, active sand movement stimulates the production of new shoots from vertical rhizomes, helping *Ammophila* to quickly colonize the foredune where wind and sand movement is highest. The spread of *Ammophila* along the foredune is characterized as a “steady advance” in “continuous wave fronts” (ibid.).

In addition to colonizing the primary foredune with rhizomatic expansion, *Ammophila* also grows from seeds in more inland dunes. These populations tend to be more dispersed, shallow-rooted and fill in more slowly in this sub-optimal habitat (Pickart and Sawyer 1998). *Ammophila* is often mixed with dune scrub or coyote brush in reardunes at the 300-acre treatment site.

Ammophila can aggressively colonize bare sand and outcompete native dunegrass, but also can displace or depress native species in dune mat vegetation. Studies of beaches along the Pacific coast both with and without *Ammophila* found that there was an overall negative correlation between beachgrass and diversity of native species (Barbour et al, 1976 as cited in Pickart and Sawyer 1998). Parker (1974 as cited in Pickart and Sawyer 1998) and LaBanca (1993 as cited in Pickart and Sawyer 1998) found that *Ammophila* and lupine associations had displaced a pre-existing native vegetative dune community 20 years after it had been found. In areas dominated by *Ammophila*, fewer native plant species are found and overall species richness is lower (Boyd 1988 as cited in Ngo n.d.) A study at Point Reyes National Seashore in 1992 (Boyd as cited by Pickart and Sawyer 1998) found that

Ammophila was negatively associated with *Leymus mollis* (American dunegrass), *Poa douglasii* (seashore bluegrass) and *Abronia latifolia* (yellow sand-verbena). Two other species, *Ambrosia chamissonis* (beach bursage) and *Agroseris apargiodes* were neither positively nor negatively affected. These studies indicate that *Ammophila* eliminates or depresses some native species, but not others.

The treatment site still contains acreage of both native dunegrass and dune mat vegetation that has either not yet been invaded by *Ammophila* or has only a few clumps or individuals of this species. Seasonally and permanently wet areas and patches of native grassland also exist on the site. *Ammophila* is capable of expanding into all of these sites, and in particular the dunegrass and dune mat communities (dunegrass is considered a subset of dune mat) in the foredune. *Ammophila* also grows readily on moist soils at the edge of dune hollows (Pickart and Sawyer 1998). It is likely that European beachgrass would eventually eliminate dune mat at the site, a moderate to major site specific and minor regional impact.

Continued loss of seasonally wet vegetation would also be an adverse impact, although currently this vegetative community is not experiencing more than minor invasion by *Ammophila*. Impacts to grasslands would likely be adverse, but minor since this is less than ideal habitat for *Ammophila*.

While iceplant is not as widespread at the site as *Ammophila*, it does have the ability to form dense mats that exclude all other species. *Carpobrotus edulis* is invasive in dunes, coastal scrub and to a lesser extent in grassland. Dunes are particularly easy for iceplant to invade. When it is in place, *C. edulis* changes soil characteristics by reducing pH and influencing soil dynamics (D'Antonio 1990 as cited in Pickart and Sawyer 1998). It also strips water from adjacent shrubs and other native vegetation; its removal has been shown to increase the growth of native species in coastal scrub. Although *C. chilensis* is not an invasive species, hybridization with *C. edulis* does appear to produce an invasive population (Pickart and Sawyer 1998). Iceplant occupies about one acre of foredune at the site, and left alone it would likely continue to expand into adjacent native dunegrass and dune mat communities, with negligible to minor adverse impacts.

Cumulative Impacts

Ammophila has had a "devastating impact" on dune resources of the west coast including displacement of entire native plant communities (Pickart 1997). It was deliberately planted in some parts of the coast beginning in the early 1900's, but rhizome fragments washed along the shore and sprouted on beaches further north resulting in extensive stands from Vandenberg Air Force Base in San Luis Obispo county north through Washington state (The Nature Conservancy n.d.). In Oregon, there were no foredunes along the coast prior to the introduction of European beachgrass, but since its introduction in 1910, *Ammophila* has created a foredune and colonized portions of the deflation plains and hummock dunes inland from the beachfront (Crook 1979 as cited in The Nature Conservancy n.d.).

As noted above, *Ammophila* can outcompete native dunegrass and eliminate or depress native species in dune mat or other vegetative communities. A sampling of 34 beaches along the entire Pacific Coast found that the presence of *Ammophila* was negatively correlated with species diversity as well as uniformity of abundance and cover of native species (Barbour et al 1976 as cited in Pickart and Sawyer 1998). The authors found that this one species exerted more "floristic control" in defining species present and absent at a site than any others. Iceplant has also formed dense monospecific mats and eliminated native plants where it grows.

Ammophila has also been credited with altering the foredune topography in northern California and Oregon. It has increased the steepness and vegetated what was formerly a

sparsely vegetated area of the dune system, decreasing the width of the open beach and slowing sand movement inland.

The changes *Ammophila* and iceplant have exerted on native dune vegetation and dune system dynamics are in addition to loss from development and disturbance from human recreation. In the long-term, rising sea levels associated with global climate change will contribute cumulative impacts by further reducing the size of the open beach. The National Park Service has not planted any iceplant or *Ammophila* in its units but has instead conducted small restoration efforts such as manual removal iceplant or smaller-scale excavation. Despite this slight offsetting beneficial impact, native dune vegetation has experienced major adverse cumulative effects from these sources along the Pacific coast.

Conclusion

The No Action alternative would likely allow continued expansion of nonnative invasive dune vegetation, and in particular *Ammophila*. Continued loss of dune mat and seasonally wet vegetation would be a moderate adverse impact. Impacts to grasslands would likely be adverse, but minor since this is less than ideal habitat for *Ammophila*. Impacts from leaving iceplant untreated would likely be negligible to minor and adverse. In combination with the coastwide impacts of development, human recreation, global climate change and spread and invasion by *Ammophila*, the cumulative impacts of leaving the site untreated would be major and adverse. Impacts to dune vegetation at the site would not constitute an impairment of park resources.

Impact of Alternative B

Analysis

Impacts of Staging and Access

The NDOC facility would be the primary point of access for the project, with the AT&T site an additional access point for the southern portions of the treatment area. The primary access road intersects the project boundary along its southeastern edge. At this intersection, a parking and staging area would be developed. It would be fenced and vehicles, fuel and materials would be stored here. Additional parking and storage, as well as jobsite trailers and offices would be located at the NDOC facility. The heavy equipment would likely be driven along the foredunes to the beach and foredune areas of the project site to minimize impact. The reardunes would be accessed by the two north/south secondary access routes further inland. A third access route connects the intersection of the primary road and project boundary to the beach.

The secondary routes would be unimproved, and selected to avoid existing dune mat and wetland vegetation and concentrate traffic in areas with high beachgrass cover. Routes would be surveyed and any sensitive or unique plants flagged. If contact is unavoidable, these native plants would be removed and relocated if possible before the routes are traveled by heavy equipment. Upon completion of the project, the routes would be reclaimed.

These staging and access management measures would help avoid any more than minor short-term impacts to native vegetation. Impacts that do occur are more likely to be to grasslands or coastal scrub, as care would be taken to avoid dune hollows, wetlands or sensitive dune mat communities. The parking and staging area would remove up to about ¼ acre of vegetation, a minor adverse impact also likely to be true in coastal scrub or grasslands.

Impacts of Treatment Methods

Alternative B would use a variety of methods to treat *Ammophila*, including deep digging and burial of vegetation in the foredune and prescribed burns and herbicide application in the reardunes. Approximately 27 acres would be treated with heavy equipment and 93 acres with the burn/herbicide combination (see figure 6). An additional 13 acres would be treated with manual removal vegetation to create buffers around wetlands to minimize impacts from spraying, burning or excavating. Vegetation would be burned in the late summer, following seed set for native species, using drip torches or ATVs to light *Ammophila* infested vegetation.

The vegetation in the area where prescribed burning would take place includes beachgrass intermixed with coastal scrub and grassland. Coastal scrub is somewhat fire-adapted; many of the dominant species have the ability to resprout following fire. In the absence of disturbance, such as from fire or grazing, grasslands may be converted to coastal scrub.

Coyote brush, the dominant species in coastal scrub, is moderately fire tolerant and regenerates primarily through basal sprouting following fire. In coastal scrub, fire creates canopy gaps with exposed mineral soil that allow coyote brush and other coastal scrub species (most of which also have small, light seeds) to establish from seed and outcompete other herbaceous vegetation. In grasslands, low fire frequency permits establishment of coyote brush and the gradual exclusion of herbaceous species, and prescribed burning has been used in grasslands to reduce invasion of coyote brush and other shrubs. In coastal scrub, decreasing fire frequency can allow coyote brush to be replaced by more shade-tolerant species.

Burning *Ammophila*-mixed scrub and grasslands with low-intensity prescribed fires would likely have relative beneficial impacts for both these vegetative communities as it would invigorate coastal scrub and coyote brush, and would help keep grasslands from converting to coastal scrub. These benefits would be minor and short term.

Burning would generally not take place in wetlands where native vegetation is intact or in dune mat habitat. A fire line adjacent to *Ammophila* would minimize burning of wetlands, although it is possible that fringes may be burned. If so, mitigation in the form of improved habitat for nearby wetlands would take place. The size of the fire line needed would be determined in a burn plan before the fire is set.

Fire would also cause a flush of growth in *Ammophila*, although this benefit would be short-lived due to herbicide application in the following growing season. The likely choice of herbicide used by the park would be glyphosate at a 7-8% solution applied with the use of calibrated backpack sprayers. Glyphosate is made by a number of different manufacturers; for example there are currently 35 commercial formulations of glyphosate registered for forestry applications (USDA Forest Service 2003). The exact product the park would use is not yet known, but is likely to be Rodeo® or some similar formulation with the lowest possible toxicity that is still effective. Roundup® is another familiar formulation of glyphosate which contains a toxic surfactant (chemical to help in the absorption of glyphosate). For purposes of analysis, it was assumed Rodeo, a formulation of glyphosate that does not include a surfactant, would be sprayed at a rate of 2 pounds of acid equivalents (a.e.) per acre. This translates to a higher concentration (10-12%) glyphosate more typical of weed removal activities conducted by the U.S. Forest Service, and estimates of impact in this assessment are therefore likely to be conservative.

The herbicide glyphosate is a broad-spectrum product that would be as lethal to neighboring native species as to *Ammophila*. The chances of overspray reaching nearby vegetation would be minimized through the use of backpack sprayers and calibrated nozzles; in addition, glyphosate is a minimally volatile chemical and shielding could be used for

additional protection from drift. To further minimize the chance of inadvertent contamination by drift, it would be applied only when wind speed is below 10-12 m.p.h.

In addition to drift, non-target vegetation could be affected through percolation or runoff offsite or by wind erosion of soil. Inadvertent direct spraying of neighboring vegetation may also occur; this would be lethal to most vegetation. A comprehensive assessment of risks of glyphosate for forestry use (including spraying of invasive weeds) applied the AGDRIFT model developed by the EPA to determine risks to neighboring vegetation of applying glyphosate using a low boom ground sprayer. Assuming a wind velocity of no more than 5 miles per hour and wind direction perpendicular to the line of application, droplets of spray typical in size emitted from the boom sprayer could drift as far as 23 feet. They could drift twice as far with winds at 10 miles per hour. No more than 0.58% (e.g., 0.0058) of the application rate would be expected to drift 100 meters offsite during low boom ground applications. The lowest concentration where no observed effect on plants has been measured (NOEC) is 0.035 lb a.e./acre, although other studies have put this value as high as 0.56 lb a.e./acre. If glyphosate is sprayed at a concentration of 2 lb a.e./acre, concentrations would be 0.012 lb a.e./acre 100 meters from the application point if a low boom ground sprayer is used. The model results do not include the amount of drift expected from a backpack sprayer, but say only that it would be lower than from a low boom ground sprayer. However, the model results indicated that even spraying a more concentrated level of glyphosate (7 lb a.e./acre) using a ground sprayer would result in measurable effects on most non-target plants from drift only as far as 25 feet (USDA Forest Service 2003).

Given that backpack sprayers and a lower concentration of glyphosate would be applied at the dune site, measurable effects on non-target vegetation further than a few feet are unlikely. Nonetheless, mitigation measures include a 25-foot buffer from sensitive vegetation, such as listed species, wetlands and dune mat where *Ammophila* would be removed by hand instead of spraying. In addition, spraying when winds are relatively calm, use of a shield where feasible, wicking directly onto Ammophila leaves and using dye to ensure the least possible glyphosate is used (e.g., to prevent reapplication and monitor drift) would be employed to reduce this impact even further. With this mitigation in place, no more than negligible or minor site specific impacts to non-target plant species from drift are generally expected. Where native plants (e.g. unlisted, non-wetland species) are so intermixed with *Ammophila* as to prevent the use of manual removal, some individuals may be killed by herbicide drift applied in close proximity, a minor to moderate site specific impact.

Glyphosate can also be transported to off-site soil by runoff or through percolation. Because percolation of herbicide would primarily affect *Ammophila* by seeping into the soil around the targeted plant, it is less of a concern for neighboring vegetation than runoff. Although runoff may be negligible in arid environments or the dry season, it may reach up to 45% of the applied amount contaminating off-site soils and vegetation at high rainfall rates (ibid.). Glyphosate would be sprayed until target vegetation is wet (avoiding excessive spraying to the point of dripping) and spray periods would be timed to avoid precipitation for a minimum of 24 hours. Because glyphosate would be applied in late spring or summer, rainfall is not likely for several months following application at the treatment site. Therefore the adverse impact of runoff on native vegetation would probably be negligible, although it could be minor in intensity and site specific if rain does fall out of season.

The amount of glyphosate that might be transported in soil by wind erosion to neighboring vegetation depends on several factors, including wind speed, soil type and rainfall. The USDA Forest Service (2003) examination of the impacts of glyphosate envisioned what could be considered typical conditions at the treatment site for its reasonable worst case scenario. That is, a sandy surface with high wind speeds and arid conditions. Under those conditions 0.54% of the applied glyphosate would be lost due to wind erosion. This is nearly

identical to the estimate of off-site contamination from overspray about 100 feet from the application, and adverse impacts to native coastal scrub and grassland vegetation from wind erosion are similarly likely to be no more than minor and short term.

The impacts from drift, runoff and wind erosion to wetland vegetation could be more severe if the park uses a formulation of glyphosate that includes surfactants known to be harmful to some sensitive aquatic life (such as Roundup®). However, it is much more likely that the park would use the less harmful Rodeo® formulation and add a surfactant known to be relatively nontoxic to aquatic animal life. No information on the impact of these surfactants to aquatic plant life is available, but similar to its relatively non-toxic effect on aquatic animal life are assumed to be less harmful to aquatic plants than those added to Roundup®.

In evaluating the impact of glyphosate itself (e.g., not the surfactant) to aquatic life, the USDA Forest Service (2003) evaluated a worst case scenario involving a spill of 200 gallons of herbicide into a small (1/4 acre, 1 meter deep) pond. They found that the concentration of glyphosate would initially be about 18 mg/L in the pond, and in the long term would drop to between 0.0001 and 0.008 mg/L with an average of 0.001 mg/L. The calculated "NOEC" or concentration where no observed effects have been noted for pond macrophytes (duckweed) is 3 mg/L (USDA Forest Service 2003). This is considered about the same as what it would be for algae. At lower concentrations, on the order of 0.002 mg/L to 0.3 mg/L, stimulation of algal growth is a common response to glyphosate. Because the park would not store pesticides at the site and would ensure storage areas away from the site are bermed, plastic-lined and away from water, the worst case scenario calculated in the USDA Forest Service document would not occur. Droplets from the backpack sprayers could be carried 45 feet away if winds are at 10 mph and could conceivably contaminate nearby wetlands or dune hollows. The concentrations would not be high enough to exceed the minimum for observable effects on macrophytic vegetation, but may stimulate algal production in some small wetlands for a season. This is an unlikely but possible site specific, adverse minor to moderate impact on aquatic vegetation.

Short-term adverse impacts to native dune mat and dunegrass vegetation from excavation of *Ammophila* from the foredunes are also possible. This is particularly true if stands of *Ammophila* are close to native vegetative communities, or where some of each are interspersed. However, hand removal of *Ammophila* would occur where intermixing of the communities does not allow mechanical equipment to operate without more than incidental impacts on native foredune vegetative communities. Occasionally, native plants would be so heavily intermixed with *Ammophila* that manual removal is infeasible and some individuals would be lost to treatment. Overall, impacts to these communities from excavation would not be more than minor and would be short-term.

Long-term Impacts of Treatment

The park has used trenching shovels and hand shovels, as well as mechanical equipment to remove beachgrass on small sites. They have not yet used prescribed fire or herbicides to control *Ammophila*. However, the California Department of Parks and Recreation used prescribed burning and herbicides for initial control, and three herbicide treatments (one initial and two follow-up treatments of resprouts) in 2000 and 2001 at Sunset State Beach near Santa Cruz. The combination of these techniques achieved 100% control (Hyland and Holloran 2005). Native annual plant species readily invaded the treated area. However, nonnative *Cakile maritime* also expanded, and short-term adverse impacts to two native species (*Baccharis pilularis* and *Ericameria ericoides*) from the combination of prescribed fire and spray from herbicide treatment occurred. At the site, there are numerous large populations of yellow-bush lupine (*Lupinus aboreus*) on sandy marine terraces adjacent to the treatment area. Although this is a native species, it is invasive and may colonize

portions of the site following removal of *Ammophila*. If so, other native species would be prevented from establishing; other lupines including the endangered tidestrom's lupine may be at risk (Baye 2008).

Adverse impacts to wetlands or other vegetation from destabilizing sand now held in place by *Ammophila* are also possible. Increases in sand movement are likely to result in the complete or partial fill of some wetland features, although returning natural processes would also result in the creating of additional dune slacks at the site. The acreage of wetlands lost is expected to be about one acre; this is predicted based on the release of sand in the immediate vicinity of wetlands in the treated area. The park would mitigate this potential impact by expanding wetlands on a nearby marine terrace south of the site and would monitor the treatment area to determine whether any additional wetland impacts may occur. The impact to wetland vegetation overall from restoration is likely to be beneficial as a result, although it could be minor or moderate and adverse on the wetlands that exist at the site now.

The park has monitored, summarized and reported long-term benefits to native vegetative and animal communities for 30 of the 50 acres treated to date in its study "Coastal Dune Restoration" (Peterson et al. 2003). The park found that mechanical removal was most successful along the top of the foredune, and in 2002 experimented with deeper burial (to one meter). Burying to 10 inches using shovels or a small bulldozer resulted in more resprouts than burying to one meter, and although it was initially more difficult and time consuming has been selected as a preferred approach because of this decrease in follow-up effort.

In examining the impacts on native vegetation, the study found that the extent of cover by native species expanded from 1.2% to 2.2% in 2003, an 83% increase. The diversity of native species in the monitoring plots also grew by 30-50%, from 9 in 2001 to 14 in 2002 and 12 in 2003. Table 7 shows the species found in 2001 before treatment and 2 years following initial treatment in 2003.

Dune habitat in the control plots showed that treatment had dramatically decreased the density of vegetation and increased the amount of open sand. Prior to the removal of European beachgrass (year 0 on figure 13 below), dunes were heavily covered with vegetation, predominantly *Ammophila*. Even a single year after treatment, dunes averaged 90% open sand and less than 10% vegetation, indicative of a much more natural condition for this vegetative community. These three factors, an increase in open sand habitat, an increase in native species diversity, and an increase in cover by native species continued to improve and/or maintain a natural state through 2008 (7 years after restoration began).

Table 7. Native Species Found on 30 Treated Acres of *Ammophila* Infested Dunes on Point Reyes National Seashore North Beach before (2001) and after (2003) Treatment

	2001	2003
Ambrosia chamissonis (silvery beachweed)	√	√
Artemisia pycnocephala (coastal sagewort)	√	√
Atriplex leucophylla (beach saltbush)		√
Baccharis pilularis (coyote bush)	√	√
Camissonia cheiranthifolia (beach primrose)	√	√
Erigeron glaucus (seaside daisy)	√	√
Gnaphalium luteo-album (weedy cudweed)	√	√

Gnaphalium ramosissimum (pink everlasting)	√	
Layia carnosa (beach layia)		√
Lathyrus littoralis (beach pea)		√
Leymus mollis (American dunegrass)		√
Lupinus tidestromii (Tidestrom's lupine)	√	√
Poa douglasii (sand dune bluegrass)	√	√

Source: Peterson et al. 2003

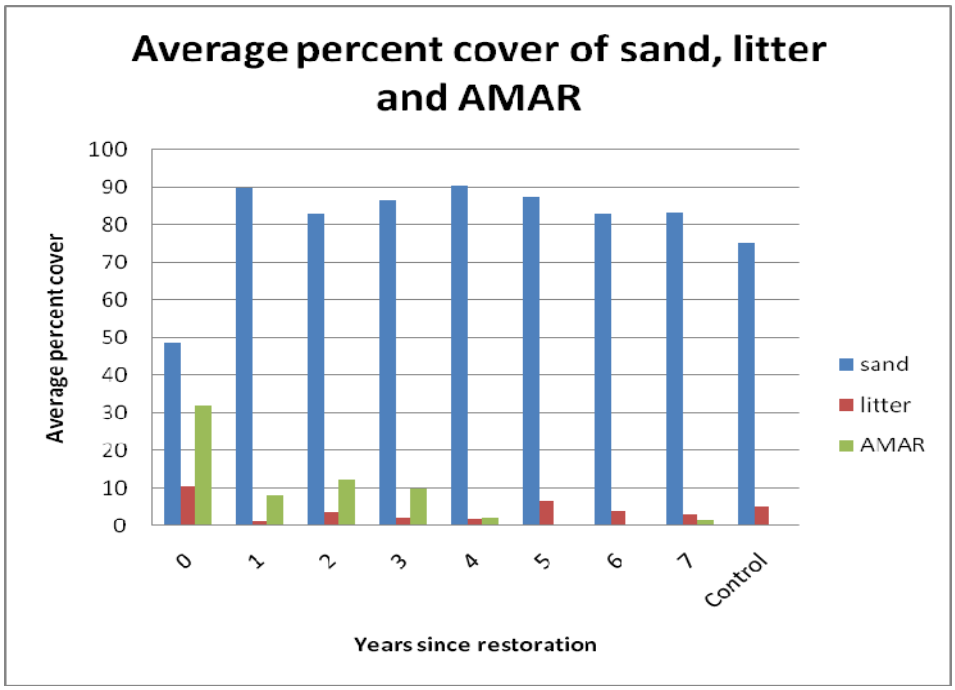

Figure 13. Results of Restoration Efforts in the Abbotts Lagoon Area to Date

(Source: Washington University report to NPS, internal data 2008.)

Overall, benefits to native vegetation from removing *Ammophila* in increased species diversity, available moisture and nutrients and increased extent of coverage by native species would be substantial, and would range from minor to possibly major depending on the vegetative type. For unique vegetative communities such as dune mat, removing the threat of *Ammophila* will help preserve some of the last remaining habitat for these populations in the world, a moderate to major site specific benefit. Removing one acre of iceplant may offer additional negligible to minor site specific benefits. Less extensive benefits would accrue to grasslands or coastal scrub/shrub habitats because well-established native communities of each are more able to repel encroachment of *Ammophila*.

Cumulative Impacts

The impacts described above for *Ammophila* and its cumulative impacts on dunes along the Pacific coast would be true for this alternative as well. However, rather than either contributing or maintaining neutrality on impacts from the park population, Alternative B

would offset the overall impacts *Ammophila* has had and continues to have by restoring a few hundred acres of native coastal dune vegetation. Given the extent of *Ammophila* infestation even in California, this offset would likely only have minor benefits to native vegetation in the state or along the entire coast. In other words, adverse impacts to native dune vegetation on the Pacific coast from *Ammophila* would continue to major and adverse, despite the site specific benefits for dunes at the park.

Conclusion

Alternative B would have minor short and long-term adverse effects on native vegetation from access and staging, primarily to grasslands and/or coastal scrub. Treatment activities B would result in adverse short-term impacts to native vegetation, particularly from herbicide drift, windblown soils and possibly from runoff if it rains following application. If herbicides are applied in small areas where rare or native plant species are intermixed with *Ammophila*, overspray could have a localized, minor to moderate adverse effect on individuals of these populations. Otherwise, the use of buffers would keep adverse effects on native vegetation from drift to no more than minor and short term. Impacts on non-target terrestrial native vegetation from runoff and windblown soils would be negligible or minor. Negligible adverse impacts on macrophytic aquatic vegetation, and minor or possibly minor to moderate short-term adverse effects on algae from herbicide drift or runoff are possible. Prescribed burns are likely to have beneficial impacts on coastal scrub and grassland vegetation at the study area; dune mat and wetlands would be protected from impacts of prescribed burning with fire lines. Excavation with mechanical or hand equipment would have minor, short-term adverse effects on native foredune vegetation, which would be kept to no more than minor by using hand shovels in native dune mat or wetlands to remove *Ammophila*.

Minor to major long-term benefits to native dune species from increases in diversity, coverage, restoration of open sand conditions and the elimination of *Ammophila*'s use of soil moisture and nutrients would result from treatment. Mitigation would keep overall impacts to wetlands from restoration of natural sand movement from becoming adverse at the site.

Restoring the study area to natural conditions would have a negligible or minor beneficial offsetting effect to cumulative adverse impacts from the invasion of *Ammophila* and iceplant along the Pacific coast, as major adverse impacts to the region would remain.

No impairment from impacts to park vegetation would occur should Alternative B be implemented.

Impact of Alternative C

Analysis

Impacts of Staging and Access

Impacts of staging and access would be similar to those described for Alternative B. However, the use of secondary roads would vary between alternatives, as Alternative C would require travel of all roads as well as across foredunes in *Ammophila* to fully access the site. Vegetation along reardune secondary roads may be more heavily affected in this alternative as a result, but impacts are not expected to be more than minor.

Impacts of Treatment Methods

This alternative would rely on the use of mechanical equipment to remove European beachgrass from the entire study site. Hand removal would be used to remove *Ammophila* when it is highly intermixed with unique or sensitive native vegetation, when it is near

bodies of water or in areas adjacent to important vegetation (such as listed species, dune hollow shorelines, dune grass etc.). Narrow-bladed shovels would be used when hand removal is needed in shrub habitat. Where beachgrass is growing in more dense stands adjacent to open sand and there are fewer existing native plants, wide blade shovels could completely excavate the rootmass and all biomass removed from the top meter of the site. Because of this careful consideration of the vicinity of unique or sensitive native plant communities, the impacts to any intermixed or adjacent native dune vegetation would be generally be no more than minor, and much of the activity would not have any detectable adverse effect, e.g., most would have negligible impacts. Some highly intermixed native vegetation would be lost to excavation when hand removal is infeasible. Because only a few individuals or small patches of native vegetation would be lost, this is a minor site specific adverse effect.

Excavation would also not take place within 5 feet of any dune slack or other wetland in the treatment area. However, some temporary drainage of surface water and impact to wetland vegetation from changes in topography so close to wetlands are possible for a few hours or days. Eventually, areas where *Ammophila* is removed by excavation would be refilled and hydrology returned to approximately the same situation as prior to digging.

Long-term Impacts of Treatment

As noted in the analysis of Alternative B, monitoring of the results of treatment with hand shovels and mechanical equipment on 30 acres at the park has shown deep burial to be effective in removing beachgrass. The extent of cover by native species has increased to a more natural 2.2%, native species diversity had increased 30-50%, and the amount of bare sand had increased three-fold. Each of these, in addition to the removal of *Ammophila* and its use of the relatively unavailable moisture and nitrogen in the soil, would offer minor to major benefits for the native dune vegetation at the 300-acre treatment site. As in Alternative B, adverse impacts to wetlands or other vegetation from destabilizing sand now held in place by *Ammophila* would be offset by restoring and adding acres to a marine terrace wetland south of the site. Monitoring the site to ensure no additional net loss of wetlands beyond the anticipated one acre would also occur; any additional net loss would be mitigated by adding to the marine terrace wetland south of the site.

Removing one acre of iceplant may offer additional negligible to minor site specific benefits.

Cumulative Impacts

Cumulative impacts would be the same as those identified for Alternative B.

Conclusion

Both action alternatives would have minor short and long-term adverse effects on native vegetation from access and staging, primarily to grasslands and/or coastal scrub. Alternative C would primarily have negligible, but no more than minor short-term impacts to native dune vegetation from hand and/or mechanical removal activities.

Minor to major long-term benefits to native dune species from increases in diversity, coverage, restoration of open sand conditions and the elimination of *Ammophila*'s use of soil moisture and nutrients would result from treatment. Mitigation would keep overall impacts to wetlands from excavation or restoration of natural sand movement from becoming adverse at the site.

Restoring the study area to natural conditions would have a negligible or minor beneficial offsetting effect to cumulative adverse impacts from the invasion of *Ammophila* and iceplant along the Pacific coast, as major adverse impacts to the region would remain.

No impairment from impacts to park vegetation would occur should Alternative C be implemented.

SPECIES OF SPECIAL CONCERN

As noted in *Affected Environment*, this section includes both species listed as threatened or endangered on the federal or state list and those that are not officially listed but are considered rare or unique by the park or other monitoring entities (such as the California Native Plant Society).

Policies and Regulations

The federal Endangered Species Act (ESA) of 1973, as amended, requires federal agencies to consult with the USFWS before taking actions that (1) could jeopardize the continued existence of any federally listed plant or animal species or species proposed for listing, or (2) could result in the destruction or adverse modification of critical or proposed critical habitat for federally listed species. The USFWS website was consulted to find the list of species that must be considered for this EA. The analysis in this EA includes an assessment of whether any of the alternatives include actions that "may affect" a listed species or its critical habitat as required under the ESA. If none of the effects are considered "adverse" as defined by the ESA, no further consultation is required. However, if an adverse effect exists, formalized consultation with the USFWS begins, with the NPS and USFWS evaluating mitigation or constraints to ensure that the species is not jeopardized. If the species would not be jeopardized, the USFWS may issue an incidental "take" permit. No finding regarding "take" is required for listed plant species, although an assessment of whether an action would put an entire species of listed plants in jeopardy is required. Therefore, the thresholds for NEPA are used for listed plants, and a finding of whether action would jeopardize the species' continued existence is included.

In addition, NPS *Management Policies 2006* state that state and locally listed species are to be managed in a manner similar to the treatment of federally listed species to the greatest extent possible. Species that are rare, unique, declining but not listed are to be inventoried and managed to maintain their natural distribution and abundance (sec. 4.4.2.3).

Assessment Methodology

The study area and its immediate vicinity have been surveyed for listed species of plants and animals. In addition, the approximate acreage and number of individuals (if it is small) of rare or declining plant species of concern have been determined through surveys. Rare animal species have either been anecdotally observed in the study area or its immediate vicinity, or are presumed to occupy habitat. These surveys and knowledge of the natural history and habitat requirements of rare species were the primary resources used to determine the intensity and duration of impacts. Context was provided by consulting the park's and USFWS' more regional information on the extent of both geographic locations of each potentially affected species and forces affecting them. Impacts were assessed by assuming mitigation and alternative methods the park would use to remove nonnative beachgrass in habitat where listed or rare species are known or presumed to exist. Timing of the treatment was compared to timing of important behavior for animal species or life cycle phases for plants. Best professional judgment was used to evaluate how each of these factors would figure into an overall impact determination for each species.

Context and Duration

Short-term: Short-term impacts are those that last no more than one year or one reproductive season.

Long-term: impacts would extend beyond a single year or reproductive season.

Impact Thresholds:

The following thresholds were used to determine the magnitude of effects on federally listed species and their associated habitat that would result from implementation of any of the alternatives. Because a separate environmental consultation and compliance process is required under the federal Endangered Species Act for listed species, these thresholds are also identified.

