Tahoe Keys Lagoons Restoration Project

Application for Approval to Reduce Aquatic Invasive and Nuisance Plant Species

July 25, 2018

Tahoe Keys Property Owners Association
356 Ala Wai Blvd
South Lake Tahoe, CA 96150
Tahoe Keys Lagoons Restoration Project

Application for Approval to Reduce Aquatic Invasive and Nuisance Plant Species

Submitted to

State of California Regional Water Quality Control Board
Lahontan Region
2501 Lake Tahoe Boulevard
South Lake Tahoe, CA 96150

Tahoe Regional Planning Agency
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1.0 PROJECT INFORMATION

1.1 Introduction to the Application

The Tahoe Keys Property Owners Association (TKPOA) has prepared this Application for Approval to Reduce Aquatic Invasive and Nuisance Plant Species as part of the Tahoe Keys Lagoons Restoration Project (Project). The Project was developed to reduce and control the abundant growth of non-native and nuisance aquatic plants that: 1) compromise the water quality and degrade the beneficial uses of the Tahoe Keys Lagoons (lagoons), and 2) threaten the future ecosystem and water quality of Lake Tahoe. The recent Lake Tahoe Aquatic Invasive Species (AIS) Implementation Plan listed the Tahoe Keys as one of the highest priority areas for control of AIS around the lake (Wittmann and Chandra 2015).

The Project includes the limited use of specific aquatic herbicides to target the areally-extensive infestation of aquatic invasive and nuisance plant species so that subsequent use of non-chemical control methods can be successful in addressing future outbreaks and maintain water quality and beneficial uses of the lagoons. Therefore, this application was also prepared in accordance with the Water Quality Control Plan for the Lahontan Region (Basin Plan) requirements for an exemption to the prohibition on the discharge of pesticides1 to surface or ground waters, and in accordance with guidelines supplied to TKPOA during the past four years of consultations with LRWQCB, Tahoe Regional Planning Agency (TRPA), and other stakeholders. The specific requirements that were followed can be found in the Basin Plan, Chapter 4.1, Waste Discharge Prohibitions – Exemption Criteria for Controlling Aquatic Invasive Species (AIS) and Other Harmful Species (LRWQCB 2015).

1.2 Project Location and Site Description

The area addressed by this application is the Tahoe Keys Lagoons (lagoons) on the south edge of Lake Tahoe. The lagoons are part of the Tahoe Keys, a multi-use development situated on approximately 372 acres of land. The Tahoe Keys development was constructed in the 1960s on the Upper Truckee River Marsh by excavating the lagoons and capping the soil with sand to form stable building sites. The development includes 1,529 homes and townhomes, a commercial marina, and a commercial center. Three primary man-made water features exist in the Tahoe Keys: 1) the Main Lagoon (also known as the West Lagoon), 2) the Marina Lagoon (also known as the East Lagoon), and 3) the Lake Tallac Lagoon (Figure 1).

The lagoons are connected to Lake Tahoe via two narrow, direct channels: The West Channel which connects the Main Lagoon; and the East Channel, which connects the Marina Lagoon. Boat access to Lake Tahoe from the lagoons is restricted to these two

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1 As defined in Chapter 4, Section 4.1, Waste Discharge Prohibitions, of the Water Quality Control Plan for the Lahontan Region (Basin Plan), “Aquatic Pesticides” are pesticides registered by the California Department of Pesticide Regulation and formulated for use in water to control aquatic animal or plant pests. An aquatic pesticide is any substance (including biological agents) applied in, on, or over the waters of the State or in such a way as to enter those waters for the purpose of inhibiting the growth or controlling the existence of any plant or animal in those waters.
channels (Figure 1). The Lake Tallac Lagoon flows into Pope Marsh, to the west of the Tahoe Keys, as shown on Figure 1. Lake Tallac does not have a direct hydrologic connection to Lake Tahoe and water levels rise and fall independently from Lake Tahoe. However, there is a small stormwater diversion structure with floodgates that allows water in Lake Tallac to be diverted into the Main Lagoon. These flood gates have only been opened approximately five times in the past several decades at the request or direction of the City of South Lake Tahoe to alleviate flooding to the east and south of Lake Tallac during periods of high runoff or snowmelt in late winter.

Figure 1. Tahoe Keys Lagoons

1.3 Background

1.3.1 History of Aquatic Invasive Plants in the Lagoons

In the 1980s and 1990s, the aquatic invasive species Eurasian watermilfoil (Myriophyllum spicatum) became established in the Tahoe Keys and other areas around Lake Tahoe. As of 2012, 18 infestation sites were known with the possibility of more that were not surveyed (Wittmann and Chandra 2015). Then, in 2003, curlyleaf pondweed (Potamogeton crispus) was first discovered in Lake Tahoe. This second non-native, invasive plant is capable of growing in deeper, colder waters, which may potentially be more detrimental to Lake Tahoe if allowed to spread unchecked. Currently, curlyleaf
pondweed is limited to the south and southeastern shores of Lake Tahoe with infestations observed from Taylor Creek to Lakeside Marina (Wittmann and Chandra 2015, LTSLT 2016). Newer infestations were also recently found as far north as Elk Point Marina (Anderson 2016, pers. communication) on the Nevada side of Lake Tahoe. Coontail (Ceratophyllum demersum) is classified as a native plant to California, but in recent years has grown in abundance in the Lake Tahoe region, specifically in the lagoons. Coontail has heavily infested the deeper channels of all of the lagoons, most abundantly in the Marina Lagoon and Lake Tallac Lagoon, where it comprises over 70% percent of the aquatic plant matter (TKPOA 2016a).

The two invasive, non-native aquatic plant populations in the Tahoe Keys have been growing rapidly. Recent aquatic plant surveys (2014, 2015, 2016, 2017) show the extent and density of excessive plant growth in the lagoons (Figures 2 and 3). In recent years, 85% to 90% of the available wetted surface in the lagoons has been infested with invasive aquatic plants with a large majority being the non-native invasive species. Of particular concern is the recent rapid growth and spread of curleaf pondweed, which has the potential to not only infest significantly more of Lake Tahoe’s aquatic habitat than Eurasian watermilfoil, but can also be more difficult to control due to the large number and dispersal capacity of its asexual turions, which are produced in mid to late summer (Woolf and Madsen 2003, Wittmann et al. 2015, Xie and Yu 2011). Turions are overwintering buds that become detached and spread throughout the waterway and have the potential to remain dormant at the bottom of the water for several years.

Seasonal harvesting has been the main weed control practice in the Tahoe Keys since the mid-1980s. Continual harvesting throughout the summer months works to keep the lagoons navigable by boat, however, harvesting operations do not, overall, reduce aquatic plant biomass. Harvesting may actually aid in invasive plant population growth (Crowell et al. 1994, TKPOA 2015).

The expansion and excessive aquatic invasive plant growth in the lagoons is due to several environmental conditions including available nutrients, protected waters with reduced wave action, and shallow water that provides sufficient light and warms quickly in spring. The non-native invasive plants introduced to the lagoons have found these to be ideal habitat conditions for prolific growth. At the same time, this setting makes the lagoons a suitable location for the use of selective herbicides as the waters of the coves do not readily transport dissolved matter, and the narrow channels connecting the lagoons to the lake reduce the potential for water mixing between the lagoons and Lake Tahoe.
Figure 2. Comparison of 2016 & 2017 Survey Results, Eurasian Watermilfoil

Figure 3. Comparison of 2016 & 2017 Survey Results, Curlyleaf Pondweed
1.3.2 Agency and TKPOA Response to the Infestation

In response to the growing Aquatic Invasive Species (AIS) problem in the Tahoe Keys and the goal to limit non-point sources of pollution, LRWQCB issued WDRs to TKPOA on July 14, 2014. As part of these requirements, TKPOA was tasked with developing two planning documents. A Non-Point Source Water Quality Management Plan (NPS Plan), which is not considered a part of this application, has been prepared and is being implemented to address potential land based sources of nutrients. An Integrated Management Plan to address the growth of aquatic invasive plants has also been prepared and implementation has been initiated. The purpose of the IMP is to optimize management effects by incorporating a suite of feasible and proven control methods that can be tailored to fit site constraints, infestation size, and urgency of control. This Application addresses, in part, long-term implementation of the IMP.

The only control methods that can currently be used in the TKPOA IMP are mechanical control methods. At this time these methods consist primarily of harvesting and bottom barriers. However, due to the size, density, and dominance of the infestation, these control methods have been shown to produce limited results. In addition, the current primary control method, harvesting, results in the production of large quantities of plant fragments (TKPOA 2014). Without proper controls, these fragments may be transported by wind, aquatic animals, and boat traffic within the lagoons and into Lake Tahoe, thus contributing viable plant fragments and turions that can become established in near shore habitats and marinas.

After more than two years of stakeholder and agency meetings to discuss and identify the best available methodologies to address the aquatic invasive plant infestation, and based on the finding of an expert panel², TKPOA developed the West Lagoon Integrated Methods Test to Control Aquatic Invasive Plants in the Tahoe Keys Lagoons (Integrated Methods Test). In January of 2017, TKPOA submitted an application to LRWQCB for an exemption to the Basin Plan prohibition on the use of pesticides for the Integrated Methods Test. Applications of aquatic herbicides were proposed to be made in the spring of 2018 by California licensed pesticide applicators to a total of 13.7 acres at nine locations in the Main Lagoon.

Based on agency feedback on TKPOA’s exemption application for the Integrated Methods Test, TKPOA prepared an amended supplemental exemption application for the Integrated Methods Test that was submitted to LRWQCB in July of 2017. Following submittal of this application, LRWQCB and TRPA performed environmental analysis of the Integrated Methods Test with an Initial Study (IS) prepared (on behalf of LRWQCB) pursuant to the California Environmental Quality Act (CEQA) and an Initial Environmental Checklist (IEC) prepared (on behalf of TRPA) pursuant to Article VII of the TRPA Compact

² The expert panel included: Joel Trumbo, Senior Environmental Scientist with the California Department of Fish and Wildlife; Dr. Kurt Getsinger, Leader of the Chemical Control and Physiological Processes Team for the US Army Corps of Engineers in Vicksburg, MS; Dr. Pat Akers, Supervising Scientist for Aquatic Weed Eradication Programs at the California Department of Food and Agriculture; Dr. Sudeep Chandra, Associate Professor of Limnology at the University of Nevada, Reno; and Dr. Joe DiTomaso, Cooperative Extension Specialist in the Department of Plant Sciences at the University of California, Davis.
and Chapter 3 of the TRPA Code of Ordinances. Following preparation of the preliminary environmental analysis in the IS/IEC, LRWQCB and TRPA identified that the Integrated Methods Test would require an Environmental Impact Report (under CEQA) and Environmental Impact Statement (under TRPA’s Compact). Based on this decision, and has prepared this application for the Project to undertake a full scale phased implementation project to bring the invasive plants under control.

1.4 Project Need

The introduction, establishment, and spread of aquatic invasive plants have compromised water quality and degraded beneficial uses of the lagoons, including wading, boating, fishing, sightseeing, aquatic life, and preservation of aquatic habitats that support cold water ecosystems. The abundant growth of non-native and nuisance aquatic plants degrades the environment by crowding out native aquatic plants and providing habitat for non-native warm water fish, which in turn increases variations in pH, reduces dissolved oxygen (DO), and increases temperature. The plant growth also impedes boating, greatly increases costs to TKPOA to maintain navigational waterways, restricts recreational opportunities (including by creating an entrapment threat to swimmers\(^3\)), contributes to sediment loading, and increases nutrient cycling in the water column that can contribute to harmful algal blooms (HAB). Furthermore, because the lagoons are estimated to be the source of more than 25% of all commercial, governmental, and private boating on Lake Tahoe, the infestation is a potential source of aquatic invasive plant spread to other Lake Tahoe near shore areas (Wittmann and Chandra 2015). As described in the Findings of the LRWQCB’s Waste Discharge Requirements for the lagoons (Order No. R6T-2014-0059 issued July 14, 2014):

> “Excessive growth of aquatic plants within the [Tahoe Keys] Facility impairs beneficial uses of water, such as Cold Freshwater Habitat, Navigation, Water Contact Recreation, Non-contact Water Recreation and possibly Rare, Threatened, or Endangered Species. The excessive aquatic plant growth has caused several adverse effects to cold water ecosystems: impaired navigation of vessels, potential health and safety risk associated with entanglement of swimmers in aquatic vegetation and lack of visibility of submerged swimmers, impairment of fishing and aesthetic quality, and increased predation of native fish species by invasive fish species.”

Due to the scale of the infestation, there are no non-herbicide control methods, used alone or in combination, capable of and/or feasible for controlling aquatic plant growth throughout the entirety of the lagoons. Chapter 3, Alternatives Considered, evaluates the effectiveness and feasibility of ten current and experimental non-herbicide control methods, providing a description of each, examples of their use and an evaluation of the method in the context of the lagoons. Some of the non-herbicide control treatment options are effective and environmentally and technologically feasible for small areas (e.g. bottom barriers combined with diver assisted hand removal is generally feasible and effective for

\(^{3}\) The TKPOA Codes, Covenants, and Restrictions along with Coast Guard regulation prohibit swimming in navigation channels which includes the Tahoe Keys Lagoons. However, swimming still takes place in the lagoons.
areas less than five acres); however, non-herbicide control options on their own were found to be ineffective to meet the stated goals and objectives of the IMP and this Application for the Aquatic Restoration Project, and/or because of their infeasibility based on cost, environmental impacts, and/or social and technological considerations.

In contrast to the non-herbicide control methods, the selective aquatic herbicides proposed for this Project have proven safety, efficacy, and utility track records in lakes, ponds, reservoirs, streams, irrigation canals, flood control channels, and wetland sites in other regions, including in high elevation water bodies and against the same target aquatic plants found in the lagoons: Eurasian watermilfoil, curlyleaf pondweed, and coontail. Additionally, the herbicides have short half-lives (0.5 to 10 days) which provides for short-term treatment of the water body. Two of the herbicides proposed, endothall and triclopyr, have been used successfully throughout California and in other high elevation water bodies for decades to control the same aquatic plants. The third herbicide, ProcellaCOR™ has recently been approved and registered by US EPA and classified as a “reduced risk” pesticide, meaning that it is used at a few parts per billion with low risk to non-target organisms. This latter herbicide will only be included if it is approved by the California Environmental Protection Agency Department of Pesticide Regulation (CalEPA-DPR), which is anticipated in 2018. Endothall and triclopyr are already included in the approved list of herbicides for National Pollutant Discharge Elimination System (NPDES) permits in California. Once ProcellaCOR™ is registered in California, it is likely to be added to the list of approved herbicides for NPDES permits as well.

