Marin Municipal Water District
Vegetation Management Plan Update

Interim Background Report No. 7

Vegetation Management Plan Alternatives Report

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Prepared for: Marin Municipal Water District
220 Nellen Avenue
Corte Madera, CA 94925

Prepared by: Leonard Charles and Associates

In Collaboration With:
Brenton VMS
Garcia & Associates
Pesticide Research Institute
Shelterbelt Builders
Wildland Resource Management

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1. Purpose of This Report

MMWD is in the process of updating the Vegetation Management Plan (VMP) that it adopted in 1994. The 1994 plan focused on managing vegetation to reduce the risk of wildfire affecting the District's Mt. Tamalpais watershed and adjacent private properties. However, it also addressed the impacts of the spread of invasive species on the ecological health of the watershed and loss of biodiversity due to suppression of fires and other ecological processes.

The current VMP update aims to revise the original plan to address altered conditions, new threats to biodiversity, improved management techniques and other changes that have occurred in the past 15 years.

To prepare the update, the MMWD consulting team has thus far prepared six background reports, and MMWD has conducted public meetings to discuss the findings of the first three reports with the public. Prior to the VMP update beginning, MMWD also conducted a public meeting regarding fire hazard. In the spring of 2008, MMWD conducted a Biodiversity Symposium to address the watershed biological resources and threats to those resources. All background reports are available for review on the MMWD website at http://www.marinwater.org. In addition, there was an initial public meeting to discuss the scope for the update and the initial plan goals.

This seventh background report is meant to outline the goals and objectives; provide a preliminary discussion of costs; and describe the two alternatives that are proposed for further assessment in the Draft VMP. Following the public meeting on this seventh background report and consultation with the MMWD Board of Directors, the consulting team will prepare the Draft VMP for public review and MMWD Board consideration. Once the Board accepts a Draft VMP, that plan will undergo CEQA review.

This report focuses on alternate approaches to controlling high priority invasive species. The consulting team and District staff are cognizant that the watershed's resources will be affected by substantial changes and forces over the coming decades. Independently and acting together, Sudden Oak Death syndrome (SOD) and other plant diseases, global climate change, the continuing suppression of wildfire, and the expansion of invasive species on the watershed will alter the ecosystem. As discussed below in Section 2, an overriding aim is to make the watershed as resilient as possible in the face of these coming changes. We do not presently have a good idea of how to address most of these factors. We do not know the full ramifications of global climate change or what actions should and could be taken in its face. There is no solution to SOD at a landscape level. It is not feasible to reintroduce wildfire on a landscape basis. However, we do know how to stop the spread of invasive species and how over time to remove the high priority species from already-invaded portions of the watershed. So, while the alternatives described later in this report do address global climate change, SOD, fire suppression, and other factors, the key differences in the alternatives are what resources are available to control and/or remove high priority invasive species for the watershed.

2. Plan Goals and Objectives

The basic goals of the plan update were prepared and presented to the public at a workshop on January 23, 2008. The basic goals are:

- Maintain the existing significant biological resources of the watersheds.

- Restore degraded habitats on the watersheds.

- Reduce the hazard of uncontrolled wildfires along the residential perimeter of the Mt. Tamalpais watershed and limit the extent of damage within and adjacent to that watershed should a wildfire occur.

- Revise future management decisions as needed to respond to changing conditions, and to develop a foundation for developing a management strategy that addresses long-term ecological changes.

Subsequent to that meeting, the consulting team working with MMWD staff has taken these basic goals and developed more explicit draft goals, objectives, and projects to implement the objectives that will guide development of the future Vegetation Management Plan. These goals, objectives and projects are described in the Background Report No. 4 titled *Draft VMP Goals and Objective*s. The specific projects to implement the objectives are draft suggestions. They have been developed in preparing the Biodiversity Management and Fire Chapters of the VMP (Background Report Nos. 5 and 6).

Goal 1 – Maintain existing significant biological resources.

Objective 1.1 Complete the inventories and mapping of significant resources and high priority invasive species.[1]

- Update and revise the special-status plant inventory and maps.

- Inventory and map wetlands and aquatic habitats throughout MMWD lands.

- Inventory and map old-growth or otherwise significant stands of coast redwood

- Inventory and map high priority invasive species, and other important invasive species, and continue to update on an on-going basis.

- Continue to map the spread of SOD through the MMWD watersheds.

[1] "Significant resources" are defined as special status species of plants and animals, wetlands, aquatic resources, and important and high quality habitats. These habitat types include oak woodlands, old growth redwoods, and native grasslands. "High quality habitats" are areas or sites within important habitats that remain relatively undisturbed by human activity, and that have relatively low levels of non-native plant cover, meaning that they are relatively uninvaded by weeds. "High priority invasive species" are species of greatest concern to the District. These weeds are listed in the Background Reports on Weed Control Techniques – available on the District website.

- Inventory the bryophytes (mosses and liverworts), lichen, and fungi.

Objective 1.2 Detect changes to special status species populations and other significant resources.

- Monitor the status of special-status plants and animals.

- Track the characteristics of ecological succession in SOD-related tree canopy openings.

Objective 1.3 Protect special status species and other sensitive resources from damage caused by District maintenance, construction, and fuelbreak projects.

- Develop and implement standardized monitoring for all District actions and projects.

Objective 1.4 Preserve the biological diversity and structure of significant plant communities that are in the process of being modified due to fire suppression.

- Develop and implement a Landscape Fire Plan that identifies locations in grasslands, oak woodlands or other significant, important or high quality habitats where succession resulting from fire suppression is changing community structure and composition. The plan will identify actions to either reintroduce fire into the landscape or conduct actions that mimic desirable results of a wildfire.

Objective 1.5 Preserve significant streams, wetlands, and associated vegetation types.

- Develop and implement a Wetland Preservation Plan to protect streams, other wetlands, and associated vegetation.

Objective 1.6 Eradicate high priority invasive species from high quality habitats.

- First priority is to remove high priority invasive species from sites with high quality habitats. The first priority is to remove broom from all fuelbreaks even though these generally are not considered high quality habitats. Treating fuelbreaks addresses fire hazard reduction and biodiversity objectives since it would free up resources to conduct other vegetation management projects; see Objective 4.5 below.

- Second priority is to remove new infestations of high priority invasive species found in high quality habitat areas. The target is to remove plants before they produce a seed crop. This would be done by implementing the EDRR plan (see below).

- Third priority is to remove existing small infestations of high priority invasive species found in high quality habitat areas. The target is to remove all plants of high priority invasive species capable of producing seed within 5 years and to re-treat the areas to maintain this weed-free status. The area identified for treatment under this priority would be the core watersheds of Mt. Tamalpais (i.e.,

the watersheds of the four reservoirs along Lagunitas Creek), Nicasio Island, and two small broom populations, one at Soulajoule and one at Nicasio.

