Memorandum of Agreement Regarding Planning, Development, and Implementation of the Conservation Plan for Franciscan Manzanita (*Arctostaphylos franciscana*)

California Department of Transportation
California Department of Fish and Game
The Presidio Trust
National Park Service
and
U.S. Fish and Wildlife Service

December 21, 2009

I. RECITALS

A. In late October 2009, after removal of existing mature vegetation in connection with the South Access to the Golden Gate Bridge Doyle Drive Replacement Project ("Project"), what is thought to be Franciscan Manzanita (*Arctostaphylos franciscana)* was discovered at the Project site along Doyle Drive. If conclusively proven to be Franciscan Manzanita, this individual plant will be the only known specimen existing in the wild today ("Mother Plant"). The last known native population was seen in 1942 and, except for a limited number of individuals growing in botanical gardens, the species was thought to be extinct.

B. The Project is a public safety and improvement project to upgrade the seismic and structural integrity of the South Access to the Golden Gate Bridge and timing is of the essence as to its construction.

C. It is the consensus of the biological experts that the Mother Plant must be relocated from its current site as soon as feasible to maximize its chance at survival.

D. The California Department of Transportation, California Department of Fish and Game, The Presidio Trust, National Park Service, and the U.S. Fish and Wildlife Service (herein after collectively referred to as "the Agencies" and each respective agency individually referred to as "Agency") share the goal of conserving and protecting Franciscan Manzanita while not impacting the schedule of the public safety Project.

E. This Memorandum of Agreement ("MOA") establishes a multi-agency process to implement the *Conservation Plan, 2009 for Franciscan Manzanita (Arctostaphylos franciscana)* ("Conservation Plan"), which is the result of a collaborative effort by the Agencies and identifies specific conservation actions and procedures to ensure the survival of Franciscan Manzanita. [Attachments A, the "Conservation Plan"; B, "Nurturing Requirements"; and, C, "Reporting Requirements" are hereby attached to this agreement and are incorporated by reference.]

F. This MOA and the Conservation Plan are intended to promote the survival, protection, and succession of the Mother Plant and her offspring by relocating the Mother Plant and salvaging cuttings and seed (offspring).

G. The Presidio Trust ("Trust") and National Park Service ("NPS") work cooperatively on native plant restoration at the Presidio pursuant to an agreement regarding natural resources management at the Presidio of San Francisco. The Trust and NPS also have an associated interagency agreement which provides a mechanism for cost allocation and transferring funds.

H. The Trust and the Golden Gate National Parks Conservancy (GGNPC) work collaboratively on native plant restoration at the Presidio pursuant to an agreement for services related to natural resource projects. Project statements under the agreement provide a mechanism for documenting work scopes, cost allocations, and transferring funds.

II. AUTHORITY

A. The U. S. Fish and Wildlife Service enters into this MOA under the general authority of the Endangered Species Act (16 U.S.C. §1631 *et seq.*) ("ESA").

B. The National Park Service enters into this MOA as the land management agency for Area A of the Presidio under the Presidio Trust Act, 16 U.S.C §460bb appendix and under the general authority of the National Park Service Organic Act (16 U.S.C. §§1-4) and ESA § 7(a)(1).

C. The Presidio Trust enters into this MOA as the land management agency for Area B of the Presidio under the general authority of the Presidio Trust Act, 16 U.S.C. §460bb appendix, and ESA § 7(a)(1).

D. The California Department of Transportation enters into this MOA as the transportation agency in California under the general authority of Streets and Highways Code §92 and other applicable provisions of law.

E. The California Department of Fish and Game enters into this MOA as the trustee agency for fish and wildlife in California under the general authority of Fish and Game Code §1802 and other applicable provisions of law.

III. STATEMENT OF AGREEMENT

The Agencies hereby agree to:

A. Implement their respective obligations, as set forth in the Conservation Plan, consistent with the obligations set forth herein.

B. Collaborate on and implement the terms of the Conservation Plan and any necessary adaptive management changes to the Conservation Plan as the primary mechanism to promote the survival of Franciscan Manzanita.

C. Support the relocation of the Mother Plant currently growing along Doyle Drive using excavation and transport methods accepted by the Agencies, and facilitate the collection of cuttings, seeds, soil seedbank, and roots of

the plant for use by appropriate botanical gardens and the Presidio Nursery for propagation and future planting in the wild.

D. Designate Betty Young, the current Head of the Presidio Nursery as the focal point for decisions regarding the nurturing and care of the Mother Plant following relocation. If at any time Betty Young cannot continue as the focal point for care and nurturing of the Mother Plant, the Trust will consult with the other Agencies to determine a mutually acceptable alternative lead person as to such activities. However, no decision by this individual shall extend to decisions regarding financial commitments by any of the Agencies.

E. Designate Michael Chassé, currently of the NPS, as the lead on monitoring and reporting activities identified in the Conservation Plan. If at any time, Michael Chassé cannot continue the monitoring and reporting program, the Trust will consult with the other Agencies to determine a mutually acceptable alternative lead person as to such activities. However, no decision by this individual shall extend to decisions regarding financial commitments by any of the Agencies.

F. Subject to the mutual agreement of the Agencies, update and revise the Conservation Plan as necessary.

G. Consistent with each Agency's mandate, responsibilities, and authority, consult with any identified lead agency with respect to required environmental review under the National Environmental Policy Act ("NEPA"), the California Environmental Quality Act ("CEQA"), and any other applicable regulations and policies, if and as needed.

H. Each Agency, in its sole discretion, may review, as necessary, any Agency or non-Agency proposed research and management activities that may affect Franciscan Manzanita, existing in Area A or B of the Presidio, in order to help promote:

1. The scientific validity and consistency of such activities; and

2. The compatibility of such activities with the goals of the Conservation Plan.

I. Monitor the status of Franciscan Manzanita populations and the species' habitat through:

1. Implementation of the monitoring tasks outlined in the Conservation Plan.

2. Preparation of annual summary reports documenting monitoring results and population status and trends.

3. Incorporation of new information and adaptive changes into the monitoring program as necessary.

J. Following relocation of the Mother Plant, the Agencies shall hold annual meetings amongst the Agencies in which they may, as appropriate:

1. Evaluate the effectiveness of the Conservation Plan;

2. Determine whether the goals and objectives identified in the Conservation Plan are being adequately achieved;

3. Review completed implementation actions;

4. Review new information, including genetic data;

5. Decide upon the actions to be implemented in the future and assign those actions to the appropriate Agency or Agencies; and

6. Discuss whether the Conservation Plan requires any adaptive changes to better conserve Franciscan Manzanita in the Presidio. All new information and specific adaptive management actions that the Agencies agree to shall be incorporated in writing and appended to the Conservation Plan for implementation.

7. Describe any conservation actions scheduled for implementation in the upcoming year and over the next five calendar years;

8. Discuss the Agencies' reviews and recommendations regarding the Conservation Plan over the previous year; and

9. Provide this information annually in electronic format or, if necessary, in writing every five years at the Agencies' discretion.

K. Initiate and facilitate public involvement and disseminate information through meetings, publications, media events, and other educational actions to foster conservation of Franciscan Manzanita, as appropriate for each Agency.

IV. AGENCY REQUIREMENTS

A. California Department of Transportation ("Caltrans") agrees to:

1. Coordinate, contract for, and fund the relocation of the Mother Plant from its current location to a suitable location selected by the Agencies and to prepare the relocation site, which is to include investigative auguring, utility verification, excavation and transplanting. All of the above is conditioned upon a suitable relocation site being identified no later than December 31, 2009 and that said relocation is feasible no later than January 23rd, 2010.

2. Provide and transport up to three (3) cubic yards of excess soil from the Mother Plant's current location to an alternate site for future use by the Presidio Nursery for the purpose of promoting mycorrhizal fungi associations in rooted cuttings. This is contingent on Trust acceptance of the material with known levels of aerially deposited lead (ADL).

3. Contract for and provide funding not to exceed $7,025.00 for initial genetic or chromosomal testing of the Mother Plant by a qualified expert to be selected at Caltrans' sole discretion.

4. Contract for and fund the input, guidance, and advice of a qualified Manzanita expert on an as-needed basis to support the tending of the Mother Plant for a period not to exceed five (5) years, provided that said expert selection, retention and replacement at any point after hiring rests in the sole discretion of Caltrans.

5. Provide funding not to exceed $5,000.00 to each of 3 botanical gardens (Strybing, UC, and Tilden) to nurture salvaged rooted layers and to monitor and report findings as outlined in the Conservation Plan.

6. Provide funding not to exceed $1,500.00 for the long-term seed storage of 300 seeds collected around the Mother Plant in November 2009 as outlined in the Conservation Plan.

7. Transfer $79,470.00 to the Trust to fund the establishment, nurturing, and monitoring of the Mother Plant in its new location for a period not to exceed ten (10) years following relocation and two (2) years for salvaged rooted layers and cuttings according to the activities outlined in the Conservation Plan. Specific activities funded are outlined in "Nurturing Requirements." This amount satisfies the entire funding contribution by Caltrans for this provision.

8. Transfer $25,605.000 to the Trust to fund the costs of reporting requirements of the initial 10 year period as outlined in the

Conservation Plan. Specific activities funded are outlined in the "Reporting Requirements." This amount satisfies the entire funding contribution by Caltrans for this provision.

9. In the event the Mother Plant dies prior to year ten (10) following relocation, any remaining funds from items IV.A. 7 and 8 above shall be used by the Presidio Trust for management of the Mother Plant's offspring or other activities related to the recovery of Franciscan Manzanita as set forth in the Conservation Plan.

B. The Presidio Trust agrees to:

1. Accept funds transferred from Caltrans and cause the work outlined in Nurturing Requirements and Reporting Requirements to be carried out. Use Trust agreements with NPS and GGNPC to transfer funds to the appropriate entities carrying out the work.

2. Provide a relocation site within the geographic bounds of Area B of the Presidio that is reasonably suitable for the survival of the Mother Plant as determined by the Agencies and experts and to approve the use of the selected site for the transplanting of the Mother Plant and consult with other Agencies as required to obtain requisite approvals.

3. Provide additional locations within the geographic bounds of Area B of the Presidio that are reasonably suitable for outplantings of the Mother Plant's offspring and to obtain all necessary approvals to use the selected sites for such outplantings.

4. Subject to concurrence by the Agencies, provide cuttings and/or seed to at least one (1) botanical garden that has experience in growing and managing species of manzanita for outplanting to a native plant display area.

5. Cooperatively support efforts and activities by the Agencies, their employees, contractors and agents to conduct post-transplant establishment, care, monitoring, measuring and other on-site activities set forth in the Conservation Plan for the care and preservation of Franciscan Manzanita at the above sites. Such cooperation and support includes allowing necessary access to the sites to the Agencies at no-cost.

6. Fund from years eleven (11) through fifteen (15) following relocation, measurement of plant size, growth rate (once per year) and percentage of live/dead surface area, estimate status of fruit set, presence of new stem growth and presence of immature

inflorescences three (3) times per year of the Mother Plant at the beginning, middle and end of the annual growth period.

7. Fund for years eleven (11) through fifteen (15) the Annual reports (once per year) for the U.S. Fish and Wildlife Service and California Department of Fish and Game.

8. Assume the lead role in implementing all future activities set forth in the Conservation Plan in Area B except for those listed in section IV.A and IV.C herein.

C. National Park Service agrees to:

1. Provide additional locations within the geographic bounds of the Golden Gate National Recreation Area (GGNRA), to include Area A of the Presidio, that are reasonably suitable for outplantings of the Mother Plant's offspring as determined by the Agencies and experts and to obtain all necessary approvals to use the selected sites for outplanting.

2. Cooperatively support efforts and activities by the Agencies, their employees, contractors and agents to conduct post transplant establishment, care, monitoring, measuring and other on-site activities set forth in the Conservation Plan for the care and preservation of Franciscan Manzanita at the above sites. Such cooperation and support includes allowing necessary access to the sites to the Agencies at no-cost.

3. Assume the lead role in implementing all future activities set forth in the Conservation Plan in Area A of the Presidio, and in the remainder of the GGNRA outside of the Presidio, except for those listed in section IV.A and IV.B herein.

V. INFEASIBLE ELEMENTS OF THE CONSERVATION PLAN OR THREATS TO THE MOTHER PLANT

A. If an element of the Conservation Plan is deemed infeasible, the Agency making such determination shall notify the other Agencies electronically or in writing within thirty (30) calendar days.

B. If a new threat to the Mother Plant and/or offspring is identified, the Agency identifying the threat shall notify the Agencies verbally or electronically within two (2) calendar days of the event so that the threat can be assessed and if necessary, alleviated in the shortest time possible.

C. As soon as practicable after notification of an infeasible element or a new threat, the Agencies shall meet to discuss and implement any actions necessary to address the infeasible elements(s) and to assess and avert any threat(s) to the Mother Plant and/or offspring.

D. The Agencies further agree that they shall support the implementation of necessary actions, described in Section V.C with adequate funding, to the extent each determines is practicable and feasible.

VI. INTERPRETATION

Nothing in this MOA should be interpreted to abrogate, reassign, delegate, or otherwise affect any of the legal responsibilities of the Agencies.

VII. DURATION

The duration of this MOA shall be fifteen (15) years after signatory execution by all the Agencies. Such duration may only be extended by written agreement of all the Agencies.

VIII. TERMINATION

At the conclusion of genetic or chromosomal testing of the Mother Plant, if it cannot be conclusively proven that the Mother Plant is Franciscan Manzanita, then the obligations and terms set forth herein and in the Conservation Plan shall automatically and immediately terminate. Any and all remaining funds appropriated for either the Mother Plant or her offspring will revert back to the original funding Agency. This section shall not be interpreted to affect any other obligations to plant life otherwise protected under federal and state law.

IX. MISCELLANEOUS PROVISIONS

A. The parties do not waive any rights, privileges, immunities, or defenses, except as expressly provided herein.

B. The parties do not intend benefits or obligations dictated by this Agreement to inure to any third party. This Agreement is entered into for the sole use and protection of the parties hereto. No other person or entity shall be a direct or indirect beneficiary of, or shall have any direct or indirect cause of action or claim in connection with this Agreement.

C. Any amendments to this Agreement or any of the incorporated attachments must be in writing and signed by all the parties.

D. Department of Transportation funding obligations are subject to the annual State Budget Act authority, the appropriation of adequate resources by the

Legislature, and the allocation of required funds by the California Transportation Commission.

E. Nothing in this MOA shall be construed as obligating the United States or any of the Agencies to any future payment of money in excess of appropriations authorized by law.

X. EXECUTION

A. This Agreement and any subsequent amendments or modifications made pursuant to Section IX.C may be executed in counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument. Copies or facsimile signatures shall be treated in all respects as having the same effect as an original.

B. The foregoing MOA for Franciscan Manzanita, and incorporated attachments, have been adopted by each of the Agencies as attested by the signatures affixed below, and each signatory warrants and represents that s/he has the requisite authority to enter into and bind his/her respective Agency to the terms herein.