For more information on the current use of aquatic herbicides, Table 1 presents a short list of other known locations where endothall and triclopyr have been applied. The complete list of current Notices of Intent and Aquatic Pesticide Application Plans for the State of California can be found at the following website: www.waterboards.ca.gov/water_issues/programs/npdes/pesticides/weed_control.shtml (June 2018).
<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Locations Used</th>
<th>Waterbody Type</th>
<th>Primary Water Use</th>
<th>Target Plants</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>East Bay Regional Park District, Oakland CA</td>
<td>Reservoir, Lake, Delta</td>
<td>Recreation and Drinking Water Reservoir</td>
<td>Algae, submersed, floating and emergent aquatic plants</td>
<td><a href="http://www.waterboards.ca.gov/water_issues/programs/npdes/pesticides/docs/weedcontrol/2013-0002-dwg/ebrpd_noi_apap2.pdf">http://www.waterboards.ca.gov/water_issues/programs/npdes/pesticides/docs/weedcontrol/2013-0002-dwg/ebrpd_noi_apap2.pdf</a></td>
</tr>
<tr>
<td></td>
<td>Lake Stevens, WA</td>
<td>Lake</td>
<td>Recreation and Irrigation</td>
<td>Eurasian watermilfoil</td>
<td><a href="https://lakestevensmilfoil.wordpress.com/2016/07/30/2016-treatment-for-eurasian-milfoil/">https://lakestevensmilfoil.wordpress.com/2016/07/30/2016-treatment-for-eurasian-milfoil/</a></td>
</tr>
<tr>
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<td>Lake Pend Oreille, ID</td>
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<td>Recreation, Irrigation, Potable Water</td>
<td>Eurasian watermilfoil</td>
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1.5 Project Purpose, Goals, and Performance Measures

1.5.1 Project Purpose

In response to the need to address and reduce the abundant growth of non-native and nuisance aquatic plants, TKPOA developed this Aquatic Restoration Project. The purpose of the Project is to improve the water quality conditions of the lagoons consistent with their designated beneficial water uses in an economically sustainable manner. Beneficial uses as designated by LRWQCB include: Cold Freshwater Habitat, Navigation, Water Contact Recreation, and Non-contact Water Recreation.

1.5.2 Project Goals

To address the need for and meet the purpose of the Project, TKPOA established the following Project goals:

1. Reduce aquatic invasive plant infestations as much and as soon as feasible to help protect Lake Tahoe proper.
2. Bring large-scale aquatic invasive plant infestations under control in an economically feasible and environmentally safe manner.
3. Reestablish and maintain high quality native aquatic life habitat, and navigation, recreation, and aesthetic uses.
4. Reduce the potential for aquatic invasive plant reinfestations after initial treatment.

1.5.3 Measurable Objectives to Ensure Project Goals are Achieved

Project effectiveness will be evaluated based on the following performance criteria:

1. Achieve and maintain at least a 75% reduction of invasive plant biomass from baseline (invasive plant biomass from hydroacoustic scans in summer of 2017).
2. Achieve and maintain a minimum three feet of vessel hull clearance within navigation channels.
3. Increase the frequency of occurrence of desirable native plants in the treatment areas from baseline (native plant frequency recorded in summer 2017).

The performance criterion to reduce invasive plant biomass by at least 75% reflects prior published studies and local mesocosm studies on the efficacy of the herbicides for controlling the target invasive plants. In addition, reducing invasive plant biomass by at least 75% presents the most realistic probability and most feasible means of long-term invasive plant control that will result in only occasional spot treatment of reinfestations. Reducing plant biomass by 75% is also anticipated to be required to achieve and maintain three feet of vessel hull clearance and to support conditions that promote native plant growth. With a 75% reduction in aquatic invasive plant biomass, competition for space, light, and nutrients is expected to be sufficiently reduced such that native plants will be able to successfully propagate and establish.
1.6  Project Description

This section provides an overview of the Project and includes detailed information on the proposed per year treatment schedule and duration, spatial extent of application, specific herbicides to be used, cost of treatment, method and rate of application, control and containment measures, and best management practices with respect to application and monitoring. For a complete description of the proposed monitoring and reporting measures associated with the Project, see Chapter 4: Monitoring and Reporting Program.

1.6.1  Overview

The Aquatic Restoration Project is planned in three phases over a 12-year period:

- Phase I, Herbicide Validation Study (HVS) – years 1 and 2
- Phase II, Full Scale Implementation – years 3 and 4
- Phase III, Maintenance – years 5-12

Principles guiding Project design are based on scientific studies, data and results from other locations and an approach developed to achieve the purpose and goals of the Project. They include:

- Utilizing best available science and proven technologies.
- Incorporating Integrated Pest Management, defined by the State as: “…a pest management strategy that focuses on long-term prevention or suppression of pest problems through a combination of techniques such as monitoring for pest presence and establishing treatment threshold levels, using non-herbicide practices to make the habitat less conducive to pest development, improving sanitation, and employing mechanical and physical controls. Pesticides that pose the least possible hazard and are effective in a manner that minimizes risks to people, property, and the environment, are used only after careful monitoring indicates they are needed according to pre-established guidelines and treatment thresholds” (California Department of Pesticide Regulation, 2000.)
- Mapping, monitoring, and quantifiable performance metrics.

Figure 4, Proposed Treatment Areas and Treatment Schedule, displays each of the areas proposed for herbicide treatment and during which year and phase each of the areas would receive treatment. Figure 5, Aquatic Restoration Project Phases, illustrates the major actions associated with each year and phase of the Project over the 12-year period.

Water quality (including herbicide residue) and effectiveness monitoring will be conducted using standard protocols each year before and after herbicide treatments. Chapter 4, Monitoring and Reporting Program, details all the elements of the Monitoring and Reporting Program including procedures related to monitoring frequencies, schedule, quality assurance and measurable objectives to determine if the Project goals have been achieved.
Figure 4. Proposed Treatment Areas and Treatment Schedule

Phase I (Years 1 & 2)
Total of 16.17 acres

Phase II (Year 3)
Maximum of 72 acres

Phase II (Year 4)
Maximum of 64 acres

Phase III (Years 5-12)

Legend:
- **Red**: Phase 1 Control
- **Green**: Complete Herbicide Treatment
- **Blue**: Herbicide Spot Treatment
Figure 5: Aquatic Restoration Project Phases (3 Phases)

Phase I, Herbicide Validation Study

Year

1
2

Defining actions of each Phase

Single herbicide applied to each of 12 sites:
9 sites in Main Lagoon (13.7 acres)
3 sites in Tallac Lagoon (4.5 acres)
Herbicide effectiveness monitored at each treatment site
Follow-up with non-herbicide controls as needed
Document results relative to Performance Criteria and Measures
Proceed to Phase II based on documented results

Phase II, Full Scale Implementation

Year 3: Herbicide treatment of Treatment Area I (72 acres)
Year 4: Herbicide treatment of Treatment Area 2 (64 acres)
Non-herbicide controls implemented as needed

Phase III, Maintenance

Year

5 6 7 8 9 10 11 12

Defining actions of each Phase

Monitoring of plant growth continues
Non-herbicide control methods implemented as needed (diver assisted hand removal, bottom barriers, and UV light treatment)
Herbicide spot treatment of larger areas of infestations. Herbicide treatment limited to 35 total acres in any one year
1.6.1.1 Phase I, Herbicide Validation Study – Years 1 and 2

During Phase I (Herbicide Validation Study), selected herbicides will be applied within each of twelve treatment areas (approximately 18 total acres) in May or the first half of June in year 1 (see Figure 4, Proposed Treatment Areas and Treatment Schedule). Early spring applications during low biomass conditions are standard, Best Management Practice, to optimize effectiveness of treatments while minimizing the potential for increased oxygen demand that could result from dye-back of dense populations with large biomass.

Based on historical data of aquatic plant growth in the lagoons, TKPOA expects the best application time to be a window of approximately 3-4 weeks. Specific application dates will be determined by composition of plant community within each of the twelve treatment areas, hydroacoustic monitoring of plant biomass, relative abundance of target plant species, weather patterns, Lake Tahoe Basin snowmelt runoff conditions, and the associated hydraulic flow patterns between Lake Tahoe and the Main Lagoon prior to the proposed application period.

Rhodamine WT dye (RWT dye), acting as an herbicide surrogate, will be applied along with the herbicides in each of the treatment areas to assess real-time movement of herbicides. Applications will take place in a single day at each site and monitoring for herbicide residues will be conducted as described in Chapter 4, Mitigation and Monitoring Reporting Program. Additionally, to ensure containment of the herbicide(s) within the target site, a single or double solid turbidity curtain will be installed prior to herbicide applications. The curtain(s) will be located either immediately adjacent to the outside edge of the application site (e.g. cove), or at a distance and location that will prohibit movement of herbicides into open water near the channels that lead to Lake Tahoe. Within Lake Tallac, a single turbidity curtain will be installed isolating the eastern arm from the rest of the lagoon.

During Phase I, year 2, the effectiveness of the herbicides applied in year 1 will be monitored and analyzed using currently established protocols for macrophyte surveys and hydroacoustic scans. In areas of observed reinfestation, permitted non-herbicide control methods may be employed as needed, to evaluate effectiveness in achieving the Project Objectives described in Section 1.5.3. For the small areas involved in Phase I, the non-herbicide control methods are anticipated to include hand pulling using divers and bottom barriers. If other technologies, such as the use of UV light, are approved for such uses in Lake Tahoe prior to year 2 of Phase I, then these technologies may also be used to address any reinfestations that may occur.

1.6.1.2 Phase II, Full Scale Implementation – Years 3 and 4

Pending verification of the effectiveness of herbicide use as an aquatic invasive weed control strategy and its ability to degrade within specified time limits in Phase I, Phase II will be launched in year 3 and herbicides will be applied to Phase II Treatment Area 1, approximately 72 acres, in the late spring. The following year, year 4, Treatment Area 1
will be monitored and spot treated as needed, and Phase II Treatment Area 2, composed of approximately 64 acres (see Figure 4, Proposed Treatment Areas and Treatment Schedule) will receive full herbicide treatment.

The same application best practices will be applied for full scale implementation as were applied during Phase I. Notably, herbicide application will be limited to late spring/early summer at the earliest feasible stages of aquatic plant growth to avoid the creation of excessive dead biomass and prevent the emerging plants from propagating before being treated (an estimated 3-4 week period). Specific application dates will be determined by composition of the plant community within the treatment area, hydroacoustic scans of plant biomass, relative abundance of target plant species, weather patterns, Lake Tahoe Basin snowmelt runoff conditions, and the associated hydraulic flow patterns between Lake Tahoe and the Main and Marina lagoons. Best practices and lessons learned from Phase I will be applied to herbicide application during Phase II.

Containment will include operation of an air-driven bubble curtain across the West Channel to prevent the movement of herbicides into Lake Tahoe. Turbidity curtains may also be used at the geographic boundaries of each treatment area where placement is possible (i.e. where there are anchors such as docks to attach the turbidity curtains to). They will only be used if Phase I monitoring indicates that turbidity curtains are necessary as a containment best practice.

Herbicide applications will take place at a rate of 8 to 15 acres per day over the course of a 5 to 10 day period for each of the Phase II treatment areas. This range will allow for adaptation to current environmental conditions and planned monitoring. Monitoring for herbicide residues will continue for a minimum of 30 days after application and possibly longer until the herbicide concentrations are non-detectable.

1.6.1.3 Phase III, Maintenance, Years 5 through 12

The initiation of Phase III is defined as the year following completion of Phase II and marks an 8-year period where TKPOA will monitor and spot-treat reinfestations as needed. Eight years is sufficient time for TKPOA to follow-up with herbicide treatment in any areas where treatment was initially ineffective, and to follow-up with herbicide treatment in areas where dormant target plant propagules begin to reestablish plant colonies. For example, curleaved pondweed turions may lay dormant for up to three or more years before propagating. During Phase III, TKPOA may identify the need for herbicide treatment at sites of contiguous plant growth, using herbicides to treat up to a maximum of 35 acres within the lagoons per year which comprises approximately 20% of the surface area of the lagoons. Assuming that Phase II is successful in controlling at least 75% of the target plant biomass within the lagoons, limiting any Phase III follow up treatment with herbicides to 35 acres should be sufficient to control any reinfestations that occur.

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4 Phase II Treatment Area 2 includes the Marina Lagoon. Treatment of the Marina Lagoon will only take place if all property owners enter into Memorandum of Agreements with TKPOA or if other regulatory permissions/orders are issued to treat in this area.
Section 1.6.8, Post Herbicide Treatment Follow-up Actions, describes the decision criteria matrix TKPOA will employ to determine the appropriate post herbicide application treatment.

1.6.1.4 Early Detection, Rapid Response

Throughout Phases I, II, and III of the Project, an Early Detection, Rapid Response (EDRR) component will be implemented. The EDRR involves routine monitoring of the lagoons to identify new invasive species, or returning growth and plant species. The EDRR component provides TKPOA the opportunity to quickly recognize new AIS or returning invasive plant species and treat the growth immediately before the plants are mature enough to propagate. As part of the EDRR, TKPOA monitoring staff will be trained to monitor for and to recognize invasive plant species, and other AIS, and to identify the appropriate plant control method (non-herbicide or herbicide as necessary) to control the growth. The EDRR component also prescribes notification protocols so that stakeholder response is rapid. Details on the EDRR component can be found in Appendix I.

1.6.2 Objectives of Each Phase

Each phase of the Aquatic Restoration Project has its own set of objectives.

Phase I, Herbicide Validation Study – years 1 and 2
- Verify the effectiveness of herbicide use as a component of an integrated control strategy in the setting of the Tahoe Keys Lagoons (i.e., validate the results of the prior mesocosm herbicide studies).
- Gather data to determine the duration of presence and fate of degradants of the herbicides’ active ingredients.
- Effectively reduce aquatic invasive plants consistent with the established performance measures for the Project within the treatment area.
- Test and validate the communication modes for the public, stakeholders and regulatory agencies.

Phase II, Full Scale Implementation – years 3 and 4
- Effectively reduce aquatic invasive plants consistent with the established performance measures for the Aquatic Restoration Project within each of the treatment areas (Treatment Area 1 and Treatment Area 2).

Phase III, Maintenance – years 5-12
- Maintain effective control of aquatic invasive plants consistent with the Project’s goals throughout the approximately 161 acres of the Tahoe Keys Lagoons.
- Refine and enhance non-herbicide control methods so that they will be effective in the long-term maintenance of the lagoons.
1.6.3 Selection of Proposed Treatment Areas

1.6.3.1 Phase I, Herbicide Validation Study, Treatment Areas

Proposed application sites were selected from the backwater coves in the Tahoe Keys Main Lagoon that are most distant from the West Channel. Application in backwater coves minimizes potential movement of herbicide toward untreated areas, reduces other possible variables (e.g., drift of plant fragments into the site), and maximizes distances to the West Channel. These types of dead-end sites comprise more than 75% of the total infested areas within the lagoons and thus represent typical infested conditions throughout most of the Project area. TKPOA evaluated the following characteristics of dead end coves when selecting coves for treatment.

- Composition of plant species present – including relative abundance of target and non-target aquatic plants.
- Ability to expose the target plant to a small but operational concentration of aquatic herbicide. Smaller size demonstration plots and volumes can result in rapid dilution, which is not typical of conditions recommended for aquatic herbicides.
- Bathymetric (bottom contours) variability present within each cove with the aim for selecting sites offering the range of bathymetric variability typically present in the lagoons.

In addition, three treatment sites were selected in Lake Tallac to evaluate the effectiveness of the herbicides within that waterbody. Lake Tallac has a different baseline water quality condition than the Main Lagoon and can be hydrologically disconnected from the Main Lagoon by keeping the stormwater diversion gates closed. In addition, the eastern arm of Lake Tallac can be hydrologically isolated from the rest of that lagoon during the May-June timeframe in a manner that will not interfere with the normal runoff and stormwater flows through the other arms of this water body. Isolating the eastern arm of Lake Tallac will prevent the potential for water from the treatment areas to flow toward Pope Marsh or to come in contact with the stormwater diversion structure along Venice Drive that separates Lake Tallac from the Main Lagoon. Sites in the Marina Lagoon were not chosen for the Phase I HVS because the Main Lagoon and Marina Lagoon have similar water quality.