- Fourth priority is to **r**emove discrete established infestations of high priority invasive species from high quality habitat in watersheds not included under Priority 3 (Deer Park, Phoenix Lake, and the south side of Mt. Tamalpais). There is a list of approximately 10 sites on the Mt. Tamalpais watershed.

- Fifth priority is to remove high priority invasive species infestations from facility sites on the Mt. Tamalpais watershed.

Objective 1.7 Prevent the spread of invasive non-native species into high quality habitat.

- Develop and implement an Early Detection-Rapid Response (EDRR) Plan that will describe how new invasions will be identified, reported and treated.

- Develop and implement a Weed Dispersal Prevention Program for equipment and landscape materials used on the watershed.

Objective 1.8 If resources are available, eradicate high priority invasive plant species from habitats that are not high quality.

Goal 2 – Restore degraded habitats.

Objective 2.1 Restore degraded high quality habitats.

- Develop and implement 10-year restoration plans for areas with significant biological resources, and important habitats, especially those areas with high quality habitats. Currently proposed projects include the following:

    - Native grassland restoration, including separate plans, to be completed within 7 years, for:

        - Potrero Meadow (Mt. Tamalpais watershed);
        - Nicasio Island (Nicasio watershed);

    - Oak woodland restoration, including separate plans, to be completed within 7 years, for:

        - Elliot Trail (Mt. Tamalpais watershed);
        - Pine Point (Mt. Tamalpais watershed); and

    - Wetlands, riparian and aquatic habitat restoration, including separate plans, to be completed within 7 years, for:

        - High Marsh/Hidden Lake area (Mt. Tamalpais watershed).

Goal 3 –Review and revise management decisions in response to changing conditions.

Objective 3.1 The District will monitor conditions and the results of actions and, if warranted, revise the management approach.

- Monitor the effectiveness of high priority invasive species treatments; conduct on-going review of progress and conditions; revise at least once every three years.

- Evaluate results of initial broom removal after 5 years, and if expected understory development has not occurred, implement follow-up actions such as modifying broom removal techniques and replanting with natives.

- At least once every 3 years, evaluate the progress of each preservation and restoration action, and modify methods and schedules, as needed.

Objective 3.2 Update the integrated Pest Management (IPM) policies and techniques toolbox in response to new information.

- Review and update the Integrated Pest Management program, as needed, including selection criteria for tools and techniques.

Objective 3.3 Develop a long-term vegetation management strategy that takes into account possible large-scale changes from forest pathogens, global climate change, and increased nitrification.

- Develop a long-term strategy for managing MMWD lands that incorporates new research and findings regarding SOD, other plant pathogens, nitrification, and Global Climate Change.

- Revise the vegetation map in 2014 to document landscape level changes.

- Participate in regional climate change research and forums.

Objective 3.4 Experiment with emerging restoration and weed control techniques and incorporate into the VMP those that are effective and safe.

- Assess the feasibility of reintroducing livestock grazing to the Soulajoule watershed.

- Conduct experiments to determine the efficacy of new biological herbicides.

- Conduct experiments to identify suitable methods for teasel control within the Nicasio watershed.

- Encourage biological research and continue to review and utilize the results of that research in managing MMWD lands.

- Develop a pilot study to assess methods to influence vegetative succession following the loss of dominant species due to SOD or other diseases.

- Conduct experiments to identify suitable methods for teasel control within the Nicasio watershed.

Objective 3.5 Continue to work with the public to foster education, research, and volunteer efforts.

Goal 4 – Minimize the risk to life and property from wildfire.

Objective 4.1 Prevent destruction of structures and loss of life from wildfires.

- Manage fuels near structures on the watershed.

- Recommend best management practices for creating defensible space for residential neighbors adjacent to the watershed lands.

- Provide neighboring private landowners at risk from a wildfire starting on or crossing the watershed with maps and information they can use to treat their own vegetation and structures to increase the survivability of their improvements.

Objective 4.2 Minimize the size of wildfires on the watersheds.

- Complete construction of the fuelbreak system within years.

- Re-treat fuelbreaks as warranted to manage fuels.[2]

Objective 4.3 Reduce the potential for fire ignitions.

- Cut easily ignitable fuels in critical areas or change the vegetation type to one that is less flammable.

Objective 4.4 Manage fuels to provide safe access and evacuation.

- Mow grass, thin the understory, and prune trees adjacent to fire access roads.

- Treat vegetation to provide safe evacuation routes.

[2] Currently, the fuelbreak system contains about 960 acres on MMWD lands, with an additional 120 acres to be constructed in the next 1 to 3 years. This includes: 117 acres managed to provide defensible space; 210 acres managed for primary fire containment; 284 acres managed for secondary containment; 396 acres managed for wide area fuel reduction; 71 acres managed for safe access; and 5 acres for other purposes. An additional 470 acres of adjacent have been identified as having strategic importance to the MMWD fuelbreak system. MMWD will partner with local fire departments and adjacent owners (private, county, state and federal) to encourage adequate fuels management in these strategic zones.

Objective 4.5 Manage broom in fuelbreaks.

- Eradicate broom to reduce the need to cut/mow fuelbreaks.

Objective 4.6 Work with other agencies and landowners to reduce fire hazard.

Goal 5 Preserve the aesthetics and recreational opportunities of District lands.

Objective 5.1 Continue to manage the watersheds to provide recreational opportunities for visitors.

- Keep lakeshores open for fishing access.
- Keep trails open for access.
- Develop and implement a volunteer recruitment and training program.

3. Extent of Invasion of the Mt. Tamalpais Watershed by High Priority Invasive Species

To date, MMWD staff has identified and mapped approximately 1,200 acres that have been colonized by high priority weeds in the Mt Tamalpais watershed (Biodiversity Management Plan, Table 4). Mapping efforts are incomplete in the Mt Tamalpais Watershed and are only in the preliminary stages for the Nicasio and Soulajoule watersheds. Within the Mt Tamalpais Watershed, weed distribution is concentrated along the wildland-urban interface (WUI) or the southern and eastern boundaries of the watershed. Analysis of vegetation and weed map data has shown that, regardless of location, some vegetation types are more vulnerable to invasion than others: Table 1 lists the 20 most vulnerable vegetation types and provides the percent of each type known to be invaded by high priority weeds.

