GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Agenda Item No. 10.A.
Special Order of Business

To: Board of Directors
Meeting of October 10, 2008

From: Ewa Z. Bauer, Deputy District Engineer
Denis J. Mulligan, District Engineer
Celia G. Kupersmith, General Manager

Subject: **DISCUSSION REGARDING THE SELECTION OF A LOCALLY PREFERRED ALTERNATIVE FOR THE GOLDEN GATE BRIDGE PHYSICAL SUICIDE DETERRENT SYSTEM PROJECT**

Recommendation

The following Report is provided for informational purposes. A final report will be presented for action at the Board of Directors Meeting of October 24, 2008.

Background

Over the years, the Golden Gate Bridge, Highway and Transportation District's (District) Board of Directors (Board) has considered numerous approaches to reduce the number of persons harming themselves by jumping from the Golden Gate Bridge (Bridge). Through this period, the District has investigated a variety of measures, both physical and non-physical in nature, and ultimately implemented several non-physical measures that are currently in operation on the Bridge.

At its March 11, 2005, meeting, the Board adopted Resolution 2005-015 that approved proceeding with environmental studies and preliminary design work for development of a potential physical suicide deterrent system on the Bridge and established a set of assumptions and conditions to govern project development, including:

- Establishment of different design and engineering criteria calling for a physical suicide deterrent system to serve as a deterrent to suicides, recognizing the difficulty, if not impossibility, to devise any practical system that would make it physically impossible in all circumstances for suicides to occur; and,
- Required generation of financial support from external public and private sources to finance the project with the understanding that much of this work cannot begin until funds have been identified and appropriated; and,

- With the further understanding that these initial actions are being authorized to enable the Board of Directors to ultimately determine whether to proceed with construction of a physical suicide deterrent system.

At its April 22, 2005, meeting, the Board adopted Resolution 2005-033, which revised the previously adopted Board criteria for a suicide deterrent system on the Bridge. The revised criteria states that any proposed physical barrier should:

- Impede the ability of an individual to jump off the Golden Gate Bridge.
- Not cause safety or nuisance hazards to sidewalk users including pedestrians, bicyclists, District staff, and District contractors or security partners.
- Be able to be maintained as a routine part of the District's on-going Bridge maintenance program and without undue risk of any injury to District employees.
- Not diminish ability to provide adequate security of the Golden Gate Bridge.
- Continue to allow access to the underside of the Bridge for emergency response and maintenance activities.
- Not have a negative impact on the wind stability of the Golden Gate Bridge.
- Satisfy requirements of state and federal historic preservation laws.
- Have minimal visual and aesthetic impacts on the Golden Gate Bridge.
- Be cost effective to construct and maintain.
- Not in and of itself create undue risk of injury to anyone who comes in contact with the suicide deterrent system.
- Must not prevent construction of a moveable median barrier on the Golden Gate Bridge.

On June 28, 2006, the Metropolitan Transportation Commission (MTC) passed a resolution providing $1,850,000 towards preliminary engineering and environmental studies for this project. Additional funding was provided by the City and County of San Francisco, Marin County and several interested individuals and groups. That same day the District issued a Request for Proposals to engineering, planning and architectural firms for preliminary design and environmental studies of a physical suicide deterrent system on the Bridge.

On September 22, 2006, the Board authorized the hiring of a consultant and the commencement of preliminary design work and environmental studies for a physical suicide deterrent system on the Bridge. The first phase of this effort was wind tunnel testing and analysis of generic physical suicide deterrent systems to study conceptual designs that would allow the Bridge to remain stable in strong winds. The results of the first phase were summarized in a report and presented to the Board's Building and Operating Committee at its May 24, 2007, meeting. The *Phase 1 Wind Studies Report* can be viewed or downloaded at the web link below:

http://www.ggbsuicidebarrier.org/studydocuments.asp?area=sd

The second phase began when the District issued a Notice of Preparation of an Environmental Impact Report/Environmental Assessment (EIR/EA) on June 14, 2007, formally commencing the environmental process. The results of the wind tunnel testing were used to develop five build alternatives which are analyzed alongside the no-build alternative in the Draft EIR/EA. Thirteen months after the Notice of Preparation, on July 8, 2008, the District issued the Draft EIR/EA for public comment.

Draft EIR/EA

Display advertisements noticing the release of the Draft EIR/EA and the public meetings were run in English, Spanish and Chinese in the *San Francisco Chronicle* (San Francisco Zones), and in English and Spanish in the *San Francisco Chronicle* (North Bay Zone). Display advertisements regarding the Draft EIR/EA and public meetings were also run in the *Marin Independent Journal*, *Santa Rosa Press Democrat*, *Napa Valley Register*, *Commuter Times*, *Ukiah Daily Journal*, *Contra Costa Times* and *San Jose Mercury News*.

Notices of Availability for the Draft EIR/EA also were mailed to interested individuals, organizations and agencies. Email notification was sent out to an "email blast" list of hundreds of individuals and organizations.

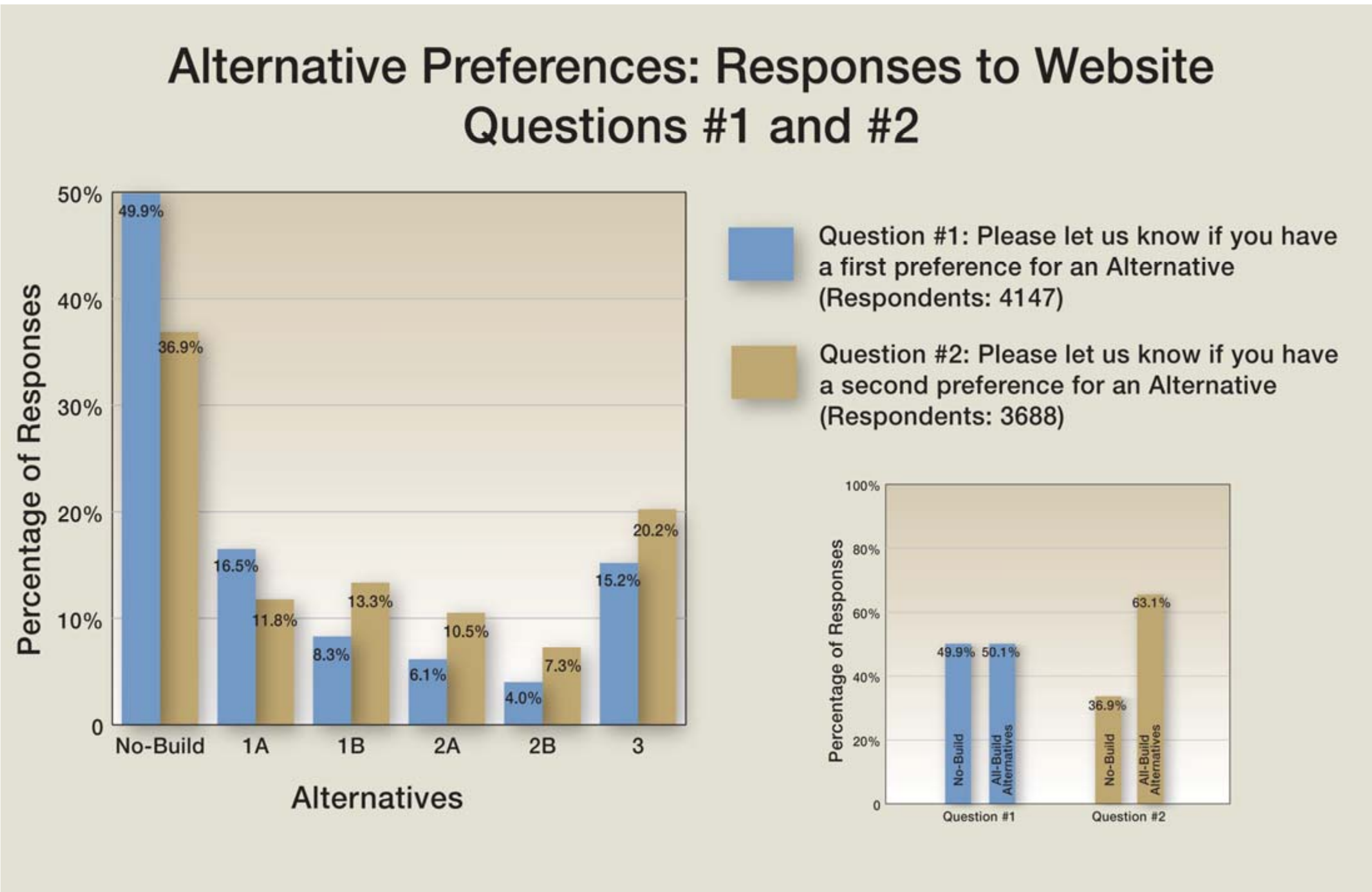
The District also received extensive media coverage regarding the project and the release of the Draft EIR/EA with numerous front page newspaper stories, plus radio and television news coverage.

The Draft EIR/EA was available online at the project website (www.ggbsuicidebarrier.org) in addition to being available at ten libraries in five surrounding counties. Also, copies of the Draft EIR/EA were provided to any individuals or organizations who requested a copy. Furthermore, a *Citizens' Guide to the Draft Environmental Impact Report/Environmental Assessment* was developed and disseminated which provided an overview of the project and key environmental considerations.

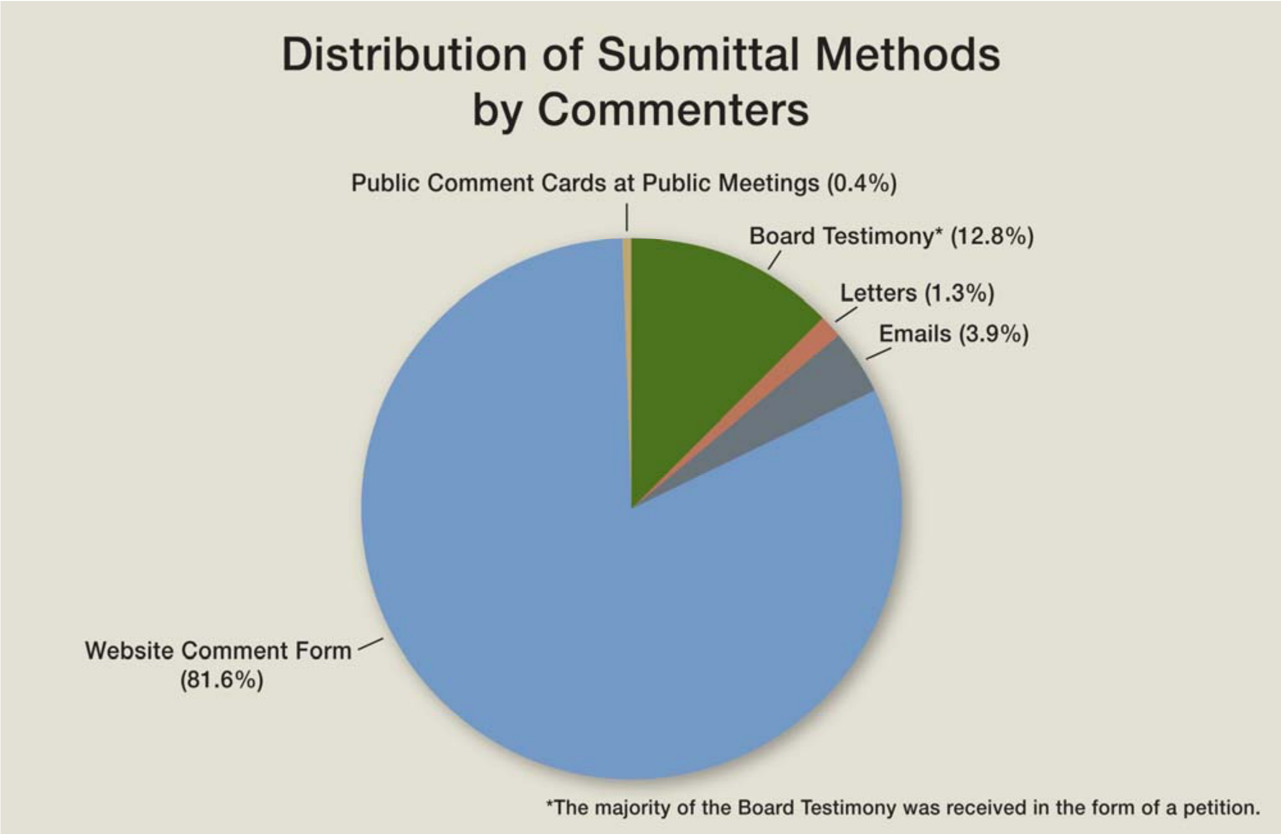
Public meetings regarding the Draft EIR/EA were held in Marin County and in San Francisco on July 22nd and 23rd, respectively. Approximately 125 members of the public attended the public meeting regarding the Draft EIR/EA in Marin, while approximately 100 attended the meeting in San Francisco.