Endangered Species Act Consultation thresholds- applicable to listed wildlife

No effect. When a proposed action would not affect a listed species or designated critical habitat.

May affect / not likely to adversely affect. When effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

May effect / likely to adversely affect. When any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, then it "is likely to adversely affect" the species. Incidental take is the take of a listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity.

NEPA thresholds:

Negligible: *There* would be no observable or measurable adverse or beneficial impacts to federally listed species, their habitats, or the natural processes sustaining them in the proposed project area.

Minor**:** Individual animals may temporarily avoid areas. Actions would not adversely affect critical periods (e.g., breeding, nesting, denning, feeding, resting, flowering, seed set) or habitat for listed species. A few individuals of a rare wildlife species or a listed or rare plant species but no individuals of any listed wildlife species would be inadvertently killed or injured. Beneficial impacts may result in slight increases to the viability of the species at the site or in the park as species-limiting factors (e.g., habitat loss, competition and mortality) are reduced.

Moderate**:** Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, resting, flowering, seed set) or habitat; however, the level of impact would not result in physical injury or mortality to more than an incidental number of individuals of a listed wildlife species, and no extirpation of any local population or species of rare plants or animals from the park would occur. A small patch of listed plant species may be injured or killed if they cannot be relocated before treatment takes place and if no jeopardy to the species continued existence would occur. Moderate beneficial impacts include improved viability of the species, population structure, and species

population levels at the site or in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are reduced.

***Major*:** More than an incidental number of listed animals may suffer physical injury or mortality or local populations of rare animals or plants may be extirpated from the site, area or even the park. A site-specific occurrence of a listed or unlisted rare plant species may be injured or killed. Beneficial impacts include highly noticeable improvements to species viability, population structure, and species population levels at the site or in the park, as species-limiting factors (e.g., habitat loss, competition, and mortality) are nearly eliminated.

Impact of No Action

Analysis

Listed Plant Species

The No Action alternative would include small-scale treatment within the affected area as money is available. Treatment activities could include the use of hand tools and heavy equipment. Some very small-scale experimentation using herbicides and/or prescribed fire is also possible. Because these tools are central to the action alternatives, the impacts to listed plant species are analyzed in Alternatives B and C in detail. The scale of *Ammophila* or iceplant removal in the No Action alternative would be much smaller than the action alternatives, and any inadvertent impact to neighboring listed plants would be less intense, e.g., likely to be negligible or minor and short-term.

In the long term, neither *Sonoma alopecurus* nor Sonoma spineflower would be likely to be affected, as they are not in the vicinity of any treatment or access route.

Beach layia. Twelve of the 14 occurrences of beach layia at the park are considered threatened by European beachgrass and/or iceplant because of these species' tendency to grow in dense monocultures that exclude native plants. Although the two populations of beach layia at the treatment site were not specifically noted as high priorities for *Ammophila* and iceplant removal in the park's Annual Report to the US Fish and Wildlife Service (NPS 2005), evidence from treatment on dunes adjacent to the study area indicate this species would benefit. Small-scale treatment under the No Action alternative may have minor benefits compared to taking no action at all, but implementing this alternative would also continue minor to moderate adverse impacts from encroachment by *Ammophila* in untreated portions of the site. Because several other populations of beach layia exist, implementing the No Action alternative would not jeopardize the continued existence of this species.

Tidestrom's lupine. Tidestrom's lupine at the site is one of seven populations at the park. Six of the 7 populations, including this one, are considered threatened by European beachgrass and/or iceplant. The population at the site is the largest population at the park, with over 100,000 individuals. Currently, neither iceplant nor European beachgrass pose an immediate threat to the population. Iceplant seedlings are present, but are in low numbers and widely scattered. Estimates of the number of lupine individuals in the park have increased from 2001 to 2003, with estimates in the 169,000 range in 2003 (NPS Annual Report to USFWS 2005). However, iceplant and European beachgrass are considered a major threat to this species in its Recovery Plan (USFWS 1998).

Tidestrom's lupine has been the subject of a research study examining predation of its large seed pods by deer mice near the site (Knight 2008). In 2005, research staff from Washington University, St. Louis, found significantly higher consumption of Tidestrom's lupine seeds at sites in close proximity to European beachgrass. In 2006, the same researcher placed seeds of a related species of non-listed lupine (*Lupinus chamissonis*) at

varying distances from *Ammophila* and found those closest to it were taken more often. In a preliminary population viability analysis, the author determined that the population of Tidestrom's lupine at a site adjacent to Abbotts Lagoon (northeast of the study area) is declining 13% per year because of the seed predation. In the absence of seed predation, it would grow about 1% per year. *Ammophila* provides excellent cover from predators for deer mice (Pitts and Barbour 1979) and facilitates this indirect effect on Tidestrom's lupine. At the site and in surrounding areas where this species and *Ammophila* co-occur, predation by deer mice could result in an ever decreasing population size of Tidestrom's lupine.

Although small-scale actions in the No Action alternative would help keep nonnative species at bay, some encroachment into the Tidestrom's lupine population at this location is likely. These removals would also help in reducing seed predation by deer mice. However, because the removals are small in scale, high seed predation levels from mice in *Ammophila* and increased encroachment of *Ammophila* where treatment is not taking place would continue to occur. Implementing the No Action alternative would provide minor benefits in slowing the loss of Tidestrom's lupine, but would also continue minor or moderate localized adverse effects at the site. Implementing the No Action alternative would not jeopardize the continued existence of Tidestrom's lupine, although over the very long term it may be reduced or eliminated at this particular study site.

Listed Animal Species

Myrtle's silverspot butterfly. Impacts from staging or access under the No Action alternative would be similar to those described for Alternatives B and C below, although because less treatment would occur, adverse impacts would be less intense than for either action alternative and on the order of negligible or "no effect" under the Endangered Species Act. Treatment with herbicides and/or fire would also "not be likely to adversely affect" this species under the No Action alternative because the scale of treatment would be very small and likely to be located away from any sensitive resources. The type of impact from these treatment activities is analyzed in more detail in Alternative B. The impacts from excavation are analyzed in both Alternatives B and C below, but again would be less intense in the No Action alternative and not likely to adversely affect Myrtle's silverspot butterfly.

Ammophila and iceplant are both considered "unambiguously bad" for butterfly habitat (USFWS 1998) are named "one of the most serious present-day threats" to this species. Iceplant crowds out all food plants in dune mat vegetative communities, and may encroach on coastal grasslands, particularly where there is open ground. The small number of butterflies in the park may be due in some part to the encroachment of both these nonnative species, which in addition to outcompeting nectar plants also displaces the dog violet, a plant used by silverspot larvae for feeding (USFWS 2008). Beachgrass particularly threatens both adult butterflies and larvae and their host plants in the southern part of the site, where native dune mat, dune shrub and grassland habitat co-exist in a small area. Under the No Action alternative, *Ammophila* and iceplant would continue to encroach upon butterfly habitat and to outcompete and displace critical host and nectar plants, a potential moderate impact. The small-scale treatment actions proposed in this alternative would likely slow the rate of encroachment to some degree, a relative minor benefit with no potential for adverse effects under the Endangered Species Act.

Red-legged frog. Because staging and access actions are located away from any known red-legged frog habitat, no impacts to this species from these actions under this alternative are expected to occur. Impacts from treatment with herbicides and/or fire would also not be likely to adversely affect this species under the No Action alternative because the scale of treatment would be very small and likely to be located away from any sensitive resources. The type of impact from these treatment activities is analyzed in more detail in Alternative B. The impacts from excavation are analyzed in both Alternatives B and C below, but again

would be less intense in the No Action alternative and not likely to adversely affect red-legged frog because this species is not normally located on the treatment site, and because crews would be trained to recognize it and stop work if a frog is sighted.

Snowy plover. Impacts from staging or access would be similar to those described for the action alternatives below, although because less treatment would occur, adverse impacts would be less intense than for either Alternative B or C and on the order of negligible or no effect under the Endangered Species Act. Impacts to nesting plovers from access activities would be kept from becoming adverse under the ESA through seasonal restrictions, and impacts to wintering plovers would be temporary and negligible or minor. Impacts from treatment with herbicides and/or fire would also not be likely to adversely affect this species under the No Action alternative because the scale of treatment would be very small and likely to be located away from any sensitive resources. The type of impact from these treatment activities is analyzed in more detail in Alternatives B and C. The impacts from excavation are also analyzed in both Alternatives B and C below, but again would be less intense in the No Action alternative and not likely to adversely affect snowy plovers because of seasonal restrictions and other mitigation, including not treating any sites closer than 500 feet from an active nest.

In the long term, *Ammophila* would continue to adversely affect the availability and quality of snowy plover habitat. One of the most significant causes of habitat loss for coastal breeding snowy plovers is the encroachment of European beachgrass (USFWS 2007). As noted in the *Vegetation* section, *Ammophila* densely vegetates and stabilizes the primary foredune, which decreases the open beach and mobile dunes plovers use as nesting habitat. The stabilized foredune also prevents blowouts and movement of sand inland, and essentially presents a barrier to plover chicks that normally move throughout the complex of ridges and hollows leeward of the primary foredune. This is exacerbated by the steep slope that develops on the windward side of these stabilized dunes from wave action (see *Soil and Sand Movement* section). The tall and dense beachgrass also provides better habitat for snowy plover predators, including foxes and coyotes, and prevents plovers from seeing oncoming avian predators such as ravens and crows. Although the park does cover most active nests to minimize predation of eggs, chicks are able to leave the exclosures and have increasingly become the target of raven, crow and gull predation.

Ammophila would likely continue to expand to cover the entire primary foredune and much of the foredune complex inland to the reardunes. However, because the No Action alternative includes sporadic and small-scale treatment, the rate of this spread would be slowed somewhat, a minor benefit to the plover population at the treatment area compared to doing nothing at the site. Because plover population numbers for this segment of beach is one of the lowest in number on the Great Beach at the park (K. Peterlein pers comm. 5/19/2008), the regional benefit of the No Action alternative is negligible. Although it may slow it down, the No Action alternative is not extensive enough to completely prevent the continued expansion of *Ammophila* and to continue moderate or even major adverse conditions at the site and a minor regional impact to the plover.

No proposed action under this alternative is likely to result in a “take,” and so although continuing current management may affect plovers, it is not likely to adversely affect them as it is defined by the Endangered Species Act.

California brown pelican. The brown pelican may occupy habitat on or near Abbotts Lagoon during the time treatment activities are conducted. The use of heavy equipment near the lagoon may disturb this species, or even cause individuals to temporarily abandon the area, especially if it is very loud and/or extends over several days.

Although some individual pelicans may habituate to nonthreatening, continuous or frequently occurring noise levels, others do not. Waterfowl studies indicate that this group

of birds is particularly slow in acclimating to continuous noise (Bowles 1995). Pelicans could retreat to parts of the lagoon or to the ocean to get away from the excavators, and some individuals may permanently leave the area. Each of these behaviors would have negative impacts on pelicans, as swimming or flying away from the source of noise increases energy expenditures, and time spent in escape can take away from feeding. In addition, pelicans may be displaced from higher quality habitat if the noise is so disruptive as to cause them to abandon the site. Because treatment would be very short-term and only in the vicinity of the lagoon or tidal flats where pelicans winter for a fraction of the time treatment takes place if at all, impacts would be negligible or perhaps minor and would not be an adverse effect under the Endangered Species Act.

In the long term, removal of *Ammophila* or iceplant would be unlikely to have any beneficial or adverse effect on pelicans.

California least tern. The California least tern is an extremely rare fall migrant that is unlikely to occur at the site. Although noise from excavation may disturb this species, the chance of treatment occurring at the same time a tern is in the vicinity is considered so low as to be negligible. In the long term, removal of *Ammophila* or iceplant would be unlikely to have any beneficial or adverse effect on least terns.

Willow flycatcher. This is a rare migrant to the area and is present primarily in August if at all. The willow flycatcher is a riparian scrub species and could rest in vegetation that surrounds dune hollows and other permanent and semi-permanent wetlands at the site, including at Abbotts Lagoon. Although this species may be disturbed by the noise from excavators or human activity (USFWS 2003), it is only on site for a very short period of time. The chance of treatment occurring in the vicinity of where the flycatcher may be roosting is considered very low, and impacts to this species from the No Action alternative negligible. In the long term, removal of *Ammophila* or iceplant would be unlikely to have any beneficial or adverse effect on willow flycatchers.

Plant Species of Concern

The plant species of concern at the site occur in dune mat vegetation, grasslands or scrub/shrub communities. As noted in the *Vegetation* analysis, each of these communities is threatened by *Ammophila* invasion, or habitat that was formerly available to these native vegetative communities is now usurped or dominated by *Ammophila*. European beachgrass appears able to outcompete native dunegrass by using water and nitrogen more efficiently, and by growing quickly by rhizomes in dense tussocks with a higher density of reproductive buds and greater root mass. This high density of aboveground foliage is effective in covering bare ground and squeezing out other species. *Ammophila* also grows by seeds in the reardunes, where its roots are shallower and its spread slower. Plant species diversity of dunes where *Ammophila* is present is lower, but *Ammophila* apparently only depresses some native plants. It can be positively associated with some (beach bursage, for example) and have no effect on other native species.

At the treatment site, *Ammophila* has not invaded some large dune mat communities and is less likely to inhabit existing grasslands. It and iceplant do invade both coastal scrub and dune shrub habitat, and although they are rare in wetlands, do occupy the shores of dune slacks and dune hollows. For rare plant species that are dune mat or dune shrub inhabitants (Blasdale's bent grass, blue coast gilia, dark-eyed gilia, short-leaved evax, Point Reyes horkelia, curly–leaved monardella and rose leptosiphon), the No Action alternative may help keep nonnative species from invading to some small degree, a minor benefit. However, dune mat at the site is bordered by *Ammophila* and with time, the chances of invasion would continue to worsen over what they are now, a moderate to possibly major site specific impact for these species. For grassland species, including Blasdale's bent grass,

Point Reyes horkelia, curly-leaved monardella and Gairdner's yampah, the chance of invasion by *Ammophila* or iceplant is not as great. The No Action alternative may offer negligible benefits compared to no management, but would also continue and worsen a minor or moderate adverse impact on grasslands.

Animal Species of Concern

No fish, amphibian or reptile species of concern occupy habitat at the site. Impacts to invertebrate species from the limited scope of treatment that may take place under the No Action alternative would be similar but less intense that those described below in Impacts of Alternatives B and C. For example, driving heavy equipment along the foredune may crush globose beetles or their burrows, but because the scope is small the impacts are likely to be no more than negligible or minor. Other invertebrates of concern are mobile and could avoid heavy equipment. In addition, although habitat exists for the Point Reyes blue butterfly, it has not been observed on or near the site. No impacts to these invertebrates from the No Action alternative are expected.

The majority of bird species of concern occupy habitat on or around Abbotts Lagoon (see table 6). Exceptions to this generalization include white-tailed kite, Northern harrier, short eared owl, burrowing owl, and Allen's hummingbird. Northern harriers nest in open areas, including dune hollows and wetter grasslands or shrublands.

The harrier breeds from late March through mid June and is known to inhabit the treatment area and adjacent habitat.

Short eared owls have similar nesting behavior and habitat, and nest where they find a high density of small rodents, their preferred prey. If they do nest in the vicinity of the treatment area, chicks would be fledged by mid-June.

The burrowing owl does not nest in or near the treatment area, but does winter in the park. It prefers to roost and forage in the dunes, and eats crickets, beetles and other insects.

Allen's hummingbird occupies undergrowth in dune hollows and wetlands, such as blackberry patches that may grow in the swales that border the project site. This species may be nesting in these patches as well, with fledging occurring no later than the end of June.

Any of these species may be directly affected by treatment activities. Mechanical equipment could crush nests, eggs or chicks, or could disturb adults so that they leave the nest, or in the case of non-nesters, would leave the area. Because the scale of treatment under the No Action alternative is quite small, these impacts are not likely to occur. If a biological monitor surveys the site where treatment is to take place and along any proposed access route for nests or adults of these and other bird species of concern, impacts would be no more than minor.

Additional adverse impacts to those bird species that use the tidal flat area on the south shore of the lower lobe of Abbotts Lagoon would also occur under the No Action alternative. Each of these species (white pelican, Tule greater white fronted goose, merlins, ferruginous hawks, willow flycatcher, horned lark, brant, elegant terns, Pacific golden plover, marbled godwit and buff-breasted, pectoral and Baird's sandpipers) either occupies habitat on this flat or is dependent on the species that do occupy this habitat for prey. If heavy machinery is operating in this area, birds may be temporarily disturbed or even displaced for a longer period of time. Some species, such as elegant tern, that depend on this location for resting while foraging for anchovies during a few days each year may be excluded from use of the site due to the presence of heavy equipment or human activity. Because the scale of treatment under this alternative would be minimal, impacts from these sources on rare birds that depend on the lagoon are also likely to be minimal, that is, no more than minor

and short-term. In the long-term, no benefits or adverse effects from removing *Ammophila* are expected.

The Point Reyes jumping mouse may inhabit moist meadow or riparian habitat on the site or in adjacent Abbotts Lagoon shrublands. No direct impacts from treatment are expected, although indirect impacts in the form of noise disturbance or disturbance from the presence of humans may temporarily displace an individual from its territory. Because the scale of treatment would be small and short-term, these impacts are negligible or minor. In the long-term, no benefits or adverse effects from removing *Ammophila* are expected.

Cumulative Impacts

Beach layia. The threats to this species include displacement by European beachgrass and other nonnative invasive species, recreational uses and urban development (USFWS 1998). Besides European beachgrass, populations of beach layia are threatened by pampas grass, yellow bush lupine and iceplant. ORVs trespassing on lands in Humboldt County are also a serious cumulative concern for the continued existence of this species. In Marin County, grazing from wildlife is named as an issue in the Recovery Plan (ibid.), but to a far lesser extent than displacement by beachgrass and iceplant. A population in Santa Barbara County adjacent to Vandenberg Air Force Base is threatened by various construction and road maintenance issues; in 1997 half of a rediscovered site of beach layia by the base was destroyed during road maintenance operations (ibid.).

Tidestrom's lupine. This species occurs on the Monterey Peninsula and from Marin County to Sonoma County. The major threats include invasion by iceplant and *Ammophila* and loss of habitat from development and recreation use, including trampling from hikers and equestrians (USFWS 1998). Two occurrences on the Monterey Peninsula were destroyed by construction of a golf course. Other occurrences in Monterey are located on private land and are potentially threatened by residential and recreational development. Another threat unknown at the time the lupine's recovery plan was written comes from the predation of tidestrom's seeds by concentrated populations of deer mice that find *Ammophila* an excellent cover from aerial predators. As noted above, at the Abbotts Lagoon site north of the study site, deer mice are consuming enough seeds of Tidestrom's lupine that it is decreasing in size by about 13% per year. The encroachment of *Ammophila* combined with seed predation by deer mice that occupy *Ammophila* habitat have the potential to eventually eliminate much of this species range over time.

Myrtle's silverspot butterfly. Myrtle's silverspot butterflies are believed to be extinct everywhere except inside and near Point Reyes National Seashore. In addition to livestock grazing, reasons for its decline include urban and agricultural development, invasive nonnative plants, over-collecting, and other human impacts. Also, although the species uses several plants in the area to obtain nectar, it has only been known to use one, western dog violet (*Viola adunca*), to feed its larvae. The patchy nature of this plant in the area also may have contributed to the rarity of silverspot butterflies.

California red-legged frogs. Human activities may have had both direct and indirect effects on red-legged frogs. Development has removed habitat, and logging or other activities may have adversely affected stream characteristics. For example, historic logging of parts of Inverness Ridge, channel alterations in the lower 2.8 km of Olema Creek, and the effects of highway culverting have removed suitable habitat along Olema Creek and its tributaries. Areas of down cutting, bank cutting, and sedimentation are present along the mainstem and its tributaries, resulting in a probable reduction in numbers of backwaters and pools.

On the positive side, lands outside of Point Reyes National Seashore and GGNRA may offer some protection for wildlife, including frogs, through conservation easements, zoning, and low-impact land use practices.

Western Snowy Plover. Along the California coast, Western snowy plovers have been extirpated from 33 of 53 nesting sites since 1970, and now number approximately 1,400 birds (USFWS 2007). Although it is not one of the eight areas that support 78 percent of the California coastal breeding population, Point Reyes National Seashore is one of only 20 remaining plover breeding areas in coastal California (USFWS 2007). The Point Reyes peninsula is one of the largest relatively undisturbed beach habitats on the California coast, providing a large area of potential snowy plover habitat free of threats that have degraded habitat elsewhere, such as development, ORV use, and heavy visitor use.

Fledging rates for snowy plovers before nest protection began were insufficient to maintain the species at Point Reyes National Seashore, as indicated by declining numbers of nests and nesting adults in the period 1986-1995. Continuation of such low nest success rates could have resulted in loss of the Point Reyes National Seashore breeding population of snowy plover. The current nest protection program has raised nest success rates to levels similar to those at other coastal California locations (USFWS 1999), but would be costly to maintain indefinitely.

In addition to reducing open beach habitat for plovers, the growth of *Ammophila* has also concentrated human activity, which has been shown to have a cumulative adverse impact on nesting snowy plovers. Page et al 1977 (as cited in USFWS 2007) found that pedestrians at Point Reyes National Seashore disrupted incubation of nests; when humans approached, adult plovers generally flew from the nest leaving eggs or chicks exposed. Adults left 78% of the time when people were with 50 meters and 34% of the time when people were over 100 meters away. The intensity of the reaction varied and appeared to be dependent on the type of disturbance and extent of recreation use at a particular beach. When an area was only rarely used for recreation, plover adults reacted when people were as far as 200 meters away. In a well-used beach, adults stayed on the nest until people were closer and returned quickly after they left. Joggers, walkers, stationary visitors all caused disruption, but ATVs elicited the most significant alert and flight behaviors. Stationary visitors and fisherman kept plovers off nests for the longest period of time.

Researchers have also found lower fledgling success where recreation use is high. For example, a study at the park found increased human activities had negative effects on chick survival, with three times greater chick loss on weekends and holidays than weekdays in 1999 and 2000 (Ruhlen et al. 2003 as cited in USFWS 2007).

Oils spills, organochloride pesticides, mercury levels and tar balls have also had impacts on plovers in the region of the park. Mercury levels in some eggs that had failed to hatch at the park were high enough to account for egg failure through direct toxic effects to embryos (Schwarzbach et al. 2003 as cited in USFWS 2007).

Animal and plant species that are not listed, but are of concern at the site are rare primarily because of habitat alteration and loss, similar to those cumulative actions described above for listed species. These include development of residential areas, roads, historic resource extraction and stream alteration and increased use of a progressively smaller area of open beach and dune habitat by recreationists. For migratory birds that require stopover habitat along hundreds of miles of coast, these human activities have additive effects in reducing available resting and feeding locations and increasing the distance between remaining habitat. This can lead to unsuccessful migration or reproduction, with reductions in the number of chicks fledged and declines in the populations.

Conclusion

Implementing the No Action alternative would provide minor benefits in slowing the loss of Tidestrom's lupine, but would also continue minor or moderate localized adverse effects at the site. Minor benefits for beach layia compared to continuing to leave the site untreated would occur, but encroachment from *Ammophila* would have minor or moderate localized adverse effects where it is left untreated. Implementing the No Action alternative would not jeopardize the continued existence of either species.

Small-scale treatment activities, such as experimental herbicide or fire use, or small areas of excavation may have negligible impacts on Myrtle's silverspot butterflies. Encroachment of *Ammophila* into dune mat or grassland habitat where it is left untreated would continue impacts on adult and larval habitat for this species, but compared to leaving the site untreated, implementing the No Action alternative would have minor benefits by removing the threat at some locations. If access is required by heavy equipment, environmental protection measures described for action alternatives would also be employed in this alternative, keeping impacts to no more than minor. This alternative may affect, but would not be likely to adversely affect the butterfly as defined by the ESA.

The red-legged frog would not be affected as biological monitors would ensure they are not present along access routes, would monitor the construction, and would train heavy equipment operators to recognize frogs. The scale of treatment would be very small compared to the actions alternatives, and would be negligible and unlikely to have any adverse effects as this is defined by the ESA.

Excavation in the foredune, which may occur on a small scale under the No Action alternative, would not take place within 500 feet of any active Western snowy plover nest. This would prevent any contact with equipment and prevent the bulk of impacts to nesting plovers. Noise from machinery or the presence of human activity may have negligible impacts on wintering plovers. In the long term, small-scale treatment would provide minor benefits for plovers compared to taking no action by slowing the encroachment of *Ammophila*. However, an existing moderate or even major localized threat to plovers at the site would continue. No proposed actions under this alternative are likely to result in a "take," and so although continuing current management may affect plovers, it is not likely to adversely affect them as it is defined by the Endangered Species Act.

Negligible or minor short-term effects from the noise of excavation may affect roosting California brown pelicans if treatment takes place near Abbotts Lagoon. Similar but less likely impacts to willow flycatchers resting in wetland scrub could also occur. There is a remote chance that a California least tern would be disturbed by noise at the site, but the impact is considered negligible because this species is considered highly unlikely to visit the site.

Rare unlisted plant species at the site may experience some minor benefit in the long term from small-scale treatment at the site by slowing the invasion of *Ammophila* or iceplant. However, minor to localized major adverse impacts from encroachment where it is not treated would continue or worsen.

Although it is possible that vehicles accessing the site or excavators digging in grasslands or scrub could crush nests of some rare birds (Northern harriers, short-eared owls, Allen's hummingbirds), the small scale of treatment means such an impact is unlikely and considered negligible or minor. Noise from excavators could also have temporary minor adverse impacts on rare birds using tidal flats adjacent to Abbotts Lagoon. Several migratory species use this site each fall and/or spring, and may be disturbed by excavator noise or the presence of humans in reardunes close to this location. These same impacts

could cause the rare Point Reyes jumping mouse to temporarily relocate, a negligible short-term effect.

Cumulative impacts to listed species include encroachment from nonnative invasive species, recreational use and development. In addition to these impacts, livestock grazing and over-collecting have had cumulative impacts on Myrtle's silverspot butterflies. Logging, development, highway culverting and other stream modifications have had additive adverse effects on red-legged frogs, but conservation efforts, stock ponds and even light grazing have had cumulative beneficial effects on this species. Development, recreational use, ORV use and growth of *Ammophila* along much of its habitat have had cumulative adverse effects on the Western snowy plover. Increases in the use of organochlorides, increased mercury levels and oil spills have also adversely affected this species. Similar increases in development, resource extraction and recreational use have diminished habitat, including for migration, for non-listed but rare species.

No impairment to park species of concern would occur from implementing the No Action alternative.

Impact of Alternative B

Analysis

Alternative B would use a variety of tools, including hand and mechanical removal of *Ammophila* in the foredunes and prescribed burning and herbicide treatment in the reardunes. Hand removal may also be used in the reardunes if *Ammophila* is intermixed with unique or sensitive native vegetation.

Listed Plant Species

Listed plant species would not be affected by access or staging. Beach layia and Tidestrom's lupine grow in dune mat communities primarily on the foredune. Although heavy equipment would be driven along the foredune to access the northern and southern portions of the site, it would specifically avoid the areas where dune mat grows. Individuals of each of these populations growing outside the dune mat have been mapped and would be flagged if they are near where heavy equipment would be driven. Sonoma alopecurus and Sonoma spineflower do not occur along the areas proposed for access or staging.

Impacts from treatment would also be minimized through the use of a biological monitor to flag individuals or the extent of populations at the site. Because Sonoma spineflower does not occur on the site, no impact to this species from treatment is expected. A few individuals of Sonoma alopecurus do occur on the shorelines of wetlands or in wet meadows. As noted in the alternatives description, hand tools would be used to remove *Ammophila* from wetlands, and buffers would be used to keep excavators from moving too close to wetland shorelines and for herbicide spraying. It is highly unlikely that one or more individuals of Sonoma alopecurus would be burned in a prescribed fire. If this were to occur, it would be after seed set to minimize impacts. This would keep impacts to minor and localized and would not jeopardize the continued existence of this species.

Beach layia. Most of the beach layia at the site is located in dune mat communities, which do not require treatment other than hand removal of a few *Ammophila* sprouts. Hand removal at the transition to *Ammophila* dominated areas adjacent to dune mat would also be a required environmental protection measure. If excavation and/or herbicide application are to be used in *Ammophila* close to beach layia, 25-foot buffers for use of herbicides and flagging would minimize impacts. It is possible that an occasional isolated individual or small patch of beach layia outside of a dune mat area is intermixed with *Ammophila* and that prescribed burning would remove these individuals. However, beach layia occurs primarily

on the foredune at the site, and would generally not be subject to burning or spraying. In addition, hand removal or mowing to create a barrier to fire around beach layia populations would be used to minimize or prevent impacts from prescribed burning. Therefore, impacts from treatment activities are expected to be no more than minor.

In the long term, removing the threat of encroaching *Ammophila* and opening up bare sand for expansion by beach layia would have beneficial effects. At a treatment site directly north of the study area, the number of beach layia individuals in February 2002 following treatment was 100. One year later, this had increased to over 800 (Peterson et al. 2003). Because the population at the treatment site is not considered immediately threatened by *Ammophila*, the increase may not be as large as in the treatment area to the north. Even so, predictions of increases in the beach layia population at the site of nearly 100,000 plants with six months to two years following treatment, enough to potentially de-list the species, have been made by park staff and consultants (Peterson and others 2003 as cited in NPS 2005). If this occurs, it would be a major benefit for this species.

Tidestrom's lupine. This species is also a foredune, dune mat species and would be protected from excavation, herbicide use and prescribed burning by the same means as beach layia. Impacts from treatment activities are expected to be no more than minor.

Similar long-term benefits to those described above for beach layia are also possible, although because Tidestrom's lupine is a slower-growing perennial species, colonization of bare sand following *Ammophila* removal is expected to be slower (Peterson et al. 2003). Seeds of Tidestrom's lupine may also be less available because of historic predation by deer mice as described above. However, in time, park staff and consultants (Peterson and others 2003 as cited in NPS 2005) predict that this endangered species could increase by as many as 50,000 individuals following restoration at the site. As with beach layia, this increase may be enough to delist or downlist Tidestrom's lupine to threatened status, and would be a major benefit for this species. A possible concern for populations of Tidestrom's lupine at the park is the chance that sand movement on dunes cleared of *Ammophila* would increase, potentially burying patches of this species for a time until native vegetation repopulates the site.

Listed Animal Species

Myrtle's silverspot butterfly. This species occupies grassland and dune habitat, including rare dune mat vegetation near and on the site. As noted in *Affected Environment*, a critical factor in its distribution is the presence of the larval host plant, western dog violet (*Viola adunca*). At the site, dog violet may occur in the grasslands and along ranch roads, particularly in the southern part of the treatment area. Impacts from access and staging could come from disturbance of dog violet habitat or from collisions between heavy equipment and adults.

The preferred locations for staging are at an already developed site (NDOC) and at the intersection of an already graveled and used road with the southeast end of the site. Because these areas are already developed or relatively well used, the impact to the butterfly's habitat (larval or nectar plants) is likely to be negligible or at most minor. The primary route to the site would be along this existing graveled road and as noted vehicles would be required to stay only on this or other graveled ranch roads. This requirement would prevent inadvertent impacts to larvae, western dog violets and adult butterflies to the extent possible.

The secondary access routes would be unimproved and would be used to drive heavy equipment to treatment sites in the reardunes or to the beach or foredune where it would be able to access the westernmost parts of the study site. The secondary access routes (see figure 5) have been selected to minimize the chance of encountering native vegetation, and

both those in the reardunes and the one that crosses the foredunes are located in heavily infested beachgrass areas. Although the routes are mapped to avoid native vegetation, a biological monitor would walk each and flag the specific path to avoid any western dog violets or adult butterflies (as well as other resources noted in other sections). Vehicles and equipment would also be subject to a 10 m.p.h. speed limit along access routes (and during excavation) when adult butterflies are active to avoid impacts from collision. These measures would prevent the majority of impacts to adult butterflies or habitat for larvae associated with accessing the site along the secondary routes.