The 1,170 gross acres of mapped weeds are dispersed irregularly through the 18,500 acre Mt Tamalpais watershed. For planning and management purposes the District has divided the Watershed up into discrete Vegetation Management Units (VMU). VMUs are designated as fuelbreaks, prescribed burn units, managed sensitive habitat, roadside corridors, habitat restoration areas, or “unmanaged” areas where there is little to no regular manipulation of vegetation. One VMU represents the total acreage covered in order to accomplish a particular management objective, not the actual acreage of a given species. For example, VMU 0024 encompasses the entire 66 acres that need to be surveyed and treated in order to eradiation an estimated 6.5 acres of goat grass.

Approximately 2,500 acres or 14% of the Mt Tamalpais Watershed fall within 105 actively managed Vegetation Management Units that have some degree of identified infestation by high priority weed species. For purposes of developing cost estimates, it is estimated approximately 750 acres that is designated as fuelbreak are infested; of this total, there are approximately 300 net acres of invasive broom. There are another 600 net acres of land outside the fuelbreak system that has been invaded by broom, 95 acres invaded by yellow star thistle or purple star thistle, and 50 acres invaded by other high priority invasive species. The other two watersheds have an estimated 200 acres of

high quality habitat that has been invaded. For cost estimating purposes, the total acreage on the Mt. Tamalpais watershed that contains some high priority weeds is 1,500 acres, and 200 acres of high quality habitat on the other two watersheds.

Table 1
High Priority Invasive Species Distribution in Watershed Vegetation Types

Vegetation Type	Percent of Total Acreage of the Vegetation Type with Broom	Percent of Total Acreage with Yellow or Purple Star Thistle	Percent of Total Acreage with Other High Priority Weeds	Percent of Acreage Infested with High Priority Weeds
Bulrush Alliance	96%	0%	0%	96%
Valley Oak Riparian Mapping Unit	66%	1%	0%	68%
Dam Face	41%	25%	0%	66%
California Bay-Buckeye	63%	0%	0%	63%
Urban Developed-Built Up	29%	22%	0%	52%
California Buckeye Alliance	49%	0%	0%	49%
Cattail Alliance	48%	0%	0%	48%
Undefined	39%	7%	0%	46%
Temporarily flooded or saturated Meadow Edge	19%	0%	19%	38%
Coast Live Oak Alliance	31%	0%	3%	33%
Coyote Brush-California Sagebrush - Sticky Monkey	32%	0%	0%	32%
Coast Live Oak-Riparian	31%	1%	0%	32%
Sparsely Vegetated or Unvegetated Areas	22%	10%	0%	31%
California Bay-Coast Live Oak	31%	0%	0%	31%
Mixed Willow Mapping Unit	19%	0%	11%	31%
Coast Live Oak-Madrone Lower elevation Mixed Broadleaf Woodland	29%	0%	0%	30%
Black Oak Alliance	25%	0%	0%	25%
Madrone-California Bay-Tanoak Forest	24%	0%	1%	25%
California Bay-Alder-Bigleaf Maple - Mixed Willow Riparian Forest	24%	0%	0%	24%
Coast Live Oak / (Grass-Poison Oak)	20%	0%	2%	22%

4. Estimating the Costs of Eradicating and Controlling High Priority Invasive Species

Estimating how much it would cost to control or eradicate a particular high priority invasive species from large areas is an imprecise science. While reasonably accurate estimates can be prepared for specific sites of a few acres, it is difficult to precisely calculate costs over hundreds of acres of sites that have substantially different characteristics and constraints. In preparing these estimates, we gathered data from

MMWD, other public landowners, and from private contractors who are on the consulting team.

The cost estimates from other public agencies in the area includes unpublished data that were provided to Janet Klein of MMWD. MMWD maintains records about the time and costs for the techniques that are being considered for use. The labor and direct cost expenses are shown in Table 2; they were used to develop the draft cost estimates presented in the next section of this report. The costs are shown for the techniques that have been identified as feasible techniques that could actually be used on the watershed.

The costs listed in Table 2 are average costs. In some of the management units mapped as being invaded by broom , broom stands are very extensive and the costs are significantly higher than described in Table 2. In other units, the broom stands are considerably smaller or less dense, so the per acre cost listed in Table 2 is higher than what it would actually cost. The overall average annual cost for hand and mechanical treatments over a 10-year treatment period is estimated to be $3,750. The average annual cost that includes the use of herbicides is $650 an acre. Mowing or cutting costs an average of $550 per acre.

Brenton VMS and Shelterbelt Builders (members of the VMP consulting team) have extensive experience assessing and implementing high priority invasive species control projects on public lands (i.e., at a landscape level of treatment). They have prepared an average cost for treating high priority invasive species by the several techniques that could be included in the final VMP. They have also developed a pricing matrix for herbicide treatment that accounts for eight variables. Once MMWD approves an alternatives approach, this approach will be used to provide more detailed price estimates for implementing the new VMP.

Comparing the cost estimates prepared by MMWD based on their experience and the costs for contractor crews prepared by such contractors (Brenton VMS and Shelterbelt Builders) shows that generally MMWD is able to get mechanical and hand vegetation management done less expensively than contractors typically charge; herbicide application costs are similar for MMWD crews and contractors.

This report assumes that most vegetation management projects will be conducted by MMWD staff or private contractors. Other labor sources available are volunteers, workers from the Adult Offenders Work Program (AOWP), and Americorps volunteers. Cost estimates do not include these other labor sources because the AOWP is an erratic program, and workers are frequently not available plus the production rate from these crews is low (they treated about 7 acres of broom in 2007). Similarly, volunteers are restricted to handpulling, and the production rate is low (see Background Report No. 2). Volunteers pulled broom from about 5 acres in 2007. While volunteer labor is extremely valuable, as it can be used on sensitive sites where handpulling is the appropriate technique, it is not effective on a landscape scale As Background Report No. 2 states: "As an example, if 500 volunteers turned out and worked 4 hours two days a year, MMWD would be able to treat about 13 acres of adult plants a year."