Summary of Public Comments on the Draft EIR/EA

In addition to the traditional means of soliciting public input, the District created an online survey which presented two questions soliciting preferences among the six alternatives (five build alternatives and the no-build alternative). In response to the survey, 4,147 answers were recorded online with approximately half of those answering favoring the no-build alternative as their first choice. The result of the online questions are depicted below:



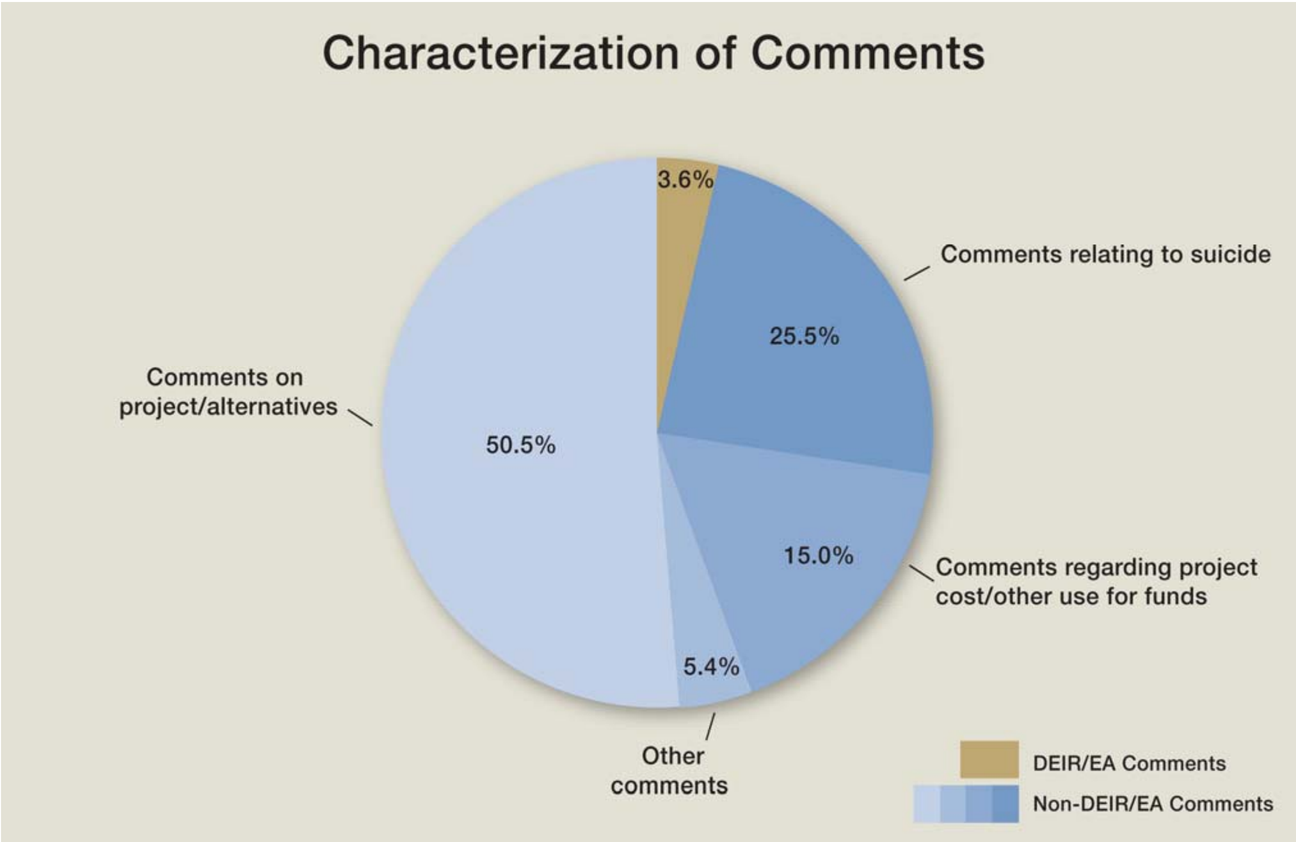
In addition to the online survey, 3,458 separate individuals, organizations and agencies provided specific comments during the Draft EIR/EA public comment period. The vast majority of these comments, 81.6 percent, were submitted online via the project website by individuals who had also participated in the survey. Another 12.8 percent were received by means of testimony at Board meetings, the vast majority of which came via a petition with 440 signatures. The pie chart below shows the distribution of comment submittal methods.



The 3,458 individuals, organizations and agencies provided 5,870 discrete comments.

- 1,497 comments were general comments about suicide. These comments typically either stated that individuals will commit suicide somewhere else if a barrier is built on the Bridge; or they stated that suicide is an impulsive act so a barrier on the Bridge will save lives.
- 2,965 comments pertained to project alternatives. These comments typically stated the reasons why the commenter liked or disliked a particular alternative, or they presented different ideas for alternatives.
- 878 comments pertained to the project cost or alternative uses for that sum of money. These comments typically either suggested that: the project funding should be redirected to mental health counseling; the expenditure of funds on this project was poor use of public funds; or, the project funding should be spent on the Moveable Median Barrier Project instead of being used to build a suicide deterrent.
- 212 comments pertained to the adequacy of the Draft EIR/EA. These comments, in general, stated that either the no-build alternative was not adequately considered, or that the commenter supported performing additional bird studies. A few of these comments addressed historic and cultural preservation issues.

The chart below depicts the distribution of the various types of comments.



The public comment period for the Draft EIR/EA formally closed on August 25, 2008.

Summary of Agency Comments on the Draft EIR/EA

A total of nine public agencies submitted comments:

State Clearinghouse – The State Clearinghouse submitted a letter which stated that no state agencies submitted comments by the close of the review period.

San Francisco Planning Department – The Planning Department recommended expanding non-physical measures to deter suicides at the Bridge. The Planning Department also stated that if a build alternative is selected, it preferred the net, but recommends a detailed color study for the netting material.

San Francisco Bay Trail/Association of Bay Area Governments – According to the San Francisco Bay Trail, all of the build alternatives have negative impacts on the Bay Trail; Alternatives 1A, 1B, 2A and 2B have serious, unmitigateable visual, cultural, and recreational impacts and should not go forward. The net has the least egregious impacts to views and aesthetics from the Bridge. The San Francisco Bay Trail contends that project requires a Bay Conservation and Development Commission (BCDC) permit.

National Park Service, Golden Gate National Recreation Area (GGNRA) – Considering all factors, cultural, scenic and biological, the GGNRA supports Alternative 3, the net system.

BCDC – BCDC is concerned about the potential impacts that a suicide barrier may have on the appearance, design and scenic views of the Bay from the Bridge. Alternative 3, the net, and the no-build are the alternatives most consistent with the goals and objectives of BCDC's regulations and Bay Plan. BCDC believes that the District must obtain a permit from BCDC before commencing any work.

California Highway Patrol (CHP) – The CHP has significant concerns with alternative 3, the net. CHP is concerned for individuals who fall into the net and about the safety of rescuers who would perform recovery of individuals who have landed in the net. CHP is also concerned about impacts to the flow of traffic on the Bridge resulting from incidents in the net and prefers other build alternatives to the net.

Marin County, Department of Public Works – Marin County expressed that pedestrian and bicycle access should be maintained during construction.

Marin Mental Health Board – The Marin Mental Health Board supports a sidewalk toll to offset the cost of suicide prevention. They believe that the Draft EIR does not consider an alternative that uses a transparent material and that the "true cost" of the no-build alternative is not disclosed in the Draft EIR. They also state that the net alternative is the most promising of the alternatives in the Draft EIR.

San Francisco Mental Health Board – The San Francisco Mental Health Board supports building a physical suicide deterrent on the Bridge.

Operations, Maintenance and Emergency Response Impacts

The introduction of any of the physical suicide deterrent system build alternatives will have an impact on Bridge maintenance and operations. These impacts can be mitigated through a combination of new equipment and staff resources. The purchase of the equipment can be included in the capital budget for the project, while the additional staff costs will require an increase to the annual operating budget.

The installation of taller railings will impact access to under-bridge maintenance activities. It will take longer for Bridge forces working at under-bridge locations to reach the work locations. The time it takes to put on a safety harness, unlock the gate, tie-off, climb or walk through the gate, and walk along the truss top chord to reach the outer scaffold location represents a decrease in productive time as compared to the existing situation. This decreased production corresponds to increased annual operating costs.

The combination of wind fairings with taller railings introduces an additional cost for those build alternatives with both features, because workers will be prevented from accessing the two of the four maintenance scaffolds from the west sidewalk and will need to use the east sidewalk as opposed to the current situation. The east sidewalk is congested with pedestrians and bicycles, so the travel time to the work locations increases.

The net alternative requires additional staff resources each time the outer maintenance scaffolds are moved. The District will also need to periodically practice retrieval operations in order to be adequately prepared in the event someone were to jump into the net. Such periodic training has an associated operating cost as it results in lost productivity.

Transparent panels, winglets and the nets all introduce new cleaning requirements which require additional staff resources.

The annual cost of these operations and maintenance impacts, based on current salary and benefit rates for the specific job classifications impacted, are as follows:

Alternative 1A	$465,589 per year
Alternative 1B	$428,693 per year
Alternative 2A	$465,589 per year
Alternative 2B	$428,693 per year
Alternative 3	$ 78,016 per year

The *Golden Gate Bridge Physical Suicide Deterrent System Operations, Maintenance and Emergency Response Report* (*Maintenance and Operations Report*) which provides a detailed discussion regarding these projected costs and is attached (Attachment 3).

Based on the findings in the *Maintenance and Operations Report*, the Director of Risk Management and Safety, the Bridge Manager and the District Engineer concur that among the build alternatives, Alternative 3's net system offers the least risk of injury to District employees.

Additional Information

1. There have been many studies performed and papers written on the effects of physical suicide deterrent systems. The Board requested a summary of relevant papers. In lieu of staff preparing summaries of published technical studies regarding this topic, staff has attached to this report opposing positions as put forth by various university professors.

   Prof. Garrett Glasgow is a political science professor at UC Santa Barbara who is opposed to constructing suicide barriers on bridges. Attached is his letter regarding the draft EIR/EA as well as a study that he prepared for Caltrans (referenced on page 2 of his letter). Prof. Glasgow offers evidence to support his argument; his paper cites numerous published papers regarding suicide (Attachment 4).

   Prof. Anne Fleming and Prof. David Elkin are medical doctors and professors at UC San Francisco, School of Medicine, Department of Psychiatry, who vehemently disagree with Prof. Glasgow. Attached is their letter, which cites many of the same published papers cited by Prof. Glasgow, and rebuts Prof. Glasgow (Attachment 5).

These two sets of documents provide a summation of the technical studies regarding this matter as well as differing interpretations of these studies.

2. One of the Board criteria addresses compatibility of any physical suicide deterrent system with the proposed moveable median barrier on the Golden Gate Bridge. As a follow up to this criteria, it was requested that a photo simulation be prepared showing the moveable median barrier with a physical suicide deterrent. Attached are two photo simulations. The first shows the existing Bridge with the moveable median barrier; this represents the no-build and net alternative. The second photo simulation shows the moveable median barrier with alternative 1A (Attachment 6).

3. Our Attorney was requested to provide advice regarding any significant legal issues associated with both the no-build and the build alternative. With respect to the primary issues that may arise, he has counseled us as follows:

   - In Milligan v. Golden Gate Bridge, a published opinion of the California Court of Appeal, First Appellate District, the court upheld a lower court ruling that those who use the Bridge to take their lives fail to use the Bridge with due care for the purpose for which it was intended. Accordingly, the court held that the District is not liable for death or injury to any person who jumps off the Bridge to commit suicide and is under no legal obligation to erect a suicide deterrent.

   - If the Board decides to build a suicide deterrent, potential liability remains fundamentally unchanged. Although some might argue that by installing a "suicide deterrent," the District is assuming a duty to protect against injury or death to those jumping, neither federal or state law likely would support such a claim. Raising the railing or installing a net will not change the fact that anyone who jumps off the Bridge is not using the Bridge with due care for its intended purpose. Additionally, a design immunity defense should be available to the District if litigation arises challenging the sufficiency or adequacy of any of the build alternatives to deter suicides caused by jumping from the Bridge. Design immunity protects the District so long as the new railing or net design is a reasonable one, and the Board or the Chief Engineer approves that reasonable design before construction.

   - One area of potential risk relates to the potential for injury incurred by those attempting to rescue individuals who have climbed over a taller railing or jumped into the net. District employees injured in the course and scope of their employment while attempting to prevent suicidal acts will be entitled to coverage under workers' compensation. This is a risk the District has faced over a period of time based on existing conditions on the Bridge. Depending on the specific design solution and operating plan adopted for any build alternative selected by the Board, this particular risk could be exacerbated but would not fundamentally change. As those decisions are made, guidance will be provided concerning ground rules for rescuers as a means of mitigating that risk to the maximum extent possible.

Next Steps

At this juncture, the environmental process requires the selection of a Locally Preferred Alternative (LPA). The selection of the LPA will provide direction for: the preparation of written responses to comments; the negotiation and execution of a Memorandum of Agreement (MOA) to mitigate the adverse effects the LPA has on the historic property; and, the preparation of any additional required studies for the LPA (for example, evaluate the potential for bird collisions). The responses to comments, MOA and additional studies will be incorporated into the Final EIR and Findings of No Significant Impacts (FONSI), which is anticipated to be completed by April 2009.

The next steps after the selection of the LPA and the preparation of the Final EIR/FONSI are the release and certification of the Final EIR/FONSI and adoption of the project. Additionally, the Board will certify that the Final EIR complies with the California Environmental Quality Act (CEQA) and will make Findings and adopts a Statement of Overriding Considerations. Caltrans, as assigned by the Federal Highway Administration (FHWA), will issue a FONSI. However, this can only occur if the project is funded as demonstrated by the project's inclusion in MTC's fiscally constrained Transportation Improvement Program (TIP) or Regional Transportation Plan (RTP).

Attachments:
1) The Alternatives
2) Environmental Timeline
3) Operations, Maintenance and Emergency Response Report
4) Correspondence from Prof. Garrett Glasgow
5) Correspondence from Prof. Anne Fleming and Prof. David Elkin
6) Moveable Median Barrier rendering

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

The Alternatives

ATTACHMENT 1

ALTERNATIVE 1A

Adds 8-foot-tall vertical system to existing 4-foot-tall outside handrail, total height 12 feet

ALTERNATIVE 2A

Replaces 4 foot outside handrail with 12-foot-tall vertical system, total height 12 feet

ALTERNATIVE 3

Adds horizontal net system 20 feet below the sidewalk, extending 20 feet out from the GGB horizontally

ALTERNATIVE 1B

Adds 8-foot-tall horizontal system to existing 4-foot-tall outside handrail, total height 12 feet

ALTERNATIVE 2B

Replaces 4 foot outside handrail with 10-foot-tall horizontal system with winglet on top, total height 10 feet

THE NO-BUILD ALTERNATIVE

Continue Non-Physical Suicide Deterrent Programs

The cost estimate for all Build Alternatives is approximately $40-50 million.