However, the butterfly uses a variety of plants for nectar and can fly quite a distance to obtain nectar, find mates or lay eggs on appropriate larval plants, and the biological monitor would not be able to find and flag every possible individual insect or plant it might use. In addition, although trucks and other vehicles would use existing ranch roads through grasslands and heavy equipment would keep to defined routes, butterflies may be feeding alongside the road or flying across it when a vehicle is coming, or pupae may be attached to plants other than the dog violet. Even slow moving vehicles may collide with adults.

As noted in *Affected Environment*, butterflies lay single eggs and large-scale fluctuations in the population are normal for this species. If population numbers in this particular area are low, the chances of a vehicle crushing a larval plant, pupa or adult butterfly is also low. Conversely, if population numbers are low, killing even a single larval plant or adult butterfly would have a larger relative impact. With mitigation described above, the impact of access and staging to the Myrtle's silverspot butterfly is likely to be no more than moderate and short-term.

In terms defined above for compliance with the Endangered Species Act, the impacts of access and staging with required mitigation would fall into the "likely to adversely affect" category.

The park has committed to mitigation actions in this alternative that would also eliminate much of the impact from treatment activities to Myrtle's silverspot butterfly. Treatment activities would be restricted during the period when adults are known to occur in the locations where they or their larval host plants are known to occur. For example, no prescribed burning or application of herbicides would occur during June 15 and August 31 in the southern portion of the project to protect adult butterflies. If butterflies are found in the northern portion of the site, these same restrictions would apply. In addition, all dog violets would be avoided by vehicles, heavy equipment and people using hand tools to remove *Ammophila*. A 10 mph speed limit on vehicles or machinery conducting excavation in the vicinity of butterfly populations would be imposed during the flight season of the butterfly. Additional protection would result from a restriction on the use of heavy equipment in the foredune during the plover nesting season, which completely overlaps the peak adult flight period.

The impact of treatment with prescribed fire in the reardunes would be minimal, but it is possible that dog violets could be inadvertently burned and larvae or eggs destroyed. Pupae may also be burned, although protecting areas where dog violets grow would also protect larvae and most pupae. The use of ATVs or individuals with drip torches or flame throwers could also crush occasional larvae or dog violets, although a biological monitor would flag individual plants and burns would try to avoid them. In addition, although prescribed burning would not take place where known adult populations exist (in the south and possible north end of the site) during their flight period, butterflies forage over a wide area. A fast moving burn in coastal scrub or grasslands in the reardunes may kill an occasional adult.

The long-term impact of prescribed fire on the habitat of Myrtle's silverspots is unknown, but could be a beneficial one, as nectar plants in grassland or coastal scrub would be native

species that inhabit a fire-prone community. A large wildfire that covered much of the park in 1995 (the “Vision” fire) benefitted the butterfly in the form of new wildflowers in coastal scrub expected to provide nectar for adults (NPS webpage www.nps.gov/pore/prkmgmt/firemanagement_visionfire; accessed 5/27/08). One study of tallgrass prairie found that populations of three species of the same genus as Myrtle’s silverspot butterfly were all immediately reduced by fire. In the long run, one continued to experience depressed population size, but the other two either benefitted or were unaffected. The recovery plan that includes this species (USFWS 1998) indicates that prescribed fire is a tool that needs significantly more work to see if it is helpful or harmful to this species. The same plan notes that as of 1998, silverspot butterflies had not yet moved into land burned by the Vision fire at the Seashore (Fellers 1998 as cited in USFWS 1998). Because information is not available, it is unknown whether prescribed burning in the reardunes at the site will have a net long-term positive or negative effect on this species.

As with burning, herbicide use would be timed to avoid adult butterflies where they are known to occur on the south end (and possibly the north end) of the site. This would prevent impact from herbicide use to most adult butterflies, although those that are foraging away from dune mat or grassland vegetation at the south end of the site may be subject to herbicide drift or inadvertent ingestion of herbicide residues. In addition, drift could affect eggs, larvae or pupae. Information in the literature on the effects of glyphosate on terrestrial invertebrates includes contact bioassays, laboratory and field studies and dietary studies. The primary test subjects have been honey bees, although spider mites, isopods, spiders and earthworms have also been exposed.

A lab and field study on the effects of glyphosate to a spider species (*Lepthyphantes tenuis*) found that direct spray with variable concentrations of between 0.16 lb a.e./acre and 1.92 lb a.e./acre resulted in low rates of mortality that were not related to dose. In the field, doses of 0.17 to 0.53 lb a.e./acre resulted in decreased spider populations attributed to secondary effects from changes in vegetation (Haughton et al. 2001b as cited in USDA Forest Service 2003). Direct toxic effects in the form of increased mortality (not statistically significant) on isopods exposed to leaf litter at levels equivalent to application rates of 1.9 lb a.e./acre have also been reported (Eijsackers 1992 as cited in USDA Forest Service 2003).

In terms of likely toxic effects in the field, the direct spray a honey bee would experience at an application rate of 7 lbs a.e./acre corresponds to a dose of 1120 mg/kg of body weight. A study by Palmer and Krueger (2001a as cited in USDA Forest Service 2003) found that a dose of 1080 mg/kg (or concentration of 100 µg/bee) was associated with five percent mortality. Although a ground sprayer may accidentally spray insects, backpack sprayers with controlled dose nozzles proposed for use with this project would prevent accidental direct spraying of silverspot butterflies. Concentrations of glyphosate would decrease with distance and would be less than 0.04 lb a.e./acre or 0.58% 100 meters from the application point assuming 7 lb a.e./acre. At an application rate more typical of this project (2 lbs a.e./acre), this would drop to about 0.016 lb a.e./acre 100 meters from the application point.

Although it is not known whether information regarding impacts of this herbicide on bees can be transferred to other invertebrate species, it is the best available information. At 100 meters from a backpack sprayer, a butterfly could conceivably be exposed to a concentration of 0.016 lb a.e./acre. This is 400 times less than the reported 5 percent mortality level for bees. Although butterflies could be closer than 100 m, even direct spraying would expose them to doses three times less concentrated that this same level and result in no detectable mortality. If butterflies land on nectar plants or rest on a blade of *Ammophila*, their exposure would be short-lived and last a matter of seconds, unlike isopods or spider mites.

Herbicides may be sprayed in vegetation adjacent to dune mat before adults emerge, but a 25 foot buffer to protect native plant species would be in effect. This would also help to prevent impact from drift to eggs, larvae, or pupae. It is also possible that larvae overwintering in ground litter may be affected by herbicide residues or windblown soil from nearby *Ammophila*. However, the timing of herbicide application would minimize these effects. Application at the beginning of the dry season would mean runoff is largely a non-issue. Also, because glyphosate would degrade in the soil over time (it has an average 30-day half-life), windblown soil would be relatively free of residues by the time wintering larvae occupy ground litter. The impacts of these sources and concentrations on eggs, pupae or larvae have not been studied, but given the timing of the application would likely to be no more than minor. With the mitigation measures described above and the low doses in drift, impacts from herbicide application to Myrtle's silverspot butterfly would be negligible or minor.

Alternative B would use mechanical removal techniques to eliminate *Ammophila* from the primary foredune on the site. As noted in Affected Environment, Myrtle's silverspot butterflies are only active in relatively wind-free environments and forage among coastal scrub, dune mat and grassland species. Of these, dune mat is most likely to occur in the foredune. However, dune mat would be off-limits to excavators year round in this alternative, and excavators would not be allowed to operate in the foredune during the nesting season for the snowy plover within 500 feet of an active nest. As noted, the nesting season covers the same period as the flight season for adult butterflies. Any excavators that are working in the foredune (further than 500 feet from a nest) may encounter a foraging butterfly, but would be required to drive no faster than 10 mph to minimize the chance of a collision during June 15 to August 31. All larval host plants in grasslands and anywhere they occur on the site or along access routes to the site would be flagged and routes changed to avoid them. The combination of environmental protection measures would prevent impact to all but incidental adults and larvae in foredunes, as well as important host and nectar plant habitat. It is possible that excavators could collide with a foraging butterfly or crush habitat where eggs, larvae or pupae are present, a moderate adverse impact and a finding of "likely to adversely affect" under the Endangered Species Act.

In the long-term, removal of *Ammophila* and iceplant from the site is likely to have a moderate or even major site specific, and minor to moderate regional beneficial impact on this species. Although the presumed larval host plant (*Viola adunca*) is not expected to grow within the project site (NPS 2005), treatment would remove potential sources of encroachment on this existing population. The quantity and variety of nectar sources for the Myrtle's silverspot butterfly would increase as native dune vegetation re-colonizes areas formerly dominated by exotic vegetation. This would result in an increase in suitable foraging habitat for the silverspot butterfly. As noted in other sections of this document, only three populations of Myrtle's silverspot butterflies are known to exist, and two occupy habitat inside the park. Removing the threat of *Ammophila* and iceplant to the butterfly's larval plant would be particularly beneficial, but eliminating the encroachment on dune mat and its nectar sources would also be a positive impact.

In summary, herbicide drift, or residues in runoff or windblown soils could have minor effects on overwintering larvae. Prescribed burning and use of excavators could inadvertently kill an adult butterfly foraging away from its primary dune mat habitat, or could burn or crush larvae, eggs or pupae. These are potential moderate or even major localized impacts, which may adversely affect Myrtle's silverspot butterflies at the treatment site. In the long term, treatment would have moderate to major benefits for butterflies by protecting their larval host and adult nectaring habitat from loss by encroaching *Ammophila*.

Red-legged frog. Red-legged frogs occupy pasture and wetland habitat north and east of the study area. As noted in the description of alternatives, NPS staff and contractors would

be trained to identify red-legged frogs and would stop work if a frog is seen in the project area. Also, to prevent inadvertently crushing a frog, the northern access route used in previous small-scale restoration work would be closed to use by vehicles or heavy equipment in completing treatment associated with this project. Because frog habitat does not appear to exist in the area where staging and access are proposed in this treatment plan, these activities would not affect red-legged frogs.

Prescribed burning and herbicide application would treat vegetation that is directly west of frog habitat. Prescribed burning would be unlikely to affect frogs both because it would occur adjacent to, rather than in frog habitat and because this species occupies moist or wet pastures or wetlands that would be effective in stopping fire from escaping outside the project boundary. Fire trucks would be parked in the immediate vicinity to help in controlling the burn if needed. The site would also be surveyed before work begins to identify and remove any red-legged frogs that do travel inside the project boundary. Smoke and heat may also have some temporary impact on frogs. If ATVs are used to disperse burning fuel, it is possible that frogs could be intercepted and crushed. However, surveying immediately before the fire is set would eliminate or significantly reduce this risk. Assuming surveys are conducted, only negligible or minor impacts to frogs from prescribed burning would occur. No adverse effects under the Endangered Species Act would result from prescribed burns.

To assess the potential impact of herbicide application to frogs, a reasonable calculation of the concentration of glyphosate in ponds, streams or other water bodies is important. The USDA Forest Service (2003) reports on several studies that measured concentrations in streams following aerial application of glyphosate. These range from 0.1 mg/L to 1 mg/L for a few minutes to a few hours following application. The highest concentration resulted from aerial spraying of 3.6 lbs/acre. Other studies found higher concentrations following repeated applications of herbicide. Clearly the volume of the stream, area of the drainage basin, area sprayed and concentration of herbicide used were all factors that changed results. Notably, all studies found rapid dissipation in stream water, particularly following storm events. In modeling impact to a small stream from 10 acres of spraying, the U.S. Forest Service made conservative assumptions such as a 1000-day half life and found spraying 1 lb a.e./acre resulted in 0.001 to 0.4 mg/L per pound applied per acre. This is the “WCR” or water contamination rate for acute exposure. Direct application of a 7% glyphosate formulation would result in about 1.25 lb a.e./acre. However, drift from a backpack sprayer would be substantially less than this. In addition, the park would not spray herbicides within 200 feet of any known frog habitat, so drift, which drops to negligible levels even after 25 feet, would be virtually undetectable in frog habitat. The above result (0.001 to 0.4 mg/L per pound applied per acre) is therefore an overestimate of concentrations in water expected to result from Alternative B.

For longer term exposure, a WCR of 0.008 mg/L is considered the highest reasonable rate and assumes sandy soils and a rainfall rate of 25 inches per year. Monitoring data following application are reasonably consistent with these estimates. Seventy days after aerial application of 1.8 lbs a.e./acre, concentrations of 0.001 to 0.002 mg/L in ponds less than 2.5 acres and 1 meter deep remained. Even in ponds directly sprayed with glyphosate at 0.8 lb a.i./acre, initial concentrations of 0.02 to 0.15 mg/L dissipated to 0.001 mg/L (a 95% to over 99% reduction) by day 12 (Goldsborough and Beck 1989 as cited in USDA Forest Service 2003).

One research study on the effects of different concentrations of glyphosate on frog tadpoles found that the dose that kills five percent of frog tadpoles is 3779 mg a.e./L after 96 hours. The most toxic agent tested was the POEA surfactant, an element of Roundup® and not anticipated to be used as part of this proposal. Another formulation of glyphosate was tested on tadpoles at much lower concentrations (Smith 2001 as cited in USDA Forest

Service 2003). This study found even exposures of 0.56 mg a.e./L resulted in 55% mortality. Concentrations higher than this killed all exposed tadpoles.

At the treatment site, some dune hollow and wetland areas exist on the eastern edge and intergrade into frog habitat outside the study area. Treatment of vegetation at the hollows or west of them could result in drift and potentially of runoff from contaminated soils into these habitats. As noted above, aerial spraying can result in concentrations in a small pond or stream of 0.001 to 0.4 mg/L per pound of a.e./acre of glyphosate in the short term. At an upper end of formulations the park might use, or 2 lb a.e./acre, this translates to concentrations of 0.002 to 0.8 mg/L in the short term. In the long term, this would fall to below 0.008 mg/L. Realistically, exposure at the treatment site would be much lower than that resulting from aerial spraying as drift from backpack spraying would be the only source. Nozzles would be calibrated and those spraying would be equipped with shields and directed to spray no closer than 200 feet from any known frog habitat. As noted in the analysis of impacts to vegetation, about ½% of the initial application rate (e.g., 0.01 lb a.e. per acre; resulting in about 0.0000054 to 0.0022 mg a.e./L short-term concentration of glyphosate) would reach a distance of even 25 feet assuming low ground boom sprayers; even less would reach 200 feet and assuming controlled backpack sprayers. This is not even one percent of the most conservative study's estimate of the level where effects are noticeable. The impact on red-legged frogs from herbicide use is likely to be negligible and short term, with no adverse effects under the Endangered Species Act.

In the long-term, removing the stabilizing influence of *Ammophila* from the foredune at the site may return sand movement and blowout conditions typical of a native dunegrass system. Sand could fill wetlands that are now artificially kept wet all year or longer into the year, with indirect impacts to red-legged frogs. However, native vegetation is expected to grow where *Ammophila* is removed and frog habitat at the site is more than 600 meters inland. Increased sand movement on the site is therefore not expected to have more than minor localized impacts on red-legged frogs, which may be only short term until native vegetation grows in. Regional effects on this species would be negligible.

Western Snowy Plover. Snowy plovers occupy habitat primarily between the foredune and the ocean, and so are not expected to be in the vicinity of the staging area. The park has committed to only driving heavy equipment along the beach/foredune to and from fueling locations and the treatment site up until March 1. This measure is to prevent impact to nesting plovers, which stage for nesting in March at the treatment site. Wintering plovers may be disturbed by heavy equipment driving along the beach or foredune, but the impact would be temporary. Experience with driving ATVs along this same area and with the use of excavators on the beach adjacent to the treatment area indicates that plovers do fly away from noisy vehicles, but land very shortly thereafter and may even roost in the tracks of excavators (K. Peterlein pers. comm. 5/19/2008). Impacts from staging and access to snowy plovers would be negligible or minor, and would only affect non-nesting birds. A slight beneficial effect from creating habitat in excavator tracks is possible as well.

For compliance with the Endangered Species Act purposes, access and staging with required mitigation may "affect but not adversely affect" wintering snowy plovers.

Treatment activities in this alternative have the potential for short-term disturbance of wintering Western snowy plovers. Nesting birds would be protected by restricting activities to a distance of at least 500 feet from any active nest during the nesting and rearing season (March 1 to September 15). Sources of short-term impact to non-nesting plovers include noise from excavators, the presence of human activities, herbicide drift and smoke from prescribed burns. Because plovers are significantly more likely to occupy habitat on the open beach, they are unlikely to be affected in more than a minor way by activities that take place in the reardunes, such as herbicide spraying or prescribed burning.

Human activity, such as from hand removal in transitional vegetative communities or backpack spraying of herbicides is likely to temporarily displace any snowy plovers that may be roosting or feeding in the reardunes. Because spraying would occur in the spring or summer, it is possible that chicks would venture into the reardunes as well as feeding or resting adults. However, the reardunes would be treated before the foredune to minimize the chance of a sand blowout in the foredune. Blowouts are the primary means chicks would use to access the reardunes, and keeping *Ammophila* in place on the foredune to stabilize it while fire and herbicides are used in the reardune would minimize the risk of plover chick exposure.

The human activity of spraying may disturb plovers in the vicinity, but may also prevent the majority of birds becoming directly exposed to herbicide. Generally, birds are less likely to leave nests than when they are not nesting if disturbed. Yet as noted above, Page et al 1977 (as cited in USFWS 2007) found that when humans approached, adult plovers generally flew from the nest leaving eggs or chicks exposed. Adult birds left 78% of the time when people were with 50 meter and 34% of the time when people were over 100 meters. On the off chance that a human spraying glyphosate comes within 50 meters of a foraging plover, this escape behavior would prevent any contamination by herbicide spray. If the plover hides and stays in place, contamination from a low concentration from drift is a remote possibility. However, the concerns for birds in areas sprayed by glyphosate are primarily associated with ingesting contaminated vegetation or insects. The glyphosate exposure modeling conducted for the USFS described above calculated risk to a small, insect eating bird (the plover is a small, insect eating bird) as part of a comprehensive report (USDA Forest Service 2003) and found the estimated dose to be 225 mg/kg assuming application rate of 2 lb a.e./acre and consumption of 100% directly sprayed insects in a single day. This is about 40% of the “NOAEL” or maximum level where no adverse effects have been observed, and a negligible to minor possible impact.

No information on the effects of fire or smoke on snowy plovers is available, except for reports of potential nest abandonment due to disturbance from human camping, campfires and smoke (USFWS 2007). Because fire would only be used in the reardunes, adult plovers would be unlikely to be present in the vicinity. If they are, they would likely fly to a different part of the site or adjacent beach during prescribed burning activities. If ATVs and flame throwers are used to start the prescribed fire, surveying the area before ATVs are allowed to enter would prevent impacts to plovers. Also driving slowly enough to allow the birds to fly away would prevent impacts. Noise levels from ATVs could be quite high, especially if they come within about 50 feet. Studies of the reaction by plovers to a similarly loud source of noise, such as low flying aircraft indicate they are highly disturbed by this level of noise, and reactions varied from crouching in depressions to taking flight (Hatch 1996). Impacts to plovers from noise from human disturbance or ATVs could be minor to moderate and short term (Peterlein, Page, pers comm. 2008).

Excavators in the foredune zone would also be noisy and disturb wintering plovers. The noise levels from excavators could be in the 80 dBA or higher range at 50 feet. This level of noise causes startle responses and flight in many bird species (see *Animal Species of Concern* below). Snowy plovers are thought to be highly disturbed by loud noise, such as from fireworks. On one July 4, all plovers occupying Coal Oil Point Reserve in Santa Barbara flushed when the fireworks display began (USFWS 2007). While noise from excavators would disturb wintering plovers and cause behavior that results in energetic losses, the impact to the plover population at the site would be minor and short-lived (K. Peterlein, G. Page, J. Rogers, J. Evens, pers comm. 2008). For example, new plovers would likely enter the site at the beginning of the breeding season and following the completion of excavation of the foredune, as wintering birds do not necessarily breed at the same location.

Alternative B would “affect, but not adversely affect” this group of wintering plovers as it is defined by the Endangered Species Act.

In the long term, the threat *Ammophila* poses in continuing to substantially alter and degrade snowy plover habitat would be abated in this 300-acre section of the beach. As explained in the No Action alternative, *Ammophila* alters the topography of the dunes, steepening the foredune and preventing natural blowouts of sand. This restricts the amount of beach snowy plovers have to use for nesting, feeding and roosting, and exposes them to predators hiding in the thick grass or screened from view when attacking from the air. Restoring dune habitat to a more natural condition and removing *Ammophila* would provide area-wide and regional benefits for the snowy plover population at the park.

The number of breeding pairs of Western snowy plovers would increase as a result of the greater availability of suitable nesting sites within the project area, including an increased usage of reardune areas for nesting and foraging. The utilization of suitable habitat by nesting pairs of Western snowy plovers is currently estimated at 3 nests per 10 acres of habitat. As noted in Affected Environment, 28 nests were recorded park-wide in 2007. It is estimated that up to 200 acres of the restored area would be suitable habitat, a potential increase of 60 plover nests (a greater than 200% increase over current conditions) (NPS 2005). Breeding success is also likely to greatly increase, as currently the fledging rate is only 37.5% (Peterlein 2007). A primary reason for this is the inability of plover chicks to find adequate hiding spots in the minimal open beach habitat remaining at the site. Instead of a low, rolling set of dunes with access to and from the reardunes where they can blend with the sand and escape aerial predation, chicks are unable to move beyond the steep, *Ammophila* covered foredune and are easily spotted and picked off by ravens and other predators. Increasing the number of breeding pairs to the predicted 60 and increasing fledging rates would have major site specific and park-wide benefits for Western snowy plovers, and minor to moderate regional benefits for the species.

California brown pelican. Pelicans may rest or feed in the adjacent lagoon or off shore of the treatment site. Driving excavators and other heavy equipment along the beach or foredune may temporarily disturb pelicans, but these actions are not expected to have more than a negligible impact. Under the Endangered Species Act, access and staging would have either no effect or would “affect but not adversely affect” California brown pelicans.

Pelicans may occupy habitat on or near Abbotts Lagoon during the time treatment activities are conducted. Prescribed burning or the use of heavy equipment near the lagoon may cause this species to temporarily abandon the area. Noise may be particularly disruptive, especially if it is very loud and/or extends over several days. In this alternative, heavy equipment would be used only to remove and bury *Ammophila* on the foredune. At its furthest northern point, the foredune is still about 200 meters from the closest point on the tidal flat on the southern shore of the lagoon. If excavators are working on this edge of the foredune, noise levels 200 meters away are not likely to be greater than 70 dBA, the noise level of auto traffic at 50 feet. This is because, although heavy equipment like excavators produce noise levels on the order of 94 dBA at 10 feet, decibel levels rapidly drop off with distance (NPS 2006b). By about 500 meters, noise levels from this same source would be at or well below 64 dBA, depending on topography and weather conditions. This is similar to the noise level of normal conservation.

Although some individual pelicans may habituate to nonthreatening, continuous or frequently occurring noise levels below 70 dBA, others would not. The studies that may best approximate impacts to the brown pelican are those for waterfowl. These reports have shown that waterfowl may be more overtly responsive to noise than other birds (Bowles 1995). Although waterfowl can adjust to noise disturbances, the process is slow. At least one study (Belanger and Bedard 1990 as cited in Bowles 1995) found that flight responses

of migratory waterfowl exposed to overflights by light aircraft and helicopters never completely habituated, and that changes in behavior as a result of exposure to noise were extensive enough that they could be translated into energetic losses. Other studies of Pacific black brants (Ward et al. 1986 and Miller 1991 as cited in Bowles 1995) found that the geese typically flew from the pond where they were exposed when aircraft flew overhead, and that the duration of responses was constant with repeated exposure, indicating no habituation. Flight responses took place even when the helicopters were as far away as 3 km, a range at which noise would be just detectable. In studies of other water birds (egrets, snow geese), individuals returned to the area less than five minutes following overflights even when the aircraft had come quite close (400 feet; Kushlan 1979, David & Wisely 1974; both as cited in NPS 1994).

Disturbance does increase the amount of energy the birds use and can have other energetic effects such as decreasing the amount of feeding time available. Pelicans may temporarily retreat to the upper lobes of the lagoon until heavy machinery is shut off for the evening, a negligible or minor impact. However, some individuals may find the noise disturbing enough that they would abandon the area, either until the *Ammophila* removal stops or permanently. This is a minor or perhaps moderate short-term or long-term impact, but would not constitute an adverse impact under the Endangered Species Act.

California least tern. The California least tern has been sited on or near the area proposed for treatment, but is considered an extremely rare fall migrant. The least tern uses tidal flats like those on the southern end of the lowest lobe of Abbotts Lagoon (bordering the northern corner of the treatment area) for roosting and forages over open water. The likelihood that it would be affected in any way by access or staging is considered extremely low, and impacts negligible.

Similar to the analysis above for brown pelicans, least terns are most likely to be affected by the noise and human activity associated with mechanical removal of *Ammophila* from the northernmost part of the foredune. This species does not regularly visit the area, and has only very rarely been sighted in the vicinity of Abbotts Lagoon. This means the site is not generally an important resting spot for the tern population on its migration. Although an individual bird may be disturbed by the noise of machinery, by smoke from prescribed burning, or by human activity associated with hand digging or herbicide spraying, the chances of such a coincidental contact are very low. Impacts would be negligible, without potential for adverse effects under the Endangered Species Act. In the long term, removal of iceplant or *Ammophila* will have neither beneficial nor adverse effects on the least tern.

Willow flycatcher. This is a rare migrant to the area and is present primarily in August at or near the site. The willow flycatcher is a riparian scrub species that finds habitat at or near the coast. It rests in brush and forages over open areas. The flycatcher would primarily be located in coastal scrub or shrub around the lagoon. Because access routes would avoid wetlands the chance of encountering and affecting an individual of this species is considered remote and impacts from staging and access negligible.

The Recovery Plan for the southwestern willow flycatcher notes that noise from recreation is a potential impact, and noise reduction in the neighborhood of nesting individuals is part of the recovery effort (USFWS 2003). Again, because very few individuals migrate through the study site, it is not likely prime resting habitat for migrants. Although individuals may be sensitive to noise or smoke, the chances of coincident management actions and migrating flycatchers is considered very low and impacts likely to be negligible. Actions “may affect, but are not likely to adversely affect” willow flycatchers. In the long term, removal of iceplant or *Ammophila* will have neither beneficial nor adverse effects on the willow flycatcher.

Plant Species of Concern

It is possible that staging or access could affect rare plants that occupy coastal scrub or grasslands. This kind of habitat includes several of the rare plants found at the site, such as Blasdale's bent grass, blue coast gilia, Point Reyes horkelia, curly-leaved monardella and Gairdner's yampah. In laying out access routes and staging spots, a biological monitor would flag and avoid any individuals of these species. However, it is possible that at least one of the secondary routes would cross through a patch of rare plants, or that the biological monitor would miss an individual. For example, the primary access route runs through a large population of Point Reyes horkelia, and using secondary routes may impact a small section of this same population. Because monitors would be looking for these rare species in laying out access routes and staging areas, it is unlikely that more than a few individuals or a small patch of a given species would be affected, although the effect would likely be lethal if crushed by vehicles or heavy equipment. The impact of access and/or staging would therefore likely be minor, but no more than moderate and localized.

The impacts to plant species of concern from treatment would be similar to those described in the *Vegetation* section for differing plant communities. Most of the plant species of concern occupy dune mat, coastal scrub or grasslands habitat. Dune mat would be hand thinned, and buffers used to minimize impacts from herbicide spraying or excavating in neighboring *Ammophila*. Prescribed burning would be carefully conducted to prevent impacts to dune mat, but inadvertent destruction of individual dune mat plants could occur. Fires would take place following seed set to ensure any impact is short-term.

Although individuals of rare plant species would potentially be flagged in grasslands or coastal scrub, it may not always be possible to avoid impacts to isolated individuals from burning or herbicide application, especially if they are heavily intermixed with *Ammophila*. Herbicide drift could have adverse effects on non-target vegetation closer than about 25 feet, although drift would be minimized through the use of backpack sprayers and calibrated nozzles. Similarly, prescribed burning could be directed to avoid large patches of rare plants, but would be impossible to use where individuals are heavily intermixed with *Ammophila*. This alternative would likely result in the loss of several individuals of some rare plant species, primarily from the use of fire, but also from herbicide drift from treatment of *Ammophila* in the immediate vicinity.

Because excavation would not be used to treat dune mat, impacts from this treatment activity to native species in this vegetative community in the foredune would not occur. However, if individuals of rare plants are heavily intermixed in *Ammophila* infested grasslands or other vegetation in the foredune, some would be removed by digging with heavy equipment.

The long-term impacts to most rare plant species would be beneficial. Because burning would occur following seed set in fire-dependent or fire-assisted vegetative communities, a flush of new growth including new seedlings of native vegetation and *Ammophila* is expected. Specific and directed herbicide application would eliminate nonnative species, freeing up soil, moisture and nutrients for native plants, including rare species, a minor to moderate benefit. Those individuals excavated from the foredunes would be permanently lost.

Of the 50 acres of dunes already treated at Point Reyes, the park has monitored, summarized and reported long-term benefits to native vegetative and animal communities for 30 of those acres in its study "Coastal Dune Restoration" (Peterson et al. 2003). In examining the impacts on native vegetation, the study found that the extent of cover by native species expanded from 1.2% to 2.2% in 2003, an 83% increase. The diversity of native species in the monitoring plots also grew by 30-50%, from 9 in 2001 to 14 in 2002 and 12 in 2003. These benefits have come from opening bare sand areas, increasing soil

moisture and nutrients and removing the threat of an *Ammophila* or iceplant monoculture. Similar increases in the extent and number of individuals of dune mat species or dune shrub/scrub species such as Blasdale's bent grass, blue coast gilia, dark-eyed gilia, short-leaved evax, Point Reyes horkelia, curly–leaved monardella and rose leptosiphon, with moderate to major site specific benefits. Because *Ammophila* does not colonize grasslands at the site as aggressively, minor to moderate long-term site specific benefits to grassland species, including Blasdale's bent grass, Point Reyes horkelia, curly-leaved monardella and Gairdner's yampah from its removal are expected.

Animal Species of Concern

No known fish, amphibian or reptile species of concern exist at the site. Therefore, the analysis examines invertebrates, birds and the Point Reyes jumping mouse.

Invertebrates. Several insects and other invertebrates are found in dune habitats in the area. Rare species include globos dune beetle (*Coelus glubosus*), sandy tiger beetles (*Cicindela hirticollis gravida*) and bumblebee scarab beetles (*Lichnanthe ursine*), as well as possibly the Point Reyes blue butterfly (*Icaricia icarioides parapheres).* Any or all of the three rare beetle species may inhabit the surface or subterrain of the dunes at the site. Although staging would not adversely affect any of the beetle species, access along the beach and foredune may crush the beetles or their tunnels. Globos dune beetles in particular tunnel under the foredune, which is one possible access route excavators may use to reach the most southern and northern parts of the site. Because the park does not know if any of the beetles occupy habitat at the site, it is unknown whether impacts would occur. As noted in Affected Environment, although habitat for the Point Reyes blue butterfly exists, a 1995 survey of the area surrounding Abbotts Lagoon did not find any individuals. Therefore, although the degree of impact to any of these rare invertebrates is not known, there would likely be no impact from access or staging to the Point Reyes blue butterfly. Impacts to the globos dune beetle may be minor or even moderate and site specific. Because the sandy tiger beetle and bumblebee scarab beetle are more mobile and occupy surface habitat, impacts to these species from access activities is likely to be negligible.

