

2019

Sonoma Water Integrated Pest Management Plan

February 7, 2019

VEGETATION MANAGEMENT IN SONOMA WATER FACILITIES

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**Sonoma
Water**

Sonoma Water

Integrated Pest Management Plan

Vegetation Management in Sonoma Water Facilities

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February 7, 2019

Table of Contents

Table of Contents.....	i
Executive Summary	1
1 Scope and Purpose	2
2 Introduction to IPM.....	3
3 IPM Program Components.....	6
3.1 Program Goals.....	6
3.2 Environmental Regulations and Compliance.....	6
3.2.1 MS4 Permit Compliance	7
3.3 Roles and Responsibilities	7
3.4 Recordkeeping, Reporting, and GIS Database Use	8
3.5 Training and Safety.....	8
3.6 Vegetation Control Tools.....	8
3.6.1 Herbicide Use Reduction	10
3.7 Special Status Species	11
4 IPM for Flood Control.....	13
4.1 Management Goals.....	13
4.2 Monitoring.....	13
4.3 Pest Types and Identification	14
4.4 Action Level	15
4.5 Treatment Options	15
4.5.1 Pruning and Removal	16
4.5.2 Mowing	18
4.5.3 Herbicide Treatment	18
4.5.4 Nursery Stock Tree Planting	19
5 IPM for Water Supply.....	20
5.1 Management Goals.....	20
5.2 Monitoring.....	20
5.3 Pest Types and Identification	20
5.4 Action Level	20
5.5 Treatment Options	21
6 IPM for Wastewater Treatment Facilities.....	22

6.1	Management Goals.....	22
6.2	Monitoring.....	22
6.3	Pest Types and Identification	22
6.4	Action Level	22
6.5	Treatment Options	23
7	IPM for Buildings.....	24
7.1	Management Goals.....	24
7.2	Monitoring.....	24
7.3	Pest Types and Identification	24
7.4	Action Level	25
7.5	Treatment Options	25
8	Important Topics Regarding Herbicide Use.....	26
8.1	Adjuvants.....	26
8.2	Herbicide Resistance	26
9	References	27

Executive Summary

Sonoma Water is responsible for maintaining vegetation at multiple locations throughout Sonoma County. Sonoma Water uses its Integrated Pest Management (IPM) program to support internal maintenance planning and provide guidance on vegetation management. Consistent with the University of California's definition of IPM, a 6-step process is used to identify and monitor undesirable vegetation and set site-specific thresholds for the following operational areas:

- Flood Control
- Water Supply
- Wastewater Treatment
- Buildings and Grounds

Vegetation in these areas is managed using one or more biological, physical, cultural or mechanical tools. Herbicides are used as needed by licensed and trained staff and herbicide use is reduced or limited based on a site-specific prioritization process. Vegetation management effectiveness and field activities are recorded in a GIS database to continually evaluate and refine IPM activities.

Recognizing the diversity and importance of natural resources in Sonoma County, Sonoma Water staff performing IPM are trained to identify habitat and recognize special status species. As necessary, work is postponed until special status species are not harmed.

Sonoma Water's IPM program complies with all local, state and federal requirements, including the its Municipal Separate Storm Sewer System (MS4) permit.

1 Scope and Purpose

Sonoma Water is responsible for maintaining buildings and facilities for water supply, flood control, and wastewater treatment grounds and facilities across Sonoma County. In addition, Sonoma Water manages approximately 75 miles of engineered flood control channels and 100 miles of modified or natural channels for flood water conveyance and habitat enhancement. Vegetation management is necessary to keep facilities maintained and functioning properly.

The purpose of this Integrated Pest Management (IPM) Plan is to support internal maintenance planning and provide information regarding Sonoma Water's approach to vegetation management.

This IPM Plan provides a summary of all vegetation management activities conducted by Sonoma Water staff for flood control, water supply, wastewater treatment facilities, and buildings that are owned or managed by Sonoma Water.

2 Introduction to IPM

IPM is defined as “an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment” (UC ANR, 2017).

IPM programs are typically comprised of the following components:

1. Pest Identification

In the context of Sonoma Water’s current IPM Plan, a **pest** is defined as undesirable vegetation (i.e., a “weed”, or “plant out of place”) that if present under specific conditions, may exceed an acceptable tolerance threshold. Proper identification of the pest, its life cycle, method(s) of reproduction, phenology, etc. are critical to understanding how to control it.

2. Establishment of Action Levels

Pest control is done only if **action levels** are exceeded or are anticipated to be exceeded. These tolerance thresholds represent the level of pest presence or damage that is not acceptable. Thresholds often vary by pest, site or time of year and are established to achieve program goals as stated in Chapter 3.

3. Monitor for Pest Presence

Ongoing monitoring is necessary to help identify what pests are present, the degree of pest presence, and any pest-related damage in a given site. Monitoring provides important information about pest biology, environmental conditions that may be conducive to pests, and whether tolerance levels have been exceeded. If pest control is necessary, such information is used to guide effective pest control decisions such as which management strategies to employ and when to employ them.

4. Select Management Options If Action Levels Are Exceeded

IPM focuses on long-term management of pests by employing one or more control strategies including:

- **Cultural controls** – practices that reduces a pest’s ability to establish, reproduce, disperse, and survive (e.g., growing competitive plants, proper watering, sanitation)
- **Physical/mechanical controls** – practices that kill or damage a pest directly, physically block or prevent pest entry, or make the environment unsuitable for pests (e.g., mowing, pruning, use of weed cloth or mulch)
- **Biological controls** – the use of natural enemies to control pests (e.g., predators, pathogens, parasites)
- **Chemical controls** – the use of pesticides which are intended to kill, prevent, repel, or mitigate pests. Pesticides intended to control plant pests are referred to as **herbicides**, while pesticides intended to control insect, fungi, and rodent pests are referred to as

insecticides, fungicides, and rodenticides, respectively. For the purposes of this IPM plan, however, only herbicides will be used. Details on other important topics including the use of adjuvants, dyes and the concept of pesticide resistance are discussed in **Chapter 8**.

If monitoring demonstrates that pest control is needed, a combination of the above management strategies is typically implemented to achieve effective, sustainable control.