During this phase there will be limited restrictions to boating access. In places where turbidity curtains have been put in place, there will be no boating access to the treated areas. Homeowners will be notified in advance according to the plan set forth in Chapter 6: Communication Plan.

The proposed Phase I sites are listed in Table 2 and shown in Figure 4, Proposed Treatment Areas and Treatment Schedule.
### Table 2: Proposed Phase I Treatment Areas and Acreage

<table>
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<tr>
<th>Site No.</th>
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<td>11</td>
<td>1.5</td>
</tr>
<tr>
<td>12</td>
<td>1.5</td>
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</tbody>
</table>

### 1.6.3.2 Phase II, Full Scale Implementation, Treatment Areas

Initial herbicide treatments for Phase II are staggered both in time (over multiple days and by year) and by area such that Phase II Treatment Area 1 is composed of only approximately half of the lagoons' acreage (72 acres in year 3), with Phase II Treatment Area 2 comprised of the remaining acreage (64 acres in year 4). This approach is consistent with standard label advice associated with the proposed herbicides to treat no more than one-half to two-thirds of a water body in a single season to avoid creating an abundance of decaying biomass, as decaying biomass can reduce dissolved oxygen in the water column.

In addition to staggering treatment over a two-year period, TKPOA’s treatment strategy further reduces the risk of causing compromised dissolved oxygen levels by treating in the late spring/early summer, just as aquatic invasive plants are emerging. This strategy reduces the total die-off of biomass after herbicide application. Furthermore, rising lake levels in the late spring/early summer push water into the lagoons, providing an outside source of oxygenated water not available later in the season (see Figure 6).

Phase II Treatment Area 1 was chosen based on connectivity to previously treated sites, distance from Lake Tahoe, and ability to treat major access points for homeowners. Phase II Treatment Area 2 includes the remainder of the major water areas.

During this phase of the project there may be boating restrictions during the treatment period. For a short period of time, in places where turbidity curtains are in place, there will be no recreational boating access to the area. Homeowners will be notified in advance according to the plan set forth in Chapter 6: Communication Plan.

Herbicides are not proposed to be used in the West Channel or in the area of the Main Lagoon directly in front (south) of the West Channel at any point during the Project because the deep basin that is in front of the West Channel does not contain an abundance of invasive species due to its depth and subsequent low light penetration.
Additionally, because the channel is directly connected to Lake Tahoe, and is a limited area, non-herbicide control methods such as diver assisted hand removal can be utilized to avoid the possibility of herbicide residue entering Lake Tahoe proper.

1.6.3.3 Phase III, Maintenance, Treatment Areas

Phase III – Maintenance, will prioritize non-herbicide control methods over the use of herbicides. However, in cases where there are contiguous, dense reinfestations of target species that cover an area that is larger than that which can be effectively treated with non-herbicide methods in one season, herbicides may be used as a follow up treatment. Figure 8 provides information on decision criteria for Phase III follow-up control actions.

During this phase there will be limited restrictions to boating access. Where turbidity curtains have been put in place, there will be no recreational boating access to the treated areas for short periods of time. Homeowners will be notified in advance according to the plan set forth in Chapter 6: Communication Plan.

1.6.4 Description of Herbicides and Approach to Application

TKPOA proposes to use three aquatic herbicide products to control the most prolific aquatic invasive plants: endothall, triclopyr, and ProcellaCOR™. The three aquatic herbicides selected, and the proposed rates and formulations, were chosen to optimize management and control of the target aquatic weeds (Eurasian watermilfoil, curlyleaf pondweed and coontail) while minimizing effects on non-target plants. The following conditions and criteria were considered as part of the selection process to tailor the product, timing of application, rate of applications and optimize control of target plants while minimizing non-target impacts:

- Plant species present in integrated test area (non-target vs. target species),
- Establishment of threshold treatment conditions (plant growth stage),
- Physical conditions (water movement, wind, total water volume),
- Method of application,
- Duration and rate of application,
- Potential risks to humans and the natural environment,
- Contingency planning and monitoring access,
- Shown efficacy of herbicide on target plants,
- Ease of use and handling requirements, and
- Limited interference with beneficial uses: e.g., recreation, habitat.

The result is a prescriptive approach designed to optimize control and minimize the amount of herbicide used while fully integrating all feasible tools and methodologies. Point sampling and hydroacoustic sampling will be conducted prior to treatment to determine which herbicide to use at each site. If there is more than 75% of Eurasian watermilfoil then the site will be treated with ProcellaCOR™ (or triclopyr if ProcellaCOR™ is not approved by CalEPA). If there is more than 75% of curlyleaf pondweed, then endothall
will be used. If there appears to be an even mix of Eurasian watermilfoil, curlyleaf pondweed, and coontail, then endothall will be used.

During Phase I, the herbicides will be used separately and not in combination. The specific herbicide to be used within each treatment area in Phase I, year 1 will be determined following detailed aquatic plant surveys conducted as soon as water conditions permit before the applications begin. During Phase II, the specific herbicide or combination of herbicides that may be most appropriate, and the respective doses, will be based on the findings of Phase I and the results of plant surveys conducted just prior to implementing Phase II. For Phase III maintenance, the need to apply herbicides will be based on the criteria presented in Figure 8, including the total contiguous area of infestation and the specific invasive or nuisance plant species present.

The total quantity of herbicides to be used depends on water depth and total water volume. Water depths in the lagoons vary with seasonal snow pack and runoff; however typical depths during late May to early June range between 8 to 12 feet deep. The movement of the applied aquatic herbicide toward Lake Tahoe will be prevented by correct timing, proper site selection, hydraulic gradients from Lake Tahoe toward the lagoons, and the bubble curtain installed in the West Channel to prevent possible movement or dissipation of aquatic herbicides into Lake Tahoe. Turbidity curtains may also be placed, as possible, and if identified as a meaningful best practice based on Phase I results, at the geographic boundaries of each treatment area to further reduce the risk of herbicides moving out of the treatment areas.

Correct timing will be determined by assessing Lake Tahoe Basin snowmelt runoff conditions and the associated hydraulic flow patterns between Lake Tahoe and the lagoons. Lake Tahoe is typically filling during the proposed application period of late May to early June as is shown in Figure 6. Therefore water will be flowing into the lagoons from Lake Tahoe which will assist with keeping herbicide from moving northward towards the lake during the application period.
Figure 6. 2015 to 2018 lake levels from April to July
No adjuvants\(^5\) are proposed for use with the aquatic herbicides and the proposed rate of use of each of the aquatic herbicides will be 50 percent, or less, of the maximum allowable concentration specified on the CalEPA-DPR approved aquatic herbicide labeling. The efficacy of these application rates was developed by TKPOA based in part on a mesocosm-scale experiment using target plant species (Anderson 2017).

A description of each aquatic herbicide proposed for use during the Aquatic Restoration Project is provided below. The registered label of each herbicide, Material Safety Data Sheet (MSDS), and relative research are contained in Appendix D.

1.6.4.1 Endothall (Aquathol K)

Endothall is a rapid-acting, contact type herbicide applied as a liquid formulation directly to aquatic plants. It typically requires a contact time of 12 to 24 hours at concentrations of either 4 or 2 ppm, respectively, for control of the target plants and has a half-life of 5 – 10 days. It has some selectivity and has little effect on *Elodea* spp. at normal application rates of 1-3 ppm (Washington Department of Ecology 2001, Gettys et al. 2014, Anderson 2017). It has proven to be effective in controlling curlyleaf pondweed when applied at low rates (Anderson 2016, 2017). Residues in water are readily determined through sampling and immunoassays with results available in real-time for moderate application levels and up to 24 to 48 hours for lower level detection. Details on the monitoring program can be found in Chapter 4: Mitigation, Monitoring, and Reporting Program.

1.6.4.2 Triclopyr (Renovate Liquid or OTF)

Triclopyr is a systemic, selective herbicide that is applied either as a liquid or a solid. It is relatively fast acting (2 to 5 days) at concentrations of 0.5- 2.5 ppm for selective control of Eurasian watermilfoil and has a half-life of 0.5 to 7.5 days. It has little to no effect on pondweeds, coontail or *Elodea* spp. (Washington Department of Ecology 2004, Gettys et al. 2014, Anderson 2017). It is readily monitored through water sampling and immunoassays with results available in 24 to 48 hours after samples are taken.

1.6.4.3 Florpyrauxifen-benzyl (ProcellaCOR™)

ProcellaCOR™ is classified as “Reduced Risk” pesticide by USEPA, which is a first for short exposure in water herbicides. It is used at extremely low rates for control of Eurasian watermilfoil (e.g. 2-4 ppb) and has been shown to be effective on newly sprouted turions (Anderson 2017). It has a very short half-life of only a few days and is the first non-copper herbicide for localized treatment without restriction on potable water consumption. See Heilman, M. (2018) (ICAIS meeting pdf) and Beets and Netherland (2018) for more information. It has also been shown to be effective on newly sprouted turions (Anderson 2017).

\(^5\) An adjuvant is an ingredient that is added to an aquatic pesticide during a treatment event to increase its effectiveness on target organisms.
EPA registered this product in 2018 and stated that there are ‘no risks of concern to human health from any route of exposure’. Additionally, there are ‘no risk concerns for non-target wildlife.’

1.6.5 Application Methods and Application Rates

Aquatic herbicides will only be applied by California licensed applicators as is described in Section 1.6.7. Aquatic herbicide labels typically specify a range of allowable application rates (concentrations). This is because: 1) the relative abundance of target plants varies and plants have different susceptibilities to herbicides; 2) the conditions in the field may vary from flowing to static, thus affecting contact time; and 3) the application method can affect the application rate. The characteristics of the lagoons (susceptible species, low dilution rates within coves, and vertical mixing) preclude the necessity to use maximum label rates. Therefore, all aquatic herbicides will be applied at rates that are well below levels allowed by the product registration, yet should still produce desired efficacy. Table 3 presents the proposed herbicides, application rates and methods.

Table 3. Proposed Herbicides, Application Rates, and Methods

<table>
<thead>
<tr>
<th>Herbicide Active Ingredient (Product Name)</th>
<th>EPA Reg. No.</th>
<th>Maximum Allowable Rate (ppm)</th>
<th>Proposed Application Rate (ppm)</th>
<th>Application Method(s)</th>
<th>Target Plants per Product Labeling</th>
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<tr>
<td>Endothall (Aquathol K) Contact-type</td>
<td>EPA Reg. No. 70506-176</td>
<td>5.0</td>
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<td>Drop hoses (liquid)</td>
<td>Eurasian watermilfoil Coontail Curlyleaf pondweed</td>
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<tr>
<td>Triclopyr (Renovate 3 (liquid) or OTF (granular))</td>
<td>EPA Reg. No. 67690-42</td>
<td>2.5</td>
<td>1.0</td>
<td>Drop hoses (liquid) or granular spreader</td>
<td>Eurasian watermilfoil</td>
</tr>
<tr>
<td>ProcellaCOR™ (florpyrauxifen-benzyl)</td>
<td>EPA Reg. No. 6790-79</td>
<td>0.050</td>
<td>0.002-0.004</td>
<td>Drop hoses (liquid)</td>
<td>Eurasian Watermilfoil Curlyleaf pondweed</td>
</tr>
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</table>

Appendix B – Aquatic Pesticide Application Plan provides the details of the methods that will be used to apply the proposed aquatic herbicides. In general, liquid formulations will be applied from a boat-mounted tank mix system with direct pumping into drop hoses that place the herbicide from mid-depth to the bottom. Should the Applicator select a granular formulation, it will be applied either by small, powered granular spreader or a powered air-stream (blower) spreader connected to a boat-mounted hopper system. These systems are commonly used and readily available commercially.

The proposed application in the Phase I, HVS minimizes both the areal extent of application and the rate of herbicide applied to result in the minimum application of herbicides to the treatment areas for an effective demonstration and evaluation of
performance criteria and measures. Chapter 2: Regional and Statewide Policies/Plans provides additional information on how the proposed application in Phase I minimizes the release of herbicides to surface waters of the Main Lagoon and Lake Tallac. Table 4 shows the sites, herbicide application rates and area of each site, and the non-herbicide methods planned for follow up management.

Table 4: Proposed Demonstration Site Acreages, Herbicides, Application Rates (ppm), and Non-Herbicide Follow-up Control Methods*

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*Note: UV light may also be used for follow-up control if technologically available and capable.
**Note: ProcellaCOR® will only be used if approved by CalEPA-DPR and is included in the list of approved herbicides for the NPDES General Permit.

1.6.6 Herbicide Cost and Time to Treat

Cost estimates for herbicide application (including market price of the herbicide, equipment and labor for application) vary according to the variety and types of herbicides used, and also according to the scale of the project. In general, herbicide application cost per acre will be less expensive on larger contiguous acreage (e.g. 10-15 acres at one time) than treating separate sites. Because Phase I involves application at twelve (12) small and separate sites, TKPOA assumes per acre application costs will be more for Phase I than for treatment of the lagoons as a whole in Phase II. Big Bear Municipal Water District budgets approximately $100,000 per year to treat aquatic invasive weeds (including Eurasian watermilfoil) covering 1,000-3,000 acres with endothall and triclopyr. Based on Big Bear Municipal Water District’s budget, but taking into consideration application of ProcellaCOR™, and the extra logistics, precautions, and lab tests
associated with herbicide application in the Tahoe Keys, TKPOA estimates $250-$500/acre for herbicide application in Phase I. Staff at the Big Bear Municipal Water District charged with triclopyr and endothall application estimate they are able to treat approximately 15 acres per day with a single herbicide (Bellis 2017 pers. comm.).

1.6.7 Best Management Practices and Additional Precautions

To help ensure the safe and efficient use of the herbicides, TKPOA has developed extensive and multi-layered plans to prevent accidental spills, to contain the herbicides within the treatment area, to precisely monitor the concentrations and movement of the aquatic herbicide after application, and to alert the public and water purveyors in the unlikely event that aquatic herbicides move beyond the treatment areas and enter the unaffected areas of the lagoons or Lake Tahoe (see Chapter 4: Monitoring and Reporting Program and Chapter 6: Communication Plan). In addition, the Monitoring and Reporting Program has been reviewed by an independent peer review committee and the LRWQCB to ensure that study design and monitoring protocols meet scientific and regulatory standards (See section 4.3).

Two of the proposed herbicides are currently used throughout the United States, including in California (Table 1), to control the same invasive aquatic plants found in the lagoons. The uses, approved sites, methods of application, limitations and restrictions of use, and the targeted aquatic weeds of aquatic herbicides are specified by each product’s labeling. Licensed applicator use of these herbicides must comply with the approved label. This includes appropriate rate (concentration) of use, proper methods of application, proper equipment, protective clothing, and proper disposal of product containers after use. Labeling also provides specific limitations and compliance actions regarding uses in or near potable water sources and waters used for irrigation, swimming, or fishing. The registered labels and MSDS for each proposed aquatic herbicide can be found in Appendix D.