ENVIRONMENTAL TIMELINE

Golden Gate Bridge Physical Suicide Deterrent Project

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

DATE	MILESTONE
June 14, 2007	District issued a Notice of Preparation of an Environmental Impact Report/Environmental Assessment (EIR/EA), formally commencing the environmental process
July 8, 2008	District released the Draft EIR/EA for public comment
July 22, 2008	District held a public meeting regarding the Draft EIR/EA in Marin County
July 23, 2008	District held a public meeting regarding the Draft EIR/EA in San Francisco
August 25, 2008	The public comment period closed regarding the Draft EIR/EA
October 3, 2008	Mail out a summary of environmental impacts, public & agency comments, and maintenance & operational impacts regarding the alternatives
October 10, 2008 Board Meeting	Presentation (summarize environmental impacts, public & agency comments, maintenance & operational impacts of alternatives, etc) and Discussion regarding the Project
October 24, 2008 Board Meeting	Discussion and possible action regarding the selection of a "Locally Preferred Alternative" (LPA) for the Project
November 2008 thru April 2009	Prepare a Final EIR and Finding of No Significant Impacts (FONSI) assuming selection of an LPA • Prepare written responses to comments • Negotiate and execute a Memorandum of Agreement (MOA) to mitigate the adverse effects the LPA has on the historic property • Prepare any additional required studies for the LPA (e.g. evaluate the potential for bird collisions)
Date uncertain - based on obtaining project funding	Next Steps: certify and release the Final EIR/FONSI and adopt the Project • Board certifies that the Final EIR complies with the California Environmental Quality Act (CEQA) and makes Findings and adopts a Statement of Overriding Considerations • Caltrans, as assigned by the Federal Highway administration (FHWA), will issue a FONSI. This can happen only if the project is funded as demonstrated by inclusion in MTC's fiscally constrained Transportation Improvement Program (TIP) or Regional Transportation Plan (RTP)

Golden Gate Bridge Physical Suicide Deterrent System Operations, Maintenance and Emergency Response Report

I. Background & Summary

This report evaluates the impacts of the proposed Golden Gate Bridge Physical Suicide Deterrent System "build" alternatives on bridge operations and maintenance activities. The analysis includes a discussion of how each alternative will impact the Golden Gate Bridge, Highway and Transportation District's (District) maintenance activities including impacts to the efficiencies and access now afforded District forces by the existing railings and maintenance travelers. Any additional equipment or ancillary modifications to the Golden Gate Bridge (Bridge) in order to ameliorate or minimize the impacts of an alternative to ongoing District operations and maintenance activities is also discussed. The information in this Report was developed based on interviews with District bridge management and maintenance staff, discussions with District engineering staff, knowledge of maintenance activities on other similar bridges and field observations.

II. District Criteria

On March 11, 2005, the District's Board of Directors (Board) approved proceeding with environmental studies and preliminary design work for development of a physical suicide deterrent system on the Bridge. The resolution authorizing this action stipulated that suicide deterrent system concepts conform to the following criteria:

1. Must impede the ability of an individual to jump off of the Bridge.
2. Must not cause safety or nuisance hazards to sidewalk users, including pedestrians, bicyclists, District staff, and District contractors/security partners.
3. Must be able to be maintained as a routine part of the District's ongoing Bridge maintenance program and without undue risk of injury to District employees.
4. Must not diminish ability to provide adequate security of the Bridge.
5. Must continue to allow access to the underside of the Bridge for emergency response and maintenance activities.
6. Must not have a negative impact on the wind stability of the Bridge.
7. Must satisfy requirements of State and Federal historic preservation laws.
8. Must have minimal visual and aesthetic impact on the Bridge.
9. Must be cost effective to construct and maintain.
10. Must not, in and of itself, create undue risk of injury to anyone who comes in contact with the Suicide Deterrent System.
11. Must not prevent construction of a moveable median barrier on the Bridge.

Criteria 1, 6, 7 & 8 pertain to the establishment of reasonable standards governing the preliminary engineering and architectural design of proposed physical suicide deterrent systems. Criterion 6 was specifically addressed as part of wind testing performed during Phase I of this study. This wind testing further confirmed that installation of a physical suicide deterrent system would not prevent construction of a moveable median barrier, thus satisfying criteria 11. The remaining criteria – specifically criteria 2, 3, 4, 5, 9 & 10 – pertain to Bridge operations and maintenance, which is the focus of this report.

III. Description of Project Alternatives

Initial wind tunnel testing identified limiting aerodynamic parameters specific to the Bridge that were used in the development of project alternatives.

In addition to defining the wind parameters, the District performed a comprehensive industry review to identify the range of physical suicide deterrent systems considered and implemented on bridges and tall structures throughout the world. The District evaluated these ideas against a set of performance criteria, which were taken from the District adopted criteria, in order to eliminate those ideas that would not likely comply with all eleven adopted criteria, and as a way to identify best practices that could be used to guide the development of alternatives for the project.

Concurrent with this, design criteria and architectural considerations which would serve as guiding principles for developing reasonable alternatives for consideration in the environmental process were identified. For example, the Bridge has symmetry, spacing of elements, shapes of elements and an architectural vocabulary which was considered in the development of alternatives.

Through a collaborative process that considered all of the above factors and the eleven District-defined criteria, numerous alternatives were considered but eliminated from further evaluation. Ultimately, five (5) “build” alternatives were developed for evaluation, along with the no-build alternative, in the draft Environmental Impact Report/Environmental Assessment (EIR/EA). Build alternatives are defined as concepts that, if implemented, will result in the Bridge remaining stable in strong winds, and which comply with all District-adopted criteria. The five build alternatives grew out of the three generic concepts identified during the wind tunnel testing. All alternatives are contemplated to be installed over the full length of the Bridge, on both sides.

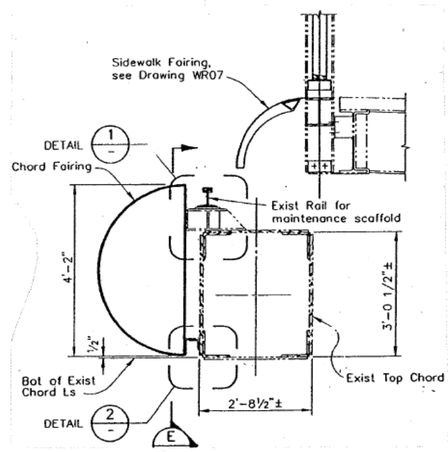
A description of the five Build Alternatives is as follows:

Alternative 1A

Alternative 1A is a new barrier placed on top of the outside hand rail and consists of ½” diameter vertical rods spaced at 6 ½ inches on center, leaving a 6-inch clear space between rods. The new barrier will extend 8 feet vertically from the top of the outside 4 foot high hand rail for a total height of 12 feet. The existing rail posts (W8x28) will be removed and replaced with new posts of the same cross-section, size, material, and color for the 12 foot height. The material to be used for the new portions of the rail will be plain galvanized A36 steel and the color will be International Orange, matching the material and color of the current outside rail.

The top horizontal railing member will consist of a chevron shaped member measuring 8 inches by 4 inches, which is similar to the existing top horizontal railing member. The vertical rods will be threaded at each end and attached to the top and bottom horizontal railing with nuts. This connection point will be hidden behind the bottom railing, which will result in a seamless look.

The outside railing at the west sidewalk between the two main towers will be modified in accordance with the findings of prior wind studies performed on the Bridge as part of the design effort for the District's seismic retrofit program. These studies concluded that the existing 4 inch wide pickets are detrimental to the aerodynamic behavior of the Bridge during high winds. The modified rail will be all new material matching the color of the current rail. The posts will be W8x28 steel posts spaced at 12 ½ feet with a chevron-shaped top horizontal member matching the existing rail. The bottom rail will be a thinner 1 inch by 4 inch member. The pickets will be ⅜ inch thick by 4 inches wide spaced at 5 inches on center for the central 3250 linear feet of the main span. This modified railing is scheduled to be installed as part of the construction contract for Phase 3B of the seismic retrofit project.



Also in keeping with the findings of the prior wind studies, wind fairings will be added to the west side of the Bridge. The wind fairings include a 3800 linear foot section of a 25-inch radius semi circle mounted to the outer vertical face of the west stiffening truss top chord and a 3800 linear foot section of 20-inch radius quarter circle mounted on the outer vertical edge of the west sidewalk (see cross section details above). As with the modified railing, these wind fairings are contemplated as part of the Phase 3B seismic retrofit construction contract. The existing main span traveler operation would be impeded by the installation of the wind fairing. In order for the two main span travelers to traverse those portions of the Bridge where these conflicts exist, the clearance between the inner face of the traveler vertical leg and the outer edge of the stiffening truss must be increased on the west side. This increased clearance can be achieved by modifying the existing traveler, or by installing a new traveler. The cost of the traveler change is included in the project cost estimate.

At the mid span of the Bridge the above-railing treatment will consist of transparent panels, 12 feet wide by 8 foot high. These panels will be placed on top of the outside railing and angled slightly inward (toward the sidewalk) in order to avoid contact with the main span cable and suspender ropes. This mid span transparent panel treatment will be placed at both the east and west outside railings over a total length of approximately 400 feet, centered on the low point of the cable.

Both the east and west sidewalks have 24 widened areas called "belvederes". Each belvedere is 12 ½ feet long. Transparent panels will also be placed above the outside railing at belvedere locations, in order to provide for unobstructed viewing by pedestrians. Transparent panels will also be placed above the outside railing at the tower locations.

Alternative 1B

Alternative 1B is a new barrier placed on top of the outside hand rail and consists of ⅜ inch diameter horizontal cables spaced at 6 inches on center leaving a 5 $^{5}/_{8}$ inches clear space between cables. The new barrier will extend 8 feet vertically from the top of the outside 4 foot high hand rail for a total height of 12 feet. The existing rail posts will be replaced with new posts of the same cross-section, size, material, and color for the 12 foot height. These posts will slightly curve forward at the top to support the winglet on top of the barrier. The material to be used for the new portions of the rail will be galvanized A36 steel and galvanized steel cables. The color will be International Orange, matching the material and color of the outside rail.

As is the case for Alternative 1A, the outside railing adjacent to the west sidewalk between the two main towers will be modified in accordance with the findings of prior wind studies performed on the Bridge as part of the design effort for the District's seismic retrofit program. The details of this modified railing are as described for Alternative 1A.

In order to provide for the necessary aerodynamic stability of the bridge, and in lieu of the wind fairings incorporated into Alternative 1A, this alternative features a winglet bolted to the top of the barrier posts. The winglet is a horizontal 1 ¼ inch thick transparent panel measuring 42 inches by 12 ½ feet with a slight downward curvature. The winglet will be positioned to have $^{1}/_{3}$ outboard and $^{2}/_{3}$ inboard relative to the plane of the barrier. The winglet will be notched at the suspender cables and at the light posts to avoid interference with these elements. While serving a similar purpose as the fairings incorporated into Alternative 1A (stabilization of the Bridge during high wind events), the winglet feature was deemed preferable to fairings for this alternative as its design will impede climbing over the top of the barrier; this climbing deterrent was deemed necessary for this alternative given the ease with which an individual could ascend the barrier using the horizontal cables as a foothold.

Alternative 1B will feature transparent panels at the mid-span, towers and at belvederes, as described for Alternative 1A.

Alternative 2A

Alternative 2A is a new vertical 12 foot tall barrier consisting of ½ inch diameter vertical rods spaced at 4 ½ inches on center, leaving a 4 inch clear space between rods. The outside hand rail will be completely removed. New 12 foot tall W8x28 posts will be installed at 12 ½ feet on center, consisting of the same cross-section, size, material, and color as the original posts. The material to be used for the new barrier posts will be galvanized A36 steel and the color will be International Orange, matching the material and color of the outside rail.

The top horizontal railing member will consist of a chevron shaped member measuring 8 inches by 4 inches by ¼ inch, which is similar to the existing top horizontal railing member. The vertical rods will be threaded at each end and attached to the top and bottom horizontal railing with nuts. This connection point will be hidden behind the bottom railing, which will result in a seamless look. There will be a rub rail consisting of a 2 $^{3}/_{8}$ inch diameter steel pipe at a height of 4 ½ feet.

In keeping with the findings of the prior wind studies, wind fairings will be added to the west side of the Bridge. The wind fairings and associated main span traveler modifications are as described for Alternative 1A.

Alternative 2A will feature transparent panels at the mid-span, towers and at belvederes, as previously described for Alternatives 1A and 1B.

Alternative 2B

Alternative 2B is a new 10 foot tall barrier consisting of posts, rub rail and horizontal cables. The cables are 3/8 inch diameter, spaced at 6 $^{3}/_{8}$ inches on center above the rub rail and 4 $^{3}/_{8}$ inches on center below the rub rail. The rub rail consists of a 2 ⅜ inch diameter steel pipe at a height of 4 ½ feet above the sidewalk. The outside hand rail will be completely removed and replaced with this alternative. New 10 foot tall W8x28 posts will be installed at 12 ½ feet on center, matching the cross-section, size, material, and color as the original posts. These posts will slightly curve forward at the top to support the winglet on top of the barrier. The material to be used for the new rail will be galvanized A36 steel and galvanized steel cable painted with International Orange color, matching the material and color of the current rail.

Alternative 2B will feature a transparent winglet attached to the post tops, as previously described for Alternative 1B, and transparent panels at mid-span, the towers and belvedere locations, as previously described.

