Avian Impact Study for the Golden Gate Bridge Suicide Deterrent System Project

Golden Gate Bridge
City and County of San Francisco, and Marin County, California

Prepared for:
Golden Gate Bridge Highway and Transportation District

Revised: November 25, 2009

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1.0 INTRODUCTION

Caltrans and Golden Gate Bridge Highway and Transportation District are proposing to construct a physical suicide deterrent system along both sides of the Golden Gate Bridge in the City and County of San Francisco and Marin County (Figure 1). The project limits are from the San Francisco Abutment (south) to the Marin Abutment (north) of the Bridge. The Draft Environmental Impact Report/Environmental Assessment (DEIR/EA) for the project (Chapter 1; CDT and GGB District 2008), provides a description of the Alternatives considered. A horizontal net system (Alternative 3) was chosen as the Preferred Alternative. Following the release of the Draft EIR/EA, refinements were made to Alternative 3 that included changing the net material color from International Orange to unpainted and uncoated stainless steel and replacing the net along the North Anchorage Housing with a vertical barrier.

The proposed horizontal net system would be constructed approximately 20 feet below the sidewalk, approximately 5 feet above the bottom chord of the exterior main truss, and would extend horizontally approximately 20 feet from the Bridge. The stainless steel netting material would have a grid of between 4 and 10 inches and would be uncoated and unpainted. There would be a support system consisting of beams connected to the vertical members of the truss and cables attached to the top chord of the truss to keep the netting taut so that it doesn't whip in the wind. The steel horizontal support system would be painted International Orange to match the bridge structure. The support system between the vertical members would be independent sections that could be rotated vertically against the truss to allow the maintenance travelers to be moved along the Bridge. There would be no modifications to existing features above the Bridge deck except for a small section located at the North Anchorage Housing. At the North Anchorage Housing, instead of the net system, a vertical barrier painted International Orange would be installed for a length of 300 feet. The barrier would extend 8 feet vertically from the top of the 4-foot high concrete wall extension of the North Anchorage Housing for a total height of 12 feet, similar to the 8-foot vertical barrier extension under Alternative 1A. The barrier's vertical members would be comprised of 1/2-inch thick diameter vertical rods spaced at 6 ½ inches on center.

Four other project alternatives, Alternatives 1A, 1B, 2A and 2B, were evaluated during the environmental review process prior to the identification of Alternative 3 as the Preferred Alternative. It was determined that these alternatives would have greater impacts on birds than the Preferred Alternative. These Alternatives proposed either a vertical extension above the existing handrail (Alternatives 1A & 1B) or replacement of the existing handrail (Alternatives 2A & 2B) with a higher barrier, creating a 10 to 12 foot vertical barrier. Transparent panels would be placed at viewing belvederes located on both sidewalks, around the towers and at the mid-span of the Bridge. In addition to being taller than the current 4 foot high outside handrails, the proposed transparent panel barriers would present new hazards for birds to strike the panels as they attempt to fly through the panels since they would not be visible. In addition, the reflective nature of the transparent panels when hit by the sun may disorient or "blind" birds. As a result, bird collisions would be more prevalent with the implementation of Alternatives 1A, 1B, 2A or 2B than with implementation of the net system chosen as the Preferred Alternative. Alternatives 1A, 1B, 2A, and 2B are not addressed further in this report.

This report serves as an addendum to the Natural Environment Study (Minimal Impacts; NES (MI)) prepared for the Golden Gate Bridge Physical Suicide Deterrent System Project dated July 2008. At the time of preparation, a Preferred Alternative had not yet been chosen, and as such, the NES and DEIR/EA included a measure to assess potential impacts to birds of the chosen Alternative (NES Measure 7, pg. 16). The measure includes a requirement to conduct more detailed studies of the selected alternative to evaluate potential impacts to birds and to develop additional mitigation measures as appropriate. The text of the NES mitigation measure in its entirety reads:

> The District will retain the services of a qualified avian biologist to further evaluate the potential of birds to collide with the transparent panels potentially used as part of the physical suicide deterrent system, and for the use of netting to harm bird species. At a minimum, the expected flight patterns of migratory and resident birds relative to the installation locations of the transparent panels or netting will be evaluated, as well as the potential of the transparent panels and associated reflections to alter regular flight patterns and encourage collisions. Should it be found that the use of the transparent panels or netting pose a substantial risk to birds, appropriate design modifications would be implemented. These measures may include, but are not limited to visual deterrents such as patterning the transparent material with a UV coating that birds can see but humans cannot; angling transparent panels to reflect the water or other surface (as opposed to the sky, mountains, trees, etc.); utilizing etching, fritting, and opaque patterned glass to reduce transparency; utilizing bird-legible patterns on the transparent material; limiting the amount of transparent panels or amount of panels without a visual deterrent; eliminating or reducing the amount of netting; or other effective means of deterring bird collisions or entrapment.

The study presented here is designed to fulfill the impact analysis requirements of the measure and was completed by carrying out research and field surveys with the following objectives:

- Conduct background research to identify existing information about bird use of the Golden Gate Bridge and surrounding area
- Conduct background research related to bird collision with bridges or similar structures such as radio towers and buildings
- Provide baseline data relative to bird use of the Bridge structure
- Document patterns of bird movement on, under, over, and around the Bridge
- Develop a visual model of bird use of different portions of the Bridge structure

Figure 1. Project Location
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California

- Identify bird behavior adjacent to the footprint of the proposed net system, and assess whether the net system has the potential to cause any changes in this behavior, or to cause injury or death to any birds
- If the proposed netting system is determined to pose a substantial risk to bird species protected by state or federal laws (i.e., Federal Endangered Species Act, Federal Migratory Bird Treaty Act, State Endangered Species Act, and State Fish and Game Code), then the District and Caltrans will develop additional measures to minimize these impacts

2.0 METHODS

2.1 BACKGROUND RESEARCH

Prior to starting field work, a series of literatures searches were conducted to identify potential impacts to birds described for similar projects and to identify existing study protocols. The literature search included a review of bird usage studies for local bridges as well as bridges in other regions (particularly coastal), and an examination of bird collision studies for other man-made structures including towers, buildings, and wind turbines.

Bird counts and relevant studies of bird ecology in and around the Golden Gate Bridge were evaluated, with a focus on species most likely to be affected by changes to the existing Bridge structure. Local research organizations with potential information were also contacted to acquire additional unpublished resources.

2.2 FIELD METHODS

Field surveys included two major components:

Standardized surveys

Quantification of bird activity through the cross-section of the Bridge and adjacent to the Bridge using standardized methods including: number of birds, identification of species, behavior, direction of movement, portion of the Bridge that was crossed, and proximity to the Bridge.

Focused searches and detailed behavioral observations

Additional searches for birds perching or nesting on the structure including: detailed documentation of special status bird species behavior around the Bridge, focusing on species that may use the Bridge structure for nesting, perching, shelter, or other activity.

2.2.1. Standardized Surveys

Standardized surveys were conducted four times during winter 2008-2009. Observation stations were established at 4 different vantage points so that as much of the Bridge as possible could be observed (Figure 2). The west side of the Bridge was observable only

from the Marin Headlands (Station 4); all other stations included the east side of the Bridge only.

Observation Stations

Station 1 (South Vista) was located near the southern end of the Bridge and toll plaza in the City of San Francisco, at the northern end of Vista Point. This station was 300 feet east of the Bridge and birds flying over and under the Bridge between the far southern end and approximately 300 feet north of the south tower were visible, up to approximately 2,000 feet from the observation station. Only activity on the east side of the Bridge was visible from this station (Photo B1).

Station 2 (North Vista) was located in Marin County at the southern end of the northern Vista Point, approximately 200 feet from the Bridge. From this station, only the eastern side of the Bridge north of the north tower was visible, up to 1,000 feet from the observation station (Photo B2).

Station 3 (Mid Span) was the only station located on the Bridge, and was established mid-way between the north and south towers on the pedestrian walkway on the east side of the Bridge. The focus of observations at this station included all birds flying under and over the Bridge between the north and south tower, within a maximum distance of approximately 2,000 feet from the observation station (Photo B3-7).

Station 4 (Marin Headlands) was located in Marin County on the southern end of Battery Spencer at an elevation of 440 feet, approximately 1,000 feet west of Bridge. From this station, the west side of the Bridge between the north tower and approximately mid-way between the two towers (3,000 feet from the station) was visible (Photo B8-9). This station offered an excellent view of the west side of the north tower where abundant peregrine falcon whitewash was visible, and was set up specifically to enable observations of peregrines if they were present on the tower.

At a distance of 1,000 or more feet, identification to species was not always possible, particularly for gulls. In addition, the angle of observation was not always optimal, i.e., observations were made directly above or below, or with sub-optimal lighting (too bright or too dim). The probability of detecting birds was lowest for the portions of the Bridge that were farthest away, and at some stations noteworthy proportions of birds may have been missed, particularly when bird activity was high and observations were required at a wide angle (i.e., Station 3). Birds flying above the height of the Bridge towers were likely missed relatively often.

Timing and Duration

Each survey visit included one-half to one hour observation at each station. Survey visits were spaced 5 to 7 days apart from late December 2008 through January 2009, as weather permitted, and were scheduled so that a range of temporal and tidal conditions were sampled.

