Contra Costa County
DECISION DOCUMENTATION for WEED MANAGEMENT
on County Flood Control Channels

Date: October 2, 2017 (last revision on 11/19/18)

Department: Public Works Roadside and Flood Control Channel Vegetation Management Div.

Location: Flood Control Channels

Situation: Vegetation management along 76 miles of flood control channels and creek banks; this includes areas ranging from unimproved natural creeks to concrete-lined channels, along with levies that are certified by the Army Corps of Engineers

Note that management decisions are site specific for flood control channels. Not every management technique will work equally well at all sites and the costs of each technique will vary depending on the site.

See the CCC General Pest Management Decision Tree for a summary of the decision-making process.

What are the management goals for the site?	To maintain vegetation along flood control channels and creek banks so that • erosion of the banks does not occur • vegetation does not impede the flow of water in a flood • vegetation does not collect silt and debris that could obstruct the passage of water • vegetation does not hide problems on banks such as ground squirrel burrows, erosion, beaver activity, etc. • vegetation does not pose a fire hazard • vegetation remains a mix of small herbaceous plants and grasses • homeless encampments cannot flourish unnoticed • waterways do not become a conduit for the spread of noxious weeds throughout the county • waterways provide habitat for wildlife • maintenance is performed in accordance with the Routine Maintenance Agreement (RMA) with the state Department of Fish and Wildlife • maintenance is performed in accordance with the regulations from the Army Corps of Engineers and the Regional Water Quality Control Boards (San Francisco and San Joaquin) Vegetation is also managed along flood control access roads to maintain the integrity of the roads and ease of access for equipment. With these management goals in mind, the most appropriate management tactics are chosen based on cost, efficacy, impacts to the environment, public health, and other impacts to the public.
How often is the site monitored?	All sites in the county are monitored every few days to every few weeks. The Vegetation Management Supervisor spends part of every day inspecting waterways on a rotating basis. The road crews, the flood control supervisors, and the vegetation management crew are all trained to recognize vegetation issues on flood control channels and creeks and to report them to the Supervisor. Monitoring information is recorded on the Vegetation Management Supervisor's Daily Report. If a new weed species is found, the Supervisor identifies and researches the weed. If he/she cannot identify the specimen, he/she consults the County Department of Agriculture. If a weed on the California Department of Food and Agriculture A-rated list is found, the County Agriculture Department is also consulted.
Weeds have been identified as the following: Note that this is not a comprehensive list, but a list of the main problem plants.	Various grasses, including • Harding grass (*Phalaris aquatica*) • Johnsongrass (*Sorghum halepense)* • Reed canarygrass (*Phalaris arundinacea*) • Wild oats (*Avena fatua*) • Quack grass (*Elymus repens*) Various broadleaf weeds including • Mustard (*Brassica* spp.) • Cocklebur (*Xanthium* sp.) • Poison hemlock (*Conium maculatum*)