*To learn about the specific management options implemented by Sonoma Water, refer to **Section 3.6**.*

5. Evaluate Treatment Effectiveness

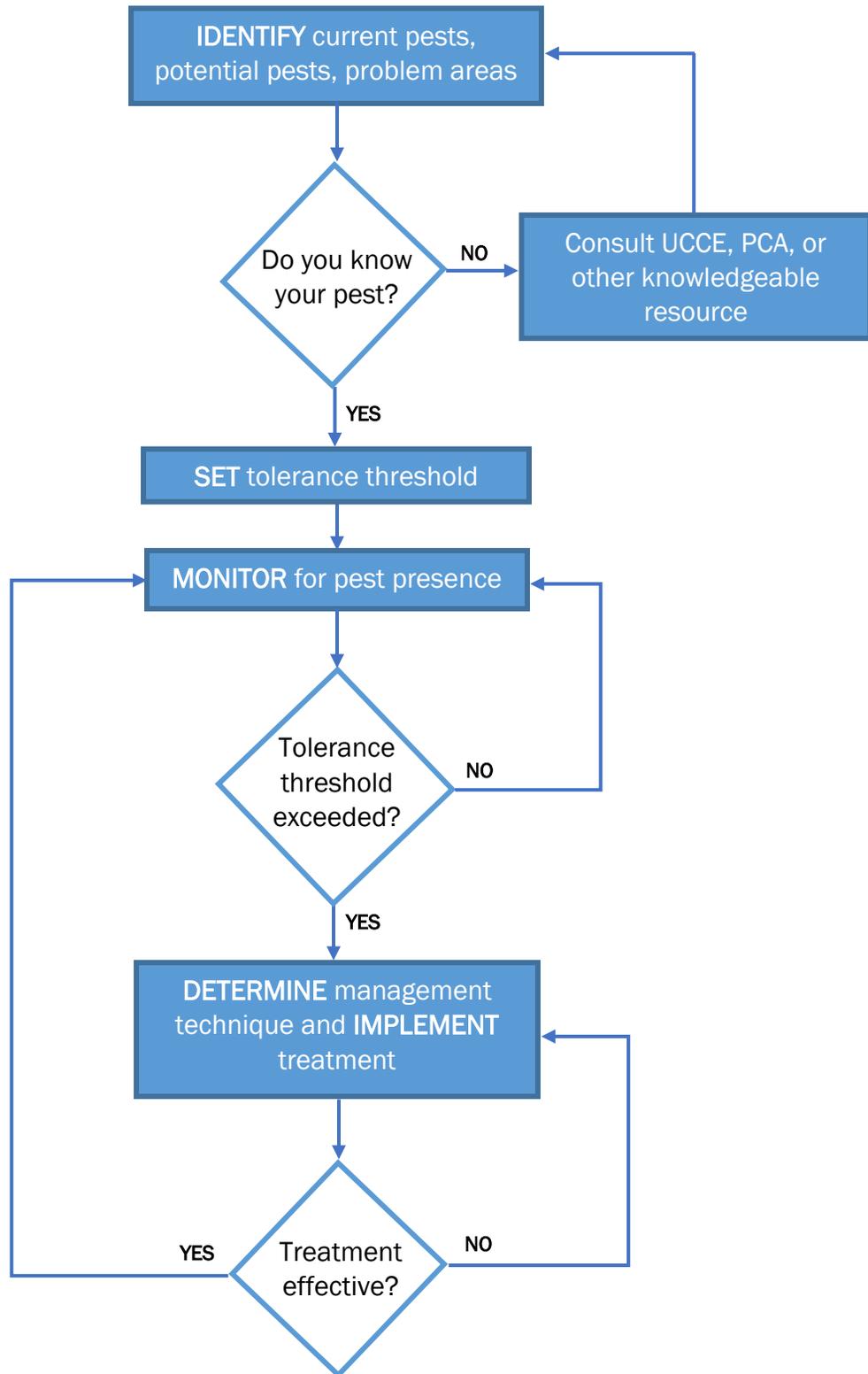
Follow-up monitoring is conducted to gather information about the effectiveness of the treatments and help guide future actions. If pest populations still exceed threshold levels, a different management option may be required. Similarly, such evaluation may reveal potential adverse impacts resulting from treatment and allows for prompt corrective action to be taken.

6. Keep Records of the Process

Data from pest control activities is recorded both for regulatory compliance and for IPM program evaluation and updates. Detailed recordkeeping can provide valuable information about pest trends and patterns over time, whether IPM activities are consistent with program goals, and adjustments that should be made to improve overall program logistics.

For a summary of these components, refer to **Figure 1**.

Figure 1. IPM Program Flow Chart



3 IPM Program Components

3.1 Program Goals

The goals of this IPM Plan are to:

- Create and maintain:
 - Suitable visibility of and access to structures and property to allow for inspection, maintenance, and use
 - Adequate flood control
 - Desirable aesthetics
 - Public access and enjoyment
 - Habitat
- Reduce fuel to prevent fire
- Prevent unacceptable risks to employee and public health and safety
- Comply with regulatory requirements
- Reduce herbicide use where feasible

3.2 Environmental Regulations and Compliance

Vegetation management activities often require environmental compliance or permitting depending on the activity type, where the activity occurs, and how the activity is implemented. Examples of environmental regulations pertaining to Sonoma Water vegetation management activities include:

- Clean Water Act, including National Pollutant Discharge Elimination System (NPDES) permitting
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- Federal Endangered Species Act, including Stipulated Injunctions regarding pesticides and pacific salmonids, 11 species in San Francisco Bay area, and the California red-legged frog
- Federal Migratory Bird Treaty Act
- National Environmental Policy Act
- California Porter-Cologne Water Quality Control Act, including the Stream and Wetlands System Protection Policy
- California Fish and Game Code, including the Lake and Streambed Alteration Agreement Program and rules related to nesting birds and birds of prey
- California Endangered Species Act
- California Environmental Quality Act

For additional information regarding the environmental regulations listed above and Sonoma Water's general permitting or compliance approach for activities in streams, please refer to the Stream Maintenance Program (SMP) Manual (Sonoma Water, 2009).

To support regulatory compliance and promote overall environmental stewardship, Sonoma Water also implements a number of Best Management Practices (BMPs) pertaining to topics including, but not limited to: biological resources protection, hazardous materials safety, vegetation management, and water quality and channel protection. A complete list and descriptions of BMPs are provided in the SMP Manual (Sonoma Water, 2009). As appropriate, the vegetation management BMPs described in the SMP are widely used by Sonoma Water and have been integrated into this document.

3.2.1 MS4 Permit Compliance

Sonoma Water is also enrolled in a municipal separate storm sewer system (MS4) permit under the State's Municipal Storm Water Program. To comply with MS4 permit requirements related to vegetation management, Sonoma Water implements principals and procedures including, but not limited to:

- Using pesticides only if evaluation indicates they are needed and according to established guidelines
- Making treatments with the goal of removing only the target organism
- Selecting and applying pest control methods in a manner that minimizes risks to human health, beneficial, non-target organisms, and the environment
- Reducing potential surface water impairment from pesticides by:
 - Quantifying pesticide use by staff and hired contractors via an internal GIS database
 - Preparing and annually updating an inventory of pesticides used by type and location via an internal GIS database
 - Continuing programs to reduce pesticide use to the maximum extent practicable
 - Reporting reductions or changes in pesticide use by type and location annually
- Ensuring pesticides or fertilizers are not applied to an area immediately prior to a likely rain event, during, or immediately after a rain event, or when water is flowing off the area
- Ensuring that no banned or unregistered pesticides are stored or applied
- Ensuring that all staff applying pesticides are certified in the appropriate category by the California Department of Pesticide Regulation (DPR), or are under the direct supervision of a pesticide applicator certified in the appropriate category
- Implementing procedures to encourage the retention and planting of native or drought-tolerant vegetation to reduce water, pesticide and fertilizer needs

3.3 Roles and Responsibilities

Two categories of Sonoma Water personnel with a role in vegetation management are environmental staff and field operations staff.