Data Collection

To facilitate recording locations of bird passage through the Bridge or perching on the Bridge, a cross-section of the Bridge was divided into sections, the size of which was based on the observer's ability to distinguish among them with sufficient accuracy. Ninety-eight map reference sections were used (Figure 3): 24 sections below the roadway, 48 sections between the roadway and the maximum height of the two suspension towers, and 24 sections above the level of the towers.

At stations where large numbers of birds were observed (particularly Stations 1 and 3) data were recorded using a digital voice recorder to be transcribed later directly into a database. Otherwise data were recorded on data forms. During the first 2 surveys, birds were recorded out to approximately 1,000 feet east or west of the Bridge. Due to the considerable effort required to record the large numbers of birds flying through the cross-section of the Bridge, the greatest effort for data collection was made for birds as they flew through the cross-section or near the footprint of the proposed netting system during the remaining surveys. If fog, wind, or precipitation conditions substantially reduced the probability of observing birds in the vicinity of the Bridge, the survey was cancelled.

The following data were recorded during each standardized survey:

Standard Information and Survey Conditions at Each Station

Date, station number, time start, time end, total survey length, temperature and wind speed (measured with a Kestrel weather meter), proportion cloud cover, proportion of Bridge covered with fog, visibility distance in each of the cardinal directions (in miles), and relative rate of precipitation (light drizzle, light rain, or heavy rain).

Bird Observations

Observations were recorded for every bird observed on the Bridge, moving though the cross-section of the Bridge, or flying within 50 feet of the Bridge. Birds flying within 200 feet or floating on the water within 500 feet of the Bridge were also recorded if possible, based on the volume of observations closer to the cross-section. Data recorded include: species, number of individuals, map reference section, additional aerial photo map references if applicable, time, behavior (flying, foraging, roosting, or swimming), movement direction, elevation relative to the water or roadway (when the angle and distance of observation allowed sufficient accuracy of estimation of these elevations), and horizontal distance from Bridge (if observation was not for birds flying through the cross-section). Additional notes included behavior relative to Bridge structure (e.g., landed on Bridge structure, perched on tower).

2.2.2. Focused Searches and Detailed Behavioral Observations

Prior to starting standardized data collection at each station, and during travel between stations, the visible portion of the Bridge structure was searched with binoculars and/or a spotting scope for roosting (i.e., resting and perching) or nesting birds. Additional detailed focused searches and behavioral observations were made on four additional site visits when

standardized data were not collected. Because abundant peregrine falcon sign was present on the north side of the north tower, this area was scanned as often as possible, and the final two site visits were concentrated on this area.

When birds were observed on the Bridge structure, detailed behavioral observations were made. The following data were recorded in note format and on a map: species, number of individuals, map reference section, additional aerial photo map reference, time, location of bird including perch locations and flight trajectory, behavior (e.g., perch, preen, fly, or nest building), time at which behavior changed, interactions with other birds of the same or other species, proximity of behavior to potential suicide barrier netting, and notes related to possible impacts of the net on nesting or behavior.

2.2.3. Data summarization

Data were entered and summarized in a database created in MS Office Access 2007. Using the standardized survey data, bird passage rates (i.e., birds per hour) through the Golden Gate Bridge were calculated for each of the ninety-eight map reference sections. The bird passage rates were calculated as follows: for each map reference section the total number of birds of all species passing through the Bridge cross-section during all surveys was calculated; this value was divided by the total survey time at the station(s) from which that map reference section was visible.

Maps and figures were created in ArcGIS 9.2 and AutoCAD 2008.

Figure 2. Location of the Golden Gate Bridge Survey Stations
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California
Source: USGS

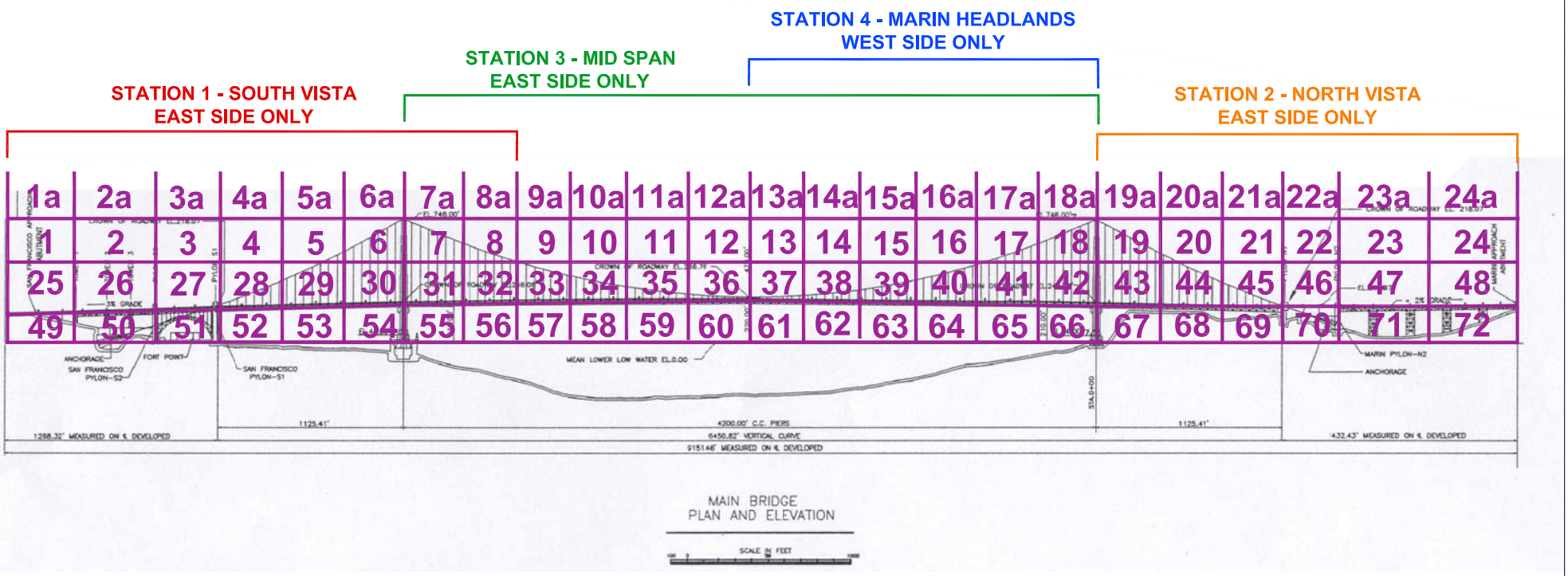

Figure 3. Golden Gate Bridge Spatial Divisions
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California

1 inch = 600 feet

0 600 1,200 ft

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3.0 RESULTS

3.1 BACKGROUND RESEARCH

3.1.1 Birds in the Vicinity of the Golden Gate

Background research was focused on identifying bird species likely to be present in the vicinity of the Golden Gate Bridge, and of these species, those that would be most likely affected by changes in the Bridge structure. Species that may be affected include breeding or winter resident species, particularly those that use the Bridge for roosting or nesting, and migrating species which may pass by the Bridge on route to wintering or breeding grounds elsewhere.

The San Francisco Estuary is one of the major sites for wintering shorebirds and waterfowl on the west coast, harboring more than a million shorebirds during migration, and more than 50% of the waterfowl using the Pacific Flyway (Accurso 1992, Takekawa et al 2000). Significant numbers of birds are resident in the Bay throughout the year, and breed in a diversity of habitats, including wetlands and terrestrial habitats. Within the immediate vicinity of the Golden Gate Bridge, much of the terrestrial habitat has been removed or altered by humans, with the exception of coastal scrub habitat on the Marin Headlands. Nearby human-altered habitats, including the open space and man-made structures of the Presidio, also provide habitat for a range of native and non-native terrestrial birds. Open water habitat within the vicinity of the Golden Gate Bridge is used year-round by a range of waterbirds and waterfowl for foraging. Species typically found in the area include gulls (*Larus* spp.), cormorants (*Phalocrocorax* spp.), and grebes, particularly western grebe (*Aechmorphorus occidentalis*). A large winter roost for California brown pelican (*Pelicanus occidentalis californicus*), federally and state-listed endangered (Appendix A), is found west of the Bridge at Rodeo Lagoon (Golden Gate National Recreation Area 2008). The Bridge itself provides roosting habitat for waterbirds between foraging bouts and during inclement weather, and may provide nesting habitat for American peregrine falcon (*Falco peregrinus anatum*), state-listed endangered and a California fully protected species (Appendix A), red-tailed hawk (*Buteo jamaicensis*), barn owl (*Tyto alba*), American crow (*Corvus brachyrhynchos*), double-crested cormorant (*Phalacrocorax auritus*), a California watch list species (Appendix A), and rock dove (domestic pigeon, *Columba livia*).