	• Wild carrot (*Daucus carota*) • Stinging nettle (*Urtica* sp.) • Himalayan blackberry (*Rubus armeniacus*) Invasive weeds such as • Perennial pepperweed (*Lepidium latifolium*) • Purple loosestrife (*Lythrum salicaria*) • Red sesbania (*Sesbania punicea)* On some engineered channels, cattails (*Typha* sp.) and trees (willow—*Salix*, walnut—*Juglans*, ash—*Fraxinus*) are considered weeds. The Maintenance Division's vegetation management crew is trained to look for invasives when they are out working and report them to the Vegetation Manager who consults with the Agriculture Department about what action to take.	
Are populations high enough to require control?	The Vegetation Management crew manages vegetation as necessary to meet the goals above.	
Is this a sensitive site?	**Is this a "highly sensitive site" as defined by PWD Environmental staff? A highly sensitive site contains a known habitat for, or is close to sightings of, endangered or threatened species.** Some sites fit in this category.	Yes
	Is this under the Routine Maintenance Agreement with Fish and Wildlife? All creeks are covered under the Routine Maintenance Agreement**.**	Yes
	Is this part of any of the court-ordered injunctions? (see: https://www.epa.gov/endangered-species/interim-use-limitations-eleven-threatened-or-endangered-species-san-francisco-bay) Some areas are included in one or more injunctions. The injunctions specify buffer zones around designated habitat for certain species for particular pesticides, but they do not preclude the use of those pesticides outside the buffer zones.	Yes
	Is this a known or potential habitat for any endangered or threatened species? Yes, some sites contain habitat for various sensitive species including salmonids, red legged frog, various nesting birds, dusky footed woodrat, salt marsh harvest mouse. Before any kind of work can be done in channels, each site must be assessed by a biological monitor (a trained Public Works staff member) or a Certified Biologist.	Yes
	Is it on or near an area where people may walk or children may play? The Division does not manage pests on established (paved) trails. These trails are mainly under the management of the East Bay Regional Park District. In cases where established trails exist along flood control channels (some areas of Walnut Creek, Marsh Creek, and Wildcat Creek) they are situated above the creek slopes. Access roads along flood control channels are County property and are posted "No Trespassing." The public should not be on the access roads and enter at their own risk. In general, the public is not allowed access to the slopes or waterway within these environments. Despite these prohibitions to public access, people may continue to visit these areas, and their presence should be noted when preparing to apply pesticides. Any person observed in the treatment area should be notified of the impending treatment and should be requested to vacate the area. Treatment should be suspended while people are present.	Yes
	Is it near an above ground drinking water reservoir? None of the flood control channels that the Division maintains is near a reservoir.	No
	Is it near crops? There are areas of Marsh Creek, Sand Creek, and Dry Creek that are near crops.	Yes
	Is it near desirable trees or landscaping? There are some flood control access roads that are near residences.	Yes

	Is the soil highly permeable, sandy, or gravelly? Yes, in some areas.	Yes
	Is it within a Groundwater Protection Area?	No
	Is it within an infiltration basin?	No
What factors are taken into account when determining the management technique(s) for vegetation?	• Species of plant • Stage of growth • Plant density • Plant location (in water/on land, accessibility, topography, adjacent properties) • Weather (precipitation, wind, temperature, relative humidity) • Personnel available to perform the management activities when they are needed • Safety (for the public, staff, wildlife, adjacent property, the general environment) • Proximity to water resources and wildlife • State and local regulations • Budget available	
Are special permits required for work?	In some instances, depending on the kind of work to be done, it could be necessary to obtain a take permit from the US Fish and Wildlife Service. This would be coordinated through the environmental staff at Public Works.	
Which cultural controls were considered?	**Mulching:** Woodchips are used on flood control access roads where appropriate to prevent and suppress weeds. Creek banks cannot be mulched. **Weed Barrier/Sheet Mulching:** This cannot be used on the creek banks, and for the access roads, it would be an added and unnecessary expense since a deep cover of woodchips serves the same purpose. **Planting Desirable Species:** The County Flood Control District is partnering with The Restoration Trust, an Oakland-based non-profit organization promoting habitat restoration and stewardship, in a native planting experiment along Clayton Valley Drain (near Hwy 4 adjacent to Walnut Creek). The study is examining the survival of several California natives: Santa Barbara sedge, (*Carex barbarae)*, common rush *(Juncus effusus),* Baltic rush *(Juncus balticus),* field sedge *(Carex praegracilis),* and creeping wild rye (*Leymus triticoide*s). The original planting occurred in December 2013, and in December 2014 and each year since, volunteers have replaced plants and planted new plugs. Originally, Santa Barbara sedge, common rush, Baltic rush, and field sedge were planted on the lower terrace near the creek and the creeping wild rye was planted on the slopes of the channel. These species spread from underground rhizomes and will anchor the soil to provide erosion control. They are all perennial species that stay green year around and are resistant to fire. The plants are compatible with flood control objectives since they do not have woody stems, and during flood events, they lie down on the slope, thereby reducing flow impedance. They are not sensitive to broadleaf-specific herbicides, and unlike non-native annuals, they provide carbon sequestration and remove as much as ½ ton of carbon per acre per year. Native grasses and sedges can potentially out-compete non-native broadleaf weeds and annual grasses, but they do require maintenance assistance from herbicides. The Division, at the request of The Restoration Trust, manages weeds to reduce competition and provide the native plants with an advantage. The Restoration Trust will monitor these plots through 2018 to assess native plant survival, the degree to which they compete with the non-native annual species, and the relative success of seeding versus planting plugs. **CONCLUSIONS**: **Mulching can be and is used along flood control access roads where the mulch will not drift into the creek. The Public Works Department is experimenting with planting desirable species to out-compete weedy species. This is an IPM technique the Public Works Department is interested in exploring further. However, establishment of desired species takes considerable time, money, and attention and may require water and/or continued use of herbicide to prevent invasion of undesirable species.**	
Which physical controls were considered?	**Pruning:** Trees are pruned for equipment clearance and for line of sight along access roads. Trees that sprout in engineered channels on the slopes or in creek channels are cut down in order to comply with Army Corps of Engineers regulations. The top of the stump is generally painted with an herbicide to ensure control. **Mowing by machine:** Many creek slopes are mowed by tractor for fire prevention, as required by the Fire District. The channels are mowed along the top of the slope and a minimum of 6 ft. down the side of the slope. Mowing works best on open spaces without a lot of trees. **Mowing by hand**: Areas that are not mowed by machine or grazed by animals are usually mowed by a crew with weed whackers. **Grazing:** Grazing is used where the presence of endangered species, such as the red legged frog, make it difficult to mow, for example, on Pine Creek Dam. Grazing is also used in areas such as Pine Creek and Ygnacio	