Dated: _____ By: _____
California Department of Transportation

Dated: _____ By: _____
California Department of Fish and Game

Dated: _____ By: _____
National Park Service

Dated: _____ By: _____
The Presidio Trust

Dated: _____ By: _____
U. S. Fish and Wildlife Service

Attachment 'A'

Conservation Plan for *Arctostaphylos franciscana* (the Franciscan Manzanita)

Michael Chassé[1], Betty Young[2], Mark Frey[3], Michael Vasey[4],
Elizabeth Warne[5], V. Thomas Parker[4], David Yam[6]

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TABLE OF CONTENTS

INTRODUCTION

Purpose

In October 2009, the exciting discovery of an individual plant of *Arctostaphylos franciscana* (Franciscan manzanita) was made in the Doyle Drive corridor of the San Francisco Presidio. This discovery was significant because the Franciscan manzanita has been considered extinct in the wild for over sixty years. Although not formally listed under the federal or state Endangered Species Act, it was recognized that this discovery creates the opportunity to bring *Arctostaphylos franciscana* back into the wild as viable, reproducing, and self-sustaining species. This conservation plan has been prepared with the overall goal of creating such self-sufficient, reproducing in-the-wild populations of the Franciscan Manzanita (Mehrhoff pers. comm.). It has three primary objectives; first, to preserve for posterity the individual (mother plant) discovered in October 2009; second, to allow for the establishment of offspring from the mother plant (clones from rooted cuttings and rooted layers, as well as plants raised from seedlings) both in the wild through reintroduction and ecological restoration and through *ex situ* preservation of the mother plant offspring in botanical gardens and special nursery environments so that it can serve as an on-going source of genetic material for this purpose; and third, to propagate other known genotypes of the Franciscan manzanita so that at least three wild, self-sustaining populations of the Franciscan manzanita can be established utilizing this diversity of genotypes to promote the long term viability of this species in the wild. Generally, biodiversity conservation strives to protect rare species *in situ*, that is, in historic wild locations whenever possible. Following this principle, the ideal approach would be to preserve the mother plant in its current location. However, if the current location is deemed infeasible because of undue risks associated with that location, the mother plant will be translocated into an environmentally appropriate location, ideally within a managed natural area on the Presidio.

This plan covers known information about the species, then describes a Short Term Plan of Action, and follows with plans for Mid Term Monitoring and Maintenance and Long Term Restoration and Recovery. It does not discuss who is responsible for what responsibilities at what cost. These important considerations will be covered in an interagency Memorandum of Agreement (MOA) between the Presidio Trust, Caltrans, the National Park Service, California Department of Fish and Game, and U.S. Fish and Wildlife Service, and possibly other relevant parties that is currently being finalized.

Discovery of Franciscan manzanita in the Presidio

Thought to have been extinct in the wild since 1947, a single individual of Franciscan manzanita was found in the Presidio in October, 2009. Local ecologist Dan Gluesenkamp notified Presidio natural resource staff of his observation of a manzanita while driving along Doyle Drive. The plant was growing in an isolated, concrete-bound median strip (a "gore point" surrounded by southbound Highway 1 on one side and a southbound on-ramp on the other) at the Doyle Drive-19th Avenue interchange. It was uncovered due to large shrub and tree removal by CalTrans in preparation for renovation of the existing Doyle Drive corridor. The location is a disturbed soil fragment underlain with serpentinite, which appears to have been cut during original Doyle Drive construction or Hwy 1 construction. Botanists from the Presidio Trust and National Park Service inspected the plant immediately. Michael Chassé of the National Park Service (NPS) tentatively keyed the individual to *Arctostaphylos franciscana*. This tentative identification was

verified with 95% confidence by Mike Vasey and Tom Parker of San Francisco State University, authorities on the genus *Arctostaphylos*, based on the available morphological characters (see Appendix 2). However, additional studies (including chromosome count, molecular analysis, and herbarium research) are needed to make a final determination as to its identity.

Despite thorough botanical inventories (Howell *et al*. 1958; Vasey 1996; VPOD 2009), the Franciscan manzanita had never been previously observed in the Presidio. The Raven's manzanita, when rediscovered by Peter Raven in 1951, was first identified as *A. franciscana* (Howell *et al*. 1958) but later modified to *Arctostaphylos hookeri* subsp. *ravenii* Wells (1968) when it was discovered to be tetraploid (n = 26). Cultivars of *A. franciscana* are known to be diploid (n = 13). Other subtle morphological characters (such as fruit diameter) were discovered to distinguish the two taxa. See "Description and Taxonomy" (below) for more details.

It is likely that patches of maritime chaparral containing manzanitas and other shrubs may have been more widespread on the Presidio within a matrix of coastal prairie and coastal scrub prior to Spanish colonization, and these were probably similar to habitats that still exist today at Arroyo de la Cruz along the San Luis Obispo coast near San Simeon Ranch. However, after the Spanish and Mexican periods, these prairie-chaparral mosaics were likely impacted by grazing and other disturbances prior to the 20th century. A dormant seed (or seeds) may have been scarified by activities associated with the original construction of Doyle Drive in the 1930's resulting in the establishment of the current survivor on the serpentine outcrop isolated by the 19th Avenue-Doyle Drive interchange. Other rare species, such as San Francisco owl's clover (*Triphysaria floribunda*) and San Francisco gumplant (*Grindelia hirsutula* var. *maritima*) have been previously found on serpentine soils in close proximity to Doyle Drive (Presidio Vascular Plant Occurrence Database 2009) in more accessible locations.

The mother plant is at imminent risk due to the planned reconstruction of Doyle Drive scheduled to begin in January 2010, and potentially also at risk due to the removal of its vegetative buffer and direct exposure to new environmental conditions and motor vehicle-related pollution. All concerned agencies were contacted and met on November 2, 2009 to share information and formulate a plan for its conservation.

Historic and current occurrences

The Franciscan manzanita presumably occurred sympatrically with the Raven's manzanita in at least three historic locations, all within the City and County of San Francisco (Roof 1976). The type locality is the former Laurel Hill Cemetery (Eastwood 1905; CCH 2009), an area currently bounded by California St., Presidio Ave., Geary Blvd., and Parker Ave. Voucher specimens for *Arctostaphylos franciscana* also exist from exposed slopes of Mount Davidson (Roof 1976; CCH 2009), and reliable observations are recorded from the former Masonic Cemetery, bounded by Turk St., Masonic Ave., Park Ave., and Fulton St., near Lone Mountain (Roof 1976). A possible fourth historic occurrence was observed by Behr (1892) near the former Protestant Orphan Asylum near Laguna and Haight Streets. These plants were described as similar in appearance to the manzanitas found on Mount Tamalpais, and may have been either Franciscan or Raven's manzanita (USFWS 2003). It is unknown how many other populations of Franciscan and/or Raven's manzanitas may have occurred in and around San Francisco, as most specimens were

collected after significant urbanization (USFWS 2003). See Table of Consortium of California Herbaria records – Appendix 1

Systematic and Ecological Context

The genus *Arctostaphylos* (commonly known as manzanita) consists of 66 recognized species and over 35 subspecific taxa (Wells 2000, Parker *et al*. 2009, Parker *et al*. in press). All of these species occur in California and northern Baja California, broadly recognized as the California Floristic Province. These are all perennial woody, evergreen shrubs to small trees. Approximately half of the taxa in *Arctostaphylos* are local endemics, occupying distributions less than 1000 km^2 in area. Of these, about 77% occur along the coast of California and northern Baja California (Vasey and Parker unpublished data) and most of these are found in maritime chaparral (i.e., chaparral within and adjacent to the summer marine fog zone). The Franciscan manzanita is one of these maritime chaparral endemics and, up until this discovery, was the only species of manzanita considered extinct in the wild. All manzanitas either resprout from dormant buds (mostly located in basal burls) after fire or are killed by fire and recruit by dormant seed located in seed banks that build up over time between stand replacing fires (so-called obligate seeders). The Franciscan Manzanita is an obligate seeder. It is also diploid, the chromosomal condition for most manzanitas, whereas about a third of the taxa are tetraploid (such as the Raven manzanita). Many manzanitas are able to successfully layer; i.e. spread by rooting along surface stems that root at their leaf nodes.

The phenology of *Arctostaphylos* is unusual. It is often one of the earliest species to bloom, flowers are typically loaded with sweet nectar, and it is pollinated by a heterogeneous group of bees, butterflies, and even humming birds. Later in the spring, flowers drop and fruit begin to ripen into "little apples". At this time, new growth is added and immature inflorescences are formed which then go dormant over the dry season. Fruits mature and drop spontaneously from the plant into the canopy below. Fruits are eaten and stored by small mammals while larger mammals, such as bears and coyotes, apparently are the more long distance dispersal agents. Seeds are encased in up to 10 hard, bone-like seed coats. Presumably, these hard seed coats help the seed to remain dormant for long periods of time, resist herbivory by some animals, and are key to the dormancy mechanisms which must be broken to stimulate germination. Mostly, dormancy is broken by fires but several species have been found to germinate upon scarification. Effective, dependable germination of manzanita seeds is still a work in progress. Hybridization between diploid species of manzanitas is well recognized and is very likely an important factor in their evolutionary diversification.

Description and Taxonomy

The Franciscan manzanita is an evergreen shrub that may reach two or three feet in height when mature. The Presidio shrub is layering (rooting at the leaf nodes of stems contacting the ground) and historic photographs show plants that appear to be layering, however, genotypes (genets) from other individuals in botanical gardens are apparently not known to layer (P. Baye, pers. comm.). As mentioned above, however, layering is common within *Arctostaphylos*. The Franciscan manzanita was first described as a unique species by Alice Eastwood (1905), who named it *Arctostaphylos franciscana*, having previously been confounded with other manzanita species such as *A. pumila* (Eastwood 1905; Roof 1976) or *A. pungens* (Behr 1888; Brandegee 1892). Taxonomic confusion has surrounded many taxa of *Arctostaphylos* and the genus has

undergone several different treatments (Wells 1968; Roof 1976; Wells 1993, Parker *et al*. In press, Parker *et al*. In Prep). The Franciscan and Raven's manzanitas, both endemic to San Francisco, were long considered to be variations of the same species (Roof 1976; USFWS 2003). Later treatments placed each taxon as a subspecies within the *A. hookeri* complex (Wells 1968; 1993). Results from recent studies (Markos *et al*. 1999; Boykin *et al.* 2005; Parker *et al*. 2007) have returned the Franciscan manzanita to species status (*A. franciscana* Eastw.) while placing the Raven's manzanita under *A. montana* subsp. *ravenii*. This will be the taxonomy used throughout the report unless noted otherwise.

A summary of morphological characters for *A. franciscana* is included in Appendix 2.

Current status

Prior to discovery in October 2009, *Arctostaphylos franciscana* was listed in the California Native Plant Society's Inventory of Rare and Endangered Plants of California at the 1A level, meaning presumed extinct in the wild (CNPS 2009). As the species was presumed extinct, it has no current federal protection under the Endangered Species Act. If successfully preserved in the wild, *A. franciscana* will undoubtedly be reclassified by CNPS at level 1B, denoting its status as rare or endangered in California and elsewhere.

Ecology

Scant ecological information exists on the Franciscan manzanita, and this is limited to voucher specimens, botanical literature, and historic photographs. Some knowledge of habitat requirements can be inferred from historic locations, which are mostly underlain by serpentine substrates (Roof 1976; Roof 1980; CCH 2009). Serpentine rocks are distinct intrusions into the typical Franciscan Formation bedrock and are exposed in a thrust-fault shear zone that runs across San Francisco, from Potrero Hill in the southeast to the Presidio in the northwest (Schlocker 1974). Serpentine soils have a strong effect on vegetation, and many plants have evolved as narrow serpentine endemic species (Kruckeberg 1984). Although the Franciscan manzanita is considered to be endemic to serpentine soils (Kruckeberg 1984; Safford 2005), its occurrence at Mount Davidson on greenstone and mixed Franciscan rocks calls into question such strict edaphic affinity. Additionally, the original Laurel Hill plants obtained by the Regional Parks Botanical Garden have been remarkably stable on non-serpentine soils for over 60 years with weeding and occasional summer irrigation (Steve Edwards, pers. comm.).

Information on the vegetative community is largely missing from the literature on the Franciscan manzanita. Although two early voucher labels describe the species growing "on rocky ground" (Eastwood 1905) or "bare, stony bluff" (Brandegee 1908, as cited in CCH 2008), an interesting voucher from Wieslander (1938, cited in USFWS 2003) associates the Franciscan manzanita with coast live oak (*Quercus agrifolia*), coast blue blossom (*Ceanothus thyrsiflorus*) and coyote brush (*Baccharis pilularis*). Rowntree (1939) observed Franciscan (and likely Raven's) manzanita "forming flat masses over serpentine outcroppings and humus-filled gravel and flopping down over the sides of gray and chrome rocks. *Ericameria*, *Baccharis*, Ferns, Buckwheats, and Golden Yarrow grow among it; and over it stand Toyons and Live Oaks – rather untidy ones, which seem to have withstood the encroachments of civilization less well than has the Manzanitas." As mentioned previously, the Raven's Manzanita was also presumably present at all Franciscan Manzanita sites. These observations, along with the geology and climate

of historic sites, allow us to infer a suitable vegetative structure as being a mosaic of coastal scrub, barren serpentine maritime chaparral, perennial grassland, with occasional woodland consisting of coast live oak and toyon shrubs and small trees.

A more thorough overview of the ecology of both the Franciscan and Raven's manzanitas can be found in the Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula (USFWS 2003).

Current *ex situ* collections

From the late 1930's through 1946, prior to the conversion of Laurel Hill Cemetery by residential and commercial development, several horticulturalists collected plant material from the Franciscan manzanita to be preserved in cultivation. The last known botanical specimen collected from the type locality was by L.S. Rose (UC 750650) on March 8, 1946. The San Francisco cemetery removal ordinance was passed in 1937 (http://www.trinalopez.com/finalrest/history.html). Odd Fellows and Masonic cemeteries were removed first, Laurel Hill and Calvary last. Remains were moved from Laurel Hill to Cypress Lawn by 1941. When the war broke out, development of the cemeteries apparently ceased. In 1946, the remains of various mausoleums were torn down and removed. Mike Vasey saw photos from this time frame of these structures at the Bancroft Library but the photos did not contain manzanitas. The grounds were then destroyed in 1947 to prepare for development. This is probably when the last of the manzanitas were uprooted. According to accession records, Roof planted the first plants at the Regional Parks Botanic Garden at Regional Parks Botanic Garden at Tilden Regional Park Regional Park (RPBG) in 1947, and writes "these plants are 'originals' from Laurel Hill, uprooted by bulldozers on the day of destruction" (Roof 1959). It is possible that the main source collection actually was planted in 1947. However, in another source Roof claims to have moved plants from the original Laurel Hill stock to the Regional Parks Botanic Garden between 1938 and 1940 (Roof 1980).

Additionally, there is another individual *A. franciscana* that came from a Lester Rowntree collection (see below). It is certainly different by history and subtly different in characters as well. Another separate genotype was apparently collected by L. Edmunds (who deposited herbarium specimens in 1938) and it is currently being propagated at the UC Botanical Garden (H. Forbes, pers. comm.) Carl B. Wolfe, of the Rancho Santa Ana Botanic Garden, collected "cuttings and rooted plants" from Laurel Hill Cemetery in November 1940, acknowledging that "soon this species will become extinct" (California Academy of Sciences Herbarium, voucher 380619). The status of this original material has not been confirmed. Laurel Hill material was also provided by the Regional Parks Botanic Garden to the Strybing Arboretum in San Francisco. So, at least three genotypes other than the Presidio plant appear to exist at botanical gardens, and possibly there are others at the Rancho Santa Ana Botanical Garden (verification in progress). No living specimens were collected from other historic locations than Laurel Hill (Roof 1980).