Peregrine falcons are present around the Golden Gate Bridge year-round, and use the structure as a look-out for foraging and for resting (D. Fish, pers. comm.; G. Stewart, pers. comm.; D. Gregoire, pers. comm.). Peregrine falcon nests documented on Golden Gate Bridge in the 1990's were not successful, although nests have not been found during all years and peregrine falcons may have successfully nested there without being noticed. However, the Golden Gate Bridge, and bridges over water in general, are not successful locations for nesting for peregrine falcons because the young almost always fall into the water or onto the roadway and perish, unless biologists intervene and take the eggs or young to another site to be raised. The Santa Cruz Predatory Bird Research Group has been removing and relocating eggs and young from peregrine nests on Bridges in the San Francisco Bay Area over the last 10 -15 years. In contrast, peregrine falcon nests built near the Bridge on the cliffs of the Marin Headlands have usually been successful (G. Stewart,

pers. comm.; D. Gregoire, pers. comm.). If possible, alterations to the Bridge structure should be intentionally designed to decrease, rather than increase, the attractiveness of the Bridge to potentially nesting peregrine falcons (Glenn Stewart, pers. comm.).

3.1.2 Migrating Birds at the Golden Gate

The fall - southbound - raptor migration through the Golden Gate has been systematically studied by staff biologists and volunteers at Golden Gate Raptor Observatory (GGRO) since 1983 (GGRO 2008). Due to a combination of the propensity for many raptors to follow the coast during migration and the fortuitous combination of landform configuration and wind patterns, raptors tend to funnel through the Golden Gate as they head south, and are easily observed from a vantage point west of the Bridge on the Marin Headlands named Hawk Hill. Raptors moving through the area are tallied by species, age, and sex, and these data can be used to look for short- and long-term trends in populations. There is also a considerable spring - northward - raptor migration through the area and a smaller-scale survey effort has developed around it (GGRO 2005).

The GGRO program also includes capturing and banding raptors to track individuals and allow resighting while the bird is still alive or return of the bands if the bird is found dead. These studies have indicated that raptors passing through the Golden Gate winter and breed throughout North America (GGRO 2008). A small number of raptors are fit with radio telemetry devices annually to track local movements. Local movements are complex and include east-west as well as north-south movements (GGRO 2005).

Thus, substantial numbers of raptors, and presumably other types of birds, migrate along the coast near the Golden Gate Bridge and are likely to pass near the Bridge. Although the overall movement is in a north-south direction, there are also east-west components of their movement.

Many species of birds exhibit short- and long-distance migratory movements throughout the year, depending on weather patterns. However, most individuals of most species are likely to pass through coastal northern California during February to May (when moving towards breeding areas) and August to November (when moving towards wintering areas; Cogswell 1977).

3.1.3 Bird Collision Literature

Applicable literature related to bird collisions includes studies covering the impacts of wind turbines, radio towers, power lines, buildings, and artificial lighting associated with a range of structures.

Avian impact studies focused on wind turbines identify a number of measures to minimize direct impacts (i.e., collision risk) and indirect impacts (i.e., habitat loss) (CEC and CDFG 2007, Global Energy Concepts 2005), many of which may be applicable to a non-mobile structure such as the Golden Gate Bridge. The applicable measures include avoiding lighting that attracts birds and bats, avoiding use of guy wires, and installing diverters around guy wires (CEC and CDFG 2007). Other potential measures with minimal

applicability to the present study include reducing the availability of artificial habitat for prey at turbine base area (i.e., to avoid luring birds into the wind turbine area), minimizing power line impacts by placing lines underground whenever possible, minimizing habitat fragmentation disturbance to sensitive habitat, establishing buffer zones to minimize collision hazards (i.e., avoiding placement of turbines within 100 meters of a riparian area), and reducing the potential for collision by determining optimal turbine design and turbine layout (CEC and CDFG 2007). Potential risks to birds from wind turbines are typically quantified during project planning by surveying for raptor nests, conducting standardized surveys for diurnal species using visual surveys, and conducting nocturnal species using radar, acoustic monitoring, or visual monitoring. These surveys can identify areas with highest risk for bird collisions, and facilitate development of optimal design and layout. Pre-project surveys may also be recommended when making substantial changes at existing wind farm sites, such as upgrading to turbines with a higher profile or faster turbine speed. After project construction, standardized monitoring is typically used to quantify mortality and mitigate for these impacts (Global Energy Concepts 2005, CEC and CDFG 2007, Smallwood and Thelander 2008).

Avian impact studies for non-moving structures have greater applicability to assessing the potential impacts of the proposed netting system. Higher collision impacts are associated with the tallest towers, excessively bright artificial lighting (particularly constant white light), the presence of transparent glass (which may be invisible to the birds or reflect landscaping, sky or water and cause collision), and narrow guy wires (Kerlinger 2000, Erickson et al 2005, CEC and CDFG 2007, New York City Audubon 2007, Longcore et al 2008). During periods of low visibility, particularly during inclement weather or heavy fog, and at night, birds may not be able to see structures such as towers, buildings and bridges. Their flight trajectories may be more haphazard, and collisions may be more likely (Dirksen et al 2000; Manville 2005). Birds are also known to fly at lower elevations during migration when weather is unfavorable, increasing collision risk with structures (Richardson 2000). Birds tend to be attracted to and disoriented by bright white lights, which causes major mortality at brightly-lit towers and tall buildings, especially during migration, at night, and during poor weather or fog. However, decreasing the number of lights overall and altering the lighting so that it flashes intermittently apparently tends to decrease mortality. Studies indicate conflicting results with the color of lights, i.e., some studies correlated higher mortality with red versus white lights, and others showed the opposite (Avery et al 1976, Manville 2005, Longcore et al 2008).

3.2 FIELD STUDIES

Field work was conducted on 9 separate days between December 19, 2008 and February 20, 2009 by EDAW ornithologist Hildie Spautz. This included 13.2 hours of standardized surveys and approximately 21.5 hours of additional focused searches and behavioral observations (Table 1). A list of the bird species and other wildlife observed during field surveys is provided in Table 2.

Table 1. Summary of Field Survey Dates and Conditions

Date	Survey Area	Time of Day (24 hour clock)	Wind	Temp (Fahrenheit)	Tides (feet)
12/19/08	focused searches	14:00 – 16:45	10	45	2.2 to 3.4
12/23/08	focused searches	12:08 – 14:30	0-3	40	2.2 to 0.0
12/30/08	Stations 1, 2, 3, 4; focused searches	10:00 – 16:37	0-5	45-60	4.4 to 1.4
01/04/09	Stations 1, 2, 3, 4; focused searches	11:43 – 17:18	2-3	45-52	1.3 to 3.2
01/11/09	Stations 1, 2, 3, 4; focused searches	11:19 – 17:30	2-5	60-68	6.6 to - 2.1
01/24/09	Stations 1, 2, 4; focused searches	11:10 – 17:00	2-4	51-53	5.5 to - 0.6
01/25/09	Station 3; focused searches	14:30 – 17:00	14-17	50	1.5 to -0.6
02/18/09	focused searches: primarily peregrine falcon observations	13:30 – 18:30	3	60	0.5 to 1.9
02/20/09	focused searches: primarily peregrine falcon observations	7:50 – 9:15	5	45	5.6 to 1.6

Table 2. List of Species Observed from survey stations at the Golden Gate Bridge

Species Name [1]	Station 1	Station 2	Station 3	Station 4	On Bridge[3]	Terrest-rial	Observed on Water	Observed in Flight
American crow (*Corvus brachyrhynchos)*	Yes	Yes	No	Yes	Yes	Yes	No	Yes
American kestrel (*Falco sparverius*)	No	No	No	Yes	No	Yes	No	No
American peregrine falcon (*Falco peregrinus anatum*)	No	No	Yes	Yes	Yes	Yes	No	Yes
Anna's hummingbird (*Calypte anna*)	No	No	No	Yes	No	Yes	No	No
Bewick's wren (*Thryomanes bewickii*)	No	No	No	Yes	No	Yes	No	No
black phoebe (*Sayornis nigricans*)	No	No	No	Yes	No	Yes	No	No
Brandt's cormorant (*Phalacrocorax penicillatus*)	Yes	Yes	No	No	Yes	No	Yes	Yes
bushtit (*Psaltriparus minimus*)	No	No	No	Yes	No	Yes	No	No
California quail (*Callipepla californica*)	No	No	No	Yes	No	Yes	No	No
California brown pelican (*Pelicanus occidentalis californicus*)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

Species Name [1]	Station 1	Station 2	Station 3	Station 4	On Bridge[3]	Terrest-rial	Observed on Water	Observed in Flight
California sea lion (*Zalophus californianus*)	No	Yes	Yes	Yes	No	No	Yes	Yes
cliff swallow (*Petrochelidon pyrrhonota*)	No	No	No	Yes	No	No	No	Yes
common raven (*Corvus corax*)	No	No	No	Yes	No	No	No	Yes
double-crested cormorant (*Phalacrocorax auritus*)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
European starling (*Sturnus vulgaris*)	Yes	No	No	No	No	Yes	No	Yes
golden-crowned sparrow (*Zonotrichia atricapilla*)	No	No	No	Yes	No	Yes	No	No
harbor porpoise (*Phocoena phocoena*)	No	Yes	Yes	No	No	No	Yes	No
harbor seal (*Phoca vitulina*)	No	Yes	Yes	No	No	No	Yes	No
pelagic cormorant (*Phalacrocorax pelagicus*)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
rock dove (domestic pigeon) (*Columba livia*)	Yes	Yes	No	No	Yes	Yes	Yes	No
red-shouldered hawk (*Buteo lineatus*)	Yes	No	No	No	No	Yes	No	No