	Valley Drain where the creek sides are steep and dangerous for human workers. Although goats are more expensive than hand mowing, their use can help avoid incurring indirect costs such as staff injuries in potentially hazardous locations. The County continues to use goats as a management technique wherever appropriate. For detailed information on how grazing is used in the County, see the decision document for weed management entitled Using Grazing Animals for Weed Abatement. **Burning:** This technique was used in the past but is no longer because the Bay Area Air Quality Control Board allows burning only in very limited circumstances. **Electrothermal weeding (Ubiqutek)**: This method uses a probe carrying electricity at a high voltage (3, 000 to 5,000 to volts) and low amperage (0.5 to 2 amps) to heat plant tissue and kill both roots and above ground plant material. The probe must contact each individual weed. This method is more efficient than steaming or flaming weeds but would be very slow compared to mowing by machine or hand. It would not be practical to use on annual grasses. High voltage can be lethal, so the device is potentially dangerous to the operator. This method also poses a fire risk because of the intense heat at the point of contact with the plant that can produce sparks and small flames. Currently there have been no independent evaluations of this method. At this time, the Department does not consider this a viable tactic for use on flood control channels. **Steam weeding (Weedtechnics):** This method works by sending water under pressure through a diesel boiler and then out through hoses to an application head. The water comes out at 205 to 218 degrees Fahrenheit. This method is slower than other weed management techniques (it appears that the applicator must drive around 2 mph to treat effectively). A new model (the SW3800KD) is advertised as killing weeds faster. It uses 30 L of water per minute, and with their 1000 L water tank, staff would have to refill the tank about every ½ hour. This tactic should be considered as a contact-only treatment and should not be expected to kill underground portions of the plant. Treatment would have to be repeated periodically during the season. At this time, the Department does not consider this a viable tactic for use on flood control channels. See Table 1 for more information on costs. **CONCLUSIONS: Each of these techniques, except burning and electrothermal and steam weeding, is used by the Department where appropriate. The County continues to explore new tactics as they emerge.**
Which biological controls were considered?	**Biological controls are not applicable in this situation unless a particular invasive weed is the target, and it has a biological control available.**
Which chemical controls were considered? For more information on pesticides listed here visit the National Pesticide Information Center (NPIC). This a joint project of Oregon State University and the US EPA. http://npic.orst.edu/ You can communicate with an actual person at **1.800.858.7378** or **npic@ace.orst.edu** They are open from 8:00AM to 12:00PM Pacific Time, Mon-Fri	**During many years of research, experience, and experimentation, including consulting the literature, researchers, and colleagues about materials that are labeled for, and effective on, weeds in rights-of-way, the Division has considered the herbicide options listed below. The Division continues to consult researchers and colleagues, as well as new literature, to identify new choices that may be more effective or more environmentally friendly.** **Pesticides may potentially exhibit both acute and chronic toxicity. The Signal Words below refer to acute hazards. For information on chronic toxicity, contact NPIC (info on left).** **Herbicides and application methods are chosen to prevent or minimize the potential for drift and exposure to humans and wildlife. As with all weed control techniques, herbicides must be reapplied periodically to suppress weeds over the long term.** Note that the Weed Science Society of America (WSSA) and the Herbicide Resistance Action Committee (HRAC) both create resistance group designations to help weed managers reduce the likelihood of creating resistant weeds. The designations below are from WSSA. Herbicide resistance groups are rotated every 2 to 3 seasons to limit the buildup of herbicide resistant weeds along flood control channels.. **Possible herbicide choices (These product names are subject to change):** **Pre-emergent Herbicides** **Esplanade and Resolute 65 WDG are pre-emergent herbicides that are used only on flood control access roads to prevent weed emergence. They each belong to a different resistance management group and are used in rotation to prevent creating herbicide-resistant weeds. The Department uses pre-emergent herbicides to reduce the amount of post-emergent herbicides that are needed. In some areas, it is very difficult to mow either by hand or by machine, and grazing would be too costly. Those areas are treated with herbicide.** **Indaziflam (Esplanade®)**: This pre-emergent herbicide controls a broad spectrum of weeds if applied before germination. It does not generally control weeds after they have emerged. For maximum weed control, the herbicide needs to reach the soil surface and be activated by rainfall or adequate soil moisture. It is applied in the fall to control winter germinating weeds and in the spring to control spring germinating weeds. Indaziflam can be used on flood control access roads, but not on creek banks or in water. Signal Word (indicates acute, or immediate, toxicity): CAUTION Rate: 3 to 5 oz/acre