Original Laurel Hill plants of Franciscan manzanita were also known to have been brought into private gardens. Lester Rowntree obtained a single plant from the abandoned Laurel Hill Cemetery on a dark night in the late 1930's and brought it to her home garden in the Carmel Highlands (Roof 1976). Roof (1980) asserts that this plant was never reproduced or cultivated,

and was lost from Rowntree's garden, but both the Regional Parks Botanic Garden and the UC Botanical Garden have living specimens labeled *A. franciscana* 'Lester Rowntree'. These are variously claimed to be grown from seed collected from the original plant collected by Rowntree (Roof 1959) or obtained from rooted layers (Knight 1983). Additionally, nurseryman Louis Edmunds "dug up and grew" *A. franciscana* at his home in Danville (Roof 1976, 1980), and was apparently used in creating cultivars. While this material may persist in commercial trade, it also is more than likely the source of the *A. franciscana* now at UC Botanical Garden.

Plantings of Franciscan manzanitas exist in several California nursery gardens, including Yerba Buena Nursery in Woodside and Las Pilitas Nursery in Santa Margarita (Kathy Crane, personal communication; Bert Wilson, personal communication). The material at Yerba Buena was obtained from the collections at the Regional Parks Botanic Garden at Tilden Regional Park (Reiss 1991), but this material was not tracked through propagation records (Kathy Crane, personal communication). The Las Pilitas Nursery material was obtained from Yerba Buena or possibly another commercial nursery (Bert Wilson, personal communication). Plants propagated from these materials are popular with home gardeners, especially in San Francisco (Kathy Crane, personal communication). Thus, it is possible that original source material from original Laurel Hill collections has persisted through clonal propagation and may currently exist in both botanical and private gardens within San Francisco.

IMMEDIATE TERM PLAN OF ACTION

Outline

This Short Term Plan of Action details the strategy to save the mother plant and propagate its offspring between November 1st 2009 and approximately January 23rd 2010. It covers 1) Consideration of options, 2) Selection of option that optimizes outcome, 3) Genetics analysis – both chromosomal and molecular, 4) Seed bank and fruit salvage, 5) Mycorrhizae salvage, 6) Propagation details for seeds, layering, and cuttings, and 7) Translocation of the mother plant, if necessary. The Monitoring and Management of the plant is covered in the Mid Term Plan.

1. Consideration of options

There are three main options for conserving the mother plant:

Option 1: Preserve in situ

Advantages: Preserves the only remaining natural occurrence of a species previously thought to be extinct in the wild.

Disadvantages: Will likely be destroyed during Doyle Drive renovations and may not survive due to changed deteriorating conditions. On-site management will be extremely difficult due to inaccessible conditions.

Option 2: Translocation to a managed natural area in the Presidio

a. Translocate to existing Raven's manzanita habitat

Advantages: Franciscan and Raven's manzanitas shared historic habitat, and the World War II area contains the last remaining natural manzanita habitat in San Francisco.

Disadvantages: There are concerns regarding genetic contamination between

the Raven's manzanita and Franciscan manzanita despite their presumed co-occurrence in the past.

b. Translocate to a protected site on appropriate soils away from the Raven's Manzanita

Advantages: Preserves the species in the wild and minimizes the chance of genetic contamination between Raven's manzanita and Franciscan manzanita. Maximizes and expedites chance that mother plant will contribute viable, uncontaminated seed to future wild populations.

Disadvantages: Natural resource staff will need to be trained to carefully observe and maintain mother plant. Appropriate infrastructure will need to be created for maintenance.

Option 3: Translocation to a Botanical Garden

Advantages: Professional garden staff are trained to provide close observation and maintenance of mother plant.

Disadvantages: Such translocation would essentially render the plant extinct in the wild (once again); it would be unlikely that the plant could be moved a second time once reintroduced populations are established; the seed from the mother plant would not be usable due to likely genetic contamination from other garden species of manzanitas.

2. Selection of option that optimizes outcome

A. Consideration of Option 1: Preserve *in situ*. CalTrans Engineer's analysis of *in-sit*u option

Refer to Engineer's drawings and analysis in Appendix 4.

The existing location of the plant will be affected by several proposed roadway improvements. Re-design of proposed improvements to maintain the plant at its present location is not feasible. This is due to the significant change in re-alignment of various proposed improvements including, but not limited to, the Hook ramp structures (Contract 3 and 7), the High Viaduct (Contract 3) and the Battery Tunnels (Contract 4). The proposed Battery Tunnels is already in a very constrained alignment. In addition, there would be additional Right of Way that would be required associated with each of the structures noted that would have impacts to the National Cemetery and historical Batteries. Any Realignment from current location will have major impacts to one or both cultural resources mentioned.

Any major undertaking of realignment to the proposed facility could result in the cancellation of Contract 3 which has been awarded already and postponement of Contract 4. This will result in major escalation of both support and construction costs. Re-design will also postpone target dates to achieve Seismic Safety by late opening of the planned temporary detour.

Please refer to the Appendix 4 depicting the location of the plant in relation to various structures in Contract 3.

1. The location of the existing plant is directly in the footprint of the proposed N101/S1 Connector Separation-Left Bridge and abutment wall, approach slab and Retaining Wall 2C.
2. The replacement of Retaining Wall 2C and the new bridge abutment Wall requires temporary shoring/sloping to be placed behind the existing wall to enable the Contractor to demo this wall, which is where the plant is located. Also, the construction wall 2C and abutment will require that the plant be removed in order to form and pour these walls. The new Retaining Wall 2C and abutment is required for the new roadway profile as it is approx. 2-3' higher than existing and the new ramp is approximately 4' wider. (Please see attached "Retaining Wall "RW2" Details" for x-section.)
3. The new approach slab for the new Left Bridge is located in the same footprint of the plant and backfill/grade will need to be raised for this slab. Excavating and placing structural backfill will be needed in this location for the approach slab.
4. If the plant is not moved, it essentially shuts down Contract 3 and 4.
5. As the new SB detour/approach cannot be built and placed in service as currently designed the SB detour/approach serves as the main connector for the new SB High Viaduct.

This outline of conflicts clearly shows that the plant cannot be left and protected at its present location. The conflicts are numerous and have far ranging impacts to public safety (schedule delays), increased impacts to cultural resources and increased support and construction costs.

B. Chosen option

All options have been carefully considered for their respective advantages and disadvantages. Given the constraints demonstrated by CalTrans, Option 1 is not likely to be feasible, either for delays or in the long term. Option 3 would mean returning the plant to an “extinct in the wild” status, at least until reintroduced populations have been established. Therefore, we prefer Option 2. Option 2a is not currently desirable because of the minimal risk of interbreeding with the Raven’s Manzanita. Therefore, Option 2b is selected (*Translocate to a protected site on appropriate soils away from the Raven’s Manzanita)*. Under Option 2b, we will maximize the chance that the mother plant genotype will survive in garden settings through plantings of its offspring (so that these will serve as source material for future wild populations) while gaining the advantage of keeping the mother plant in a wild setting near its current natural site, providing it with appropriate soil and climate conditions, and allowing it to become a future donor to the population seed bank that is established in its vicinity by reintroducing other outplanted cuttings from different Franciscan manzanita genotypes currently restricted to cultivated environments.

Candidate sites in the Presidio were chosen based on preliminary GIS analysis (Chassé,

unpublished data) and local expertise. See Section 7A below for details.

In implementing Option 2b, prior to excavation, rooted layers that would be difficult to move during translocation will be separated from the mother plant so that these can be directly outplanted into botanical gardens and specialized nurseries. The goal with these rooted layers will be to quickly establish viable clones of the mother plant in carefully controlled environments so that the risks of translocating the mother plant into its managed natural habitat will be minimized if the translocation is ultimately not successful. Distribution of these rooted layers will depend on the number available. If enough are available to plant out into managed natural habitats, for example near the location of the mother plant, this will be done but priority will be given to establishing these rooted layers in carefully controlled environments to buffer the risk of translocating the mother plant into a managed wild habitat. We will also reserve a set of rooted cuttings to be planted in botanical gardens in the long term for additional insurance. See propagation section below.

3. Obtaining genetic analyses

A. Count of chromosomes (determining whether plant is diploid (like *A. franciscana*) or tetraploid (like the Presidio manzanita) will help in confirming its identity.

Supplies required: small vials with alcohol-based preservative, stains, and microscope. Timeline: depends on swelling of buds. Under normal rainfall and temperature, there should be appropriate buds by 15-20 December. Chromosome count would be finished normally within a week to 10 days. *(Caltrans), TParker/SFSU*

B. Sequencing of 3 nuclear genes to confirm that they align with *A. franciscana* plants in Botanical Gardens. Sequences already exist for 3 nuclear genes (RPB2, *Waxy*, *Leafy*) for *A. franciscana* from Botanical Gardens, for the Presidio Manzanita, and a number of regionally similar species. This project would sequence the plant from Doyle Drive/Park Presidio for the 3 genes, which, in combination, will determine whether this plant is *A. franciscana*. At this stage the scope of work would only examine the single Doyle Drive individual to compare with existing sequences. Future work will look at all known or suspected specimens of *A. franciscana*.

Supplies required: approximately $600 worth of solutions, DNA primers, materials for extraction, amplification, cloning and sequencing. Labor ($2000-flat fee from lab) would include all the steps described, plus hand alignment of sequences with existing sequences, and analyses using computer programs to confirm that the plant clusters with known *A. franciscana* individuals. *(Caltrans), TParker/SFSU*

4. Seed bank and fruit salvage

During observations of the *in situ* plant, seeds were observed both on the plant, presumably produced by the plant in early 2009, and on the ground under and around the plant. Seed is also likely buried in the soil, as evidenced by the fact that branches of the plant have been buried sufficiently to root by natural layering. In order to conserve all possible seed from the

site, it is recommended that the following steps be taken.

A. In November 2009, all fruits on the plant were removed, accessioned (GGNPC Nursery Accession # 2009-403P) and stored temporarily at the Presidio Nursery.

B. Under the direction of at least one of the authors of this plan, surface soil will be excavated in a ring around the plant starting from 8" outside of the leaf canopy out to a distance of 3 feet from the edge of the leaf canopy. Excavation will be 4 inches deep, unless a root is encountered. In that case that root zone will be avoided. Soil on the down slope side next to the retaining wall will be excavated more deeply, as most seed was observed in that area and would have been buried more deeply by soil from higher on the hill. *(Caltrans)*

C. Soil containing seed will be stored at the Presidio Nursery. Due to the presence of Aerially Deposited Lead (ADL) at levels higher than 400PPM in the soil co-mingled with the seed.

D. Tom Parker, in collaboration with the Presidio Nursery, will germinate the seed in the soil. Sprouts will be collected by the Presidio Nursery and the remaining soil returned to Caltrans for disposal.*(Caltrans) TParker*

E. All parties that participate in experimental trials will report findings to GGNPC Nurseries. They will distribute to all interested parties and post on their website for reference by propagators and restorationists. (for further information See Propagation Section) *(Caltrans) BYoung, MVasey*

5. Arbutoid Mycorrhizae salvage

Plants in the *Arctostaphylos* genus form strong symbiotic relationships with unique fungal mycorrhizae. These fungi form an external 20-80 micron thick sheath surrounding the plant's own roots, engendering a strong dependency by the plant on their fungal associates, since all water and nutrients pass through this sheath rather than imbibition directly through the plant's own roots (Smith and Read 1997). Therefore, it is critical to provide these fungi when outplanting if new sites are without nearby related plants. Those associations or dormant spores can be provided in the container media or added to the planting hole when outplanting. *Arctostaphylos* species are known to form associations with many different fungi. A single plant may be associated with over 100 different species.

To provide the maximum diversity of symbionts, soil from trenches dug to excavate the plant will be stored and added to potting media when rooted cuttings are transplanted at Presidio Nursery. Botanical gardens will follow their successful protocols. (See Propagation section) The soil stored will be stored at a site on the Presidio. This soil will also introduce some serpentinite conditions into the container media, helping the plants to become adapted to the unique chemistry of serpentine sites.

Before removal, soil will be sampled for lead. If lead is found to exceed 400 ppm, worker

precautions will be needed to work with the material. Samples for lead should be taken throughout the soil column to be excavated. Lead contaminated soil should still be used to inoculate soil in pots. *(Caltrans)*

In addition, if possible, fruiting bodies of fungal associates of *A. montana* or other appropriate *Arctostaphylos* taxa will be collected in the late winter to supplement spore inoculation of any propagated plants. Spores can simply be added to irrigation water and hand watered into containers or around plants in the ground. However, this method will not provide the complete and complex suite of fungi that are used by the plant throughout its life. A greater chance of providing mycorrhizal diversity will be had through the use of both methods of acquisition of fungi. *(Caltrans) BYoung*

6. Propagation

The *in situ* plant has multiple stems emerging from the ground. The plant was visited on November 9, 2009, by Holly Forbes from UC Berkeley Botanical Garden, Phil Van Soelen from California Flora Nursery and longtime Manzanita expert, Peter Ehrlich, Presidio Trust Forester and Manzanita connoisseur, Brianna Schaefer, Presidio Nursery Manager and Betty Young, director of Golden Gate National Parks Conservancy nurseries *(Park Conservancy)*. At least 8 individually rooted sections of the plant were observed, raising the possibility that there are either several genetically unique individuals produced from seed, or one individual whose stems have been buried over the years, and have naturally layered. It was the consensus among the group that layering of a single plant is the most likely reason for the multiple rooted sections of the plant. Layering is the process whereby the plant forms roots at the point a node touches the ground. These rooted sections of the plant can be detached from the main plant, but are genetic clones. Observations of the plant on November 9, 2009, showed many long branches snaking along the ground, sometimes 2 or 3 levels of branches one on top the others.

Propagation of this *Arctostaphylos franciscana* therefore, may be possible with 3 different methods. Two of these methods would provide clones of the current plant and one, if successful, would result in sexually reproduced seedlings, providing some genetic variation from the plant found on the Presidio. These possible methods are 1) propagate seedlings for later outplanting, 2) outplant rooted layers directly and 3) propagate cuttings or tissue culture- aka: micropropagation or meristematic propagation for later outplanting. Methods for the GGNRA Nurseries are detailed in Appendix 3. Following is a record of the immediate actions taken to preserve the plant, and information gathered from experts in manzanita propagation and care. It is presented as background for later consideration of next propagation steps for research into further propagation of the species.

A. <u>Propagation of seed.</u>

Seed found on the *in situ* plant (aka: Mother Plant) and from the seed bank in the soil may be of two types, self-fertile or cross pollinated by another *A. franciscana* or a closely related manzanita. If self-fertile, there would be no additional genetic material in the seedling. However, due to reduction and recombination of chromosomes during meiosis,

different genes are paired producing a genotypically unique individual. If cross-pollinated by pollen from another individual *A. franciscana* or closely related species, new genetic material would have been introduced and would produce a genetically unique individual. Since there are presently no other *A. franciscana* nearby (within pollinator travel distance-usually bees) (unless the *in situ* plant is actually different individuals) it is most likely, that the seeds collected are self-fertilized.