In addition, in accordance with California state law, aquatic herbicide applications will be made only by a Qualified Applicator Certificate Holder (QAL) from the CalEPA-DPR. The staff directed by the QAL will have knowledge of the proper selection, use, and calibration of the equipment used during the application of aquatic herbicides. The QAL will follow all Best Management Practices (BMPs), monitoring, reporting, and contingency measures set forth in the Monitoring and Reporting Program and the corresponding Aquatic Pesticide Application Plan (APAP), which is included as Appendix B. As a condition of the contract with the QAL, TKPOA shall receive written documentation and verification of the QAL’s training, including any staff used for the Project. In addition, proof of liability insurance coverage will be required of all contractors that do work for TKPOA. These documents will be in possession of the TKPOA before any application is made and shall be made available to staff of the LRWQCB at least 30 days before applications are made.
1.6.8 Post Herbicide Treatment Follow-up Actions

Follow up actions for each phase of the Project are based on type of plants that emerge (target: invasive and nuisance plants; desirable: native non-nuisance plants), total contiguous area of plant populations, and relative abundance of target and desirable plants in each area. The follow up actions can be characterized as either selective or non-selective. Selective actions, such as diver assisted hand removal and herbicides, are those that remove target plants while leaving desirable plants intact. Non-selective actions, such as bottom barriers and UV light, will potentially remove all vegetation in the area.

1.6.8.1 Phase I, Herbicide Validation Study – Years 1 and 2

During the spring and summer of the year following herbicide treatment at the twelve identified sites in the HVS (Phase I), non-herbicide control follow-up methods consisting of bottom barriers, diver assisted hand removal, and other methods that might be approved for use prior to Phase I implementation (e.g. UV light) will be implemented based on post-herbicide plant biovolume and relative species abundance. Figure 7 summarizes the options and the criteria for deploying each non-herbicide follow-up option, or for taking no action.

Appropriate non-herbicide control methods will be used depending on the target plants, size of infestation and location of infestation. For example, consistent with the decision process described by Figure 7, when a treated site is surveyed in spring of year 2, if some target plants still remain, but no desirable native plants are present, the site will be assessed to determine the size of the infestation. If the area of infestation is less than 1.5 acres in size, then the follow up control measure will either be bottom barriers or UV light (if proven and feasible). Both of these methods are non-selective. Thus, they are most applicable to areas where desirable native plants have not yet been re-established. This assessment will be made for each of the 12 herbicide validation study sites based on the expectation that each site may demonstrate a different response due to the herbicide used and plant species composition and distribution.

TKPOA’s WDRs permit the use of up to 5 acres of bottom barriers. This, along with diver assisted hand removal, will likely be the primary non-herbicide control methods utilized after the initial use of herbicides in the treatment areas. Figure 7 Decision Criteria for Phase I Follow-Up Control Actions in Year 2 shows the decision matrix for follow up actions during Phase I, year 2.

1.6.8.2 Phases II and III Follow-up Treatments – Years 3 through 12

Phase II and III follow-up treatments will prioritize non-herbicide follow-up actions (e.g. bottom barriers, diver assisted hand removal, UV light treatment) to manage any reinfestations in the season and year following initial treatment. In general, reinfestations of less than 1.5 acres, particularly if herbicides were used in the area of reinfestation the prior year, will be treated with permitted non-herbicide control methods. However,
herbicide may be used at infestations sites of less than 1.5 acres if there is presence of desirable native species in addition to dense growth of invasive species, or in cases where there is indication that the reinfestation is due to initial misapplication of herbicide (e.g. herbicide application in the area was too diluted to be effective). With consideration for a Project design that adheres to Integrated Pest Management recommendations, TKPOA is seeking, as much as possible, to limit application of herbicides at the same site within the year following initial application. In any case, herbicide use as a follow-up treatment will be limited to a maximum total of 35 acres in any one season. Figure 8, Decision Criteria for Phase II and III Follow-Up Control Actions, describes the decision criteria matrix TKPOA will employ to determine the appropriate post herbicide application treatment at sites of reinfestation.
Figure 7. Decision Criteria for Phase I Follow-Up Control Actions in Year 2

Initial Herbicide Treatment

- No target plants emerge
  - No action

- Only desirable native plants emerge
  - Total contiguous acreage of infestation is less than 0.5 acre
    - Diver-assisted hand removal and/or UV light if feasible
  - Total contiguous acreage of infestation is more than 0.5 acre
    - Install bottom barriers and/or UV light if feasible

- Some target plants emerge and no undesirable native plants emerge
  - Total contiguous acreage of infestation is less than 0.5 acre
    - Diver-assisted hand removal
  - Total contiguous acreage of infestation is more than 0.5 acre
    - Assess need to treat with herbicides in Phase II

- Target plants emerge AND desirable native plants emerge
  - Total contiguous acreage of infestation is less than 0.5 acre
    - Assess need to treat with herbicides in Phase II
  - Total contiguous acreage of infestation is more than 0.5 acre
    - Bottom barriers and/or UV light if feasible

- Target plant biomass is NOT reduced by at least 75%
  - Total contiguous acreage of infestation is less than 1.5 acre
    - Assess need to treat with herbicides in Phase II
  - Total contiguous acreage of infestation is more than 1.5 acre
    - Bottom barriers and/or UV light if feasible
Figure 8. Decision Criteria for Phase II and III Follow-Up Control Actions

*NOTE: Decisions will be based on relative abundance of target (invasive and nuisance) plant species within the contiguous area.*
2.0 REGIONAL AND STATEWIDE POLICIES/PLANS

The proposed Project will improve the water quality and beneficial uses of the Tahoe Keys Lagoons by adaptively managing the large scale infestation of AIS. The proposed Project is also consistent with regional implementation and management plans, including the Lakewide Implementation Plan (2015), Lake Tahoe Region Aquatic Invasive Species Management Plan (2014), and antidegradation laws and policies.

2.1 2015 Lakewide Implementation Plan

The 2015 Lakewide Implementation Plan (Lakewide Plan) discusses the effects of AIS on water quality, aquatic ecology, and recreation. Two of the aquatic macrophytes of concern in the lagoons, Eurasian watermilfoil and curlyleaf pondweed, are specifically discussed in the Lakewide Plan as the highest priority invasive aquatic species for control in the region. The Lakewide Plan specifically identifies the Tahoe Keys Lagoons as a priority control area due to the size of the AIS infestation and the frequency of recreational use. Next steps presented in the Lakewide Plan call for the development of: metrics to evaluate AIS control actions, a nearshore monitoring program, a research plan to address data gaps, and new technologies and strategies to control AIS in Lake Tahoe. At the time the Lakewide Plan was written, herbicides were not allowed in the Lahontan region. Nevertheless, the Lakewide Plan states that if herbicides are permitted, then they should be considered for use in the Tahoe Keys Lagoons (Wittmann and Chandra 2015).

The proposed Project is consistent with the recommendations of the Lakewide Plan because it will utilize all available methods, including herbicides, to control the main invasive species of concern within the lagoons. It also includes an extensive monitoring plan and an Early Detection and Rapid Response program that will monitor for and quickly handle new infestations that may arise.

2.2 Lake Tahoe Region AIS Management Plan

The Lake Tahoe Aquatic Invasive Species Management Plan (AIS Plan) explains how invasive aquatic plants have deleterious effects on water quality and the beneficial uses of water, including recreational use and navigation, and recommends combining control and eradication work with research to improve the level of control of aquatic invasive species. The AIS Plan outlines the history, current policies, and goals for AIS in the region and is the guiding document for coordinating committees and resource managers in the Lake Tahoe basin. Like the Lakewide Plan, the AIS Plan also specifically discusses the Tahoe Keys Lagoons as a priority area of concern and highlights the need for continued development of long term eradication goals that incorporate all available technologies (Action D2b).

The goals set out by the current AIS Plan are to prevent new introductions of AIS to the region, limit the spread of existing AIS populations in the region by employing strategies that minimize threats to native species, extirpate existing AIS populations when possible, and abate harmful ecological, economic, social, and public health impacts resulting from
AIS. The use of EPA approved herbicides will help achieve these goals by providing a proven safe and effective means to selectively control AIS in the Tahoe Keys lagoons.

A previous version (2009) of the AIS Plan highlighted the need to pursue all methods of control including the use of herbicides. The current document from 2014 discusses the now-approved Basin Plan Amendment allowing herbicide prohibition exemptions to be granted at the discretion of the LRWQCB. The use of herbicides provides another valuable tool for resource managers to help combat the increasing spread of AIS within the basin and the long-term threat to Lake Tahoe’s ecosystem.

2.3 Antidegradation

California State Water Resources Control Board (SWRCB) Resolution No. 68-16 states that any degradation of high quality water is permissible only if the Regional Board finds that a lowering of the existing water quality is consistent with the maximum benefit to the people of the State.

The LRWQCB Basin Plan Amendment states that, under certain circumstances, an exemption to the prohibition on the use of aquatic pesticides may be allowed for the control of AIS and that in granting the exemption, the waters in the treatment area may be temporarily degraded due to the application of aquatic pesticides. The temporary degradation of high quality water is only permissible if the LRWQCB determines that the proposed project is consistent with the maximum benefit to the people of the State of California. The federal anti-degradation Policy (40 CFR §131.12) also states that water quality is to be preserved unless it is determined that lowering of water quality is necessary to accommodate important economic or social development. In the case of Lake Tahoe, the control of AIS is vital to existing and future economic and social sectors in the Lake Tahoe region. Furthermore, the presence of the parent herbicide and any degradants is expected to be temporary and short-lived, and ultimately result in an appreciable improvement in water quality within the Tahoe Keys lagoons and a substantially diminished threat to future water quality in Lake Tahoe.

The previously submitted and rescinded exemption application submitted by TKPOA for the Integrated Methods Test included a qualitative antidegradation analysis completed by TKPOA. That analysis has been updated for this application and is included as Appendix G. Per conversations with LRWQCB staff, TKPOA expects that LRWQCB will oversee completion of a quantitative antidegradation analysis associated with this application during preparation of the environmental documents. The antidegradation analysis shall consider all relevant information to determine if the Project would unreasonably affect the water quality of the Tahoe Keys lagoons or adversely affect the designated beneficial uses of the Tahoe Keys lagoons.

To assist the LRWQCB in assessing the impact of the proposed fully integrated program, the Phase I HVS will include sampling and analysis of degradants of each herbicide, including the parent (active) ingredient. It is anticipated that this phase of the project will
show the limited temporal effects of the herbicides which allow for widespread use in Phases II and III of the Project.

2.3.1 Spatial Extent of the Herbicide Demonstration Project

Phase I of the Project will demonstrate the efficacy and utility of aquatic herbicides under the site conditions of the Tahoe Keys lagoons. The experimental design minimizes the spatial extent of the application by treating only a small portion of the total area infested with aquatic weeds in the Tahoe Keys lagoons.

The demonstration project will take place in 12 locations totaling 18.2 acres (Figure 4). This is approximately 8 percent of the total surface area of the lagoons, which cover approximately 161 acres. The scientific basis for the actual size of the demonstration area and the locations for treatment relies on information provided by the USEPA under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA), the CalEPA-DPR, and Guidelines published by the Department of Pesticide Regulation. A summary is provided below.

- Each site chosen displays typical aquatic plant species distribution, based on historic sampling and surveys.
- Each site is a dead-end cove. This minimizes potential movement of herbicide toward untreated areas and provides maximum distances to the West channel, which connects the Main Lagoon to Lake Tahoe.
- In order to obtain scientifically and statistically valid data on the herbicide efficacy and non-target effects of the treatments, each type of herbicide product must be separately applied to similar sites.
- To properly replicate herbicide treatments, three replicate sites per herbicide are required for three products, therefore a total of at least nine sites are needed.
- The minimum size of each site is 1.0 acre in order to encompass sufficient plant diversity and to allow for diffusion of the active ingredients. The minimum scale per site (1 acre) is based on the following criteria:
  - The need to expose all typical plant species found in the lagoons, including target species and desirable, native plants.
  - Sufficient volume to expose target plants with a small, but operational use of the herbicides. Smaller sites (and volumes) often result in too rapid dilution of herbicides and would not represent conditions under which they would be recommended for use.
  - Sufficient size and depth variations to assess effects of herbicides on water quality such as dissolved oxygen, pH, temperature, and turbidity. Since these parameters vary with depth in normal conditions, sites need to encompass the full range of typical bathymetric conditions in the lagoons.
  - In order to obtain similar conditions in replicate treatments sites, the areas need to be sufficiently large to minimize unusual conditions that may occur in smaller size plots (e.g., 500 or 1,000 square feet). An acre typically encompasses variations found at other sites of similar size in the lagoons.
In addition to the 12 demonstration sites, there are three proposed sites designated as control (untreated) areas as seen in Figure 4. These sites are subject to change based on final integrated test design, target plant composition, and permitting conditions.

2.3.2 Spatial Extent of Full Scale Integration

After Phase I of the proposed project, herbicides will be used in larger portions of the lagoons in order to provide adequate control of AIS. During Phase II, the entirety of the lagoons will be treated. However, in order to limit the spatial extent of herbicide application, treatment will be split into two years. This will reduce the potential effects of large scale die off of aquatic plants, such as reduced DO levels, and provide adequate receiving waters for dilution.

During Phase III of the project, herbicide use will be limited to areas requiring follow up spot treatment, as indicated in Figure 8. The total area to be treated in one year will be no more than 35 acres. This will allow for adequate treatment of any reinfestations that may occur while limiting the spatial extent of the treatment.

2.3.3 Limiting Temporal Effects of Treatments

Application rates of the aquatic herbicides will be well below the maximum label rates set by the US EPA (see Chapter 1, Table 3). The herbicide products themselves are subject to degradation by microbes in the water and the sediment layer and subject to UV degradation (Washington Department of Ecology 2001, 2004, and 2011, Gettys et al. 2014). By limiting the concentrations of herbicide used the project design limits the temporal effect of the Project to the greatest extent possible.

2.3.4 Estimation of Herbicide Concentrations in Receiving Waters

Based on Rhodamine WT dye studies (Anderson 2011, 2016), movement away from treated sites will take two to four weeks. Over that time period, several half-lives of the active ingredients will take place, which will reduce the remaining concentration of active ingredient and degradant as well. In addition, target plants will absorb the active ingredient, further reducing the concentrations in the treatment area.

The likelihood that the remaining amounts of active ingredient would result in detectable levels or exposure effects near the West Channel is extremely low. It is unlikely that residues will be detected at all within 200 feet of the West Channel given the large volume of water in the Main Lagoon coupled with the degradation (photolysis, microbial activity) and target plant uptake. Therefore, it is estimated that there will be undetectable herbicide concentrations within the receiving waters.

2.3.5 Sampling and Analysis of Degradants

During the specified monitoring for Phase I of the Project, as described in detail in Chapter 4, samples will be obtained for analysis of known degradants for each applied herbicide.
These analyses will help determine the validity of the estimated dissipation characteristics of the active ingredient(s), and their known degradants. Thus, although the known half-lives of the active ingredients suggest strongly that there will be no detectable levels at the West channel or exposure to Lake Tahoe proper, these samples will provide data to address that question.

2.4 State Implementation Plan (SIP)

Compliance with the SIP is only required for aquatic herbicides containing priority pollutants identified by the State of California. None of the proposed aquatic herbicides contain priority pollutants. Therefore, SIP compliance is not necessary.
3.0 ALTERNATIVES CONSIDERED

For more than 30 years, TKPOA has taken responsibility for removing aquatic plants from the Tahoe Keys Lagoons to maintain navigation of the waterways and other beneficial uses of the surface water. Mechanical harvesting, a LRWQCB approved aquatic plant management method, has been the primary method of aquatic plant control in the Tahoe Keys lagoons. Other methods to remove aquatic plants from the waterways of the Tahoe Keys Lagoons, including bottom barriers, hand-pulling, rotovation, dredging, SolarBee®, and water circulation – have been tried, but these methods either did not effectively control aquatic plant growth sufficient to maintain waterway navigation, or were not feasible for controlling aquatic plant growth at scale (approximately 161 acres of waterways).