Alternative 3

Alternative 3 is a horizontal net located near the bottom chord of the Bridge east and west stiffening trusses. The support system will consist of steel beams installed directly to the truss verticals and support cables attached to the ends of the beams and back to the truss top chord. The support system for the netting will include cables that will pre-stress the netting to keep it taut and to prevent the wind from whipping the netting resulting in a propensity for fatigue failures. The net will project 20 feet from the Bridge and be covered with marine-grade stainless steel cable netting with a grid between 4 and 10 inches. The net will be covered with a plastic coating that could match the Bridge color and the steel support system would also be painted to match the Bridge.

The horizontal net will consist of independent 25 foot long sections that can be rotated vertically against the truss so the maintenance travelers can be moved as necessary. The clearance between the inner face of the traveler vertical leg and the outer edge of the stiffening truss must be increased to accommodate the raised net and the wind fairing. This increased clearance can be achieved by modifying the existing traveler, or by installing a new traveler. The cost of the traveler change is included in the project cost estimate.

Alternative 3 incorporates the west outside hand rail modifications developed in accordance with the findings of prior wind testing. These railing modifications are described under the description for Alternative 1A. Alternative 3 also incorporates the wind fairings and associated traveler changes as previously described.

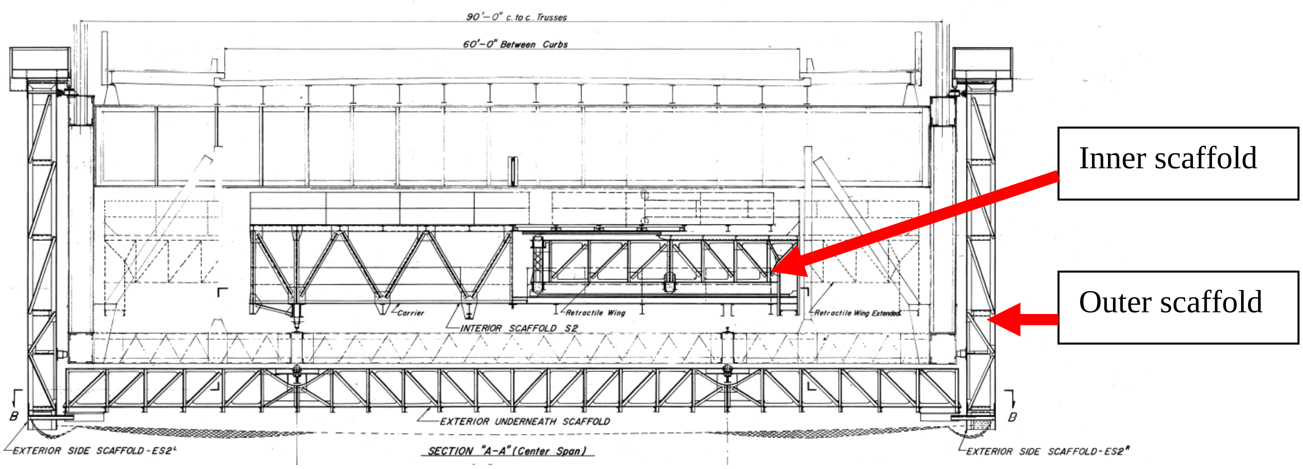
IV. Discussion of Existing Bridge Access Methods

Suspension Spans Maintenance Traveler Operation

Access under the Bridge and access outboard of the stiffening trusses on the suspension bridge portion of the Bridge is provided by four sets of travelling scaffolds (travelers): one in each side span and two within the main span. The travelers, which were installed in the mid-1950s as part of the construction contract for the lower lateral bracing, can be positioned and parked at almost any location along the suspension bridge. Each set of travelers includes an "inner scaffold" and an "outer scaffold." A set of inner and outer scaffolds can move and operate independently.

An outer scaffold is a "U" shaped system attached to the top and bottom chords of the truss and the lower lateral bracing system. The outer scaffold includes the underneath scaffold and exterior side scaffolds on both the east and west sides all of which move as one unit. Currently, access to the outer scaffold is by climbing over the top of the 4-foot tall outside railing from either the west or east sidewalks.

The inner scaffold is a horizontal system located below the floorbeams and attached on top of the existing lower lateral bracing system. The inner scaffolds have "retractable wings" which are extended or retracted as necessary to gain full access to and to allow passage of the inner scaffolds around the upper lateral bracing. The inner scaffolds can be accessed either via the outer scaffold or via a ladder from the extended wing of the inner scaffold to the upper chord of the stiffening truss.



Each traveler is driven by synchronized electric motors powered by a diesel generator. A minimum of three workers are needed in order to move an outer scaffold. The speed at which the outer scaffolds move is a function of many variables. The outer scaffolds can move faster when travelling downhill as opposed to uphill. When climatic conditions result in the rails on the top chord of the stiffening truss being wet the traveler wheels can spin on the rails without moving the traveler, so two additional workers must "sand" the rails so that there is adequate friction between the scaffold wheels and the rail. The east and west exterior side scaffolds can also start to move slightly out of sync which requires correction to avoid twisting or racking the outer scaffold. Depending on these variables it can take 15 to 30 minutes to move an outer scaffold 75 feet.

The inner scaffolds are smaller, lighter and less complex than the outer scaffolds, so movement of the inner scaffolds is easier and less labor intensive. A minimum of 2 workers (operator and spotter) are needed in order to move an inner scaffold and it can take 15 to 20 minutes to move 75 feet.

Approach Span Access
Access to the north and south approach truss spans is via a longitudinal maintenance catwalk running the entire length of these spans. The north approach has several "tributary" catwalks offering access to bearings located at the top of each support tower. Catwalks do not exist within the south approach plate girder spans or within the arch span. Traveler rails were recently installed as part of the Phase II seismic retrofit project throughout the south approach for maintenance access platforms, but these platforms have not been deployed. Access to plate girder spans is from the ground or via temporary "job-specific" platforms/scaffolding; temporary platforms/scaffolding are used to access under bridge portions of the arch structure.

Under Bridge Access Equipment
Currently, the District does not have under bridge inspection trucks (UBIT), which are commonly referred to as "snooper trucks". The practical daytime deployment of the District's existing crane truck is limited for under bridge inspection and/or maintenance because: the crane does not articulate; it is not routinely equipped with a personnel-basket; and because deployment of this unit requires the closure of two lanes of traffic, which reduces lane capacity to an unacceptable level during normal (daytime) hours.

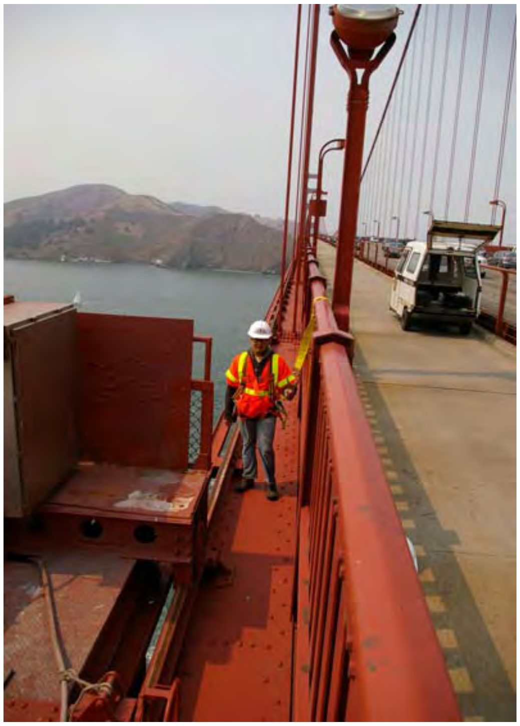
V. Discussion of Existing Bridge Operations

The primary Bridge operations which will be impacted by a proposed physical suicide deterrent system relate to: i) access to under-bridge areas for planned maintenance operations; ii) access to under-bridge areas for emergency operations; and iii) cleaning and painting of suspension system components. The following is a discussion of the current operating environment for these areas.

Access to Under-Bridge Areas for Planned Operations
On a daily basis, Monday through Friday, District forces access the under-bridge areas of the Bridge. This typical activity involves painters, ironworkers, operating engineers, and electricians and is performed on two or three of the travelers at any given time. The west sidewalk is exclusively available for District forces to perform maintenance activities during normal daily work hours since it is not open to the public during at this time. Therefore, the west sidewalk is the primary route used for accessing below-deck areas of the Bridge for planned maintenance and repair work. For the majority of planned maintenance activities, workers transport equipment to the work area via light-duty motorized carts (scooters) on the west sidewalk. Equipment, tools and material are also staged on the west sidewalk, since as stated above, there is no public access allowed on the west sidewalk during normal work hours.

For planned activities, the outer scaffold is positioned directly at the work area (see photograph at right). Workers are then able to efficiently access the work area by driving scooters on the sidewalk to the location of the outer scaffold and then climbing over the outside hand rail directly onto the travelers. Since there is a handrail which provides fall protection on the travelers, the workers are not required to wear their safety harnesses and "tie-off" to the outside railing or other such support when accessing the outer scaffold. To aid in the movement of workers over the top of the railing, step ladders designed specifically to attach to the outside hand rail top members are used.

Tools, small pieces of equipment and materials are easily loaded over the top of the outside railing onto the outer scaffolds.



On a less frequent, although still routine, basis, work is performed on the outboard side of the outside hand rail without the use of the travelers. While working on the outboard side of the handrail, District forces stand on the stiffening truss top chord and tie-off to the railing using appropriate fall protection as shown in the photographs above. In certain instances workers tie-off their safety harness lanyards to a temporary safety cable attached to the outside leg of the railing posts as depicted above.

Access for Emergency Operations
Emergency operations are unplanned operations requiring District forces to climb over the outside handrail. This activity typically occurs once or twice per month, and it typically involves two ironworkers for a couple of hours on the outboard side of the outside handrail per event. Access to the outboard side of the outside handrail for emergency response activities is primarily related to “snatch-and-grab” operations involving individuals who have positioned themselves on the outboard side of the railing (usually on top of the stiffening truss top chord). In these instances, Bridge Patrol or California Highway Patrol (CHP) officers position themselves on the sidewalk and attempt to dissuade the individual from jumping. Meanwhile, two ironworkers are dispatched to climb over the outside hand rail, and onto the top chord, at an appropriate distance on either side of the individual. Currently, Bridge forces are able to climb over the top of the railing onto the top chord at any point along the longitudinal continuum of the outside railing. Responding ironworkers are then able to move along the top chord of the stiffening truss toward

the individual, maintaining appropriate fall-protection via double lanyards attached to the railing. Access for other emergency response situations is similar.

Cleaning & Painting of Suspender Ropes

While this is a current project, it is not a common maintenance activity. Once the current painting cycle is complete, it is anticipated the suspender ropes will not be repainted again for 15 years. However, repainting the suspender ropes is a significant undertaking requiring multiple crews and two years to complete, so it is discussed herein.

This activity includes cleaning and painting the suspender ropes and associated hardware which connect the suspension bridge roadway and sidewalk to the main cables. The suspender ropes are a group of 4 steel cables located every 50 feet along the length of the suspension spans at both the east and west sidewalks.

Cleaning and painting of the suspension system elements involves access from both the sidewalk and traveler platforms and requires access from both the east and west sidewalks. When this work activity is ongoing on the east side, temporary barriers are used to separate the work activity from the general public.

The vertical suspender ropes are painted using a combination of a “cable master” device and self-hoisting platforms (cable box). The cable-master device is an unmanned motor-driven unit which has been designed for the District to perform cleaning and painting of individual suspender ropes; the cable box (see photograph above) is a tethered, self-hoisting platform manned by two workers that allows for the cleaning and painting of four suspender ropes in an enclosed environment.

The painting devices are rigged and tethered to the existing outside railing via fabricated connections and pulleys as depicted in the photograph to the right. The cable boxes are brought to the work site on both the east and west sidewalks via work carts and are then manually lifted over the outside handrail into place around a group of suspenders using a rope and pulley system. Workers enter the cable box after it is installed by climbing step ladders from the sidewalk level.

VI. Operations & Maintenance Impacts

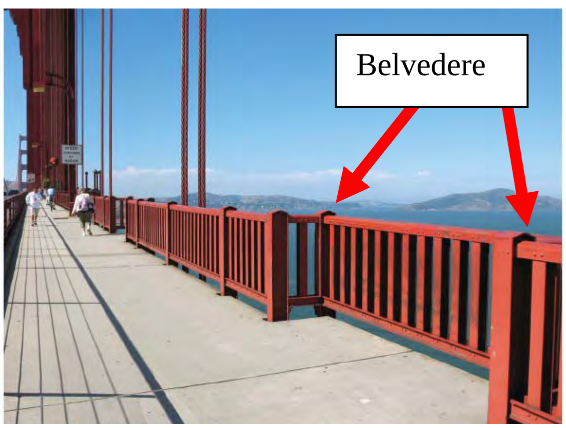
Access for Planned Maintenance Operations with Taller Railings (Alternatives 1A, 1B, 2A and 2B)

The installation of any physical suicide deterrent system that provide a taller railing (Alternatives 1A, 1B, 2A and 2B) will inhibit access to under-bridge areas for planned maintenance activities using the current access techniques. In order to mitigate this impact, access gates are proposed. The gates will be located at a spacing of 150-feet on center to match the spacing of existing light posts and the bicycle safety rail gates.

Gates will consist of two 4-foot wide swinging sections with a common hinged post, and will be constructed of rods to match the appropriate deterrent system design. The frame for each gate door will be constructed of 2 inch by 2 inch steel tube members. As with the fixed sections of each alternative, the rods will connect to the gate framing members with nuts which will be shielded from view, resulting in a seamless look.

The gates will be locked at all times to restrict access by other than Bridge personnel. For Alternatives 1A and 1B (vertical systems extending on top of the outside hand rail), the gates will be 8 foot tall and be positioned on top of the existing outside railing; for Alternatives 2A and 2B, the gates will be the entire height of the replacement fence (12 foot for Alternative 2A, 10 foot for Alternative 2B).