Rare invertebrates may be affected by each of the treatment tools in Alternative B. For example, fire may be too rapidly advancing to allow beetles or butterflies to escape. Excavators could crush globose beetle tunnels or the beetles themselves. Herbicide use is unlikely to have more than a negligible or minor adverse effect for the reasons identified above for the Myrtle's silverspot butterfly; for example, the concentrations in drift are unlikely to have any noticeable effect. The intensity of impacts from fire or excavators is unknown, primarily because the location or even whether these species occupy habitat at the site is unknown. Therefore, impacts could range from negligible to moderate and would be site specific and short-term.

Birds. Bird species that roost or nest in brush or on the ground in vegetation at or near the site may experience adverse impacts from vehicle traffic or the movement of heavy equipment. In particular, the Northern harrier, white-tailed kite, short-eared owl, Allen's hummingbird and willow flycatcher may all be at some risk as each occupies habitat or nests in low brush or in open country like grasslands, swales and coastal scrub. As noted above for listed species, a biological monitor would survey any proposed access routes and flag a route that does not affect these species or their habitat. If this same monitor is looking for other wildlife, including these rare bird species or their nests, impacts would be avoided and would be no more than negligible or minor and temporary. If the monitor misses a nest, impacts could include injury or death of eggs or chicks, a possible minor to moderate localized impact. Because the remainder of rare birds listed in table 6 occupy habitat near or on Abbotts Lagoon, or are dependent on species that do so, they are unlikely to be disturbed by vehicles or heavy equipment solely related to staging or access.

This is because staging areas and access routes do not come close to the lagoon for the most part.

Treatment activities may also affect rare or sensitive bird species. The noise associated with excavation in this alternative has the potential to flush several species of rare shorebirds or even to exclude migrating shorebirds from resting at the site. In addition, prescribed burning and/or herbicide use could disturb nesting rare birds, such as Northern harriers, white-tailed kites, Allen's hummingbird or short-eared owls.

As noted above in the discussion of impacts to brown pelicans, waterfowl and shorebirds may be more sensitive to noise than other bird species (Bowles 1995; NPS 1994). Migratory birds are also considered more sensitive to noise, and although the reason for this is unknown, scientists speculate that it may be because birds are relatively unfamiliar with each area they use as a stopover, including whether noises are sources of danger (Bowles 1995). Birds can and do habituate to noise; for example, Robbins (1966 as cited in Bowles 1995) unsuccessfully attempted to drive Laysan albatrosses nesting near a military installation away using aircraft, intense tones, gunfire and even chasing and handling by humans. Although the birds would fly away from the most intense noise sources (120 dBA), they returned quickly.

When birds are disturbed, they may initially alert, flip their wings, walk, swim or fly short distances. More intense aversion triggers longer movements, crouching on the nest for nesting individuals, attacks on the source of the disturbance (by raptors or terns particularly) and long interruptions of normal behavior. In the extreme, individuals or flocks respond with panic flight or running (Bowles 1995). Panic flight is the most dangerous of the responses, as animals can abandon nests or chicks, knock eggs in panic or leave chicks or eggs vulnerable to weather and predation. Many wildlife managers are particularly concerned about massive, flock-wide losses in marine bird species; examples of these losses include a near 50,000 nest failure of sooty terns that may have been related to repeated sonic booms and the crushing of 88% of eggs in a rookery by adult white pelicans escaping overflight noise (ibid.).

Physiologically, noise is suspected of causing stress-related illness when it is chronic. Startles are characterized by a rapid increase in heart rate and cardiac output, shutdown of the gut and other nonessential functions, and rapid mobilization of glucose reserves to supply muscles. Energetic output is increased, which in an environment with less than abundant food resources or environmental stress (such as cold weather), can cause illness, reproductive failures or even death in the long run. Noise can also mask other important sounds such as the approach of a predator or between individual adult birds, or between parents and chicks.

Birds like waterfowl that migrate or occupy habitat in groups appear to be most likely to fly from noise sources. Authors speculate that this is because the entire flock will fly when the most sensitive individual in the group does (Bowles 1995). The brant, which occurs at Abbotts Lagoon, has been studied by several researchers and found to be sensitive to even relative distant sources of loud noise, perhaps because of the combination of sound and visual stimulus (of a helicopter, for example). Other species that may be more likely to exhibit startle and/or escape behavior when excavators are near the site include terns, sandpipers, geese and marbled godwits.

The combination of the sight and sound of an excavator, even at 65 or 70 dBA, may frighten some waterfowl and/or shorebirds. Because treatment would continue for what could be several days within 200-400 m of the shoreline where these birds rest and forage, some are likely to move out of the area permanently. Others would experience the physiological and behavioral effects of stress. Some, like the elegant tern, may be excluded from using the site during a critical week of their migration.

For those birds that are nesting, prescribed fire, herbicide application and/or excavation could have for short-term impacts. Adults may abandon the nest for several hours while a prescribed burn takes place, resulting in the loss of eggs or possibly of chicks. Excavators may approach nests of dune species, such as short-eared owls, quite closely and may even crush eggs or chicks. Surveying by a biological monitor before removing *Ammophila* minimize the chance of this impact.

Birds that nest in scrub or shrub near the lagoon or wetlands (Northern harrier, white-tailed kite, Allen's hummingbird) may be disturbed by the noise of excavation or by human activity as *Ammophila* is removed with the use of hand tools. Nesting birds are less likely to fly away than wintering birds (Bowles 1995), but eggs or chicks may be temporarily left uncovered or unprotected, with possible increases in predation or losses from weather. The chances of nesting birds experiencing impacts greater than minor or moderate in intensity could be diminished by the use of the biological monitor and through seasonal restrictions. For example, all nesting by these species is completed by the end of June (J. Evens, pers comm. 2008). If work in this part of the site is targeted for completion in July, it would also precede fall migration, and so would minimize impact to near all species that use the tidal flats and lagoon as habitat. With these mitigation measures in place, impacts to rare birds, including nesting birds, would be minor. Without it, impacts to some species, including those that nest in the area or those that use the site for a particularly critical time in their migration or that are displaced to less productive habitat, could be moderate and short-term.

Point Reyes jumping mouse. This species occupies moist grassland and riparian habitat and may occur in the vicinity of the site or Abbotts Lagoon. However, it would not be affected by staging or access, as any secondary routes would be planned to avoid dune hollows or other wet areas. Also, as noted above, access routes would not come close enough to the lagoon to encroach on habitat that may be used by this species.

Although it may be disturbed by noise, smoke or herbicide drift, the impacts are likely to be no more than minor and short term. If herbicide drift covers some of the vegetation consumed by the jumping mouse, ingestion could mean a higher exposure to glyphosate. In an acute exposure scenario where application rates are 3-7 times those anticipated at the park, continuous consumption of contaminated vegetation resulted in 225 mg glyphosate per kg body weight in terrestrial vertebrates (USDA Forest Service 2003). The lowest observed adverse effect level in mammals is 350 mg/kg. Given that applications would be more dilute, that the only source of contamination of non-target plants is drift (and therefore even more dilute than direct spray) and that herbicide would not be sprayed in the vicinity of Abbotts Lagoon riparian vegetation, the chances of more than minor adverse effects to this species from glyphosate are minimal. Smoke or noise may temporarily disturb mice and cause them to move deeper into shrub or away from the source of these disturbances; again impacts would be no more than minor and short term.

Cumulative Impacts

The cumulative impacts from actions beyond implementing Alternative B are the same as those described for Alternative A. However, removing *Ammophila* would help in offsetting some impacts to listed plant and animal species, including Tidestrom's lupine, beach layia and Western snowy plover. As noted above in the analysis of impacts from this alternative, these benefits could be substantial, particularly for the two endangered plant species at the site. If restoration results in the extent of repopulation of the 300-acre treatment site the park is expecting, it could lead be enough to de-list both Tidestrom's lupine and beach layia, a major benefit to the species. Snowy plovers would also experience substantial benefits from restoration, and Alternative B would result in minor to moderate regional positive effects to this species.

Conclusion

Impacts from staging and access common to both action alternatives would not affect listed plant species because they do not occur along routes or in areas proposed for staging. Seasonal restrictions, speed limits and other mitigation would prevent most impacts from driving vehicles and heavy equipment to and from the site to Myrtle's silverspot butterflies, but collisions with adults and inadvertent crushing of larvae or pupae are possible, a moderate short-term localized effect and possible adverse effect under the Endangered Species Act. Red-legged frogs would not be affected because they do not occur along the access routes and because equipment operators would be trained to recognize them and stop work. Nesting snowy plovers would not be affected by access or staging, but wintering plovers may experience negligible or minor short-term impacts from disturbance by heavy equipment moving along access routes on the foredune. No or negligible impacts to California brown pelicans, least terns and willow flycatchers from access or staging would occur. Access could crush and kill individuals or small patches of rare unlisted plants, a minor to moderate localized impact. Rare invertebrates could be crushed, or collisions with other rare beetles could occur, with negligible to more intense, but unknown impacts. Rare birds nesting in scrub or other open country may be at risk from access, with minor to moderate adverse localized impacts possible.

Localized minor impacts to a few individuals of Sonoma alopecurus from prescribed burning are possible. Mitigation to minimize impacts from burning, herbicide spraying and excavation would keep impacts from treatment activities to no more than minor for beach layia and Tidestrom's lupine. In the long-term, both species would experience major benefits from removal of *Ammophila*. Increases in sand movement following removal of *Ammophila* may cause temporary adverse impacts to Tidestrom's lupine.

Seasonal and geographic restrictions, flagging of access routes to avoid important habitat and a speed limit during the period when adults emerge would help keep impacts of excavation to moderate for Myrtle's silverspot butterfly. Still, even a single collision or destruction of a caterpillar means the impact would be moderate and possibly adverse effect. Prescribed burning could also kill an occasional larva, pupa, adult or larval host plant. The use of herbicides is not expected to have more than minor short term impacts, which at the highest exposure would be 1/3 of that shown to be statistically indistinguishable from the no effect level. In the long term, removal of *Ammophila* and iceplant would have moderate or even major localized and minor to moderate regional benefits for silverspots by increasing the abundance of native dune mat nectar species.

Negligible to minor impacts from prescribed burning, negligible short-term impacts from herbicide use and no impacts from excavation to red-legged frogs are expected from Alternative B. Some negligible or minor impact from increased filling of wetland habitat with more mobile sand following the removal of *Ammophila* is possible.

Although human activity (manual removal, spraying herbicides, preparing the site for a prescribed burn) in the reardunes could disturb plovers, it may also protect them (especially chicks) by minimizing the chance of inadvertently ingesting herbicide or being burned. Negligible to minor short-term impacts to plovers from ingesting sprayed insect prey are a possibility. Smoke or flames from fires in the reardunes could disturb nesting or wintering birds temporarily, with minor impacts. The noise of ATVs may be particularly disturbing, with minor to moderate impacts. While excavators would only affect wintering plovers in this alternative, noise levels could be high and continuous along the foredune with minor or even moderate localized impacts. No adverse effect to plovers from any treatment activities as defined by the Endangered Species Act would occur. Removal of *Ammophila* would provide major long-term parkwide and moderate regional benefits for plover breeding and rearing success.

California brown pelicans would be disturbed by the noise of excavation, as well as by smoke or flames from prescribed burning or ATVs distributing flames. Minor to moderate short-term or long-term impacts could occur, but no adverse effect under the Endangered Species Act is expected.

Negligible short-term impacts to the California least tern and willow flycatcher from human activity and noise could occur, but either is a very rare migrant to the site.

Rare plants could experience minor to moderate adverse short-term impacts from the loss of a few individuals or small patches during prescribed burning or from herbicide drift, especially where they are heavily intermixed with *Ammophila*. In the long-term, they would experience minor to moderate benefits from reducing competition for soil moisture and nutrients and creating bare sand for them to colonize.

Negligible to moderate localized adverse short-term impacts to rare invertebrates from prescribed fire, herbicide drift and excavating could occur. Rare birds, particularly some waterfowl, are likely to make repeated flights away from noisy equipment, including ATVs as well as excavators, and they and other species may abandon the site for the season. Some species may pass the site by when migrating, resulting in possible moderate adverse effects on energetics. Nesting birds may experience loss of eggs or chicks from fire or nest abandonment, as well as physiological stress and increased expenditures of energy. If biological monitors are used to scan for rare species in the vicinity and alter treatment accordingly, these impacts could be minor; without this mitigation they would be localized, short-term and moderate.

Smoke or noise may have temporary minor impacts on the rare Point Reyes jumping mouse.

Cumulative impacts to listed and rare species would continue to include those from encroachment from nonnative invasive species, recreational use and development, livestock grazing, over-collecting (Myrtle's silverspot butterflies), stream modifications, development, recreational use, pesticide use, increased mercury and oil spills and loss of habitat. However, restoration at the treatment site would offset impacts from encroaching *Ammophila* along the Pacific Coast to a substantial degree for Tidestrom's lupine and beach layia, and to a lesser but still minor or moderate degree to the regional Western snowy plover breeding population.

No impairment to park species of concern would occur from implementing Alternative B.

Impact of Alternative C

Analysis

Alternative C would rely on mechanical and hand removal of *Ammophila* and iceplant from the site. Although the types of impacts identified above for excavators, e.g.. noise and the presence of human activity, would be the same as in Alternative B, the intensity of the impact could differ. For example, whereas heavy equipment would only be used to remove *Ammophila* from the foredune in Alternative B and thereby remain several hundred meters from the shoreline of Abbotts Lagoon, excavation would be used to treat the entire site in Alternative C. At some points, the reardune *Ammophila* comes to within 200 meters of the lagoon shoreline, and within 20 or fewer meters of the tidal flats at the lagoon's southern end. This means noise levels would be substantially higher for some rare birds than in Alternative B. If one piece of equipment is operating in the area, noise levels would be in the 80-85 dBA range (a bulldozer at 50 feet emits 85 dBA; a backhoe emits 80 dBA [US DOT 2006]). If more than one is operating simultaneously, a combined effect would occur, with noise levels possibly reaching 90 dBA or greater at a distance of 50 feet. Although

equipment may be working several hours per day, it would not be as close as 50 feet for more than a day or two. At 100 feet, noise from each of these pieces of equipment would drop by about 6 decibels, and at 200 feet by another 6 decibels.

In addition, *Ammophila* would be removed by hand where it transitions into dune mat or dune shrub habitat. The disturbance from this human activity would be similar to that in Alternative B for the contractors and volunteers applying herbicide using backpack sprayers, although the seasons in which the activity occurs could be different and the extent of backpack spraying would be larger than the area slated for hand removal.

Listed Plant Species

Listed plant species would not be affected by access or staging. Because Sonoma spineflower does not occur on the site, no impact to this species is expected. A few individuals of Sonoma alopecurus do occur on the shorelines of wetlands or in wet meadows, but impacts to this species would be avoided through the use of flagging, buffers and required hand removal of *Ammophila* from wetlands. With these mitigation measures in place, impacts from treatment are expected to be no more than minor.

Whereas individuals of beach layia, Sonoma alopecurus and/or Tidestrom's lupine could be inadvertently sprayed or burned in Alternative B, this would not be the case in Alternative C. Biological monitors would flag the limits of a population as well as individual plants. However, like Alternative B, if an individual or small patch of a listed species in heavily intermixed with *Ammophila*, the park would likely excavate it along with the nonnative species. If it is isolated, it may be removed and relocated before excavation takes place. Impacts from treatment to these three species would be no more than minor.

Long-term benefits to beach layia and Tidestrom's lupine would be the same as described for Alternative B. Over time, the removal of the threat of encroachment by *Ammophila* and iceplant would allow expansion of beach layia and Tidestrom's lupine. Because it spreads more quickly, it is possible that beach layia could reach a population of 100,000 individuals at the site within six months to two years following treatment. Tidestrom's lupine is also expected to expand to a lesser extent, and may reach a population size of 50,000 plants in this same time period. If these expansions occur, they would be major benefits for both species and could result in de-listing from the Endangered Species Act (Peterson and others 2003 as cited in NPS 2005). Temporarily stabilizing dunes upwind of Tidestrom's lupine may prevent short-term impacts from burying following the removal of *Ammophila*.

Listed Animal Species

Myrtle's silverspot butterfly. Impacts from access would be the same as for Alternative B. Collisions with heavy equipment accessing the site are possible, as are inadvertent crushing of larvae or pupae. Impacts would be moderate and short-term, and would fall into the "likely to adversely affect" category under the Endangered Species Act.

The park has committed to mitigation actions in this alternative that would eliminate much of the impact to Myrtle's silverspot butterfly associated with digging. First, removal work would be halted in dune mat areas or wherever concentrations of nectar plants and adult butterflies are found between June 15 and August 31. Second, any known population of the butterfly's larval plant, western dog violet, would be avoided year round. The larval plant grows in grassland environments, where any vehicles would be required to stay on existing graveled roads. Biological monitors would be used to identify and dog violets along routes proposed for secondary access to the site so that they can be avoided. In addition, any vehicles or heavy equipment accessing or treating the site in the vicinity of known populations would be restricted to a 10 m.p.h speed limit to avoid collisions with adult butterflies.

As noted in Affected Environment, Myrtle's silverspot butterflies nectar on a variety of plant sources, many of which grow in dune mat and coastal scrub. Grasslands also contain both nectar species and the larval host for silverspots (e.g., dog violets). Excavators would also avoid work in much of the foredune between March and September as they would be limited to work further than 500 meters from nesting snowy plovers. This could help protect nectaring butterflies.

Dune mat areas, where most of the plants used by the silverspot butterfly occur, would generally be off-limits to heavy equipment throughout the entire construction period. Limited foot traffic may be allowed through these areas with the concurrence of a biological monitor if sensitive species occur in the dune mat. If no sensitive species occur, some limited access with heavy equipment with the concurrence of the biological monitor is also possible.

Avoiding all dog violets would eliminate nearly all impacts to eggs and emerging larvae, and stopping treatment in silverspot habitat in the summer would eliminate the bulk of impacts to adults. The wintering larvae or pupae, and an occasional adult nectaring in unexpected locations or outside known habitat would be subject to crushing or being hit by excavators in this alternative. Although the chances of this are low, the possibility that an individual could be killed means impacts could be moderate, with the potential for adverse impacts under the Endangered Species Act. The presence of humans is not expected to have any impact on butterflies or their larvae, particularly since anyone conducting hand removal operations would have been trained to identify the butterfly and plants on which larvae feed so that each of these could be avoided.

Long-term benefits would be the same as described above for Alternative B. The removal of *Ammophila* and iceplant from the site is expected to have a moderate or even major site specific, and minor to moderate regional beneficial impact on this species. The benefit would result from an increase in nectaring plants and dune mat habitat, and protection of dog violets from continuing encroachment by *Ammophila* and iceplant.

Red-legged frog. Because frog habitat does not appear to exist in the area where staging and access would occur, these activities would not affect red-legged frogs.

Excavation could affect frogs if an individual moves onto the site. However, NPS and contractors would be trained to identify red-legged frogs and would stop work if an individual frog is spotted on the site. U.S. Fish and Wildlife personnel would be contacted to remove any frog seen on the site unless it moves off the site on its own.

Although red-legged frogs have not been observed on the site, they do occupy habitat that borders it, including dune slacks and wet grasslands. In addition to stopping work if a frog is found on the site, dune slack wetlands would generally be treated only around the edges, where *Ammophila* would be removed by hand. No treatment is planned within known wetlands, and equipment would not be allowed within five feet of any wetland. Frog habitat would also be kept from impacts from fuel or chemicals by storing these liquids well away from any dune slack or wetland habitat. Because they do not generally occur on the site, the direct impact of excavation would not be at issue.

Frogs have been sighted as close as a few hundred feet from at least one portion of reardune habitat that would be treated with excavation in this alternative. Although research on the effects of noise or vibrations on amphibians is scarce, it is possible that red-legged frogs could experience temporary impacts from either. For example, ground vibrations are known to be used by some amphibians to transmit social signals and to avoid prey (Bowles 1995). Spadefoot toads in estivation (warm weather hibernation) responded to very loud noise (94 dBA) of motorcycles driving overhead by exiting their burrows during the wrong season of the year (Federal Highway Administration 2004). Although red-legged

frogs in the vicinity of the site may experience some temporary impacts from noise or vibrations, they would be short term and dissipate as the equipment moves west or otherwise out of range. Therefore, the impact of treatment to red-legged frogs assuming all mitigation described above is in place would be negligible or at most minor and short term, with no potential for adverse effects under the Endangered Species Act.

Although some increase in sand movement would likely take place following *Ammophila* removal, the frog habitat is well back from the shoreline and would not experience more than minor localized impacts. These impacts may be short term until the site is colonized by native vegetation, or persist as a long-term effect. Regional effects on this species would be negligible.

Snowy plover. Wintering Western snowy plovers may be disturbed by heavy equipment driving along the beach or foredune to access the site, but the impact would be temporary and no more than minor. A slight beneficial effect from creating habitat in excavator tracks is possible as well. For compliance with the Endangered Species Act purposes, access and staging with required mitigation may "affect but not adversely affect" wintering snowy plovers.

As noted in Alternative B, no excavation within 500 feet of a snowy plover nest would take place from March 1 to mid-September. It is possible that hand removal could take place during this period, and excavation would be permitted both outside the 500 foot buffer in foredunes, as well as in the reardunes where nesting plovers would not generally go. With these mitigation measures in place, no impacts to nesting plovers from treatment activities are expected in Alternative C.

Wintering plovers may experience impact from noise and human activity, as this would be the season plover habitat is treated. Alternative C would involve the travel of heavy equipment back and forth along the *Ammophila*-covered foredune to fuel outside the nesting season, as well as working steadily in a particular part of the site to remove *Ammophila* at a rate of between 0.6 and 0.9 acres/day for up to 160 days (NPS 2005). As noted in Alternative B, loud noise and/or the presence of mechanized equipment approaching disturbs individuals of this species, as does the presence of humans. Response to very loud noise in the form of fireworks has on at least one occasion flushed all snowy plovers from a reserve where they were nesting. A study of plovers' reaction to low-flying helicopters indicated hiding and/or escape via flight were common responses (Hatch 1996). Noise from helicopters in the study likely ranged between 60 dBA (500 feet) to as high as 80 dBA (50 feet). These decibel levels are in the same range or lower than those from excavators and bulldozers that would be used at the site, and some avoidance behavior, increased hiding, loss of foraging time and other energetic consequences are likely for wintering plovers as a result of excavation.

Hand removal of *Ammophila* in dune mat or other vegetation near the foredune could also disturb plovers. At least one study cited in the Recovery Plan for plovers (Page et al. 1977 as cited in USFWS 2007) found that pedestrians at Point Reyes disturbed plovers. Birds flew away 78% of the time when people were with 50 m and 34% of the time when people were over 100 m. The intensity of the reaction varied and appeared to be dependent on the type of disturbance and extent of recreation use at a particular beach. When an area was only rarely used for recreation, plover adults reacted when people were as far as 200 meters away. In a well-used beach, adults stayed until people were closer and returned quickly after they left. Joggers, walkers, stationary visitors all caused disruption.

While noise and human activity would disturb wintering plovers and cause behavior that results in energetic losses, the impact to the population at the site would be minor and short-lived (K. Peterlein, G. Page, J. Rogers, J. Evens, pers comm. 2008). Although some wintering plovers may leave the area for the season, a separate set of plovers would likely

arrive following work on the foredune to nest. Alternative C would "affect, but not adversely affect" this group of wintering plovers as it is defined by the Endangered Species Act.

The long-term benefits of Alternative C would be the same as described in Alternative B. Restoring dune habitat to a more natural condition and removing *Ammophila* would provide area-wide and regional benefits for the snowy plover population at the park.

The number of breeding pairs of Western snowy plovers would increase as a result of the greater availability of suitable nesting sites within the project area, including an increased usage of reardune areas for nesting and particularly for foraging. Given current utilization rates of available habitat, restoration could result in a surge of new nests, perhaps as many as 60. This would be a greater than 200% increase over current conditions, and a major site-specific and park-wide benefit for this species, as well as minor to moderate regional benefit. Additional benefits from an increase in the fledging rate are also expected as habitat for chicks to take cover from ravens and other predators would be returned.

California brown pelican. Driving excavators and other heavy equipment along the beach or foredune may temporarily disturb pelicans, but are not expected to have more than a negligible impact. Under the Endangered Species Act, access and staging would have either no effect or would "affect but not adversely affect" California brown pelicans.

The brown pelican and other waterbirds of special concern (see *Animal Species of Concern* below) use Abbotts Lagoon and its shoreline for feeding, roosting and other purposes. The pelican sits on the lagoon and uses the tidal flat at the southern end of the lagoon for much of the year. The noise and presence of machinery, as well as the presence of humans removing *Ammophila* or conducting other activities (monitoring, for example) is likely to disturb pelicans as described in Alternative B. Because this alternative involves 160 days of excavating (Alternative B would take 65 days to excavate a portion of the site) and excavators would move to within a few meters of the lagoon, the chances of permanently displacing one or more individuals from the lagoon or tidal flat are higher than in Alternative B. As noted above, noise levels from a single piece of heavy equipment at 50 feet are 80-85 dBA. If they move closer or if more than one is operating at the same time, noise would be louder, on the order of 90 dBA.

As noted in the analysis of Alternative B, some migratory waterfowl exposed to overflights by aircraft in a much lower noise range than this never completely habituated, and changes in behavior as a result of exposure to noise were extensive enough that they could be translated into energetic losses. Black brants (a goose found at the site) would fly away even when helicopters were as far away as 3 km in one study. However, in other studies of water birds (egrets, snow geese), individuals returned to the area less than five minutes following overflights even when the aircraft had come quite close (400 feet; Kushlan 1979 and David & Wisely 1974; both as cited in Report to Congress on the Effects of Aircraft Overflights on the National Park System, NPS 1994). Similar to Alternative B, some individual pelicans may retreat to the upper lobes of Abbotts Lagoon or the coast and wait for the day's noise to end before returning to the lobe of the lagoon and coastal flat they occupy now. However, others may find the noise disturbing enough that they will abandon the area, either until the *Ammophila* removal stops or permanently. The number of pelicans permanently moving from the site is likely to be larger than in Alternative B, and may be a moderate short-term impact on the population near the site. However, the impact is not likely to last beyond one season; that is, the lagoon would be occupied with a similar number of pelicans in the winter following treatment. Therefore, although treatment activities would affect this species, they would not adversely affect it as defined by the Endangered Species Act. No impact in the long term from *Ammophila* removal is expected.

California least tern. The likelihood that California least terns would be affected in any way by access or staging is considered extremely low, and impacts negligible. Similarly,

although it is possible that an individual would move on beyond the site rather than use if for a fall migration stop over because of the noise of excavation or human activity during treatment, it is considered highly unlikely because this species so rarely visits the area. Impacts would be negligible, without potential for adverse effects under the Endangered Species Act. In the long term, removal of iceplant or *Ammophila* would have neither beneficial nor adverse effects on the least tern.

Willow flycatcher. Because access routes would avoid wetlands the chance of encountering and affecting an individual of this species is considered remote and impacts from staging and access negligible.

As in Alternative B, the chances of coincident excavation and migrating flycatchers is considered very low and impacts likely to be negligible. Actions "may affect, but are not likely to adversely affect" willow flycatchers. In the long term, removal of iceplant or *Ammophila* will have neither beneficial nor adverse effects on the willow flycatcher.

Plant Species of Concern

Because monitors would be looking for rare plant species in laying out access routes and staging areas, it is unlikely that more than a few individuals or a small patch of a given species would be affected, although the effect would likely be lethal if crushed by vehicles or heavy equipment. The impact of access and/or staging would therefore likely be minor, but no more than moderate and localized.

The impacts to plant species of concern from excavation would be similar to those described above for Alternative B, but more extensive. If rare plants are part of a protected patch of native vegetation, such as dune mat, dune shrub/scrub or grassland which is not heavily intermixed with *Ammophila*, no or only incidental negligible impact from trampling would occur, as hand removal would be used to take out individuals of iceplant or *Ammophila*. As noted in other sections of this document, a buffer of hand removed vegetation would make it clear where excavators could work near these native plant communities. Because the majority of rare plants at the site are in native communities, they would be protected in Alternative C by this single mitigation measure.

However, in some cases one or a few individuals are heavily intermixed with *Ammophila* and it would be nearly impossible to avoid or remove them. These few individuals would be killed as part of the *Ammophila* removal process.

The long-term impacts to most rare plant species would be identical to those described for Alternative B, with moderate to major site specific benefits for dune mat or dune shrub species, and minor to moderate benefits for grassland species.

Animal Species of Concern

Invertebrates. Impacts from staging or access to the globos dune beetle may be minor or even moderate and site specific. Because the sandy tiger beetle and bumblebee scarab beetle are more mobile and occupy surface habitat, impacts to these species from access activities are likely to be negligible.

As noted in Alternative B, the impacts of excavation on rare invertebrates at the site are unknown, in large part because it is unknown where or even whether they exist. If they are present, excavators could crush globose beetle tunnels or the beetles themselves. In Alternative C, nearly all or all tunneling beetles in the dunes would experience mortality from excavation, as it is extensive across the site. Only those in larger communities of native vegetation would escape. Flying beetles or butterflies may collide with heavy equipment, although seasonal speed limits in the southern portion of the site to protect Myrtle's silverspot butterfly may also help minimize impacts to these species. If these

insects are crushed or killed, it is possible and even likely that the site would be recolonized with the same species from adjacent dune areas. However, short-term impacts could range from negligible to moderate for these rare insects at the site.

Birds. Some species of rare birds nesting near access routes may experience minor to moderate localized impacts from heavy equipment through crushing nests, eggs or chicks. A biological monitor would survey any proposed access routes and flag a route that does not affect these species or their habitat. If this same monitor is looking for other wildlife, including these rare bird species or their nests, impacts would be avoided and would be no more than negligible or minor and temporary.

The noise associated with excavation in this alternative has the potential to flush several species of rare shorebirds or even to exclude migrating shorebirds from resting at the site.

As noted above in the discussion of impacts to brown pelicans, waterfowl and shorebirds may be more sensitive to noise than other bird species (Bowles 1995; NPS 1994). Migratory birds are also considered more sensitive to noise, and although the reason for this is unknown, scientists speculate that it may be because birds are relatively unfamiliar with each area they use as a stopover, including whether noises are sources of danger (Bowles 1995). As noted in other portions of this document, birds can and do habituate to noise, although it appears than some species never habituate.

Physiologically, noise is suspected of causing stress-related illness when it is chronic. Startles are characterized by a rapid increase in heart rate and cardiac output, shutdown of the gut and other nonessential functions, and rapid mobilization of glucose reserves to supply muscles. Energetic output is increased, which in an environment with less than abundant food resources or environmental stress (such as cold weather), can cause illness, reproductive failures or even death in the long run. Noise can also mask other important sounds such as the approach of a predator or communication between individual adult birds, or parents and chicks.

Birds like waterfowl that migrate or occupy habitat in groups appear to be most likely to fly from noise sources (Bowles 1995). The brant, which occurs at Abbotts Lagoon, has been studied by several researchers and found to be sensitive to even relative distant sources of loud noise, perhaps because of the combination of sound and visual stimulus (of a helicopter, for example). Other species that may be more likely to exhibit startle and/or escape behavior when excavators are near the site include terns, sandpipers, geese and marbled godwits.

The combination of the sight and sound of an excavator moving toward them would undoubtedly frighten some waterfowl and/or shorebirds. Because treatment would continue for what could be several days within 15 to 400 m of the shoreline where these birds rest and forage, some are likely to move out of the area permanently. Others would experience the physiological and behavioral effects of stress. Some, like the elegant tern, may be excluded from using the site during a critical week of their migration.