The records of the amount of plant material removed by mechanical harvesting show that the problem of aquatic weeds has increased greatly since the 1980s. The general conditions of the lagoons provide ideal habitat for prolific plant growth with abundant light, nutrients in the sediment, and near-optimal water temperatures for most of the summer months. The continuation of the status quo will increase the incidence and frequency of AIS plant and fragment production and increase the risk of dispersal and spread of invasive aquatic plants into Lake Tahoe.

TKPOA has completed a comprehensive evaluation of the current literature on alternative mechanical and biological control methods. The following sections a) describe each method explored, b) evaluate the ability of each method to meet the objectives of the proposed Project as defined in this application, and c) examine the feasibility of each method – including its cost, potential environmental impacts, and other social and technological considerations.

In summary, some of the non-herbicide control treatment options are effective and environmentally and technologically feasible for small areas (e.g. bottom barriers combined with diver assisted hand removal is generally feasible and effective for areas less than five acres); however, non-herbicide control methods are typically non-selective (i.e. they will not allow desirable native species to propagate while removing invasive and nuisance native species) and cannot be deployed at a scale that can address the full magnitude of the infestation within the Tahoe Keys. Therefore, non-herbicide control methods alone will not achieve the goals and performance objectives of the Aquatic Restoration Project. A summary of the methods considered is provided in Table 5.

3.1 Bottom Barriers

3.1.1 Description

Bottom barriers, also known as benthic barriers, physically suppress aquatic plant growth and restrict sunlight. Depending on the barrier material, gas exchange may also be restricted. Barriers are typically large sheets of an impermeable or semi-permeable synthetic or natural material that is placed directly on the plants and anchored in place.
with weight. Barriers are installed by diver assisted hand crews and can be placed under docks or piers that otherwise may be difficult areas to treat with other methods. Synthetic barriers remain in place for at least 2-4 months and are either removed from the lake or moved to a new location, typically immediately adjacent to the site just treated. Alternatively, barriers may remain in place over the winter depending on site characteristics, plant composition, water temperature, and placement timing. Barriers left in the water over the winter would be monitored on a regular basis and be prioritized for removal or relocation in the subsequent year.

3.1.2 Effectiveness

TKPOA evaluated the use of bottom barriers through its collaboration with Tahoe Resource Conservation District (TRCD) and TRPA via the Tahoe Keys Aquatic Plant Management Research Project from 2011 to 2013 (TRCD 2014). The study found that the (synthetic) bottom barriers provided short-term control of aquatic plants within the treatment area, but that aquatic plants did eventually recolonize an area that had been treated. In addition, in densely infested areas TRCD has noted that sediment can settle on top of the barriers providing substrate for fragment rooting and growth. These results of the TRCD show consistency with other tests of bottom barriers, including in oligotrophic lakes in other parts of the country. A study of bottom barrier effectiveness in Lake George, New York found that at sites where barriers were removed, milfoil had recolonized 71% percent of the grid squares within one-year following barrier removal (Boylen et al. 1996).

Previous use of bottom barriers around Lake Tahoe have been successful, including in Emerald Bay where TRCD treated approximately six acres of Eurasian watermilfoil with bottom barriers and diver assisted hand removal over the course of 4 years with an additional year of maintenance hand removal (Shaw et al. 2016). While this project technically was a success, bottom barriers had to be placed and removed during each of the 3-4 years of control, along with diver-assisted hand removal, to eradicate the small area of infestation.

3.1.3 Feasibility and current status

3.1.3.1 Cost

The most up-to-date and relevant cost estimates for bottom barrier placement in the Tahoe Keys lagoons come from TKPOA’s 2017 large scale bottom barrier test. This test involved installation of bottom barriers covering a 0.75 acre section in one backwater channel area of the Tahoe Keys. The total cost of the project was $71,250. This cost includes pre-project planning, permitting, diver installation and removal, monitoring, and reporting. The per-acre cost for this project was approximately $95,000.

3.1.3.2 Environmental Impact

There are few long-term ecological concerns associated with bottom barrier placement. One potential drawback is that barriers are non-selective in regards to aquatic plant
control, potentially eradicating native species, such as Elodea, along with target aquatic weed species. However, given that bottom barriers are used within targeted areas, there is little concern that their use would have widespread repercussions on the total native aquatic plant population. There are also potential negative impacts to the benthic invertebrate community as macroinvertebrates could be suffocated by the barriers. However, studies on the impact of barriers to benthic invertebrates in Lake Tahoe have shown no apparent impacts to macroinvertebrate density (TRCD 2012; TRCD 2013).

3.1.3.3 Current Status and Conclusion

TKPOA has implemented an in-house permitting system for bottom barriers for homeowners who choose to install the barriers for seasonal control of aquatic plants around private docks. However, large-scale placement using trained divers is expensive and time-consuming. Contractors responding to TKPOA’s May 2017 bottom barrier RFP estimated up to 13 days per acre to complete installation. July 2017 bottom barrier installation resulted in successful installation of 0.75 acre bottom barriers using a two person diver team plus one boat within six days. Additional days would be required for removal. The labor intensive nature of bottom barrier installation, combined with the large per acre expense, make bottom barriers an infeasible large-scale solution for the Tahoe Keys lagoons. Bottom barrier placement may be especially useful in small areas where successful use of aquatic herbicides has reduced aquatic plant biomass. Bottom barriers are included as part of the proposed follow up actions for the areas treated with herbicides.

3.2 Rotovation

3.2.1 Description

Underwater rototilling, called rotovaling, involves the use of hydraulically operated rototilling machines. To rotoval, a rotating, solid tine head is lowered to the bottom of the waterbody and physically tills the sediment to a depth of 8-10 inches, dislodging the roots and rhizomes of the plants. Much of the plant material floats to the surface where it must be removed by screens and suction systems to prevent rotovated fragments from drifting and reestablishing invasive plant populations. Developed as an aquatic plant control method in the late 1970s, rotovalation is not a commonly used aquatic plant control method in the U.S. Rototation involves destruction of the substrate during tilling which, among other ecological considerations, can impact fisheries and benthic populations and is considered “dredging” by the U.S. Army Corps (USACE) of Engineers, requiring a Clean Water Act section 404 permit. Rotovation has been used to manage Eurasian watermilfoil in a few lakes in Canada (e.g., Cultus Lake in British Columbia and Okanagan mainstream lakes in British Columbia), and is regularly used as a treatment method for Eurasian watermilfoil in at least one U.S. waterbody, the Pend Oreille River in Washington. Most studies regarding the effectiveness of rotovalation as a treatment method come from these geographic areas.
3.2.2 Effectiveness

The effectiveness of rotovation as an aquatic plant control method is mixed. Most studies are more than 20 years old and point to immediate reductions in plant densities of 90-98 percent (Washington Department of Ecology 2017a, Gibbons and Gibbons 1988, Okanagan Basin Water Board. 2009). Some studies note reduction in plant stem density in the year following rotovation as well, between 25 and 70 percent reduction in plant stem density according to one 1986 study on the Pend Oreille River (Gibbons and Gibbons 1988). However, these positive results are tempered by noted variability in treatment area success and increases in Eurasian watermilfoil in plots adjacent to those being treated. The 2005 Aquatic Plant Management Plan for the Box Canyon Hydroelectric Project on the Pend Oreille River discussed rotovation as a watermilfoil control method, including attaching a Review of Rotovation Effectiveness Studies for the Pend Oreille River in the appendix to the document. Authors of the plan noted that while rotovation does effectively reduce aquatic macrophytes, recolonization rates can vary and, in some cases, re-established macrophytes exceeded pre-treatment densities (Public Utility District No. 1 of Pend Oreille County 2005). The State of Washington Department of Ecology’s webpage includes information about the use of rotovation and considerations for use of rotovation as a potential treatment method. The Department cautions against pursuing rotovation in water bodies with early infestations of watermilfoil because fragments are created and rotovation may increase the spread of milfoil throughout the water body (Washington Department of Ecology 2017a).

Another concern with the effectiveness of rotovation relates to the method as a means of curlyleaf pondweed control. Most of the studies regarding rotovation focus on Eurasian watermilfoil, not on curlyleaf pondweed. The reproductive biology of curlyleaf pondweed suggests the plant is likely to be more resistant to rotovation as a control method because curlyleaf pondweed successfully repopulates via turions. Turions can be less than ½ inch in diameter and eventually sink and settle into bottom substrate. Turions are thus more likely to be missed during fragment collection after rotovation. For these reasons, rotovation could actually facilitate the spread of curlyleaf pondweed by distributing turions into an area of newly tilled substrate where the turions have reduced plant competition. The 2005 Aquatic Plant Management Plan for the Box Canyon Hydroelectric Project on the Pend Oreille River pointed to several studies that found other species of aquatic plants readily invade sites after rotovation, noting particularly several studies (Maxnuk 1979; Bryan and Armour 1982; Boulduan et al. 1994) that documented the rapid colonization of rotovated sites by curlyleaf pondweed.

Rotovation has been attempted as an aquatic weed control method in the Tahoe Keys before. TKPOA contracted with Clean Lakes Inc. to complete rotovation trials in the Tahoe Keys lagoons in 1988. At the time, Clean Lakes Inc. had just completed two years of rotovation trials for the Washington Department of Ecology on the Pend Oreille River. Rotovation did occur in the Tahoe Keys that year (1988) for 27.5 days, however, there is limited documentation relating to the success of the treatment. James Holse, a primary operator of the Clean Lakes Inc. rotovation equipment, the Aquamog, now works as a harvester operator for TKPOA. Holse provided his memory of the rotovation trial, stating
rotovation successfully cleared the waterways for the season and that the waterways remained clean throughout the following year. However, he also recalled that aquatic weed growth was worse the following summer than it had been prior to rotovation (Holse 2016 pers. comm.). The Tahoe Keys rotovation test occurred prior to the first documented observation of curlyleaf pondweed in 2003.

3.2.3 Feasibility and Current Status

3.2.3.1 Cost

The most up-to-date and relevant cost estimates for rotovation in the Tahoe Keys lagoons come from responses to a May 2017 request for proposals (RFP) issued by TKPOA. The RFP presented a rotovation project at three sites in the Tahoe Keys lagoons, for a total of 3.25 acres. Two contractors responded to the proposal request, Aquatic Environments and Clean Lakes Inc.

Aquatic Environments estimated approximately $31,000 per acre for rotovation and installation of turbidity curtains, and assumed they could rotove approximately ½ acre per day. Aquatic Environments explained that, under other circumstances, the company would assume one acre of rotovation to be possible in one day, but conservatively reduced their time estimate for the Tahoe Keys lagoons because of an expectation of dense vegetation, screening for submerged obstacles, and the need to prove the efficacy of the technique. Aquatic Environments noted that in their experience, treating rotoverted areas with chemicals after rotovation can increase aquatic plant control efficacy (Aquatic Environments 2017).

Clean Lakes Inc. responded with a written letter to the RFP, but not a proposal. In their correspondence regarding the RFP, Clean Lakes Inc. said they were declining the opportunity to produce a proposal for the project, citing concerns that the project would not be able to maintain compliance with existing environmental permits, laws, and regulations. In the letter, Clean Lakes provided an estimate of $40,000 - $60,000 per/acre for the rotovation trial, should all environmental conditions to initiate the trial be met (Clean Lakes, Inc. 2017).

3.2.3.2 Environmental Impacts

Multiple potentially significant environmental impacts can be associated with rotovation. The process of rotovation tills the substrate causing increased turbidity (Okanagan Basin Water Board. 2007), which can adversely affect fish and other aquatic species by clogging gills and causing asphyxiation, interfere with filter feeding organisms, and smother eggs deposited in the substrate. Few studies exist regarding the impact of rotovation on benthic invertebrates (Public Utility District No. 1 of Pend Oreille County 2005). However, given that rotovation physically tills the substrate, it is reasonable to expect some invertebrate mortality associated with the activity. In areas with toxic sediments, rotovation may remobilize toxics trapped in the sediments back into the water column (Washington Department of Ecology 2017a). Rotovation also has the potential for increasing aquatic
weed growth in locations adjacent to treatment areas due to macrophyte fragmentation, and for potentially encouraging the growth of curly leaf pondweed, a plant well suited to take advantage of tilled substrate and reduced plant competition for space (Maxnuk 1979; Bryan and Armour 1982; Boulduan et al. 1994). Rotovation, like most mechanical control methods, is also not species specific – the treatment does not differentiate nuisance plants from native plants.

On June 14, 2017 TKPOA met with several regulatory stakeholders to discuss the possible rotovation trial as a treatment method for aquatic weed control in the Tahoe Keys lagoons. Representatives from LRWQCB, TRPA, USACE and California Department of Fish and Wildlife (CDFW) were in attendance at the meeting. Regulators expressed concern regarding multiple potentially significant environmental impacts associated with rotovation as an aquatic weed control method. These concerns included: potential spread of aquatic invasive weeds due to the rotovation activity, potential for rotovation to remobilize alum trapped in the Tahoe Keys substrate leading to potentially toxic concentrations, and impacts to benthic invertebrates and fish associated with rotovation trauma. CDFW noted the potential for fish kill within the rotovated treatment area, pointing out that the turbidity curtains could trap fish that would otherwise migrate out of the area of disturbance.

Due to the potentially significant impacts associated with rotovation, the rotovation trial would require substantial environmental and permitting review requirements including a Nationwide 404 Permit from USACE, 401 Water Quality Certification (WQC) from the LRWQCB, a Lake and Streambed Alteration (LSA) Agreement from CDFW, and potentially a Shorezone permit from TRPA. Evaluation of environmental impacts per CEQA and TRPA regulations would also be required.

3.2.3.3 Current Status and Conclusion

Based on the above facts and analysis, rotovation would not be feasible as a means for controlling aquatic invasive weeds, and would likely facilitate the spread and density of curly leaf pondweed, making rotovation an ineffective mechanical control option. Feasibility issues include its anticipated significant environmental impacts, including water quality impacts associated with remobilization of substrate alum, significant increases in turbidity, and decreased dissolved oxygen levels. From an operational and technical standpoint, submerged obstacles, such as rocks, fallen trees, water system infrastructure and anchors, could also damage rotovation equipment, delay or postpone treatment, and increase costs. Finally, the high cost of rotovation (between $30,000-$60,000 per acre), the time required to treat a single acre (two days per acre), and documented repopulation of invasive plants within a short period of treatment make rotovation an infeasible option for aquatic weed control in the Tahoe Keys lagoons.
3.3 Weed Rollers, Sweepers, and other Automatic Plant Control Products

3.3.1 Description

Several commercially available products roll, rake, or drag along the lake bottom to disturb the sediment, remove aquatic plants, and prevent regrowth within the treatment area. Common types of these products include weed rollers and sweepers.