Table 2
Costs for Proposed Techniques for Treating High Priority Invasive Species

Treatment	Labor Type	Labor Source	Average Hours/ Acre	Hourly Labor Rate	Labor Cost Per Acre	Additional Expenses	Additional Expenses Per Acre	Total Cost
Handpulling/Weed Wrench	Initial Clearing with slash disposal	Contract Crews	350	$25	$8,750	Pile burning or slash disposal	$6,250*	$15,000
Handpulling/Weed Wrench	Initial Clearing	Contract Crews	350	$25	$8,750	N/A		$8,750
Handpulling/Weed Wrench	Follow-up	Contract Crews	200	$25	$5,000			$5,000
Propane Flaming	Follow-up	Contract Crews	75	$25	$1,875	Propane	$550	$2,425
Handpulling/Weed Wrench	Maintenance	Contract Crews	10	$25	$250			$250
Brushcutting	Initial Clearing	Contract Crews	24	$25	$600			$600
Heavy Equipment	Initial Clearing	MMWD	Variable	Variable	Variable	Equipment		$550**
Spot Herbicide Application	Follow-up after Brushcutting	Contract Crews	4	$75***	$300			$300

* Assumes 50% pile burn disposal at 250 hours/acre
** Cost as MMWD average over 8 years
*** Average of cut-stump, foliar, basal bark, and low volume application methods

5. Existing Costs

The District estimates the total 2008/2009 cost of the vegetation management program is $1,263,673. This total includes an operational budget of $1,026,273 in planning and administration, labor, materials, non-capital equipment, consulting, and contract services (Table 3).[3] This also includes $100,000 in capital equipment and an additional $137,400 in funds provided via hazard reduction grants, Marin County Fire Department assistance, the Marin County Probation Department Adult Offender Work Program (AOWP), and volunteer in-kind service donations.

MMWD has prepared the following tables showing how much of the MMWD total budget ($57,117,616 for fiscal year 2007/2008) was spent on Vegetation Management between 2006 and the 2008/2009 budget. In Fiscal Year 2008/2009, staff salary accounted for approximately 50% of the Total Vegetation Management Operational Budget.

Table 3
Vegetation Management Operational Budget
(includes management of the Mt Tamalpais, Soulajoule, and Nicasio watersheds)

Fiscal Year	Fuelbreak Maint.	Habitat Restoration	Roadside Brushing	Dam Maint.	Hazard Tree Removal	Planning Admin.	Total
05/06	$ 167,024	$ 87,688	$ 91,863	$ 16,702	$ 54,283	$393,470	$ 811,030
06/07	$ 164,528	$ 86,377	$ 90,490	$ 16,453	$ 53,472	$387,590	$ 798,910
07/08	$ 250,405	$ 80,000	$ 90,490	$ 16,453	$ 68,472	$405,965	$ 911,785
08/09	$ 281,847	$ 90,045	$101,852	$ 18,519	$ 77,070	$456,940	$ 1,026,273

6. Estimated Costs for Implementing All Potential Projects

To realize the proposed objectives and implement the specific projects listed in Section 2 above will require a significant commitment of time and resources. The cost estimates developed to date (to be refined in the final VMP) are described below. Costs for weed control and mowing are initial order-of-magnitude estimates, and final cost estimates may range from 20% lower or higher than these draft estimates. Costs are estimated for 1) implementing the projects using only mechanical or hand work or prescribed burning, and 2) implementing the projects using the above methods with supplemental application of up to three conventional herbicides and the three organic herbicides being considered for use on the watersheds. Cost projections extend 10 years out, but do not adjust for inflation.

Table 4 lists one-time costs for developing various plans, mapping, and inventories. Table 5 describes the costs for the possible actions. The costs are expressed as an average annual cost. The actions in the tables are cross-referenced to the plan objective listed earlier in this report.

[3] Planning and administration includes environmental compliance, mapping, database management, data analysis, monitoring, research and experimentation, and contract oversight.

Table 4
One-Time VMP Costs

Plan Objective	Project	Total Cost
1.1, 1.2, 3.1, 3.2, 3.4, & 3.5	Initial hire of biological technician (vehicle, computer, miscellaneous equipment)	$35,000
1.1	Complete special status species inventory and map	MMWD staff
1.1	Wetland/seeps/riparian habitat mapping	$40,000
1.1	Wetland/riparian habitat mapping	MMWD staff
1.1	Bryophyte inventory	$30,000
1.1	Lichen inventory	$30,000
1.1	Fungi inventory	$30,000
1.3	Protect special status species by developing BMPs for watershed work	MMWD Staff
1.4	Prepare Landscape Fire Plan	$75,000
1.5	Develop restoration plans for 5 sites	$100,000
1.6	Develop wetland preservation plan	MMWD staff
1.8	Develop EDRR plan and weed dispersal prevention program	$25,000
3.3	Develop long-term management strategy (addressing GCC, nitrification SOD, etc.)	$200,000
Total	**Total over Ten Years**	**$565,000**

Table 5
Annual or Other Ongoing Costs of Implementing All Potential Actions

Plan Objective	Project or Action	Assumptions and Comments	Average Annual Costs	
			Without Herbicides	With Herbicides
All	General Vegetation Plan Expenses	Administration, planning, mapping, crews, supervision, environmental compliance, dam maintenance, roadside brushing, hazard tree removal, and miscellaneous expenses	$800,000	$800,000
1.1, 1.2, 3.1, 3.2, 3.4, & 3.5	Hire one additional staff person (a biological technician)	The staff person would implement many of the actions in the VMP	$70,000	$70,000
1.1	Map SOD spread every two years	Photo-interpretation of existing imagery; cost of $15,000	$7,500	$7,500
1.4 & 2.2	Implement Landscape Fire Plan projects	Staff would select what project to implement	$50,000	$50,000
1.6	Implement the recommendations of the wetlands preservation plan	Staff would select what project to implement	$10,000	$10,000
1.7	Implement the EDRR plan (Priority 2)	Existing staff and volunteers would implement	$0	$0
1.7	Eradication of high priority invasive species from sites not in fuelbreaks on the Mt. Tamalpais watershed	About 600 acres of broom, 100 acres of thistle, & 50 acres of other weeds calculated at an average cost of $3,750/acre for non-herbicide approach and $660/acre for herbicide approach	$2,812,500	$487,500
1.7	Eradication of high priority invasive species from sites on Soulajoule and Nicasio watershed	About 200 acres	$750,000	$130,000
1.8	Implement high priority invasive species dispersal prevention program	Existing staff and volunteers would implement	$0	$0

Table 5
Annual or Other Ongoing Costs of Implementing All Potential Actions
(continued)

Plan Objective	Project or Action	Assumptions and Comments	Average Annual Costs	
			Without Herbicides	With Herbicides
2.1	Implement the restoration plans for 5 target sites	Highly variable costs per project, but assume an average of $500,000 per site	$250,000	$250,000
4.1 through 4.5	Complete construction of the fuelbreak system	Approximately 119 acres @ $9,000/acre to implement	$108,000	$108,000
4.1 through 4.5	Fuelbreak management of broom-infested sites	Annually eradicate 100 acres of the 750 acres of broom on broom-infested fuelbreaks; annual mowing until broom is gone and then an average of mowing once every 3 years	$2,810,625	$823,250
4.1 through 4.5	Treatment/mowing of non-infested fuelbreaks	Assumes an average mowing of once every 3 years of the 330 acres that are not infested	$72,600	$72,600
	One-time costs from Table 4 above averaged over 10 years		$56,500	$56,500
Average annual cost			**$7,797,725**	**$2,865,350**

The estimated total annual costs for implementing all actions shown in Table 5 exceed the current total operational budget for vegetation management by about 660% if implementation exclude herbicides or by 180% if implementation includes supplemental herbicides.

