

5.1 Introduction

The Conceptual Restoration Approaches outlined in the Maintaining Corte Madera Creek: A Citizen’s Guide to Creek-Side Property Protection report provide an outline for property owners and stakeholders to use for planning, design, permitting and construction of future stabilization and revegetation projects on Corte Madera Creek. The Conceptual Approaches emphasize limiting structural or hard approaches or adapting them to integrate roughness and revegetation components. The conceptual approaches are based on findings of the geomorphic assessment and vegetation surveys conducted to support the report. The approaches are compatible with the existing conditions and function of Corte Madera Creek. The geomorphic and habitat conditions of Corte Madera Creek are described in detail in Section 4 - Corte Madera Creek Watershed.

In this section we describe the development of bank stabilization alternatives recommended for the entire study area of the creek. The preferred situations and most appropriate locations for application of each of the conceptual approaches as well as general costs and benefits are provided. The approaches are based on the defined project goals.

5.2 Methods

The approaches range from complete removal and replacement of bank protection features to revegetation using native species. Where bank erosion and site constraints are more severe, a more limited set of approaches apply that tend to be more structural, and provide less habitat. Several of the preferred stabilization and revegetation approaches are appropriate to all three reaches of the study area.

Given the degraded and developed character certain sections of the creek corridor, there are many constraints to bank stabilization and enhancement of riparian habitat. As such, the critical goals of the stabilization approaches within the Citizens’ Guide include:

- To increase the overall stability of the creek, or at least to avoid localized solutions that unintentionally reduce the stability of neighboring reaches.
- To provide alternatives for bank stabilization and protection that improve creek function and habitat values.
- To enhance and increase native vegetation – extents and diversity. This will also support the improvement of habitat values and long-term bank stability.
- To describe preferred conceptual approaches for property protection that are consistent with local and regulatory agency priorities and jurisdictions
- To include a range of cost effective solutions that can be implemented throughout the reach.

5.3 How to Protect Creek Banks?

When done thoughtfully, stabilizing an eroding creek bank can protect the property and improve the creek resource. Preferred approaches will not increase erosion risk for neighbors up and downstream and are based on the existing physical processes and support creek habitats. Three key questions are critical when considering stabilization of an eroding bank

1. Bearing in mind the cost and process associated with undertaking a bank stabilization project, the first is to ask ‘is this protection necessary?’ If erosion directly threatens a residence it is clearly necessary to prevent the bank from undermining the structure. On the other hand if the creek bank is slowly eroding the edge of a garden it may be preferable to monitor the condition for several seasons before deciding whether and what level of intervention is appropriate. Often where the total bank height is low (eight feet or less) bank erosion may be temporary or even reverse itself, as part of the ‘**dynamic equilibrium**’ of the creek. This is particularly likely if property is on the inside of a bend. In this case, planting riparian vegetation along the edge of the creek may be more effective than using rock or hard structures. Unnecessary bank armoring protection is expensive and can make other sections of the creek less stable by increasing and transferring erosive forces downstream.
2. Second, if protection is determined to be necessary, the approach for bank stabilization and protection should address creek dynamics, bank stability and riparian habitat enhancement. As a general rule the most effective way to stabilize a bank is to regrade it to a flatter, more stable angle and cover it with a rough and resistant material. In some cases this material may be native vegetation, which both reinforces the soil and reduces flow velocities. Where erosion is more of a problem or the site is more constrained the preferred approach is typically to regrade the slope to a stable angle (2:1) and place vegetated rock revetment at the toe of slope. The engineered rock section should extend to the **bankfull** elevation on the bank at a minimum, and should be placed with native riparian branch cuttings (willows) integrated into the rock layer (Vegetated Rock).

When significant constraints exist (e.g. a threatened structure within a few feet of the top of bank) that prevent or limit bank grading, the solutions are limited to constructing retaining walls in the lower sections of the channel. Footings for walls (or any structural element) constructed in the active channel must be keyed into the channel bed to address potential scour. It is preferable to utilize construction materials or approaches that ‘roughen’ the surface of the walls to prevent creek flows from accelerating along the smooth bank and increasing erosion potential elsewhere downstream.

Durability of materials used in bank stabilization efforts is also important. For example, most construction debris is not heavy enough to withstand the flows found in Corte Madera Creek and will simply wash away and fill the creek downstream with unsightly and

potentially hazardous material. Even rock filled gabions, though very strong when constructed, only have a design life of approximately 15 years in creeks, as the wire baskets degrade (rust) and rupture.

Bank treatments must also plan for and accommodate dynamic conditions in the creek. Corte Madera Creek is incising in locations, and even robust bank treatments can be undercut as a result. Keying the bank protection into the bed of the creek to the anticipated scour depth can prevent undercutting and destabilization.

Some bank erosion is natural, and slowly eroding banks that have diverse native vegetation cover represent valuable riparian habitat. Bank conditions like this are not necessarily a problem. The presence of structures, utilities or other infrastructure close to the top of bank may guide specific stabilization requirements and approaches. Where erosion is not directly threatening property and the banks are lower (less than eight feet high) no treatment may be required beyond planting and/ or maintaining native vegetation. Where erosion occurs on a higher bank behind a yard or away from structures, the preferred approach may be to terrace or regrade the bank to a stable angle (3:1) and stabilize/ plant the bank face to provide erosion resistance and improve riparian habitat. It is typically beneficial to plant native riparian trees (for example willows, alders or dogwood). These species will help to anchor and stabilize soils, slow erosion, and provide valuable riparian habitat.

3. Finally, any bank protection approach selected should not make the erosion problem worse for other property owners and should enhance the creek environment.

Some typical guidelines for bank stabilization approaches include:

- Do not reduce the width of the creek, as this will almost certainly cause erosion in the bed, on the opposite bank, and downstream.
- Do not reduce the length of the creek (by straightening a bend for example). This action will steepen the bed profile, increasing erosion locally, and on the next bend downstream.
- Where possible, combine grading activities to flatten bank angle and using a mixture of biotechnical methods such as brush mats and willow planting.
- Where rock is required, place rock (mechanically or by hand) rather than by dumping. Dumped rock generally forms an unsustainably steep angle, which eventually collapses and rolls rock into the creek.
- Limit the upper vertical extent of placed rock for structural and erosion protection requirements on the bank slope to maximize plantable areas. Key rock into the bed several feet to prevent undercutting.
- Utilize rock sizes based on calculations of flow force and resistance.