Each sidewalk has 24 belvederes. At these locations the belvedere extends out over the upper chord of the stiffening truss, blocking workers from walking along the truss top chord. The spacing of the belvederes presents several locations where District forces will have to carefully walk along the small traveler rail as shown in the photo below. Fortunately gates can be located such that this will only occur at a few locations on each sidewalk.



Fall protection will be required when walking from the gates to the travelers. It is proposed that a permanent stainless steel safety cable be installed on the outboard side of the east and west outside handrail or new barrier, along the entire length of the Bridge, for workers to “tie-off” to when walking along the stiffening truss upper chord or traveler rail. The cable will be on the outer face of the outside hand rail posts to minimize its visibility.

For Alternatives 1A, 1B, 2A and 2B, worker access for planned maintenance activities on the outer scaffold will be as follows:

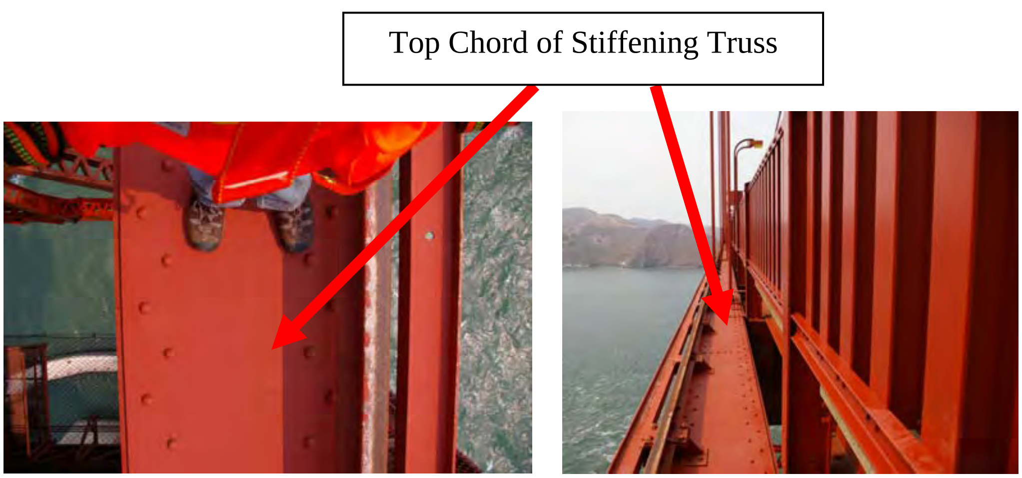
- drive a scooter on the sidewalk to the location of the gate closest to the traveler;
- don a safety harness for fall protection;
- for Alternatives 1A and 1B, climb over the outside hand rail and through the gate while “tied-off” with fall protection;
- for Alternatives 2A and 2B, walk through the full height gate;
- close and lock the gate; and
- while “tied-off” walk along the top chord of the stiffening truss (a maximum of 75 feet) to the outer scaffold.

For planned maintenance activities on the inner scaffold, workers will access the scaffold as follows:

- drive a scooter on the sidewalk to the location of the gate closest to the traveler;
- don a safety harness for fall protection;
- for Alternatives 1A and 1B, climb over the outside hand rail and through the gate while "tied-off" with fall protection;
- for Alternatives 2A and 2B, walk through the full height gate;
- close and lock the gate; and
- while "tied-off" walk along the top chord of the stiffening truss (a maximum of 75 feet) to access outer scaffold and access the inner scaffold from the outer scaffold.

or,

- drive a scooter on the sidewalk to the location of the gate closest to the traveler;
- don a safety harness for fall protection;
- for Alternatives 1A and 1B, climb over the outside hand rail and through the gate while "tied-off" with fall protection;
- for Alternatives 2A and 2B, walk through the full height gate;
- close and lock the gate; and
- while "tied-off" walk along the top chord of the stiffening truss (a maximum of 75 feet) to the location of the inner scaffold and then climb down a ladder that extends from the extended wing of the inner scaffold to the upper chord of the stiffening truss.



The maximum distance that personnel will have to walk along the truss top chord is 75 feet, since the gates are spaced 150 feet apart. The suspender ropes are spaced 50 feet apart, so there will be instances where workers will need to climb around the outside of the suspender ropes as they walk along the top chord to the travelers. There will also be instances where workers will need to climb around the belvederes on the traveler rail as discussed above.

Thus, for Alternatives 1A, 1B, 2A and 2B it will take longer for Bridge forces working at under-bridge locations to reach the work locations. The time it takes to don a safety harness, unlock the gate, tie-off, climb or walk through the gate, and walk along the truss top chord to reach the traveler location represents a decrease in productive time as compared to the existing situation. This decreased production corresponds to an increased annual operating cost. It is anticipated that it will take an extra seven minutes each time a worker travels between the sidewalk and a traveler. Bridge workers travel back to the shop for one coffee break and for lunch each day. This corresponds to six one-way trips through a gate and walking on the upper chord of the truss per worker per day, or 42 minutes of lost productivity per day for each worker engaged in planned maintenance activities below the deck.

A typical paint crew has eight workers, so this represents 336 minutes of lost productivity per paint crew per day as compared to the existing condition. (42 minutes per worker per day * 8 workers per crew = 336 minutes of lost productivity per crew per day)

If, on average, two crews are working on the travelers, this would correspond to 672 minutes of lost productivity per day associated with Alternatives 1A, 1B, 2A or 2B, but does not apply to Alternative 3.

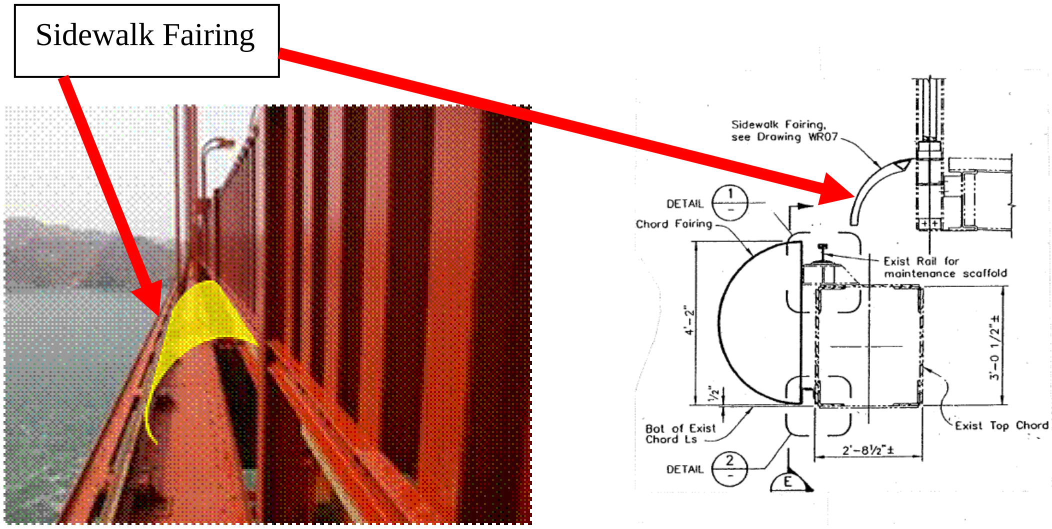
In addition to the loss in productivity, the District's workers compensation experience may change with the taller railing alternatives due to workers accessing the travelers via walking on the top chord of the stiffening truss. Currently, workers do perform some tasks from the top chord, away from the travelers; however, it is not an everyday occurrence.

Loading tools, equipment and supplies will also be less efficient, and thus costlier. Currently tools, equipment and supplies are loaded over the existing rail directly onto the traveler on a daily basis. The installation of Alternatives 1A, 1B, 2A or 2B will necessitate either: travelers must be moved to the gate locations on a daily basis in order to load tools, equipment and supplies through the access gates and then the travelers would then be relocated back to the work location after the loading and transfer operations were completed; or the travelers would remain parked at the work locations and a boom would lift supplies over the taller railings avoiding the additional frequent traveler moves.

Access for Planned Maintenance Operations with Fairings (Alternatives 1A and 2A)

Alternatives 1A, 2A and 3 include fairings on the west side of the main suspension span between the north and south towers. The fairings will be located on the truss top chord and sidewalk as shown on the next page for approximately 3800 feet centered about mid span. This represents approximately 42 percent of the length of the Bridge.

As stated above, Alternatives 1A and 2A will include access gates and with either of these alternatives, District workers will access the scaffolds by opening a gate, climbing over the outside handrail through a gate or just passing through a gate and walking along the upper chord of the stiffening truss. However, the introduction of the fairing will preclude walking along the west stiffening truss top chord for the 3800 feet length between the north and south towers where the fairings are to be installed. Therefore, for Alternatives 1A and 2A, District workers will be required to access the outer scaffolds for this 3800 foot length of the main span from the east sidewalk, as opposed to the current situation where they access it from the west sidewalk.



As stated previously, District workers utilize the west sidewalk to access the travelers since the west sidewalk is closed to the public during the District's normal work hours. The east sidewalk is open to the public during the District's normal work hours and is occupied with pedestrians and bicyclists. It is estimated that 10 million visitors come to the Bridge each year enjoying the sidewalks. On a summer day the sidewalks are crowded with bicycles and pedestrians. For example, over 5,000 bicyclists may use the Bridge sidewalks on a summer day. Thus, the scooters traveling on the east sidewalk move much more slowly than the scooters on the west sidewalk. On average, a scooter on the west sidewalk travels at approximately 15 miles per hour, while on the east sidewalk a scooter travels at approximately 5 miles per hour.

The minimum trip length on the east sidewalk to reach one of the two main span travelers is approximately 1100 feet, while the maximum trip length is approximately 5200 feet. Thus the average trip length would be 3150 feet [(1100 + 5200) / 2 = 3150]. The average increased travel time per scooter trip would then be:

[3100 feet / 5280 feet per mile / 5mph * 60 minutes per hour] –
[3100 feet / 5280 feet per mile / 15 mph * 60 minutes per hour] = 4.7 minutes per scooter trip (one-way)

District workers travel back to the shop for one coffee break and for lunch each day. This corresponds to six one-way trips per day. Assuming that one of the two main span travelers are in use, on average, each day; and assuming that one paint crew is working on the traveler, then this corresponds to:

4.7 minutes per trip * 6 trips * 8 workers (one paint crew) = 226 minutes of lost productivity per day

The 226 minutes of lost productivity for Alternatives 1A and 2A due to scooters on the east sidewalk is in addition to the 672 minutes due to the taller railing which was discussed on pages 11, 12 and 13.

In addition to the loss in productivity, mixing intensive maintenance activities with bicycle and pedestrian traffic on a long-term basis is less desirable from a risk management perspective; since it introduces greater opportunity for conflicts between maintenance activities and the public's recreational use of the same sidewalk.

One possible alternative to avoid these impacts would be to move all bicycle and pedestrian access to the west sidewalk and then stage all maintenance activities from the east sidewalk away from bicycle and pedestrian conflicts. Bicyclists could use the east sidewalk during non-working hours. This is essentially a reversal of the current maintenance and public access situation. The tradeoff is that pedestrians and bicyclists would not have the view corridors that they currently enjoy from the east sidewalk; so all things considered, this is not recommended.

Alternative 3 does not require access gates so walking on the stiffening truss top chord in order to access the outer scaffolds does not apply. Workers will be able to climb over the rail directly onto the traveler as is done today.

Access for Planned Maintenance Operations with Horizontal Nets (Alternative 3)
Alternative 3, the installation of a horizontal net system, will not require workers to pass through gates and then walk on the upper chord of the stiffening truss in order to reach the outer scaffolds, so the above inefficiencies are not applicable. However, Alternative 3 would introduce other inefficiencies. Specifically, it will affect the staff resources necessary to move the outer scaffolds.

The horizontal extension of the net will interfere with the current operations of the outer scaffold. To mitigate this impact, it is proposed that the net be designed to rotate, in 25-foot long segments, to a vertical position such that the maintenance traveler can pass without the vertical exterior side scaffolds of the traveler interfering with the net. This rotation will be achieved through the use of a pinned connection detail between the net structure and the stiffening truss, and by using a portable winch device that will attach to and pull on the outer net framing to move it into a vertical position.

Currently, a minimum of three workers are needed to move an outer scaffold. Two additional workers, one on the west sidewalk and one on the east sidewalk, would be required to rotate the net sections up and down as the outer scaffold moves. This represents a decrease in productive time as compared to the existing situation. This impact would be particularly noticeable for those less frequent, but longer scaffold moves.

The frequency and length of outer scaffold moves varies with the activity underway. Bridge inspection typically requires daily moves of 25 feet for two scaffolds, while routine maintenance may require only weekly moves for a scaffold. Long scaffold moves of multiple bays are less frequent. Typically, there are 1.5 outer scaffold moves per day, and each move takes 20 minutes (assuming the scaffold moves are only one bay which is 25 feet) and requires two additional workers, this corresponds to 60 minutes of lost productivity per day.

1.5 moves per day * 20 minutes per move * 2 additional workers = 60 minutes of lost productivity per day.

Access for Emergency Operations with Taller Railings (Alternatives 1A, 1B, 2A and 2B)
The installation of any physical suicide deterrent systems will impede individuals from jumping off of the Bridge. However, it is possible that a few individuals may still attempt to defeat a physical suicide deterrent system and jump from the Bridge, so it is appropriate to contemplate the requisite emergency operations.