Species Name [1]	Station 1	Station 2	Station 3	Station 4	On Bridge[3]	Terrest-rial	Observed on Water	Observed in Flight
red-tailed hawk (*Buteo jamaicensis*)	No	Yes	No	Yes	Yes	Yes	No	Yes
song sparrow (*Melospiza melodia)*	Yes	Yes	No	No	No	Yes	No	No
spotted towhee (*Pipilo maculatus*)	No	No	No	Yes	No	Yes	No	No
turkey vulture (*Cathartes aura*)	Yes	Yes	Yes	Yes	No	No	No	Yes
unknown cormorant species (*Phalacrocorax* sp.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
unknown gull species (*Larus* sp.) [2]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
white-crowned sparrow (*Zonotrichia leucophrys*)	Yes	Yes	No	Yes	No	Yes	No	No
western grebe (*Aechmophorus occidentalis*)	Yes	Yes	Yes	No	No	No	Yes	Yes
western gull (*Larus occidentalis*)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
wrentit (*Chamaea fasciata*)	No	No	No	Yes	No	Yes	No	No

[1] All native bird species are protected by the Migratory Bird Treaty Act. Non-native species not protected by this act include rock dove and European starling

[2] Gull species common in the San Francisco area, and likely to be present in the area around the Golden Gate Bridge include glaucous-winged gull (*Larus glaucescens*), California gull (*L. californicus*), a California Watch List species, mew gull (*L. canus*), ring-billed gull (*L. delawarensis*), and glaucous-winged x western gull hybrids.

[3] Birds observed on all portions of the structure the Bridge structure including above and below the roadway, and on the bases of the north and south towers.

3.2.1 Results of Standardized Surveys

During standardized surveys, observations were recorded for 3,797 birds; of these, 73% were gulls, primarily western gull (*Larus occidentalis*) or unidentified gull species (*Larus* spp.), and 9% were cormorants, including double-crested cormorant, Brandt's cormorant (*Phalacrocorax penicillatus*), and pelagic cormorant (*P. pelagicus*; Table 2). Of these observations, 2,524 birds passed through the Bridge cross-section and were used to calculate passage rates (Figure 4) or were roosting on the Bridge structure (Figure 5). Of the bird observations used for these calculations, 84% were gulls, primarily western gulls or unidentified gull species, and 4% were cormorant species, including double-crested cormorant, Brandt's cormorant, and pelagic cormorant. The observations not used for the passage rate calculations included birds floating on the water or flying near the Bridge, primarily western grebe, gulls, and cormorant species. Other species observed, each of which accounted for 1% or less of all the observations collected, including the subset of observations used for passage rates, included California brown pelican, peregrine falcon, red-tailed hawk, turkey vulture (*Cathartes aura*), American crow (*Corvus brachyrhynchos*), common raven (*Corvus corax*), and rock dove. The first three of these species are discussed in more detail below as they are considered the most sensitive.

Birds tended to pass over the Bridge roadway in the central and southern portions of the Bridge, and they appeared to avoid flying close to the two main towers (Figure 4). Only one bird, a gull, was observed flying through the vertical cables above the roadway; all of the other birds flying at roadway level flew north or south to a point where they could cross through the cross-section of the Bridge by going over the cables at their lower points. At the northern end of the Bridge, on some days birds appeared to avoid flying over the cables north of the north tower. Birds tended to fly along the curve of the Marin Headlands, particularly when going east, and likely crossed over the Bridge far north of the north tower.

Height above and below the roadway and height above water was collected for 30% and 24% of observations, respectively (i.e. for 1,330 birds). The average height above the roadway for birds flying in the map reference areas directly above the roadway (i.e., map reference areas 25-28, 34-39, and 45-48 on Figure 3) was 73 feet. Of these birds, 22% flew within approximately 30 feet of the roadway, and the lowest flight trajectory (not including the birds that landed on the roadway) was 5 feet above the roadway. Only the birds that landed on the Bridge structure at roadway level came within the proposed netting system footprint (i.e., 20 feet below and 20 feet out from the roadway). These birds included red-tailed hawk, American crow, and rock dove. The peregrine falcon was not seen at roadway level, but was observed on the north and south tower (mid-way up or at the top) and on the main cable about 20 feet south of the north tower (Figure 5, Figure 6).

More birds were observed passing through the Bridge going east (68%) than west (30%). Birds circling above the Bridge were tallied going both east and west. On most days, birds tended to fly across the Bridge directly east and west, but on some days, apparently due to strong winds in a direction opposing their flight path, most birds tended to fly north-east or south-west across the Bridge.

Most of the birds that passed under the Bridge flew an average of 25 feet over the water, and only four birds flew within 100 feet of the underside of the Bridge. The greatest concentration of birds flying under the roadway was around the base of the southern tower, where large concentrations of gulls and cormorants and an occasional brown pelican typically roosted (Figure 5).

Many birds that were observed using the Bridge as a perch or roost (Figure 5, Figure 6), or flying around the Bridge but not crossing it (Figure 6), were observed during the standardized surveys, although some were also observed during the general focused searches (the type of observations are not distinguished in the figures). Observations of sensitive species using the structure are addressed separately, below.

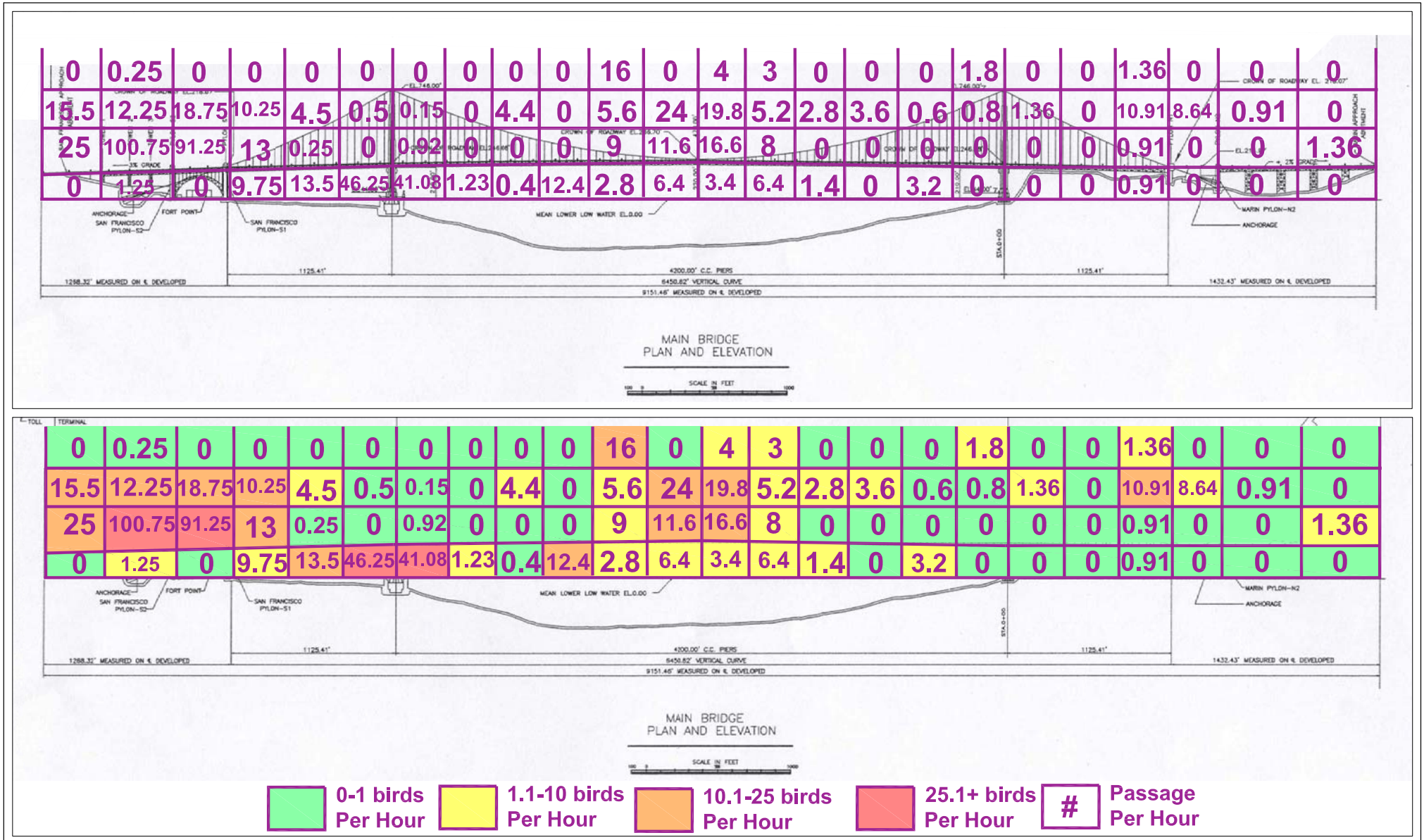

Figure 4. Bird Passage Through the Golden Gate Bridge
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California