For those birds that are nesting, excavation could have for severe impacts. Excavators may approach nests of dune species, such as short-eared owls, quite closely and may even crush eggs or chicks. Surveying by a biological monitor before removing *Ammophila* would help ensure this impact does not occur. Birds that nest in scrub or shrub near the lagoon or wetlands (Northern harrier, white-tailed kite) would be disturbed by human activity as *Ammophila* is removed with the use of hand tools. Nesting birds are less likely to fly away than wintering birds (Bowles 1995), but eggs or chicks may nonetheless be temporarily left uncovered or unprotected, with possible increases in predation or losses from weather. The chances of nesting birds experiencing greater than minor or moderate in intensity could be diminished by the use of the biological monitor and through seasonal restrictions. For

example, all nesting by these species is completed by the end of June (J. Evens, pers comm. 2008). If work in this part of the site is targeted for completion in July, it would also precede fall migration, and so would minimize impact to near all species that use the tidal flats and lagoon as habitat. With these mitigation measures in place, impacts to rare birds, including nesting birds, would be minor. Without them, impacts to some species, including those that nest in the area or those that use the site for a particularly critical time in their migration or that are displaced to less productive habitat, could be moderate and short-term.

Point Reyes jumping mouse. This small mammal may occupy moist meadow or riparian habitat in the vicinity of Abbotts Lagoon. It would not be affected by staging or access, as routes would not come close to its habitat. Noise during excavation may temporarily disturb mice and cause them to move deeper into shrub or away from the source of these disturbances but impacts would be no more than minor and short term.

Cumulative Impacts

Cumulative impacts would be the same as described for Alternative B.

Conclusions

Impacts from staging and access would be the same as described above for Alternative B.

Minor short-term impacts to Sonoma alopecurus from occasional excavation of an individual plant may occur. Minor adverse impacts from excavation to beach layia or Tidestrom's lupine when an individual is highly intermixed with *Ammophila* and cannot be treated with manual removal are also possible. Long-term benefits would be the same as described for Alternative B, as would a possible concern that remobilized dune sands could bury parts of the Tidestrom's lupine population at the site.

Similar to Alternative B, although mitigation would prevent most impacts from treatment from adversely affecting Myrtle's silverspot butterfly, collisions with adult butterflies or crushing larvae, eggs, pupae or habitat remain a possibility with moderate short-term impacts and the possibility of an adverse effect as defined by the Endangered Species Act. Moderate or even major localized benefits from the return of species diversity and abundance of native nectaring plants would result in the long-term from treatment.

Although excavation would be unlikely to directly affect red-legged frogs given the mitigation included in this proposal, noise could disrupt communication temporarily, a negligible or minor short-term impact with no potential for adverse effect as defined by the Endangered Species Act. Increased sand movement following treatment may have additional minor short-term adverse impacts on frog habitat.

Wintering plovers would be disturbed by the noise and presence of excavators treating the site, and the foredune particularly. Energetic losses as well as possible abandonment of the area for the season may result, although impacts to the population at the site would remain minor or moderate and short term because nesting would be unaffected. Although plovers would experience effect it would not be an adverse effect as defined by the Endangered Species Act. Moderate regional and major localized benefits would result in the long-term from increases in breeding and rearing success.

Noise in this alternative would be more intense and closer to California brown pelican wintering habitat than in Alternative B. The number of pelicans abandoning the site for at least a season is likely to be larger than in Alternative B, a moderate short-term localized effect, but not likely to adversely affect this species as defined by the Endangered Species Act.

Impacts to the California least tern and willow flycatcher would be negligible and not likely to adversely affect either species as defined by the ESA.

Similar to Alternative B, a few individuals of rare plants would be so heavily intermixed with *Ammophila* that they would be impossible to hand treat and would be killed by excavation. This is a minor to moderate, short-term localized impact. Long-term localized benefits would be minor to major, depending on the habitat for the species and extent of encroachment by *Ammophila*.

Negligible to moderate short-term impacts from crushing or colliding with rare insects may occur. To an even greater extent than in Alternative B, rare birds, and particularly those wintering on the shore of Abbotts Lagoon, would be disturbed by the presence and noise of excavators. Impacts would range from negligible for those species or individuals that can habituate to moderate for more sensitive species or nesting species. If it is present, the rare Point Reyes jumping mouse may experience minor, short-term adverse effects from the noise and presence of excavators.

Cumulative impacts to listed and rare species would continue to include those from encroachment from nonnative invasive species, recreational use and development, livestock grazing, over-collecting (Myrtle's silverspot butterflies), stream modifications, development, recreational use, pesticide use, increased mercury and oil spills and loss of habitat. However, restoration at the treatment site would offset impacts from encroaching *Ammophila* along the Pacific Coast to a substantial degree for Tidestrom's lupine and beach layia, and to a lesser but still minor or moderate degree to the regional Western snowy plover breeding population.

No impairment to park species of concern would occur from implementing Alternative C.

WILDLIFE

Policies and Regulations

The NPS *Management Policies 2006* require parks to maintain animals (and plants) that are native to park ecosystems (sec. 4.4.1). Specifically, they are to preserve and restore natural abundances, diversities, distribution and behaviors, restore native animal populations where they have been extirpated by past human actions and minimize human impacts.

Some groups of wildlife, including marine mammals, commercial fish species and migratory birds are further regulated. For example, "Essential Fish Habitat," as established under the Magnusen-Stevens Fishery Management Act, is intended to protect spawning and rearing habitat of more than 65 commercially fished species. Protection is managed through the National Marine Fisheries Service.

The Federal Migratory Bird Treaty Act enacts the provisions of treaties between North American and European countries. Over 800 bird species are protected under the legislation. It mandates federal agencies to consider impacts to protected breeding birds during implementation of projects on federal lands, including disruption to nesting and egg-laying activities.

Assessment Methodology

The sources of information used to determine the types of wildlife at the site are anecdotal observations by wildlife specialists and visitors, and surveys of habitat that is very similar and in the vicinity of the project site. No wildlife surveys for this site have been conducted.

Natural history information including habitat use, breeding cycles and sensitivity to noise or disturbance was gathered from the scientific literature.

Context and Duration

Short-term: Short-term impacts are those that last no more than one year or one reproductive season.

Long-term: impacts would extend beyond a single year or reproductive season.

Impact Thresholds

The following thresholds were used to determine the magnitude of effects on wildlife and wildlife habitat:

Negligible: There would be no observable or measurable impacts to native wildlife species, their habitats, or the natural processes sustaining them.

Minor: Impacts would be detectable, but they would be well within the natural range of variability of impact and would not be expected to result in any long-term changes in the number of individuals, the extent or quality of their habitats, or the natural processes sustaining them. Generally, no discernable adverse or beneficial impacts at the population level or to key ecosystem processes would occur. Occasional responses to disturbance by some individuals could be expected, but without detectable interference to feeding, reproduction, or other factors affecting population levels. If impacts are beneficial, a detectable decrease in responses to disturbance may occur.

Moderate: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and they could be outside the natural range of variability for short periods of time. Population numbers, population structure, genetic variability, and other demographic factors for species might experience short-term changes, but would be expected to quickly rebound to pre-impact numbers and to remain stable and viable in the long term. More regular responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, or other factors affecting short-term population levels. If impacts are beneficial, reductions in disturbance would be readily observable.

Key ecosystem processes might experience short-term disruptions that would be outside natural variation (but would soon return to natural conditions).

Major: Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and they would be expected to be outside the natural range of variability for long periods of time or be permanent.

Population numbers, population structure, genetic variability, and other demographic factors for species might experience large, short- or long-term declines, with population numbers noticeably depressed because of actions in the proposal. Frequent responses to disturbance by some individuals would be expected, with negative impacts to feeding, reproduction, or other factors resulting in a long-term decrease in population levels. If impacts are beneficial, disturbance would stop and population levels would increase in the short and/or long-term. Breeding colonies of native species might relocate to other portions of the park.

Key ecosystem processes might be disrupted in the long term or permanently. Loss of habitat might affect the viability of at least some native species.

Impact of No Action

Analysis

As noted in the Affected Environment section of this document, species diversity and of mammals at the site is probably quite low. The exception to this is that a larger than expected number of deer mice occupy *Ammophila* grasslands. Researchers (Pitts and Barbour 1979 and Knight 2008) have indicated that it is an apparently successful strategy for deer mice to occupy *Ammophila* and feed off the seeds of Tidestrom's lupine (a member of the pea family with large, nutritious seeds) in adjacent dune mat communities. The dense vegetation of *Ammophila* hides the mice from predators; they only venture into the much less vegetated dune mat to feed. Aerial predators of deer mice and other small rodents in the dune area where a 1979 study took place near the project site included barn owl, red-tailed hawk, Northern harrier, great horned owl and American kestrel. Although the study found *Ammophila* was the dominant vegetative community favored by deer mice, it was not the only place they were found, as they are considered highly mobile and were found in a variety of vegetative types (Pitts and Barbour 1979). However, the density of trapped mice was consistently higher where cover was dense. Deer mice also feed on other vegetation and insects and are frequently depicted in the literature as insectivores who may occasionally take seeds. The same study found that deer mice eat leaves as well. Although these early authors did not see mice feeding upon lupine or examine stomach contents, indirect evidence of consumption existed in that "every single pea was consumed."

As the analysis of impacts to Tidestrom's lupine shows, a more recent study which experimentally placed fruits from a lupine species near *Ammophila* and further away found those located near beachgrass were more likely to be consumed (Knight 2008). The author concluded that predation by deer mice was the most likely reason, and used the information to calculate the rate of disappearance of endangered Tidestrom's lupine that would occur if no action were taken to eliminate *Ammophila* from the study site.

Under the No Action alternative, deer mice would continue to thrive at concentrated levels. Other small mammal species would likely continue to decline in number and diversity, as suggested by the Fellers and Pratt (2002) study of a similar dune location in the park. This likely means that the majority of native mammals are currently experiencing adverse impacts from the predominance of nonnative vegetation at the site. Compared to existing conditions, the long-term impacts of the small-scale treatment under No Action to most native mammals would be minor and beneficial. However, implementing this alternative would also continue what may be a moderate adverse impact to most small mammals and the species that use them as prey by reducing plant and animal species diversity and wildlife habitat.

Treatment activities may have short or long-term adverse effects on small mammals that are unable to outrun an excavator, for example. The deer mouse would be most likely to be adversely affected in both the short-term the long-term by removal of *Ammophila*, as it would be more likely to be in European beachgrass and killed by heavy machinery. This species may also experience long-term moderate adverse effects from a reduction in its available habitat, although an increase in Tidestrom's lupine may slightly offset this effect by providing more abundant food resources.

The larger predatory mammals (fox and badger) presumably at the site would experience similar indirect effects from a continued reduction in available prey. Herbivorous mammals may be benefitted from the more dense vegetative coverage *Ammophila* provides and experience some adverse impacts when small-scale removal takes place under this alternative.

Predatory birds are likely to be adversely affected by the continued presence of *Ammophila*, as it would screen much of the available small mammal prey and reduce habitat and abundance of small mammals. Small-scale removal of *Ammophila* could provide relative minor benefits for these birds in the long-run compared to existing conditions.

It is unknown whether passerines (songbirds, non-raptors) are affected by *Ammophila*, although likely that most are adversely affected by its presence. Food resources, such as insects, or the leaves, fruits or seeds of native plants are less available or hidden from view in *Ammophila*. Habitat in the dunes or on the open beach has been altered and reduced in its geographic extent, and would minimize habitat for and the number of individual birds requiring this kind of niche. For example, the stabilized foredune has shortened the width of open beach available to shorebirds to feed, and has also concentrated visitors into a smaller space with short-term adverse impacts to birds along the shoreline from the presence and activity of humans. The degree of impact to birds from continuing the No Action alternative is unknown, but likely to be adverse and minor to moderate. Small-scale treatment to remove *Ammophila* under this alternative could offset these impacts to some degree.

Treatment activities could scare away birds (see analysis of *Animal Species of Concern* for more information) with resultant energetic losses or possible impacts on reproductive success for those birds nesting or preparing to nest during the treatment period. This would be a short-term negligible or minor impact, as the scale of treatment is very small.

It is unknown whether *Ammophila* has adversely affected any amphibians or reptiles at the site. Reptiles at the site may include garter snakes or alligator lizards. Amphibians at the site, if they exist, occupy wetland and riparian habitat, as would garter snakes. Although *Ammophila* has not infested dune hollows or dune slacks at the study area, it does grow around the shorelines. This may have impeded travel by amphibians or garter snakes to or from these wetlands, with possible minor adverse effects. Small-scale treatment could inadvertently crush an amphibian or reptile, although because wetlands have a treatment buffer would be less likely than other types of wildlife to experience impacts.

Fish in dune hollows or in adjacent Abbotts Lagoon have not likely experienced any effects from the growth of *Ammophila* at the study site and would be unaffected by small-scale treatment.

Insects and invertebrates that occupy dune habitat may have experienced adverse effects from *Ammophila*, as they would depend on open sand habitat and native flowers and vegetation for food. One study of arthropods (insects and spiders) in dunes vegetated with *Ammophila* compared to those covered by native plants found an inverse relationship between species diversity and *Ammophila* cover (Slobodchikoff and Doyden 1977 as cited in Ngo n.d.). Those insects that occupy wetlands may not have been as affected, however, as *Ammophila* has not infested this vegetative community to the degree it has other habitats. Although the degree of impact to invertebrates from *Ammophila* is unknown, decreased diversity suggests it is minor or moderate and adverse. The No Action alternative would continue this impact for the most part, although small-scale treatment activities could result in additional short-term minor adverse impacts from crushing or collisions.

Cumulative Impacts

Actions in the park that may have cumulative effects on wildlife include fire management activities, small- and large-scale habitat restoration, rehabilitation and re-use of existing structures, cultural resource preservation and sewage system upgrades. Short-term adverse impacts and long-term beneficial impacts from restoration at Giacomini Ranch to some of the same coastal wildlife species as the dune restoration effort would affect are possible. In addition, past dune treatment at Abbotts Lagoon and likely future restoration along the Great Beach have beneficial impacts to most dune wildlife species. The rehabilitation and

upgrade of existing structures such as those named in the park's current draft of its General Management Plan could have short-term negligible impacts on wildlife, but may not affect the same species as this treatment effort and would therefore be unlikely to have cumulative or additive effects. Fire management efforts are also unlikely to have additive effects, as no prescribed burn or thinning operations are anticipated for coastal dune habitat. Cattle grazing is allowed on some areas of the park, including some dune habitat currently. Cattle can trample vegetation or slow moving wildlife and alter habitat through nutrient inputs, soil compaction and changes in the type of vegetation that grows. Ranch management, such as with the use of ATVs in the dunes could also crush wildlife or their habitat.

Conclusion

The monospecific dense vegetation of *Ammophila* at the site would continue to keep native species diversity of wildlife lower than in surrounding areas. Some species that thrive in *Ammophila*, such as deer mice, would potentially increase in number, but overall, No Action would continue a moderate adverse impact to most small mammals. Predators would also be adversely affected by the scarcity of prey and dense cover *Ammophila* provides. Native birds, including shorebirds, would have less native plant habitat for seeds, vegetation and nesting materials; shorebirds may be additionally adversely affected by the concentration of human activity into a smaller beach area, with minor to moderate adverse effects likely. Small-scale treatment activities could kill some small mammals, invertebrates or other slow moving animals or scare mammals or birds away, with negligible to minor short-term localized effects. Cumulative effects on wildlife include adverse impacts in the park from ranch management and beneficial impacts from restoration efforts at Giacomini, former and likely future dune restoration along the park's Great Beach.

No impairment to park wildlife from implementing Alternative A would occur.

Impact of Alternative B

Analysis

Impacts to wildlife from access or staging would largely depend on the habitat they occupy, although noise from heavy equipment being driven to the site along access roads would temporarily frighten any animal within hearing range. These would be primarily grassland species. Vehicles or heavy equipment could also inadvertently crush slower moving animals, particularly beetles or other invertebrates, or amphibians or slower moving reptiles. Generally the impacts from access or staging activities to wildlife would be minor, short-term and localized.

Treatment activities in this alternative include the use of prescribe fire, herbicide spraying and excavation. Each of these may have adverse effects on wildlife.

Prescribed fire would be started using people with drip torches or on ATVs and using flame throwers. Fire lines (fuel breaks) would be created around dune mat and wetland vegetation to prevent it from burning. *Ammophila*, native grasses and shrubs and coastal scrub would be burned in the fire. Slower moving animals, such as crawling invertebrates, amphibians, reptiles and even small mammals may be unable to outrun a prescribed fire and would be killed. Deer mice, known to concentrate in *Ammophila*, may experience particularly adverse impacts from burning. ATVs may crush slow-moving wildlife as well. Larger mammals and birds would be able to escape a fire, and would likely vacate the area when humans or ATVs approach. Impacts would be short-term, adverse and minor to moderate for most species.

In the long run, many native wildlife species would likely benefit from a controlled burn, as coastal scrub, grasslands and many shrub species such as coyote brush are adapted to light

fires. New spring growth would provide food, nesting materials and cover for wildlife and would have minor to moderate beneficial impacts for most species.

The use of herbicides could also adversely affect wildlife, although only those in the immediate vicinity of backpack sprayers or aquatic wildlife suffering from runoff of sprayed vegetation and soil are likely to experience any impact. At very high doses (2000-6000 mg glyphosate/kg body weight) of oral ingestion, glyphosate can be fatal (50% of mice with this level of glyphosate ingestion die), or cause respiratory, urinary, renal, gastrointestinal or other illness. Subchronic exposures in animals have been associated with weight loss, liver and kidney pathology, reproductive system changes and possible neurotoxicity. Estimates of ingestion by humans applying glyphosate via backpack spraying range from 0.026 mg/kg/day to 0.045 mg/kg/day (USDA Forest Service 2003). Because those applying the spray would be most likely to inhale or ingest it, these numbers are considered the highest possible exposure for any animal. The dose of no apparent effect in humans is 175 mg/kg—4000 to 7000 times higher than the dose a worker spraying glyphosate in a backpack sprayer would receive in a single day.

For mammals, the level of no observed effect is assumed to be the same as for humans. For birds, a chronic exposure of 100 mg/kg has no observable effect and the acute level (single dose) where no effect was observed in two bird species (bobwhite quail and mallard ducks) was 562 mg/kg. This level for honey bees was 50 µg/bee.

In aquatic animals, the concentration in water is the measurement used to determine effect. For most fish, the concentration where no effects were observed was 25.7 mg/L. Regulators and researchers estimate that sensitive fish species would be 10 times more likely to experience effects, so that the NOEC (no effect concentration) is 1/10 that of less sensitive species, i.e. 2.57 mg/L. Sensitive fish species include salmon and trout. The NOEC for Roundup®, which contains a surfactant toxic to fish, is much lower than for glyphosate, 0.64 mg/L for most fish, and 0.36 mg/L for sensitive species (USDA Forest Service 2003). Amphibians are considered no more sensitive than fish to glyphosate or Roundup®. The only chronic study of aquatic invertebrates found an NOEC of 50 mg/L, and estimated the NOEC for Roundup® to be 0.7 mg/L. The lethal concentration at which 50% of aquatic invertebrates died was 780 mg/L for glyphosate and 11 mg/L for glyphosate with toxic surfactants, such as the one in Roundup®.

The Environmental Protection Agency characterizes the risk of effect from glyphosate to wildlife as very low, noting “effects to birds, mammals, fish and invertebrates are minimal” (USDA Forest Service 2003). Scenarios investigated by contractors to the U.S. Forest Service, which regularly uses glyphosate to control weeds and other vegetation, showed that none of the concentrations cited above as levels of no effect were reached under any scenario at an application rate of 2 lbs a.e./acre, which is the high end of what the park is expected to use at the site. At higher application rates (7 lbs a.e./acre), direct spray of invertebrates (in this case, honey bee), and ingestion by birds or mammals from consumption of contaminated vegetation or insects did exceed these levels. Aquatic life was also at risk from direct spraying over water or rainfall following herbicide application to adjacent vegetation if the glyphosate compound included toxic surfactants, even if it was applied at a lower 2 lb a.e./acre rate.

Although the concentration of glyphosate used at the site would be 1-2 lb a.e./acre and not contain toxic surfactants, it may have direct or indirect impacts on wildlife. For example, studies on invertebrates show that direct spraying of a spider species in the lab and field using variable concentrations of between 0.16 lb a.e./acre and 1.92 lb a.e./acre resulted in low rates of mortality that were not related to dose. In the field, doses of 0.17 to 0.53 lb a.e./acre resulted in decreased spider populations attributed to secondary effects from changes in vegetation (Haughton et al. 2001b as cited in USDA Forest Service 2003). Direct

toxic effects in the form of increased mortality (not statistically significant) on isopods exposed to leaf litter at levels equivalent to application rates of 1.9 lb a.e./acre have also been reported (Eijsackers 1992 as cited in USDA Forest Service 2003). While it is unlikely that more than a few individual flying insects would be killed by drift (see impacts to Myrtle's silverspot butterfly for more information), those insects or invertebrates that are ground dwellers or that inhabit leaf litter could be killed both by crushing from workers applying herbicides and from runoff and soil contamination, particularly following a heavy rain. Although glyphosate degrades in soil over time, its half life averages 30 days, longer than the lifetime of some insects and invertebrates. The potential for wide-spread mortality would be mitigated somewhat by the fact that the site would be sprayed at the beginning of the coastal dry season. If rain occurs, impacts to ground dwelling invertebrates from herbicide runoff and concentration could be moderate; without rain, it is likely to have no more than minor short-term adverse impacts.

For birds or mammals that consume *Ammophila* stems, or seeds or other vegetation that lies on the ground and has been contaminated with spray, wind erosion or runoff, glyphosate could be ingested. The contractors to the USFS modeled exposure of a large herbivorous mammal, a small insectivorous bird and a large herbivorous bird to see what each would ingest from food sources following spraying. Glyphosate was not assumed to accumulate in tissues.

At a direct application rate of 2 lbs a.e./acre, a deer sized mammal consuming contaminated *Ammophila* would ingest 97 mg/kg/day. Smaller mammals would absorb as much as 48 mg/kg/day. The level of no adverse effect in mammals is 175 mg/kg, indicating that death of mammals is unlikely. In birds, the acute ingestion of contaminated insects (e.g. 100% of all insects a bird eats are assumed to be contaminated) could concentrate glyphosate at 225 mg/kg, the highest of any group studied. Large herbivorous birds could consume 152 mg/kg the day the area is sprayed, or 83.2 mg/kg/day on average over the next 90 days (see table 4-3 in USDA Forest Service 2003 for more information). The NOEC for birds is 562 mg/kg. Each of these modeled scenarios supports the finding by the EPA that glyphosate does not present more than a minor risk to terrestrial wildlife species.

To assess the potential impact of herbicide application to fish and amphibians, a reasonable calculation of the concentration of glyphosate in wetland or riparian areas following spraying is important. This is reported in more detail in the analysis of Alternative B impacts to red-legged frogs and summarized here. Making very conservative assumptions (such as the half life of glyphosate is 1000 days), the U.S. Forest Service contractors modeled the contamination a stream or pond would experience following application on adjacent slopes. For sandy soils, immediate or acute concentrations were higher, in the neighborhood of 0.4 mg/L per pound applied. Over time, this would fall to below 0.008 mg/L. As noted above, the NOEC for glyphosate in most fish is 25.7 mg/L, and for more sensitive species is 2.57 mg/L. Under even high rainfall and sandy soils conditions, concentrations would not approach even the level where no effect on fish has been observed. The US EPA has declared that glyphosate "should not cause acute or chronic effects to aquatic environments. Therefore, minimal risk is expected to aquatic organisms from the technical glyphosate" (EPA/OPP 1993 as cited in USDA Forest Service 2003).

Although glyphosate may be non-toxic or nearly non-toxic to aquatic life, the surfactants added to some formulations such as Roundup®, are not. For example, the LC_{50}, or the concentration at which 50% of the fish exposed are killed, of glyphosate for the fathead minnow is 97 mg/L, whereas a formulation similar to Roundup® has an LC_{50} for the same species of 2.3 mg/L. The concentration of Roundup® or similar formulation where no effects are observed on most fish is 0.64 mg/L, and is assumed to be half that, or 0.32 mg/L for sensitive fish species.

Significantly less toxic surfactants are available. For example, at least one study (McLaren and Hart 1995 as cited in USDA APHIS 1997) has demonstrated that either the surfactants LI-700 or Agri-Dex have considerably lower toxic potency than other surfactants on two species of fish and the tiny freshwater crustacean *Daphnia*. Table 8 shows the differences in the concentration of each of three surfactants tested on a species of fish considered less sensitive (bluegill sunfish), more sensitive (rainbow trout) and on Daphnia needed to kill 50% of those individuals exposed.

Table 8. Lethality of Surfactant Formulations of LI 700, R-11 and Agri-Dex for Aquatic Species

Genus/species	LI 700	R-11	Agri-Dex
Bluegill sunfish	210 mg/L	4.2 mg/L	>1000 mg/L
Rainbow trout	130 mg/L	3.8 mg/L	>1000 mg/L
Daphnia magna	170 mg/L	19 mg/L	>1000 mg/L

Source: McLaren/Hart 1995 as cited in USDA APHIS 1997

Note that Agri-Dex is essentially non-toxic to fish and if used, herbicide application in Alternative B would have only negligible or minor localized and short-term adverse impacts to aquatic life.

Alternative B also involves the use of excavators to remove *Ammophila* from the foredune. These and other heavy equipment would also drive to and from the work site along the foredune in the winter to minimize impacts to other resources. The prohibition of work in the bulk of the foredune during the months March 1 to mid-September to protect breeding Western snowy plovers would also help protect any other nesting shorebirds or waterfowl along the beach. However, wintering shorebirds that use the beach to forage or rest would be disturbed from the noise and presence of heavy equipment, and would likely escape by flying some distance. Most would return after the machinery passes. All wildlife in the vicinity of a worksite where loud mechanized equipment is being used would flee, or freeze and hide if they are unable to flee, as decibel levels would be in the 80-90 dBA. This level of noise is detectable by most species even several kilometers from its source in a quiet environment like the study site (Bowles 1995).

Although the frequency of noise affects different species differently, the following summarizes the response at different decibels for each group of wildlife.

The literature has several studies that indicate that invertebrates may be sensitive to low frequency vibrations. Honeybees will stop moving for up to 20 minutes and flies show a startle response at noise levels of 80 to 120 dB. Underground invertebrates, such as earthworms, move toward the surface near roadways at low frequencies, exposing them as food for birds (FHWA 2004).

A few studies of underwater noise and its impact on fish have found that low frequency noise and pressure changes from noise can cause changes in distribution and startle responses in goldfish, herring and salmon. Another has found that the growth rate and fry survival of two minnow species increased for those held in quieter tanks.

Few studies have found any impact on amphibians or reptiles from road noise, although vibrations are known to be used by some amphibian species to transmit social signals and

avoid prey (Bowles 1995). Spadefoot toads in estivation (warm weather hibernation) responded to motorcycles driving overhead by exiting their burrows during the wrong season of the year (FHWA 2004). Noise levels were very high, on the order of 94 dBA. Other studies that have found lower densities of both reptiles and amphibians along roadways have attributed the loss to increased roadkills, which may indicate indifference or unawareness of noise for individuals of these species.

Studies of birds have found that some birds will not nest near chronic noise (such as road noise), but others are unaffected. Other studies found the density of territorial males was lower at distances up to 200 meters from chronic noise than it was at greater distances. The same researchers found 17 of 23 grassland bird species studied for three years showed some adverse effect from chronic road noise. Another study had similar results, finding that the density of 7 of 12 grassland species was reduced as noise levels increased. The effect appeared to be most significant above a decibel level of 50 dBA.

Waterfowl and other waterbirds such as black-tailed godwit and oystercatcher were particularly sensitive, and reductions in density were found as far away at 1500 meters from car noise (measured at 70 dBA at the source). Construction noise in the 25 to 95 dBA range displaced up to 67% of nesting greater whitefronted geese in one study (Johnson et al. 2003 as cited in AMEC 2005). Incubating waterfowl responses to aircraft summarized by Johnson et al. 2003 (as cited in AMEC 2005) include alert and concealment posture, interruption of foraging behavior, flight and decreases in nest attendance. Of the various aerial disturbance types, helicopters were the most disturbing to most species. Black brant geese were disturbed by aircraft overflights at altitudes of 500 m up to 1.5 km (AMEC 2005).

Raptors are also affected by noise. Several species of raptors increased their home range size during military activity that included vehicle activity, human activity and helicopter flights. Red-tailed hawks shifted their activity away from the noise, but returned when training had ceased (FHWA 2004). Ellis et al (1991 as cited in AMEC 2005) reported frequent and nearby jet aircraft passes noticeably alarmed peregrine falcons and sometimes caused a flight response, but never caused nest abandonment or reproductive failure. Fraser et al. (1985 as cited in AMEC 2005) found that 10% of nesting bald eagles interrupted their incubation or brooding activities during overflights. Mexican spotted owls were observed to flush at noise levels of 92 dBA, but returned to pre-disturbance behavior within 10 to 15 minutes after the noise (Delaney et al. 1999 as cited in AMEC 2005).

Some birds do become habituated to continuous or frequent noise. For example, a study of actual or simulated jet aircraft at 63 dBA did not disturb wood ducks. A field study of several species of duck found no effect on the time-activity budgets at a mean sound level of 85 dBA when exposed to low-flying aircraft.

Similarly, many large mammals show little disturbance from car traffic, snowmobiles or other sources of noise in areas where noise has not been associated with hunting or other danger. Indirect evidence such as the frequency of ungulate scat has not been noticeably different close to roads or further away from them in several studies (FHWA 2004). A few studies have documented increases in activity in large mammals after aircraft approaches, but these have been mild, such as taking a few steps or walking away slowly (Bowles 1995). However, individuals tracked remotely moved greater distances in the 24 hours after exposure. In other words, wild ungulates and carnivores changed their movements in response to loud noise (snowmobiles, construction, aircraft and even walking visitors in parks for example) (ibid.). The behavioral response to noise in small mammals has not been studied, but physiologically, rodents increase adrenal activity after chronic exposure to noise. Heart rate, corticosteroid levels and other chemicals increase as well. However, no change in population density of free ranging individuals resulted from chronic noise (ibid.).

No evidence supports the idea of increases in abortions in mammals associated with loud noise (ibid.).

Although site specific wildlife studies have not been performed at the project location, the results of noise studies generally indicate that fish, reptiles, amphibians and mammals would experience minor adverse impacts from excavation, while birds and in particular waterfowl or shorebirds, would be repeatedly disturbed and even displaced from habitat at the site. Migrating birds or marine mammals that occasionally use the area to haul out may avoid it during treatment. These would be moderate adverse localized short-term impacts. The impacts for some invertebrates from noise could also be moderate and short term.

Excavation could also kill less mobile or smaller animals in the foredune area in Alternative B. Those animals at particular risk include deer mice, which occupy and even concentrate in *Ammophila*. Insects may be crushed or collide with excavators, and reptiles, amphibians or small mammals may also be at high risk. The impact from this activity would be confined to only those species that feed, rest, cross or have territory in the foredune and are present in the months September to February. For these species, the impact would be moderate and short-term.

In the long-term, removal of *Ammophila* would likely benefit most wildlife, as most animals in the area are adapted to conditions in more open, sparsely vegetated dunes that would result from treatment. Results from the one mammal study in a nearby *Ammophila* infested dune substantiates this by showing that the species diversity and average number of mammals is only about 20% that in other parts of the park (Feller and Pratt 2002). A second study examining insects and spiders found an inverse relationship between species diversity and *Ammophila* cover (Slobodchikoff and Doyden 1977 as cited in Ngo n.d.). With the removal of monocultures of a nonnative species, species diversity of both arthropods and mammals, and presumably of other wildlife, would be expected to increase, a minor to moderate benefit for the site. Some species, such as the deer mouse, would be adversely affected in the long term by removal of *Ammophila*, as it has adapted to this invasive species and flourishes in it, although because this species is highly mobile and a generalist feeder, the impact may be minor. Blowing sand from stockpiled supplies could increase sedimentation in wetlands and have minor short impacts to fish and amphibians; this could increase following removal of *Ammophila* as sand movement is remobilized until native vegetation recolonize the site, a possible moderate and longer-term effect.