Environmental staff includes biologists that are responsible for conducting environmental resource, special status species, and nesting bird surveys prior to vegetation management activity. Other activities include coordinating with regulatory agencies, data management, and preparing permit applications, annual reports and notifications.

Field operations staff are responsible for planning and conducting vegetation management activities to meet program goals. Field operations staff have experience and expertise in all aspects of IPM and include a DPR-licensed Pest Control Adviser (PCA) and Qualified Applicators License (QAL) holders who are responsible for the safe and legal use of herbicides, and International Society of Arboriculture (ISA) Certified Arborists® who are responsible for the safe and effective work practices in all arboricultural operations. PCAs and QALs are required by the State to pass relevant examinations and complete 20-40 hours of continuing education (CE) biannually to stay current on pest control regulations, best practices, and techniques. Similarly, Certified Arborist credentials are obtained by passing a knowledge examination and maintained by completing 30 hours of CE triennially.

3.4 Recordkeeping, Reporting, and GIS Database Use

Herbicide use is recorded and reported to the Sonoma County Agricultural Commissioner (CAC) via monthly Pesticide Use Reports. In addition, the IPM activities that are conducted, some of which are part of the SMP, are logged in an internal database via a Vegetation Maintenance Form. The Vegetation Maintenance Form prompts Sonoma Water staff to record date, time and location of work, make note of any special status species present, BMPs employed, vegetation control method(s) used, and the amount, if any, of herbicide applied. Completed Vegetation Maintenance Forms are imported into Sonoma Water's internal Geographic Information System (GIS) database and used to assess, track, and summarize vegetation management activities.

3.5 Training and Safety

As appropriate, all field operations staff engage in daily tailgate meetings to discuss topics related to upcoming vegetation management activities. For example, daily tailgates may discuss pertinent herbicide application methods, how to properly use herbicides, how herbicides work, anticipated treatment results, and mechanical equipment safety. An in-depth training on proper tree pruning practices is held seasonally. As needed, weekly tailgate meetings are also held to review general safety considerations, such as working in hot weather and safely operating Sonoma Water vehicles.

Staff involved in the application of herbicides practice safe herbicide applications by following product label instructions and wearing, at minimum, the label-prescribed Personal Protection Equipment (PPE), chemical-resistant gloves, and protective eyewear. In addition, Sonoma Water policy requires that staff involved in herbicide applications wear half-mask respirators with organic-type filters. Per 29 CFR § 1910.134 (2011), Sonoma Water's written respiratory protection program contains fit testing, training, and other procedures for respirator use.

3.6 Vegetation Control Tools

Sonoma Water utilizes a variety of tools to manage vegetation throughout its facilities, with particular emphasis on minimizing herbicide use by encouraging the use of non-herbicide control methods. A brief overview of the vegetation control tools used by Sonoma Water is

provided below. Additional detail on the treatment options and control tools used for flood control, water supply, wastewater treatment facilities, and buildings can be found in **Sections 4, 5, 6, and 7**, respectively.

Physical/Mechanical Methods. The primary mechanisms of mechanical control in Sonoma Water facilities include mowing, pruning, and weed eating. The use of such tools varies based on site characteristics and consideration of the pest being controlled, special status species, and worker safety. In some sites, weed cloth and mulch are installed into landscape plantings as a method of physical control.

Cultural Methods. As appropriate, Sonoma Water staff employ cultural tools such as growing or encouraging native plant growth to outcompete or shade out invasive species. Such practices have shown to be effective in reducing non-native populations to manageable levels and aid in the development of a native riparian canopy.

Biological Methods. Sonoma Water intends to implement a pilot goat grazing program for the control of weeds in flood control sites. Based on the success and feasibility of this pilot program, grazing may be employed as a routine vegetation control tool in candidate flood control sites.

Herbicide Use. Sonoma Water seeks to use the minimum amount of herbicide necessary. As part of the IPM program, Sonoma Water staff integrates the uses herbicides with other control methods to meet program goals. Herbicide selection and use is overseen by Sonoma Water's in-house PCA and QAL personnel. All applicable product label instructions are followed.

When herbicides are needed for the control of broadleaf and grass weeds and woody vegetation, the herbicide Roundup Custom™ is typically applied. Depending on the target pest, however, other herbicides may be used. Application methods are determined based on label requirements and site conditions and may include spot spray, cut-stump, and broadcast applications. When used for woody vegetation, the surfactant Agri-Dex is mixed with Roundup Custom. No surfactant is used for the control of grasses or broadleaf weeds. As needed, drift-reduction agents such as Stay-Put® may be mixed with the herbicide to reduce potential non-target impacts from spray drift.

Mixing and loading of herbicides is carried out at a designated Sonoma Water wash rack, away from drain inlets or other features that may discharge to State or Federal waters. During transport, all herbicide containers are secured in the back of Sonoma Water vehicles. In addition, to prevent potential exposure to the public, all herbicide spraying is halted until passing joggers and hikers are at safe distances from the application site. When not in use, herbicides are stored in a locked shed with secondary containment in the event of an accidental spill. Emptied herbicide containers are properly disposed of per label instructions.

All Sonoma Water herbicide use complies with CAC, DPR, and Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulations. Further, herbicide use is consistent with the requirements of court-ordered injunctions such as the Salmonid Injunction, the Stipulated Injunction and Order for Protection of California Red-Legged Frog, and the Bay Area Stipulated Injunction and Order for the protection of endangered species occurring in California and the Bay Area (i.e., "Goby-11").

3.6.1 Herbicide Use Reduction

Sonoma Water is committed to reducing herbicide use to the extent feasible. Over-reliance on or misuse of herbicides may result in increased risk of adverse impacts to workers, the public, and the environment. In some cases, it can also lead to the development of herbicide resistance and exacerbate existing vegetation problems. In an effort to reduce herbicide use, Sonoma Water engages in the following practices:

- **Properly identify and monitor target vegetation.**

Proper plant identification can play an important role in the success of vegetation management activities. Identifying target plants provides information on its life cycle, growth stages most vulnerable to control methods, habitat preferences, and control methods that may be most effective. Together, such information often results in an increased likelihood of long-term prevention and management success. Proper identification allows IPM practitioners to treat only the target vegetation, which can significantly reduce unnecessary vegetation control efforts. By monitoring the vegetation population, Sonoma Water staff are able to determine when treatment is necessary and take action before plant populations cause damage or become very difficult to control. Efficient management of vegetation in this manner reduces the need for follow-up treatments, allows for preventative action and rapid response to emerging issues, and ultimately reduces the level of effort necessary to control unwanted vegetation.

- **Utilize multiple control and prevention methods to manage nuisance vegetation.**

As described above, Sonoma Water uses a variety of control methods to manage problematic vegetation rather than relying solely on herbicides. By integrating non-herbicide control methods into vegetation management activities, the quantity of herbicides applied and frequency of applications is greatly reduced. The establishment of pest populations is prevented or reduced by physical and cultural control methods such as developing a shaded canopy over problem areas and adopting landscape designs which utilize weed cloth and mulch. Established weed populations are preferentially managed using mechanical methods such as mowing and pruning. Herbicides are applied only when necessary in order to keep Sonoma Water staff from slip, trip and fall and other hazards, regulatory requirements, or insufficient results of non-herbicide vegetation management strategies. In addition, Sonoma Water continuously seeks alternative control methods to further reduce reliance on herbicides (e.g., goat grazing).