1 inch = 600 feet

0 600 1,200 ft

EDAW | AECOM

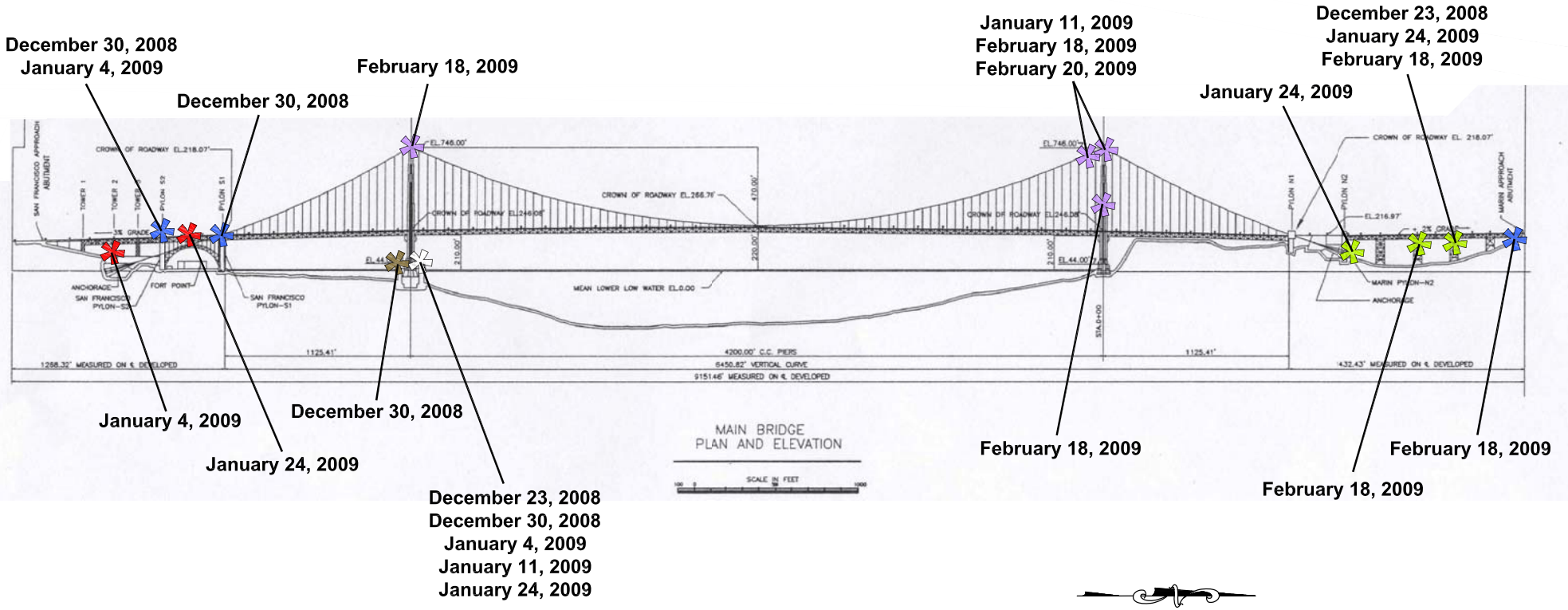

Figure 5. Observations of Birds on the Golden Gate Bridge
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California

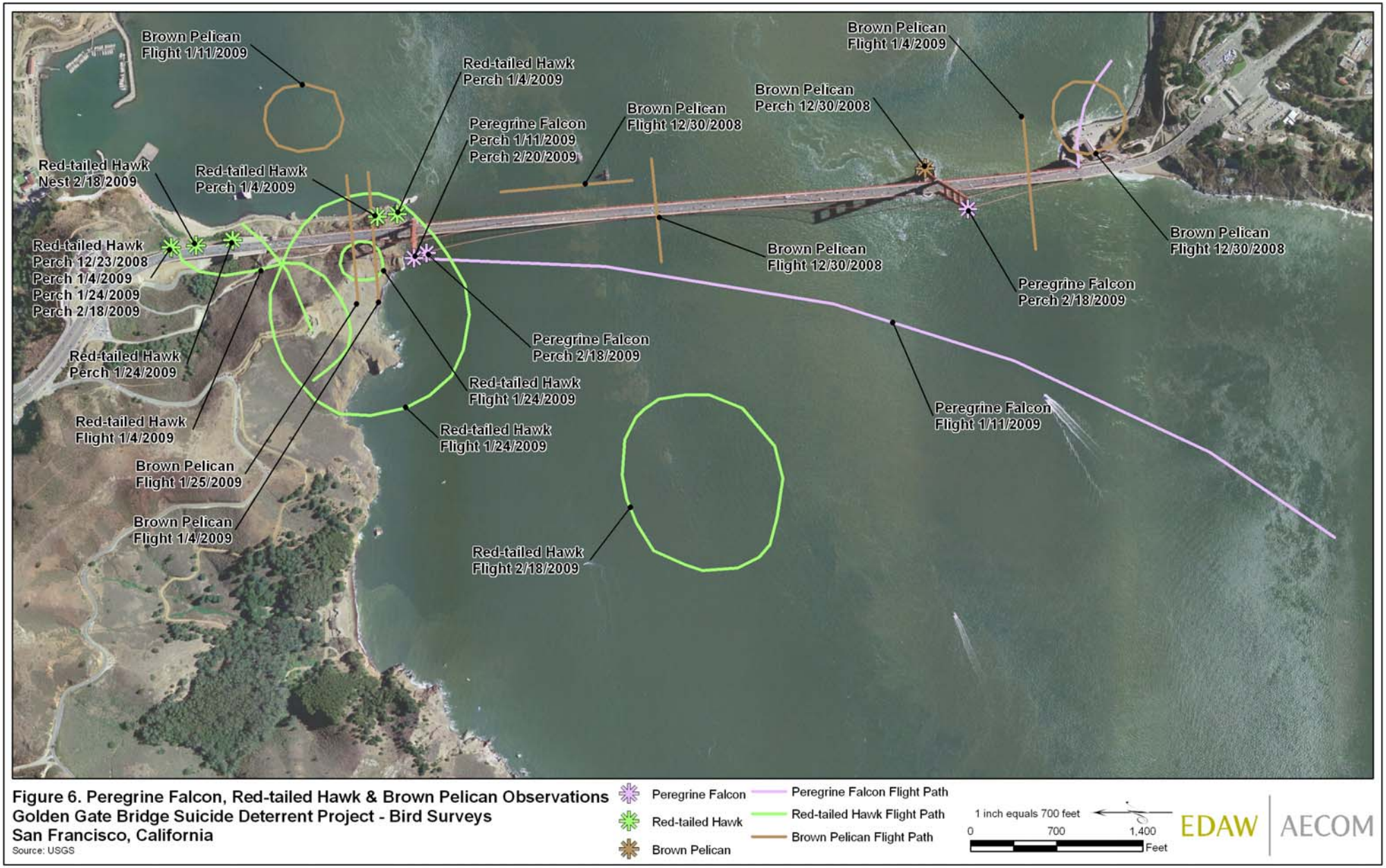

Figure 6. Peregrine Falcon, Red-tailed Hawk & Brown Pelican Observations
Golden Gate Bridge Suicide Deterrent Project - Bird Surveys
San Francisco, California
Source: USGS

3.2.3 Focused Searches and Detailed Behavioral Observations

Focused searches resulted in observations of several individual birds or flocks of birds using the Bridge structure, or flying in the footprint of the proposed netting structure (Figures 4 and 5). Detailed behavioral observations were focused on peregrine falcons and red-tailed hawks. These observations are described in detail below. Detailed behavioral observations were not recorded for waterbirds roosting on the base of the south tower since they are well below the proposed netting footprint, or for the flocks of American crows or rock doves that were seen landing on the main truss of the Bridge structure as these are common species in urbanized environments.

Peregrine Falcon

Abundant peregrine falcon whitewash was observed in several places on the north-west corner of the north Bridge tower on all visits starting on December 19, 2008 (Photo B9). A peregrine was seen flying over the south vista area at Station 1 on December 30, and the first sighting of a peregrine on the north tower was on January 11, 2009 (Figure 5, Figure 6).

A peregrine, presumably a male based on size, was seen perching at the top of the north tower on a railing several times during the day on January 11, starting at 11:34 a.m., from Station 4 at Battery Spencer on the Marin Headlands (Fig C10). At 12:06 p.m. it flew south approximately 200 feet west of the Bridge, at an elevation of about 200-250 feet above the roadway, and disappeared from sight near San Francisco's Presidio. Later, during the survey at Station 3, mid-span, it was back on the tower. It remained there for the rest of the survey.

No peregrines were seen on the January 24th visit. On February 18th, a peregrine was observed perching mid-way up the north tower on a railing, starting at 1:30 p.m., from Station 4 (Photo B11-13) There were apparent prey remains on the walkway below it, including feathers. At approximately 2:00 p.m., it flew south and west, and sparred with a red-tailed hawk that was circling in the area (including direct mid-air physical contact). This was approximately 2,000 feet west of the Bridge and approximately level with the top of the north tower. The peregrine then flew northwest and to a lower elevation, and disappeared out of sight somewhere west of the survey station on the Marin Headlands. At about 2:30 p.m., a peregrine (possibly the same bird) was again on the tower, now at the top railing. At 2:45 p.m. a large dark helicopter flew over the Bridge within 1,000 feet of the bird, at about its elevation. This caused the bird to startle and fly in circles close to the tower, and in several minutes it landed on top of the cable about 20 feet south of the previous perch on the tower (Photo B13). It was still there at 3:11pm. At 4:45 p.m. it was observed again, circling about the north tower. At 5:24 p.m. it flew from the north tower to the south tower where there appeared to be an additional peregrine, although it was seen for less than one second; one did several short display flights characteristic of pair bonding.