Timing: Before weeds sprout in either fall or spring near the time rain is expected.
Cost to apply (includes material cost): $125/acre
Herbicide Resistance Management Group: 29
On Ground Water Protection List (b): potential to contaminate ground water, but not yet found in ground water

Prodiamine (Resolute® 65 WDG): This pre-emergent herbicide controls grass and broadleaf weeds by preventing the growth and development of newly germinated weed seeds. Weed control is most effective when the product is activated by at least ½" of rainfall or irrigation, or shallow (1" to 2") incorporation before weed seeds germinate and within 14 days following application. Prodiamine can be used on flood control access roads, but not on creek banks or in water.

Signal Word (indicates acute, or immediate, toxicity): CAUTION
Rate: 1 to 2 lbs/acre
Timing: Before fall weeds or spring weeds germinate, and close to the time rain is expected.
Cost to apply (includes material cost): $97/acre
Herbicide Resistance Management Group: 3

Post emergent (contact) herbicides

Glyphosate, which is not a selective herbicide, is used at a regular rate in areas where it is not necessary to maintain a cover of grasses. Glyphosate, at a much reduced rate, is used to chemically "mow", or stunt, vegetation on creek banks where feasible.

Garlon 3A and Renovate 3 are specific for broadleaf weeds and are used where the Department wants to keep a grassy cover on the creek slopes. Renovate is used to control cattail growth in areas not subject to the injunctions. Either might be used as a cut stump treatment.

Clearcast is used for spot treating cattails in flood control channels.

Glyphosate (Roundup® Pro Concentrate & Roundup Custom®): Glyphosate is a systemic herbicide (it is absorbed into the plant and circulates to kill the entire plant) that will kill almost any type of vegetation—grass, broadleaf, vines, brush, etc. Roundup Custom is used on creek slopes for many different weeds. Roundup Custom is used at a much reduced rate for chemical "mowing" on creek slopes to stunt vegetation but not kill it. Roundup Custom is registered for use in water so the Department uses that formulation if applications are going to be very near water.