If an individual were to climb over Alternatives 1A, 1B, 2A or 2B and stand on the top chord of the stiffening truss (on the outside of the railing) the Bridge Patrol or California Highway Patrol (CHP) officers would position themselves on the sidewalk and attempt to dissuade the individual from jumping similar to today. Meanwhile, Bridge ironworkers would be dispatched who would access the stiffening truss upper chord, on the outside of the railing, via a gate at an appropriate distance from the individual. Responding ironworkers would then move along the truss top chord toward the individual, maintaining appropriate fall-protection via safety harness lanyards attached to the new steel safety cable. The ironworkers would then escort the individual along the truss chord to the nearest gate. It is anticipated that with the taller railing this operation would be a rare occurrence, so the associated cost would be negligible.

Access for Emergency Operations with Nets (Alternative 3)
If an individual were to jump into Alternative 3, the net, the District would need to rescue the individual from the net which would introduce a significant new operational challenge. In order to provide for the safe retrieval of such an individual, it is recommended that the District purchase an under bridge inspection truck (UBIT), which are some times referred to as "snooper trucks" (see photograph to the right). The snooper truck would be used to access and facilitate retrieval of jumpers from the horizontal netting along most of the length of the Bridge. Snooper trucks have a truck-mounted bucket-controlled basket that can be used for access beneath a bridge from the roadway. The District would purchase a snooper truck which operates within a single lane closure and that has a reach to span over the sidewalk and reach down to the net. Several manufactures make such a unit. One example is the Aspen A-62, manufactured by Aspen Aerials, Inc.

It is anticipated that the rescue operation discussed above would be a rare occurrence based on the history of other net applications; however the cost and operational impacts of being prepared for such an operation would not be negligible. The equipment and procedures involved are quite complex and the District would have to periodically practice retrieval operations in order to be adequately prepared to retrieve someone if necessary. Assuming retrieval operations are practiced once a month, require six staff (2 ironworkers, 2 operating engineers and 2 Bridge Patrol personnel) and last two hours, this corresponds to 12 hours or 720 minutes of lost productivity per month which corresponds to 32.8 minutes of lost productivity per day (720 minutes/month / 22 days/month).

The cost to maintain snooper trucks would also be an additional cost. It is estimated that 1 mechanic would spend 6 days per year on mandated inspections and the annual certification of the snooper trucks, plus 1 mechanic would spend 6 days per year maintaining the snooper trucks.

This corresponds to 12 days per year or 8 hours per month or 22 minutes per day (8 hours/month * 60 minutes/hour / 22 days/month) of required additional resources.

It is important to note that the use of snooper trucks would be limited within approximately 300 feet of either side of mid-span. Rescue of victims from this area would require specialized and highly technical “suspended rescue” techniques. Operation of snooper trucks would also be prohibited during severe wind conditions.

Although not a cost to the District, traffic congestion and motorist delays are a possibility associated with a net rescue. The deployment of the snooper truck would require the closure of a traffic lane, reducing vehicular capacity on the Bridge during the incident. Depending on the time of day (lane configuration in place and traffic demand) this may result in significant delay to the motoring public. In addition, the Bridge sidewalk would need to be closed in the vicinity of the snooper truck during such an operation.

The normal working hours for operating engineers and ironworkers, who would participate in a response, is from 7:00 a.m. to 3:30 p.m., Monday through Friday. Any rescue operation outside normal work hours, such as on weekends, would require that operating engineers and ironworkers be contacted and travel to the Bridge in order to participate in a response. These employees reside in locations at varying distances from the Bridge, so call-out and response times on weekends or after-hours could be several hours.

Maintenance of Suicide Deterrent System – Steel Components

The steel components for Alternatives 1A, 1B, 2A and 2B will be fabricated then hot-dipped galvanized and painted in order to protect the steel from corrosion (or rust). Minor painting “touch-up” would be an ongoing minor effort. It is anticipated that an entire repainting (over-coating) would need to occur in 15 to 20 years. The support beams for Alternative 3 would be similarly galvanized and painted. The netting for Alternative 3 would be marine-grade stainless steel with a colored plastic coating; this will provide a long service life with minimal maintenance of the netting material.

Cleaning of Suicide Deterrent System – Transparent Panels (Alternatives 1A, 1B, 2A & 2B)

The transparent panels and winglets introduce new materials and new maintenance requirements. The very purpose of the transparent panels at mid span, the towers and at the belvederes is to provide an opportunity for photographs to be taken with people on the Bridge with the un-obscured landscape as the backdrop for the photograph. This will create expectations that these transparent panels be sufficiently clean for this purpose, necessitating regular cleaning. The climactic conditions at the Bridge (e.g. fog and drizzle) would increase the frequency of cleaning necessary to maintain adequate clarity for photographic purposes, perhaps two or three times per week.

It is anticipated that the transparent panels can be cleaned using pressure washers and hand cleaning tools with extension capability. Water is not available on the span, so water will have to be delivered to the sidewalks via tanks towed by scooters. Access to the outer face of these panels would be through the access gates via the traveler or top chord (while tying off to the proposed permanent safety cable).

Access to the outer face of the transparent panels at tower locations can not be achieved using the traveler or truss top chord. For these locations, one of two methods is proposed. The first method would be to install a temporary work platform, using rigging attached to the transparent panel framing and/or sidewalk support framing. An alternative method would be to access the outer face via a traveling vertical scissor lift device such as those manufactured by Genie, Inc (see photograph at right). This device is self-driven and would travel on the sidewalk, allowing access to the top of the panels. Once at the top, a worker could use a fully-extended hand cleaning tool to reach the transparent panel outer surface. This technique could also be used to clean the outside of the transparent panels at the belvederes.

If possible, to simplify cleaning the outside face of the transparent panels, the panels would be designed to either rotate about a horizontal axis or hinge, or swing into the sidewalk. This would allow the outside surface to be cleaned directly from the sidewalk.

It is anticipated that cleaning the transparent panels at mid span, the towers and the belvederes would require two full-time equivalent positions which corresponds to 960 minutes per day (16 hours * 60 minutes/hour) of required additional resources.

Cleaning of Suicide Deterrent System – Winglets (Alternatives 1B and 2B)
Winglets would not need to be cleaned as frequently as the transparent panels at mid span, the towers and belvederes, since they serve a different function.

A traveling vertical scissors lift device is recommended for use in cleaning transparent winglets for Alternatives 1B and 2B. The lift device would be a benefit to other maintenance activities, including providing access to the cable boxes or “Spider” platforms (see discussion under “Cleaning and Painting Operation” below). Water is not available on the span, so water will have to be delivered to the sidewalks via tanks towed by scooters. The nature of this activity would require that it occur when the sidewalks are closed to bicyclists and pedestrians.

The proposed total length of the winglets on the east and west sides is 3.5 miles. It is anticipated that it would require 2 workers for 3 days per month to clean the winglets. This corresponds to 48 hours per month or 130 minutes per day (48 hours/month * 60 minutes/hour / 22 days/month) of required additional resources.

Cleaning of Suicide Deterrent System – Nets (alternative 3)
Alternative 3, the horizontal netting system, will introduce a new debris removal activity. The net will incorporate a grid between 4 and 10 inches, the actual size to be determined during final design. The larger size would allow many common items, such as cameras, to pass through the net and fall to the water similar to what happens if a camera is dropped today. A smaller grid would capture more debris.

In addition to pedestrians dropping items into the net, debris from the roadway may accumulate in the horizontal net system. The Bridge is located at a windy site and lightweight debris may be blown onto the net. However, this lightweight debris which has been transported into the net by wind may similarly be removed from the net by the wind.

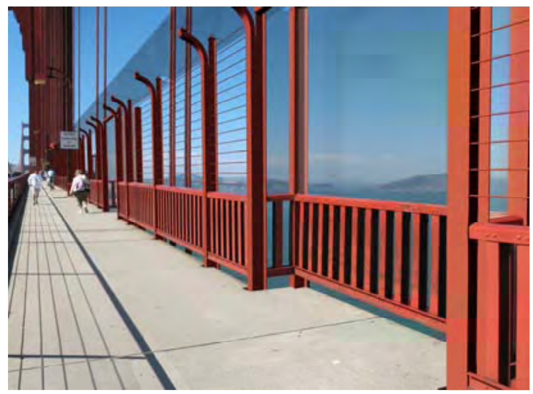
The net is most visible from the sidewalks at the towers (see photograph at right). Thus, along the majority of the length of the net, where it is not readily visible to the public, a once every three month cleaning interval would likely be adequate. However, the approximately 200 foot long length nearest the towers would be very visible, necessitating that this area be more regularly cleaned. The required frequency of cleaning to satisfy public expectations of cleanliness is unknown at this time, since we do not have any basis to estimate how quickly trash will accumulate in these segments of the net. However, it will require that manpower resources be allocated to this task. It is anticipated that it would require 2 workers for 5 days per month to clean the nets. This corresponds to 80 hours per month or 218 minutes per day (80 hours/month * 60 minutes/hour / 22 days/month) of required additional resources.

The snooper truck which would be used for emergency operations with the net can be used to clean debris from the net. However, the snooper for emergency operations requires a single lane closure. In order to avoid traffic impacts associated with trash removal the District should purchase a second, smaller sidewalk-sized snooper (see photographs above) for debris removal operations. The cost of the smaller snooper truck is also included in the project cost estimate. As previously discussed the use of snooper trucks near mid-span is limited. Alternate methods will be used for cleaning the nets at these locations.

Cleaning and Painting of Suspender Ropes

As previously discussed, District workers currently rig the cable boxes and Cable Master from the sidewalk and the outer traveler, and workers access the cable box via a step ladder from the sidewalk (see photograph at bottom left). The construction of Alternatives 1A, 1B, 2A or 2B will impact the installation and utilization of the cable boxes and Cable Master currently used to paint suspender ropes (see photograph at bottom right). Access to and attachment of these devices will be at an elevation 10 feet or 12 feet above the sidewalk. Current attachment and rigging devices and techniques will need to be modified accordingly, and access will need to be via the portable scissors lift unit previously described.

While these impacts will have a negative effect on productivity, the cleaning and painting of the suspension system is not a regular daily maintenance activity, so the cost impact is not significant.



VII. Summary

The introduction of any of the physical suicide deterrent system alternatives will impact Bridge maintenance and operations. These impacts can be minimized through a combination of new equipment and staff resources. The purchase of the equipment can be included in the capital budget for the project, while the additional staff costs will require an increase to the annual operating budget.

The table on the following page summarizes the operations and maintenance impacts as measured in lost productivity and additional required resources as compared to the existing situation.

		Alternative 1A	Alternative 1B	Alternative 2A	Alternative 2B	Alternative 3
A	**Planned Maint. with Taller Railings**	672 minutes per work day	672 minutes per work day	672 minutes per work day	672 minutes per work day	
B	**Planned Maint. With Fairings**	226 minutes per work day		226 minutes per work day		
C	**Planned Maint. With Nets**					60 minutes per work day
D	**Emergency Operations**					33 minutes per work day
E	**Maintain Snooper Trucks**					22 minutes per work day
F	**Clean Transparent Panels**	960 minutes per work day	960 minutes per work day	960 minutes per work day	960 minutes per work day	
G	**Clean Winglets**		130 minutes per work day		130 minutes per work day	
H	**Clean Nets**					218 minutes per work day
	Total	1,858 minutes per work day	1,762 minutes per work day	1,858 minutes per work day	1,762 minutes per work day	333 minutes per work day

The table below summarizes the annual cost of these operations and maintenance impacts based on current salary and benefit rates for the specific job classifications impacted.

		ALTERNATIVES				
	Description	***1A***	***1B***	***2A***	***2B***	***3***
A	**Planned Maintenance w/Taller Railings** **15.23 Hrs/Month/FTE** **# FTE affected: 16 FTE** Salaries & Benefits	$ 194,471	$ 194,471	$ 194,471	$ 194,471	
B	**Planned Maintenance w/Fairings** **10.25 Hrs/Month/FTE** **# FTE affected: 8 FTE** Salaries & Benefits	$ 65,287		$ 65,287		
C	**Planned Maintenance w/Nets** **10.92 Hrs/Month/FTE** **# FTE affected: 2 FTE** Salaries & Benefits					$ 16,526
D	**Emergency Operations** **2 hrs/Month/FTE** **# FTE affected: 6 FTE** Salaries & Benefits					$ 8,514
E	**Maintain Snooper Trucks** **8 Hrs/Month/FTE** **# FTE affected: 1 FTE** Salaries & Benefits					$ 5,658
F	**Clean Transparent Panels** **174 Hrs/ Month/FTE** **# FTE affected: 2 FTE** Salaries & Benefits	$ 205,832	$ 205,832	$ 205,832	$ 205,832	
G	**Clean Winglets** **24 Hrs/Month/FTE** **# FTE affected: 2 FTE** Salaries & Benefits		$ 28,391		$ 28,391	
H	**Clean Nets** **40 Hrs/Month/FTE** **# FTE affected: 2 FTE** Salaries & Benefits					$ 47,318
	TOTAL COST	**$ 465,589**	**$ 428,693**	**$ 465,589**	**$ 428,693**	**$ 78,016**

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August 7, 2008

Mr. Jeffrey Lee, PE, Project Manager
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San Francisco, California 94129-0601

Via e-mail attachment (JYLee@goldengate.org)

RE: Comments on Draft Environmental Impact Report, Golden Gate Bridge Physical Suicide Deterrent Project,

Dear Mr. Lee:

Thank you for the chance to review and comment on this draft environmental impact document. As my area of expertise is in social science statistics and research design, I will limit my comments to that topic, in particular the "purpose and need" section of the document.

Section S3 and pg. 1-5, Purpose and Need. The purpose of the proposed project as stated is ambiguous. For instance, Section S3 states "[t]he purpose of the proposed project is to consider a physical suicide deterrent system on the Bridge that reduces the number of injuries and deaths associated with individuals jumping off the Bridge." As stated, the ultimate goal of the project is unclear – is it designed to save the lives of suicidal people, or simply to keep suicidal people off of the Golden Gate Bridge? There is a difference between preventing suicides at a particular location and saving lives, and this document should state explicitly which of these goals the project is intended to achieve.