Weed rollers are dock-mounted, electrically-driven systems that slowly and continuously move a long rotating arm (up to 30 feet long) across the sediment layer. The system is usually installed for operation in early spring so that the rotating arm can periodically move over newly sprouted plants, thus maintaining a relatively clear area beneath its path. The Washington Department of Ecology notes that some products do not work well after plants have already grown (Washington Department of Ecology 2017b). Weed rollers on the market advertise the ability of a weed roller to cover between 1,100 and 3,200 square feet with an arm that moves in an arc of 270-300 degrees from the mounted location (Crary Industries 2017). Fin-like projections on the rollers help detach plants from the sediment and remove roots. Alternatively, plants may simply be flattened (inhibiting growth) by the roller.

A sweeper is similar in concept to a weed roller. Like a weed roller, a sweeper is an electrically-driven system with a slow and continuously moving rotating arm that may attach to a dock, though the commercially available Lake Maid™ floats along the lake surface. Like a weed roller, a sweeper arm rotates in an arc around a pivot point. Rather than rolling over the substrate, a sweeper drags a series of lightweight rakes or chains behind its arm that gradually weaken and eventually kill aquatic plants. The Lake Maid™ advertises that its product can make up to 3,000 radial passes around its center point in one day (Lake Restoration Incorporated 2017). Lake Maid™ also recommends using the product for up to nine continuous days to clear plants.

The Washington Department of Ecology suggests that once plants are cleared from the area by a roller or sweeper, the equipment can be used as little as one day per week or less to keep plants from recolonizing the area (Washington Department of Ecology 2017b).

3.3.2 Effectiveness

Informal reports from product users suggest that weed rollers do effectively clear aquatic plants from the area they are used. In its webpage focused on automatic plant control methods, the Washington Department of Ecology reports that: “repetitive sediment agitation suppresses the regrowth of plants in areas where it is regularly used” (Washington Department of Ecology 2017b). In a pamphlet produced by the Washington Department of Fish and Wildlife (WDFW) to provide guidance in selecting control methods for aquatic noxious weeds, WDFW reports that weedrollers are useful for controlling plants in small defined areas (WDFW 2011).
In one study evaluating the Lake Maid™ in the San Joaquin River Delta, the machine was found to successfully remove all above ground plant biomass at two of the study sites where employed, though authors of the study noted that the likelihood of spreading plant fragments during the sweeping was high (David et al. 2006).

The effectiveness of automatic plant control products like weed rollers and sweepers is limited by: a) geographic constraints on the location of their use as sweepers require areas without obstructions (e.g., piers/docks) and relatively shallow water, <5 feet; rollers require a dock as a mounting point, b) the size of area each piece of equipment is able to treat (maximum of ~3,000 square feet which is 0.07 acre), and c) the potential for the equipment to interfere with navigation of the Tahoe Keys waterways by boat.

3.3.3 Feasibility and Current Status

3.3.3.1 Cost

The manufacturer's suggested retail price for the Crary WeedRoller® PRO is approximately $4,000 as of June 2017. A Google search for other commercially available automated aquatic plant control devices did not generate any alternative commercially available weed roller products. Assuming an installed weed roller could treat as much as 3,200 square feet, at least 13 weed rollers would need to be installed to treat a single acre (one acre is 43,560 square feet), at a cost of around $52,000/acre for equipment alone (not including labor costs for installation, permitting, maintenance or fragment collection and disposal).

Costs for the Lake Maid™ are slightly higher per acre, because though each sweeper costs less, approximately $1,300 as of June 2017, each Lake Maid™ unit has a capacity to treat only around 1,000 square feet at one time. A Google search for other commercially available automated aquatic plant control devices did not generate any alternative commercially available sweeper products. Treating one acre of the Tahoe Keys lagoons would require at least 40 sweepers at a calculated cost of around $75,000/acre for equipment alone (not including labor costs for installation, permitting, maintenance or fragment collection and disposal).

3.3.3.2 Environmental Impacts

Weed rollers have more potential environmental impacts than sweepers because the weed roller rolls directly on the substrate, resulting in substantial sediment disturbance and modification. Environmental impacts associated with use of a weed roller include: potential interference with fish spawning, non-species specific impacts (does not discriminate between nuisance plants and beneficial plants), may generate weed fragments, and can create an increase in short-term turbidity. A study evaluating the impacts of weed rollers in littoral habitats found that:

“Commercially available mechanical macrophyte removal devices that employ a submerged roller arm and paddle design to entangle and uproot macrophytes may have indirect negative impacts to littoral habitat by re-suspending and
scouring sediment and associated nutrients. Excavation and alteration of sediment substrate can have an impact on invertebrate and fish habitat and lead to enhanced nutrient recycling, depending on the density of use in relation to lake shoreline size” (James et al. 2004). The Minnesota Department of Natural Resources requires permits for the use of weed rollers to protect littoral habitats.

Sweepers, specifically the Lake Maid™, have less environmental impacts than weed rollers. Environmental drawbacks of a sweeper are the production of fragments and, like the weed roller, a sweeper does not differentiate between nuisance and beneficial plants. The study of the Lake Maid™ in the San Joaquin River Delta included an evaluation of the product on water quality, including total suspended solids, total and dissolved phosphorus, nitrate and nitrite, and organic carbon. The study found no significant effect of the Lake Maid™ on the water quality parameters tested (David et al. 2006). However, the study did find the Lake Maid™ dramatically increased the number of viable plant fragments during its use (David et al. 2006).

3.3.3.3 Current Status and Conclusion

Installation of either weed rollers or sweepers in the Tahoe Keys lagoons is possible, however environmental impacts, cost constraints, installation limitations, conflicts with boating navigation, and the limited area a single product is able to treat reduce their feasibility. Due to the environmental impacts associated with weed rollers, environmental review prior to its permitting would be necessary. Any identified significant environmental impacts associated with the use of weed rollers would outweigh their effectiveness given their high cost per unit (roughly $4,000) and ability to treat a maximum of approximately 3,000 square feet (0.07 acre). Additionally, weed rollers, like sweepers, are a poor choice in areas with significant boat traffic due to the potential for collision between boats and weed rollers. The requirement that a weed roller be dock mounted restricts the total area of the lagoons where a weed roller could be installed.

Sweepers are more environmentally palatable, and, because they float, have fewer limitations on the geography of their use. Sweepers may be a working option in areas with minimal or zero boat traffic, such as the Lake Tallac Slough. However, mitigation measures to reduce weed fragments generated by the use of a sweeper, such as the Lake Maid™, would need to be employed. Sweepers are also costly to install and can treat only a small area.

In conclusion, weed rollers and/or sweepers may be a feasible option for small areas of targeted aquatic plant treatment. Weed rollers and/or sweepers may be pursued in combination with other aquatic plant control methods in select locations with limited potential for conflicts with boat traffic, and provided the environmental impacts associated with their operation have been adequately mitigated. Given the costs discussed above, these products are not a feasible alternative for treating large sections or the entire Tahoe
Keys lagoons, and would not meet the objectives of the IMP or goals of the proposed project.

3.4 Mechanical Cutting and Harvesting

3.4.1 Description

Aquatic plant mechanical cutters and harvesters are large machines that remove the upper portion of aquatic plants, typically the area of the plant between five and ten feet below the surface of the water. Cut weeds can be transferred to holding platforms and be taken to areas approved for disposal. Cutting and harvesting is widely used and has been the primary means of AIS control in the Tahoe Keys lagoons since the 1980s. TKPOA currently operates five (5) large hydraulically-controlled harvesters. The harvesters are propelled by paddlewheels and include a basket on the front with cutting teeth, and a conveyor system to move cut weeds to a holding area in the back. Weed fragments collected by the harvesters are transferred to trailers, dried, and transported to a disposal site outside the Tahoe Basin. During the growing season, TKPOA continuously operates harvesters during working daylight hours (approximately 9 a.m. to 5 p.m. daily). Current harvests total around 10,000 cubic yards annually with 9,996 cubic yards collected in 2017. Obstructions such as docks, pilings, and moored boats prevent the use of large mechanical harvesters in smaller areas. Regardless of the size of the machine used, the plants in target areas must be harvested multiple times during the growing season to maintain navigable conditions.

3.4.2 Effectiveness

Mechanical harvesting offers immediate improvement of access to waterways for boating and other recreation. The large harvesters operated by TKPOA have been efficient in clearing thousands of pounds of plant material in a relatively short time period. Harvesting is not, however, a method for reducing overall aquatic weed growth, but, rather, a management technique to maintain navigable waterways in the Tahoe Keys lagoons. Ultimately, harvesters do not assist with reduction of aquatic weeds, but actually may increase the area of weed density and infestation via the incidental dispersal of plant fragments and turions that escape collection during harvesting. Plant fragments created during harvesting are viable and can disperse to uninfested areas by waterfowl, boat traffic, and by wind and water movement (Gettys et al. 2014, TKPOA 2016b). TKPOA undertook a study of plant fragmentation and is currently using that information to improve the harvesting practices in the Tahoe Keys lagoons (TKPOA 2014). Even with harvesting improvements, it would be impossible to collect all fragments.

3.4.3 Feasibility and Current Status

3.4.3.1 Cost

The most recent cost estimates for harvesting operations are from TKPOA’s own budget. In 2016, TKPOA reported spending approximately $2,900 per acre (including harvester
maintenance and operation, labor, and disposal of weeds) for the treatment of 145 acres which equates to $420,500 per year.

3.4.3.2 Environmental Impacts

Multiple known potential environmental impacts are associated with harvesting. The physical actions from harvesting operations can cause direct harm to fish, amphibians, invertebrates, and other organisms through injury or mortality, and by removing cover to protect native fish from prey (SFEI 2004). These impacts are directly related to the scale of operations and to the abundance and occurrence of non-target organisms in the treatment area. Mechanical harvesting can also impact water quality by increasing turbidity and releasing nutrients otherwise bound in the sediment. Like most mechanical treatment techniques, mechanical harvesting is non-selective in that it does not discriminate between nuisance plants and beneficial plants. This lack of selectivity can negatively impact desirable, native aquatic species. The most significant impact associated with mechanical harvesting is fragment production and associated spread and propagation of aquatic invasive weeds resulting from the spread of such fragments.

3.4.3.3 Current Status and Conclusion

TKPOA plans to continue harvesting to maintain navigation in the Tahoe Keys waterways until such a time that harvesting is no longer needed. Harvesting facilitates boat and swimmer access to the Tahoe Keys lagoons and Lake Tahoe. However, harvesting does not reduce the density of aquatic invasive weeds and does not assist with achieving the objectives of the IMP or the goals of the Integrated Methods Test, with exception of assisting with maintenance of vessel hull clearance. Furthermore, the production of many thousands of viable plant fragments as a result of harvesting makes the continued reliance on this method inconsistent with reduction in risk of further spread of invasive plants into Lake Tahoe.

3.5 Dredging

3.5.1 Description

Dredging, which is most commonly used to deepen navigation channels, removes both sediment and plant material. There are two types of dredging, hydraulic and mechanical. Hydraulic dredging pumps sediment to a disposal area and is best suited to remove loose organic sediment. Mechanical dredging employs heavy equipment from a barge or the shore to dig out sediment and transfer spoils to trucks for removal. Both types can be employed as a type of habitat manipulation to manage aquatic plants by increasing the water depth, which reduces the level of light available to the plants for growth. Dredging can also control plant growth by physically removing seeds, turions, roots, and rhizomes, thereby reducing the ability of macrophytes to repopulate the site.
3.5.2 Effectiveness

Dredging can be an effective, though not permanent, aquatic plant control technique. Dredging is not commonly practiced as an aquatic plant control technique because of its expense, and because of the multiple significant environmental impacts and permitting requirements associated with dredging activities. Furthermore, like rotovation, while dredging is likely to offer temporary relief from aquatic weeds for one or two seasons, plants will typically recolonize disturbed soils and begin the process of building new organic matter, enabling aquatic weed infestations to eventually repopulate dredged areas.

In addition, dredging, like rotovation, may help facilitate the spread and density of curlyleaf pondweed, which has shown to be a successful invader of disturbed conditions. At Elk Point Marina, dredged in 2015, populations of invasive Eurasian watermilfoil and native Elodea recolonized the entire marina within one year. Elk Point Marina now also supports new populations of curlyleaf pondweed for the first time as of July 2016, a year after dredging operations (Anderson 2016). Similarly, the navigation channel leading from Lake Tahoe into the Marina Lagoon was dredged in 2015, and then showed extensive infestations of curlyleaf pondweed that were never previously observed in this area (TKPOA 2016a).

3.5.3 Feasibility and Current Status

3.5.3.1 Cost

Approximately 5,600 cubic yards of sand from 24,000 square feet was dredged from the Tahoe Keys West Channel in 2015. RO Anderson Engineering, Inc. (ROA) oversaw much of the permitting for the project. Based on ROA’s experience, and after further investigation of dredging as a control option in their report: Treatment Options and Engineering Controls for Aquatic Invasive Plant Mitigation (ROA 2016), ROA estimated costs for dredging, dewatering of dredged material, and disposal outside of the basin at more than $24 million dollars, translated to approximately $140,000 per acre (ROA 2016). These costs do not account for expected additional costs associated with environmental review, permitting, or mitigation measures that would need to be employed.

3.5.3.2 Environmental Impacts

Dredging is a highly regulated process in Lake Tahoe and has multiple potential significant impacts to water quality, aquatic life, wildlife, air quality, recreation, and water aesthetics. At a minimum, dredging disturbs sediments, removes or smothers bottom-dwelling organisms, and releases nutrients and contaminants settled in the substrate. Due to the potentially significant impacts associated with dredging TRPA adopted stringent dredging standards. TRPA Code of Ordinance 84.14.3 Dredging, specifies: “There shall be no removal or materials within the lakezone or shorezone, except at those locations where such removal or rearrangement is found by TRPA to be beneficial to existing shorezone conditions, and water quality and clarity.” These conditions, combined
with permitting requirements of LRWQCB, California State Lands, USACE, and CDFW guarantee that any large scale dredging activity pursued within the Tahoe Keys would necessitate significant environmental review, likely triggering the need for an Environmental Impact Study (EIS) for TRPA and Environmental Impact Report (EIR) under CEQA. In addition, dredging, like rotovation, has the potential to facilitate the spread and density of curlyleaf pondweed – as resulted with the East Channel dredging TKPOA 2016a) by dispersing seed banks in the existing substrate and creating disturbed substrate absent of plant competition.

3.5.3.3 Current Status and Conclusion

Dredging may arguably be considered an effective aquatic plant control method for one or more seasons, however, the intensity of its environmental impacts and its cost far exceed the one or two seasons of aquatic weed control that dredging might provide. Furthermore, the substantial permitting, environmental review, and implementation time that would be required for a large-scale dredging project in the Tahoe Keys likely would create delays of multiple years, during which time curlyleaf pondweed could further spread within the lagoons and extend its invasion into Lake Tahoe.

Additional problems associated with dredging in the Tahoe Keys are related to the complexity and extent of physical structures (e.g., piers, pipes, bulkheads) within the waterways. These structures present serious hazards and risks for dredging operations, as well as risks to private property and valuable infrastructure within the Tahoe Keys. Due to its cost, environmental impacts, and technical challenges, dredging is not a feasible option for control of aquatic plants in the Tahoe Keys lagoons.

3.6 Circulation System/Treatment Plant

3.6.1 Description

TKPOA’s water treatment plant and circulation system were originally constructed and operated to reduce turbidity and mitigate algae blooms in the waterways of the lagoons. The system circulates water through both the Main (West) and Marina Lagoons, but has not been operated since the late 1990s. The water treatment plant consists of a large 117-foot diameter circular clarifier and mechanical building. The clarifier is approximately 15.8 feet deep and equipped with a rotary suspended rake and baffle, launders, overflow, and sludge collection line. Many of the components of the treatment plant have been removed, but the large clarifier is still in place.