- **Identify sites where herbicide use is necessary or can be reduced or eliminated.**

Based on regulatory requirements, potential for structural damage and impaired functionality, and feasibility and adequacy of vegetation management using non-herbicide techniques, Sonoma Water prioritizes herbicide use in some sites and identifies other sites where herbicide use can be reduced or eliminated. Non-herbicide control methods are preferred in sites where the IPM Plan goals can be achieved with reduced or no use of herbicides. Herbicide use is prioritized in the following manner, with sites of lower priority being the best candidates for further herbicide use reduction:

Priority	Description	Rationale for Herbicide Use
1	Weeds occurring in dams and facilities under Division of Safety of Dams (DSOD)	Regulatory requirements (e.g., maintain ability to inspect for damage and leaks, maintain water flow and storage capacity); site features often incompatible with use of mechanical control methods alone
2	Woody invasive plants in flood control facilities	Maintenance of flood conveyance capacity; inadequate control and/or worker safety concerns via mechanical control methods alone
3	Woody invasive plants at critical infrastructure	Prevention of structural damage; necessity of staff access
4	Cut stump treatment in flood control channels	Maintenance of flood conveyance capacity; inadequate control via handheld mechanical tools alone
5	Access road spraying	Reduction of tripping and falling hazards; preservation of structural integrity; fire fuel reduction
6	Non-woody weeds and grasses in grounds and landscape	Aesthetics

- **Consider the use of herbicides categorized as alternative or organic.**

Sonoma Water may also choose to reduce the use of conventional herbicides by utilizing alternative or organic herbicides. In some cases, these non-conventional herbicides may be less toxic than conventional herbicides. To determine whether these non-conventional herbicides may be suitable replacements for conventional herbicides, Sonoma Water intends to develop a pilot program to compare the effectiveness and feasibility of such products.

3.7 Special Status Species

Several special status plant and animal species have the potential to occur in areas where vegetation management is done. As such, an on-call, qualified Sonoma Water biologist is available to visit a project site at any point during maintenance activities in the event a special status species is suspected or encountered. A list of special status species with the potential to occur with the SMP area is updated annually via the California Natural Diversity Database

(CNDDDB). The list of special status species is reviewed by a Sonoma Water biologist and species known or likely to be present based on habitat requirements are recorded.

All staff performing vegetation management are trained by a qualified biologist at the beginning of each maintenance season and before performing vegetation management. The training includes instruction on how to identify bird nests, recognize special status species that may occur in work areas, and the appropriate protocol if any nests or listed species are found.

Vegetation management activities comply with applicable federal, state, and local laws and policies that protect biological resources, including but not limited to: the Federal Endangered Species Act, the Federal Migratory Bird Treaty Act, the California Endangered Species Act, the California Environmental Quality Act, and the California Fish and Game Code.

Several BMPs have been established to protect special status plants and animals during vegetation management activities. For example, pre-work surveys for special status plants and animal species with known or potential occurrences in the work area are conducted by qualified biologists. If special status species are discovered, the work area is flagged and avoided. In certain instances, the potential presence of special status animals warrants entry into sensitive areas by foot only, while vehicles are restricted to existing access roads. In the event that a special status animal species is encountered within the work area, work is stopped and a biologist with an Incidental Take Permit or approved by the U.S. Fish and Wildlife Service (USFWS) will move the animal to a safe location away from the work site. All actions to move special status species are consistent with applicable USFWS and the California Department of Fish and Wildlife (CDFW) regulations and permits. Special status plant species near the work site will be protected from temporary disturbance by installing environmentally sensitive area fencing around special status plant populations under the direction of a botanist. Where feasible, the area fencing is installed at least 50 feet from the edge of the plant population.

To the extent feasible, maintenance activities, including tree trimming and mowing, take place outside the migratory bird and raptor nesting period (February 15 through August 15 for most birds). If maintenance activities must be scheduled to occur during the nesting season, a qualified wildlife biologist conducts pre-maintenance surveys for raptors and nesting birds within suitable nesting habitat within 300 feet of SMP activities. If no active nests are discovered during surveys, maintenance activities may proceed, with vegetation removal activities conducted under the guidance of a biologist. If active nests are identified within the SMP area, non-disturbance buffers are established in cooperation with CDFW at a distance sufficient to minimize disturbance based on the nest location, topography, cover, and species' tolerance to disturbance. If active nests are found within 300 feet of the project area, a qualified biologist is stationed on site as necessary to monitor the nests for signs of nest disturbance.

For the complete list and descriptions of BMPs implemented under the SMP, including BMPs for special status species, refer to Table 7-1 in Sonoma Water's (2009) SMP Manual.

4 IPM for Flood Control

Sonoma Water manages approximately 75 miles of engineered flood control channels and 100 miles of modified or natural channels for flood water conveyance and habitat enhancement. Other flood control facilities include in-channel structures, reservoirs, and sediment basins. Sonoma Water also maintains five flood control reservoirs, flow diversion and bypass structures, stream and rain gauge stations, riprap levees, fish ladders, and recreation facilities.

4.1 Management Goals

The two overarching goals of vegetation management for flood control are to ensure that adequate flood conveyance capacity is maintained and to develop a mature and complex riparian canopy and corridor of native species which serve to armor side banks, stabilize the active channel edge zone, offer habitat and beneficial uses such as creek shading, provide aesthetic value, and reduce the need for future in-channel and bank vegetation maintenance.

To accomplish these goals, several objectives have been established for channel maintenance and are applied appropriate for reach-specific conditions. These objectives include:

- Develop riparian woodland/forest canopy closure
- Encourage native vegetation and discourage non-native vegetation, particularly invasive species
- Control in-channel emergent vegetation
- Establish optimal channel boundary conditions that promote stream form and pattern stability
- Minimize flow obstructions
- Improve bank stability



Vegetation management at other flood control facilities is focused on maintaining clear access to in-channel engineered structures and sediment basins and ensuring that in-channel engineered structures and reservoirs can operate as designed.

4.2 Monitoring

Each year, Sonoma Water staff conduct a complete assessment of vegetation conditions in flood control channels. Such assessments are typically done in the spring, with determinations of reach-specific vegetation management needs based on an understanding of the stream channel hydrologic and geomorphic context and setting in addition to an assessment of existing in-channel vegetation conditions.

Annual monitoring and evaluation considers factors such as dominant geomorphic processes in the channel (e.g., erosional, depositional), available flood conveyance capacity, channel roughness, vegetation growth conditions, and the amount of in-stream vegetation that has grown since the last assessment. Details of the types, beneficial functions, and drawbacks of vegetation are recorded, as well as any evidence of vegetation obstructing flows, accumulating other debris, deflecting flows and causing bank scouring, or directing flows toward other infrastructure or banks, or causing other flow-related issues such as ponding or bed scour.