Cumulative Impacts

Cumulative effects on wildlife species would be the same as described for Alternative A. Combined with this alternative, the benefits of past and potential future restoration of dune habitat and the Giacomini project would be substantial for many native species and could provide offsetting regional benefits for historical impacts from development and habitat loss.

Conclusion

Impacts to wildlife from staging or access include crushing or noise, particularly for grassland species or slower moving animals. These would be minor, short-term and localized.

Prescribed fire could kill slower moving animals as well or species that occupy *Ammophila* as habitat, such as deer mice. Larger mammals and birds would be less affected. Short-term impacts from prescribed burning would be adverse and minor to moderate for most species. Long-term benefits from stimulating growth by prescribed burning in most native vegetative communities would result for many wildlife species.

The use of herbicides would generally not adversely affect wildlife directly, as exposures would be lower than those known to cause any negative effects. Surfactants in the herbicide formulation could harm aquatic animals and inadvertent spraying may kill some insects or invertebrates with minor to moderate short-term impacts. Ingestion of contaminated vegetation or insects may have minor impacts on some birds or mammals.

The noise of excavators would particularly affect waterfowl or shorebirds at the site, which would be repeatedly disturbed and even displaced from habitat at the site in some cases. Fish, amphibians, reptiles and mammals would experience minor short-term localized impacts. Migrating birds or marine mammals that occasionally use the area to haul out may avoid it during treatment, a moderate adverse localized short-term impact. The impacts for some invertebrates from noise could also be moderate and short term. Excavation could also kill less mobile or smaller animals in the foredune area, a moderate localized impact.

In the long-term, removal of *Ammophila* would likely have minor to moderate benefits for most wildlife, although possible moderate adverse effects to fish and amphibians from restoring natural sand movement may also occur.

Cumulative effects on wildlife include adverse impacts in the park from ranch management and beneficial impacts from restoration efforts at Giacomini, former and likely future dune restoration along the park's Great Beach.

No impairment to park wildlife would result from implementing Alternative B.

Impact of Alternative C

Analysis

Impacts to wildlife from access or staging would largely depend on the habitat they occupy, although noise from heavy equipment being driven to the site along access roads would temporarily frighten any animal within hearing range. These would be primarily grassland species. Vehicles or heavy equipment could also inadvertently crush slower moving animals, particularly beetles or other invertebrates, or amphibians or slower moving reptiles. Generally the impacts from access or staging activities to wildlife would be minor, short-term and localized.

Alternative C differs from Alternative B in that only excavation and hand treatment would be used. No burning or herbicide use would take place. This means that the primary short-term impacts to wildlife would occur as a result of digging and noise. The same prohibition on excavation within 500 feet of nesting plovers between March 1 and mid-September would be true of Alternative C; however extensive excavation in most of the reardunes would take place during this period (because plovers nest in the foredune). The impact of noise and excavation on wildlife is already discussed above in Alternative B in some detail, and is summarized here.

The literature has several studies that indicate that invertebrates may be sensitive to low frequency vibrations, with behavioral changes including startle responses, stopping activity or moving to the surface for underground invertebrates. Fish can hear very loud noise (over 100 dBA) underwater, and respond to it by changing distribution. Growth of young fish is improved in a quiet environment. Vibrations from excavators may interrupt social signals used by frogs and other amphibians, or may cause amphibians to surface from burrows during the wrong time of year. Some species of amphibians appear to be indifferent to noise. Several studies have found that birds tend to avoid areas for roosting and nesting where noise levels are above about 50 dBA, but that this tendency is not universal. Waterfowl and waterbirds appear to be particularly sensitive to even lower levels of noise. Generally nesting raptors do not abandon their nests during loud noise, although they are

noticeably alarmed. Some birds do become habituated to even very frequent loud noise. Large mammals do not generally show flight responses, but do change their long-term movements to avoid noisy areas. Impacts to small mammals have not been studied in the field, but indicate increased adrenal activity when exposed to continuous noise. Reproductive failure in mammals does not appear to be caused by noise.

Noise impacts would be much further ranging than in Alternative B and could particularly have moderate effects that last at least one season and possibly two (both fall and spring, for example) on migratory birds. Some individuals may choose not to use the site during treatment as a migratory stopover; with limited resting habitat for migratory birds along the coast, this could have substantial adverse impacts to those individuals in terms of energetic costs. Sensitive birds, such as waterbirds, waterfowl or birds that nest in the area, may also abandon the site for the winter as noise would be continuous during the day for more than five months. This same avoidance and displacement would be true for other mobile wildlife, including large mammals, which may avoid the site during the day, during the entire treatment period, or for a longer period of time. The impacts to these mobile and sensitive species would be moderate, area-wide and could be long-term (e.g., last longer than one or two seasons).

Although smaller or less-mobile species may also experience impact from noise, they are also more likely to be killed from crushing or digging by excavators. Those animals at particular risk include deer mice, which occupy and even concentrate in *Ammophila*. In Alternative C, much of the 300 acres would be traveled and/or dug by excavators and other heavy equipment. This would likely result in many higher invertebrate, reptile and small mammal deaths from crushing or digging than in other alternatives. Insects could also be killed from collisions with excavators. As noted above, larger mammals and birds could escape, and fish and amphibians would be largely unaffected as wetland areas would be treated with hand removal.

Loosening and stockpiling sand at the site may have short or even long-term adverse effects on amphibians and fish, as wind or water erosion could move sand to dune hollows and dune slacks, as well as to Abbotts Lagoon and increase turbidity or sedimentation of these wetland areas. This same phenomenon could occur to a much greater extent as dunes are cleared of *Ammophila*, as beachgrass binds and stabilizes dunes. Hollows are downwind of the foredune, and returning it to its natural windblown and sparsely vegetated state would increase sand movement toward these small wetlands. The degree of impact to fish and amphibians is unknown, but could be minor or moderate and short or long-term.

The long-term benefits described in Alternative B would also be true of this alternative and would minor to moderate for most wildlife species.

Cumulative Impacts

Cumulative impacts would be the same as described above for Alternative B.

Conclusion

Impacts to wildlife associated with staging and access would be the same as described above for Alternative B; that is, minor, short-term and localized effects to populations at the site from noise or injury.

The primary impacts from Alternative C to wildlife would be noise and crushing or collision injuries from heavy equipment. These impacts would be wider-ranging than in Alternative B and could have moderate effects that last at least one season and possibly two (both fall and spring, for example) on migratory birds or other mobile and sensitive species. Although smaller or less-mobile species may also experience impact from noise, they are also more

likely to be killed from crushing or digging by excavators. Blowing sand from stockpiled supplies could increase sedimentation in wetlands and have minor short impacts to fish and amphibians; this could increase following removal of *Ammophila* as sand movement is remobilized until native vegetation recolonize the site, a possible moderate and longer-term effect.

The long-term benefits described in Alternative B would also be true of this alternative and would be minor to moderate for most wildlife species.

Cumulative effects on wildlife include adverse impacts in the park from ranch management and beneficial impacts from restoration efforts at Giacomini, former and likely future dune restoration along the park's Great Beach.

No impairment to park wildlife would result from implementing Alternative C.

SOILS AND SAND MOVEMENT

Policies and Regulations

Relevant sections of the NPS *Management Policies 2006* regulate soils and shoreline processes. Shoreline processes, including erosion, deposition and dune formation are to be continued without interference. Where human activities have altered the nature or rate of a natural shoreline process, the NPS is to investigate alternatives to mitigate the effects of those activities and to restore natural conditions (sec. 4.8.1.1).

Assessment Methodology

The primary source of information in assessing impacts to soils and sand movement is monitoring results from previous nonnative species removal projects conducted by the park north of Abbotts Lagoon. Because conditions are very similar on the project site (which is directly south of the lagoon), the same degree of change in the movement and shifting of dune sands following treatment was assumed. The scientific literature and other published environmental assessments for similar treatment in other locations were also consulted for additional information.

Context, Duration and Impact Thresholds

The standardized definitions of each of these factors as described at the beginning of this section were used to evaluate impacts to soils and sand movement.

Impact of No Action

Analysis

The presence of *Ammophila* has altered dunes at the site, and would continue to do so under the No Action alternative.

Ammophila foredunes have an internal structure of interbedded unconsolidated sand (mostly horizontal or gently sloping beds) formed by pulses of sand that bury surface shoots (burial episodes) and shallow layers of persistent, dense *Ammophila* vegetation, including roots, rhizomes, and shoots. *Ammophila* roots and rhizomes concentrate in the upper 20-30 cm of any temporarily stable sand surface because of its tendency to branch, elongate and form buds when briefly exposed to light. Foredunes tend to have young, viable buds capable of resprouting (after rhizome breakage and light exposure) distributed deeply through the dune profile. The faster the foredune accumulates sand, the deeper these viable buds are likely to be found. In addition, the persistent root, rhizome, and leaf litter "fabric" inherent

in young foredune stratigraphy provides significant surface roughness and resistance to wind deflation even after shoots are removed. This combination of deep rhizomes with buds provide *Ammophila* with a stabilized dune and the ability to reproduce even after shoots are taken, which is the reason deep digging and burial are required to remove it from the foredune.

This deep burial of *Ammophila* and persistence of its roots, rhizomes and other vegetative material is also the reason the structure of the foredune is altered in *Ammophila* dominated dunes. While the roots hold sand in place, the fabric of its vegetative mass makes it resistant to wind even if surface layers are blown away. This resistance to wind also increases its ability to trap sand. As noted in the discussion of vegetation at the site, *Ammophila* thrives where it is being actively covered by sand and briefly exposed to light, which leads to additional colonization and the dense tuft formation this species displays. Rather than the hummocky low foredune typical of pre-*Ammophila* coastlines along the Pacific, those vegetated by European beachgrass are stabilized, steep and continuous (Pickart 2008). Sand flow to the region inland of the foredune (the reardunes) is slowed or stopped, and blowouts are infrequent or non-existent. As noted in other sections of this document, the taller, steeper foredune has had consequences for animals like the threatened Western snowy plover, whose chicks are virtually unable to access the reardunes where they would normally find cover from predators and additional food sources.

Many of the older, landward stabilized reardunes have a different internal structure than the foredune. Most of the reardunes at the site are heads or flanks of formerly migrating U-dune lobes that stabilized decades ago. Over time (decades), the internal fabric of interbedded *Ammophila* root/rhizome meshes decays, as it is active burial that keeps it expanding and growing. In addition, *Ammophila* grows singly by seeds in the reardunes. This makes it more likely that viable buds of *Ammophila* in the reardunes are concentrated in the upper 20-40 cm. This was confirmed by digging several test pits in the reardunes which showed mostly unconsolidated sand below depths of about 0.3 m (Baye 2008). These less stabilized sands are more susceptible to wind movement, although because they are distant from the shore and are protected somewhat by the foredune, are not subject to as high wind speeds or sand accretion as the foredune.

Small-scale removal of *Ammophila* under this alternative would loosen sand and restore some movement at the site. However, most of the *Ammophila* dominated foredune would continue to remain in place, with continued moderate to major localized long-term adverse impacts on the natural movement of sand.

Cumulative Impacts

Cumulative effects to soils and sand movement at dunes in the park and vicinity include encroachment by *Ammophila*, iceplant and other invasive species over much of the Pacific Coast, as well as some more minor impacts from ranch management activities, cattle grazing and recreational use. Restoring natural sand movement patterns from small-scale treatment north of Abbotts Lagoon has had beneficial cumulative effects, as would future treatment of additional sections of the Great Beach at the park.

Conclusion

Small-scale removal of *Ammophila* under this alternative would loosen sand and restore some movement at the site. However, most of the *Ammophila* dominated foredune would remain in place, with continued moderate to major localized long-term adverse impacts on the natural movement of sand. Cumulative adverse effects in the region would continue to result from colonization by invasive stabilizing plant species, with some small-scale localized

cumulative benefits from past restoration at the park and larger-scale benefits from possible future restoration in the park.

No impairment to park soils would result from implementing Alternative A.

Impact of Alternative B

Analysis

Staging and Access

Grading for staging sites or travel, particularly by heavy equipment, along secondary access routes may increase bulk density of soils. In some soils where the particle sizes are small or pore spaces between particles are large, compaction and increased bulk density of soils can cause increases in runoff and erosion. However, because soils at the site are sandy and not easily compressed, the increase in bulk density or erosion would be minimal. Some soils may be removed to create a level area for staging, a negligible or minor site specific impact.

These same soils, including those along access routes, may be contaminated with fuel, oil or herbicides in the case of an uncontained spill or leaking equipment. However, equipment would be regularly inspected and the staging area would be impermeable, bermed or both to minimize the chance that fuel or chemicals could reach soils. Given these mitigation measures, the impact of staging or access to soils is likely to be negligible or minor and localized.

Treatment Activities

Soil at the site could experience impact from prescribed fire, herbicide use and excavation, as well as long-term impacts from removing *Ammophila*.

The impact of fire to soils varies with a number of factors, including vegetation and organic matter, soil moisture, soil type and steepness of slopes. Grass fires, such as would occur in *Ammophila*, tend to burn quickly over an area and cause little or no soil heating (NPS 2004). Grassland thatch even one centimeter thick can serve to insulate soils from heating in a typical fire. Even the heat generated by the heavier fuels in chaparral fires in southern California was found to be restricted largely to the surface soil layer (DeBano et al. 1998 as cited in NPS 2004). The damage to soils at the site would likely be minimal, as prescribed burns would tend to move quickly through the *Ammophila* dominated vegetation, even if it contains some shrubs or heavier fuels.

Fire can also convert nutrients in *Ammophila* into ash deposits, making them readily available to native vegetation as it recolonizes the treated area. This is particularly true for nitrogen, which is responsible for the rapid growth that often takes place following a fire.

Overall, prescribed fire may have negligible to minor short-term effects to the surface layer of soil where *Ammophila* is burned and negligible to minor short-term benefits to soils by increasing nutrient levels.

Soil microbes are responsible for the reduction of glyphosate following spraying, and half lives for glyphosate have been variously found to be between 20 and 60 days under aerobic conditions (and 96 days under anaerobic conditions) in soil, with an average of 30 days (USDA Forest Service 2003). Herbicide use would be expected to adversely affect soil microbes because microorganisms have the same metabolic pathway inhibited by glyphosate in plants. However, little information to suggest a harmful interaction and substantial research that indicates either neutral or enhanced effects exists (ibid.). For example, glyphosate is known to be readily metabolized by soil bacteria and many species of soil microbes can use it as a sole source of carbon. Most studies in the field have found

increased microbial activity following glyphosate exposure, including transient increases in soil fungi that may be detrimental to some plants. Further investigation of this phenomenon showed no indication that temporary increases of soil fungi resulted in any substantial or lasting damage to soil ecology.

Little information on the impact of glyphosate to the nutrients in soil exists. However, one study (Pell et al. 1998 as cited in USDA Forest Service 2003) found that concentrations of 100 ppm (parts per million, or mg/kg) had no significant effect on soil denitrification, a process whereby bacteria turn nitrates into nitrites or nitrogen gas and reduce fertility of soils. A second study (Bromilow et al. 1996 as cited in USDA Forest Service 2003) noted no effects on soil fertility in repeated applications of glyphosate over a 14 year period (at an application rate of 1.25 lb a.e./acre).

The impact of glyphosate spraying to the biological and nutrient properties of soil are expected to be negligible to minor, may be beneficial or adverse, and would be short-term.

Soils could also be affected in the short and/or long-term by excavation. As noted in the description of alternatives, excavation in the foredune must be very deep to capture buds and rhizomes buried by sand accumulation. This involves both digging to as deep as 6 feet to capture vegetation, and digging a minimum 9-foot trench in which to bury the vegetation and cap it with 6 feet of clean sand. The clean sand is then graded and contoured to match the surrounding dunes. In the reardunes, vegetation that has been removed is capped with 3-4.5 feet of clean sand (in Alternative C only). In Alternative B, excavation of 27 acres of foredunes to 6 feet and burial to 9 feet would involve digging of about one million cubic yards of sand. Although this would be highly noticeable and therefore a moderate impact, sand would be replaced and recontoured to minimize the impact to the surrounding topography. This would help prevent increases in erosion that would otherwise take place from altered topography and exposed slopes. In addition, wind would continue to sculpt and mold dunes at the site over time. In the long-term, impact to sand at the site from excavation would be negligible. In the short-term, some sand that is stockpiled waiting to be reburied may be lost to wind or wave erosion, a negligible to minor temporary effect.

Removing *Ammophila* would return natural movement of sand across the entire 300-acre treatment site. Results of removal in the site adjacent to and north of this site indicated that open sand was present on about 76% of the treated area (Peterson et al. 2003). The average change in absolute sand depth in European beachgrass removal areas was 4.9 inches. Most monitoring posts experienced sand burial, with an overall gain of 3.6 inches of sand around the posts. Observation by NPS staff suggests this was not due to an overall increase in dune height, but rather to the dunes being re-contoured to a more even surface (ibid.).

A comparison of the effectiveness of different mechanical removal methods for *Ammophila* in a series of experimental plots conducted at Little River State Beach in Humboldt County measured sand movement as one of the parameters of success (California Department of Parks and Recreation 2005). While the control plot lost sand over the two-year monitoring period, the plot treated with excavation had more than double the sand movement rate of other plots (0.11 cubic meters/square meter/year). The authors estimated that it would take fewer years to fill an experimental target storage compartment at these movement rates than for other methods. The study examined bulldozers, bulldozers with rakes and excavators.

Although the return of natural sand movement rates at the site would be a moderate to major positive impact to soils, topography and the ecology of the area, the quick pace of removal may temporarily destabilize the dunes to a greater extent than they would be under natural conditions. This could result in some filling of wetlands or burial of rare plant species downwind of the site as noted in the analysis of impacts to Vegetation.

Cumulative Impacts

In addition to the cumulative effects described for Alternative A, implementing Alternative B would have offsetting positive impacts for soil and sand movement in the region by returning natural conditions to 300 acres.

Conclusion

Grading to prepare staging areas would remove soils and use of access routes would increase compaction and possibly runoff or erosion. Heavy equipment may leak or spill fuel with some very localized contamination, although mitigation would keep these impacts to negligible or minor.

Soil at the site could experience short-term impact from prescribed fire, herbicide use and excavation, as well as long-term impacts from removing *Ammophila* under Alternative B. Prescribed fire may have negligible to minor short-term effects to the surface layer of soil where *Ammophila* is burned and negligible to minor short-term benefits to soils by increasing nutrient levels. No impacts to the biological properties of soil from fire are expected. The impact of glyphosate spraying to the biological and nutrient properties of soil are expected to be negligible to minor, may be beneficial or adverse, and would be short-term. Excavation could have minor short-term impacts from eroding stockpiled supplies or redistributing sand. Recontouring would keep long-term impacts from excavation to negligible. Restoring sand movement at the site would be a moderate to major localized benefit for soils, topography and the natural ecology of the area.

Cumulative adverse effects in the region would continue to result from colonization by invasive stabilizing plant species, although more substantial benefits from returning natural conditions than in Alternative A would result.

No impairment to park soils would result from implementing Alternative B.

Impact of Alternative C

Analysis

Staging and Access

Impacts from grading or access would be similar to those described for Alternative B. The only difference is that the secondary routes accessing the reardunes would be more heavily used in Alternative C, and impacts to bulk density would therefore be greater along these routes. Impacts are not likely to be more than minor in intensity for access because soils are sandy and not easily compressed. Impacts from staging would be similar to those in Alternative B, although spilled herbicides would not be a factor as herbicides are not used in this alternative except potentially as a small-scale measure to control resprouts.

Treatment Activities

Impacts of this alternative to soils would be from excavation and long-term restoration. The type of impact described above for excavation, including displacement of soils, subjecting stockpiled soils to wind and water erosion and long-term effects on topography and sand movement would be the same for this alternative. However, the extent of the impact would change.

For example, whereas Alternative B treats 27 acres of *Ammophila* with excavation, Alternative C would excavate 126 acres, and remove and rebury about three million cubic yards of sand. The chances that stockpiled soils would be subject to erosion from wind and rain is greater in this alternative because excavation extends over a longer period of time.

In addition, the potential for impacts (see *Water Resources*) to water quality or wetlands at the site is greater because excavation would take place in the reardunes, closer to dune hollows, dune slacks or Abbotts Lagoon. The impact of erosion would likely be adverse, minor and perhaps long-term as eroded sand could be displaced permanently from its original location. The effect of removing and reburying sand on topography would be temporary and negligible or minor, as sand would be regraded to blend with surrounding dunes.

The long-term impact of restoring natural movement of sand at the site would be moderate to major, long-term and beneficial as it would in Alternative B. However, the concern about sand movement burying wetlands or rare vegetation in the reardunes would be true of this alternative as well. Because large stockpiles of sand would be temporarily stored at the worksite and subject to being blown by wind, the chances of burying these resources even during treatment may be greater than in Alternative B.

Cumulative Impacts

Cumulative impacts from implementing Alternative C would be the same as those described above for Alternative B.

Conclusion

Grading to prepare staging areas would remove soils and use of access routes would increase compaction and possibly runoff or erosion. Heavy equipment may leak or spill fuel with some very localized contamination, although mitigation would keep these impacts to negligible or minor.

Minor short-term and possibly long-term impacts from exposure of stockpiled soils to wind and water erosion could occur across the site. The effect on topography of removing and reburying sand would be temporary and negligible or minor, as sand would be regraded to blend with surrounding dunes.

Restoring sand movement at the site would be a moderate to major localized benefit for soils, topography and the natural ecology of the area.

Cumulative adverse effects in the region would continue to result from colonization by invasive stabilizing plant species, although regional benefits from restoring natural conditions at the site would result from implementing Alternative C.

No impairment to park soils would result from implementing Alternative C.

WATER RESOURCES

Policies and Regulations

The NPS *Management Policies 2006* requires parks to avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks (sec. 4.6.3). The primary potential for impact to water resources at the site will be to Abbotts Lagoon and dune slacks, which are both considered wetlands. Therefore, information included in the policies and regulations section above for *Vegetation* also applies. In addition to protecting water quality, the NPS is also required to re-establish natural functions and processes in human-disturbed components of natural systems, including to water, hydrologic patterns and sediment transport (sec. 4.1.5).

Assessment Methodology

The literature was consulted to determine the potential toxic ecological or other impact from the use of glyphosate and surfactants to water resources and the probability of overspray contamination with distance. Monitoring results from sand movement correlated with treatment of *Ammophila*-infested dunes to the north of Abbotts Lagoon, expert opinion and the scientific literature were used to determine the extent to which dune slacks may be filled with sand following treatment.

Context and Duration

The standardized definitions for context and duration are used to evaluate impacts to water resources.

Impact Thresholds

Negligible: Chemical, physical, or biological changes to water quality, to dune slacks or to natural hydrologic patterns and sediment transport would not be detectable.

Minor: Chemical, physical, or biological changes to water quality would be detectable, but no standard or criterion would be exceeded because of proposed actions. Changes in degraded water quality would be detectable. Changes in the geographic extent or quality of dune slacks or to natural hydrologic patterns and sediment transport would be measurable.

Moderate: Chemical, physical, or biological changes to water quality would be noticeable, but no standard or criterion would be exceeded. Desired water quality conditions may be exceeded for a short period of time. Beneficial changes would be quite noticeable. Adverse or beneficial changes in the aerial extent of dune slacks or to natural hydrologic patterns and sediment transport would be obvious.

Major: The impact is severe or exceptionally beneficial. If the impact is adverse, chemical, physical, or biological effects would be frequently altered from stated desired water quality conditions. Quality may slightly and singularly exceed federal or state standards or criteria. Beneficial changes would be highly noticeable and could result in increased ability to meet water quality standards and support beneficial uses. Adverse or beneficial changes in the aerial extent of dune slacks or to natural hydrologic patterns and sediment transport would be obvious and extend across all or most of the treatment area.

Impact of No Action

Analysis

As noted in the Affected Environment, there are several dune slacks and dune hollows at the site, in addition to the permanently wet Abbotts Lagoon to the northeast. These dune slacks lie in deflation plains where wind has removed sand to the level of the groundwater and the soil is wet either seasonally or permanently. At the site, the slacks are oriented with their long axes NW-SE, the predominant direction of wind in the area.

The larger dune slacks at the site have several features that make them unusual. These include domination by an unusual association of vegetation, a sloping floor that dips seaward (rather than the flat floor at groundwater typical of most slacks) and peat soils. Some elements of riparian scrub occur on these wetlands, which are best referred to as sedge meadows.

It is possible and even likely that stabilization of the foredune and some of the reardunes with *Ammophila* has facilitated the creation of these perennial wetlands by reducing sand flow. Wind has continued to blow sand from the deflation plain, which has exposed what is

believed to be a perched groundwater table with subsurface flows (Baye 2008) underlying the dune hollows and dune slacks at the site. This has been a relative positive impact for wetlands at the site, as it has preserved and extended the season they are wet and allowed them to expand.

Ammophila may have also stabilized sand that would otherwise blow into and partially fill the shoreline of Abbotts Lagoon. Because it is heavy, sand would quickly fall to the bottom of the lagoon and would have no water quality impacts. However, over time, sand may fill in part of the lagoon and decrease its size. Again, *Ammophila* may have played a role in maintaining the size of the lower lobe of the lagoon, a relative benefit for water resources at the site.

The degree of benefit is unknown, but may be negligible to moderate and long-term.

Cumulative Impacts

Cumulative impacts to wetlands at the site include cattle grazing nutrient inputs and alterations in the species and structure of wetland vegetation. By grazing vegetation at wetlands, cattle can keep wetlands from becoming closed and filled. Grazing operations upstream of Abbotts Lagoon contribute fecal coliform and are considered primarily responsible for coliform counts than exceed standards in tributaries of the Abbotts Lagoon watershed. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would prevent adverse impacts from grazing.

Conclusions

Relative long-term negligible to moderate benefits to water resources from the stabilization of soils at the site may have occurred and would continue if *Ammophila* is not removed. Cumulative impacts include nutrient and pathogen inputs from cattle grazing in the watershed and locally, as well as possible changes in wetland structure and vegetation.

No impairment to park water resources from implementing Alternative A would occur.

Impact of Alternative B

Analysis

Staging and Access

Staging or access routes would be sited to avoid wet areas at the study area, and no or only negligible indirect impacts to water resources from increased compaction and runoff or erosion from either access routes or the staging area itself would occur.

The use of heavy equipment on the project site would require the development of a plan and strategy to address the prevention and containment of leaks or accidental spills of hazardous substances, particularly hydraulic fluid, gasoline, and oil. Spill prevention measures would include ensuring that equipment is parked or staged on top of an impermeable surface. This may include the use of tarps or pans while the equipment is parked on the project site, or paved parking areas in an off-site staging area. Staging or parking areas would be located away from water bodies or other sensitive areas. Daily inspections of machinery would be required to detect leaks and identify preventive maintenance needs.

In the event of a spill or leak, each piece of equipment would have the proper containment equipment readily at hand, and the operator would be trained in the proper protocol and use. NPS staff and/or biological monitors would be notified and the disposal procedures outlined in the prevention plan initiated. Spill response kits would be kept with the heavy

equipment and stored in the on-site staging areas. Kits would likely contain spill berms, hazardous materials drums, drip pans, and absorbent materials.

The combination of these mitigation measures and locating access routes and staging areas away from dune slacks or dune hollows would keep impacts to water resources from staging or fuel leaks during access to no more than negligible.

Treatment Activities

Prescribed fire or herbicide use could affect water resources, as could erosion from excavation and long-term changes in sand movement at the site.

Much of the impact of treatment under Alternative B would be kept from directly affecting wetlands through the use of buffers and fire breaks. No excavation of wetlands would take place and a buffer in which manual removal of *Ammophila* around the shorelines of wetlands of 5 feet would help ensure no inadvertent crushing or compacting of wetland vegetation or soils by heavy equipment. The manual removal of *Ammophila* would also help to create an unvegetated ring around dune slacks and dune hollows, which would be further developed through the use of hand mowing if needed. This would help keep prescribed burns from entering wetlands. Herbicide spraying would also be prohibited any closer than 25 feet from dune mat or wetland vegetation to prevent impacts to non-target native vegetation that could otherwise occur from herbicide drift.

Although fire would not affect wetlands directly, ash generated from burning *Ammophila* could be carried by wind or water runoff to dune hollows and slacks, or into Abbotts Lagoon. Ash generated by fires is usually rich in nitrogen (NPS 2004), a nutrient essential to plant growth. Excess nitrogen in a water body can increase production of algae or macrophytic vegetation, and possibly lead to fish kills. Although the degree of impact from prescribed burning is unknown, monitoring following the Vision fire at the park indicated that current nitrogen levels sites was below detectable limits in 22 of 23 streams and ponds sampled. This suggests that the impact of nutrients in ash to dune wetlands at the site would be negligible or minor and likely short-term. Given that soils at the site are low in nitrogen, this impact could be beneficial.

Herbicide spraying would also not directly affect water resources at the site. Drift could cause some contamination, although at 100 m, only about ½% of the applied concentration is left in the air (USDA Forest Service 2003). This means, at 1-2 lb a.e./acre, about 1 ounce (=28 grams) would drift into dune slacks or hollows. As noted in other parts of this document, contractors to the USDA Forest Service (2003) modeled the potential for glyphosate spraying in an area to concentrate through wind erosion and runoff into small streams or ponds. Making very conservative assumptions (such as the half life of glyphosate is 1000 days), the contractors found the highest contamination in ponds where surrounding slopes had sandy soils and annual rainfall exceeded 25 inches. This is similar to conditions at the study site, and so is used in this analysis. The acute concentration of glyphosate in a small stream immediately following application and rainfall was 0.4 mg/L per pound applied. The half-life in water has been found to be between 40 and 70 days in most studies, and over time, concentration would fall to below 0.008 mg/L.

Field sampling has also been conducted in streams and ponds. Immediately following aerial application, concentrations ranged from 0.1 mg/L to 1 mg/L for a few minutes to a few hours following application. The highest concentration (1 mg/L) resulted from aerial spraying of 3.6 lbs a.e./acre. Notably, all studies found rapid dissipation in stream water, particularly following storm events. Seventy days after aerial application of 1.8 lbs a.e./acre, concentrations of 0.001 to 0.002 mg/L were found in ponds less than 2.5 acres and 1 meter deep. Even in ponds directly sprayed with glyphosate at 0.8 lbs a.e./acre,

initial concentrations of 0.02 to 0.15 mg/L dissipated to 0.001 mg/L (a 95% to over 99% reduction) by day 12 (Goldsborough and Beck 1989 as cited in USDA Forest Service 2003).

While direct spraying of wetlands would not occur, there may be some contamination through inadvertent drift. At 100 m from the source (boom ground sprayer), the amount of glyphosate remaining in drift is about 0.06% of that originally sprayed. Assuming 1-2 lb a.e./acre is sprayed, this means about 0.14 ounces on average, or 4 grams would remain in the spray at 100 m. Although spraying may be closer than 100 m, modeling assumed a low boom ground sprayer rather than a backpack sprayer, and only evaluated concentrations at this distance. Concentrations in drift may therefore be slightly greater or lesser than those reported in this analysis. Assuming the volume of water in a dune hollow is similar to the small pond modeled by USFS (less than 50 cubic meters), concentrations from drift could initially reach 0.08 mg/L. Acute concentrations from spraying *Ammophila* followed by heavy rainfall could be about 10 times this amount. In either case, glyphosate would rapidly dissipate and would not be expected at these concentrations to have any impact on aquatic animals. The reference dose for human consumption, which is 1/100 the amount where no adverse effects in any study have been observed, is 2 mg/kg/day. A human or other mammal weighing 70 kg would need to drink 175 liters of contaminated water from the wetlands the day the area was sprayed and rainfall occurred and absorb 100% of the glyphosate in the water to reach this level. As noted in the discussion of vegetation, low amounts of glyphosate could stimulate algae production, which ultimately could mean reductions in oxygen and fish kills. Overall, impacts to water resources from herbicide spraying are not expected to be greater than minor in intensity, and would be short-term in duration.