Any seedlings germinating from seeds from the mother plant or seed bank should undergo DNA sequencing to determine degree of heterozygosity, whether they are recombined offspring of the one plant or have unique genetic characters from another plant. This would be done 1-5 years after germination, when the seedling plants have reached sufficient size. *(Presidio Trust)*

Seed from the summer seed set on the mother plant in 2009 were collected from the plant. Approximately 300 seeds were collected. Taking the most conservative approach, the assumption must be made that the *in situ* plant does not survive translocation, and therefore the seeds that are collected from the plant and seed bank are the only non-clonal propagules that would remain from this plant. Seed collected should be divided in half. One half of the seed should be sent to long-term seed conservation storage facility at Rancho Santa Ana Botanic Gardens and the other half to UC Berkeley Botanical Garden or to another facility as deemed appropriate by the agencies. See Long Term portion of the plan for further information. *(Caltrans)*

There is no definitive method for successful germination of this species. Success rates in botanical gardens have been 1-2%. Experiments should be carried out on closely related species such as *A. hookeri* and *A. montana* until a definitive propagation protocol is perfected. Only then should an attempt be made to germinate either the seed collected from the plant itself or seed in the soil seed bank. The following may inform germination trials on closely related species before germination of seed in the seed bank soil is attempted. Once germination success is met with seed from the soil seed bank, then seed from long-term storage can be germinated. There are many methods used as pre-germination treatments to induce germination.

It has been shown that manzanita seed should have a minimum of 9 month after-ripening before any treatment is given (Meyer 2008; Forbes 2008, personal communication) Germination of seed, from plants at Regional Parks Botanic Garden (RPBG) at Tilden Regional Park and at University of California Botanical Garden at Berkeley (UCBBG), was undertaken at each garden, Steve Edwards, at RPBG (personal communication, Steve Edwards) notes that in fire adapted species such as manzanitas, fire successfully scarifies the hard seedcoat, or removes the hypocotyl plug. (Edwards, personal communication with Michael Chassé) Seed can be mixed with sand and covered with sand in a fire proof pan. The standard method is to cover with pine needles or straw 4”-6” deep and ignite. However, length of time to burn is unknown for this species. It is quite easy to kill the seed if the fire is too hot or for too long a period. If it is too short, or seed buried too deeply, exposure time may be insufficient to scarify the seedcoat adequately for water imbibition and radicle emergence.

There is also research showing that the high temperature of fire does not induce germination in *Arctostaphylos* spp. (Kauffman and Martin 1991) but rather, that the chemical compounds in smoke or charate from fire may be responsible for seed scarification in fire-adapted species (Keeley and Fotheringham 1998; Tieu, *et al*., 2001; Shebitz,*et al*., 2009) Holly Forbes and John Domwalski, at UC Berkeley Botanical Garden, note that full strength liquid smoke in 250 ml of water for 4 hr, followed by 30 day cold stratification lead to germination. Presidio Nursery found that smoke treatment rather than fire induced germination in Ravens manzanita (*Arctostaphylos montana* ssp. *ravenii*). Smoke + heat did not induce germination. This species is one of *A. franciscana's* closest relatives. Tom Parker at San Francisco State University notes that his experiments have given a small percentage of germination with hickory liquid smoke at 1:1000 dilution. (personal communication) All trials and standard pre-germination treatments for *Arctostaphylos* spp. do require cold stratification after scarification. One seed germinated after smoke treatment and 30 days cold stratification, in germination Trials for *Arctostaphylos montana* subsp *ravenii* at Presidio Nursery, (Laskowski/Swenerton 2009, internal document)

Extensive propagation records from Rancho Santa Ana Botanical Garden show numerous methods tried without definitive success. (B. O'Brien pers. comm.)

This information should inform germination trials on closely related species.

Suggested approaches for trials:

1. Seed should be treated with smoke infused water (Shebitz 2009) or cool dry smoke. This manzanita also requires a cold moist stratification. It is recommended that checking for germination begin no later than 30 days, allowing the hormones, such as gibberillin, which will initiate cell division in the embryo and radicle to metabolize.

2. Smoke and controlled heat at a non lethal level <90^{o}C (194^{o}F) (Kauffman 1991). Heat at 200^{o}F induced no germination in the Ames-Rancho Santa Ana trials. By providing heat and smoke, both in controlled conditions, we are assured that the seed receive whatever natural process induce germination in the wild. Follow with cold stratification, as above.

3. Actual burning. Seed can easily be damaged during burning. If this is tried, pine needles, trimmed non-Franciscan manzanita branch pieces and *Adenostoma* trimmings would be piled 6" high over the heat proof pan filled with sand and seed. Seed would be covered with sand to a depth of 1cm.

B. Layering of the mother plant.

The mother plant has apparently formed rooted layers of branches which are in contact with the ground. There is a downslope section of the plant which is not possible to move with the main body of the mother plant. This fortunately is the section of the plant which has numerous rooted layers. On December 14, 2009 these downslope sections of the mother plant were carefully hand dug, under the supervision of Mike Vasey, SFSU manzanita expert and

Conservancy Nursery staff. Sections (4 well rooted and from 7-9 somewhat rooted sections to each) were separated and distributed to three botanical gardens (Regional Parks Botanical Garden, University of California Botanical Garden at Berkeley, and San Francisco Botanical Garden at Strybing Arboretum) and to the Presidio Nursery as shown under the Long Term Plan, Section 2: Outplant of clones and/or seedlings from mother plant. *(CalTrans) BYoung*

The successful transplantation of the mature plant from its site is very risky. Cuttings should be done, see below. The possibility of propagation can also be increased by rooting branches that are still attached to the mother plant. Rooting may take place more quickly, as the mother plant will provide water and nutrition to the propagule, unlike detached cuttings. The number that can be done is limited by the number of branches available on the in situ plant that can be pinned to the ground. *(CalTrans) BYoung*

If successful, these rooted distal portions of the plant can be detached from the mother plant and planted out or potted up separately for further development. They will, of course, be exact clones of the main plant. Since layered areas would be detached before moving the plant, layering had to be carried out as quickly as possible. *BYoung*

November 16, 2009, lateral branches of the mother plant were lifted, area under the treated stem was irrigated, epidermis on the bottom side of the branch removed by scraping, and application of rooting hormone (Hormex ™16) was made. The branch was laid back down, covered with soil, and pinned to the ground with landscape fabric pins, to keep it buried. 19 stems of the plant were treated as above on November 16, 2009. *BYoung*

The main goal for outplanting these rooted layers is to provide short-term maintenance of the mother plant genotype while the mother plant is translocated to its managed habitat and rooted cuttings are propagated in the mid term. If additional suitable rooted layers can be directly outplanted, sites will be identified on the Presidio for this planting effort. If sites are not yet determined at the time of removal, they will be potted up and held at the presidio Nursery. Sufficiency will be determined by an on-site professional, such as Betty Young, Director of Nurseries for the GGNRA. If insufficiently rooted, they will be potted up to appropriate size containers, until of sufficient size to out plant. Insufficiently rooted layers will also be distributed to Botanical Gardens for propagation or growing on depending on their availability. as listed in the Long-term Safeguards, Section 2: Outplanting Clones. *(Caltrans), BYoung*

C. Cuttings

Cuttings were taken on November 9 and again just before main plant is lifted, probably in mid-January. Cuttings will also produce identical genetic clones of the original plant. However, since the plant is large, covering an area about 3 x 4m., there are numerous branches from which to take cuttings. Cuttings can be divided between experienced manzanita propagators to increase chances that one or more methods and environments will successfully lead to rooting of many cuttings. November 9 cuttings were divided between the Presidio Native Plant Nursery in the GGNRA, the UC Berkeley Botanical Garden Nursery, Cal Flora Nursery in Fulton, CA., UC Santa Cruz Botanical Garden, and Regional Parks

Botanic Garden at Tilden Regional Park the week of November 9. The January cuttings will first go to SF Botanical Garden at Strybing Arboretum, Rancho Santa Ana Botanical Garden and then to the botanical gardens receiving 11/9/09 cuttings. As of December 18, 2009 at 50 of the cuttings struck at Cal Flora Nursery were rooted and potted up.. *(Caltrans) BYoung*

Ultimate disposition of rooted cuttings may change with further research. A thesis is in process on reintroduction of this species to the wild. That resulting work may change final distribution as outlined in Section 2: Outplanting Clones in the Long-Term Section.

Each of these nurseries has had success rooting this species or other manzanitas. John Domzalski at Berkeley B.G. has previously treated *A. franciscana* tip cuttings with Dip N Grow™ 1:2 parts water; on heated bench under lights, with intermittent mist. Rooting media consisted of perlite: peat, with some red lava rock and charcoal added. First signs of rooting were believed to be in about 2 months, with plants at transplantable size in 5 months. Rooted cuttings were moved to shadehouse, potted up to 3" or 4" pots and returned to shadehouse.

Phil Van Soelen at Cal Flora Nursery have stuck cuttings wounded on the bottom ¼" and treated with Hormex ™ 16 (16,000 ppm IBA) in perlite:vermiculite 2:1, on 21°C (70°F) heated bench and mist on warm –hot days only.

Betty Young and Chelsea Dicksion currently at GGNRA nurseries have rooted other manzanitas using (5000 ppm IBA) on tip cuttings, in perlite, on heated bench-21°C, with minimal mist.

November 9, Brianna Schaefer and Betty Young from GGNRA nurseries, Phil Van Soelen and Holly Forbes from UC Berkeley Botanical Garden took cuttings, divided them up and propagated, as outlined above, at our respective nurseries. Cuttings were given a 2% chlorine bleach 30 second dip and rinsed. The GGNRA-Presidio, UCSC and RPBG cuttings were refrigerated until trimmed.- November 12 at Presidio, and November 13 at UCSC. Each location treated and struck cuttings in the manner they have found most successful. Results will be reported.

Cuttings will again be taken from prunings from the mother plant just before it is moved. Different experiences by these and other propagators, indicate January may be a better time in the phenology of the plant for rooting of cuttings.

Details of all propagation protocols to be followed at the GGNRA Nurseries are in Appendix 3. All other propagators will report to GGNRA, their protocols used. Records of protocols and success rates will be kept and shared with all propagators and be made available on the Golden Gate national Parks Conservancy website, nursery section Information for Nurseries section. http://www.parksconservancy.org/our-work/native-plant-nurseries/information-for-nurseries.html

Once rooted, plants will be successively potted up until grown into 1 gallon cans or sleeves. At the Presidio Nursery, potting media will be supplemented 2-5% with native soil from the original plant. They will then be evenly divided between the Presidio and Botanical Gardens

as noted Long-term Safeguards, Section 2: Outplanting Clones.

Outplanting seed or nursery grown plants should be in serpentine soil for wild locations. Container plants should be planted just above soil line. Crown rot is a common disease of manzanitas. Once outplanted, either seed grown plants, plants from cuttings or layered plants should be provided with aftercare. Non-overhead watering should be provided through the first year every 4-6 weeks. Care should be taken in the summer to only provide a barely moist environment. Manzanitas are susceptible to warm season fungal pathogens which need moist conditions. Manzanitas have not evolved to tolerate moisture in the summer. A rock mulch could be added covering the soil to hold moisture and prevent weeds. *(Presidio Trust)*

The Presidio Nursery and botanical Gardens given cuttings, layered plant pieces or seed bank soil, will experiment with propagation methods as time and funding allows. All results will be reported back to the Presidio Nursery for inclusion in Monitoring Reports. *BYoung*

A suggested timeline for propagation is included in Appendix 5.

7. Translocation *(Caltrans) MVasey, MFrey,MChassé*

Translocation involves four steps; A) Analysis of potential planting sites, B) Preparation of the planting site, X Day/s before translocation, C) Excavation and translocation techniques, and D) Day of translocation actions.

A. Analysis of potential planting sites

A preliminary analysis of potential sites for translocating the remaining wild Presidio individual of *Arctostaphylos franciscana* (mother plant) was conducted by M. Vasey, M. Frey, and M. Chassé on November 16 2009. A number of sites were considered. We visited: 1) the Log Cabin area, 2) the northern coastal bluffs, 3) a meadow along Washington Blvd, 4) Inspiration Point, and, 5) the Presidio golf course serpentine area. Two other candidate locations (West Crissy Bluffs and Yerba Buena Serpentine Prairie) were not visited but were evaluated based on a high level of staff familiarity. See Table 1 for a comparison of all assessed sites.

As we considered each of these candidate locations, we focused upon the goal of a short term successful translocation of the mother plant as our first priority but also considered the long term desire to have the mother plant become part of a population of different genotypes of *A. franciscana* planted in the same general habitat so that a viable stand of different individuals can be created which will promote genetic variability in the seeds generated by this population for future propagation and long term persistence of this species. Further, as part of this long term vision, we kept in mind that introduction of this population of *A. franciscana* on the Presidio creates the opportunity to bring back a vanished plant community in San Francisco, that of maritime chaparral.

The criteria we evaluated included the following:

1. Amount of area available for establishing a future population

2. Distance from the mother plant's current location
3. Distance from *A. montana* subsp. *ravenii*'s current location
4. Location on serpentine or another suitable substrate (*A. franciscana* cultivars are known to grow well in non-serpentine soils)
5. Soil development
6. Adequate drainage (on slopes or well drained soils)
7. slope and aspect
8. Current vegetation
9. Threats of invasive species
10. Other threats
11. Preparation Needed
12. Accessibility to the area for heavy equipment (to excavate the bed for the transplant, to place the transplant after removal, and to potentially scrape soil and clear brush and trees from the area for the future establishment of propagated clones)
13. Potential for management of the population, including prescribed burns
14. Designation within the current Presidio Vegetation Management Plan
15. Maintainability
    a. Accessibility to the area by site stewards who will insure that the mother plant (and future clones) is/are properly attended (e.g., watered and weeded)
    b. Accessibility to the area by the public (whose access will need to be controlled)
    c. Access to an irrigation water source for maintenance
    d. Short and long term protection of the site from future disturbance
16. Desirability of the site for public appreciation of the significance of *A. franciscana* and the future population of clones and other maritime chaparral species that complement this habitat restoration project.

Regarding the proximity to the Raven manzanita, the probability of cross-pollination falls off as the distance increases from one shrub to another; however, a bumble bee (typical pollinator of manzanitas) can fly well over a kilometer while foraging (T. Parker, personal communication). Consequently, the possibility of cross pollination between *A. montana* subsp. *ravenii* and *A. franciscana* is present at all candidate sites that have been presented. The question then becomes 'what if cross-pollination occurs?' Since these two manzanitas are of a different ploidy level (*A. franciscana* has two sets of chromosomes while *A. montana* subsp. *ravenii* has four sets of chromosomes), the chances of hybridization are relatively low and gene flow would almost certainly be in the direction of *A. franciscana* to *A. montana* subsp. *ravenii*. In that event, the worst possible outcome is that some seed that is produced by *A. montana* subsp. *ravenii* would have *A. franciscana* genes (which is likely anyway since *A. franciscana* is probably one of the parents in the original cross that gave rise to *A. montana* subsp. *ravenii*). In short, the actual risks to the genetic integrity of these two taxa being in relatively close proximity are very low to theoretically non-existent.

Many of the sites visited would be suitable for populations of this species. However, two sites were identified that would be most suitable for the mother plant based on a comparison of criteria. The top sites are the Log Cabin area and the Washington Prairie.

On November 30, 2009 we (Vasey, Frey, and Chassé) revisited the top two candidate sites (see below) because of the results of auger holes drilled at these sites to determine subsurface conditions and also to discuss a consultation with geologist Dr. David Mustart from San Francisco State University regarding the Washington Blvd site. We also visited a new candidate site at Inspiration Point because of concerns raised by the borings and geological consultation.

Given these new findings, we will first discuss reasons why we now believe that the two former leading candidates (Log Cabin and Washington Blvd) are less desirable than previously judged. We will then evaluate the new East Grassland Quarry site at Inspiration Point on the basis of the criteria listed below and present reasons why we think it has emerged as the leading candidate.