Signal Word (indicates acute, or immediate, toxicity): CAUTION
Rate for spot spraying on access roads using a boom mounted on a truck: 2 pts in 20 gal of water/acre
Rate for spot spraying by pulling hose with a handgun attached: 6 pts in 100 gal of water/acre
This method is used mostly where a crew must walk rather than drive.
Rate for chemical mowing: 1/5 pt in 10 gal of water/acre
Timing: Varies depending on the location, the weather, the weed growth, the work load
Costs to apply (includes material cost):

- $135/acre for Roundup application from a boom mounted on a truck
- $673/acre for Roundup application from a hose with a handgun
- $606/acre for Roundup Custom used for chemical mowing

Herbicide Resistance Management Group: 9
**Enjoined for red legged frog
On Ground Water Protection List (b): potential to contaminate ground water, but not yet found in ground water

Triclopyr TEA (Garlon® 3A and Renovate® 3): Triclopyr controls woody plants and broadleaf weeds, but not grasses. Garlon 3A is used when needed on flood control access roads. Renovate is registered for use within or adjacent to aquatic sites.

Signal Word (indicates acute, or immediate, toxicity): DANGER (for eye damage to mixer/loader and applicator)
Rate for Garlon 3A or Renovate on access roads using a boom mounted on a truck: 2 pts in 20 gal of water/acre
Rate for use of Garlon 3A or Renovate pulling hose with a handgun attached: 4 pts in 100 gal of water/acre
Rate for cut stump treatment: Undiluted material (using squirt bottle to spray the surface of the stump)
Timing: Varies depending on the location, the weather, the weed growth, the work load
Cost to apply (includes material cost):

- $146/acre for Garlon 3A application from a boom mounted on a truck
- $714/acre for Garlon 3A application from a hose with a handgun
- $130/acre for Renovate application from a boom mounted on a truck
- $647/acre for Renovate application from a hose with a handgun

Herbicide Resistance Management Group: 4
**Enjoined for red legged frog
On Ground Water Protection List (b): potential to contaminate ground water, but not yet found in ground water

	Imazamox (Clearcast®): Imazamox is a post-emergent, slow acting, systemic herbicide for use in and around aquatic and non-cropland sites. Currently, it is only used for spot treating cattails with a hose and handgun in highly sensitive sites. Signal Word (indicates acute, or immediate, toxicity): CAUTION Rate for spot spraying cattails with a hose and handgun: 4 pt./100 gal/acre Timing: Varies depending on the location, the weather, the weed growth, the work load Cost to apply (includes material cost): $730/acre Herbicide Resistance Group: 2 On Ground Water Protection List (b): potential to contaminate ground water, but not yet found in ground water **<u>Herbicides with both Pre- and Post-Emergent Activity</u>** **Chlorsulfuron (Telar® XP)**: Telar XP is both a pre-emergent and post-emergent herbicide for the control of many invasive and noxious broadleaf weeds. Warm, moist conditions following application enhance the effectiveness of Telar XP since moisture carries the herbicide into weed roots and prevents them from developing. Weeds hardened off by drought stress are less susceptible to this herbicide. This herbicide is used by the Department mainly for control of perennial pepperweed. Signal Word (indicates acute, or immediate, toxicity): CAUTION Rate: 1.6 oz./acre Timing: Before fall weeds or spring weeds germinate and close to the time rain is expected. Cost to apply (includes material cost): $113/acre Herbicide Resistance Management Group: 2 **Imazapyr (Habitat®):** Habitat is registered for the control of undesirable vegetation in and around standing or flowing water, and can be used for wetland, riparian, and terrestrial vegetation growing in or around surface water when treatment might inadvertently result in application to surface water. Habitat has both pre- and post-emergent activity and is a systemic herbicide (is absorbed into the plant and circulates to kill the entire plant) that controls grass and broadleaf weeds, brush, vines, etc. It will not control vegetation submerged in water. Habitat is used only as a spot treatment for *Arundo*, pampas grass, ivy growing on fences and in creeks, and as a cut stump treatment for feral trees (the tree is cut down and the herbicide is immediately applied to the cut stump). Signal Word (indicates acute, or immediate, toxicity): CAUTION Rate: 8 oz./3 gal of water in a backpack for spot treatments and for cut stumps Timing: Timing: Varies depending on the location, the weather, the weed growth, the work load Cost to apply (includes material cost): $79/backpack load (3 gal) Herbicide Resistance Management Group: 2 **Enjoined for red legged frog On Ground Water Protection List (b): potential to contaminate ground water, but not yet found in ground water **CONCLUSIONS: When the IPM process calls for the use of herbicides, the products described above are used where most suitable considering cost, efficacy, the environment, human communities, and resistance management.**
Which herbicide application methods are available for this chemical?	Methods available: Current Department equipment allows for 4 methods of application: a boom attached to a truck, a handgun attached to a hose connected to a truck-mounted tank, spot treatment with a backpack, and spot treatment with a squirt bottle. The truck with a boom is used wherever possible since it is most efficient. A handgun attached to a hose is used where access is difficult for a truck, the backpack sprayer is used for small spot treatments, and the squirt bottle is used for cut stump treatments. **CONCLUSIONS: The terrain, the proximity to the water, the kind of weed, and the goal of the treatment dictate the application method.**
What weather concerns must be checked prior to application?	The Vegetation Manager takes into consideration the pesticide label and all site specific factors. Each day, the Vegetation Manager checks the weather when he/she arrives at work at 6:00 AM. Rain can prevent application of some herbicides because of the danger of runoff. For most pre-emergent herbicides, rain is needed after application in order for the herbicide to be effective. The Vegetation Manager must also consider wind speed (generally it should be <7 mph) to avoid herbicide drift. Crews carry wind meters in their trucks. Excessive heat or cold makes plants shut down, and herbicide applications at that time would be ineffective. The Vegetation Manager uses these factors to write Pest Control recommendations for the crew to follow on the days that spraying takes place.
Cost Comparisons for various management	See Table 1, below.