As explained in the analysis of soils and sand movement, excavation could increase erosion of stockpiled clean sand either from wind or water. If sand is washed into nearby wetlands, it may affect turbidity for a short period of time and over a longer time, could fill in a portion of the wet area. However, sand would only be stockpiled for a short period of time in any one area of the site, and impacts to water resources from erosion are not expected to be more than negligible or minor and short term.

In the long-term, dunes across the site would be free of *Ammophila* and sand movement would increase. Although this is a more natural state, the pace of removal would be quick and dunes across the site would be left unvegetated for a time until native species can re-colonize the site. During this time, sand movement could reduce the size of Abbotts Lagoon and dune slacks and hollows at the site. Burial of the site's unique fen-like sedge wetlands would be a particularly adverse impact, as this combination of vegetation, soils and topography are very rare and perhaps even unique in central coastal California (Baye 2008). The long-term impact from treating *Ammophila* to water resources is likely to be minor to moderate, adverse and localized.

Cumulative Impacts

Cumulative impacts to wetlands at the site include cattle grazing nutrient inputs and alterations in the species and structure of wetland vegetation as described above for Alternative A. Cattle grazing may have a beneficial cumulative impact on maintaining open water wetlands by consuming wetland vegetation.

Conclusions

Storing equipment, chemicals and fuel at the staging site would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed.

Fire breaks and mowed buffers would keep direct impacts to wetlands from becoming more than negligible or minor. Ash from prescribed burns could add nutrients to soils and water, with possible negligible benefits. Impacts to water quality from herbicide spraying would be short-term and no more than minor; algae production may be stimulated if low levels of herbicide enter dune hollows or slacks. The exposure of stockpiled sand to wind and water erosion may increase sedimentation in the short-term, a negligible or minor localized effect. In the long-term, remobilizing sand movement could fill in small wetlands completely and reduce the size or period the dune slack stays wet, a minor to moderate, localized adverse effect. Burial of the site's unique fen-like sedge wetlands would be a particularly adverse impact should it occur. Cumulative impacts from pathogens and nutrients from cattle grazing would likely be adverse, although cattle may help in keeping wetlands from filling in where they are able to access vegetation. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would both prevent adverse and possible beneficial impacts from grazing.

No impairment to park water resources would occur if Alternative B were implemented.

Impact of Alternative C

Analysis

Staging and Access

As in Alternative B, staging or access routes would be sited to avoid wet areas at the study area, and no or only negligible indirect impacts to water resources from increased compaction and runoff or erosion from either access routes or the staging area itself would occur.

Impervious surfacing at the staging facility, a spill cleanup plan, daily inspections of equipment for fuel leaks and training of NPS staff and contractors at the site on spill response procedures would be in place as it would in Alternative B. The combination of these mitigation measures and locating access routes and staging areas away from dune slacks or dune hollows would keep impacts to water resources from staging or fuel leaks during access to no more than negligible.

Treatment Activities

In Alternative C, the only treatment activity that may affect water resources in the short term is the stockpiling of sand during excavation. Because excavation would be site-wide among *Ammophila* infested areas in this alternative, the chance of windblown sand or erosion from rainfall affect turbidity or filling in some portion of smaller wetlands is higher than in Alternative B. Because sand would not be stockpiled for more than a short period of time in any one location, the impacts to water resources from erosion are expected to be no more than minor and short-term.

Long-term impacts would be identical to those described above for Alternative B, and could be minor to moderate, localized and long-term if they result in the filling of some of the more unique wetlands at the site.

Cumulative Impacts

Impacts would be the same as described above for Alternatives A and B.

Conclusions

Storing equipment, chemicals and fuel at the staging site would have no more than negligible short-term impacts to water resources because the area would be impermeable and bermed. Short-term increases in sedimentation from eroded stockpiles of sand would be minor, and long-term filling of some wetlands, particularly unique wetlands at the site, would be minor to moderate and permanent.

Cumulative impacts from pathogens and nutrients from cattle grazing would likely be adverse, although cattle may help in keeping wetlands from filling in where they are able to access vegetation. Fencing cattle from all dune locations is called for in the park's General Management Plan, which would both prevent adverse and possible beneficial impacts from grazing.

No impairment to park water resources would occur if Alternative C were implemented.

CULTURAL RESOURCES

Policies and Regulations

The NPS is charged with management and protection of cultural resources through a variety of guidance documents and legislation in which NPS managers avoid, or minimize to the greatest degree practicable, adverse impacts on park resources and values.

The National Historic Preservation Act (NHPA), as amended, is the principal legislative authority for management of cultural resources located within national parks. It requires federal agencies to strive to minimize harm to historic properties that would be adversely affected by an undertaking. Section 106 of the NHPA requires all federal agencies to consider the effects of their actions on cultural resources determined eligible for inclusion in the National Register of Historic Places (NRHP) (see discussion below). Section 110 of the NHPA, among other things, charges federal agencies with the responsibility to establish preservation programs for identification, evaluation and nomination of cultural resources to the NRHP.

NPS-28: Cultural Resources Management Guidelines (NPS 1998) provide the fundamental basis for managing cultural resources in the National Park System. This guidance document contains park management standards and other requirements for cultural resources, including archeological resources, historic and prehistoric structures, museum collections, cultural landscapes and ethnographic resources.

Section 106 Compliance

This cultural resource analysis is intended to comply with the requirements of both NEPA and section 106 of the NHPA (36 CFR 800, Protection of Historic Properties).

Section 106 of the National Historic Preservation Act mandates that federal agencies take into account the effects of their actions on properties listed or eligible for listing in the National Register. Under the ACHP's regulations, a determination of either adverse effect or no adverse effect must be made for affected NRHP-listed or eligible cultural resources. An adverse effect occurs whenever an action in an alternative alters, directly or indirectly, any characteristic of a cultural resource that qualifies it for inclusion in the NRHP. Adverse effects also include reasonably foreseeable effects caused by the proposal that would occur later in time, be farther removed in distance, or be cumulative (36 CFR 800.5, Assessment of Adverse Effects). The resolution of adverse effects can occur in a variety of ways, in accordance with 36 CFR 800.6 (Resolution of Adverse Effects). A determination of no adverse effect means there is an effect, but the effect would not diminish, in any way, the

characteristics of the cultural resource that qualify it for inclusion in the NRHP. All effect determinations are made in consultation with the California State Historic Preservation Officer (SHPO) and/or the appropriate Tribal Historic Preservation Officers (THPO).

Assessment Methodology

The primary reference for assessment of impacts within the Area of Potential Effect is a survey report prepared for the site in 2006 (*Archaeological Survey and Geoarchaeological Trenching Results for Abbotts Lagoon Dune Restoration, Point Reyes National Seashore* [Meyer and Dalldorf 2006]). The information in the study was used to assess the probability of encountering an archeological resource given mitigation measures the park would enforce during treatment.

Context and Duration

The standardized definition for context was used to evaluate impacts to cultural resources. However, due to the non-renewable nature of archeological resources, adverse effects to archeological resources are considered permanent.

Impact Thresholds

The following thresholds were used to determine the magnitude of impacts to archeological resources resulting from implementation of any of the alternatives. (Note: archeological resources are nonrenewable resources and adverse effects to them generally consume, diminish, or destroy the original historic materials or form, resulting in a permanent loss in the integrity of the resource that can never be recovered. Therefore, although actions determined to have an adverse effect under section 106 may be mitigated, the effect remains adverse).

In addition to the adverse effects thresholds described below, offsetting beneficial effects to archeological resources could involve a range of preservation and stabilization actions, all of which would result in a determination of effect of no adverse effect for purposes of section 106.

Intensity definitions of adverse effects to archeological resources are described as follows:

Negligible. Impact is at the lowest levels of detection. For purposes of section 106, the determination of effect would be *no adverse effect*.

Minor. Disturbance of a site(s) results in little, if any, loss of integrity. For purposes of section 106, the determination of effect would be *no adverse effect*.

Moderate. Disturbance of a site(s) results in loss of integrity but not in a substantial loss of important data. For purposes of section 106, the determination of effect would be *adverse effect*. A memorandum of agreement is executed between the NPS and applicable State or Tribal Historic Preservation Officer and, if necessary, the ACHP in accordance with 36 CFR 800.6(b).

Major. Disturbance of a site(s) results in loss of most or all of the site and its potential to yield important information. For purposes of section 106, the determination of effect would be a*dverse effect*. The NPS and applicable State or Tribal Historic Preservation Officer are unable to negotiate and execute a memorandum of agreement in accordance with 36 CFR 800.6(b).

Impacts of No Action

Under the No Action alternative, small-scale dune restoration projects would continue as they have been in the Abbotts Lagoon area with beachgrass and other nonnative, invasive

plants being removed with heavy equipment and hand tools. The continuation of this ground disturbing activity includes the potential to unearth previously unidentified buried cultural resources. However, whenever unidentified cultural resources are encountered during restoration activities, the NPS ensures that appropriate actions (e.g., cease work, evaluation of resource by qualified professional) for Section 106 (NHPA) compliance are taken. Consequently, this on-going restoration constitutes only a negligible to minor, localized adverse effect to cultural resources.

Cumulative Impacts

Past actions along the shoreline prior to the establishment of the park, including cattle grazing and transportation development, have resulted in considerable ground disturbance with associated moderate adverse impacts to archeological resources. Recent small-scale dune restoration projects undertaken by the park have resulted in negligible impacts to archeological resources. The NPS anticipates that implementation of the park's 2004 Fire Management Plan at fire management units (FMUs) along the shoreline could result in moderate adverse impacts to archeological resources. The negligible to minor adverse effect of the No Action alternative would contribute a very small increment to the overall minor to moderate adverse impacts to archeological resources along the park's shore.

Conclusions

Implementation of the No Action alternative would result in no greater than minor, localized adverse effects to cultural resources related to ground disturbance. Cumulative negligible to moderate adverse effects to archeological resources within the Seashore are related to cattle grazing, transportation development, dune restoration, and implementation of the Fire Management Plan.

The No Action alternative would not result in impairment of cultural resources within Point Reyes National Seashore.

Impacts of Alternative B

Analysis

Under Alternative B, the primary access route (figure 5), currently being used for access to the general project area would be improved (graded and graveled). Three secondary access routes would be designated with flagging but not improved. Ground disturbance related to the creation and use of the new staging area and access routes has the potential to adversely affect buried cultural resources.

A cultural resources study conducted within the APE resulted in the identification of no cultural resources (Meyer and Dalldorf 2006). However, the identification of cultural resources in areas adjacent to the study area suggests that their presence is also possible in the current project area. While prehistoric and historic cultural resources may be buried within the study area, the location of these deposits is difficult to predict.

It is possible that buried prehistoric and historic archeological resources could be encountered during preparation and use of staging and access areas. However, with the implementation of standard environmental protection measures, no more than minor, localized adverse effects to cultural resources are anticipated. Minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For the purposes of Section 106 of the NHPA, this would result in *no adverse effect*.

Under both action alternatives, hand tools--trenching shovels, scalping tools, rakes, etc.--would be used for the removal of nonnative, invasive plants. Hand tools would be used in

areas where heavy equipment is inappropriate (e.g., presence of sensitive resources, problematic access) or the use of herbicide and fire are not proposed. Ground disturbance from the use of hand tools could vary in depth from 6" to 3-4 feet in depth.

As described above, there is the possibility that buried historic and prehistoric artifacts could be encountered during the removal of dune vegetation. With standard environmental protection measures adverse, localized effects to buried cultural resources would range from negligible to minor. Negligible to minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For the purposes of Section 106 of the NHPA, there would be *no adverse effect.*

Under Alternative B, heavy equipment excavation and deep burial of nonnative and invasive plant species within the foredune area is proposed. Equipment used for removal and deep burial includes excavators and bulldozers. Excavators would be used to remove vegetation below the root mass which can range from 3-6 feet in depth. Clean sand beneath the root zone would be excavated to an approximate depth of 9 feet and stockpiled. Bulldozers may be used to re-contour the area to match the surrounding grade. A total of approximately 27 acres would be treated in this manner.

As noted above, recent investigations within the APE have identified no cultural resources (Meyer and Dalldorf 2006). However, two buried soil layers have been identified within the APE and it was recommended that monitoring of excavations activities be implemented (Meyer and Dalldorf 2006). One of these two areas is located within the foredune area where mechanical excavations are proposed under Alternative B. As the potential for buried cultural deposits exists in these areas, the implementation of appropriate mitigation measures is recommended. As a result, it is expected that the use of heavy equipment for restoration activities would result in no greater than minor, localized adverse effects to cultural resources. Minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For purposes of Section 106 of the NHPA, this would constitute *no adverse effect.*

Cumulative Impacts

Cumulative impacts would be the same as described under Alternative A.

Conclusion

Actions in Alternative B are expected to result in no greater than minor, localized adverse effects to cultural resources related to ground disturbance associated with staging and access, the use of hand tools, and the use of heavy earth-moving equipment. Cumulative negligible to moderate adverse effects to archeological resources within the Seashore are related to cattle grazing, transportation development, dune restoration, and implementation of the Fire Management Plan. When compared to the No Action alternative, the intensity of adverse effects to cultural resources under Alternative B is similar (no greater than minor) but the number of restoration activities that have the potential to affect cultural resources are greater under Alternative B. Restoration activities and their associated effects to cultural resources under Alternative B are similar to those expected under Alternative C.

Implementation of Alternative B would not result in impairment of cultural resources within Point Reyes National Seashore.

For purposes of Section 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected under this alternative (*no adverse effect*).

Impacts of Alternative C

Under Alternative C, the primary access route (figure 5) currently being used for access to the general project area would be improved (graded and graveled). Effects to cultural resources related to staging and access under Alternative C would be similar to those described under Alternative B--minor, localized, and adverse. Minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For the purposes of Section 106 of the NHPA, this would result in *no adverse effect*.

Alternative C includes the use of hand tools--trenching shovels, scalping tools, rakes, etc.—for removal of nonnative, invasive plants. Effects to cultural resources related to the use of hand tools under Alternative C would be similar to those described under Alternative B—negligible to minor, localized, and adverse. Negligible to minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For the purposes of Section 106 of the NHPA, there would be *no adverse effect.*

Under Alternative C, heavy equipment deep burial of nonnative and invasive plant species would occur within both the foredune and reardune areas of the project site. Equipment used for removal and deep burial (excavators and bulldozers), and excavation and re-contouring techniques are similar to that described under Alternative B. However, the total number of acres treated in this manner under Alternative C would increase by an additional 99 acres for a total of 126 acres as a result of the inclusion of the reardune area of the project site.

Although recent investigations within the APE have identified no cultural resources, it was recommended that monitoring of excavations activities be implemented in these areas (Meyer and Dalldorf 2006). One of these two areas is located within the foredune of the project site; another larger one is located within the reardune area. Both of these areas are located where mechanical excavations are proposed under Alternative C. Monitoring, which is included as an environmental protection measure in both action alternatives, would keep impacts from the use of heavy equipment for restoration activities to impacts that are no greater than minor and localized. Minor effects are defined as those that cause little, if any, loss of integrity to cultural resources. For purposes of Section 106 of the NHPA, this would constitute *no adverse effect.*

Cumulative Impacts

Cumulative effects would be the same as described for Alternatives A and B.

Conclusion

Effects related to the implementation of Alternative C include no greater than minor, localized adverse effects to cultural resources related to ground disturbance associated with staging and access areas, the use of hand tools, and the use of heavy earth-moving equipment. Cumulative negligible to moderate adverse effects to archeological resources within the Seashore are related to cattle grazing, transportation development, dune restoration, and implementation of the Fire Management Plan. When compared to the No Action alternative, the intensity of adverse effects to cultural resources under Alternative C is similar (no greater than minor) but the number of restoration activities that have the potential to affect cultural resources are greater under Alternative C. Restoration activities and their associated effects to cultural resources under Alternative C are similar to those expected under Alternative B.

Implementation of Alternative C would not result in impairment of cultural resources within Point Reyes National Seashore.

For purposes of Section 106 of the NHPA, no identified cultural resources listed in or eligible for the NRHP are expected to be affected under this alternative (*no adverse effect*).

VISITOR EXPERIENCE

Policies and Regulations

The NPS *Management Policies 2006* regulate several features of the visitor experience, including soundscapes, lightscapes, facilities, recreational use and interpretation. For this proposal, regulation of soundscapes and access are important. An "open, inviting and accessible" atmosphere is considered central to the purpose of all parks (sec. 8.2). Visitor use or visitor access is to be restricted if it impedes attainment of the park's desired condition for natural resources (sec. 8.2) and for several other resource or safety reasons. Soundscapes, which may be part of visitor experience but which are also considered important independent of the visitor are to be preserved to the greatest extent possible in a natural state (sec. 4.9). Parks are to use appropriate management planning, such as this environmental assessment process, to determine what levels and types of unnatural sound constitute acceptable impacts on the natural soundscape.

Assessment Methodology

Decibel levels for the activities proposed in the action alternatives were collected from the construction, scientific and government literature. The number of visitors was either determined from an average anecdotally observed at the site by park personnel or assumed to be zero during the operation of heavy equipment as appropriate given advance notification and outreach to the public associated with the project implementation.

Context and Duration

The standardized definitions of context and duration were used to evaluate impacts to visitor experience.

Impact Thresholds

Negligible: Visitors would not likely be aware of treatment or staging operations at the site and changes to the natural quiet would be barely perceptible. Changes in the landscape would not generally be noticeable by visitors. Inaccessibility would not affect the great majority of visitors.

Minor: Visitors would be aware of treatment or staging operations and changes to the natural quiet, but activities would not disrupt the experience and enjoyment of the site for the majority of visitors. Changes in the landscape would be noticeable by a few visitors, who would have differing opinions on whether the changes are positive or negative. Inaccessibility would affect a few visitors.

Moderate: Visitors would be aware of treatment or staging operations, and activities could disrupt the natural quiet, experience and enjoyment of the site for some visitors. An occasional visitor would leave the area upon hearing or seeing treatment activities. Changes in the landscape would be noticeable by many visitors, who would have differing opinions on whether the changes are positive or negative. Inaccessibility would affect several visitors

Major: Visitors would be aware of treatment or staging operations, and activities could disrupt the natural quiet, experience and enjoyment of the site for most visitors. The majority of visitors would leave the area upon hearing or seeing treatment activities. Changes in the landscape would be noticeable by most visitors, who would have differing

opinions on whether the changes are positive or negative. Inaccessibility would affect many visitors.

Impacts of No Action

Under the No Action alternative, small-scale dune restoration projects would take place at the site. Nonnative, invasive vegetation would be removed with heavy equipment and hand tools, and some very small experimental treatment with prescribed fire and herbicide may take place. The continuation of the current dune restoration efforts includes the potential to affect the visitor experience related to noise, odors and dust associated with the use of heavy equipment, and the potential for occasional visitor restrictions during restoration efforts. Because they are central to Alternative B, the impact of prescribed fire or herbicide use is analyzed in that part of the document.

Currently, both hand tools and heavy equipment (excavators, bulldozers) are used for vegetation removal activities. Heavy equipment can create unwanted mechanized noise for visitors. The noise level of a bulldozer at its source is approximately 105 dBA and 85 dBA at 50 feet, while normal human conversation levels are typically about 60 dB (Centers for Disease Control [CDC] 2008). In addition, fuel odors related to the use of heavy equipment and blowing sand related to excavations are also possible and could negatively affect visitors. These impacts could affect the visitor experience for those on adjacent park lands, even if visitors are restricted from the specific project site.

Much of the park's seashore areas are remote and quiet. Noise-free intervals are high and ocean waves can sometimes mask out mechanized sound depending on conditions (wind speed/direction, ocean waves) and location of visitors. The presence of odors and blowing sand created by heavy equipment use along the seashore are also rare. Restoration activities would typically involve small areas and heavy equipment is not always used. Work would be typically scheduled from 7 a.m. to 6 p.m., Monday through Friday (low visitation period when compared to weekends). As a result, adverse effects to visitor experience related to heavy equipment noise, odors and blowing sand would likely range from negligible to minor, short-term, and localized.

Cumulative Impacts

On-going, small-scale dune restoration projects have been occurring periodically around Abbotts Lagoon, just north of the current project site. This work has resulted in occasional heavy equipment noise, blowing sand and odors which has the potential to adversely affect visitors. These adverse effects are mitigated to a degree by the dissemination of project information to alert visitors of future work so that they can avoid the area if they so desire.

In addition, coastal watershed restoration efforts within Drakes Estero have resulted in long-term benefits related to the provision of visitor interpretive and educational materials associated with the restoration and the natural processes of the seashore ecosystem. Minor, short-term adverse effects from coastal watershed restoration efforts are related to temporary road and trail closures and noise.

Habitat restoration projects which have or will occur throughout the Seashore could have minor to moderate, short-term adverse impacts on the visitor experience similar to that expected under the current proposal--noise, dust, and visual intrusions, as well as possible closures. Once completed, however, restoration projects typically result in minor to major benefits to the visitor experience by enhancing opportunities for enjoying more natural settings.

In more general terms, the Fire Management Plan (NPS 2004) has resulted in both short-term adverse effects (prescribed fires, noise, closures) and long-term benefits (restoration of scenic vistas) to the visitor experience.

Conclusions

Implementation of the No Action alternative would result in no greater than minor, short-term, localized adverse effects to the visitor experience related to the use of heavy equipment (noise, blowing sand, odors).

Impacts of Alternative B

The creation of a new staging area and three secondary vehicular routes under Alternative B would introduce new visual intrusions into the natural seashore landscape. This visual intrusion would likely result in minor to possibly moderate, localized, short-term adverse effects to the visitor experience.

Impacts to visitors from the use of heavy equipment under this alternative include noise, blowing sand and odors. Noise levels from heavy equipment such as bulldozers are approximately 105 dBA at the source and 85 dBA at 50 feet (CDC 2008) and have the potential to affect visitors in the vicinity of access routes to the site, staging areas and actual dune restoration areas. Depending on weather conditions and location of visitors, noise levels could range from 85 dBA to 65 dBA at the far end of the site from where work is taking place for two months. In addition, visitor exposure to fuel odors related to heavy equipment use, and increases in blowing sand related to stockpiled soils and generalized soil redistribution efforts are also possible during the period of heavy equipment use.

Analysis of the effects of noise on visitor experience in national parks include, among other things, a visitor's expectation (e.g., presumptions of noise levels in developed vs. undeveloped areas), a visitor's personal characteristics (the likelihood of being annoyed by noise), and the degree to which a quiet experience is desired (Gramann 1999). For instance, visitors may perceive noise as more annoying when it occurs in areas they expect to be very quiet like the study site.

As explained under the No Action alternative, much of the park's coastal areas, including the Abbotts Lagoon vicinity immediately to the north of the project area, are remote and quiet. Visitors have experienced little, if any, effect from heavy equipment odors and blowing sands related to excavations, although some treatment on sites directly north of the study area has taken place. Depending on a visitor's location and environmental conditions (wind speed/direction), mechanized sound can be mitigated by natural sounds such as ocean waves or dune topography. However, the approximate two-month period during which effects of mechanized noise and odors may be experienced, as well as the presence of blowing sand related to excavations, has the potential to negatively affect some visitors' experiences in a minor, localized, short-term manner.

Alternative B proposes the use of prescribed burning to pre-treat *Ammophila* in the reardunes prior to the application of herbicide the following spring or summer. The burn would be started using drip torch fuel distributed by hand crews or crews on ATVs . The timing of such activities would be determined by the Fire Management Officer and would depend on environmental conditions, season, day, and time of day. While visitors would be restricted from these areas during burn activities, they could encounter smoke, odor, and possible ATV noise in adjacent areas, including along the seashore. Such visual intrusions, odors and possible ATV noise associated with burn activities could result in negligible to minor, short-term, localized adverse effects to the visitor experience. Implementation of mitigation measures (such as publishing the date and time the park anticipates specific restoration activities) could mitigate these effects further.

Visitors may also experience adverse impacts by being restricted from certain areas of the 300-acre project site during prescribed burning and herbicide application. Restrictions would not apply to the single public trail that leads to the beaches north of the project area or to beaches along the study area, as these would not be subject to burning or spraying. However, the reardunes, which are much less heavily used than the open beach area, may be closed during weekdays while these activities are ongoing. As any potential visitor restrictions would most likely occur during the weekdays and for short periods of time (less than 48 hrs.) visitors could experience negligible to minor, short-term, localized, adverse effects.

The impacts of herbicide spraying to the visitor experience would be mitigated through the use of closures and restrictions. The potential for impacts to public health and safety from herbicide use is analyzed in that section of the document.

In the long term, the dune restoration project is expected to result in a more natural dune setting and a better functioning ecosystem. In addition to the more natural visual setting once the project is complete, visitors will be informed through the use of interpretive and educational materials of the goals of the restoration project. For those visitors who value this type of experience, this would likely result in a minor, long-term, localized benefit to the visitor experience.

Cumulative Impacts

Cumulative impacts would be similar to those described under Alternative A.

Conclusions

Under Alternative B, visitors to the project vicinity could experience negligible to possibly moderate, short-term adverse impacts from visual intrusions associated with new staging and vehicular access areas; smoke/odors and possible ATV noise from prescribed burning activities; and potential visitor restrictions during restoration activities. In addition, the exposure to noise from heavy equipment as well as related odors and associated blowing sands have the potential to result in minor, short-term, adverse effects. Minor, long-term benefits to the visitor experience are expected as a result of the restoration of this dune area to a more naturally functioning state and the provision of educational materials related to the restoration efforts. When compared to the No Action alternative, Alternative B would result in additional activities (e.g., burning, herbicide application, etc.) that would adversely affect visitors. However, the intensity of these adverse effects under Alternative B would be similar to that of No Action—not expected to exceed minor.

Impacts of Alternative C

The creation of a new staging area and three secondary vehicular routes under Alternative C would result in effects to visitor experience similar to those described under Alternative B--minor to possibly moderate, localized, short-term and adverse.

As is true under Alternative B, Alternative C includes the technique of heavy equipment deep burial of nonnative and invasive plant species. However, while this technique would occur only in the foredune area under Alternative B, it would be employed throughout the project site under Alternative C (foredune and reardune areas—approximately 126 acres). Equipment and the type of impacts associated with removal and deep burial of vegetation are the same as described under Alternative B (excavators, bulldozers). Due to the larger area where this activity would take place under Alternative C, excavation would occur for approximately five months.

Noise levels from heavy equipment such as bulldozers are similar to those described under Alternative B. Noise from heavy equipment has the potential to affect visitors in the vicinity of access routes to the site, staging areas and dune restoration areas. Depending on environmental conditions (weather, wind direction/speed) and the location of visitors, such sounds could potentially be heard for approximately three of the five-month project schedule. In addition, visitor exposure to fuel odors related to heavy equipment use and blowing sand related to excavations are also possible during the period of heavy equipment use.

As explained under the No Action alternative, much of the park's coastal area, including the Abbotts Lagoon vicinity immediately to the north of the project area, is remote and quiet. Visitors currently experience little if any effect from heavy equipment odors or noise. The noise generated by heavy equipment under this alternative could be much closer and would be longer-lasting for visitors on the Abbotts Lagoon trail or beaches north of the site than that expected under Alternative B. It would also be disruptive for visitors for a longer period of time when compared to Alternative B. Visitors in the immediate vicinity of the area designated for treatment would be particularly adversely affected, as distance, wind speed and direction and topography would dampen sounds farther away. Odors in the immediate vicinity of the excavators could also be annoying to visitors. An increase in the amount of sand stockpiled or being redistributed would also likely result in an increase in blowing sand for those visitors inland of the foredune. Because work would take place during the weekday, the majority of visitors would not experience these impacts. Overall then, the impact of this alternative to the visitor experience would likely be minor or perhaps moderate, localized and short-term.

Long-term benefits to visitors related to restoration efforts would be the same as described for Alternative B—minor and localized.

Cumulative Impacts

Cumulative impacts would be similar to those described under Alternative A.

Conclusions

Effects to visitor experience under Alternative C include minor to possibly moderate, short-term adverse impacts from visual intrusions of new staging and vehicular access areas, noise and odors from heavy equipment and an increase in blowing sand. At the same time, minor, long-term benefits to the visitor experience are expected as a result of the restoration of this dune area to a more naturally functioning state. When compared to the No Action alternative, Alternative C would result in additional restoration activities that would adversely affect visitors, over a longer period of time (when compared to alternative B). The intensity of these adverse effects under Alternative C would be slightly increased—possibly moderate—compared to those expected under Alternative B and would be related the use length of use of heavy equipment.

NEIGHBORING LAND USE

Policies and Regulations

Little guidance exists in the NPS *Management Policies 2006* with regard to the particular land use issues in this proposal. Parks are instructed generally to cooperate with neighboring landowners to jointly protect park resources, provide for visitor enjoyment, and to avoid and resolve potential conflicts (NPS 2006a sec. 1.6). Any construction considered in a park, such as secondary roads or staging areas, is to reduce traffic congestion if possible (NPS 2006a sec. 9.2).

Though the current project site is not identified as wilderness, it is located adjacent to proposed or designated wilderness areas to the north, south and west. Proposed wilderness areas are managed as are designated wilderness areas. While the NPS can choose to control noise and other project effects which could impact adjacent wilderness areas, compliance with the Wilderness Act is not required for the dunes restoration project.

Assessment Methodology

Impacts include the potential for noise on adjacent wilderness lands and visitors to them, and the possibility of building roads and driving vehicles and heavy equipment through adjacent ranchlands. The assessment of impacts considers existing levels of use and the increase in use and potential conflict from these activities and is both qualitative and quantitative in nature.

Context, Duration and Impact Thresholds

The standard definitions of context, duration and impact thresholds were used to evaluate impacts to neighboring land use and traffic.

Impacts of No Action

Under the No Action alternative, small-scale dune restoration work at the site would take place as funds are available. Access and the noise of treatment have the potential to affect neighboring land use, such as ranching and wilderness.

Vehicles and equipment for treatment would use the same access as described for action alternatives, and so impacts to ranching use are analyzed below in Alternatives B and C.

As noted above, the project site is bounded on the north, east and south by wilderness. Even small-scale restoration efforts such as those that would take place under the No Action alternative can result in limited visual, odor and noise intrusions on adjacent wilderness areas where land uses are typically characterized by natural sounds (ocean waves, etc.) and low impact uses by humans. Potential adverse effects to wilderness land uses are related to the use of heavy equipment (noise, odors); the presence of work crews (visual/noise intrusion); and possible very small-scale experimental prescribed burning and herbicide use (visual and odor effects), all of which would normally be considered out of place if they affect the wilderness setting. These impacts would be temporary and collectively, could result in negligible to minor, adverse, localized effects to wilderness land uses.

Cumulative Impacts

If future small-scale restoration work in the vicinity of the project is located in areas zoned or proposed for wilderness, it would proceed in compliance with the Wilderness Act. While management actions are discouraged in wilderness where ecosystem processes are naturally functioning, they are allowed when needed to correct “past mistakes” or “the impacts of human use” (NPS 2006a sec. 6.3.7). Section 4(c) of the Wilderness Act discourages motorized equipment in the wilderness to accomplish the tasks of preservation and protection, but does allow it if there is justifiable need and it has been found to be the “minimum requirement needed by management to achieve the purposes of the area as wilderness” (NPS 2006a sec. 6.3.5). Whether the use of motorized equipment is in compliance with the Wilderness Act is determined through a “minimum tool requirement” assessment which evaluates both whether intervention in wilderness is warranted, and whether the proposed techniques or tools would have the minimum impact to wilderness resources. Such an assessment was completed for treatment adjacent to Abbotts Lagoon, which concluded that management was warranted and heavy equipment would have less

impact on wilderness resources and values than hand tools given the pace of encroachment by *Ammophila*.