Log Cabin Area

Although the level terrace considered for planting of the mother plant is adjacent to a serpentine slope, we were concerned about potential drainage issues because of the grassland species at this site and the wet meadow characteristics nearby. We were surprised that the auger bore hole, revealed no serpentine bedrock despite reaching a depth of nearly two meters. Further, there were no rock fragments in the boring. Rather, all of the boring material appears to be a clay-based soil that readily clumps together into clods. These soil characteristics and the lack of serpentine bedrock suggest that this site will be poorly drained and could be problematic for survival of the mother plant.

Washington Blvd.

One of the key questions concerning the Washington Blvd. site concerns its geology. Although originally interpreted as “Franciscan mélange”, there was some concern that this former quarry site is primarily a fill site. Consultation with Dr. Mustart confirmed these fears. His view was that the site has probably been used as a fill site with the main rock component being greenstone brought in from somewhere else. The bore holes tend to confirm this analysis. Soil was rocky for the first half meter and then the soil below is primarily sand (similar to the substrate on Rob Hill).

While this site is likely to have better drainage than the Log Cabin site, the Presidio staff have had mixed success with restoration planting in fill sites. Given the sensitivity of this translocation project, and the need to be sure that we have a suitable site adjacent to the mother plant for establishment of a stand of diverse rooted cuttings, the Washington site no longer appears suitable.

East Grassland Quarry (Inspiration Point)

The East Grassland Quarry site occurs in a southeast direction below the vista area at Inspiration Point. The site is an active native plant management area that is protected from public access by a cable and post fence. The main reason this site was not initially visited is that it is an active management area for another rare and listed species, *Clarkia franciscana*,

and there was concern that it would not be accessible to the heavy equipment needed for translocation of the mother shrub. However, Michael Chassé informally scoped the site after the borings suggested problems with the leading candidate sites. Our visit on November 30 followed up on this informal scoping.

Our follow up inspection reveals what appears to an ideal site for planting the mother plant and one that, although challenging, is likely to be achievable.

Advantages to the East Grassland Quarry site are that it contains habitat that is most similar to what we know about the historic type locality for *A. franciscana* on Laurel Hill. Large open serpentine outcrops are covered in dry coastal prairie with obvious good drainage. Introduced conifer trees at the site have been removed for many years to promote coastal prairie recovery. A relatively shallow slope that would be planted with the *A. franciscana* population (including the mother plant) has a south facing exposure with good access to light. As mentioned, the site is protected from public access (and public view) but is close to the Inspiration Point vista area, one of the most popular places on the Presidio. A serpentine bluff near the vista point could become a future Franciscan Manzanita restoration, as could another serpentine knob on grassland to the west of the vista area. This would eventually allow good public interpretation opportunities without risk to the mother plant. The nearby clusters of Franciscan Manzanita subpopulations would be within pollination distance of the mother plant, thus promoting population diversity of the seed bank. There is no need for preparation of the site. Another advantage is that this site is more than 2000 m from the Raven Manzanita site so issues of gene contamination are less than either of the other preferred candidate site. The site is designated as a Native Plant Management Zone so most habitat manipulations – including burning - would be as possible as anywhere on the Presidio.

Disadvantages to the East Grassland Quarry site are more practical. Access to heavy equipment for the translocation could be challenging. However, there is a narrow access road (the Ecology Trail) leading from Arguello Blvd. (across from) the golf course that leads to the planting site. There would need to be some limbing of overhanging trees and removal and replacement of a section of the post and cable fence (both should be achievable with minimum effort), Water is not immediately available, however, there is a water source for the landscaping up at the vista area and a line can be run to the area with minimal problems.

Although the substrate at the Quarry site appears to be ideal, prudence would suggest that we do at least one auger core at the proposed translocation site to be sure, which we hereby recommend.

In summary, given that the Log Cabin and Washington Blvd sites are now deemed problematic, and given that the East Grassland Quarry site appears to be ideal except for possible logistical challenges of accessing the site, we recommend that the East Grassland Quarry site be chosen as the preferred translocation site. This recommendation is contingent on approval by the engineers who will have to move the plant to this site and one auger bore hole to confirm the subsoil characteristics at the site.

Table 1 Potential translocation sites for *Arctostaphylos franciscana*, Presidio of San Francisco *

Potential translocation sites for *Arctostaphylos francsicana* , Presidio of San Francisco

	Lower Log Cabin Prairie and Slope		Upper Log Cabin Prairie and Slope		Washington Blvd. Prairie		Inspiration Point Overlook		Inspiration Point West Grassland		Inspiration Point East Grassland Quarry Site		Golf Course Serpentine Area		West Crissy Bluffs		Presidio Reservoir		Coastal Bluffs		Yerba Buena Serpentine	
Area (sq. m.)	3,620		1,981		2,122		1,285		1,543		to be determined		13,587		715		400		822		2,126	
Acres	0.90		0.49		0.21		0.32		0.38				3.36		0.18		0.10		0.21		0.53	
Distance from original location (m.)	92	2	249	2	1,045	1	1,643	1	1,521	1	1,703	1	1,516	1	205	2	1,119	1	609	2	954	2
Dist. from *A. montana ravenii* (m.)	833	2	836	2	381	2	1,944	2	1,777	2	1,979	2	1,489	2	1,075	2	1,284	2	677	2	83	0
Geology	Serpentine?	2	Serpentine?	2	Fill	1	Serpentine	3	Serpentine	3	Serpentine	3	Serpentine	3	Serpentine	3	Franciscan?	2	Serpentine	3	Serpentine	3
Soil development	Well developed		Well developed		Poorly developed		Varies		Varies		Varies		Varies		Poorly developed		Varies		Poorly developed		Poorly developed	
Drainage	top: poor, slope: moderate	2	top: poor, slope: good	2	South: good, north: poor	3	Moderate	2	Moderate	2	Good	3	Moderate	2	Moderate	2	Moderate	2	Moderate	2	Moderate	2
slope and aspect	gentle NE	2	gentle NW	2	gentle S	2	moderate	2	moderate	2	moderate	2	gentle to moderate S	2	gentle to steep E	2	gentle NE	2	gentle to steep W	3	gentle to moderate W	2
Current vegetation	disturbed prairie	2	disturbed prairie	2	disturbed prairie	2	scrub	3	grassland	3	grassland	3	disturbed grassland	2	grassland and bluffs	3	disturbed grassland	2	grassland and bluffs	3	grassland	3
Invasives	low	3	low	3	low	3	low	3	moderate	2	low	3	high	1	low	3	high	1	low	3	low	3
Other threats	high visitor use	1	high visitor use	1	social trail	2	social trail	2		3		3		3		3	construction	1	social trails	2		3
Preparation Needed	tree removal, some scraping	2	tree removal, some scraping	2	some scraping	3	scraping, shrub removal	2	scraping, shrub removal	2	Possible translocation of a few Clarkia seedlings	3	tree removal, invasives removal, scraping	1	some scraping	3	tree removal, invasives removal, scraping	3	some scraping	2	none	3
Equipment access	easy to moderate	2	easy to moderate	2	easy to moderate	2	moderate	2	difficult	1	moderate to easy	3	difficult	1	difficult	1	easy to moderate	2	impossible	0	difficult	1
Potential for controlled burning	highly unlikely	1	highly unlikely	1	likely	3	likely	3	likely	3	likely	3	unlikely	2	unlikely	2	unlikely	2	unlikely	2	likely	3
VMP zoning	landscaped	2	landscaped	2	NPCZ	3	NPCZ	3	NPCZ	3	NPCZ	3	landscaped	2	NPCZ	3	landscaped	2	NPCZ	3	NPCZ	3
Jurisdiction	Area B		Area B		Area B		Area B		Area B		Area B		Area B		Area B		Area B		Area A		Area A	
Total with access (for mother plant)		23		23		27		28		27		32		22		29		22		27		28
Total without access (for other)		21		21		25		26		26		29		21		28		20		27		27

B. Preparation of new location *(Caltrans) MVasey, MChasse, MFrey*

1. Mark the planting hole perimeter, access route, stockpile location, and an area to take removed top soil.
2. Salvage any uncommon natives within the area to be excavated.
3. Request excavation clearance for hole, and fence for protection, two weeks before excavation is required.
4. Conduct bird nesting surveys and public outreach in advance.
5. Prepare access route.
   a. trimming trees
   b. identifying any narrow areas
   c. remove fencing
   d. install temporary construction fence
6. Scrape top 6" of soil within the planting area and place in an area with no clarkia adjacent to the planting location.
7. Remove non-native species from within 10 feet at the edge of the hole. Remove any aggressive non-natives within 20 feet of the planting hole.
8. Excavate hole the same depth as the rootball of the original plant on the sides of the hole, but mounded slightly in the middle to prevent subsidence of the rootball. Hole should be 1 foot wider than the rootball on each side. If possible, excavate on a dry day to reduce compaction. The removed material should be set aside in a manner that does not damage surrounding resources.
9. If soil at the bottom of the hole is compacted, or plow pan was created in the excavation of the hole, the bottom of the hole should be scarified to roughen the surface and then raked smooth, allowing for easy migration of roots into the soil underlying the plant.
10. Flag off area of hole until day of translocation and install temporary orange fencing in place of removed post and cable fence.
11. Water the hole at least two days before the plant is to be placed - this will help encourage roots to grow down.
12. Amend the bottom of the hole with slow-release fertilizer- this will help encourage roots to grow down as fertilizer leaches from the bottom of the hole.

C. Before translocation *MVasey, MChasse, MFrey*

1. Establish limits for mother plant removal and portion for hand removal
   a. The removal of the mother plant will be done in 2 phases.
   b. The first phase will consist of the hand removal and salvaging of portions of the plant on the sloped portion of the site. Please refer to Section 6., Propagation B.) 'Layering of the mother plant' and Long Term Section 2: Outplant of Clones. This work will be carried out as soon as lead testing is complete. This will provide the opportunity to establish these rooted layers before the mother plant is lifted.
   c. The Parks Conservancy in collaboration with others will determine the hand removal limits.
   d. The hand removal work will be conducted prior to the removal of the remaining portion of the mother plant.
   e. The seed bank will also be removed.
   f. At the inspiration point receiving site, begin site preparation January 6, 2010.

g. Lay down protective cover for access to the transplant site and areas for stockpiling of excavated material
h. Excavate hole by a combination of auguring and excavation via light backhoe.
i. The receiving hole size will be slightly larger to comfortably seat the mother plant.
j. Install protective high visibility fencing around work areas.
k. Cover excavated material

2. Prepare plant *BYoung and staff*
   a. Under direction of Betty Young, prune plant to reduce transpiration loss and water stress.
   b. Use branch tips for additional cuttings; a portion of these will go to Strybing Arboretum, in addition to those gardens who previously received cuttings.
3. Remove any sections of plant lying outside the excavation perimeter; this should be conducted carefully using hand tools and under the strict guidance of Presidio staff.
4. Excavation requirements for seed bank recovery, refer to Section 4, Seed bank and fruit salvage, B.) & C.)
5. Prepare site
6. Lead testing at the mother plant site is scheduled for Monday, November 30, 2009.
7. Determine root ball depth
   a. Root ball depth and the limit of removal of the mother plant with roots intact will be determined by preliminary augering adjacent to the mother plant. The auger holes will be dug mid December.
8. Excavation of removal trenches on each side of mother plant
   a. timing of excavation pits in advance of January 23rd.
   b. machinery and materials required, size of removal pits
   c. The removal trenches on each side of the mother plant will be performed in early December. A small backhoe will be used for the excavation. The trench alignments will be marked in the field and approved by Mike Vasey prior to the work. Hanford ARC will perform the excavation.
9. Mobilize equipment and machinery
10. Lane closure requirements / CHP requirements
    a. The target date for removal of the mother plant for transplanting is Saturday, January 23rd.
    b. During the week in advance, Environmental Design and Professional Tree Care will be mobilizing equipment, machinery and equipment in preparation for the work on the 23rd.
    c. The Trust will be notified 2 weeks in advance if any temporary road closures will be required.

D. Excavation and translocation techniques *(Caltrans)*

1. Representatives from Professional Tree Care, Environmental Design Specialists, Mike Vasey, Tom Parker and Caltrans met at the site on November 20 to discuss mother plant salvaging and transplanting.
2. Following hand removal and salvaging work, the remaining portion of the mother plant will be removed on January 23rd. The plant will be removed monolithically by inserting pipes and other stabilizing materials under and along the sides of the plant rootball and then lifting the plant out by crane.
3. The basic steps are as follows:

a. Trench around plant perimeter.
b. Wrap surrounding root ball with jute netting supported by wire mesh to keep the rootball tight.
c. Insert a series of 3-3 1/2" diameter steel pipes laterally under the rootball in a close spacing.
d. Place a steel I beam under each end of the steel pipes and install a flange at the ends of the I beam to lock the pipes in place. This establishes the frame.
e. Lift the plant out by Crane.
f. Environmental Design from Monterey Ca., will be performing the removal work in conjunction with Professional Tree Care. Environmental Design has experience in removing manzanita (a groundcover plant) from a previous project in Carmel Valley (Monterey/Tehama area).
g. The mother plant will be loaded onto a flat bed truck and moved to its target location.

E. The day of translocation *(Caltrans)*
1. Remove post-and-cable fence at East Grassland Quarry site
2. Lay 1 3/4" plywood on the ground to drive upon.
3. Remove construction fence
4. Re-water the hole as necessary, depending on drainage.
5. Place the plant in the hole - make sure the soil surface of the plant matches the soil surface level surrounding the hole. Use excavated material from recipient site, if needed, to insure a level planting.
6. The supporting steel pipes are left in place below the soil mass. The steel pipes can be removed, but not recommended as the removal procedure will loosen the rootball mass. The upper 12-18" of the netting/wire mesh is removed once the plant is in the ground. The lower sections of the netting/wire mesh is left in place to keep the root ball tight. Further consultation will be required to determine if the steel pipes should be left in place.
7. Firmly place soil around the plant using excavated material from recipient site.
8. Conduct further shoot trimming if needed
9. Water in the planted plant
10. Construct a fence around the area, corresponding roughly to the scraped area surrounding the planting. Make sure any fence posts are not hitting the root ball.
11. Replace post-and-cable fence removed in step i.

MID TERM CONSERVATION PLAN

Monitoring and Management Post-Translocation (Mother Plant) *(Caltrans)*

The translocated plant will require careful monitoring and management to increase the chances for survival and long term contribution to the reintroduction and recovery of this species. Resources will need to be dedicated to regular observations of the plant's health and the conditions of the planting site. Inspection of the plant should be carried out by an experienced manzanita horticulturist. Maintenance required would be directed by this expert. The mother plant will be monitored for signs of stress. Weed removal should be carried out, as needed. Recommendations for summer water from the botanical gardens have varied. Irrigation should be given through spring (April) whenever 2 weeks has passed with no rain. Watering can then taper off but plant should not be allowed to dry out through the first summer. (pers. comm.: Steve Edwards and Don Mahoney). Stewards and visitors should avoid going within 10 feet of the mother plant if possible, especially when soil is wet. Weeders should use boards to access the site. This spreads the weight around and reduces compaction.

The Parks Conservancy *(BYoung)* will convene a workshop to be held as soon as possible of all personnel from botanical gardens who currently maintain *A. franciscana*. Their advice and recommendations will be incorporated into the maintenance and monitoring plan.