7. Potential VMP Alternatives

The consulting team has developed four alternatives to be considered for the Draft VMP. Though they differ in emphasis and scale, they all acknowledge the primary importance of reducing the risk wildfire poses to District facilities, natural resources, and lives and property beyond watershed lands. The first priority of the VMP under any alternative is to complete construction of the fuelbreak system. The next priority is to establish a sustainable maintenance regime for that fuelbreak system.

A. No Project Alternative – Maintain Status Quo

Under this alternative the District would continue to manage vegetation per the adopted 1995 VMP. The alternative maintains current funding (approximately $1,026,000 per year) and management practices. This would include:

- The fuelbreak system described in the 1995 VMP would continue to be constructed.

- There would be incomplete annual maintenance of fuelbreaks (all the fuelbreaks could not be mowed in 2007-2008 due to inadequate funding), thereby increasing the risk of wildfire escape.

- If time and labor are available, the EDRR Program might be developed and implemented by staff.

- There would be no control nor eradication of high priority invasive species in areas outside the fuelbreaks except as done by volunteers. As such, these weedy species would continue to expand and replace native species and habitat. It can be expected that non-treatment of these populations plus incomplete mowing of broom-infested fuelbreaks will result in broom spreading into currently uninvaded fuelbreaks, thereby requiring additional mowing and additional expense.

- Habitat restoration projects would be limited to about 2 acres per year.

- The landscape fire plan, wetlands preservation plan, and the long-term management strategy (for addressing GCC, nitrification, SOD, etc.) would not be developed or implemented.

- The mapping and recording of special status plant and animal species, bryophytes, and wetland/riparian habitat would occur only as staff and volunteers had the time and resources.

Under this alternative, resources will continue to be expended on fuelbreak expansion in areas with limited utility. The number of high priority invasive species-infested acres will increase significantly over time with an associated degradation in habitat quality. Long-term implementation costs would likely increase as broom spreads into more of the fuelbreak system and adjacent lands. Currently degraded habitat is likely to degrade further.

This alternative will be examined in the CEQA document. It will not be assessed further at this stage as it does not meet most of the proposed draft goals and objectives of the VMP.

B. Fuelbreak Management Alternative

This alternative assumes funding levels would remain consistent with the current budget ($1,026,000 per year). This alternative would include the following.

The revised fuelbreak plan per Background Report 6: Fire Hazard Management would be adopted and constructed. The one exception is that the District would continue to defer constructing two proposed fuelbreaks in areas with heavy broom invasion until a method for eradicating broom is approved and funded. The two fuelbreaks that have been deferred currently are Bill Williams Road from Phoenix Dam to the end and Blithedale Ridge Road to the intersection with Indian Fire Road. This would reduce the amount of new fuelbreak to be constructed by about 20 acres.

Priority would be given to completion of the fuelbreak system, followed by annual mowing of the broom-infested portions of the fuelbreaks and mowing non-infested fuelbreaks as needed (an average of once every three years).

The current budget does not provide sufficient funding to conduct this mowing regime. Currently, the District budgets about $282,000 for fuelbreak maintenance and about $90,000 for habitat restoration. As shown on Table 3, most of the vegetation management budget is used for programs that cannot be deleted or substantially reduced (hazard tree removal, dam maintenance, roadside brushing, and fuelbreak maintenance). The one area of expenditure that could be redirected is the approximately $90,000 budgeted for habitat restoration. Some additional money could be available if the District reduces wildlife monitoring and reduces or defers trail and road maintenance. Table 6 shows the costs for an optional alternative that includes completing fuelbreak construction and management of the fuelbreaks. No other programs would be funded.

It is estimated that the cost of completing all but 20 acres of the fuelbreak system, annual mowing of the completed fuelbreak system that has broom, and triennial mowing of the 330 acres without broom would cost about $563,200 per year. Because broom would not be treated outside the fuelbreaks, over time broom from nearby stands would be expected to invade currently uninfected fuelbreaks, thereby requiring additional mowing and additional funding.

The options under this alternative are to: 1) maintain existing budget priorities (i.e., maintain the same amounts for fuelbreak management and habitat restoration), or 2)

focus the vegetation management budget on fuelbreak construction and maintenance. In the first case, the fuelbreak system would not be completed and/or there would continue to be incomplete mowing of fuelbreaks thereby reducing their effectiveness. If the recommended fuelbreaks were constructed, it is calculated that approximately 50% of the fuelbreak system could be maintained in the average year. In the second case (with the $90,000 for habitat restoration redirected to fuelbreak management), about 66% of the fuelbreak system could be mowed/maintained in the average year. It is possible that fuelbreak construction could be funded through grants rather than District revenues. If the cost of fuelbreak construction is removed, the existing budget would be able to fund mowing about 60% of the fuelbreak system, or about 78% if the habitat restoration funds are transferred to fuelbreak management.

Table 6
Estimated Costs for Implementing "Fuelbreak Management Alternative" Actions

Action	Acres	Average Annual Cost
General program expenses	NA	$800,000
Annual mowing of broom-infested fuelbreaks	730	$401,500
Triennial mowing of non-infested fuelbreaks	330	$72,600
Fuelbreak construction	119	$108,000
Total annual cost		**$1,382,100**

Notes: Average mowing cost is $550 per acre.

Under both scenarios for this alternative, there would be insufficient funding to maintain the effectiveness of the fuelbreak system. Most of the other actions recommended previously would not be funded. Any other actions would either be through grant funding or done by staff and/or volunteers. To summarize the likely results of this alternative:

- There would be inadequate maintenance of the fuelbreak system, thereby increasing the risk of wildfire escape. Alternately, the District could reduce the mowing frequency to concentrate on fuel reduction and allow broom to flower and set seed, which over time would result in an extensive spread of broom in the fuelbreaks.

- If time and labor are available, the EDRR Program might be developed and implemented by staff.

- There would be no control nor eradication of high priority invasive species in areas outside the fuelbreaks. As such, these weedy species would continue to expand and replace native species and habitat. It can be expected that non-treatment of these populations plus incomplete mowing of broom-infested fuelbreaks will result in broom spreading into currently uninvaded fuelbreaks, thereby requiring additional mowing and additional expense.