Vegetation conditions that may be problematic at other flood control facilities may also be noted during reconnaissance done by Sonoma Water staff performing non-IPM activity. Because some flood control facilities are publicly accessible or in close proximity to residences, nuisance vegetation is also reported by the public. Furthermore, flood control reservoirs under the jurisdiction of the State of California are inspected annually by the California Department of Water Resources (DWR) Division of Safety of Dams (DSOD) to ensure they are safe, perform as intended, and do not develop issues related to reservoir infrastructure and flow capacity.

4.3 Pest Types and Identification

The two categories of pests in flood control creeks include problematic in-channel vegetation (Class 2) and other non-native vegetation (Class 3). Class 2 vegetation inhibits and prevents the establishment of a native riparian canopy and limits the beneficial uses that can be achieved in the riparian zone. Class 2 vegetation includes: cattail (*Typha* sp.), himalayan blackberry (*Rubus discolor*), arroyo willow (*Salix lasiolepis*), giant reed (*Arundo donax*), pampas grass (*Cortaderia selloana*, and *C. jubata*), Indian bean (*Catalpa bignonioides*), privet (*Ligustrum* sp.), English and Algerian ivy (*Hedera helix*, *H. canariensis*), periwinkle (*Vinca major*), red clusterberry (*Contoneaster* sp.), brooms (*Spartium* and *Genista* spp.), sweet fennel (*Foeniculum vulgare*), harding grass (*Phalaris aquatica*), water primrose (*Ludwigia peploides montevidensis*), eucalyptus (*Eucalyptus* spp.), tree of heaven (*Ailanthus altissima*), acacia (*Acacia* spp.), white poplar (*Populus alba*), lombardy poplar (*Populus nigra 'Italica'*), tamarisk (*Tamarix* spp.), and rattlebox (*Sesbania punicea*).

Class 3 vegetation is defined as non-native species that are not part of Class 2. Examples of Class 3 vegetation include various landscaping species that are establishing in the flood control channels but are recognized as providing beneficial uses similar to their native counterparts. These may include a variety of ash species (Modesto ash (*Fraxinus velutina*), green ash (*F. pennsylvanica*), raywood ash (*F. oxycarpa*), and evergreen ash (*F. uhdei*), London plane tree (*Platanus acerifolia*), and Carolina poplar (*Populus canadensis*).

Native riparian species that are not listed under Class 2 are referred to as Class 1 vegetation. Class 1 vegetation is desirable and includes species that are not considered nuisance vegetation. Class 1 vegetation is retained wherever possible and includes species such as white alder (*Alnus rhombifolia*), box elder (*Acer negundo*), big leaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), red willow (*Salix laevigata*), Pacific willow (*Salix lucida lasiandra*), Fremont's poplar (*Populus fremontii*), and oaks (*Quercus* spp.). Native understory riparian shrubs that may be suitable for certain flood control channels include species such as American dogwood (*Cornus sericea*), Western spicebush (*Calycanthus occidentalis*), elderberry (*Sambucus* spp.), snowberry (*Symphoricarpos* spp.), and hazelnut (*Corylus cornuta californica*). Because some native species are similar in appearance to undesirable non-native species (e.g.,

native versus non-native blackberry), field staff are trained to identify such species and target only non-native species for removal.

Undesirable vegetation in other flood control facilities include vegetation that is growing within or overhanging access roads, encroaching on concrete structures, or establishing in sediment basins. In reservoirs, all vegetation except grass and other low ground cover is considered a pest per DSOD requirements. Taller vegetation is unsuitable around dams because it interferes with dam inspection and monitoring for seepage and other defects.

4.4 Action Level

Some flood control facilities require annual vegetation management while others do not. In channels, vegetation management is conducted when growth is causing significant bank scour or decreasing flood conveyance capacity, particularly where infrastructure or adjacent properties are at risk, and when the success of native vegetation recruitment is compromised by the presence of invasive, non-native species. The spread of Class 2 vegetation to greater than 10% ground cover may also trigger maintenance activities.

Action levels for flood control reservoirs, dams, and their appurtenances are dictated by DSOD requirements. Grass and other low ground cover growing past ankle height on the dam levee, both inside the reservoir and on the outer dam face, must be controlled. This includes tall and dense vegetation that may prevent proper dam inspection or serve as habitat for burrowing rodents. In addition, dam spillways must be kept open and clear, free of trees, bushes, and woody roots that can impede water flow and storage capacity, cause cracks along spillway walls, and displace concrete walls. There is also very low to zero tolerance for vegetation within five feet of embankment groins and adjacent abutments.

The presence of vegetation along access roads, on concrete structures, and in sediment basins also warrants management activities, especially when it presents safety hazards, limits staff access, or impedes visual inspections for damage.

4.5 Treatment Options

Vegetation management around flood control channels includes the removal, thinning, and preservation of vegetation, in addition to the planting of new trees. Management activities emphasize the preservation of large mature trees that provide well developed overstory for bird habitat, canopy closure for stream shading, and add vertical complexity to the riparian corridor. Vegetation management in other flood control facilities is focused primarily on selective removal and thinning for DSOD compliance.

Vegetation removal and thinning may utilize small tools, handheld equipment, mechanical equipment, and/or targeted herbicide applications. Heavy equipment used for vegetation removal may include a flail mower attachment on an excavator or Bobcat® that is used to cut cattails or blackberries, or a backhoe or rubber-tracked excavator that is used for removing material from the channel. In sediment basins, removal occurs during sediment management activities. Refer to the SMP Manual (Sonoma Water, 2009) for information pertaining to sediment removal activities.

Timing of vegetation management activities is based on the location and type of work to be done; however, all maintenance activities are typically conducted during periods of low rain and

channel flow in an effort to minimize potential impacts resulting from channel work (e.g., erosion or introduction of pollutants from work equipment entering the creek). The types and general work window of vegetation management activities include:

- Routine vegetation pruning and removal on the lower bank and in channel bed (trees, Ludwigia, cattails, blackberries) – June 15th to October 31st (with the potential for an extension dependent upon dry conditions and CDFW notification and approval)
- Tree planting, relocating, and/or transplanting – all year
- Upper bank planting, pruning, and removal, access road, and v-ditch clearing – all year
- Nursery stock tree planting – December 1st to May 31st
- Mowing (access roads and dam faces) – March 1st to August 31st
- Access road herbicide spraying – April 1st to May 31st

Vegetation pruning and removal activities are conducted under the guidance of a staff biologist or certified arborist following the approaches described in Appendix E (Vegetation Management Plan) of Sonoma Water's (2009) SMP Manual. For tree relocation activities, a botanist, certified arborist, or other vegetation specialist are stationed on-site to help direct maintenance activities and to consult if questions and/or issues arise.

Additional information regarding the management techniques used in creeks, streams, and channels is presented in the SMP Manual (Sonoma Water, 2009) and summarized below. Furthermore, Sonoma Water staff consider the use of other management strategies that may help increase pest control efficiency or reduce potential human safety risks. In some flood control sites, for example, a goat grazing pilot study has been proposed. Based on the success and feasibility of this study, grazing may be employed in candidate sites throughout Sonoma Water facilities.