- Integrate native trees such as willow and alder with the engineered rock bank protection. Integrated planting has several benefits:
 1. Roots anchor the soil beneath the rock, providing a living support system that increases the strength of the bank protection over time;
 2. Vegetation slows water velocities, reducing erosion both at the bank and downstream, and;
 3. Trees provide shaded cover for the creek, improving habitat conditions.

5.4 Conceptual Restoration Approaches

Six conceptual restoration approaches are described in the report. The approaches outlined include:

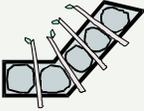
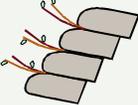
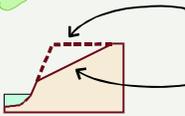
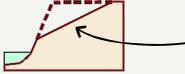
- Vegetated Rock
- Bulkhead Wall (Rock)
- Grade Control Structure (GCS)
- Biotechnical Stabilization
- Bioengineering Stabilization/ Planting
- Native Planting – Stable Channel

Descriptions of the conceptual stabilization approaches for multi-objective bank stabilization and revegetation efforts within the Corte Madera Creek study area are found below.

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Conceptual Stabilization Approaches Key

Key

	<p>Vegetated rock protection</p> <ul style="list-style-type: none"> • bankfull elevation • toe & scour protection
	<p>Bulkhead wall (rock)</p> <ul style="list-style-type: none"> • bankfull elevation • toe & scour protection
	<p>Biotechnical stabilization</p> <ul style="list-style-type: none"> • vegetated soil lifts (VSL) • brush mat with vegetated rock toe
	<p>Bioengineering stabilization (live plant materials)</p> <ul style="list-style-type: none"> • brush mat • live pole planting • biodegradable fabrics
	<p>Native tree planting</p>
	<p>Native shrub planting</p>
	<p>Existing (eroding) bank</p>
	<p>Regrade banks</p>

Potential Cost (relative)	Potential Ecological Benefit (relative)
high	high
med	med
low	low

Note: Relative cost and ecological benefit of each conceptual stabilization approach is measured against the entire set of potential approaches presented in the report. Many factors influence cost including source and extent of erosion, access, technical assistance, and permitting. Potential ecological benefits are measured primarily on revegetation potential and soil stabilization factors.

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Conceptual Stabilization Approaches

Vegetated Rock

What is the solution?

Vegetated rock is the installation of large rock to armor and protect the channel bank toe. Live pole cuttings of native riparian tree species (Alder and Willow,) typically are built into the rock section and ultimately establish and grow into the bank. The rock provides structural stabilization to the creek channel while the trees will enhance soil stabilization and habitat qualities as they establish. Vegetated rock is effective in increasing channel roughness, slowing flow velocities and reducing shear stresses. Vegetated rock can be integrated with biotechnical / bioengineering approaches and should be used for toe protection.

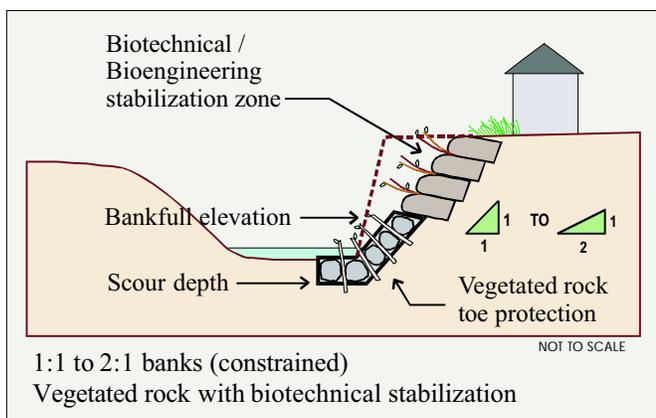
The design and installation of vegetated rock requires technical engineering analysis and design. Implementation of vegetated rock requires grading of the affected bank to key the structure into the channel and banks. The rock section must be designed to accommodate predicted scour to protect the installation from under-cutting and should be designed to the bankfull elevation. On the bank, the scour depth varies from site to site, but is usually at least 3-4 ft*.

Sequence of Installation

1. Remove old or failing bank protection
2. Regrade the bank slope to a stable slope or subgrade for biotechnical applications. (2:1 or flatter where possible)
3. Install vegetated rock section in lower channel bank
4. Install biotechnical (VSL) or bioengineering/ planting stabilization in upper channel bank

Benefits

- Flexible long-term stabilization approach
 - Can be used in high energy constrained locations
 - Stabilizes & armors toe of bank to bankfull elevation
 - Increases channel area
 - Maximizes bank area for biotechnical and bioengineering / planting approaches
 - Reduces flow velocities and shear stresses
- Improves native vegetation cover



Recommended Section

Potential Cost (relative)	Potential Ecological Benefit (relative)
med	high

*Analysis of potential hydraulic and shear stress forces as well as acceptable risk should inform design conditions.

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Conceptual Stabilization Approaches

Bulkhead Wall (Rock)

What is the solution?

Bulkhead walls are robust structural walls that resist significant hydraulic and shear stress forces to protect and retain creek banks. Bulkhead walls are most appropriate in situations where severe topographic constraints / steep banks exist that prevent or limit bank grading. Bulkhead walls may also be the preferred solution where structures, infrastructure and facilities are present and potentially threatened. The vertical extent of the bulkhead retaining walls in the lower sections of the channel should be defined by the bankfull water surface elevation to maximize areas for active planting of vegetation above the wall. Analysis of potential hydraulic and shear stress forces as well as acceptable risk should inform design conditions.

Footings for walls constructed in the active channel must be keyed into the channel bed to address potential scour and prevent undercutting. It is preferable to utilize construction materials or approaches that 'roughen' the surface of the walls to prevent creek flows from accelerating along the smooth bank and increasing erosion potential elsewhere downstream.