A. One interpretation of the purpose of the project as stated is that it is meant to save the lives of suicidal individuals. If this is in fact the goal of the project, then it should be noted that to date no scientific study has been able to demonstrate that physical suicide deterrent systems save lives.

It is true that means restriction (limiting the availability of lethal means to suicidal individuals) has proven effective at reducing suicides by some methods. This evidence of the effectiveness of means restriction as a suicide prevention strategy comes from studies of lethal agents people keep in their homes and might use in an impulsive suicide, such as firearms and prescription medications.

While some have argued that the concept of means restriction might also extend to suicides by jumping from bridges, this is purely conjecture. To date every study on the effectiveness of physical suicide deterrent systems on bridges has been inconclusive – nobody knows whether such systems save lives, or just divert suicides to other locations.

The fact that means restriction works for some methods of suicide but is unproven in the case of bridges is well known among researchers and public health officials. For instance, after endorsing means restriction strategies for firearms, domestic gas, and toxic substances, on the topic of suicide barriers the World Health Organization states:

In addition to the measures described, whose efficacy is attested to by the scientific literature, it is thought that other measures, such as the use of fencing on high buildings and bridges, could also contribute to a reduction in suicide rates, although there is no definitive evidence to support this idea. (p. 87)

In more than 30 years of research, not one study has found evidence that suicide barriers save lives. For instance, in the most recent study on the topic (published in December 2007), Reisch et al. conclude "[b]arriers on bridges may prevent suicides but also may lead to a substitution of jumping site or method" (p.681). In sum, there is no scientific evidence that suicide barriers on bridges save lives. For more detailed information on this point see: http://www.polsci.ucsb.edu/faculty/glasgow/Caltrans.pdf

Thus, the ability of a physical suicide deterrent system to accomplish this interpretation of the project goal is unknown.

B. Another interpretation of the purpose of the project as stated is that it is meant to simply to keep suicidal people from using the Golden Gate Bridge as their means to suicide. A physical suicide deterrent system is likely to accomplish this goal – numerous studies have demonstrated that the suicide rate on bridges and other tall structures declines when suicide barriers are constructed. Again, this is not proof that lives have been saved – it could be that suicidal individuals simply go elsewhere to end their lives. However, if the goal of the project is narrowly defined as preventing suicide at a particular location (the Golden Gate Bridge), the physical suicide deterrent system is likely to work.

There are two caveats here. First, it should be noted that while physical deterrent systems are generally effective at reducing suicides from bridges, this is not always the case. For instance, the Colorado Street Bridge in Pasadena has seen four suicides in the last 2 years despite having suicide barriers in place (*Pasadena Star-News*, various dates). This is a higher rate of suicide than the average rate of suicide from this bridge in the period before the barrier was installed (based on newspaper reports, approximately 1.25 per year). In the event a physical deterrent system is installed on the Golden Gate Bridge this case should be studied to determine if the recent failure to reduce the suicide rate at this bridge is due to a design flaw or an unforeseen maintenance issue with the system.

However, this case may simply be an indication that physical deterrent systems are unable to prevent determined individuals from committing suicide.

Second, this narrow definition of the goal of the project is at odds with the public understanding of the goal of this project. Most existing public support for this project is based on the belief that the ultimate goal of the project is to save lives. If the actual goal of the project is simply to move suicidal behavior away from the bridge, without regard for the ultimate fate of the suicidal individuals, this must be made clear in the document.

C. In conclusion, this document is unclear about what the actual purpose of the project is (keeping suicidal people away from the bridge or saving lives). If the actual goal of the project is to save the lives of suicidal individuals, the document must note that there is no scientific evidence that a physical suicide deterrent system will accomplish this goal. If the actual goal of the project is simply to keep suicidal people away from the Golden Gate Bridge without regard for saving lives, this must be made clear in the document so the public can make an informed decision about whether to support what amounts to a $50 million suicide diversion project.

Sincerely,
Garrett Glasgow

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Report on the Proposed Cold Spring Canyon Bridge Suicide Barrier
February 5, 2008

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As requested, here is my evaluation of the proposed suicide barrier on the Cold Spring Canyon Bridge. The administrative record in this matter shows that the basic objective and underlying purpose of the proposed barriers project is to save lives by preventing suicides (Caltrans 2006a, 2006b). My area of expertise is in research design and statistics in the social sciences. Thus, I will confine my report to a review of the evidence presented on the likelihood that this project will achieve its objective of saving lives by preventing suicides.

The Effectiveness of Suicide Barriers: A Review of the Evidence

As a suicide prevention strategy, suicide barriers fall in the category of "means restriction." It is widely believed that some suicides are impulsive, and thus some suicidal individuals can be saved by restricting their access to lethal agents, allowing time for the suicidal crisis to pass (Clarke and Lester 1989). As one might expect, most of the evidence for the effectiveness of means restriction as a suicide prevention strategy comes from studies of lethal agents people keep in their homes and might use in an impulsive suicide, such as firearms (Caron 2004) and prescription medications (Lester 1989). In a review of a series of studies on suicide attempts, Hawton (2001) notes:

> Perhaps the most important implication of a highly impulsive suicide attempt is that it is most likely to involve a method of suicidal behavior that is immediately to hand. This is the situation in which a policy of limiting availability of dangerous means for suicidal actions is most likely to be effective. It has clear relevance to limiting availability of means such as firearms, dangerous medicines, and toxic substances such as pesticides and insecticides. (p. 80).

Due to its distance from local population centers, suicide by jumping from the Cold Spring Bridge seems less likely to be the product of an impulsive suicidal moment than suicide by a lethal agent found in the home. Nevertheless, it is possible that the concept of means restriction might also extend to suicides by jumping from bridges.

While this idea seems plausible, at this point it is purely conjecture. To date every study on the effectiveness of suicide barriers has been inconclusive – nobody knows whether suicide barriers are an effective method of preventing suicide and saving lives.

Preventing Suicides at a Particular Location versus Saving Lives

How can we determine if suicide barriers on bridges save lives? It is not enough to simply point out that bridges that have installed barriers see fewer suicides, as there is a distinction between preventing suicides and preventing suicides at a particular location.

While we can be reasonably confident that a suicide prevention barrier on the Cold Spring Bridge will reduce suicides at that location, it does not follow from this that a barrier would save lives.

We must consider the possibility of *displacement* – that is, will placing a barrier on the Cold Spring Bridge simply lead those intending to commit suicide to jump at another location? For instance, there are preliminary reports by local officials in Toronto that suicides by jumping from freeway overpasses have increased since the installation of a suicide barrier (the "Luminous Veil") on the Bloor Viaduct in 2003, although this has not yet been the topic of a formal study (Mandel 2007). We must also consider the possibility of *substitution* – that is, will placing a barrier on the Cold Spring Bridge lead those intending to commit suicide to substitute a different method of suicide, such as poison or a handgun? There is research that suggests that substitution does take place in some cases – for instance, Rich et al. (1990) found evidence that the implementation of stricter gun laws in Canada in 1978 led to more suicides by jumping among those most likely to use guns for suicide (young men).

If installing a suicide prevention barrier on the Cold Spring Bridge simply leads suicidal individuals to kill themselves in another place or in another way, we are not saving lives, and the proposed Caltrans project will not achieve its objective.

Several people have observed that the Cold Spring Bridge has the highest concentration of fatalities in any spot location owned by the state in Caltrans District 5. However, if the objective of the project is to save lives, this fact is irrelevant. Again, the stated objective of the project is to save lives, and this objective will not be achieved if the barrier on the Cold Spring Bridge simply disperses suicidal individuals to take their lives elsewhere.

Existing Research on Suicide Barriers is Inconclusive

What kind of evidence should we look for in order to know if suicide prevention barriers save lives? We cannot simply look at the numbers who jump from a bridge before and after the installation of a suicide barrier for the reasons discussed above. Instead, we must look for changes in the *suicide rate* in the communities surrounding the bridge. If suicide prevention barriers are saving lives, then this means that there will be some individuals who would have committed suicide if there had been no barrier, but instead choose to live – all else equal, this will lead to a reduction in the overall suicide rate. Conversely, if suicide prevention barriers do not save lives, individuals deterred from jumping from the bridge in question will simply commit suicide in another place (displacement) or in another way (substitution) – all else equal, this will leave the overall suicide rate unchanged. Finding a decrease in the *suicide rate by jumping* would suggest there is no *displacement*, while finding a decrease in the *overall suicide rate* would suggest there is neither *displacement* nor *substitution*.

Perhaps the most widely cited study in debates about suicide barriers on bridges is Seiden (1977). This study tracked 515 people who were restrained from committing suicide from the Golden Gate Bridge between 1937 and 1971, and found that about 94% of these people did not go on to commit suicide in the following 7 years. Although this study is frequently interpreted as evidence of the likely effectiveness of suicide barriers, it actually does not speak to this question for two reasons.

First, and most obviously, the individuals in this study were restrained from suicide not by a physical barrier, but by human intervention. Thus, the results of this study are better interpreted as an examination of the long-term effectiveness of human intervention strategies such as call boxes and patrols rather than physical suicide barriers.

Second, if we are to interpret this study as evidence of the likely effectiveness of physical barriers, we must assume that installing suicide barriers does not result in displacement or substitution. The individuals in this study were prevented from committing suicide at their preferred location, and then chose to live – but if barriers made suicide at the Golden Gate Bridge impossible, would they still go to the Golden Gate Bridge, or would they simply go to another bridge or substitute another method? In order to regard this study as evidence that suicide barriers would save lives in the same way as the human intervention actually observed, then we must assume these individuals would have behaved in exactly the same way whether or not the Golden Gate Bridge had suicide barriers – in other words, we must assume away the possibility of displacement and substitution.

Also note that this study suffers from what is known as a *self-selection bias*. That is, there are many reasons to believe that the individuals tracked in this study are not representative of individuals that actually commit suicide by jumping from bridges. Simply put, were the people in this study serious about committing suicide, or did they go to a highly visible public place and threaten to commit suicide as a "cry for help"? If it is the latter, it would be a mistake to count them as examples of the lives suicide prevention barriers could save if they never intended to die in the first place.

Studies based on interviews with those who survived a jump from a bridge are similarly flawed (Rosen 1975). Survivors often report they only planned to jump from a specific bridge, but one factor that likely influenced this preference was the fact that it was actually possible to commit suicide at this location. If a suicide barrier had made suicide at their preferred location impossible, would these individuals have simply formed a suicide plan involving a different location or a different method? We have no way of knowing. Some survivors also claim that they would not have attempted suicide if a barrier had been in place, but the experience of the suicide attempt may be influencing their statements (Simon et al. 2001), and a barrier does nothing to solve the mental and emotional problems that led these individuals to attempt suicide in the first place.

Another well-known study of a suicide barrier on a bridge was a comparison of the number of suicides from the Ellington and Taft Bridges in Washington, D.C. (O'Carroll et al. 1994). After a suicide prevention barrier was installed on the Ellington Bridge, this study found there were no further suicides from that bridge, and the number of suicides per year from the Taft Bridge remained roughly constant. However, this is not proof that the suicide prevention barrier on the Ellington Bridge is saving lives. In the words of O'Carroll:

> Are the data provided sufficient to substantiate the effectiveness (or lack thereof) of bridge barriers as a means to prevent suicide? The answer is no, the data are not sufficient to answer that question, because they do not touch on the issue of whether persons who would have committed suicide by jumping from the Ellington Bridge went on to commit suicide by other means. … [P]ersons frustrated in their efforts to commit suicide by jumping from the Ellington Bridge are in no sense restricted to committing suicide by jumping from the Taft Bridge. (p. 92)

Similarly, Silverman states there is a "… lack of clear evidence unequivocally proving that the construction of barriers on the Ellington Bridge has resulted causally in an absolute reduction in the *number* and *rate* of suicides in Washington D.C. …" (p. 99). Thus, both authors in this study conclude that the effectiveness of suicide barriers has not been proven. Note further that no statistical tests for changes in the suicide rate were conducted.

Another commonly cited study examined a case where a suicide barrier was removed from a bridge (Beautrais 2001). This study found that when barrier were removed from the bridge, the number of people jumping from this bridge increased substantially (3 in the 4 years before the removal of the barrier versus 15 in the 4 years after the removal of the barrier). Note this bridge was adjacent to the region's largest inpatient psychiatric unit, which would seem to make it a more likely site for "impulsive" suicides than the Cold Spring Bridge.

As with O'Carroll et al., the results of this study were inconclusive. Beautrais did not test the impact of the removal of the barrier on overall suicide rates, which is the test we would need to see in order to determine if the removal of the suicide barrier resulted in more suicides. In reviewing her own study and others, Beautrais concludes:

> The weight of evidence from these studies clearly suggests reductions in the rate of suicide by jumping from the sites following the introduction of barriers. However, the extent to which such changes lead to (i) an overall reduction in suicide or, (ii) increased preferences for other sites or methods of suicide remains contentious. (p. 561)

One study specifically cited in the Caltrans memorandum of August 18, 2006 is a study by Pelletier (2007, cited by Caltrans as a 2006 unpublished working paper). This study examined the impact of a suicide barrier on the Memorial Bridge in Augusta, Maine. As with the studies examined above, Pelleiter found that while the barrier reduced suicides at the bridge, it did not have a statistically significant impact on the suicide rate (p. 58).

Other studies on suicide barriers produce equivalent results. Reisch and Michel (2005) examine the effect of a safety net designed to prevent suicides from the Bern Muenster Terrace, and found no statistically significant change in the suicide rate by jumping (they did not test the effect of the net on the overall suicide rate). Bennewith et al. (2007) found that a suicide barrier on the Clifton Suspension Bridge in England reduced the suicide rate at the bridge, but did not have a statistically significant effect on either the suicide rate by jumping or the overall suicide rate. Reisch et al. (2007) test the relationship between suicide by jumping and the accessibility of bridges, and conclude "[b]arriers on bridges may prevent suicides but also may lead to a substitution of jumping site or method" (p.681).