4.5.1 Pruning and Removal

Maintenance activities related to tree pruning focus on selectively thinning brush and multi-trunked trees. In order to develop a native canopy over channels without increasing channel roughness such that the flood hazard is increased, the preferred maintenance approach is to prune lower limbs up to the top of the channel banks. If possible, multi-stemmed trees are also pruned down to a single trunk. In the top-of-bank area outside the stream channel, healthy mature native trees may be trimmed if a limb is blocking the access road, extending into a private yard, or appears unbalanced or broken. Trees may also be pruned in order to maintain appropriate spacing needed for staff to access channels.

Pruning on the bank side slopes, at dam spillways, and along access roads typically requires careful hand clearing using chainsaws, pole saws, pruners, and loppers. In areas at the top-of-bank high in public use or adjacent to residences or other structures, hand clearing may also be used to remove hazards such as snags, dying or dead trees, and broken branches.

If pruning is unsuitable or insufficient to provide necessary channel conveyance capacity, removal may be considered for vegetation that is noxious, invasive, hazardous, or could obstruct channel flows. Consideration for individual tree removal is based on several factors including: type and age of the tree, degree of blockage across the channel, location in the channel, potential shade or habitat benefits provided, and potential longer-term canopy

development or riparian corridor benefits provided. The consideration of such factors is done under the oversight and guidance of a biologist or arborist that is familiar with the vegetation in the area and knowledgeable of channel botanical conditions.

As needed, vegetation is removed and/or pruned in such a manner that reduces channel roughness while allowing the maximum amount of vegetation, especially vegetation that provides erosion protection and habitat value, to remain in place. Per DSOD requirements, emerging trees and bushes are removed from reservoir embankments, groins, and abutments annually. Invasive plant species that inhibit the health and/or growth of native riparian trees along channels are also generally targeted for removal. In areas where extensive vegetation removal is recommended to maintain flood flow capacity, phased removal is considered so that some vegetation may remain in place to provide habitat to birds.

Examples of pests that may be pruned or removed based on these factors are presented below.

4.5.1.1 Arroyo Willows

Arroyo willows are a prominent vegetation management issue in the SMP due to the rapid growth and bushy structure of the species, which can reduce channel flows and trap debris. Because of the rapid growth, multi-stemmed base, and bushy nature of the arroyo willow, it is not generally feasible to limb and prune the plant so as not to extensively block the channel cross section. In contrast to species such as the white alder, big leaf maple, Oregon ash, and red and Pacific willow which generally form a single main trunk and are suitable for pruning, management of arroyo willows is typically done via removal.

Arroyo willows may be removed wherever they are significantly impeding flows and reducing the channel conveyance capacity. In some cases, however, presence of arroyo willows is needed to retain sufficient canopy cover and may instead be retained and pruned to minimize their ability to catch debris and impede the flow of water.

Willow removal generally requires hand clearing using chainsaws, pole saws, pruners, and loppers. To slow or prevent future regrowth, willow stumps may also be hand treated with herbicide.

4.5.1.2 Exotic Trees

Non-native, invasive trees such as tree of heaven, acacia, white poplar Lombardy poplar, eucalyptus, Indian bean, and London plane trees (Classes 2 and 3) may be cleared from the top-of-bank area or within the channel as appropriate. In the event that a channel reach is rich in native trees that provide sufficient canopy or habitat to nesting birds or raptors, non-native, mature trees may be selectively removed. If removal of such trees results in significant loss in canopy and/or habitat in the reach, however, they are left in place until such a time as a native canopy is developed.

4.5.1.3 Sick, Dying, or Dead Mature Trees

Sick, dying, or dead mature trees that reduce channel capacity, increase roughness, are likely to fall into the channel and increase flood hazard, or present a potential safety hazard to recreational users or adjacent structures may be recommended for removal by appropriate environmental staff (e.g., arborist, biologist). Snags that do not pose a flood or safety hazard are typically left in place to provide habitat for birds and small mammals. In cases where flood and/or safety hazards can be reduced without removal, sick, dying, or dead trees and snags

may also be pruned such that at least a portion of the tree may remain in place to provide habitat.

4.5.1.4 Exotic Bushes

Non-native, invasive bushes such as blackberry, privet, brooms, red cluster berry, and ivy (Class 2) may be cleared from the top-of-bank area or within the channel as needed, generally using a bladed weed eater or excavator or Bobcat® with a flail mower attachment. Due to the fast-growing nature and ability to grow into and across the channel bed within a single season, the remaining cut stalks of blackberries are also spot sprayed with herbicide to control regrowth. Consistent with the management goals of SMP streams, creeks, and channels, vegetation management staff are trained to identify and preserve native blackberry populations, selectively treating non-native, invasive populations. Because blackberries are commonly found in reaches with little to no riparian canopy, the development of a canopy via nursery stock tree planting also helps to reduce the regrowth of blackberries. Other invasive bush species are removed using similar methods; however, herbicides are applied only to blackberries.

4.5.1.5 Aquatic Vegetation

Invasive aquatic species such as cattails and water primrose may be targeted for removal based on their tendency to trap sediment and cause subsequent impacts to channel conveyance. Cattail removal may be carried out using heavy equipment such as an excavator with a flail mower extension positioned at top-of-bank. When mature trees prevent access for such equipment, bladed weed-eaters are used. Longer-term control may be accomplished when cattail removal is combined with sediment removal, a necessary maintenance activity for the SMP. In this case, cattail roots and sediment are removed from channels using equipment such as long-reach excavators, bulldozers, scrapers, or front loaders. As cattails are commonly found in reaches with little to no riparian canopy and in low-gradient channels that support flows throughout much of the year, growth is further discouraged by the development of a canopy over the channel, strategic planting of cattail competitors, and the establishment of a low-flow channel.

While water primrose has the potential to completely fill and block channels, populations are not particularly problematic to SMP conveyance flows because most Sonoma Water flood control channels streamflow rises above established water primrose patches. As needed, water primrose is similarly removed using mechanical equipment such as long-reach excavators from maintenance roads adjacent to the project site channel. Future removal efforts may also utilize aquatic harvesters.

4.5.2 *Mowing*

Sonoma Water staff mow grasses in the top-of-bank area up to three times annually using a flail mower. Vegetation within 3 to 4 feet of access roads or on dam levees is also maintained by mowing. In areas that are not easily accessed by a mower (e.g., fence lines, around poles), hand-held tools such as weed whackers are preferred. All cuttings resulting from use of flail mowers are left in place as mulch so long as they are kept outside of active channels.

4.5.3 *Herbicide Treatment*

Herbicides are used sparingly and applied carefully by qualified personnel to targeted areas. Sonoma Water staff use only the minimum amount of herbicide needed to adequately control

vegetation and are trained not to apply herbicides to upland areas within 72 hours of predicted rainfall.

Outside of the active channel, herbicides may be broadcast sprayed via truck-mounted rig to access roads to protect roadway integrity and prevent human safety risks such as tripping and falling hazards. The area sprayed is limited to as narrow a width as practicable. To reduce the potential for public exposure, top-of-bank access road spraying typically occurs very early in the morning and concludes around nine o'clock AM.