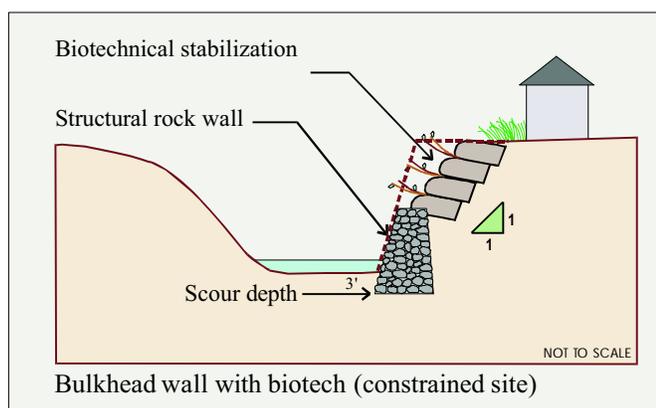
Sequence of Installation

1. Remove old or failing bank protection (if present)
2. Install bulkhead wall in lower section of channel bank to bankfull elevation (or higher if necessary)
3. Regrade the bank slope above bulkhead wall to a stable slope or as subgrade for biotechnical applications. (2:1 or flatter where possible)
4. Install biotechnical (VSL) or bioengineering/ planting stabilization on upper channel bank

Benefits

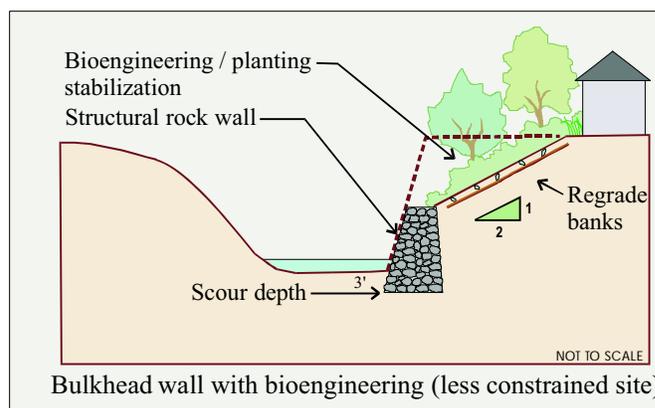
- Reliable long-term stabilization approach
- Can be used in high energy, constrained locations
- Stabilizes and armors toe of bank
- Maximizes available channel area
- Maximizes bank area for biotechnical and bioengineering/planting approaches
- Reduces flow velocities and shear stresses
- Improves potential for native vegetation cover at top of bank

Potential Cost (relative)	Potential Ecological Benefit (relative)
high	
	low



Recommended Section

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Conceptual Stabilization Approaches

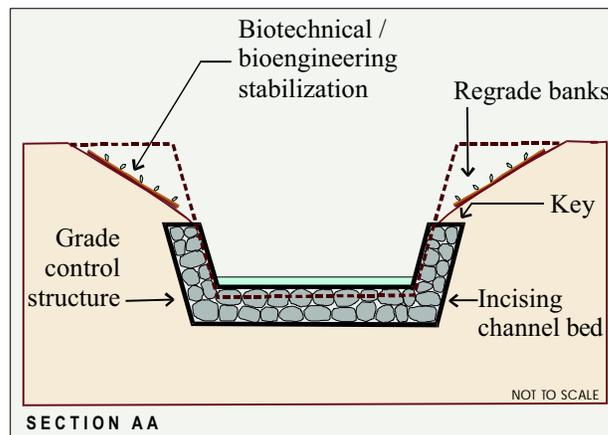
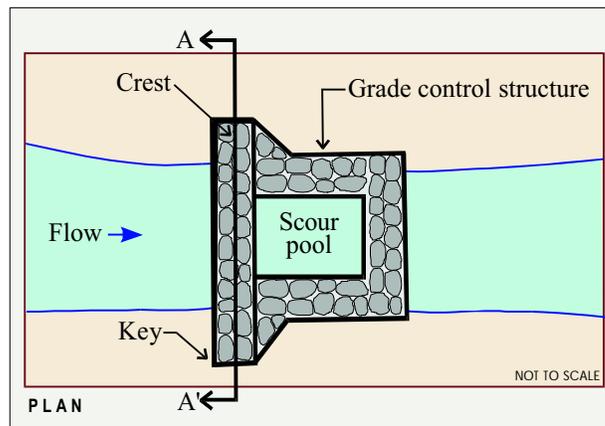
Grade Control Structure (GCS)

What is the solution?

Grade control structures are structures utilized for longitudinal channel stabilization and are typically constructed from rock, concrete or large wood elements. The structures are intended to address incision and channel profile instability by controlling and stabilizing bed materials upstream of the structure. Grade control structures are built across the entire channel and must be keyed into channel banks and bed to prevent scour and flanking. In high energy creeks like Corte Madera Creek grade control structures should address energy dissipation, incision and existing and potential habitat quality. Grade control structures can help to stabilize channel banks by raising bed levels and limiting potential of undercut banks.

Grade control structures are typically built at locations where head-cuts or channel incision are evident. These structures can have profound hydraulic affects and must be considered and designed carefully. Grade control structures in Corte Madera Creek must be constructed of materials that can resist the extreme hydraulic environment and remain stable. In this case large rock or structural concrete weirs may be the preferred materials. Grade control structures should be constructed in straight sections of the creek channel and generally should not be built on channel bends. Grade control structures must be designed on a reach scale to properly locate the top and toe of structures.

Potential Cost (relative)	Potential Ecological Benefit (relative)
high	high



Sequence of Installation

1. Identify appropriate location for grade control structure
2. Install grade control structure
3. Install biotechnical (VSL) or bioengineering/ planting stabilization around edges of grade control structure

Benefits

- Reliable long-term stabilization approach
- Can be used in high energy, constrained locations
- Raises or stabilizes channel bed elevation
- Stabilizes local bank conditions
- Mitigates flow velocities and dissipates energy

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Conceptual Stabilization Approaches

Biotechnical Stabilization:

- Vegetated Soil Lifts (VSL), Brush Mat with Vegetated Rock

What is the solution?

Biotechnical bank stabilization applications are measures that utilize structural or hard materials in combination with living plant elements. Biotechnical applications rely on structural materials for short-term protection while integral live cuttings establish and root throughout the creek bank. As the live materials establish, the roots provide long-term stabilization to the soils, the vegetation reduces flow velocities and shear stresses on the bank surface and provides improved habitat.