A. Mid Term Monitoring and Maintenance

1. *Document the habitat at location of mother plant on Doyle Drive*. This information will be needed to identify potential receptor sites for the mother plant, manage the mother plant after transplantation, and to select sites for outplanting cuttings or seedlings. *(Caltrans/Trust) MVasey,MFrey, MChasse*
   a. Other species of plants co-occurring with the mother plant on the site currently and prior to the site being cleared. The latter information may have to be deduced from aerial photos and adjacent remaining vegetation unless records exist.
   b. Amount of shade or direct sunlight the plant was receiving. Since the adjacent trees have been removed, this information may need to be deduced from photos as noted above. Check aerial photographs taken from years prior to the project.
   c. Soil type, physical characteristics, and chemistry, including macro- and micronutrients.
   d. Slope and exposure.
2. *Document site selection and installation (Presidio Trust)*
   a. Identify and describe potential receptor sites. Receptor sites should approximate conditions at the mother plant site. Habitat that supports Presidio manzanita may provide an appropriate template.
   b. Preliminary results of GIS site suitability analysis should identify a number of potential sites that could support experimental reintroduction and long-term recovery of the Franciscan manzanita in San Francisco. These include several Presidio locations (Inspiration Point, Coastal Bluffs, West Crissy Bluffs, Golf Course Serpentine area, and the Doyle Drive serpentine corridor) as well as Mount Davidson, Bernal Heights, McLaren Park, Potrero Hill, and Bayview Hill in San Francisco. Field surveys of current site conditions are necessary for a finer-grained analysis of site suitability, and will be conducted by Michael Chassé in 2010 as part of thesis research through San Francisco

State University. This research may be used to guide an experimental reintroduction program aimed at long-term recovery of the species.

c. Describe method of installation (e.g. soil basin, one-time use of slow release fertilizer, etc.). Soil salvaged from donor site should be incorporated into the planting hole to provide inoculum.

3. After three years, the strategy should be thoroughly reviewed and the following should be evaluated.
   a. Suitability of field sites
   b. Potential additional field sites within the Presidio
   c. Potential additional field sites outside the Presidio (in San Francisco)
   d. Planting raven's clones within one of the populations, following guidance from the USFWS and per the Recovery Plan for Serpentine Soil Species.

B. Short-term monitoring

1. *Convene a workshop with horticultural experts to develop a protocol for observing the mother plant and cuttings and reporting significant changes and obtaining advice on how to proceed. [BYoung]*
2. *Monitor the mother plant(s), cuttings, or seedlings daily after transplanting or installation* For the first 10 days after transplanting, staff shall visit the plant daily to ensure that the plant(s), cuttings or seedlings are appropriately watered and cared for. If the plant(s) appears to be stressed (wilting, dropping leaves, leaf discoloration, insect infestation, etc.), the Agencies will be notified within 12 hours and a joint decision made on how to rectify the problem. A sufficient number of propagated individuals will be needed to offset mortality. *CalTrans)Presidio Trust [Frey], Golden Gate National Parks Conservancy (Parks Conservancy) [Young], GGNRA [Chasse], SF Botanical Garden at Strybing Arb. [Mahoney] and/or other appropriate staff approved by the Agencies). (Caltrans)*
3. *Monitor the plant(s), cuttings, or seedlings weekly thereafter until November 1st*. Beginning 10 days after transplanting; staff shall visit the plant(s), cuttings, or seedlings once each week until November 1st. If at any time, the plant(s) appears to be stressed (wilting, dropping leaves, insect infestation, etc.), the Agencies will be notified within 12 hours and a joint decision made on how to rectify the problem. *(CalTrans) (Staff from the Presidio Trust (Frey), Parks Conservancy (Young), GGNRA (Chasse), or other appropriate staff approved by the Agencies) (Caltrans)*

4. *Monitor the plant(s), cuttings, or seedlings monthly thereafter for 2 years*. Beginning the November 1st after transplanting, staff shall visit the plant(s) once each month for two years (November 2010-November 2012). If at any time, the plant(s) appears to be stressed (wilting, dropping leaves, insect infestation, etc.), the Agencies will be notified within 12 hours and a joint decision made on how to rectify the problem. *(CalTrans) (Staff from the Presidio (Frey), Parks Conservancy (Young), GGNRA (Chasse), or other appropriate staff approved by the Agencies) (Caltrans)*
5. *Control nonnative or native invasive vegetation within 20 feet of the edge of the canopy of the plants, cuttings, or seedlings*. Staff responsible for direct care of the plants shall remove or suppress nonnative and native invasive plants where needed. This action will protect the Franciscan manzanita from shading or competition for water and nutrients from invasive plants and promote natural recruitment of Franciscan manzanita plants

from the mother plant and cuttings. Herbicide spraying foliar application of herbicides will not be allowed within 30 meters (100 feet) of the mother plant, cuttings or seedlings unless there is no other method of control. Cut and paint methods are not allowed within 3 meters (10 feet) of the mother plant. *(Caltrans) (Presidio Trust, GGNRA).*

LONG-TERM CONSERVATION PLAN (Trust)

The best chance for survival of the species, *Arctostaphylos franciscana* is within its historic natural community. Full restoration and recovery of the species and the ecological function it provided can only be assured by moving the discovered plant and maintaining it in a population, by propagation of the mother plant offspring and additional genotypes which will eventually be outplanted with it, and ultimately through the restoration of the plant within the full suite of vascular and non vascular plants, pollinators, and the appropriate physical factors such as parent material, aspect, and hydrology which comprised this lost ecological system.

This portion of the plan addresses the long term conservation needs of the mother plant, its offspring, and the introduction of a minimum of three diverse populations of this species (including all remaining genotypes) on the San Francisco Presidio. Actions in this plan start after the time that the mother plant has been transplanted, either as a whole or in sections, and cuttings, seed, and soil seedbank have also been collected. This is an adaptive plan whose actions may be altered by the Agencies based on new information.

The goal of this Long Term Plan is consistent with the overall goal of creating self-sufficient, reproducing in-the-wild populations of the Franciscan Manzanita. To accomplish this goal, the intent and immediate goal of this Conservation Plan is to promote the survival of the Franciscan manzanita by meeting the habitat and growth needs of the plant and through the reduction and elimination of threats to its continued existence. The intermediate goal is to insure the success of this first objective and to lay the foundation for the future establishment of at least three distant, unconnected populations in the wild using cuttings or other propagules to ensure that the genetic material from the mother plant is conserved. Plants should be provided to one or more botanical gardens to mitigate for potential stochastic events that could impact these established populations. The Long Term goal is the establishment of viable, naturally-reproducing populations of this species using cuttings or clones from the mother plant and the other genotypes in order to maintain genetic variation. Success should include the restoration of the maritime chaparral plant community that historically sustained this species.

A. <u>Long-Term monitoring for the mother plant, seedlings, and rooted cuttings and layers</u>
   1. *Monitor condition and size of the mother plant(s) in late spring of each year*. From November 2012 to December 2024, presence of new stem growth, and presence of immature inflorescences. Staff shall measure plant size and growth rate once per year. Proportions of live and dead vegetation, if any, on the plant shall also be measured at the beginning, middle and end of the annual growth period. *(CalTrans-10 yr) (Golden Gate National Recreation Area [Chasse] (Presidio Trust -thereafter)*
   2. *Continue control of nonnative or native invasive vegetation around the plant*. Staff responsible for direct care of the plant shall remove or suppress nonnative and native invasive plants when needed. Herbicide spraying foliar application of herbicides will not be allowed within 30 meters (100 feet) of the mother plant, cuttings or seedlings unless

there is no other method of control. Cut and paint methods are not allowed within 3 meters (10 feet) of the mother plant. *(Caltrans – 10 yr)(Presidio Trust [Frey] –thereafter)*

3. *Seed accession*. Collect seed from the mother plant and store in at least two locations, including the USDA National Center for Genetic Resources Preservation in Fort Collins, CO, approved by the Agencies for use if mother plant(s) fails to survive, as well as for long-term conservation storage. Seed collection should follow Center for Plant Conservation guidelines. Seed storage facilities must be affiliates of the Center for Plant Conservation. Eventually reach a goal of 1500 stored seeds from each genet as long as seed collection does not result in adverse impacts to translocated mother plant or established outplants. (CalTrans) *Parks Conservancy [Young],*
4. *Pollen collection*. If distances between different established genotypes planted near the mother plant exceeds pollinator range, consider collecting pollen from the mother plant for either long-term storage or for immediate cross-pollination of other Franciscan manzanita plants. Pollen shall be stored at a location with adequate facilities to maintain the appropriate desiccation and temperature of the pollen. (Parks Conservancy [Young] Presidio Trust, GGNRA, and/or the UC Berkeley Botanical Garden). (Trust)
5. *Threats control*. Protect the mother plant(s) and outplantings of rooted layers, cuttings and/or seedlings from various threats including: fire, vandalism, trampling, insect damage, and disease. (Presidio Trust and/or GGNRA).

B. Record keeping.

1. *Record all data collected*. Establish an easy-to–follow data collection system to document results of treatments including watering and application of fertilizer or pesticide (if any), and monitoring, and to track genetic material from source plant to cuttings/seedlings to transplanted/outplanted material. (Presidio Trust and/or GGNRA). Botanical gardens would provide their standard records of propagation and outplanting to Parks Conservancy for analysis and reporting to the appropriate agencies. *(NPS-mother plant) (Parks Conservancy –propagation information*)
2. *Mapping.* Create a map of the area where the mother plant was found and where transplanting and outplantings take place. The GIS shape files and survey GPS data points used to create the map should include metadata in addition to a list of imagery used. This information will be provided to the CNDDB. The map should also show soil types, elevation, landmarks, locations of historic Franciscan manzanita populations and locations of other manzanita species. A GIS database should also be used as a permanent record of the source plant(s) and to track propagules. *(Presidio Trust and/or GGNRA).(NPS)*
3. *Propagation, Monitoring, and Management Reports*
   a. *Management and monitoring reports*. All short-term and long-term monitoring and management reports shall be stored and available at the GGNRA. Data will then be provided directly to Federal and State Agencies and to interested conservation groups. *(Presidio Trust/NPS)*
   b. *Transplanting and propagation reports.* Methods used for transplanting and propagation and their success rates shall be summarized and provided to the Agencies for future efforts to recover Franciscan manzanita and other manzanita species. Botanical Gardens shall provide their standard records to the Parks Conservancy nurseries for summarization and reporting the Agencies. *(Presidio Trust, GGNRA, and/or the Parks Conservancy).*

c. *Biannual reports* (twice per year). Biannual email reports shall be submitted to U.S. Fish and Wildlife Service and the Department of Fish and Game in years one through four of the Franciscan manzanita conservation project including updates on all conservation activities including transplanting, propagation, monitoring, maintenance, and progress reaching success criteria. After four years, reports will be provided annually. *(Presidio Trust, GGNRA, UC Berkeley Botanical Garden, and/or the Parks Conservancy).(NPS)*

C. Outplanting of clones and/or seedlings from mother plant. Because of the risk of failure of the mother plant to survive the transplant process, cuttings from the mother plant will be outplanted at protected sites in the wild and at botanical gardens to ensure that the genetic material of this plant is not lost. It is understood that a majority of clones will return to Presidio natural areas, until multiple self-sustaining populations of the species are established. Additional rooted propagules or seedings would be distributed, as research indicates. *(Presidio Trust)*

1. *Success criteria*. To ensure that the genetic material of the mother plant is not lost, a goal of at least 100 rooted clones of each genetic individual should be established between three botanical gardens and in the wild. Botanical gardens can vegetatively propagate these plants. Seeds from these plants, however, could be cross-pollinated by closely related species and therefore may not reliably be *A. franciscana*. The gardens that currently have specimens are the first choice. Gardens known to have specimens include UC Botanical Garden in Berkeley, Regional Parks Botanic Garden at Tilden RP, and the Strybing Arboretum in San Francisco. Below is a preliminary list of recommended botanical gardens and a nursery, which specializes in natives and has supported rare plant conservation, and their representatives. Until further research indicates a different treatment, layers or cuttings will be distributed in the order below. Rooted cuttings from the Presidio Nursery would be outplanted in areas of the Presidio deemed appropriate for the species, to either add individuals at the site with the transplanted mother plant or at other appropriate natural area sites on the Presidio (as outlined in Section 4: Experimental introduction) or in San Francisco, where there is a likelihood of establishing a viable functioning plant community. The goal at botanical gardens is to establish plants to ensure that the genetic material is not lost and to provide material for future vegetative propagation if requested.

Holly Forbes/John Domwalski	UC Botanical Garden, Berkeley	Berkeley
Steve Edwards	Reg. Parks Bot. Garden, at Tilden RP	Berkeley
Don Mahoney	SF Bot Garden at Strybing Arboretum	San Francisco
Betty Young-Brianna Schaefer	GGNP-Presidio Nursery	San Francisco
Brett Hall	UC Botanical Garden, Santa Cruz	Santa Cruz
Bart O'Brien.	Rancho Santa Ana Botanical Garden	Claremont
Phil Van Soelen	California Flora Nursery	Santa Rosa

2. *Ensure that clean techniques and tools (clean gloves, shoes and equipment) are used for all transplanting, outplanting, and invasive plant control activities.* Provide for onsite sterilization such as isopropyl alcohol stations. These techniques are mandatory to minimize transmitting pathogens (such as *Phytophthora*) contaminants, and weedy

species to the mother plant and cuttings or seedlings. *(Presidio Trust, GGNRA, Parks Conservancy and UC Berkeley Botanical Garden)*

3. *Location of outplantings*. The majority of outplantings should not be placed in areas where there could be cross pollination with other species or subspecies of manzanitas such as the Presidio manzanita (*Arctostaphylos hookeri* ssp. *ravenii*). Potential sites should also be examined for potential pathogen infection prior to installation. Appropriate areas will be determined by Franciscan manzanita experts in conjunction with GGNRA, Presidio Trust and Parks Conservancy. *(Presidio Trust)*
4. *Identify all individuals of the species.* Using genetic analysis of all known or suspected specimens, as well as other historic and biological data, locate each unique genetic individual of the Franciscan manzanita. *(GGNRA)*
5. *Encourage exchange of genetic material among the remaining clones of Franciscan manzanita.* Increase outcrossing between the mother plant and clones existing in cultivation (at UC Botanical Garden and Regional Parks Botanical Garden or other confirmed locations) through planting mixed groups of cuttings of all the cultivars at the botanic gardens or on the Presidio and by outplanting cuttings from the mother plant in groups with cuttings from other clones into wild locations. The goal of the latter plantings will be to establish new, self-reproducing populations with consideration of local adaptation. *(Presidio Trust) (UC Berkeley Botanical Garden, Parks Conservancy, GGNRA, others as appropriate).*
6. *Source of cuttings*. Plants used in the reintroduction of the mother plant and other genotypes of the Franciscan manzanita should be as close in lineage to the plants of origin as possible. Plants that have been grown in a greenhouse for several generations may have been selected for different conditions than the outplanting site. Label or tag outplantings, if necessary, to facilitate tracking. Cuttings should be taken only from clones of the original genotypes, if in botanical gardens unless distance from related species of manzanita, can assure that no hybridization occurred. *(UC Berkeley Botanic Garden, GGNRA,).*
7. *Consider local pollinators when selecting a site for transplanting or outplanting*. Successful cross-pollination between clones of the mother plant and clones of other genotypes of Franciscan manzanita will likely result in increased seed set if the clones are planted in an area that supports pollinators known to visit the Franciscan manzanita. Research will be done to determine rates of outcrossing and inbreeding. Efforts will be made to introduce other suitable species to attract pollinators as part of the community restoration effort *(Presidio Trust and GGNRA).*

D. <u>Conduct research to determine appropriate management for the Franciscan manzanita and identify future receptor sites.</u> *(Presidio Trust)*

1. *Genetics* Research will be conducted on the genetic identity of the mother plant and other related genotypes *(CalTrans-Mother plant) (Presidio Trust –future activies)_(Franciscan manzanita experts, GGNRA, UC Berkeley Botanical Garden –other genotypes).*
2. *Importance of soil microbiology.* Soil and litter from the site of the mother plant will be transported to the translocation site to facilitate the establishment of suitable mycorrhizal mutalists *(Presidio Trust*)*(Franciscan manzanita experts, GGNRA, UC Berkeley Botanical Garden, and/or the Parks Conservancy).*
3. *Propagation and transplant techniques* See recommendations under Immediate Plan of Action-Propagation. Research could also be conducted into the meristematic propagation

(tissue culture) of the species. This is a helpful technique when propagation material is limited, and provides clean disease free plants. *(Presidio Trust) (Franciscan manzanita experts, GGNRA, UC Berkeley Botanical Garden, and/or the Parks Conservancy).*

4. *Habitat requirements (Presidio Trust) (Franciscan manzanita experts, GGNRA, UC Berkeley Botanical Garden, and/or the Parks Conservancy).*

E. Experimental introduction *(Presidio Trust)*

Once an *ex situ* conservation program is established, the next step in providing for longer-term recovery would be to establish multiple populations in the Presidio, or in other appropriate locations within the historic distribution of the Franciscan manzanita. Three experimental populations should be established in the Presidio containing three representatives of each known genetic individual of *A. franciscana*. The populations should span the environmental gradient of the Presidio. However, all sites should meet the ecological requirements of the species. The remaining clones should be maintained in cultivation. Field-planted specimens should be tracked quarterly for three years and annually thereafter. These steps would provide guidance on possible future experimental plantings in other San Francisco sites, as recommended by USFWS (2003).