On February 20, 2009 at 7:50 a.m., two peregrines were observed on the top railings of the north tower. One did several short display flights (probably the male). At 8:17 a.m. one had left without being seen, and at 8:18 a.m. the remaining bird flew west around the Headlands in the direction the peregrine had flown on the 18th. At 8:45 a.m., two peregrines were seen on the Headlands west of Kirby Cove, approximately 0.7 miles west of the Bridge, from an

observation point on the west end of Battery Spencer. The birds were observed on a perch with abundant whitewash, displaying and calling, and entering numerous times a small cave on the cliff wall that we believe will be used as the nest site for 2009 (Figure 6).

David Gregoire of the Santa Cruz Predatory Research Group verified over the following weeks that the peregrines appear to have chosen this spot for their nest site, and that it was in the same general area as the nest site used in 2005. Because the peregrines in the area are not banded, it is impossible to determine whether the same birds have been in the area from one year to the next. Given the close proximity of nesting sites in 2005 and 2009, it is probable that at least one member of the pair was present in both years. Although peregrines have been documented attempting to nest on the Golden Gate Bridge only once (in the late 1990's, D. Gregoire and G. Stewart, pers. comm.), it is likely that they will attempt to nest again on the Bridge.

There were no observations of peregrine flight at the roadway level in the footprint of the proposed netting system. However, the total time spent observing the peregrines was approximately seven hours, and no observations were conducted during poor visibility conditions, including dense fog or rain, or at night. Thus, there is some potential for peregrines to fly in the vicinity of the netting system on occasion. The peregrines in the area around the Golden Gate Bridge appear to be residents, and are likely to be aware of any changes to the Bridge structure and avoid them. There is a chance that migrating peregrine falcons may collide with the Bridge itself or with the proposed netting system during inclement weather if visibility is poor, particularly if lighting is so bright that they become disoriented.

Additional life history information for the peregrine falcon is provided in Appendix A.

Red-Tailed Hawk

At least one red tailed hawk was observed on and around the northern end of the Bridge and on the Marin Headlands on December 23, 2008, and January 4, January 24, and February 28, 2009 (Figure 6). Remains of an apparent old nest were seen on December 23 (Photo B14), within a sheltered area immediately below the bottom chord of the exterior main truss at the top of the third tower north of the Marin anchorage. An apparently active nest was observed on February 18 at the top of the second tower north of the Marin anchorage (Photo B15-16). No hawk was seen on this nest or entering or leaving it, but an attentive hawk perching on the third tower seemed to be interested in the nest and looked at it while flying closely past it several times. This nest location appears to be very close to the northern end of the proposed netting system footprint.

Resident red-tailed hawks are likely to be highly aware of the proposed netting system and are not likely to collide with it. Migrating red-tailed hawks may collide with the Bridge structure itself or proposed netting system during inclement weather if visibility is poor, particularly if lighting is so bright that they become disoriented. This hazard may be reduced by adjusting lighting using the standards developed for radio towers and other tall structures (Longcore et al 2008).

California Brown Pelican

Small numbers of California brown pelicans were observed in the vicinity of the survey area during every site visit. A total of 11 pelican observations were recorded. Most pelicans observed near the Bridge were in flight, either flying parallel to it, circling nearby, or flying across it (Figure 6). Several were observed roosting on the base of the south tower (Figure 5, Figure 6), or on rocks east of the Bridge on the Marin Headlands. Brown pelicans flew over the Bridge south of the south tower and north of the north tower, and under it just over the water. None of these birds approached the footprint of the proposed netting system.

Migrating brown pelicans may collide with the Bridge structure itself or proposed netting system during inclement weather if visibility is poor, particularly if lighting is so bright that they become disoriented. This hazard may be reduced by adjusting lighting using the standards developed for radio towers and other tall structures (Longcore et al 2008).

Additional life history information for the California brown pelican is provided in Appendix A.

Double-Crested Cormorant

Double-crested cormorants were observed in large numbers roosting on the base of the south tower, on various structures or rocks adjacent to the Bridge, and in flight. Double-crested cormorants flew over the Bridge structure or low over the water under the Bridge structure. This species was not observed roosting or flying near the footprint of the proposed netting system, but given their large numbers, some individuals are likely to occasionally fly near it.

Resident double-crested cormorants are likely to be highly aware of the proposed netting system and are not likely to collide with it, especially during the day. However, collision with the Bridge and the netting structure is more of a hazard during inclement weather.

Migrating double-crested cormorants may collide with the proposed netting system during inclement weather if visibility is poor, particularly if lighting is so bright that they become disoriented. This hazard may be reduced by adjusting lighting using the standards developed for radio towers and other tall structures (Longcore et al 2008).

There was no evidence of nesting by double-crested cormorants on the Bridge during site visits for the present study or in June 2008 for the Natural Environment Study; however, these were not ideal times to observe nesting as the nesting season typically begins in March or April and is completed by July (Cogswell 1977, Spautz pers. obs.). Because individuals of this species are known to nest on other bridges in the San Francisco Bay, they are likely to attempt nesting on the Golden Gate Bridge at least occasionally.

Additional life history information for the double-crested cormorant is provided in Appendix A.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The majority of the birds observed utilizing the area around the Bridge were gulls (73%). Gulls are accustomed to flying around the structure and are common, therefore their populations are not likely to be affected by any hazards introduced by the structure. However, a small percentage of sensitive species were documented regularly during our surveys including: peregrine falcon, double-crested cormorant, red-tailed hawk, and brown pelican. These individuals are likely residents of the area and based on our observations of their regular flight and behavior patterns, these activities are not likely to be affected by the netting structure. With the exception of the brown pelican, these species nest on or in the vicinity of the Bridge. As discussed previously, many birds migrate through the area during fall and spring migrations. The impact analysis based on this study is limited by duration and timing of the surveys (after fall migration and prior to spring migration and the breeding season for some species) as well as being conducted during fair weather conditions. Based on field surveys and background research the proposed suicide deterrent netting structure may pose some risk to migrating and nesting birds beyond that of the existing structure and additional evaluations including post construction monitoring of the project are warranted. The following hazards are the most likely:

- migrating birds may collide with the netting system, particularly during inclement weather, and
- birds may be lured to nest or perch in an inappropriate spot on or adjacent to the netting system where mortality risk is high.

5.0 MITIGATION MEASURES

The mitigation measures presented here are based on the assumptions regarding the design of the Preferred Alternative as described in the introduction and Chapter 1 of the Draft EIR/EA, unless otherwise noted.

In addition, the net will be manufactured of flexible stainless steel cables (S. Morton pers. comm.) and would not be likely to cause entanglement with birds that may perch on it.

Mitigation Measure 1:

Monitoring and minimization of impacts to birds flying through the Golden Gate under or over the Bridge

Potential Impact. The proposed netting may be a collision hazard to birds flying over or under the Golden Gate Bridge, or flying parallel to it. Observations made during daylight hours with high visibility (i.e., with a limited reduction in visibility due to rainfall, fog, or nightfall) have shown that birds do not typically fly in a trajectory in which they are likely to collide with the net when installed (i.e., they rarely fly in a vertical trajectory within 20 feet of the Bridge structure). However, during periods of low visibility and at night, particularly during migration, birds may not be able to see the Bridge or netting system as well; their flight trajectories may be more haphazard, and collisions may be more likely

(Dirksen et al 2000). Birds are also known to fly at lower elevations during migration when weather is unfavorable, increasing collision risk (Richardson 2000). Lighting required at night to illuminate the roadway for motorists and the Bridge towers to avoid collisions with aircraft may light the netting structure so that birds will be able to see it. Alternatively, birds may be attracted to the lights of the Bridge and may collide with the Bridge structure or the proposed netting.[1] However, collisions with the main structure of the Bridge will be much more likely than collisions with the netting structure due to the overall relatively larger size of the Bridge. The netting system is not likely to significantly increase mortality associated with bird collisions beyond that which may already be occurring with the Bridge structure. However, there is no available baseline information on bird collisions at the Bridge, and thus increases due to the netting system may be difficult to assess.

Mitigation Measure. Additional mitigation measures relative to monitoring include the following:

- Bridge District and Caltrans personnel will conduct observations of the netting system to determine if bird carcasses are present. These observations will be conducted at least two times per month for the twelve months following project implementation during the core of the spring and fall bird migration periods: February to May and August to November [2]. These surveys will include observations from the Bridge walkway level on both the west and east sides of the Bridge. Observations will be conducted within 3 hours of sunrise, immediately following a storm or foggy night when collisions with the structure are more likely. Observers will document the presence of any bird carcasses with photographs and data forms that include the date, time, weather conditions, and location of the observation. Photographs will be submitted to biologist staff at the Golden Gate National Recreation Area (GGNRA) for identification and interpretation within 3 days.