Potential Cost (relative)	Potential Ecological Benefit (relative)
	high
med	

Biotechnical stabilization applications can be utilized in areas that are not exposed to more significant flow conditions. Biotechnical stabilization measures employed in lower channel areas must be keyed into the adjacent bank and channel. Vegetated soil lifts (VSL) is a robust stabilization approach that involves the construction of engineered soil lifts wrapped in woven biodegradable erosion control fabrics inter-planted with live cuttings (willow, alder and dogwood). VSL can be utilized with a variety of structural toe protection approaches and in some situations can be used independently to reconstruct entire sections of bank. Brush mat with rock toe protection is another effective biotechnical stabilization that involves installation of live plant materials (willow) on the affected bank. The willow material is anchored to the bank using stakes, biodegradable fabrics and rock revetment at the toe.*

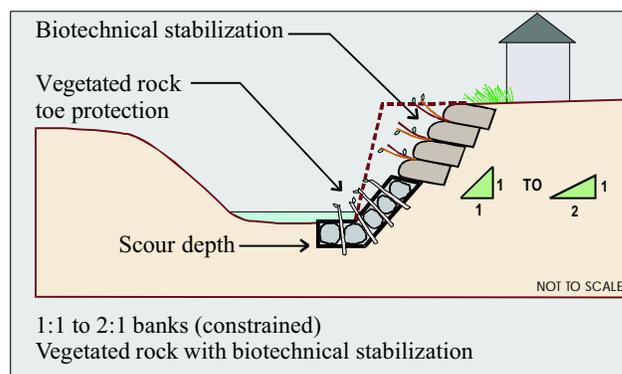
Sequence of Installation

1. Remove old or failing bank protection. (if present)
2. Regrade the bank slope to a stable slope or subgrade for biotechnical applications. (2:1 or flatter where possible)
3. Install toe protection if proscribed and as appropriate.
4. Install biotechnical stabilization on channel bank.

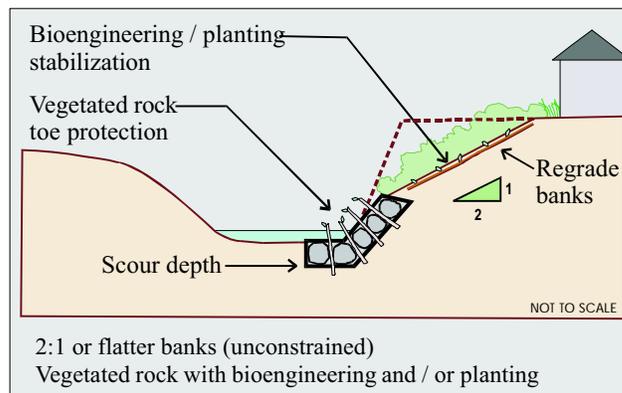
Benefits

- Reliable long-term stabilization approach
- Can be used in many locations
- Stabilizes and armors toe of bank to bankfull elevation
- Maximizes channel area
- Maximizes bank area for biotechnical and bioengineering/planting approaches
- Reduces flow velocities and shear stresses
- Improves potential for native vegetation cover

*Maintenance, such as irrigation, to support plant / tree establishment should be planned for and undertaken.



Recommended Section



Recommended Section

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Maintaining Corte Madera Creek: A Citizen's Guide to Creek-Side Property Protection

Conceptual Restoration Approaches: Reach 1, 2, and 3

Bioengineering Stabilization/ Planting

What is the solution?

Bioengineering bank stabilization applications are measures that utilize living plant materials, dead brush and biodegradable erosion control fabrics. Bioengineering applications rely on the establishment of the live plant materials throughout the creek bank. As the live materials establish, the roots provide long-term stabilization to the soils, the vegetation reduces flow velocities and shear stresses on the bank surface and provide improved habitat.

Bioengineering stabilization applications can be utilized in areas that are exposed to less significant flow and shear stress conditions. Bioengineering applications often include preparation of bank slopes through grading. Bioengineering approaches can range from live pole cuttings (willow, alder and dogwood) planted in the bank to more complex structures involving the placement of dead brush and fabrics in addition to the live plant material. Maintenance, such as irrigation, to support plant / tree establishment should be planned for and undertaken.

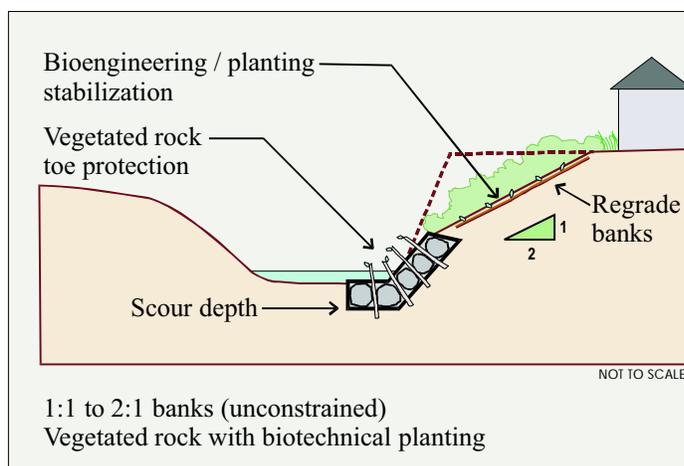
Sequence of Installation

1. Remove old or failing bank protection (if present).
2. Regrade the bank slope to a stable slope or subgrade for biotechnical applications.
(2:1 or flatter where possible)
3. Install bioengineering stabilization on channel bank.
4. Install planting and seeding.

Benefits

- Supplements and enhances other bank stabilization applications
- Stabilizes bank soils
- Reduces flow velocities and shear stresses
- Improves potential for native vegetation cover
- Improves habitat qualities

Potential Cost (relative)	Potential Ecological Benefit (relative)
low	med



1:1 to 2:1 banks (unconstrained)
Vegetated rock with biotechnical planting

Recommended Section

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Conceptual Stabilization Approaches

Native Planting - Stable Channel

What is the solution?

Planting for bank stabilization utilizes the installation of container plants, cuttings and seed to establish vegetation. Successful planting on stable channel areas may require site preparation such as non-native exotic plant removal, grading / soil preparation and vegetation management. Planting can supplement and enhance other structural and biotechnical approaches for bank stabilization. Native Willow, Alder and Dogwood species have been used successfully as cuttings in riparian settings

Potential Cost (relative)	Potential Ecological Benefit (relative)
	med
low	

Planting of native riparian species in stable channel areas can further enhance channel stability and improve habitat qualities over the long term. It is important to select an appropriate mix of tree and plant species to establish a variety of habitat elements and soil stabilization properties. Establishing native trees and plants in stable channel areas can be a proactive and cost effective measure for long term creek stability and provide important long-term benefits to the creek system.