TKPOA commissioned a study by ROA to evaluate re-use of the treatment plant and circulation system. ROA’s report, Treatment Options and Engineering Controls for Aquatic Invasive Plant Mitigation was completed for TKPOA in 2016 (ROA 2016). The report presents a thorough evaluation of the likely effectiveness and feasibility of utilizing the water treatment plant and circulation system for nutrient reduction or water cooling to control target macrophytes.
3.6.2 Effectiveness

The ROA study found that the water treatment system, even if retrofitted to become a biological nutrient removal system, would not be able to reduce nutrients in the water column below already existing low levels (ROA 2016). In addition, even if the water treatment system could be used to further reduce nutrients in the water column, nutrient reduction in the water column would probably not substantially affect invasive plant growth since Eurasian watermilfoil and curlyleaf pondweed, as rooted macrophytes, obtain >90% of their nutrients directly from the sediment and not the water column (Smith, C.S. and Barko, J.W. 1990; Barko, J.W. and Smart, R.M. 1986).

Controlling aquatic plant growth by reducing water temperature shows more initial promise because water temperature does significantly affect aquatic plant biomass production and plant propagation (Freedman 2006). However, despite the likely efficacy of aquatic invasive plant control via reducing water temperature, using either the circulation system or treatment plant to attempt water cooling was found to be economically prohibitive (ROA 2016) as well as technically challenging enough to be deemed infeasible.

3.6.3 Feasibility and Current Status

The report produced by ROA in 2016 did not identify any feasible options for reuse of the treatment plant or circulation system for aquatic invasive plant control. Options were either dismissed based on questionable efficacy, impermissible environmental impacts and/or excessively high economic costs in the tens of millions of dollars depending on the control options. The following descriptions summarize key findings of ROA’s assessment.

3.6.3.1 Nutrient Control

As discussed above, the biomass and density of the Eurasian watermilfoil and curlyleaf pondweed are unlikely to be effected by reduction of nutrients in the water column because the rooted macrophytes obtain >90% of their nutrients directly from the sediment. Nevertheless, TKPOA evaluated use of the water treatment system for nutrient control in the water column to address resource agency and other stakeholders’ interest in that possibility, and also because nutrient reduction in the water column has been shown in some instances to assist with algae and cyanobacteria control.

Two options were explored for retrofitting the treatment plant to reduce nutrients (phosphorous and nitrogen) from the water column: 1) retrofitting the water treatment system to become a biological nutrient removal (BNR) system, in which biological or microbial processes reduce nitrogen and phosphorous, or 2) adding coagulant that binds with phosphorous (e.g. alum or lime) could be added while pumping water through the treatment system so that the phosphorous could be filtered out along with the coagulant.

As described in the ROA (2016) evaluation, neither of the retrofit options would be effective or feasible. Concentration of total phosphorous occurs in the Tahoe Keys.
lagoons at an average concentration of about 0.030 parts per million (ppm). Converting the system to a BNR treatment system would not be able to reduce nutrients further given the already relatively low levels in the water column. Likewise, chemical-physical nutrient removal via addition of a chemical coagulant has not been shown to achieve concentrations of phosphorous lower than 0.1 ppm (ROA 2016). Even if additional investigation found that chemical-physical nutrient removal could reduce phosphorous below existing average concentrations of 0.030 ppm, evidence suggests reduction of phosphorous levels in the water column would not limit growth of rooted invasive macrophytes. Utilizing the treatment system to reduce nitrogen in the water column was dismissed as infeasible both because nitrogen is not expected to be the limiting nutrient in the lagoons, and because current technologies (e.g. reverse osmosis or distillation) available for reducing nitrogen below its existing levels are prohibitively expensive. Total nitrogen in the Tahoe Keys lagoons occurs at an average concentration of about 0.37 ppm, of which 0.36 ppm is total Kjeldhal nitrogen and 0.01 ppm is oxidized nitrogen (TKPOA 2017).

3.6.3.2 Water Cooling

Controlling aquatic plant growth by reducing water temperature is an initially attractive option because water temperature does have a significant effect on aquatic plant biomass production and plant propagation (Freedman 2006). Therefore, TKPOA investigated both circulating deep cold water from Lake Tahoe into the lagoons, and mechanically cooling the lagoon water by pumping it through a cooling treatment plant (ROA 2016). However, neither option was found to be feasible. Cooling via circulating deep cold water from Lake Tahoe into the lagoons would require design, environmental review, and permitting to build nearly 3,800 feet of large pipeline at an estimated cost of more than $3.5 million. Environmental impacts would be significant both to construct a buried pipeline into Lake Tahoe and to operate the project. The cold water pumped into the lagoons would displace the existing lower quality warm water, which would outflow into Lake Tahoe at a volume that could impact lake waters and habitat.

Mechanical cooling was also found to be economically prohibitive. According to ROA (2016), a cooling water plant with a capacity of approximately 24,000 gallons per minute would be required to sufficiently cool the Tahoe Keys Lagoons, and at a rate of $0.13 per kW-hour, would cost $8.6 million dollars to run over the course of each summer with uncertain effectiveness for the long-term control of the invasive plants.

3.7 Aeration or Mixing

3.7.1 Description

Physical mixing of water, sometimes called Laminar Flow Aeration (LFA), can improve dissolved oxygen levels and reduce nutrient loading, which can otherwise contribute to increased algal and plant growth. Individual aerators can be deployed in small lakes and ponds, which may reduce the amplitude and frequency of algal blooms. Other specific devices on the market are designed to increase vertical water movement and create less
favorable conditions for algal blooms (SFEI 2004). LFA and oxygenation both include mechanical parts. Generally these parts consist of, at a minimum, a compressor and diffuser. This technology is often also combined with bioaugmentation.

One company, Clean-Flo, sells LFA technology and bioaugmentation products. Clean-Flo representatives participated in a TKPOA Stakeholders meeting on May 2, 2017 to present their technology as a potential solution to some of TKPOA’s aquatic weed control issues. The Clean-Flo website describes its laminar aeration and oxygenation system as follows:

“Laminar flow created by our systems is non-turbulent and will not increase suspended solids or increase turbidity. In fact the opposite is true, suspended solids and turbidity will be reduced. Our diffusers are placed on the bottom and are not suspended above the sediments, to ensure oxygenation of the sediment-water interface. As the bubbles release from a diffuser, oxygen is transferred to the water from the bubble, and they also move water gently to the surface and across the surface where additional oxygen is absorbed by the water. Clean-Flo systems are designed to completely mix the surrounding waters and evenly distribute dissolved oxygen throughout the sediments for efficient microbial utilization” (Clean-Flo 2017).

3.7.2 Effectiveness

Based on stakeholder interest in LFA as a means for aquatic weed control, TKPOA undertook research to determine if LFA was a method worth exploring to address aquatic weeds in the Tahoe Keys. Overall, there is lack of evidence suggesting that aeration or mixing is a successful control method for Eurasian watermilfoil or curlyleaf pondweed. As discussed above, Eurasian watermilfoil and curlyleaf pondweed are rooted macrophytes that obtain >90% of their nutrients directly from the sediment and not the water column (Smith, C.S. and Barko, J.W. 1990; Barko, J.W. and Smart, R.M. 1986). TKPOA reviewed various state agency-recommended aquatic plant control management methods, including from California, Washington, Wisconsin, Michigan, Illinois, Vermont and New Hampshire, and found that aeration is not a recommended treatment method for aquatic invasive plant control (New Hampshire Department of Environmental Sciences 2008; Indiana Department of Natural Resources 2009; Gunderman 2014; Davidson 2015; Slagle and Allen 2016; Minnesota Department of Natural Resources 2017; Vermont Department of Environmental Conservation 2017; Wisconsin Department of Natural Resources 2017). Thus, while aeration can help reduce algal growth, this method has not been a demonstrated technology for the control of rooted plants.

3.7.3 Feasibility and Current Status

3.7.3.1 Cost

Cost estimates for a LFA system would depend on the company, the shape, depth, and total water volume proposed for treatment. A multi-year trial of the Clean-Flo technology
could be arranged for approximately $100,000. One estimate for LFA technology, extrapolated based on total area of the Tahoe Keys lagoons assumed comprehensive inclusion of LFA technology, not including supplemental bioaugmentation, would be around $1 million.

3.7.3.2 Environmental Impacts

There are few anticipated impacts associated with use of LFA technology. However, LFA technology is commonly accompanied by bioaugmentation – bacteria and enzyme treatments. The environmental impacts associated with additions of bacteria and enzymes to the lagoons would need to be evaluated, reviewed by resource agencies (e.g., CDFW), and permitted by LRWQCB, TRPA, and other regulatory agencies.

3.7.3.3 Current Status and Conclusion

Stakeholders are consulting with CleanFlo to experiment with LFA as an aquatic weed treatment method at other locations in the basin. TKPOA has submitted applications to TRPA and CDFW for the use of LFA as a means to reduce the potential for harmful algal blooms. LFA may be a helpful technology to employ alongside or following herbicide use to reduce the potential for algae blooms. However, at this time, negligible information supports use of this method to control invasive plants. This option will be considered in the future as a non-herbicide control method to possibly pursue in combination with herbicide application.

3.8 Diver Assisted Hand Pulling

3.8.1 Description

Diver-assisted hand pulling requires divers using specialized equipment to remove nuisance plants from the treated areas. Qualified divers or snorkel crews carefully dislodge rooted plants from the sediment and guide them into a suction device mounted on a floating platform or barge. Pulled plants are taken to the surface and trapped in a sieve on the barge. Water taken up by the process is returned some distance from where the diver is working. The sediment is not removed directly by this action. Pumps used to create the hydraulic suction are mounted on barges and the divers manipulate the suction hose to stay away from direct contact with the sediment. Typically, trapped plants are bagged and removed for disposal off site. A skilled diver can avoid removing non-target plants and most non-target animals (except those attached to the plants) making this a selective control method.

3.8.2 Effectiveness

Thorough operations can be extremely effective in removing all or nearly all viable plant propagules (as was demonstrated in Emerald Bay). However, the method is slow and quite labor-intensive. Hand-pulling is best used in small-scale removal projects in shallow water with small numbers of plants where the plants can easily be identified and reached.
In waters deeper than three feet, hand-pulling requires certified divers to reach and remove rooted plants. Success is dependent on the sediment type, visibility, and the proper identification of undesirable species.

3.8.3 Feasibility and Current Status

3.8.3.1 Cost

Diver-assisted hand pulling may range in cost from approximately $6,000-$12,000 per acre in Lake Tahoe, depending on hardness of substrate, density and type of plant (Thomas Hiuga pers. comm). One diver working six hours could potentially treat ¼ to ½ acre per day. Densely populated areas require more time and, therefore, cost more to treat. Labor time and costs for diver-assisted hand pulling in Lake Tahoe are greater than in most other locations due to the added human safety procedures required for diving at high elevations.

3.8.3.2 Environmental Impacts

Diver-assisted hand pulling is an environmentally friendly method of aquatic plant control. The process can increase turbidity, however common mitigation measures simply require that divers halt their operation until turbidity declines below thresholds established under permits for the control work. Diver-assisted hand pulling also has the potential to create plant fragments that are hard to capture and remove. Plant fragments and plant propagules/turions not captured can re-infest the treated area quickly.

3.8.3.3 Current Status and Conclusion

Due to the time and costs associated with diver-assisted hand pulling, the method is not a feasible alternative for large-scale treatment of the aquatic weed problem in the Tahoe Keys lagoons. Diver assisted hand pulling will be utilized as follow up and maintenance after primary control takes place in the herbicide demonstration areas.

3.9 Ultra Violet Light

3.9.1 Description

Ultra Violet (UV) light is an experimental method of control for aquatic macrophytes still in the early stages of testing. The method involves exposing plants to prolonged periods of intense UV light, which appears to damage the cell structure and DNA of plants. TRCD, with a contract to the private engineering firm, Inventive Resources Inc., launched an experimental pilot UV light project in Lakeside Marina at the end of June 2017. The project involved using a specially-made boat fitted with a drop-down panel of UVC lights to treat roughly 0.4 acres of the marina. Initial bench testing has shown positive results, but larger scale tests are still needed to determine the long term efficacy of the method.
3.9.2 Environmental Impacts

UV light has known detrimental effects on cell structure, DNA integrity, and can increase the frequency of and rate of mutations in biological organisms. However, potential impacts from proposed operational uses that require exposure to aquatic plants have not been determined or investigated to date on non-target organisms such as invertebrates, fish, and desirable, native plants and algae. The risk from increased mutation rates in exposed organisms, including invasive aquatic plants, found in the lagoons has not been investigated to date. Furthermore, the potential physio-chemical reactions of proposed UV energy and wavelengths with organic water constituents in the natural waters is unknown. Thus, the scope of potential environmental impacts from operational use of UV light exposure is unknown at this time.

3.9.3 Feasibility and Current Status

TKPOA is tracking the TRCD UV study with interest and will reference the study and its status as a potential aquatic weed plant management strategy in the Tahoe Keys lagoons in its annual update to the TKPOA IMP. TRCD plans to release a report describing the results of the pilot test, including on its effectiveness, following additional monitoring taking place within the pilot study area in 2018. TKPOA maintains an interest in pursuing UV light as a follow-up treatment method to herbicides pending additional studies demonstrating its feasibility and analyzing its environmental impacts. Cost per acre of treatment and its particular feasibility within the environment of the lagoons must also be addressed and analyzed.

3.10 Biological Controls

3.10.1 Description

Biological control means the use of one or more live organisms to suppress a population of a target pest. Typically, herbivores or pathogens found in the native range of the target pest are examined for potential use to control the target. The criterion for release of a control organism, whether an insect or pathogen, is the presence at the treatment site of strict host specificity, so that the control organism does not have an effect on other non-target species. Strict federal and state guidelines and review processes ensure that biological control agents are safe for introduction. In many areas, introduction of non-native species are legally prohibited.

Several biological control methods have been used in research studies to impede the growth of non-native aquatic plants. The watermilfoil weevil (*Euhrychiopsis lecontei*) is native to North America and has been reported to feed and reproduce on both native Northern watermilfoil and non-native Eurasian watermilfoil. Water hyacinth weevils (*Neochetina eichhorniae* and *N. bruchi*) have been used to control populations of water hyacinth. There has been considerable research on the potential use of the fungal pathogen *Mycoleptodiscus terrestris* against Eurasian watermilfoil in laboratory settings.
Another biological control agent for aquatic plants is the herbivorous fish, grass carp or white amur (*Ctenopharyngodon idella*), a strict herbivore native to Asia. Grass carp have been widely used as biocontrol agents for aquatic macrophytes including Eurasian watermilfoil. Unfortunately studies have found that Grass Carp will feed on Eurasian watermilfoil only after other macrophytes (including natives) have been consumed by this species. As a result, grass carp are currently not recommended for Eurasian watermilfoil control by some agencies (Washington State Department of Ecology 2013). It is important to note that Grass Carp are not native to the Lake Tahoe region and are considered invasive in many regions of North America. In addition, Section 238.6 of the California Fish and Game Code prohibits stocking grass carp in a major drainage, or in waters having an open freshwater connection to other waters of the state, such as streams, rivers, lakes or reservoirs and, with a few exceptions, the Code prohibits stocking grass carp in waters within the 100-year floodplain. TKPOA has requested consultation with CDFW on the possible use of grass carp in the Tahoe Keys (Montalvo 2016), but was declined and referred to the conclusions of the Lake Tahoe Lakewide Implementation Plan (Wittmann and Chandra 2015).