- If mortality levels are beyond pre-established limits (e.g. greater than 10 native birds[3] of any species per month for one month; or one individual peregrine falcon, 2 individuals of any other raptor species, or 4 individuals of other special status species during one year) additional observations will be made for 6 months to determine patterns of bird strike (i.e., to identify times of the day and visibility conditions that contribute to strikes). In coordination with the California Department of Fish and Game and the Migratory Bird Division of the U.S. Fish and Wildlife Service, additional mitigation measures will be designed and implemented, including changes to the netting structure as feasible, to reduce mortality. After these

[1] Birds tend to be attracted by and disoriented by bright white lights, which causes major mortality at towers, especially during migration, at night, and during poor weather or fog. However, flashing lights, particularly flashing red lights, tend to decrease mortality (Avery et al 1976; Longcore et al 2008).

[2] Many species exhibit short- and long-distance migratory movements throughout the year, depending on weather patterns. However, most individuals of most species are likely to pass through coastal northern California during February to May (when moving towards breeding areas) and August to November (when moving towards wintering areas).

[3] Non-native species including European starling and rock dove are not protected by the Migratory Bird Treaty Act (MBTA).

changes are made, the system will be monitored for 6 months, including periods where conditions associated with the documented mortality are most likely to be present, or for a period of time determined by the Agencies. If mortality is decreased to below the limits identified above, the changes will be deemed acceptable and monitoring will no longer be required.

Mitigation Measure 2:

Monitoring and minimization of impacts to birds nesting on the Golden Gate Bridge Structure

Potential Impact. The proposed netting system may become attractive to birds nesting on the Bridge structure. Birds may use the netting for perching or building nests. Birds may perceive the netting system to be a suitable nesting or perching substrate, and as a result, nests may fail (due to exposure or insufficient support structure) or young perching on the net may fall into the water and drown. There is evidence that most peregrine falcon young fall into roadways or into the water from nests built on bridges, and the proposed netting system may increase the area available for this potentially hazardous behavior.

Mitigation Measure 2. a. Measures should be taken to ensure that the netting structure does not become an attractive nuisance to nesting birds. These measures may include the following:

- No new stable, wide beams or wind sheltered areas will be created that may be attractive for nesting.
- Trash and other large objects will be removed from the netting as needed to minimize the attraction for foraging and nesting material or substrates for nesting.
- Use largest mesh size possible [4]

Mitigation Measure 2. b. General mitigation measures relative to nesting birds.

- Regular observations will be made of the netting system by trained Bridge District personnel or a qualified consultant for one year after installation to determine if bird carcasses are present in or on the netting system and whether these carcasses are juvenile birds that may have fledged from a nest adjacent to or on the Bridge during the first breeding season after construction. These observations will be conducted weekly during the period when nests are most likely to contain young (i.e., the months of February– July) and may be combined with the migration monitoring visits. These surveys will include searching for nests on the Bridge and bird carcasses in the net system and photographing any observed, for identification by GGNRA staff within 3 days. If Bridge personnel are used, a training program for Bridge District personnel will be developed by a qualified biologist that will include methods for detecting and photographing nests on the Bridge structure.

[4] Larger mesh size will be less likely to accumulate trash or to become a base for nesting, although it is less visible to flying birds and is more of a collision hazard.

- If mortality levels are greater than the pre-established limits (e.g. greater than 10 birds of any native species[5] per month for one month; or one individual peregrine falcon, 2 individuals of any other raptor species, or 4 individuals of other special status species during one year) in coordination with the California Department of Fish and Game and the Migratory Bird Division of the U.S. Fish and Wildlife Service, additional mitigation measures will be designed and implemented, including changes to the netting structure, as feasible, to reduce mortality. These changes will be implemented prior to the following breeding season (i.e. prior to December of the current year). The modified system will be monitored twice per week during this following breeding season (i.e., December to July of the following year.) If mortality is reduced to below the levels identified above during this following breeding season, the changes will be deemed acceptable, and further monitoring will not be required. If mortality levels are not reduced below the recommended levels, the District will consult with the Agencies and Caltrans to develop a feasible alternative mitigation strategy.

[5] Non-native species including European starling and rock dove are not protected by the Migratory Bird Treaty Act (MBTA).

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Personal Communications

Alan Fish, Director, Golden Gate Raptor Observatory, December 12, 2008

David Gregoire, Santa Cruz Predatory Research Group volunteer, February 21, 2009

Glenn Stewart, Coordinator, Santa Cruz Predatory Research Group, February 11, 2009

APPENDIX A
SPECIES ACCOUNTS

AMERICAN PEREGRINE FALCON

Common name:	American Peregrine Falcon
Scientific name:	*Falco peregrinus anatum*
State status:	Endangered, Fully Protected
Federal status:	Delisted

Agency concerns for peregrine falcon include:

- Environmental contaminants – DDT, which caused eggshell thinning is now banned, but still persists in isolated areas; other persistent contaminants, including heavy metals, continue to cause concern.
- Young in urban nests in danger when fledging; e.g., young in nests on bridges have high probability of falling into water when fledging.
- Collisions with buildings, power lines.
- Collecting by falconers.
- Shooting and hunting, particularly by ranchers.

The peregrine falcon (*Falco peregrinus)* is one of the most widely spread bird species, found on all continents except Antarctica. The species requires open areas for foraging, and for nesting uses cliffs in isolated areas, or bridges and buildings in urban areas. Other potential but rarely nest sites include abandoned nests of ravens, hawks or cormorants. Nests typically consist of a scrape in bare dirt or sand. This species is known for its high speed flight; it a foraging specialist, catching birds in flight (White et al 2002).

The peregrine falcon is sexually dimorphic, with females up to one-third larger than males. Breeding typically begins at age 3, and individuals have been documented to live up to 20 years (White et al 2002).

The peregrine falcon is resident all year in California. In California, breeding starts in late February and young are typically fledged by late July (Santa Cruz Predatory Research Group 2008; White et al 2002). Populations in other parts of North America migrate to Central and South America for the winter. Peregrines with breeding grounds in Alaska, for example, start northern spring migration as early as March and start breeding in May. Fall migration for these populations starts in September (White et al 2002).

Listed in 1973 as an endangered species under the federal Endangered Species Act, the peregrine was delisted in 1999 after a successful recovery program that included banning DDT and other chlorinated hydrocarbons, protection from shooting and trapping, and captive breeding. At its lowest, the population had been reduced to several hundred breeding pairs in the USA, and only two of these nested in California in 1970. Now the population numbers approximately 2,000 breeding pairs, with at least 250 pairs estimated in California. Persistent pesticides and heavy metals including mercury continue to pose a threat to populations, but there is only isolated evidence of eggshell thinning and embryonic deformity in a limited area (USFWS 2003). A petition to delist the peregrine under the

California Endangered Species Act is currently under consideration (Comrack & Logsdon 2007).

Peregrine falcons have been documented around the Golden Gate Bridge since 1985. Nests have been documented during the last 10 years on cliffs on the Marin Headlands near the Golden Gate Bridge, and, two times in the late 1990's, on the Golden Gate Bridge itself. Researchers from the Santa Cruz Predatory Research Group (SCPRG) have been regularly removing peregrine eggs and young from Bay Area bridges (including the San Francisco Bay Bridge) to be raised elsewhere to increase the chance of survival, because young tend to fall off the bridges and into the water. When SCPRG descended Golden Gate Bridge to retrieve the eggs one of the years, the nest had already been abandoned, and several abandoned eggs from additional attempts were found on other portions of the Bridge nearby. The Golden Gate Bridge nest was built on the west side of the Bridge on a scrape of sand that may have been left during paint sand-blasting efforts (G. Stewart, pers. comm.; D. Gregoire, pers. comm.)

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CALIFORNIA BROWN PELICAN

Common Name: California brown pelican
Scientific name: *Pelicanus occidentalis*
State status: Endangered
Federal status: Endangered

Agency concerns for California brown pelican include:

* Documented decline in sardine and anchovy populations, their primary food source
* Climate-driven effects: particularly El Nino.
* DDT – caused eggshell thinning
* Oil spills
* Entanglement with fishing lines & hooks
* Disease due to overcrowding
* Predation on nesting grounds

The California brown pelican (*Pelecanus occidentalis californicus)*, federally and state-listed endangered, is a large grayish-brown bird with a long, pouched bill and a wingspan of over six feet, weighing from 8 to 11 pounds. Adults have a white or yellowish head and dark body while immature birds are dark with a white belly (Sibley 2003). Non-breeding California brown pelicans range from the Gulf of California to southern British Columbia. They nest on islands in the Gulf of California and along the coast to West Anacapa and the Santa Barbara Islands. The California brown pelican is not known to nest in the San Francisco Bay region. They are rarely seen either inland or far out at sea.

California brown pelicans are plunge divers that fly over water bodies scanning the surface for the shimmer of schooling fish. Upon locating the bait, they dive headfirst and use the pouched bill to capture food. In California, they feed mainly on sardines (family Clupeidae), mackerels (family Scombridae) and anchovies (family Engraulididae). Pelicans breed in colonies on islands without mammal predators along the Baja peninsula and in the Gulf of California in Mexico. They build nests of sticks on the ground. All courtship happens at the nest site. Normal clutch size is three eggs which are laid in March or April. Both parents take turns sitting on the eggs and feeding the chicks (USFWS 2008).