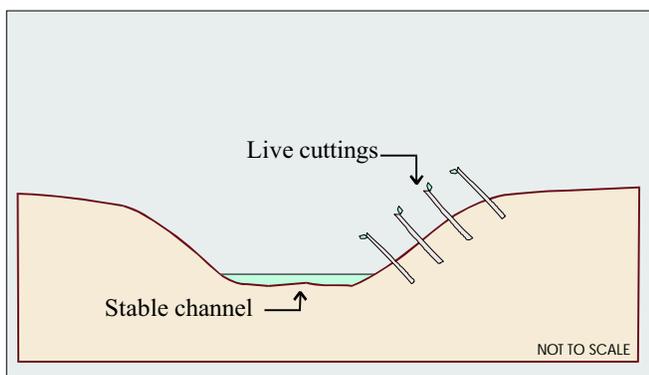
Many properties along Corte Madera Creek could better integrate the creek corridor and appropriate plantings with residential yard areas. Property owners should consider the use of native plants in projects adjacent to the creek. Maintenance, such as irrigation, to support plant / tree establishment should be planned for and undertaken.

Sequence of Installation

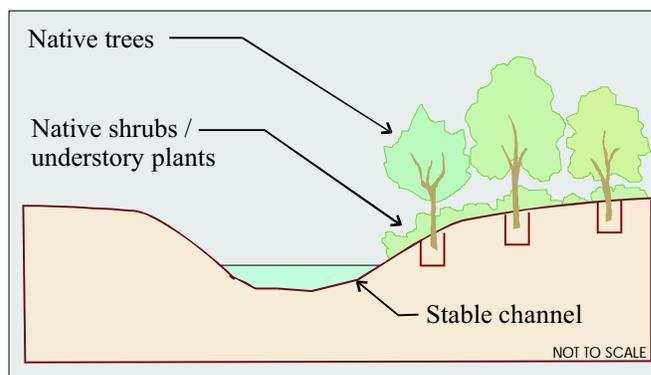
1. Remove non-native exotic species
2. Prepare site and/ or bank soils
3. Install planting and seeding.

Benefits

- Supplements and enhances other bank stabilization measures
- Stabilizes bank soils
- Reduces local flow velocities and shear stresses
- Improves potential for diverse native vegetation cover
- Improves habitat quality



Cuttings will establish and grow into trees



Stable channel native revegetation (enhanced habitat value)

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5.5 Undertaking a Stabilization Project

Bank restoration and stabilization approaches in the Citizens' Guide are outlined at a conceptual level and are not prescribed for specific locations nor are they intended for construction. Site and project specific analyses will be required for a property owner intending to plan and undertake a stabilization or revegetation project. The development of a sufficiently detailed project design will involve a team of professional consultants including a licensed professional civil engineer, geomorphologist, biologist, and geotechnical engineer. Consultation with appropriate experts can help to develop a project approach that addresses erosion in the most effective, timely, sustainable and cost effective manner.

Refer to flow chart on following page.

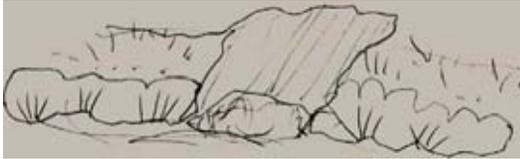
Any proposed project is subject to review and approval from a set of local and state agencies and potential federal jurisdictions. See the Section 5.6 – Permitting for more detailed information.

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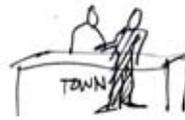
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Undertaking a Stabilization Project (in Sequence)

1. IDENTIFY PROBLEM AND PROJECT LOCATION



2. Consult with Town
- Identify Resources and existing information
 - Project Approach
 - Opportunities & Constraints



3. Consult with Professional Expertise
- Engineering & Design
 - Geomorphology
 - Permitting

4. Undertake Technical Analysis (as appropriate)
- Hydrology & Hydraulics
 - Geomorphology
 - Biology
 - Geotechnical & Soils
 - Engineering



* Define design for cost and feasibility by referring to technical analyzes

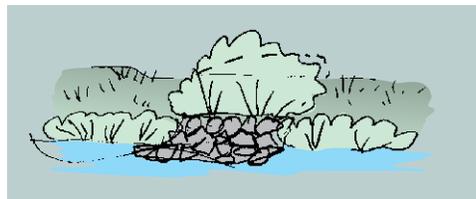
5. Develop Stabilization Design



6. Permitting
- CA Dept of Fish & Game
 - US Army Corps of Engineers
 - RWQCB
 - Town of Portola Valley

7. Contracting
- Restoration Experience

8. Construction & Monitoring



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5.6 Permitting

Various State and Federal environmental regulations require the acquisition of permits prior to implementation of stabilization projects that could affect regulated habitats (such as riparian areas and wetlands) and/or protected wildlife species. Implementation of a bank stabilization or revegetation project within the bed and banks of Corte Madera Creek would likely require a Streambed Alteration Permit (“1601-1603 permit”) from the California Department of Fish and Game (CDFG), a Section 401 Water Quality Certification from the Regional Water Quality Control Board (RWQCB), a Section 404 Permit from the U.S. Army Corps of Engineers (USACE), and a Section 7 Consultation with the U.S. Fish and Wildlife Service (USFWS) for the California red-legged frog. The following table summarizes the jurisdictional area, permit type and the average duration for receipt of a permit from each of these agencies.

SECTION 5 – Conceptual Restoration Approaches and Permitting

Table 1. Regulatory Agencies and Permits for Creek Related Projects

Agency	Jurisdiction	Permit Type	Duration for Receipt of Permit Following Application
California Department of Fish and Game	Stream bed and banks	Streambed Alteration Agreement (Sections 1600-1603)	60-90 days
Regional Water Quality Control Board	Streambed below ordinary high water and wetlands	Clean Water Act Section 401 Water Quality Certification/Water Discharge Requirement	3-4 months
United States Army Corps of Engineers	Streambed below ordinary high water and wetlands	Clean Water Act Section 404 (Nationwide or Individual Permit)	Nationwide = 3-6 months
			Individual = 6-9 months
United States Fish and Wildlife Service	Anywhere a special-status species may be impacted	Endangered Species Act Section 7 Consultation (Informal Consultation = Letter of Concurrence or Formal Consultation = Biological Opinion)	Informal = 2-4 months
			Formal = 6-12 months

The types of activities typical to most stabilization and some revegetation projects for which permits are required include, but are not limited to, the following:

- Grading, excavation, placement of fill
- Placement of materials (erosion control blankets, rock revetment, boulders, logs, drain outfalls, fences, etc.)
- Removal or planting of vegetation
- Use of herbicides or pesticides
- Diversion, dewatering, or damming of stream flow
- Disturbance of wildlife

The CDFG Streambed Alteration Agreement would be necessary for any project that affects the bed and/or banks of the creek. A 1601 permit application would be filed by a public agency while private individuals would file a 1603 application.