- There would be no habitat restoration projects developed or implemented.

- The landscape fire plan, wetlands preservation plan, and the long-term management strategy (for addressing GCC, metrication, SOD, etc.) would not be developed or implemented.

- The mapping and recording of special status plant and animal species, bryophytes, and wetland/riparian habitat would occur only as staff and volunteers had the time and resources.

Under this alternative, fuelbreak maintenance costs would remain constant or, likely, increase. The number of high priority invasive species-infested acres will increase over time and high quality habitats will degrade. Currently degraded habitat is likely to degrade further. There will be adverse effects on biodiversity, and the watershed will not be resilient to changes resulting from macro processes such as SOD, nitrification, GCC, and fire suppression as well as loss of habitat due to weed invasion.

This alternative is considered feasible since it maintains the current budget for vegetation management. However, this alternative does not meet most of the draft goals and objectives of the VMP.

Alternative B Herbicide Option

If herbicides were included in the IPM program, the District could treat portions of the fuelbreak that are annually mowed to eradicate broom from specific areas. When the District used herbicides earlier in this decade, that treatment substantively reduced broom infestations in treated areas. The District would also be able to use herbicides to complete eradication projects where the remaining broom plants could be treated one or two times before hand follow-up treatment could be implemented. Including herbicide in the IPM program would let the District address some of the proposed biodiversity goals and objectives. The amount of area treated would likely remain small as the existing budget would not fund eradication efforts on a large scale. However, the work that could be included in current funding would allow eradication of important stands or in important high quality habitat. For example, if the $90,000 currently budgeted for habitat restoration was used for broom eradication with herbicides allowed, the District could work to eradicate broom on 150 acres per year. By targeting critical populations of high priority invasive species, it is expected that the District could eradicate weeds on a much larger acreage (e.g., by working on areas where broom stands are currently small, invading new areas, or already under some form of management).

It costs $550 per acre per year to mow infested fuelbreaks and, using herbicides, $660 per acre per year to eradicate broom from the infested fuelbreaks. However, by eradicating broom from at least some portions of the fuelbreak system, after 8-10 years, the cost of mowing the area where broom was eradicated would cost less than $200 an acre (mowing on an average of once every three years) as compared to the $550 per acre for the required annual mowing. This gradually increasing cost savings would allow the District to address some of the proposed biodiversity goals and objectives such as treating isolated weed populations in otherwise high quality habitat or initiating planning efforts to respond to climate change, Sudden Oak Death, and changing fire regimes. Table 5 above and Tables 8 to 10 in the later discussion of Alternative D provide additional information about the comparative costs of managing vegetation with and without herbicides included in the IPM program.

If herbicides are allowed as part of the Integrated Pest Management program, per the application guidelines recommend in Background Report No. 3, a maximum of 2.5 pounds ai of Glyphosate or 2 pound ai of Triclopyr or a combination not to exceed a combined total of 2.5 pounds ai per acre, plus a maximum of 96 ounces per acre of surfactant would be applied per acre of areas targeted for weed removal.[4]

C. Suppression Alternative

This alternative would complete construction of the fuelbreak system; manage that fuelbreak system so that it is effective in reducing fire hazard; suppress the ability of high priority invasive species to spread back into the fuelbreaks or into high quality habitat; and conduct some of the other potential actions previously recommended to meet the goals and objectives. While this alternative would not include eradication of high priority weed species from the watershed, it would substantially reduce the ability of these high priority invasive species to expand their coverage. Specifically, this alternative includes the following components:

- The fuelbreak system would be completed as recommended in Background Report 6: Fire Hazard Management.

- The fuelbreaks would be mowed to prevent broom and other high priority invasive species from setting seed in invaded fuelbreaks and as need in uninvaded fuelbreaks.

- Areas infested with broom outside fuelbreaks would be treated on a biannual basis to prevent broom from flowering.[5]

- The goat grass population would be extirpated.

- The use of conventional herbicides would be limited to a maximum of 25 pounds active ingredient (ai) of Glyphosate, or 20 pounds ai of Triclopyr if either herbicide is used exclusively. Realistically, both herbicides will be utilized, alone or in combination, with total combined herbicide use not to exceed 25 pounds of active ingredient per year for treating high priority species that cannot be effectively treated by other measures (Ehrharta, acacia, eucalyptus). Any herbicide used would be applied per all requirements established in the 2008 Herbicide Risk Assessment Mitigation Measures and Recommendations (see Background Report No. 3).

- The plans and mapping catalogued in Table 4 would be done. However, there would be no implementation of these plans except to the degree that staff and

[4] This is the maximum allowed application rate for the water district. When the District was allowed to use herbicides, the District never used more than 1.875 ai pounds of Glysophate per acre (in a first year treatment of a heavy broom stand on Indian Fire Road). The average use was 0.78 ai pounds of Glysophate per acre. The amount of surfactant depends on the type of treatment and the surfactant - with a maximum of 1.6 to 38 ounces per acre.

[5] This is a conservative estimate since in some locales District staff has seem broom blooming after one year. Thus, the projected cost may underestimate the true cost of ensuring that broom does not set seed.

volunteers could implement them. This would likely result in very little implementation.

Table 7 summarizes the costs of implementing this alternative. It is calculated that this alternative would cost an average of approximately $1,765,850 per year over ten years. This budget exceeds the existing total vegetation management budget by about 71%.

Table 7
Estimated Costs for Implementing "Suppression Alternative" Actions

Action	Acres	Average Annual Cost
General program expenses		$800,000
Annual mowing of broom-infested fuelbreaks	750	$412,500
Triennial mowing of non-infested fuelbreaks	330	$72,600
Biannual mowing of other weed-infested habitat	950	$316,250
Fuelbreak construction	119	$108,000
One-time costs		$56,500
Total annual cost		**$1,765,850**

Note: Average mowing cost is $550 per acre.

This alternative would meet the goals and objectives related to fire hazard management. It would have the major advantage over Alternatives A and B of preserving uninvaded habitat from weed expansion.

Management under this alternative would significantly slow the expansion of high priority invasive species. However, it is never possible to find all flowering plants plus there will always be times when labor resources are not available during the time period when treatment must be done. So, it should be expected that there would be some expansion of high priority weed invasion, with consequent increased costs of management.

There would not be sufficient finances to address existing habitat degradation or to plan for and implement long-term plans aimed at restoring biodiversity and improving the resiliency of the watershed. The alternative would have significant benefits as compared to Alternatives A and B., but would not meet many of the biodiversity objectives.