Herbicide used in proximity to channels and other water bodies are labelled for aquatic use but never applied directly to water bodies. Instead, herbicides are selectively applied to specific problem pests and used in conjunction with other non-chemical control methods when in-channel vegetation requires removal. Due to their fast-growing, persistent nature and potential to significantly impede channel flows, arroyo willows and invasive blackberries are the primary targets of in-channel herbicide applications. Arroyo willows targeted for removal are first managed with mechanical or manual equipment such as chainsaws, pole saws, pruners, and loppers, then treated with herbicide via cut-stump application to prevent future growth. Similarly, invasive blackberry bushes are spot sprayed with herbicide only after mechanical treatment using equipment such as a bladed weed eater or excavator or Bobcat® with a flail mower attachment. Woody plants such as coyote brush are also controlled using this approach for dam safety and upkeep.

4.5.4 Nursery Stock Tree Planting

In sites where maintenance activities result in exposed soil (e.g., tree removal), grounds are stabilized to prevent erosion and revegetated with native vegetation as soon as feasible after maintenance activities are complete. Nursery stock trees are typically planted during winter and spring, then monitored and hand-watered during dry seasons until they are satisfactorily established. Trees planted along the top-of-bank may include big leaf maple, oaks, box elder, buckeye, and Fremont poplar. At the ordinary high-water mark, slightly above the toe-of-slope, species such as alders, ash, maples, and red or Pacific willows may be planted. All species eligible for planting are riparian species found in Sonoma County waterways, with consideration given to the current and known historic native flora of the site and local subwatershed area.

Planted trees are spaced strategically to allow room for a mature tree canopy to develop and later thinned as necessary to maximize the canopy and retain channel capacity. The planting of trees and other vegetation within the SMP area is guided by predetermined plant palettes according to channel geometric form. Examples of such templates are shown in Table 8-3 and Figures 8-2 and 8-3 of the SMP Manual (Sonoma Water, 2009).

5 IPM for Water Supply

Sonoma Water is the primary provider of potable water for approximately 600,000 people in Sonoma and Marin Counties and operates a transmission system includes diversion, corrosion control, and chlorination facilities at the Russian River and an aqueduct system comprised of pipelines, fifteen booster pumps, and eighteen water storage tanks in addition to three production wells. Water supply facilities also include three water storage reservoirs, six collection wells, and four infiltration ponds.

5.1 Management Goals

IPM in water supply facilities focuses on maintaining Sonoma Water's retail distribution system, managing reservoir storage space, and maintaining flows in water supply reservoirs. Management goals for water supply also includes general facility upkeep to retain accessibility of water supply structures, cleanliness, and visibility as well as minimize safety risks such as tripping and fire hazards.

5.2 Monitoring

Monitoring of water supply facilities typically occurs when Sonoma Water staff are on-site to perform tasks that may or may not be related to vegetation management. Nuisance vegetation encountered by Sonoma Water staff is reported to the appropriate personnel for future management.

5.3 Pest Types and Identification

Pests in water supply facilities include nuisance vegetation that interferes with water supply storage or flow, presents safety hazards, or reduces visibility or accessibility of water supply structures. For example, weeds along access roads, grounds, and appurtenant structures associated with booster stations, storage tanks, and emergency wells can pose risk to human safety, obstruct staff access, and have the potential to impede visual inspections for damage. Trees and other woody vegetation in close proximity to tank farms are also undesirable. Non-native plants are prioritized as pests while the establishment of native species is encouraged so long as the functionality and ease of access of water supply facilities remains satisfactory.

5.4 Action Level

Tolerance levels for pests in water supply facilities vary based on the type of pest and where it occurs. There is low to no tolerance for weeds occurring in access roads, cracks, grounds, and structures associated with booster stations, storage tanks, and emergency wells, for example, due to the resultant safety hazards, access limitations, and potential impediment of visual inspections. All trees and other woody vegetation found within 100 feet of tank farms also require control. In contrast, some grounds (e.g., roadsides, open areas) have higher tolerance for weeds depending on factors such as the degree of public access and richness of native species in the facility. In general, Sonoma Water staff have a higher tolerance for annual weeds than perennial weeds.

5.5 Treatment Options

The primary mechanisms of vegetation control in water supply facilities include mowing, grazing, pruning, and weed eating. The inner banks and nearby hills of reservoirs are mowed, while trees that approach power lines or overhang roads are pruned. When vegetation requiring management occurs in areas that are hazardous or not conducive for Sonoma Water staff to treat via mowing (e.g., steep slopes; gravel pump stations; fencelines; around vaults, meters, or telephone poles), treatment via weed eating or herbicide application is implemented. Non-native plants growing around and along the banks of ponds are often controlled culturally through the installation of native vegetation which may outcompete or shade out undesirable species. To achieve adequate control, such methods may be supplemented by spot applications of herbicide. Herbicides are also sprayed on weeds growing along roads and in pavement cracks to reduce potential tripping hazards and preserve structural integrity.



6 IPM for Wastewater Treatment Facilities

Sonoma Water manages seven wastewater Districts and Zones. The Sanitation Districts clean wastewater from homes and businesses to secondary or tertiary standards so that it can be recycled for other uses such as irrigation of crops and large landscaped areas, industry, wildlife habitat enhancement, and residential landscapes. Recycling treated wastewater in this way helps Sonoma Water reduce potable water demands.

Wastewater treatment facilities include: lift stations, tertiary micro filters, chlorination and dechlorination facilities, headworks, and various types of ponds (aeration, settling, storage percolation, holding).

6.1 Management Goals

IPM in wastewater treatment facilities focuses on maintaining functionality, integrity, and capacity. Similar to water supply facilities, management goals for wastewater treatment facilities include general facility upkeep to retain accessibility, cleanliness, visibility, and general aesthetic quality as well as to minimize safety risks such as tripping and fire hazards.

6.2 Monitoring

Undesirable vegetation is typically identified during reconnaissance done by Sonoma Water staff performing non-IPM activity. Problematic or potentially problematic weeds are reported to personnel responsible for maintaining the site of interest so that the species can be managed in a timely and efficient manner.

6.3 Pest Types and Identification

Pests in wastewater treatment facilities include vegetation that may disrupt the intended functionality, accessibility, or visibility of structures. As in other Sonoma Water facilities, vegetation posing a human safety or fire risk is also a primary target for control. Examples of such vegetation include weeds in walkway cracks and along access roads, grounds, and appurtenant structures such as lift stations, as well as trees and other woody vegetation occurring in close proximity to tank sites. Nuisance vegetation also includes invasive species such as blackberries, coyote brush, Russian thistle, and stinkwort. Around ponds under DSOD jurisdiction, all vegetation except grass and other low ground cover also requires management to prevent the impediment of proper inspection and monitoring for current or potential operational defects including leaks or erosion. Woody vegetation such as trees and bushes, for instance, may displace or cause cracks in concrete walls or structures.

6.4 Action Level

Action levels vary for pests occurring in wastewater treatment facilities and are established with consideration given to IPM program goals. Because wastewater treatment facilities are not open to the public, there is a higher tolerance for vegetation along roadsides and in open areas; however, tolerance levels for weeds growing in walkway cracks and access roads and on facility appurtenances are very low due to safety and accessibility concerns and the potential

interference with visual inspections for damage. Similarly, there is a lower tolerance for non-native vegetation than there is for nuisance native vegetation.