SECTION 5 – Conceptual Restoration Approaches and Permitting

A USACE Section 404 permit application would be necessary for any project that disturbs the creek bed below ordinary high water (approximately the 2-year flood water level) or any area designated as wetlands. Depending on the nature of the project either a Nationwide or Individual permit application would need to be submitted. Nationwide permits are more streamlined and for projects that result in minimal impacts while individual permits are more elaborate and address more complex impacts. For example, USACE Nationwide permit #13 is for bank stabilization projects, however, these projects must meet a number of limiting conditions to qualify.

The guidelines for a RWQCB Section 401 Water Quality Certification are the same as for the USACE Section 404 permit. In addition, for any work above the ordinary high water mark or in a wetland a Water Discharge Requirement (WDR) may be needed.

A Section 7 Conference/Consultation with the USFWS may be necessary whenever a project has the potential to impact a federally-listed special-status wildlife species, such as the California red-legged frog. There are two types of Section 7 Consultations, formal and informal. A Formal Section 7 Consultation requires the preparation of a Biological Assessment on the projects effects on the listed species and proposes measures to avoid, minimize and mitigate the negative effects. The formal consultation concludes with the USFWS issuance of a Biological Opinion. The Biological Opinion typically includes an incidental take statement, essentially permitting a certain amount of “take” (death of species) as well as Terms and Conditions to protect the listed species. An Informal Section 7 Consultation applies to projects that are unlikely to adversely affect the federally-listed species. If the USFWS agrees they issue a Letter of Concurrence, however an informal consultation does not provide “take” authorization.

While the permitting process seems burdensome for certain projects it is important to remember that the real reason for the laws and guidelines from the regulatory agencies is the proper management, protection and preservation of our natural resources. In the long run it is more beneficial to the local ecosystem for projects to go through the proper permitting process which includes input from biologists, environmental planners, regulatory specialists, etc. so that projects are designed to avoid and/or minimize impacts to regulated habitats and special-status species to the greatest extent possible.

Due to the multiple agencies and jurisdictions many property owners may find the project permitting process to be very daunting. Given the amount of time and energy typically associated with permit acquisition it is often much more cost effective and efficient to coordinate the permitting effort with the support of an experienced professional consultant who is familiar with the priorities and submittals required to support the process.

5.7 Recommended Trees and Plants for Corte Madera Creek

There are many benefits to using California native plants either to integrate into bank stabilization structures or for landscaping property along or within the riparian corridor. The integration of residential gardens and the riparian corridor through the installation of native plants can be a very effective approach defining a buffer or transitional zone along the creek. Property owners are encouraged to view the creek corridor and native trees and plants as resources for planning landscape and property improvement efforts. California native plants are adapted to the local climate, soils, topography, etc. and require much less maintenance and irrigation than most traditional horticultural landscaping plants. Additionally, native plants provide food and shelter for local wildlife. Plant material that originates in, and is native to, the geographic region in which it is to be used is generally the most appropriate. These are referred to as local “ecotypes”. Using local ecotypes has many added benefits, such as:

1. Ensuring the greatest success in landscaping efforts.

In general, the more closely you match the environmental conditions of the source of your plant material to that of the planting site, the better it will grow.

2. Helping to preserve the genetic diversity and integrity of native plants.

A common concern today for plant ecologists is the preservation not only of a diversity of species, but also of the genetic diversity within each species. Native species vary genetically in their adaptation to the particular localities and environmental conditions under which they grow. You can help preserve the local ecotypes in your area by using them in your landscaping.

There are many nurseries that sell local California native plants and some can collect and propagate local ecotypes from the Corte Madera Creek watershed for interested property owners.

Tables 2 and 3 list recommended tree and plant species for use in bank stabilization and landscaping/gardening applications.

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Table 2. Recommended Plant Species for Revegetation on Corte Madera Creek: Reaches 1 - 3

Common Name	Scientific Name	Creek Bank Location	
		Floodplain/ Lower bank	Upper bank/ Top of bank
Trees:			
Red willow *	<i>Salix laevigata</i>	X	
Arroyo willow *	<i>Salix lasiolepis</i>	X	
Black cottonwood ^{1,*}	<i>Populus balsamifera</i>	X	
White alder	<i>Alnus rhombifolia</i>	X	
Box elder	<i>Acer negundo</i>	X	X
Bigleaf maple ^{2,3}	<i>Acer macrophyllum</i>	X	X
Coast redwood ^{2,3}	<i>Sequoia sempervirens</i>	X	X
California bay ^{2,3}	<i>Umbellularia californica</i>	X	X
Coast live oak	<i>Quercus agrifolia</i>		X
California buckeye	<i>Aesculus californica</i>		X
Blue elderberry	<i>Sambucus mexicana</i>		X
Shrubs:			
Brown dogwood	<i>Cornus glabrata</i>	X	
Mulefat *	<i>Baccharis salicifolia</i>	X	
Elk clover	<i>Aralia californica</i>	X	
Thimbleberry ³	<i>Rubus parviflorus</i>	X	
California blackberry *	<i>Rubus ursinus</i>	X	X
Mugwort	<i>Artemesia douglasiana</i>	X	X
Snowberry	<i>Symphoricarpos albus</i>	X	X
Coyote brush ^{2,3}	<i>Baccharis pilularis</i>		X
Toyon ³	<i>Heteromeles arbutifolia</i>		X
California wild rose *	<i>Rosa californica</i>		X

¹ Species more suitable for Reach 1

² Species more suitable for Reach 2

³ Species more suitable for Reach 3

* Species commonly used in bioengineering/ biotechnical soil stabilization applications.