F. Periodically update and revise the Conservation Plan *(Presidio Trust)*
The Agencies shall revise the Conservation Plan, as needed, to promote adaptive management and to reflect any new scientific information regarding the plant. *(Franciscan manzanita experts, GGNRA, UC Berkeley Botanic Garden, Parks Conservancy, and all signatory Agencies).*

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REFERENCES

Baye, P. Pers. Comm. Comment in email to CNPS, November 30, 2009.

Behr, H. H. 1888. Flora of the Vicinity of San Francisco. San Francisco, CA.

——. 1892. Botanical reminiscences. *Zoe* 2:2-6.

Brandegee, K. 1892. A catalogue of the flowering plants and ferns growing spontaneously in the city of San Francisco. *Zoe* 2:334-383.

Boykin, L. M., M. C. Vasey, V. T. Parker, and R. Patterson. 2005. Two lineages of Arctostaphylos (Ericaceae) identified using the internal transcribed spacer (ITS) region of the nuclear genome. *Madroño* 52:139-147.

California Native Plant Society (CNPS). 2009. Inventory of Rare and Endangered Plants (online edition, v7-09d). California Native Plant Society. Sacramento, CA. Accessed on Tue, Dec. 15, 2009 from http://www.cnps.org/inventory

Chassé, M. unpublished data. Site suitability analysis for the potential reintroduction of *Arctostaphylos franciscana,* May 2009. San Francisco State University, Department of Geography and Environmental Studies.

Consortium of California Herbaria (CCH). 2009. Data provided by the participants of the Consortium of California Herbaria. Available: http://ucjeps.berkeley.edu/cgi-bin/get_consort.pl (Last accessed: November 6, 2009)

Forbes, H, Propagation records for *Arctostaphylos franciscana* from University of California Botanical Garden at Berkeley.

Howell, J.T., P. H. Raven, and P. R. Rubtzoff. 1958. A flora of San Francisco, California. *The Wasmann Journal of Biology* 16:1-157.
Kauffman, J.B. & Martin, R.E. (1991) Factors influencing the scarification and germination of three montane Sierra Nevada shrubs. Northwest Science. 65(4) 180-187.

Keeley, J.E. & Keeley, S,C, (1987). Role of fire in the germination of chaparral herbs and suffrutescents. *Madrono*, 34(3), 240-249.

Keeley, J.E. & Fotheringham, C.J. (1998). Smoke-induced seed germination in California chaparral. Ecology, 79(7). 2320-2336.

Knight, W. and I. Knight. 1988. Guide to the Regional Parks Botanic Garden, with notes on Native American uses. Oakland, CA: East Bay Regional Park District.

Laskowski, M, Swenerton, K & Schaefer, B. (2008) Germination Trials of *Arctostaphylos montana ssp. ravenii*. Golden Gate National Parks, unpublished.

Mehrhoff, L. Pers. Comm. Email of December 7, 2009.

Meyer, S.E. (2008) *Arctostaphylos* Adans. The Woody Plant Seed Manual. USDA Agriculture Handbook 727. 266-269.

O'Brien, B, Propagation records for *Arctostaphylos franciscana* from Rancho Santa Ana Botanical Garden.

Parker, V.T., M.C. Vasey, J.E. Keeley. 2009. Volume VIII. *Arctostaphylos*: Flora of North America, Missouri Botanical Garden.

Parker, V.T., M.C. Vasey, J.E. Keeley. In review. *Arctostaphylos*. Jepson Manual, 2nd Edition.

Riess, S. B. 1991. Gerda Isenberg, "California Native Plants Nurserywoman, Civil Rights Activist, and Humanitarian," an oral history conducted in 1990, 1991 by Suzanne B. Riess, pp. 105 - 107. Regional Oral History Office, The Bancroft Library, University of California, Berkeley, 1991.

Roof, J. B. 1959. Guide to the plant species of the Regional Parks Botanic Garden, Botanic Publication No. 2.

——. 1965. Honorary president of California Native Plant Society -- Lester Rowntree, *The Four Seasons* 1(3): 9 – 10.

———. 1976. A fresh approach to the genus *Arctostaphylos* in California. *The Four Seasons*, 5(2): 21-24.

———. 1980a. California's *Arctostaphylos uva-ursi* alliance. *The Changing Seasons*, 1: 2, 21-24.

———. 1980b. California's *Arctostaphylos uva-ursi* alliance (continued). *The Changing Seasons*, 1: 3, 19-20.

Shebitz, D.J.; Ewing, K., & Gutierrez, J. (2009) Preliminary observations of using smoke-water to increase low-elevation Beargrass. Native Plant Journal. 10(1). 13-20.

Smith, S.E. and D.J. Read. 1997. Mycorrhizal Symbiosis; 2nd ed. Academic Press, London., 299-304.

USFWS (U.S. Fish & Wildlife Service). 2003. *Recovery Plan for Coastal Plants of the Northern San Francisco Peninsula*. U.S. Fish & Wildlife Service, Portland, Oregon, xvi + 304 pp.

Vasey, M. 1996. Baseline Inventory of the Presidio, a report submitted to the National Park Service, GGNRA.

VPOD. 2009. Vascular Plant Occurrence Database, Presidio of San Francisco. National Park Service, Presidio Trust, and Golden Gate National Parks Conservancy, internal data.

Wells, P. V. 1968. New taxa, combinations and chromosome numbers in Arctostaphylos (Ericaceae). *Madroño* 19:193-210.

——. 1993. *Arctostaphylos*. Pp. 545 – 563 in Hickman, J.C. (ed.), *The Jepson Manual: Higher Plants of California*. Berkeley, CA: University of California Press.

Appendix 1: Accession summary

accession id	Taxon	collector	collection number	date	county	elevation	locality
UC82949	Arctostaphylos hookeri subsp. franciscana	Katharine Brandegee		1889	SF		Laurel Hill Cemetery (type locality)
UC185737	Arctostaphylos hookeri subsp. franciscana	Katharine Brandegee		Apr 2, 1907 - May 29, 1908	SF		Bare stony bluff, Laurel Hill Cemetery
RSA7423	Arctostaphylos hookeri subsp. franciscana	Alice Eastwood	226	6/6/1912	SF		Laurel Hill Cemetery
UC1281201	Arctostaphylos hookeri subsp. franciscana	Dr. W. B. Stephens		Nov.-Dec. 1920	SF		Laurel Hill Cemetery
UC517512	Arctostaphylos hookeri subsp. franciscana	Alice Eastwood	11072	3/7/1922	SF		Laurel Hill Cemetery
UC518000	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	33033	3/26/1933	SF		Laurel Hill Cemetery (type locality)
UC876403	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	33033	3/26/1933	SF		Laurel Hill Cemetery (type location)
UCR208138	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	33033	3/26/1933	SF		Laurel Hill Cemetery
RSA70875	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	33033	3/26/1933	SF		Laurel Hill Cemetery
UC581328	Arctostaphylos hookeri subsp. franciscana	L. L. Edmunds		2/15/1938	SF		Laurel Hill Cemetery
UC600990	Arctostaphylos hookeri subsp. franciscana	L. L. Edmunds		8/4/1938	SF		Laurel Hill Cemetery
UC1281195	Arctostaphylos hookeri subsp. franciscana	H. E. McMinn		10/7/1938	SF		Laurel Hill Cemetery
UCD50809	Arctostaphylos franciscana	A. E. Wieslander	853	10/27/1938	SF	300 ft.	At Laurel Hill Cemetery
RSA139990	Arctostaphylos hookeri subsp. franciscana	A. E. Wieslander	853	10/27/1938	SF	300 ft.	Laurel Hill Cemetery

RSA141473	Arctostaphylos hookeri subsp. franciscana	A. E. Wieslander	852	10/27/1938	SF	300 ft.	Laurel Hill Cemetery
RSA24255	Arctostaphylos hookeri subsp. franciscana	C. B. Wolf	3872	11/12/1940	SF	200 ft.	Laurel Hill Cemetery
UC1048582	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	42002	3/19/1942	SF	350 ft.	Laurel Hill Cemetery
UC750650	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	46106	3/8/1946	SF	300 ft.	Laurel Hill Cemetery
UCR58359	Arctostaphylos hookeri subsp. franciscana	Walter Knight	3768A	6/14/1946	SF		Original from Laurel Hill Cemetery, now in Tilden Regional Park Botanic Garden
POM367337	Arctostaphylos hookeri subsp. franciscana	Lewis S. Rose	46016	3/8/1946	SF	300 ft.	Laurel Hill Cemetery
RSA252262	Arctostaphylos hookeri subsp. franciscana	G. D. Wallace	1357	12/24/1974	SF		Cultivated at Strybing Arboretum, Golden Gate Park, San Francisco. Originally from nursery material. This specimen seems to agree quite well with the type descriptionfor this subspecies.
RSA252263	Arctostaphylos hookeri subsp. franciscana	G. D. Wallace	1356	12/24/1974	SF		Cultivated at Strybing Arboretum, Golden Gate Park, San Francisco. Claimed to be material from the Laurel Hill type locality for this subspecies but leaves do not look like typical specimin of the subspecies which has glabrous leaves.
UCR58358	Arctostaphylos hookeri subsp. franciscana	Walter Knight	3736	4/28/1980	SF		Original from Laurel Hill Cemetery, now in Tilden Regional Park Botanic Garden
CAS259	Arctostaphylos franciscana	Alice Eastwood			SF		unspecified
UCD50811	Arctostaphylos franciscana	Milo S. Baker	5622		SF		Laurel Hill Cemetery
RSA63689	Arctostaphylos hookeri subsp. franciscana	Milo S. Baker	s.n.		SF		Laurel Hill Cemetery
UC1388993	Arctostaphylos hookeri subsp. franciscana	Milo S. Baker			SF		Laurel Hill Cemetery (type location)

Appendix 2: Summary of characters of the individual

Habit
The habit is mounding and layering, not truly prostrate. There is no evidence that it is a sprouter. This is consistent with *A. franciscana* in the field and as it has been described in historic records.

Structure
No burl was found consistent with *A. franciscana*.

Setting
On serpentine in San Francisco consistent only with *A. franciscana* and *A. montana* ssp. *ravenii*

Leaf
Spreading, petioles 3–5 mm, blade 1.5–2 cm, 0.5–1 cm wide, oblanceolate, lf base wedge-shaped, lf tip acute, margin entire, plane; isofacial, bright green, ± puberulent, becoming glabrous, smooth. No evidence of glands, consistent with *A. franciscana*.

Leaf stomata
There are stomata on the upper leaf surface, fewer than below but that is not that unusual, so the leaf qualifies as isofacial - a key character that separates *A. franciscana* from *A. uva-ursi*.

Inflorescence
Hooked shaped. Terminal with multiple flowers, although no flowers yet present. Inflorescence with pubescence. The diminutive inflorescence, many branched, is also like *A franciscana.* This is similar to *A. hookeri* and *A. pumila*, which is largely why Wells removed *A. franciscana* from *A. pungens* and put it into *A. hookeri,* and why it was originally identified as *A. pumila* until Eastwood named it in 1905. *A. hookeri* and *A. pumila* are most often not branched, while *A. franciscana* is described as having branches. Also, *A. franciscana* is described as having scaly bracts like the specimen found, and more importantly, having the lowest bract leaf-like, just like the specimen found. Also appears identical to specimen in our herbarium.

Twig pubescence
Lightly tomentose, not glandular, lacking long hairs, consistent with *A. franciscana*.

Fruit
The fruit of this specimen looks identical to other A franciscana cultivars. Dark mahogany brown and very depressed-spheric, like a vertically compressed apple. That is nothing like *A. uva-ursi* fruits, even the ones up on San Bruno Mountain. Fruit size is 4.5-6mm but only dried specimens are available. The Jepson description identifies the fruits as 6-8mm.

Appendix 3: Propagation Protocols –GGNRA Nurseries

Seed Germination

Treatments will be given as described in Propagation Section. Standard seed germination procedures in GGNRA nurseries are:

1. Scarification as determined with experimental trials.
2. Stratification should occur from 1^{o}– 4^{o} C (34-39^{o}F). Seed is soaked 48 hours to imbibe water. It is then surface dried, and placed in perlite in a Ziploc™ type bag.
3. Seed will be sown in commercial germination media, like Sunshine™ brand Propagation media #5 mixed. Flat will be watered in with spore containing water. Each seed will be sown in individual 2" containers, to prevent spread of any pathogens in the soil. The pots will be placed on a heated greenhouse bench at 16^{o}C (60^{o}F). Since most manzanitas are very susceptible to waterborne fungal pathogens, media will be kept barely moist.
4. Once 2 true leaves have emerged or roots show at drain holes of pot, seedlings will be transplanted to Deepot16™ (Stuewe & Sons) containing a well drained potting media with 10% soil from under the mother plant added to provide additional mycorrhizal inoculation.
5. Plants will be moved to larger containers as they grow. Once plants are well established in containers, they will be outplanted to the designated site in the Presidio, and botanical gardens – as designated in the Long Term Strategy below.

Cuttings

Remove tip cuttings from Mother plant.

1. Downslope portion of plant, seems to be more vigorous. Use this material preferentially.
2. Each cutting to be 7-11 cm long. Best with at least 4 nodes.
3. Leave any tips with developing flower buds on mother plant. (they are small <1cm raceme, usually double dangling from terminal end of branch.
4. Put cuttings in large white plastic bag while in the field, to protect from drying.
5. Return to nursery, clean and dip cuttings 30 sec. in 2% bleach solution, rinse. (PPE-nitrile gloves, goggles, and rubber apron) This removes any superficial pathogenic fungal spores, virus or bacteria.
6. Divide cuttings between Cal Flora Nursery, UC Botanical Garden at Berkeley, UC Santa Cruz Arboretum, Regional Parks Botanic Garden at Tilden Regional Park and Presidio Nursery, in November.
7. January cuttings will also be divided with Strybing Arboretum. Cutting treatment method will be adjusted if any favorable results occur on November cuttings.