Alternative C Herbicide Option

This alternative could include the use of herbicides as part of the IPM program. As discussed under the Herbicide Option for Alternative B, allowing staff to include herbicides as a treatment tool would allow the District to address biodiversity objectives by eradicating at least some stands of high priority invasive species or engaging in long-

term planning and/or monitoring efforts. As was explained in that earlier discussion, it would also reduce the long-term management costs for maintaining the fuelbreak system.

D. Resiliency Alternative

This alternative includes implementing all the actions summarized in Table 5. By the end of the planning period, this alternative would result in near eradication of target high priority invasive species, limit the spread of invasive species into high quality areas, and restore some currently degraded high priority sites. It is clearly noted that complete eradication is never a realistic target for weeds. There comes a point of diminishing returns where the remaining number of plants is so small that they are difficult to locate and treat. As such, there will remain the ongoing need to monitor and periodically treat, when warranted, locales and populations where "eradication' has been accomplished. To summarize, the alternative would include the following actions:

- The fuelbreak system will be completed.
- Within the fuelbreak system, eradicate high priority invasive species within the fuelbreak system and mow the fuelbreaks to meet fire objectives.
- Outside the fuelbreaks, eradicate high priority invasive species.
- Develop and fully implement the EDRR program.
- Hire an additional staff person.
- Map SOD spread.
- Implement landscape fire plan and wetland preservation plan.
- Develop other plans and studies listed in Table 4.
- The restoration plans would be developed and implemented at the rate of $250,000 per year.

Under this alternative, fuelbreak maintenance costs gradually decrease as eradication efforts precede, and resources will become increasingly available to address other biodiversity and recreational objectives. Re-infestation from adjacent, untreated areas would decrease as these areas come under management. The number of high priority invasive species-infested acres will begin to decrease, and high quality habitats would remain stable. Some improvements are expected in currently degraded habitats.

Table 8 shows the cost for implementing this alternative if no herbicides are used except for the 25 pounds per year allowed under Alternative C to treat certain high priority invasive species that cannot feasibly be controlled by hand or mechanical measures. Table 9 shows the cost of implementing this alternative if herbicides are allowed as part of the Integrated Pest Management program. Per the application guidelines recommend in Background Report No. 3, a maximum of 2.5 pounds ai of Glyphosate or 2 pound ai of Triclopyr or a combination not to exceed a combined 2.5 total pounds ai per acre, plus a

maximum of 38 ounces per acre of surfactant would be applied per acre for areas targeted for weed removal.[6]

Table 8
Estimated Costs for Implementing "Resiliency Alternative" Actions with Herbicides Not Included in the IPM Program

Action	Acres	Average Annual Cost
General program expenses	NA	$800,000
Broom eradication and mowing of fuelbreaks	750	$2,810,625
Triennial mowing of non-infested fuelbreaks	330	$72,600
Weed eradication of other weed-infested sites	950	$3,562,500
Implement habitat restoration, landscape fire plan, and wetlands preservation plan	NA	$310,000
Fuelbreak construction	119	$108,000
One-time costs	NA	$56,500
New staff person, SOD mapping	NA	$77,500
Total annual cost		**$7,797,725**

Notes: Average annual cost for eradication by hand/mechanical methods is $3,750 per acre averaged over 10 years; Average cost for mowing is $550 per acre.

Table 9
Estimated Costs for Implementing "Resiliency Alternative" Actions with Herbicides Included in the IPM Program

Action	Acres	Average Annual Cost
General program expenses	NA	$800,000
Broom eradication and mowing of fuelbreaks	750	$823,250
Triennial mowing of non-infested fuelbreaks	330	$72,600
Weed eradication of other weed-infested habitat	950	$617,500
Implement habitat restoration, landscape fire plan, and wetlands preservation plan	NA	$310,000
Fuelbreak construction	119	$108,000
One-time costs	NA	$56,500
New staff person, SOD mapping	NA	$77,500
Total annual cost		**$2,865,350**

Notes: Average cost for eradication including herbicide use is $650 an acre averaged over 10 years; Average mowing cost is $550 per acre.

[6] This is the maximum allowed application rate for the water district. When the District was allowed to use herbicides, the District never used more than 48 ounces per acre (in a first year treatment of a heavy broom stand on Indian Fire Road). The average use was 20 ounces per acre. The amount of surfactant depends on the type of treatment and the surfactant - with a maximum of 1.6 to 38 ounces per acre for low volume foliar and a maximum.

The Resiliency Alternative option that does not include herbicides assumes that there would be sufficient labor available to treat up to 1,700+ acres a year. It will likely be very difficult to contract with the number of workers required to do this work within the limited window of time that broom and other invasive species need to be pulled or propane flamed. In this regard, it is noted that in Background Report No. 1, handpulling or weed wrenching of these species was identified as suitable for populations between 1-5 acres in size. Even if sufficient funding were available, it is expected that some areas infested with broom and other high priority invasive species would not be treated each year; the plan could take longer to implement in that case.

Besides the difference in costs, the use or non-use of herbicides has other environmental ramifications. These impacts have been identified and briefly discussed in Background Reports 1 to 3, and they will be further reviewed in the Draft VMP and the EIR that will be prepared on that Draft Plan. To summarize, the primary impacts of herbicide use are the potential health and environmental hazards these chemicals pose to humans (applicators and the general population) and other life forms. These hazards and the risk they pose are discussed in detail in Background Report No. 3. The potential adverse effects of using hand and mechanical means of implementing this alternative are soil compaction, soil erosion, non-target vegetation loss, and injury to workers.

By implementing all the recommended actions, this alternative meets the draft goals and objectives set forth at the beginning of this report.

The cost projections in Tables 8 and 9 examine costs over the 10-year planning period. Under this alternative, costs would decline substantially over time. By the end of 10 years, remaining target weed populations could be quickly treated by hand crews. The mowing regime for fuelbreaks would reduce to an average of once every three years.

It is estimated that after year 8 follow-up work in areas where eradication has been implemented for both approaches would cost about $250 per acre per year. Table 10 shows the management costs in year 10. In future years the cost would continue to decline as seedbank of invasive species decline. In terms of weed management (in and out of fuelbreaks), the cost for this alternative in year 10 (under either option – using herbicides or not) would be $635,100 per year as compared to Alternative C that only cuts weeds but does not eradicate them at an annual cost of $957,350. Even Alternative B (if mowing were fully funded) which focuses solely on cutting weeds in the fuelbreaks and does not include any treatment outside the fuelbreak or eradication within the fuelbreaks would cost an average of $474,100 per year.

Alternative D meets the goals and objectives of the plan. As importantly, over the long term it would cost less than any of the alternatives as regards meeting fire hazard reduction goals and objectives. If biodiversity goals and objectives are included in the comparison, this alternative is substantially less expensive over the long term.