Table 3. Recommended Plant Species for Revegetation on Corte Madera Creek: Reach 4 (Headwaters/ Upper Watershed)

Common Name	Scientific Name	Creek Bank Location	
		Floodplain/ Lower bank	Upper bank/ Top of bank
Trees:			
Coast redwood	<i>Sequoia sempervirens</i>	X	X
Douglas fir	<i>Pseudotsuga menziesii</i>	X	X
Bigleaf maple	<i>Acer macrophyllum</i>	X	X
California bay	<i>Umbellularia californica</i>	X	X
Red willow *	<i>Salix laevigata</i>	X	
White alder *	<i>Alnus rhombifolia</i>	X	
Shrubs:			
California blackberry *	<i>Rubus ursinus</i>	X	X
Giant chain fern	<i>Woodwardia fimbriata</i>	X	
Western sword fern	<i>Polystichum munitum</i>	X	X
Thimbleberry	<i>Rubus parviflorus</i>	X	
Huckleberry	<i>Vaccinium ovatum</i>		X
California wild lilac	<i>Ceanothus thyrsiflorus</i>		X

* Species commonly used in bioengineering/ biotechnical soil stabilization applications.

5.8 Non-Native/ Undesirable Plant Species on Corte Madera Creek

Invasive non-native plants are a serious threat to the riparian ecosystems of the United States and compete with or exclude many native plant and animal species. People often introduce invasive, non-native plants both unknowingly and accidentally through landscaping. These species tend to spread aggressively and can reproduce rapidly. Their rate of growth allows them to overwhelm and displace existing native plants by reducing the availability of light, water, nutrients and space. In addition, they can reduce biodiversity, alter hydrology, soil chemistry and erodability, change fire intensity and frequency, interfere with natural succession, compete with native plants for pollinators, and replace diverse communities with single species monocultures. Some non-native plants can even hybridize with genetically similar native plant species resulting in the dilution of the genetic composition of native species populations. The proliferation of invasive, non-native plants also results in the loss of habitat and food sources for native wildlife species.

These species spread quickly due to the absence of their home-range predators and diseases, aggressive growth habits, abundant pollen and seed production and seed that remains viable for long

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periods in the soil. Often there is a lack of organisms adapted to eating or competing with the invasive plant in the ecosystem that is being invaded.

Some of the most abundant and problematic invasive, non-native plants of riparian ecosystems of the San Francisco Bay Area are shown in the table below.

Table 4. Common Invasive, Non-native plant species of the San Francisco Bay Area

Common Name	Scientific Name
French broom*	<i>Genista monspessulana</i>
Scotch broom	<i>Cytisus scoparius</i>
Himalayan blackberry*	<i>Rubus discolor</i>
Cape ivy*	<i>Senecio mikanioides</i>
English ivy*	<i>Hedera helix</i>
Periwinkle*	<i>Vinca major</i>
Pampas grass*	<i>Cortedaria selloana</i>
Giant reed	<i>Arundo donax</i>
Poison hemlock*	<i>Conium maculatum</i>
Wild fennel	<i>Foeniculum vulgare</i>
St. John's wort*	<i>Hypericum sp.</i>
Blue gum	<i>Eucalyptus globulus</i>
Tree-of-heaven	<i>Ailanthus altissima</i>

*Observed in Reaches 1-4 of Corte Madera Creek

Planting of invasive species listed above should be avoided in and adjacent to Corte Madera Creek. In addition, there are numerous opportunities to enhance the riparian habitat along Corte Madera Creek by removing invasive understory species and revegetating the understory with native shrubs and grasses.

For additional resources and information regarding encouraged native and discouraged non-native plant species in the Town of Portola Valley refer to the Design Guidelines – Town of Portola Valley (Revised September 2003). This document is available at the Town Planning Office.

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SECTION 6 - Creek Walks

Four Creek Walks were organized by the Town and supported by the project team to introduce the *Maintaining Corte Madera Creek: A Citizens' Guide to Creek-Side Property Protection* report to interested community members. These coordinated sessions, hosted by Town residents who live along Corte Madera Creek, focused on bringing small groups of interested creek-side property owners and Town staff together for presentations of the overall project approach and methodology as well as discussion of issues and concerns regarding a diversity of topics relating to Corte Madera Creek. The walks were held within each of the three primary study reaches within the project area, and each included a visit to the creek for a question and answer session with the technical members of the team.

The Creek Walks were intended to encourage input and solicit feedback from stakeholders in order to establish understanding, interest and support for the Citizens' Guide. Early in the project, the team members determined that an engaged, participatory process, targeted at the stakeholders most impacted by Corte Madera Creek, would provide valuable input to the project.

During the Walks the team presented an overall summary of physical and biological processes that influence erosion conditions within the Corte Madera Creek watershed. In addition to the existing conditions, typical problems, issues and recommendations associated with bank stabilization and revegetation on the creek were also presented.

The Creek Walks became productive venues for the Town, JPA and project team to introduce the Citizens' Guide. The events allowed for broad and enthusiastic discussion of elements presented in the study as well as exchange of ideas and experiences between the attendees. Turnout and participation in each of the events was generally limited to neighbors who lived near the host residence. Summaries of input from each of the Creek Walks are provided below:

Reach 1

The Creek Walk for Reach 1 was held on April 21, 2005. Specific topics of interest explored during the walk included permitting, emergency protocols and the desire for 'pilot' or reference projects in the Town. Several attendees communicated their concern and frustration around the project permitting process and the irony that the process may actually discourage well-intentioned property owners from undertaking beneficial projects. The sense was that people who chose to implement responsive, creek sensitive projects are often 'penalized' by regulatory agencies. The project team members acknowledged this concern and worked to clarify the groups' understanding of regulatory priorities and recommendations to facilitate the project planning, design and implementation process.

The group discussed some of the typical problems that have been associated with bank stabilization measures undertaken under flood conditions/ emergency permits. Although the Citizens' Guide does not provide specific guidance on erosion control and bank stabilization activities under emergency situations the group discussed potential collaborative and regulatory opportunities that could improve coordination between the residents and Town.

The attendees were interested in seeing example projects that could be used as references by property owners to better understand potential approaches for bank stabilization projects. The group discussed the value of ‘pilot’ or demonstration projects to help develop understanding and confidence in the approaches outlined in the Citizens’ Guide. Team members pointed out that several example projects are presented in the appendices of the Citizens’ Guide.

During the visit to the creek the group noted the wide riparian corridor and coinciding native tree canopy. Project team members and Town staff also facilitated discussion of a failing bank protection (gabion) structure and alternative approaches for bank stabilization and property protection. The team members outlined the types of technical analyses and expertise that are typically required to develop understanding of geomorphic and hydraulic conditions at a given site. The group discussed the role of woody debris within the creek corridor and specifically considered potential management practices that allow for woody debris accumulations for habitat values while accommodating flood protection goals.