methods	
Changes in management methods since the previous iteration of this document	Since FY 12-13, the Department (as of 2018): • Decreased acres of roadsides treated with chemicals by 61% • Increased acres mowed on flood control channels by 25% • Decreased acres of access road shoulder and fenceline chemical treatments by 37% • Decreased acres treated with chemicals on flood control banks by 92% • Increased acres grazed by goats by 151% • Decreased acres of aquatic chemical treatments by 31%
Recommendations from the IPM Advisory Committee	• Continue to review all vegetation management methods available for flood control channels and access roads considering efficacy, cost, impacts to the environment and to the human community. • When improved wellhead location information becomes available in the future, the Committee recommends that the County consider that information during the pest management decision making process. • Encourage investigation into, and experimentation with, new methods. • Review this document every 3 years.

Table 1. Methods, Acres Treated, and Cost* for Vegetation Management along Contra Costa Roadsides and Flood Control Channels, Averaged over Two Years (2016-2018)[§]

Vegetation Management Method	Avg # of Acres Treated	% of Total Acres Treated	Avg. Total Cost for all acres treated	Avg Cost/Ac	% of Total Cost for all acres treated	% Change in Total Acres Treated from FY 12-13
Chemical Treatment - Roads	714.5	48%	$137,896	$193	18%	-61%
Right of Way Mowing (mainly flood control facilities)	318	22%	$348,856	$1097	47%	25%
Chemical Treatment – Flood Control Access Roads	144.5	10%	$50,065	$346	7%	-37%
Chemical Treatment – Flood Control Banks	14.5	1%	$7,467	$515	1%	-92%
Grazing (flood control facilities)	240.7	16%	$158,355	$658	21%	+151%
Chemical Treatment - Aquatic Applications	41	3%	$37,686	$919	5%	-31%
Mulching (flood control fence-lines and access road shoulders)	0.65	0.04%	$6,642	$10,218	1%	-89%
Totals	1473.75		$746,967			-31%

*Table lists the most accurate costs available. The cost figures above for each method include labor, materials, equipment costs, contract costs (for grazing), and overhead (includes training, permit costs, and habitat assessment costs). Licensing costs for staff members are paid by the individual and not by the County. The cost of the Vegetation Management Supervisor when he supervises work is not included in any of the figures but is comparable among the various methods.

[§]Table is updated each year in the IPM Annual Report. See cchealth.org/ipm.