In a review of the existing literature on suicide prevention on bridges Gunnell et al. (2005) conclude "[w]hilst there is no clear evidence that the installation of barriers results in a reduction in overall population suicide rates, extrapolation from other studies concerning the effect of changes in the availability of commonly used methods suggests this may be the case" (p. 17). That is, while researchers hypothesize that the concept of means restriction might be successfully extended to suicide prevention on bridges, there is currently no proof that barriers save lives.

Thus, while there is growing evidence that installing a suicide barrier will reduce the incidence of suicides on a bridge, there is no proof that this in turn results in lives saved. That is, no existing research has been able to rule out the possibility that suicide barriers simply lead people to commit suicide in another place or in another way.

Changes in the Suicide Rate

Although not the subject of a published study, it has been pointed out that there is evidence that suicide rates have dropped in communities that have installed suicide barriers on bridges. For instance, according to data from the Center for Disease Control (CDC 2008) the suicide rate in Washington D.C. declined by almost 49% from 1986 (the year of the installation of the suicide barrier on the Ellington Bridge) to 2004. However, this remarkable decline should give us pause for two reasons.

First, suicides by jumping comprise a small fraction of suicides overall – suicides by jumping from all bridges comprised less that 10% of all suicides in Washington D.C. from 1981 to 1986 (Forgey 1987), so it seems implausible that a barrier on a single bridge could produce such a dramatic drop in the suicide rate.

More importantly, the suicide rate has been dropping everywhere in the U.S. (Lubell et al. 2008, McKeown et al. 2006), both in communities that have installed suicide barriers and in communities that have not. For instance, over the same 1986-2004 time period suicides in San Francisco County (the site of the barrier-less Golden Gate Bridge) dropped by over 30%, and by a remarkable 56% from 1979-2004 (the numbers remain roughly the same if Marin County is included in these calculations). Given that there are clearly other forces at work reducing the suicide rate, attributing changes in local suicide rates to the installation of a suicide barrier is premature.

A Possible Case of Barrier Ineffectiveness

It should be noted that while barriers are generally effective at reducing suicides from bridges, this is not always the case. For instance, the Colorado Street Bridge in Pasadena has seen four suicides in the last year despite having suicide barriers in place (*Pasadena Star-News*, various dates). This is approximately three times the average rate of suicide from this bridge in the period before the barrier was installed (based on newspaper reports, approximately 1.25 per year). In the event a barrier is installed on the Cold Spring Bridge this case should be studied to determine if this increase in suicides is due to a design flaw or an unforeseen maintenance issue with the barriers. However, this case may simply be an indication that barriers are unable to prevent determined individuals from committing suicide.

Who Endorses Bridge Barriers as a Suicide Prevention Strategy?

It is clear from the discussion above that suicide barriers are not proven to save lives. However, this raises another point of confusion. During the course of the debate about the barrier on the Cold Spring Bridge several statements were made that seemed to suggest that a number of public health agencies endorse the construction of barriers on bridges as an effective strategy for suicide prevention. How can this be, given the state of the evidence we have reviewed above?

A review of the policy statements put forth by these public health agencies quickly clears up the confusion – public health agencies do not explicitly endorse suicide barriers as an effective method of suicide prevention. I have reviewed the National Strategy for Suicide Prevention, which is a collaborative effort from the Substance Abuse and Mental Health Service Administration (SAMHSA), the Center for Disease Control (CDC), the National Institutes of Health (NIH), the Health Resources and Services Administration (HRSA), and the Indian Health Service (IHS). I have also studied reviews of suicide prevention strategies put forth by the American Medical Association and the World Health Organization (WHO). None of these organizations explicitly endorses the use of suicide barriers as a suicide prevention method.

For instance, consider the National Strategy for Suicide Prevention (NSSP 2001). All of the suicide prevention strategies based on means restriction in the NSSP are focused on reducing access to lethal agents in the home. Suicide barriers are simply mentioned in passing as a subject of interest (p. 72), and the NSSP recommends further research on the topic (p. 77).

SAMHSA also maintains the National Registry of Evidence-based Programs and Practices (NREPP), a searchable online registry of scientifically tested mental health and substance abuse interventions that have been reviewed and rated by independent reviewers (SAMHSA 2008). Bridge barriers are not included in the NREPP registry.

The AMA review (Mann et al. 2005) simply notes that "suicides by such methods have decreased following … construction of barriers at jumping sites (p. 2070)" – in other words, this review points out that barriers on bridges reduce the number of suicides by jumping from bridges, which as we have already seen is not proof that suicide barriers save lives. More importantly, the AMA makes no specific recommendation regarding suicide barriers. The AMA's policy recommendation for means prevention reads:

> Restricting access to lethal methods decreases suicides by those methods. Priority should be given to the most commonly used methods used in each country. The possibility of substitution of methods requires ongoing monitoring, as does compliance with restrictions such as firearm access. (p. 2071)

This policy recommendation in fact seems to suggest that we should focus our means restriction efforts on projects other than suicide barriers, as suicide by jumping is comparatively rare in California – for instance, in 2005 (the last year for which data is available from the CDC) suicide by firearm (41.5%), suffocation (26.4%) and poisoning (19.2%) were all far more common than suicide by jumping from a high place (4.1%).

Finally, after endorsing means restriction for firearms, domestic gas, and toxic substances, on the topic of suicide barriers the WHO (WHO 1998) states:

> In addition to the measures described, whose efficacy is attested to by the scientific literature, it is thought that other measures, such as the use of fencing on high buildings and bridges, could also contribute to a reduction in suicide rates, although there is no definitive evidence to support this idea. (p. 87)

Thus, while regarding suicide barriers as a promising area of research (in part though the hope that restricting access to very lethal means will lead suicidal individuals to substitute less lethal means), these agencies acknowledge that this is an unproven suicide prevention strategy, and the specific means restriction policies these organizations endorse are focused on lethal agents in the household.

To the best of my knowledge, the only organizations that explicitly endorse suicide barriers as a suicide prevention strategy are suicide prevention advocacy groups such as the American Foundation for Suicide Prevention (AFSP 2008) and the Glendon Association (Glendon Association 2007).

Implications for the Caltrans Project

It appears that the existing Caltrans analysis (Caltrans 2006a, 2006b) is overly optimistic in estimating the likelihood a suicide barrier on the Cold Spring Bridge will achieve the stated objective of saving lives.

The benefit:cost ratio presented in the Caltrans memorandum on this project assumes that the barrier would save 1.6 lives per year (Caltrans 2006b). This assumption is flawed for two reasons.

First, this benefit:cost ratio makes the assumption that the Cold Spring Bridge averages two suicides per year. However, information released by the Santa Barbara County Sheriff-Coroner reveals that the average number of suicides from the bridge in a year is actually 0.98, or 43 suicides in 44 years (Santa Barbara County Sheriff-Coroner, 2007). That is, the benefit:cost ratio calculation is based on assuming that the suicide rate from the Cold Spring Bridge is twice as high as the rate we have actually observed.

Second, and more importantly, the benefit:cost ratio assumes that 80% of individuals who would have committed suicide from the Cold Spring Bridge would be saved by the proposed suicide barrier. As we have seen, this assumption is not supported by the data, the academic literature, or public health agencies. In short, there is no proof that the proposed suicide barrier will save lives, and thus no basis for the assumption that the project will save 1.6 lives per year. Given the state of the evidence, the conservative estimate for lives saved by this project would be 0, which in turn would yield a benefit:cost ratio of 0.

Thus, the prospects for the success of this project are very uncertain, and there is a significant chance that this project will not achieve its objective.

Nevertheless, some may feel the project should go forward regardless of proven effectiveness, arguing that if it saves even one life, it will be worth it. This is flawed logic, as the same argument could be used to justify any project without evidence of effectiveness. Given that the Caltrans highway safety budget is not infinite, all proposed safety projects must be evaluated based on existing evidence in order to determine the most cost effective way to improve highway safety. The proposed suicide barrier on the Cold Spring Bridge should not be an exception.

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ATTACHMENT 5

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John J Moylan, President
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August 22, 2008

Dear Mr. Moylan,

We are responding to a report sent to you by Mr. Garrett Glasgow regarding the evidence for the effectiveness of a physical suicide deterrent system on the Golden Gate Bridge. We have significant concerns about this report as we feel it paints an inaccurate picture of the evidence and does not reflect the view of the majority of researchers on this subject. Mr. Glasgow asserts, "To date, every study on the effectiveness of suicide barriers has been inconclusive." However, the authors of these studies would disagree with him. Every author of all published studies on the effectiveness of suicide barriers has concluded that his or her study supports the effectiveness of bridge barriers to save lives. The evidence for the effectiveness of suicide barriers is similar to the evidence for the health dangers of smoking (which were long disputed as not conclusively proven): no single study can conclusively prove the case, but the collected results of study after study point to a clear answer.

The medical literature is clear that reducing access to lethal means (such as building bridge barriers) is an effective method in preventing suicide. In the largest review to date (published in the *Journal of the American Medical Association*), Mann et al. concluded "these studies demonstrate the life-saving potential of restricting lethal means."[1] In addition, the three other scientific reviews, including one that specifically looked at suicide by jumping, concluded that means restriction is an effective method of suicide prevention.[2],[3],[4] Finally, the Substance Abuse and Mental Health Services Administration (SAMHSA) has concluded that means restriction is effective and includes it as one of its National Goals for Suicide Prevention (Goal 5: Promote Efforts to Reduce Access to Lethal Means and Methods to Self-Harm)[5]

The overwhelming evidence that reducing access to lethal means is an effective method of suicide prevention strongly supports the effectiveness of bridge barriers, particularly one easily accessible and as close to a large population center such as the Golden Gate Bridge. However, there are several studies on bridge barriers in particular, and all authors conclude that

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their study supports the efficacy of suicide prevention barriers. Glasgow quotes these studies out of context or otherwise minimizes their findings. In the end, Glasgow ignores the large collection of evidence and instead focuses on the fact that no single study can prove the case (which would be unusual in such an area of public health research).

A striking example of Glagow quoting a study out of context comes from the study by Riesch et al Glasgow writes, "Reisch et al. (2007) test the relationship between suicide by jumping and the accessibility of bridges and conclude '[b]arriers on bridges may prevent suicides but also may lead to a substition of jumping site or method' (p681.)"[6] However, the sentence is not from the conclusion of the paper. It is on the first page as part of the introduction. In fact, it is the very question that authors are attempting to answer – how many suicides would be prevented and how many suicides would still occur with a substitution of method. The authors report, "Regions with high rates of bridge suicides were identified and compared with regions with low rates, and the analysis revealed that only about one third of the individuals would be expected to jump from building or other structures if no bridge was available."[7] Their report suggests that only one third of people would substitute a new jumping site. The authors' actual conclusion is "The results support the notion that securing bridges may save lives."[8]

In addition, Glasgow minimizes the findings of the other studies on suicide barriers. He states that Pelletier and Bennewith's studies do not support efficacy of bridge barrier, when both authors conclude that their studies do, in fact, support this efficacy. Pelletier's study at the Aurora River bridge in Augusta, Maine did find a 9% decrease in the suicide rate in Augusta after the construction of the barrier (which was greater than the 3% decrease seen in the surrounding area).[9] While this decrease did not achieve statistical significance (i.e. there is still the possibility that the decrease was due to chance), it is another piece of evidence supporting the effectiveness of barriers. Pelletier's reported his conclusion, " On the basis of this study, the safety fence seemed to be effective in preventing suicides."[10] Bennewith et al. found a statistically significant reduction in the rate of male suicide by jumping after the construction of the Clifton River Bridge. In addition, there was an overall reduction in the suicide rate by jumping, though it did not reach statistical significance.[11] Bennewith concludes, "This study provides evidence for the preventive role of barriers on bridges."[12] Reisch and Michel looked at suicides off the Bern Meunster Terrace after the installation of a safety net and found a significant decrease in the number of suicides by jumping. They concluded, "The number of people jumping

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from all high places in Bern was significantly lower compared to the years before, indicating that no immediate shift to other nearby jumping sites took place."[13] They had and additional interesting point, "An installation of a physical barrier has an effect which reaches beyond physical obstruction … It maybe perceived as a sign of care."[14]

Similarly, Glasgow states that O'Carroll and Silverman's paper does not unequivocally prove that the Ellington suicide barrier saved lives. Of course, no single paper can offer unequivocal proof, and the authors would be imprudent to claim that theirs did. However, the authors did find that constructing a suicide barrier on the Ellington bridge eliminated suicides at that bridge while there was no increase in suicides at the nearby Taft bridge (which is easily visible to from the Ellington bridge). In addition, the suicide rate in the Washington D.C. area fell after construction of the barrier.[15] The authors did not feel that their study could offer unequivocal proof but did again feel that their study supported the effectiveness of suicide barriers.[16]

In addition to the above studies, studies by Beautrais[17], Rosen[18] and Seiden[19] all looked at the question of preventability and suicide by jumping and concluded that their study supported the efficacy of barriers. All told, there are eight separate studies looking at the question of whether bridge barriers could be effective, and all of the authors feel that their studies support this efficacy. There are no published studies of bridge barriers that do not support this efficacy. This is in addition to the huge body of literature on the efficacy of means reduction in general. Glasgow states "no existing research has been able to rule out the possibility that suicide barriers simply lead people to commit suicide in another place or way."[20] Again, the picture is similar to the case for the health dangers of smoking or the existence of global warming. No single study can prove the case, and it is impossible to completely rule out the possibility of the opposite scenario. However, the collection of a large body of evidence clearly points to the answer that smoking does cause cancer, global warming does exist, and a suicide barrier on the Golden Gate Bridge would save many, many lives.

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