The California brown pelican, as of October 13, 1970, was listed as endangered on both the federal and state level. As of February 4, 1985, the species listing was amended to remove those populations on the Atlantic and Gulf coasts of the United States, except for Texas, Louisiana, and Mississippi. On February 20, 2008, the USFWS proposed to delist the California brown pelican (USFWS 2008).

Threats to the California brown pelican have included predation of eggs by domestic and wild mammals, decreases in food supply, anthropogenic pollution (e.g., oil spills, fishing line and hooks, and floating debris), and, primarily, the use of the pesticide Dichloro-Diphenyl-Trichloroethane (DDT). This pesticide was banned in 1972, and by 1985 Atlantic

coast brown pelicans had recovered significantly and were delisted. The ban of DDT use and subsequent recovery of the California brown pelican on the Pacific Coast has now prompted the delisting of the species. There is no critical habitat designated for the California brown pelican (USFWS 2008a).

Pelicans are present in the San Francisco Bay area as they disperse after breeding in southern California as early as April. By July, thousands of pelicans are seen and remain in the region through September. Pelicans usually retreat to the south by about December (Jacques-Strong 1994).

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DOUBLE-CRESTED CORMORANT

Common Name: Double-crested cormorant
Scientific name: *Phalacrocorax auritus*
State status: Watch List
Federal status: None

Agency concerns for double-crested cormorant include:

* Nesting habitat destruction
* Disturbance at nesting grounds
* Decline in fish populations
* Climate-driven effects: particularly El Nino.
* DDT – caused eggshell thinning
* Oil spills
* Conflicts with recreational fishing and aquaculture, which resulted in initiation of cormorant control programs

Double-crested cormorant (*Phalacrocorax auritus*) is a state-listed watch list species. It is a common resident in waterways and water bodies throughout California (DFG 2005). Double-crested cormorants feed on a wide range of fresh and saltwater fish species (Cogswell 1977; Wires et al 2001). Foraging habitat includes almost any significant water source, from ponds and streams to the open ocean. Nesting habitat, which must be within 10 miles of water and a dependable food source, includes steep slopes, cliff faces, tall trees (such as those found in riparian forests), and tall human-made structures such as transmission towers (Granholm 2005). They nest in colonies of up to several hundreds of pairs. Roosting habitat mush be devoid of vegetation and typically includes offshore rocks, cliffs, man-made towers, and wharves (Bartholomew 1943). Due to lack of plumage oils present in most other groups of birds, double-crested cormorants do not float as high in the water and they need to visit roosting sites several times per day to dry their feathers. Distribution of the double-crested cormorant has changed significantly since the early 1900's; the species was a common breeder on the Farallones and in the Central Valley but these populations were virtually extirpated by the 1970's (Remsen 1978). This species was declining in much of its North American range, including along the western coast of Baja, California and within the Gulf of California (Remsen 1978). However, recovery of some populations, due to banning of DDT and protection of nesting grounds, has been so great in some areas, particularly on the east coast, that conflicts with recreational fishing and aquaculture have resulted, and cormorants are considered pests (Wires et al 2001).

Double-crested cormorants are found year-round in the San Francisco Estuary and have been documented nesting regularly on other bridges in the region including the Richmond San Rafael Bridge and San Francisco Bay Bridge (LSA 2008).

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APPENDIX B
PHOTOS OF PROJECT SITE

Photo B1. View of Golden Gate Bridge from survey Station 1 – South Vista; January 24, 2009

Photo B2. View of Golden Gate Bridge from survey Station 2 – North Vista; January 25, 2009

Photo B3. View of Golden Gate Bridge from survey Station 3 – mid-span, looking south; December 30, 2008

Photo B4. View of Golden Gate Bridge from survey Station 3 – mid-span, looking south; January 25, 2009

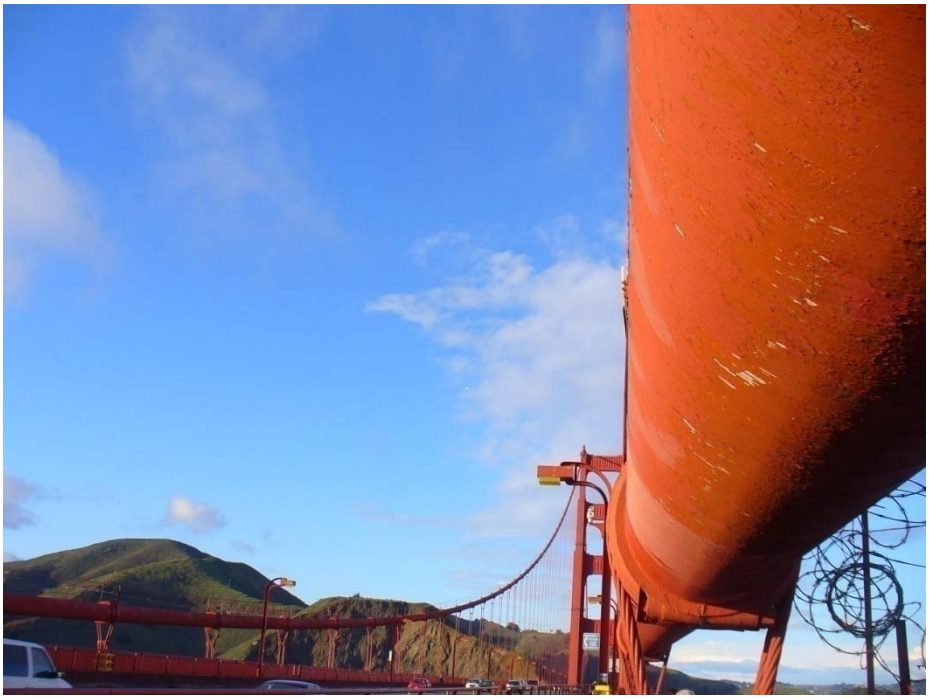

Photo B5. View of Golden Gate Bridge from survey Station 3 – mid-span, looking north; January 25, 2009

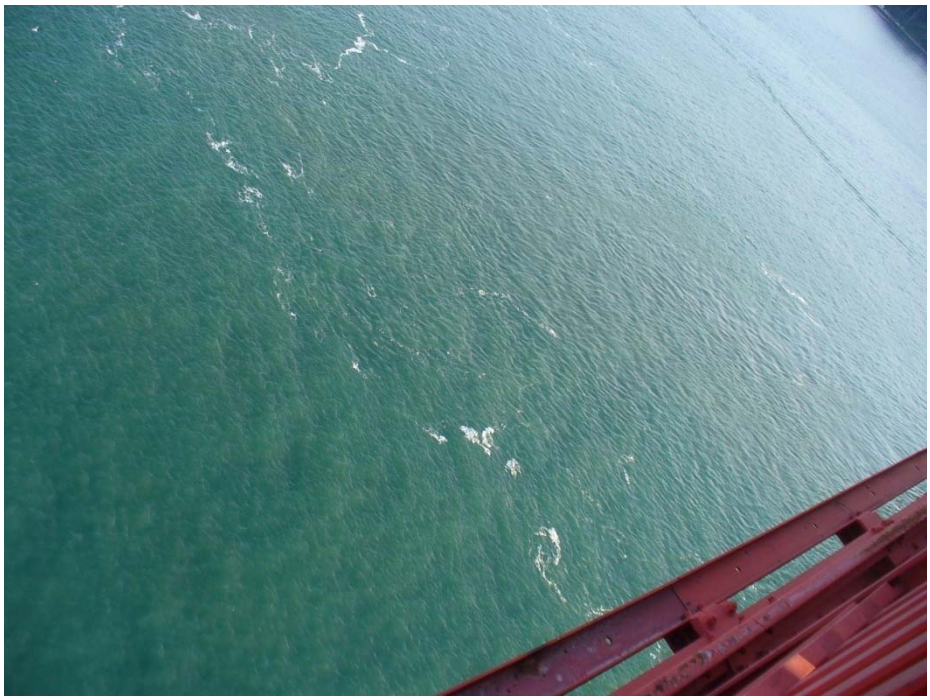

Photo B6. View of Golden Gate Bridge from survey Station 3 – mid-span; looking south and down; January 4, 2009

Photo B7. View of Golden Gate Bridge from survey Station 3 – mid-span; looking north and down; January 25, 2009

Photo B8. View of Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; January 4, 2008

Photo B9. View of Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; February 18, 2009. Note peregrine falcon whitewash on right side of tower.

Photo B10. Peregrine falcon on north tower of Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; January 11, 2009.

Photo B11. View of north tower of Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; February 18, 2009. Note peregrine falcon on top of railing center right.

Photo B12. View of north tower of Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; February 18, 2009. Peregrine falcon is on top of railing just above center and whitewash lower left.

Photo B13. View of peregrine falcon on Golden Gate Bridge from survey Station 4 – Battery Spencer; looking south; February 18, 2009. Peregrine is perched on cable railing south of north tower after flushed by helicopter.

Photo B14. Probable old red-tailed hawk nest on Golden Gate Bridge north of Marin anchorage, from Station 2. January 25, 2009.

Photo B15. Probable active red-tailed hawk nest on Golden Gate Bridge north of Marin anchorage, view from below; February 18, 2009.

Photo B16. View of red-tailed hawk nest on Golden Gate Bridge north of Marin anchorage; February 18, 2009.