The Seashore currently contains approximately 33,000 acres of designated or proposed wilderness in which human modifications and uses are minimized to the extent possible. In the past, wilderness lands have incurred both cumulative adverse and beneficial impacts. For instance, Tule elk and nonnative deer management within the Seashore has resulted in short-term adverse (use of motorized vehicles in wilderness areas) and long-term beneficial (enhancement of wilderness) effects. Coastal restoration projects have resulted in short-term, adverse (project implementation) and long-term beneficial (restoration of natural processes) effects to wilderness lands.

Conclusion

Small-scale restoration efforts would have negligible to minor, adverse, localized effects on wilderness uses of adjacent lands.

Impacts of Alternative B

Alternative B includes the creation and use of two staging areas, both of which are located within G Ranch. One would be located on the existing NDOC facility property and require little improvement. The second is located near the southeastern project boundary (figure 5) at the AT&T site. The primary vehicular route for equipment and crew transport for all alternatives would be via an existing road from the NDOC facility which runs to the west for a short distance to the dunes area across G Ranch. This roadway would be improved (graded/graveled) prior to use. Two secondary, north-south unimproved routes created to allow access to the project site cross both G Ranch and ATT parcels, both of which are used for grazing operations. The third route is located within G Ranch and crosses the project site from east-west from the western-most staging area. This route would provide heavy equipment access to foredune areas.

No access would be routed through land used for grazing operations, and no direct impact on cattle is expected. Noise from the use of roads and access routes by even heavy equipment is also not expected to affect grazing cattle, as they are currently habituated to vehicular traffic, including ATVs. All project work would be coordinated with ranching permitees to minimize the potential for conflict, such as when cattle may need to be moved across roads to adjacent pastures. As a result, only negligible adverse, short-term, localized effects to ranching from staging or access within these two parcels (ATT and G) are expected.

Herbicide application would be done in coordination with both ranching permitees. As of 2008, G Ranch is certified organic. As such, no herbicide would be allowed within the ranch boundaries.

Prescribed burning would create smoke and odors, and the potential for intrusions of obvious human activity and management (e.g., herbicide application) into an otherwise natural wilderness experience on adjacent wilderness lands. Although wilderness visitors would generally not be aware of herbicide use, those that are would potentially find it in conflict with wilderness values that normally do not include management activities or the use of potentially toxic chemicals.

Wilderness uses of adjacent areas could also be adversely affected by the visual presence of work crews and heavy equipment for excavations, as well as the presence of noise and odors related to the use of heavy equipment. These potential intrusions into adjacent wilderness lands would last approximately two months. Wind and wave action can often mitigate adverse noise and odor effects (see Visitor Experience above). Collectively, these

noise, odor and visual intrusions would likely result in negligible to minor, localized, short-term and adverse impacts to those using wilderness lands adjacent to the project site.

Cumulative Impacts

Approximately 21,000 acres encompassed within the Seashore boundaries represents active ranching land uses (NPS 2008 p. 204). Ranching land uses often overlap with other land uses such as transportation, residential, and park management.

Cumulative impacts to wilderness lands adjacent to the project site under Alternative B are similar to those described for the No Action alternative, with additional negligible to minor, adverse effects related to project implementation (noise, odors, increased activity).

Conclusion

The implementation of Alternative B would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to minor adverse effects to those using wilderness lands to the west and north of the project site from smoke, odors, herbicide use and noise are also expected. When compared to the No Action alternative, Alternative B would result in similar adverse effects to adjacent ranching and wilderness land uses.

Impacts of Alternative C

The impact of access and staging under Alternative C to adjacent land uses would be similar to that described above under Alternative B--negligible adverse, short-term, and localized.

Though similar in nature to those under Alternative B, effects to adjacent wilderness users associated with excavation would be more extensive under Alternative C. Excavation would take place Monday through Friday during the day for a five month period in this alternative. For those visitors accessing adjacent wilderness along the Abbotts Lagoon path, or visiting beaches in wilderness areas adjacent to the site, noise and odors may be obvious during certain periods of time. If so, they would be out of character with wilderness and have at least a minor impact on those using these adjacent lands. When excavation is taking place further from the trail or beaches, noise would be dampened by distance, wind and topography, and may not be noticeable. In either case, excavators would be visually apparent for some visitors and would be out of character with and disruptive to the usual wilderness experience near the site. Short-term, localized, adverse impacts would range from negligible to moderate.

Cumulative Impacts

Cumulative impacts under Alternative C are similar to those described for Alternative B, with additional negligible to moderate, adverse effects to those using adjacent wilderness lands. These additional effects would be related to project implementation (noise, odors, increased human activity).

Conclusion

The implementation of Alternative C would result in negligible, adverse, short-term, localized impacts to ranching land uses adjacent to and overlapping the project site. Localized, short-term, negligible to moderate adverse effects to those using wilderness lands to the west and north of the project site are also expected as a result of noise, odor and visual intrusions into wilderness areas. When compared to the No Action alternative, Alternative C would result in slight elevated adverse effects to adjacent wilderness land uses related to the extended period of heavy equipment.

HEALTH AND SAFETY

Policies and Regulations

The health and safety of park staff and the public is an over-arching priority in all actions taken in park management. The NPS *Management Policies 2006* indicate that parks prevent injuries by applying nationally accepted codes, standards and engineering principals, as well as other appropriate measures such as closures, guarding, signing or other forms of education (sec. 8.2.5.1).

Assessment Methodology

The analysis of effects on public health and safety is primarily qualitative and uses the scientific and agency literature to determine the risks of injury from heavy equipment and residual glyphosate related to herbicide use. Park specialists and the park's Fire Management Plan were consulted to determine the risk of an escaped fire if prescribed burning is used.

Context, Duration and Impact Thresholds

The standard definitions of context and impact thresholds were used to evaluate impacts to public and staff or contractor health and safety.

Impact of No Action

Under the No Action alternative, small-scale dune restoration projects would take place primarily using hand tools and heavy equipment. The use of heavy equipment has the potential to negatively affect worker health and safety due to risk of potential injuries related to equipment rollovers, maintenance/operation activities, lack of sufficient monitoring of nearby human activities while equipment is in use, etc. The use and compliance with a contractor's safety plan would keep these effects to worker health and safety to negligible and short-term.

Cumulative Impacts

A variety of past and future projects are expected to continue to contribute to effects on public health and safety issues within the Seashore. In general, habitat, watershed, and cultural resource restoration projects, as well as improvements to sewage systems, have provided long-term, cumulative benefits to health and safety by way of improved water quality and compliance with health and safety regulations.

Conclusions

Only negligible, adverse effects to worker health and safety are anticipated as a result of the use of heavy equipment.

Impact of Alternative B

Alternative B would result in negligible, short-term, adverse impacts to health and safety related to the driving of heavy equipment or vehicles to and from the site and the use of existing roads and secondary routes. These would be related to typical vehicular accidents, including collisions, navigating rolling topography, etc. Staging areas could be potentially hazardous because fuels, herbicides and equipment would be stored on them. As noted in other sections of this document, the risk of accidents would be minimized through the use of

standard spill prevention measures such as using impervious surfaces for storage, berming and a spill/response plan.

The use of heavy equipment for dune restoration activities is proposed under both action alternatives. The types of potential adverse effects are similar to those described under No Action. However, this alternative includes the treatment of 27 acres of very steep foredune and the risk of rollovers off the windward face may be higher than on more gently rolling terrain in the reardunes. The machinery used to treat the foredune would need to have adequate horsepower to flatten the dunes and dig deeply to minimize the need for balancing on top of what could be a steep slope. With proper equipment, training and a safety plan, the chance of accidents and impacts from the use of heavy equipment on the foredune would be negligible to minor and short-term.

Under this alternative, the initial treatment for nonnative, invasive vegetation within a large portion of the reardune area would consist of a single prescribed burn over a period of a few hours to five days. Risk of fire escaping to adjacent areas is considered low as the project site is located within dunes where vegetation is patchy and natural barriers exist. The timing of the burn(s) would be determined by the Fire Management Officer and would depend on environmental conditions, season, day, and time of day. Health and safety issues would be paramount in this decision. With implementation of appropriate mitigation measures spelled out in a burn plan, effects to health and safety from risk of fire and smoke injuries during burn activities would be minor, adverse, short-term and localized.

After initial treatment of the reardune area (approximately 90 acres) with prescribed burns, herbicides would be directly applied to *Ammophila* leaves the following spring and summer. Herbicide application would involve about 18 days although this activity could be spread out over a longer period of time to avoid the windiest conditions and comply with other manufacturers' application recommendations. Resprouting of invasive vegetation may also be controlled by herbicide application in the foredunes area after initial mechanical removal is completed.

Glyphosate, the herbicide other *Ammophila* control projects have used, primarily affects plants by inhibiting a metabolic pathway that only occurs in plants and microbes. Since humans do not have this particular pathway, no metabolic effects of glyphosate occur. However, at sufficiently high exposures, glyphosate is toxic and/or lethal, and can cause gastrointestinal effects, respiratory tract damage, pulmonary edema, renal and urinary effects as well as the more common irritation of the mucosa (eyes in particular). The primary mode of concern is ingestion, as glyphosate is poorly absorbed through the skin. Because glyphosate has a very low volatility, inhalation is not considered an important route of exposure by the EPA (USDA Forest Service 2003).

Subchronic effects in mammals include loss of body weight, liver toxicity, and possible neurotoxicity. Effects on the endocrine system or immune system on mammals have not been found, nor has evidence of birth defects from exposure been uncovered (studies were performed on rats, rabbits and human agricultural workers). Although glyphosate is classified by the US EPA as "Group E: Evidence of non-carcinogenicity for humans," this assessment has been challenged based on some studies that indicate marginal carcinogenic activity (ibid.).

Contractors to the U.S. Forest Service, which uses glyphosate for weed control and other vegetation management, prepared a report that included an exposure assessment, dose-responses assessment and a risk assessment for both those workers applying the herbicide and the general public (USDA Forest Service 2003). For each, they evaluated a "general" and an "accidental/incidental" scenario. For backpack spraying, the dose estimate varied from a low of 0.0009 mg/kg of body weight/day to a high of 0.16 mg/kg/day. The highest level of glyphosate where no adverse effects in humans have been observed (NOAEL) is 175

mg/kg/day, which the EPA has reduced by 100 times and rounded off to 2 mg/kg/day as the reference dose for humans. The highest dose of 0.16 for worker exposure is lower than the reference dose by a factor of 12 and therefore is not expected to pose any “general” health risk to those applying herbicide.

The “accident” scenarios include immersion of hands, contaminated gloves, spills on hands or lower legs left untreated for an hour. Of these, the spill on lower legs had the highest potential for exposure, a scenario that could result in a dose of glyphosate of between 0.000295 mg/kg/day and 0.014 mg/kg/day (ibid.). This is lower than the reference dose by a factor of 140, and also would not be expected to pose any health risk. This does not mean that glyphosate would not cause irritation of the eyes or skin if direct contact is made, only that no internal damage would result from glyphosate exposure. The level of irritation from glyphosate is considered the same as from standard dish washing detergents or all purpose cleaners (ibid.).

Several possible exposures to the general public were also examined, including direct spray of the entire body, contamination through contact with sprayed vegetation and ingestion directly through consumption of contaminated fish or fruit. Long-term exposures through the consumption of sprayed fruit, water or contaminated fish were also examined. Of those examined, contact with contaminated vegetation is considered of most concern at the site. The range of acute exposure from this source is estimated at between 0.000698 mg/kg/day to 0.00531 mg/kg/day (ibid.). These values are below the reference dose by hundreds to thousands of times. Long-term scenarios all involved consumption of contaminated food or water, and are not relevant to this analysis.

The potential impact to workers from glyphosate would be short-term, minor and only occur from direct exposure to the eyes or skin. No or only negligible short-term impact to the public from spraying glyphosate is expected.

Cumulative Impacts

Cumulative impacts are similar to those described under the No Action alternative.

Conclusions

Negligible to minor, adverse, short-term, localized impacts to worker and public health and safety are expected under Alternative B. These effects are related to vehicular access and staging, the use of heavy equipment, prescribed burning activities and the use of herbicides.

Access and staging of vehicles used for restoration activities would result in negligible, short-term adverse effects related to travel along primary and secondary access routes and the storage of potentially hazardous (e.g., fuel, herbicide) materials at staging areas. The use of heavy equipment to treat the steep foredune would require proper equipment, training and a safety plan to keep the chance of accidents and impacts to negligible or minor. A burn plan and closure of the area during prescribed fire would keep the risk of fire and smoke injuries to park staff and the public to minor, adverse, short-term and localized. Workers applying herbicide would be exposed to a dose of glyphosate that is 12 times lower than the EPA reference value where no adverse effects are expected. The worst accident scenario for workers would expose them to a level 140 times lower than this value. The most likely herbicide exposure scenario for the public, given that the area would be closed for 48 hours following spraying, is contact with sprayed vegetation which would expose a visitor to a dose hundreds to thousands of times lower than the reference dose. These are all negligible impacts. Glyphosate can irritate the mucosa, and injuries from direct contact to the eye for example, would be minor and similar to that from household cleaning products or dish detergent. When compared to the No Action alternative, Alternative B

would result in additional negligible to minor adverse effects to health and safety, primarily related to project site access/equipment staging, prescribed burns and herbicide application.

Impact of Alternative C

As described under Alternative B, Alternative C would result in similar negligible, short-term, adverse impacts to health and safety related to the driving of heavy equipment or vehicles to and from the site and the use of existing roads and secondary routes.

Under this alternative, removal of nonnative, invasive vegetation species would be accomplished primarily through the use of mechanical techniques (heavy equipment), similar to that described under No Action. The possibility of rollovers or accidents would increase simply because this tool would be used nearly exclusively for five months instead of the two expected under Alternative B. However, with proper equipment, training and implementation of a safety plan, impacts are likely to be no more than minor and short-term.

Cumulative Impacts

Cumulative impacts are similar to that described under the No Action alternative.

Conclusions

Short-term, negligible to minor short-term adverse impacts to health and safety are expected under this alternative. Access and staging of vehicles used for restoration activities would result in negligible, short-term adverse effects related to travel along primary and secondary access routes and the storage of potentially hazardous (e.g., fuel, herbicide) materials at staging areas. The use of heavy equipment for restoration activities would require proper equipment, training and a safety plan to ensure the chance of accidents and adverse impacts remain no greater than minor and short-term. When compared to the No Action alternative, Alternative C would result in additional negligible to minor adverse effects to health and safety, primarily related to project site access/equipment staging and heavy equipment use.

CONSULTATION AND COORDINATION

PUBLIC INVOLVEMENT AND SCOPING

On October 14, 2005 a scoping letter and press release was sent to interested parties regarding the Coastal Dune Restoration Project. The scoping letter was sent to approximately 300 parties on the park's mailing list. In addition, a project description and scoping letter was placed on the NPS Planning, Environmental, and Public Comment (PEPC) website (http://parkplanning.nps.gov/).

The scoping period closed on December 2, 2008 and three letters were received. Two were from organizations—Marin Audubon Society and the Native Plant Society. Both organizations were supportive of the project, but had specific concerns about implementation that have been addressed in this EA. The private party letter was concerned about noise and adverse impacts of heavy equipment in the dune area to wildlife. These issues are also addressed in this EA.

The park has also produced a flyer "Restore Critical Dune Habitat" (NPS 2005) that has been available to interested parties and placed on the PEPC and Point Reyes websites.

NPS has conducted internal scoping as well. Through internal scoping, NPS examined potential environmental issues (raised by NPS staff) that are relevant to the proposal. Those issues with potential for effect are addressed as part of this EA.

A site visit for US Fish and Wildlife Service was conducted on August 12, 2008.

COMPLIANCE STATUS

Documentation of NPS compliance with federal and state laws and regulations is incorporated into the text of the EA. Compliance with the nine major federal laws, executive orders, and associated state regulations is summarized here.

National Environmental Policy Act (NEPA) of 1970. PL 91-190, 83 Stat. 852, 42 USC §4341 et seq. The EA provides disclosure of the planning and potential environmental consequences of the proposed action and alternatives, as required by NEPA. All substantive comments received on the EA are addressed before the EA is used in any decision-making. In addition, an alternative is identified as preferred (in this case, the preferred alternative is Alternative C). It is anticipated that a Finding of No Significant Impact (FONSI) which records the final decision and any mitigation measures, as well as a summary of how significant impacts are avoided would be prepared following the finalizing of the EA. If public comments or other new information indicate a significant environmental impact is possible, the NPS would either mitigate the impacts or begin preparation of an environmental impact statement (EIS). The NPS will wait 30 days from the time the FONSI is published to either implement the selected alternative or begin preparation of an EIS.

Endangered Species Act of 1973, as amended, PL 93-205, 87 Stat. 884, 16 USC §1531 et seq. The Endangered Species Act protects threatened and endangered species, as listed by the U.S. Fish and Wildlife Service, from unauthorized take, and directs federal agencies to ensure that their actions do not jeopardize the continued existence of such species. Section 7 of the act defines federal agency responsibilities for consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (for marine life) and requires preparation of a Biological Assessment to analyze impacts to any threatened or endangered species that is likely to be affected by the proposal. The National Park Service is providing this EA as a Biological Assessment for consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.

Archeological Resources Protection Act of 1979, PL 96-95, 93 Stat. 712, 16 USC §470aa et seq. and 43 CFR 7, subparts A and B, 36 CFR. This act secures the protection of archeological resources on public or Indian lands and fosters increased cooperation and exchange of information between private, government, and the professional community in order to facilitate the enforcement and education of present and future generations. It regulates excavation and collection on public and Indian lands. It requires notification of Indian tribes who may consider a site of religious or cultural importance prior to issuing a permit. The NPS will meet its obligations under this Act in all activities conducted.

National Historic Preservation Act of 1966, as amended, PL 89-665, 80 Stat. 915, 16 USC §470 et seq. and 36 CFR 18, 60, 61, 63, 68, 79, 800. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed in or eligible for listing in the National Register of Historic Places. The NPS sent a scoping notice to the state historic preservation officer and the Advisory Council for Historic Preservation to initiated consultation. Consultation will continue throughout the planning process.

Executive Order 11990: Protection of Wetlands. This Executive Order established the protection of wetlands and riparian systems as the official policy of the federal government. It requires all federal agencies to consider wetland protection as an important part of their policies and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. All of the actions proposed are consistent with this executive order.

Executive Order No. 13112: Invasive Species. This Executive Order prevents the introduction of invasive species and directs federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species. Actions proposed measures to prevent the introduction and spread of invasive species.

California Coastal Zone Management Act. This act protects coastal environments. While this act transferred regulatory authority to the states and excluded federal installations from the definition of the “coastal zone,” it requires that federal actions be consistent with state coastal management plans. Activities taking place within the coastal zone under the definition established by the California Coastal Management Plan require a federal consistency determination. The EA will be submitted to the Coastal Commission for federal consistency determination.

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DISTRIBUTION LIST

List of agencies and organizations to whom copies of Notice of the Draft Environmental Assessment have been sent:

Federal Agencies
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Commerce, National Oceanic and Atmospheric Administration
U.S. Geological Survey
U.S. Fish and Wildlife Service
U.S. Natural Resources Conservation Service
U.S. NOAA Fisheries
U.S. Environmental Protection Agency

Federal Advisory Groups
Advisory Council for Historic Preservation

Elected Officials
Marin County Supervisor Steve Kinsey
California State Assemblyperson Jared Huffman
U.S. Representative Lynn Woolsey
U.S. Senator Barbara Boxer
U.S. Senator Dianne Feinstein

State Agencies
Bay Area Air Quality Management District
California Coastal Commission
State of California Department of Environmental Science
State of California Department of Fish and Game
State of California Department of Parks and Recreation
State of California Department of Transportation
State of California Office of Planning and Resources State Clearinghouse
State Historic Preservation Office
University of California, Berkeley
University of California Cooperative Extension

Regional, County, and Municipal Agencies
Bolinas Fire Protection District
Bolinas Community Public Utility District
Inverness Fire Department

Marin Humane Society
Marin County Community Development Agency
Marin County Fire Department
Marin County Open Space
Marin County Sheriff's Office
Marin County Resource Conservation District
Marin Municipal Water District
San Francisco Regional Water Quality Control Board
Sonoma County Agriculture Preservation and Open Space District
Sonoma County Water Agency

Non-Governmental Organizations, Non-Profit Organizations, etc.
Animal Protection Institute
Audubon Canyon Ranch & Cypress Grove Preserve
Bay Area Ridge Trail Council
Bay Institute
Bayrose Morgans
Bicycle Trails Council
Bolinas Community Parks Planning
California Native Plant Society
Coastwalk
Committee for the Preservation of Tule Elk
Defenders of Wildlife
East Shore Planning Group
Environmental Action Committee of West Marin
Environmental Forum of Marin
Federated Indians of Graton Rancheria
Friends of the Estero
Gardener's Guild
In Defense of Animals
Inverness Association
Inverness Ridge Association
Marin Agricultural Land Trust
Marin Audubon Society
Marin Conservation League
Marin County Farm Bureau
Marin Horse Council
Mow our Weeds
National Parks and Conservation Association
National Trust for Historic Preservation
North American Trail Ride Conference
Point Reyes Light
Point Reyes Village Association
PRBO Conservation Science
Preserve Historic Olema Valley
Sierra Club, Marin Group
Sonoma Horse Council
Sonoma County Farm Bureau
Sustainable Conservation
Tomales Bay Advisory Committee
Trout Unlimited
Trust for Public Land
Vedanta Society

Waste Watch
West Marin Chamber of Commerce
West Marin Community Radio (KWMR, 90.5 FM)
West Marin Paths
Wilderness Society

Libraries
Bolinas Library
Inverness Library
Marin County Library
Point Reyes Library
Stinson Beach Library
Marin County Civic Center Library
San Francisco Main Public Library

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horkelia; 4/9); Hesperevax sparsiflora var. brevifolia; 4/9); Gilia mieelfoliata (dark-eyed gilia; 4/9); Gilia capitata ssp. Chamissonis (blue coast gilia; 4/9)

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GLOSSARY

Aggradation: The process by which a stream's gradient steepens due to increased deposition of sediment.

Clonal Mat: A smooth mat of rhizomatous plants which share the same genetics.

Macrophytic Aquatic Vegetation: Aquatic vegetation observable with the naked eye.

Monospecific: Composed of a single species

Morphology: The branch of biology that deals with the form and structure of organisms without consideration of function.

Organochloride: The simplest forms of organochlorides are chlorinated hydrocarbons. These consist of simple hydrocarbons in which one or more hydrogen atoms have been replaced with chlorine. Many pesticides widely used in agriculture are organochlorides. These include DDT, dicofol, heptachlor, endosulfan, chlordane, mirex, and pentachlorophenol.

Surfactant: A substance that when dissolved in an aqueous solution reduces its surface tension between it and another liquid. When added to glyphosate, it allows for more complete wetting of the leaf.

Symbiology: The study of symbiosis-- the close association between two or more organisms of different species

APPENDIX A- LISTED SPECIES IN THE VICINITY OF THE POINT REYES NATIONAL SEASHORE DUNES RESTORATION PROJECT

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the

DRAKES BAY (485C) U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: January 31, 2008

Document Number: 080520022227

Species of Concern - The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. See www.fws.gov/sacramento/es/spp_concern.htm for more information and links to these sensitive species lists.

Red-Legged Frog Critical Habitat - The Service has designated final critical habitat for the California red-legged frog. The designation became final on May 15, 2006. See our map index.

LISTED SPECIES

Invertebrates

Haliotes sorenseni
white abalone (E) (NMFS)

Speyeria zerene myrtleae
Myrtle's silverspot butterfly (E)

Syncaris pacifica California
freshwater shrimp (E)

Fish

Eucyclogobius newberryi
tidewater goby (E)

Oncorhynchus kisutch
coho salmon - central CA coast (E) (NMFS)
Critical habitat, coho salmon - central CA coast (X) (NMFS)

Oncorhynchus mykiss

Central California Coastal steelhead (T) (NMFS)
Central Valley steelhead (T) (NMFS)
Critical habitat, Central California coastal steelhead (X) (NMFS)

Oncorhynchus tshawytscha
California coastal chinook salmon (T) (NMFS)

Amphibians

Rana aurora draytonii

California red-legged frog (T)
Critical habitat, California red-legged frog (X)

Reptiles

Caretta caretta
loggerhead turtle (T) (NMFS)

Chelonia mydas (incl. agassizi)
green turtle (T) (NMFS)

Dermochelys coriacea
leatherback turtle (E) (NMFS)

Lepidochelys olivacea
olive (=Pacific) ridley sea turtle (T) (NMFS)

Birds

Brachyramphus marmoratus Critical
habitat, marbled murrelet (X)
marbled murrelet (T)

Charadrius alexandrinus nivosus Critical
habitat, western snowy plover (X)
western snowy plover (T)

Diomedea albatrus
short-tailed albatross (E)

Pelecanus occidentalis californicus
California brown pelican (E)

Sternula antillarum (=Sterna, =albifrons) browni
California least tern (E)

Strix occidentalis caurina
northern spotted owl (T)

Mammals

Arctocephalus townsendi
Guadalupe fur seal (T) (NMFS)

Balaenoptera borealis
sei whale (E) (NMFS)

Balaenoptera musculus
blue whale (E) (NMFS)

Balaenoptera physalus
finback (=fin) whale (E) (NMFS)

Eubalaena (=Balaena) glacialis
right whale (E) (NMFS)

Eumetopias jubatus
Steller (=northern) sea-lion (T) (NMFS)

Physeter catodon (=macrocephalus)
sperm whale (E) (NMFS)

Plants

Alopecurus aequalis var. sonomensis
Sonoma alopecurus (E)

Chorizanthe robusta var. robusta
robust spineflower (E)

Chorizanthe valida
Sonoma spineflower (E)

Layia carnosa
beach layia (E)

Lupinus tidestromii
clover lupine [Tidestrom's lupine] (E)

CANDIDATE SPECIES

Invertebrates

Haliotes cracherodii

black abalone (C) (NMFS)

Key:

(E) Endangered - Listed (in the Federal Register) as being in danger of extinction.

(T) Threatened - Listed as likely to become endangered within the foreseeable future.

(P) Proposed - Officially proposed (in the Federal Register) for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.

Critical Habitat - Area essential to the conservation of a species.

(PX) Proposed Critical Habitat - The species is already listed. Critical habitat is being proposed for it.

(C) Candidate - Candidate to become a proposed species.

(X) Critical Habitat designated for this species.

APPENDIX B- STATE HISTORIC PRESERVATION OFFICE CONSULTATION LETTER FOR POINT REYES NATIONAL SEASHORE DUNES RESTORATION PROJECT

United States Department of the Interior

NATIONAL PARK SERVICE

Point Reyes National Seashore

Point Reyes, California 94956

IN REPLY REFER TO:

H24

July 14, 2008

Mr. Milford Wayne Donaldson

State Historic Preservation Officer

Department of Parks and Recreation

P.O. Box 942896

Sacramento, CA 94296-0001

Subject: Point Reyes National Seashore - Section 106 Consultation for the Proposed Undertaking: Restoration of Coastal Dune Habitat at Abbotts Lagoon (Project Number PORE 7151)

Dear Mr. Donaldson:

The purpose of this correspondence is to notify your office of the National Park Service (NPS) proposed undertaking to restore dune habitat south of Abbotts Lagoon at Point Reyes National Seashore (Enclosure A). The park preserves some of the last remaining high quality coastal dune habitat in the United States however this habitat is seriously threatened by the rapid encroachment of two nonnative plant species, European beachgrass and iceplant that have greatly altered sand movement, dune structure and habitat function for native plants and animals. Point Reyes National Seashore has targeted the Abbotts Lagoon area as a site that offers both the largest acreage of potentially high quality dune habitat in the park and the chance to try different methods of removing exotic plant species. The restoration area provides critical habitat for many federally listed plant and animal species.

In accordance with the Advisory Council on Historic Preservation's regulations for the Protection of Historic Properties 36 CFR 800 the NPS is initiating standard Section 106 consultation with your office regarding this proposed undertaking. The NPS is seeking your concurrence with the Area of Potential Effect (APE) and the NPS finding of effect.

Undertaking

The proposed NPS undertaking would restore approximately 300-acres of dune habitat south of Abbotts Lagoon by removing nonnative plant species. The NPS efforts would focus on restoring foredune habitat to maximize Western Snowy Plover habitat, and a more

generalized effort that includes both foredune and reardune habitat for a wider variety of federally listed species. Restoration treatment would consist of mechanical and hand removal of vegetation and burial of the biomass. The NPS is proposing to remove and bury nonnative vegetation species using heavy equipment and/or may alternatively use controlled burns and follow-up application of herbicide in small, isolated patches.

Area of Potential Effect

The area of potential effects (APE) for the Restoration of Critical Dune Habitat project near Abbotts Lagoon consists of about 300 contiguous acres of coastal dune in the northwestern portion of the Point Reyes National Seashore (Enclosure A). The removal and burial is anticipated to result in dune excavation to depths of 12 feet or more.

Cultural Resource Investigation

Archeological field investigation was conducted for the NPS by Anthropological Studies Center, Sonoma State University in December 2005. A final report describing this investigation and recommendations for further treatment was submitted to NPS in June of 2006. A copy of this report in enclosed with this correspondence (Enclosure B).

The upper deposits examined in the dune-habitat restoration project area are comprised almost exclusively of aeolian sand. Therefore, there is the potential for buried archeological resources within the APE for the proposed undertaking. To address sub-surface as well as surface resources the archeological survey included an intensive archeological surface survey and limited geoarcheological excavation. No prehistoric archeological materials were observed, but two buried soil horizons were identified and dated through geoarcheological trenching and the subsequent radiocarbon dating of soil samples.

One previously recorded site, CA-MRN-295, originally recorded in the 1930s, imprecisely located and consisting only of surface artifacts, may be within the APE but could not be relocated. An earlier reconnaissance level survey (Edwards 1968) attempted to relocated the site but was unsuccessful. It has either been obscured or destroyed.

Finding of Effect

No prehistoric archeological deposits were identified within the APE. Isolated historic artifacts were observed, and as indicated by the presence of a ship's timber within an adjacent environmental restoration project, similar finds could be uncovered within the APE for this undertaking. Two buried soils were identified that could contain buried archeological deposits. The dune restoration undertaking would be designed to avoid or minimize impacts to unknown archeological resources. The NPS would implement recommendations in the 2006 archeological report calling for a qualified archeologist to monitor excavations that could penetrate the buried soils. Monitoring would be conducted to ensure that unknown potentially significant buried archeological resources are identified, and not impacted by restoration activities.

After applying the Advisory Council on Historic Preservation's regulations for the Treatment of Historic Properties, the NPS finds that there could be an effect on properties that may meet eligibility criteria for listing in the National Register of Historic Places, but that this effect would not be adverse. We hope you can concur with these determinations of eligibility and for your convenience have provided a concurrence lines on both the list of eligible properties determined eligible and on the list of properties found not eligible for the National Register.

We appreciate your assistance in consulting with us regarding the Abbotts Lagoon dune restoration at Point Reyes National Seashore. Your participation will help ensure that cultural resources are adequately considered in the proposed undertaking. We welcome your comments and are available to discuss the project and the cultural resources survey at

any time. Should you have any questions about any of the information contained herein, please contact Mark Rudo at (510) 817-1405 or Jane Sikoryak at the Denver Service Center (303) 969-2524.

Sincerely,

Don Neubacher
Superintendent

Enclosures (4):

Map: Site Location
Map: Abbotts Lagoon Dune Restoration Project Area
Map: Site Access and Infrastructure
Map: Recommended Monitoring Areas
Report: Archaeological Survey and Geoarchaeological Trenching Results for Abbotts Lagoon Dune Restoration, Point Reyes National Seashore, 2006

cc:

Federated Indians of Graton Rancheria
Attention: Sacred Sites Protection Committee
6400 Redwood Dr, Suite 300
Rohnert Park, CA 94928-2338

Concur APE

California State Historic Preservation Officer Date

Concur no adverse effect Date

California State Historic Preservation Officer Date