Table 10
Estimated Annual Costs in Year 10 Under Alternative D

Action	Acres	Average Annual Cost
General program expenses	NA	$800,000
Follow-up weed eradication in fuelbreaks	750	$187,500
Triennial mowing of fuelbreaks	1,080	$210,100
Weed eradication of other weed-infested habitat	950	$237,500
Implement habitat restoration, landscape fire plan, and wetlands preservation plan	NA	$310,000
New staff person, SOD mapping	NA	$77,500
Total annual cost		**S1,822,600**

Resiliency Alternative Options

Recognizing the cost of this alternative might make it difficult for the District to fund, the alternative could be scaled back to eliminate various actions. The actions of lowest priority would be:

- Treatment of high priority invasive species in the Soulajoule watershed.
- Treatment of high priority invasive species in the Nicasio watershed.
- Implementing the wetlands preservation and the landscape fire plans.
- Restoration of target sites (this budget item could be reduced by 50% or more).
- Eradication of high priority invasive species on Priority 5 sites and sites that have no priority on Mt. Tamalpais watershed (approximately 300 acres).

Eliminating these actions would reduce the cost for the non-herbicide approach by about $2,000,000 per year, and the cost for the herbicide approach would be reduced about $500,000 per year. Eliminating other recommended actions would further reduce the projected annual budget.

A second option would be to delay completion of the plan by reducing the target areas for high priority invasive species eradication. For example, instead of eradicating broom from 100 acres of fuelbreak per year, the target could be 50 acres per year.

8. Comparison and Conclusions

The preceding discussion presented four basic alternatives. Except for Alternative A (the maintain status quo alternative), all alternatives have the option of excluding or including the use of herbicides. This list does not limit the District's choices. It is certainly feasible to develop a hybrid alternative that selects certain parts of one or more of these alternatives. Table 11 summarizes the costs of the alternatives and the degree to which they meet the five proposed VMP goals.

The next step of the VMP planning process is to gather public input regarding these alternatives, incorporate that input into a final Alternatives Report, and obtain District Board direction as to which of these alternatives, revised alternatives, or combination of alternatives should be included in the Draft VMP. The summary below identifies the key issues to be considered in identifying the alternative(s) to be carried forward for further analysis and consideration.

- The existing budget does not provide sufficient funds to maintain the planned effectiveness of the existing fuelbreak system. The existing budget does not provide sufficient funding to adequately protect existing biological resources, limit the spread of invasive high priority invasive species into currently uninfected habitat, restore habitats degraded by past actions and weed invasion, or prepare the watershed for long-term changes resulting from SOD, GCC, and other processes. With the current budget the District would not have an effective fuelbreak system, and the biodiversity of the watersheds would continue to deteriorate.

- If all discretionary funds in the current budget were directed to fuelbreak construction and management, the existing budget would still not contain sufficient funding to maintain the planned effectiveness of the fuelbreak system. In this case, none of the other goals would be met. Again, after 10 years, the District would continue to spend the same amount of money without fully realizing its fire hazard reduction goals, and the biodiversity of the watersheds would continue to deteriorate.

- If the budget were expanded by about $750,000, Alternative C (the Suppression Alternative) could be funded. This alternative would meet the goal and objectives regarding fire hazard reduction. It would maintain the status quo for high priority weed invasions, as the weeds would be mowed to prohibit the seeds from setting, It would fund the creation of certain long-range plans. However, there would be insufficient funding to begin eradicating populations of high priority invasive species. There would be insufficient funding to implement restoration plans, a landscape fire plan, the wetlands plan, or other long-term plans. While a principal threat to biodiversity (expansion of high priority invasive species) would be met, restoration and long-term actions would not be implemented. As such, the biodiversity would continue to deteriorate, though at a slower rate than under Alternatives A and B.

Table 11
Comparison of Plan Alternatives

Alternative	Goals					Annual Cost (Average Over 10 Years)	Annual Cost at Year 10 and After
	Maintain Ex. Bio. Resources	Restore Habitat	Adaptive Mgmt.	Fire Mgmt.	Aesthetics & Recreation		
A. Maintain Status Quo	no	no	no	no	partly	$1 million	$1 million
B(1). Fuelbreak Management without Herbicides	no	no	no	no	partly	$1 million	$1 million
B(2). Fuelbreak Management with Herbicides	partly	no	no	no	partly	$1 million	$1 million
C(1). Suppression without Herbicides	partly	partly	no	yes	yes	$1.8 million	$1.45 million
C(2). Suppression with Herbicides	partly	partly	no	yes	yes	$1.8 million	$1.45 million
D (1). Resiliency without Herbicides	yes	yes	yes	yes	yes	$7.9 million	$1.8 million
D (2). Resiliency with Herbicides	yes	yes	yes	yes	yes	$2.9 million	$1.8 million

- If herbicides were allowed as part of the IPM program under either Alternative B or C, it would increase the ability of the District to control and eradicate stands of high priority invasive species from high quality habitat and engage in long-term monitoring and planning. By eradicating stands within the fuelbreaks, the District would reduce the long-term costs of managing the fuelbreak system. For every acre of fuelbreak where broom is eradicated, the long-term management cost would be one-third the cost of treating that same broom-infested acre. If the budget is not expanded, the inclusion of herbicides in the IPM program would allow the District to address at least some of the biodiversity goals and objectives while over the long-term increasing its ability to effectively manage the fuelbreak system. Alternative C, with its increased funding level, goes further in this regard, than Alternative B.

- If the budget were expanded to implement all the potential actions, then all the goals and objectives of the plan could be met. This does not mean that there will not continue to be threats to the watershed biodiversity from macro processes like SOD, GCC, nitrification, and other factors. Over the long term, it is expected that these processes may substantially affect watershed resources and biodiversity and necessitate potentially costly responses. However, by implementing Alternative D, the District will have made the watersheds as resilient as possible given fiscal realities and the current unknowns about what changes these macro processes may bring.

- Alternative D is the only alternative that would fund the studies and plans needed to address the threats that will be coming from climate change, expansion of SOD, nitrification, and the absence of fire in the ecosystem. These processes will not only adversely affect watershed biodiversity, but left unchecked, they will increase the fire hazard on the watershed. This increased fire hazard (i.e., from dead trees

- Both options under Alternative D are expensive compared to the current budget. However, they have the distinct advantages of improving the biodiversity while also meeting fire hazard reduction goals and objectives, and, in the future, are not that much more expensive on an annual basis than Alternative C.

- Alternative D best meets proposed goals and objectives. While more costly at the outset, over time it would not cost much more on an annual; basis than the current vegetation management budget.