Action levels for reservoirs under the jurisdiction of DSOD are guided by DSOD requirements. For example, there is very low tolerance for grass and other low ground cover growing past ankle height on and around pond banks as it is not conducive to thorough inspections for erosion, leaks, or damage. This tolerance level also holds for grasses occurring in other areas of wastewater treatment facilities where fire fuel reduction is a concern. Any vegetation that reduces the capacity or compromises the structure or intended function of ponds, including emerging trees and bushes, must also be removed per DSOD requirements.

6.5 Treatment Options

Nuisance grass-like or low-growing vegetation occurring around ponds, including down side banks, is managed via mowing. Herbicides are selectively applied in areas that are not suitable for mowing (e.g., steep slopes) or where specific target pests such as blackberries, coyote brush, and other woody vegetation require complete control (e.g., ponds under DSOD jurisdiction). Herbicides are only applied according to label instructions and only when weather conditions are favorable (e.g., low wind speed, no predicted rainfall) and pond water levels are low. Spot spray herbicide application is typically used in combination with hand removal to control woody vegetation, while broadcast application is used to control weeds growing on access roads. Where feasible, establishment of native vegetation is encouraged as a mechanism to culturally control and outcompete undesirable vegetation.



7 IPM for Buildings

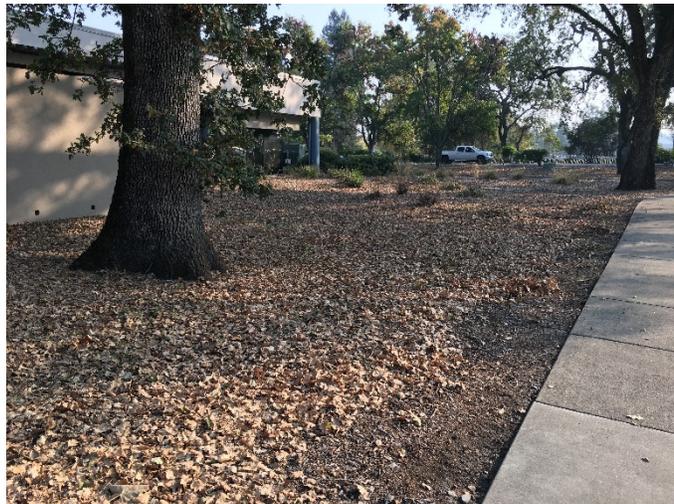
Sonoma Water conducts vegetation management activities around two office facilities, one of which is powered by roof- and ground-mounted solar panels, and an operation and maintenance services center. Sonoma Water also owns and maintains a Water Education building which is intended for public use. In an evaluation of one of the office facilities conducted by an independent consultant, it was determined that the greatest opportunities to increase water use efficiency were the landscape areas surrounding the building. Thus, low water-use landscaping has been an important theme around Sonoma Water-owned buildings in recent years.

7.1 Management Goals

The goal of IPM around buildings is to maintain the landscape in such a way that promotes growth of native vegetation and discourages invasive weeds. The purpose of vegetation management around buildings intended for public use is to preserve the aesthetic quality and provide for human enjoyment of such areas. IPM under and around ground-mounted solar panels is also needed to maintain the structural and functional integrity of the panels while also providing for staff safety and accessibility during cleaning and maintenance.

7.2 Monitoring

Landscape plantings around Sonoma Water buildings are monitored at least once per month. Due to the preventative cultural and physical barrier controls established in such areas (e.g., weed cloth, drip irrigation), monitoring at more frequent intervals is not typically required; however, nuisance weeds in both landscape and around solar panels may also be reported during reconnaissance done by Sonoma Water staff performing non-IPM activity.



7.3 Pest Types and Identification

Landscape pests around buildings include all vegetation which was not intentionally planted by the Sonoma Water vegetation adviser, particularly invasive and non-native species. Native species intended for landscape planting are selected by the vegetation adviser, who also oversees any follow-up maintenance required. All vegetation in the direct vicinity of solar panels is also considered a pest; however, broadleaf weeds are generally more problematic than grasses.

7.4 Action Level

Due to the limited area allocated for landscape plantings around buildings, there is relatively low tolerance for pests in these areas, particularly around buildings intended for public use. The presence of any landscape pests at the time of monthly monitoring events may therefore require vegetation management.

There is also a low tolerance for pests under and around solar panels. All vegetation with the potential to hinder solar panel functionality or access, or impede worker safety, is controlled promptly.

7.5 Treatment Options

Due to the implementation of preventative cultural and physical control methods such as proper watering techniques and the use of weed cloth and mulch, minimal additional vegetation management is required around Sonoma Water buildings. As appropriate, plant pests are controlled by way of hand-pulling or targeted herbicide spot treatments.

Because of the limited space available under solar panels, vegetation management by way of mechanical control is infeasible. Thus, herbicide use via spot spray application is implemented in these areas.

8 Important Topics Regarding Herbicide Use

8.1 Adjuvants

Herbicides are often mixed with or are formulated to include adjuvants which are added to enhance its efficacy. Adjuvants include materials that perform a variety of functions, including, but not limited to: aiding in water conditioning and pH stabilization in order keep herbicides dissolved in solution; enhancing the penetration of a herbicide into the plant's waxy cuticle layer in order to increase efficacy and limit the amount of herbicide needed; controlling spray drift to limit the amount of herbicide that may travel with wind to non-target locations; and decreasing the surface tension of a herbicide mixture to allow for better deposition and coverage on the plant surface. Surfactants are a type of adjuvant designed to enhance the absorbing, emulsifying, dispersing, spreading, sticking, wetting, or penetrating properties of an herbicide. Sonoma Water uses adjuvants as appropriate.

8.2 Herbicide Resistance

An important factor in sustainable vegetation management is herbicide resistance management. Herbicide resistance describes the ability of a plant to survive and reproduce after exposure to a dose of herbicide that would normally be lethal to a non-resistant counterpart. Repeated applications of the herbicide over multiple generations can quickly lead to widespread resistance in a plant population, reducing the effectiveness of the herbicide. Certain plant characteristics and herbicide application practices increase the likelihood of resistance development. Examples of vegetation management practices that increase the risk of resistance development are using less than the label rate and overreliance on herbicides with the same or similar modes of action.

While proactive herbicide resistance management is most effective in avoiding or delaying the development of resistance, species showing signs of potential resistance development must be addressed promptly in order to maintain adequate control of target vegetation. For information on herbicide resistance management practices, refer to a University of California IPM Program weed specialist, a crop adviser, the U.S. Environmental Protection Agency (USEPA), or similar resource.

9 References

Code of Federal Regulations (CFR). 29 CFR § 1910.134 (2011), Respiratory Protection.

Sonoma Water. 2009. Stream Maintenance Program Final Manual. Available: <http://www.scwa.ca.gov/environmental-documents/> (Accessed: September 25, 2018).

University of California Agriculture and Natural Resources (UC ANR). 2017. Statewide IPM Program. Available: <http://ipm.ucanr.edu/> (Accessed September 23, 2018).