At Presidio Nursery

1. Seal bag and store in refrigerator no more than 3 days. Indole-3-acetic acid (IAA) is the naturally occurring hormone which must be present in plants in order for roots to be initiated. chilling may induce the commencement of production of IAA in the cuttings, increasing the probability of rooting.

Presidio Nursery procedures for sticking cuttings.

1. Sterilize flat (2" x 16" x 16") with 30 sec dip in 2% bleach solution and rinse.
2. Fill with 100% perlite.
3. Wound cuttings ¼" below the basal node.Trim cuttings by making a 45^{o} cut at the base.

4. With sterilized shears, trim out the distal tip using only a slightly angled cut. Trim the terminal back to the next node. If terminal end is very soft (floppy), trim out to the second node.
5. Remove, the leaves from the bottom 2 nodes of cutting.
6. Thin leaves on nodes which will be above media surface to no more than 3 or 4 leaves.
7. Prepare Dip 'n Grow™ rooting hormone (Astoria-Pacific, Inc, Clakamas, OR 97015-0830. Dip 'n Grow is 1% Indole-3-Butyric acid (IBA), 0.5% Naphthalene Acetic Acid (NAA), isopropanol and ethanol. Dilute with water to 1 part Dip 'n Grow to 2 parts water. (PPE- nitrile gloves, goggles) This dilution results in 3333ppm IBA and 1667ppm NAA.
8. Hold basal end of cutting, including nodes from which leaves were removed, in the dilute Dip 'n Grow for 3 to 5 seconds.
9. Stick these cuttings, 20 per row in the prepared flat.
10. Place flat in greenhouse with heated benches and intermittent mist. Bench heat set at 21^{o}C (70^{o}F).
11. Set mist for no more than 5 seconds every hour or a very high VPD. Media must not be saturated. Only sufficient moisture to keep the cutting turgid is required. Manzanita cuttings very susceptible to water borne fungal attack through the basal cut. Standing water must be avoided. Media should feel just barely moist to the touch.
12. Check cuttings in flats for signs of rooting beginning 6 weeks after cuttings struck.

When a cutting has at least 3 roots, each at least 1'long, begin transplanting to Deepot 16™ (DP16) plant container tubes (Stuewe & Sons, Corvallis, OR)

1. Prepare potting media using
   a. 6 parts GGNRA nursery standard media (composed of 40% compost (grass clippings and ground conifer bark), 30% perlite, 10% coarse sand, 20% nitrolized ground bark + plus amendments)
   b. 3 parts perlite and
   c. 1 part soil salvaged from under the mother manzanita plant (hopefully containing beneficial mycorrhizal fungal symbiots).
2. Clean DP16s in 2% bleach solution and rinse.
3. Fill 2/3 full with media.
4. Holding rooted cutting by the stem, backfill the DP16 with media.
5. Tap tube on the bench to settle media around the roots and stem.
   a. Water in. Place in shadehouse. Not on automatic irrigation. Hand water only when dry to second knuckle.

Layering

Where prostrate branches of *the in situ* plant touch the ground, apply rooting hormone to induce rooting.

1. On the basal side of the each node touching the ground, using a small knife, scrape the epidermal layer from the bottom side of the stem.
2. Touch this scraped surface to Hormex™ # 16. (16,000ppm IBA) (PPE – latex gloves, goggles).
3. Buried treated area with at last ½" of soil. Pin the area to the ground using a landscape fabric U shaped staple.

Appendix 4: Engineering drawings of construction factors at site of plant

Sent separately as PDF

Appendix 5: Compiled Timeline

11/9/2009	Obtain up to 200 cuttings from the *in situ* plant. Distribute between propagators experienced with *A franciscana* and manzanita.
11/9/2009	Remove shallowly rooted layered stems (that could be removed without disturbance to the main plant) and distribute.
11/16/2009	Layer prostrate stems of the in situ plant.
11/9/2009 week	Treat and stick initial cuttings
11/23/2009	Auger analysis of Log Cabin and Washington Prairie
Nov-December 2009	Lead testing
Mid-December 2009	Begin checking flower buds for harvest for chromosomal study
Mid-December 2009	Hand dig naturally rooted pieces of the plant and distribute as outlined.
Mid-December 2009	Begin checking cuttings for signs of rooting.
Mid January, 2010	Repeat harvest of cuttings. If original cuttings rooted, use protocol that was most successful with original accession.
Mid January, 2010	Check layered stems. Harvest, if rooted, and pot up.
Mid-January 2010	Remove top 4 inches of soil in a 2 foot wide corridor beginning 8" outside of the plant canopy and from all the area on the down slope side of the plant. Store seed bank for future restoration and seed germination studies.
January 22-23, 2010	Excavate and move individual
December 2009-spring 2010	Pot up any rooted cuttings. Add 5% soil from the site to potting media to provide mycorrhizal associates.
2010	Germination trials on closely related species.
2010	Genetics work to determine number of individuals
2010	Choose locations for individuals
2010	Clone each individual
Fall 2010-2011	Distribute clonal plants as directed in long term protection portion of plan.
2011→	Germination studies on seed from seed bank
2012	Test seedlings produced plants to determine if from self-pollination in the original plant or if out crossed.
2012	Establish clones in cultivation
2013	Plant populations in the Presidio. Reintroduce associated plants.

ATTACHMENT B

Caltrans funded care and nurturing of the mother plant (10 years) salvaged rooted layers and cuttings taken during initial salvaging (2 years)

Requirements:

- *Convene a workshop with horticultural experts to develop a protocol for care and nurturing of the mother plant and cuttings and reporting significant changes and obtaining advice on how to proceed.*

- *Monitor the mother plant(s), rooted layers, cuttings, or seedlings daily after transplanting or installation* For the first 10 days after transplanting, staff shall visit the plant daily to ensure that the plant(s), rooted layers, cuttings or seedlings are appropriately watered and cared for.

- *Monitor the plant(s), rooted layers, cuttings, or seedlings weekly thereafter until November 1st. Beginning* 10 days after transplanting; staff shall visit the plant(s), cuttings, or seedlings once each week for nine months to water, fertilize, weed, and all other determined necessary care for the plant(s).

- *Monitor the plant(s), rooted layers, cuttings, or seedlings monthly thereafter for 2 years*. Beginning nine months after transplanting (November 1, 2010), staff shall visit the plant(s) once each month for two years (November 1, 2012) to water, fertilize, weed and other all other determined necessary care for the plant(s).

- From November 1, 2012 to December 1, 2019, staff will check on the plant 3 times per year and continue to weed the site and provide care as necessary.

- *Control nonnative or native invasive vegetation within 20 feet of the edge of the canopy of the plants, rooted layers, cuttings, or seedlings*. Staff responsible for direct care of the plants shall remove or suppress nonnative and native invasive plants where needed. This action will protect the Franciscan manzanita from shading or competition for water and nutrients from invasive plants and promote natural recruitment of Franciscan manzanita plants from the mother plant and cuttings. Herbicide spraying foliar application of herbicides will not be allowed within 30 meters (100 feet) of the mother plant, cuttings or seedlings unless there is no other method of control. Cut and paint methods are not allowed within 3 meters (10 feet) of the mother plant. (Presidio Trust, GGNRA, and/or UC Berkeley Botanical Garden).

  If at any time, the mother plant appears to be stressed to the degree that triggers Agency notification, the Agencies will be notified within 12 hours and a joint decision made on how to rectify the problem which could include altering the level of effort and schedules identified above.

Estimated hours spent on the mother plant (10 years) and rooted layers and cuttings (2 years) after relocation

Task	Time for Task	Frequency	Duration	TOTAL Hours
1. Weeding/pruning/fertilizing (Mother)	2 - 20 hours	Every month 10 months per year (No work in Sep & Oct) 9 months per year (No work in Aug, Sep & Oct) 10 months per year (No work in Sep & Oct)	First 3 years Years 4 Years 5 to 9 Years 10	528 hours
2. Weeding/pruning/fertilizing (layers & cuttings)	4 - 24 hours	Every month	First 2 years minus last month	209 hours
3. Monitoring/reporting (Mother)	4 - 20 hours	Every month 10 months per year (No work in Nov & Dec) Once a year in Jun	First 2 years Years 3 Years 4-10	271 hours
4. Monitoring/reporting (layers)	2 - 20 hours	Every month 10 months per year (No work in Nov & Dec) Once a year in Jun	First 2 years Years 3 Years 4-10	224 hours
5. Watering (Mother)	4 -16 hours	May thru Nov	First 2 years	136 hours
6. Watering (layers & cuttings)	4 - 8 hours	May thru Nov	First 2 years	104 hours

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Monthly 10 hrs Jan, & Mar thru Aug 20 hrs in Feb Monthly 8 hrs Sep thru Oct Monthly 16 hrs Nov thru Dec	Monthly 16 hrs Jan thru Apr Monthly 8 hrs May thru Jul, & Nov thru Dec Monthly 2 hrs Aug thru Oct	Monthly 8 hrs Jan thru May Monthly 4 hrs Jun thru Jul Monthly 2 hrs Aug thru Oct Monthly 4 hrs Nov thru Dec	Monthly 4 hrs (No work in Sep & Oct)	Monthly 4 hrs (No work in Aug, Sep & Oct)	Monthly 4 hrs (No work in Aug, Sep & Oct)	Monthly 4 hrs (No work in Aug, Sep & Oct)	Monthly 4 hrs Jan thru Jul Monthly 2 hrs Nov thru Dec (No work in Aug, Sep & Oct	Monthly 2 hrs (No work in Aug, Sep & Oct)	Monthly 2 hrs (No work in Sep & Oct)
Monthly 5 hrs Jan thru Mar, & May thru Jun 8 hrs in Apr 24 hrs in Jul Monthly 12 hrs Aug thru Dec	Monthly 12 hrs Jan thru Apr Monthly 8 hrs May thru Jul, & Nov Monthly 4 hrs Aug thru Oct								
15 hrs in Jan Monthly 10 hrs Feb thru May 20 hrs in Jun Monthly 8 hrs Jul thru Oct Monthly 4 hrs Nov thru Dec	Monthly 4 hrs except 20 hrs in Jun	Monthly 4 hrs except 20 hrs in Jun (No work in Nov & Dec)	8 hrs in Jun	8 hrs in Jun	4 hrs in Jun	4 hrs in Jun	4 hrs in Jun	4 hrs in Jun	4 hrs in Jun
5 hrs in Jan Monthly 3 hrs Feb thru May 15 hrs in Jun Monthly 3 hrs Jul thru Oct Monthly 2 hrs Nov thru Dec	Monthly 2 hrs except 20 hrs in Jun	Monthly 2 hrs except 20 hrs in Jun (No work in Nov & Dec)	8 hrs in Jun	8 hrs in Jun	16 hrs in Jun	16 hrs in Jun	16 hrs in Jun	16 hrs in Jun	16 hrs in Jun
Monthly 8 hrs May thru Aug Monthly 16 hrs Sep & Oct 4 hrs in Nov	Monthly 8 hrs May thru Aug Monthly 16 hrs Sep & Oct 4 hrs in Nov								
Monthly 8 hrs May thru Oct 4 hrs in Nov	Monthly 8 hrs May thru Oct 4 hrs in Nov								
538 hours	**428 hours**	**156 hours**	**56 hours**	**52 hours**	**56 hours**	**56 hours**	**52 hours**	**38 hours**	**40 hours**

Subtotal = 1472 hours
20% contingency = 294 hours
Total = 1,766 hours
Total cost = $79,470.00
* Funding based on 1,766 hrs. @ $45.00/hr. (base rate of $40.00 over 10 years adjusted for 80% of work performed during the first 5 years)

ATTACHMENT C

Caltrans funded monitoring and reporting of the mother plant (10 years), salvaged rooted layers and cuttings (2 years) taken during initial salvaging.

Requirements:

1. Provide daily monitoring of the Mother Plant, salvaged root layers, and cuttings for ten (10) days following relocation.

2. After the first ten (10) days, provide weekly (every 7 days) monitoring of the Mother Plant, salvaged rooted layers, and cuttings until November 1, 2010.

3. After November 1, 2010, provide monthly monitoring of the mother plant for another two (2) year period until November 2012.

4. From November 2012 to year ten (10), measure plant size, growth rate (once per year), and percentage of live/dead surface area, estimate status of fruit set, presence of new stem growth and presence of immature inflorescences three (3) times per year of the Mother Plant at the beginning, middle and end of the annual growth period.

5. Preparation of Bi-annual reports (twice per year) for the U.S. Fish and Wildlife service and California Department of Fish and game for the first four (4) years following relocation and annually for the final six (6) years of this MOA.

6. The above activity levels assume that the plant remains healthy. Per the Conservation Plan, if the plant shows stresses the agencies will convene to assess the level of monitoring.

Record keeping

1. *Record all data collected*. Establish an easy-to–follow data collection system for documentation.

2. *Propagation, Monitoring, and Management Reports*

    - *Management and monitoring reports*. All short-term and long-term monitoring and management reports shall be stored and available at the Presidio. Data will then be provided directly to Federal and State Agencies and to interested conservation groups.

    - *Transplanting and propagation reports.* Methods used for transplanting and propagation and their success rates shall be summarized and provided to the Agencies for future efforts to recover Franciscan manzanita and other manzanita species. Botanical Gardens shall provide their standard records to the Presidio Nursery for summarization and reporting to the Agencies.

    - Email reports shall be submitted to U.S. Fish and Wildlife Service and the Department of Fish and Game including updates on all conservation activities including transplanting, propagation, monitoring, maintenance, and progress reaching success criteria.

Estimated hours spent on the mother plant (10 years) and rooted layers and cuttings (2 years) after relocation

Task	Time for Task	Frequency	Duration	TOTAL Hours
7. Monitor daily	2 hours	30 days	First 30 days	60 hours
7. Bi-annual reports	16 hours	2 times per year	first 4 years	32 hours/year
7. Annual reports	8 hours	1 time per year	From year 5 to 15	8 hours/year
8. Monitor every other week	2 hours	48 hours 1st year, 52 hours 2nd year	First 2 years minus 1st month	100 hours
8. Monitor monthly	2 hours	12 days per year	Years 3 & 4	24 hours
9. Monitor and measure	10 hours	3 days per year	Years 5-10	180 hours

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Daily - 60 hours first month	Bi-weekly - 52 hrs	Monthly - 24 hours	Monthly - 24 hours	Monitor 3 times - 30 hrs	Monitor 3 times - 30 hrs	Monitor 3 times - 30 hrs	Monitor 3 times - 30 hrs	Monitor 3 times - 30 hrs	Monitor 3 times - 30 hrs
Bi-Weekly - 48 hrs rest of first year	Reporting - 32 hrs	Reporting - 32 hrs	Reporting - 32 hrs	Annual report - 8 hrs	Annual reports - 8 hrs	Annual reports - 8 hrs	Annual reports - 8 hrs	Annual reports - 8 hrs	Annual reports - 8 hrs
Reporting - 32 hrs									
				- 15 NPS support	- 15 NPS support	- 15 NPS support	- 15 NPS support	- 15 NPS support	- 15 NPS support
140 hours	**84 hours**	**56 hours**	**56 hours**	**23 hours**	**23 hours**	**23 hours**	**23 hours**	**23 hours**	**23 hours**

Subtotal = 474 hours
20% contingency = 95 hours
Total = 569hours
Total cost = $25,605.00

* Funding based on 569 hrs. @ $45.00/hr. (base rate of $40.00 over 10 years adjusted for 80% of work performed during the first 5 years)