Reach 2

Two Creek Walks were held in Reach 2 due to the high level of community interest. The first Walk, held on April 26, 2005, had a large turnout and the group was particularly engaged in discussions focused on specific types of bank protection measures, fish populations and creek management responsibilities. There was interest in the different characteristics and function of specific bank protection structures. The team members discussed how bank roughness can influence flow velocity and shear stress conditions and in turn erosion of the creek bed and banks. In particular, the group reviewed the integration of native vegetation as a way of improving upon structural stabilization solutions. The group’s discussion also focused on the consideration and design of transitional features for all bank stabilization measures such as scour protection, cut-off features and critical water surface elevations. The natural resources (plant and animal communities) of Corte Madera Creek were identified as community assets. There was interest in native fish populations and potential actions to improve aquatic habitats.

During the visit to the creek the group observed the destabilization of a rock revetment structure, native riparian tree establishment and multi-stage channel features. Team members emphasized the relationship between flow conditions (velocity, direction, water depth) and determination of appropriate bank stabilization measures. The group discussed the preferred approach to limit the use of more structural stabilization approaches (vegetated rock, gabions, bulkhead walls) based on shear stress analyses and the presence of residences, utilities and/or other threatened property. In particular, the team members presented the benefit of using structural responses in the lower sections of the channel to maximize plantable areas in the upper bank that are typically less susceptible to erosive forces. Project team members and Town staff also facilitated discussion of approaches for retrofitting existing structures with native plantings to improve long-term stability and habitat values. The group

discussed the role of woody debris within the creek corridor and specifically considered potential management practices that allow for woody debris accumulations for habitat values while accommodating flood protection goals. Additionally, the attendees discussed ideas for neighborhood coordination and potential protocols for public input to the project planning process. There was considerable interest in understanding and discussing how one property owner's project may impact erosion and property protection requirements downstream.

The second Walk was held on May 14, 2005. Key issues that were raised during this Walk included a desire to coordinate bank stabilization and revegetation efforts to protect property and improve the Creek's function and health. Several attendees presented their concern regarding site specific projects that fail to consider impacts to the creek system as a whole and adjacent property owners. Interestingly, one attendee visiting from Los Altos shared their experience with channelized, eroding and degraded sections of Adobe Creek and in particular stressed the need and value of residents working together to develop comprehensive solutions for creek restoration. There was an emphasis on the social aspects of creek restoration work and a recognition that committed groups of people can influence decision-making and improve planning for property protection and environmental enhancement efforts. Given this discussion, the group appreciated the relative health, beauty and quality of Corte Madera Creek and hoped to explore future creek protection planning and coordination as a group with the Town.

Reach 3

The Creek Walk for Reach 3 was held on April 21, 2005. Specific topics explored by the attending group during the Walk included discussion of creek history and processes, opportunities and benefits of integrating garden areas with the adjacent riparian corridor and the desire for 'pilot' or reference projects in the Town. There was significant interest in and support for the Citizens' Guide as well as the surveys that were undertaken to support the project. Many attendees of the Reach 3 Walk shared their recollections of their experiences with Corte Madera Creek. There was particular interest in the history of human development and recreation, fish populations and flooding on the creek.

Like the attendees in the Reach 1 Creek Walk this group was also interested in seeing example projects that could be used as references by property owners to better understand potential approaches for bank stabilization projects. The group discussed the value of 'pilot' or demonstration projects to help develop understanding and confidence in the approaches outlined in the Citizens' Guide. Team members referred the attendees to the example projects presented in the appendices of the Citizens' Guide.

During the visit to the creek the group focused on recommendations and activities that property owners can undertake to integrate their garden areas with the adjacent riparian corridor. Some of the benefits of this approach include non-native vegetation management, native planting/revegetation, habitat enhancement and aesthetic improvements. Attendees discussed use of herbicides along the

SECTION 6 - Creek Walks

creek and concerns regarding potential infiltration and contamination of the creek (the application of herbicides and pesticides is a regulated activity). Additionally, the attendees discussed ideas for neighborhood coordination and potential protocols for public input to the project planning process. There was considerable interest in understanding and discussing how one property owner's project may impact erosion and property protection requirements downstream.

The Town and JPA intend to maintain the initiative and interest around the Maintaining Corte Madera Creek: A Citizens' Guide to Creek-Side Property Protection report through several coordinated activities. Opportunities for outreach and education with the Town staff and residents through presentations of the Citizens' Guide and its objectives should be identified and pursued. The Maintaining Corte Madera Creek: A Citizens' Guide to Creek-Side Property Protection report is intended to initiate and establish a supportive and collaborative framework to encourage multi-objective bank stabilization ongoing efforts between the Town and community. Effective and comprehensive change and improvement in bank protection and stabilization activities, both public and private, will be supported by the provision and availability of appropriate information and resources. The project team has identified a number of potential actions for further consideration going forward. These are listed below:

- Undertake and coordinate a local 'Creek Awareness Campaign'.
- Sponsor additional Creek Walks to build interest and awareness of the Citizens' Guide and commitment to desirable creek-side property protection activities.
- Establish stronger partnership, coordination and collaboration between the Town of Portola Valley, its residents and other organizations such as the school district, watershed protection groups and neighboring municipalities.
- Post and provide the Citizen's Guide on the Town of Portola Valley's webpage. Make the report easily available to Town staff and residents via the Internet.
- Identify and develop 'pilot projects' to demonstrate preferred stabilization and revegetation techniques, and include monitoring to track success. These could be collaborative efforts led or sponsored by the Town of Portola Valley. Potential projects should be located in visible areas where typical project conditions and constraints are similar to those encountered by the Town's citizens.
- Develop and advertise standard protocols to improve Town and property owner coordination in the event of emergency and/ or flood conditions.
- Develop a Corte Madera Creek stabilization and enhancement master plan for the 6-mile study area or individual study reaches to identify key erosion issues and causes as well as specific recommended stabilization measures. Additionally, a master plan could determine where reach scale grade control is required vs. individual bank protection schemes. This plan would effectively separate out regional vs. homeowner scale projects.
- Develop a GIS database to present existing conditions along Corte Madera Creek and the Conceptual Restoration Approaches for recommended bank stabilization activities.
- Produce and display posters, brochures and handouts based on the Citizens' Guide to Creek-Side Property Protection.