3.10.2 Effectiveness

Biological control has the potential to suppress the growth of aquatic plants that impact water quality. If the biological control agent can maintain a low level of the host population, little need exists for additional inputs for the control system to keep functioning. The levels of aquatic plant control reported are variable, and, with the exception of grass carp, biological controls do not eliminate the plants completely.

3.10.3 Feasibility and Current Status

At this time, regardless of cost or effectiveness, no commercially or legally available biological control products for the invasive aquatic plants are authorized or available in the Tahoe Keys lagoons. Therefore, biological controls are not considered to be feasible and will not be investigated further.
<table>
<thead>
<tr>
<th>No</th>
<th>Control Method</th>
<th>Description</th>
<th>Effectiveness</th>
<th>Estimated Cost (not including monitoring and reporting costs)</th>
<th>Common potential environmental impacts</th>
<th>Feasibility</th>
<th>Potential use as a post-herbicide integrated control method?</th>
<th>Primary Reasons for Dismissal as a means for large scale treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bottom Barriers</td>
<td>Mats placed on the sediment to block sunlight and deter plant growth</td>
<td>Effective method of plant control at treatment site. Treated areas may remain largely weed free for up to two seasons.</td>
<td>$70,000 - $100,000 / acre for mat assembly, installation and removal</td>
<td>Minimal or no plant fragmentation expected. Localized short term turbidity increases during installation and removal. No plant control selectivity. Potential to smother macroinvertebrates.</td>
<td>Approximately 13 hours per acre for installation. No significant time required for permitting.</td>
<td>Seasonal installation and removal and targeted maintenance on individual mats as needed. Expectation that mat installation would be needed for 3-4 continuous seasons to successfully reduce plant biomass.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Rotovation</td>
<td>Large tines inserted into the sediment that dislodge roots</td>
<td>Questionably effective method of plant control for Eurasian watermilfoil with multiple studies showing mixed treatment results and some studies showing an increase in target nuisance species following rotovation. Several studies indicate that rotoverted areas have been recolonized successfully by curlyleaf pondweed.</td>
<td>$30,000 - $60,000 / acre for equipment mobilization and staging, deployment of turbidity curtains and actual rotovation. Does not include costs associated with environmental permitting or unforeseen mitigation costs associated with potential toxicity concerns.</td>
<td>Significant plant fragmentation expected. Significant increases in turbidity throughout the rotoverted area during and immediately following rotovation. Potentially longer-term water quality impacts associated with release of nutrients and contaminants settled in the substrate. No plant control selectivity. Significant disturbance of the benthic invertebrate environment expected.</td>
<td>Approximately two days per acre to rotovote, and up to a year to acquire the necessary permits.</td>
<td>One-time operation with expectation for plant re-growth within two growing seasons without follow-up treatment; potentially unusable to permit due to environmental impacts.</td>
<td>No</td>
</tr>
</tbody>
</table>
### Table 5. Summary of Potential Aquatic Invasive Plant Control Methods – Alternatives Considered + Herbicide Application (Cont.)

<table>
<thead>
<tr>
<th>Control Method</th>
<th>Description</th>
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<th>Estimated Cost (not including monitoring and reporting costs)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>3. Automated Plant Control Device (Weed Roller or Sweeper)</td>
<td>Rotating arm that drags along the sediment</td>
<td>Effective method of plant control at treatment site with weekly follow-up maintenance.</td>
<td>Between $52,000-$75,000/acre assuming a cost of $2,000 - $4,000 to purchase a sweeper or roller that can treat between 1,000 - 3,000 square feet. Does not include costs associated with installation, maintenance, permitting or fragment removal.</td>
<td>Significant plant fragmentation expected</td>
<td>Localized short term turbidity increases during operation anticipated</td>
<td>No plant control selectivity</td>
<td>Depending on the type of device, minor localized impact to benthic invertebrate environment anticipated</td>
<td>Approximately one week at each location to remove or kill plants. Once-a-week maintenance required thereafter. Potential time (up to a year) to acquire permits required for a weed roller.</td>
</tr>
<tr>
<td>4. Mechanical Cutting and Harvesting</td>
<td>Hydraulically operated boats with cutters and conveyance systems</td>
<td>Effective method of managing macrophytes for navigation, not effective as a control method for reducing aquatic weeds.</td>
<td>$2,900 / acre for cutting, harvesting, fragment collection and fragment disposal.</td>
<td>Significant plant fragmentation documented</td>
<td>Minor increases in turbidity and adjustments to nutrients in the water column due to plant removal</td>
<td>No plant control selectivity</td>
<td>Minor or no impacts to macroinvertebrates</td>
<td>Multiple acres in one day. Cutting and harvesting is an active management strategy used throughout the Tahoe Keys lagoon system each summer.</td>
</tr>
<tr>
<td>5. Dredging</td>
<td>Removing sediment from the lagoons</td>
<td>Potentially effective method of plant control for up to two seasons, however dredged areas may be colonized especially quickly by curlyleaf pondweed, potentially increasing the spread of this aquatic invasive in the basin.</td>
<td>$140,000 / acre to dredge, treat, and dispose of dredged material. Does not include costs associated with environmental permitting or unforeseen mitigation costs associated with potential toxicity concerns.</td>
<td>Little or no plant fragmentation expected depending on time of year that dredging occurs and dredging method</td>
<td>Significant increases in turbidity throughout the dredged area depending on type of dredging pursued. Potentially longer term water quality impacts associated with release of nutrients and contaminants settled in the substrate.</td>
<td>No plant control selectivity</td>
<td>Significant disturbance of the benthic invertebrate environment expected</td>
<td>Assume up to 1/2 acre per day could be dredged. Acquiring necessary permits would likely take a minimum of 2-3 years and possibly longer for large scale dredging.</td>
</tr>
<tr>
<td>Control Method</td>
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<tr>
<td>6. Circulation System/ Treatment Plant</td>
<td>Retrofitting the current system for nutrient reduction or water temperature cooling</td>
<td>No evidence indicating operation of the circulation system could successfully result in increased aquatic plant control.</td>
<td>~$9 million for retrofits, plus substantial energy and electric utility demand operational costs.</td>
<td>Fragmentation / spread of plants: Minimal or no plant fragmentation expected. Water quality impacts: No negative water quality impacts anticipated. Plant control selectivity: No plant control selectivity. Benthic macroinvertebrate impacts: No impacts to benthic invertebrates anticipated.</td>
<td>Feasibility: Not applicable. If operational the circulation system would be operated as many hours a day through the season as needed to achieve the stated goal of its operation. Maintenance expectations: Seasonal operation on selected days and times. Targeted maintenance of the circulation system and treatment plant as needed to ensure proper function.</td>
<td>No</td>
<td>Lack of efficacy and high cost</td>
<td></td>
</tr>
<tr>
<td>7. Aeration or Mixing</td>
<td>Use of circulation pumps to oxygenate the water column (including Solar Bee types)</td>
<td>Lack of evidence indicating aeration can treat reduce aquatic plant growth.</td>
<td>Approx. $100,000 for small experimental test in the Tahoe Keys to install, monitor and maintain diffusers, compressors and other needed equipment. Costs do not include use of accompanying bioaugmentation products.</td>
<td>Fragmentation / spread of plants: Minimal or no plant fragmentation expected. Water quality impacts: No negative water quality impacts anticipated. Plant control selectivity: No plant control selectivity. Benthic macroinvertebrate impacts: No impacts to benthic invertebrates anticipated.</td>
<td>Feasibility: If laminar flow technology is employed in the Tahoe Keys and found to be helpful, the technology may remain in place, with maintenance and replacement as needed, for an indefinite number of years. Maintenance expectations: Continuous annual operation with routine maintenance of technology to ensure function.</td>
<td>Yes</td>
<td>Lack of proven efficacy as a control method for macrophytes</td>
<td></td>
</tr>
<tr>
<td>8. Diver Assisted Hand Pulling</td>
<td>Divers selectively pull out invasive plants and guide them into a suction device mounted on a floating platform or barge</td>
<td>Effective method of plant control at treatment site. Treated areas may remain largely weed free for one to two seasons.</td>
<td>$6,000-$12,000/acre depending on density of plants and hardness of substrate. Does not include permitting costs.</td>
<td>Fragmentation / spread of plants: Some minor fragmentation expected. Water quality impacts: No negative water quality impacts anticipated.</td>
<td>Feasibility: An experienced diver assisted by a suction device could potentially treat a few hundred square feet per day. Maintenance expectations: One-time treatment in targeted areas with expectation for plant re-growth within one-two growing season.</td>
<td>Yes</td>
<td>Time prohibitive at a large scale (beyond several acres)</td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Summary of Potential Aquatic Invasive Plant Control Methods – Alternatives Considered + Herbicide Application (Cont.)
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<tr>
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<tr>
<td>9. UV Light</td>
<td>High intensity UV light that damages the cell structure of plants prohibiting growth. Initial pilot in Lakeside Marina looked promising from an aquatic plant control perspective. Pilot still under study as of June 2018.</td>
<td>9. UV Light</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
<td>~ $500/acre, for test-scale application of Procellacor, endothall and triclopyr and application of RWT dye to track herbicide dispersal. Cost estimate includes materials, labor and equipment. Does not include permitting or monitoring costs.</td>
<td>No plant fragmentation expected.</td>
<td>No negative water quality impacts anticipated.</td>
<td>Herbicides are selected according to the target species. Herbicides have been shown to have little or no effect on native Elodea.</td>
</tr>
<tr>
<td>10. Biological Controls</td>
<td>Use of introduced organisms that feed on or otherwise deter the growth of aquatic plants.</td>
<td>10. Biological Controls</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
<td>~ $500/acre, for test-scale application of Procellacor, endothall and triclopyr and application of RWT dye to track herbicide dispersal. Cost estimate includes materials, labor and equipment. Does not include permitting or monitoring costs.</td>
<td>No plant fragmentation expected.</td>
<td>No negative water quality impacts anticipated.</td>
<td>Herbicides are selected according to the target species. Herbicides have been shown to have little or no effect on native Elodea.</td>
</tr>
<tr>
<td>Herbicide Application (Procellacor, Endothall and Triclopyr)</td>
<td>Applied to the water in dry or wet form by a licensed applicator.</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
<td>Demonstrated method of targeted plant control at treatment sites for at least a season.</td>
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<td>~ $500/acre, for test-scale application of Procellacor, endothall and triclopyr and application of RWT dye to track herbicide dispersal. Cost estimate includes materials, labor and equipment. Does not include permitting or monitoring costs.</td>
<td>No plant fragmentation expected.</td>
<td>No negative water quality impacts anticipated.</td>
<td>Herbicides are selected according to the target species. Herbicides have been shown to have little or no effect on native Elodea.</td>
</tr>
</tbody>
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Note: Shaded rows represent alternatives that were not evaluated in further detail due to legal infeasibility (Biological controls) or insufficient information (UV light).
4.0 MONITORING AND REPORTING PROGRAM

This section describes the pre- and post-treatment monitoring methods, informational goals of the monitoring, duration of the monitoring, quality assurance practices that will be used, and reporting requirements. Monitoring and reporting for Phase I will include tracking the herbicide concentration and movement and herbicide degradants. Monitoring for all phases will include evaluation of water quality parameters, and evaluating effects on target plants and non-target species.

4.1 Monitoring

In order to track the efficacy of the herbicide treatments and how long the herbicides remain active in the treatment area, a detailed monitoring program has been developed for all the phases of the Project.

4.1.1 Phase I Monitoring

The monitoring program for the proposed herbicide validation study (Phase I) has the following objectives:

- Determine the target and non-target plant occurrence and abundance within the Tahoe Keys lagoons, particularly within the treatment sites.
- Determine the movement and dissipation of herbicides from the treated site following applications.
- Determine compliance with water quality parameters such as dissolved oxygen, pH, temperature, turbidity, and concentration or residue levels of herbicides and their degradants inside and outside the treatment sites.
- Determine the efficacy and relative selectivity of herbicide treatments.

For Phase I, monitoring for herbicide active ingredient and water quality parameters will take place at approximately 20 locations within the Main Lagoon as well as an additional 4 monitoring stations in Lake Tahoe near the lagoon entrance, and to the east and west of the west channel. The proposed monitoring locations for collecting data within the West Lagoon are shown in Figure 9. Adjustments in numbers and locations may be made prior to herbicide application based on environmental factors. Herbicide residue is not anticipated to move more than 1,000 feet from the application sites based on previous dye studies conducted within the lagoons (Anderson 2011, 2016). However, the comprehensive and extensive monitoring program has been designed to provide further data on herbicide movement within the Keys Lagoons and to ensure that no herbicide residue reaches Lake Tahoe. All samples will be taken in duplicate following Good Laboratory Practices (GLP).
4.1.2 Phase II Monitoring

Phase II monitoring will follow the same monitoring protocols as Phase I. However, monitoring stations will be set up as indicated in Figure 9. During Phase II degradants will not be tested for and tracked. Monitoring protocols for Phase II may be altered based on information obtained from Phase I of the Project. A detailed monitoring plan will be provided in the APAP for Phase II.

Samples will be taken 72 hours after treatment and then once weekly until levels for the herbicide active ingredient are non-detect. In situ water quality measurements will be taken three times per week to track water quality throughout the course of treatment. Plant species and abundance will be monitored according to Section 4.1.5: Monitoring Aquatic Plant Populations.

4.1.3 Phase III Monitoring

Phase III monitoring will primarily be focused on tracking aquatic plant populations to determine the necessary follow up treatments needed for control. This phase will prioritize the use of non-herbicide control methods such as bottom barriers, diver assisted removal, and UV light (if available). In areas where herbicides are used, monitoring will follow the same protocols set forth for Phase II of the Project at the stations indicated in Figure 9.

4.1.4 Record Keeping

Detailed records of each herbicide application will be created and the records of application and monitoring will be maintained by TKPOA. Information for each application will include:

- Date of application
- Location of application (treatment sites)
- Name of Applicator
- Type and amount of aquatic herbicide used, with supporting calculations for target concentrations
- Application and site details: area, water depth, water volume, method of application, start and finish time, and rate or concentration of aquatic herbicide applied
- Visual monitoring assessment
- Certification that the applicator followed the APAP (Appendix B)
4.1.5 Monitoring Aquatic Plant Populations

4.1.5.1 Pre-Treatment

Toward the end of the growing season and prior to the treatment year, TKPOA will conduct final seasonal hydroacoustic and point-sampling surveys (Madsen 1999) to determine the extent and composition of aquatic plants in the Keys lagoons. Prior to herbicide application, plant surveys, including point sampling, will be conducted in the spring of the same year to confirm growth stages of the target plants and their relative abundance. Data collection will include digital photos to aid in documenting effects on both the target plants and non-target plants. The combined survey information from the two seasons will determine the appropriate herbicides to use at each site.

4.1.5.2 Post-Treatment

Hydroacoustic surveys will be conducted every two weeks starting in spring of the treatment year and continuing until mid-October. Additionally, point surveys will be conducted according to the schedule shown in Table 6 to determine both native and
non-native species absence and presence. For Phase I, results in the treatment sites and untreated control sites will be compared to determine the efficacy of the aquatic herbicide treatment, non-target effects, duration of control, and level to which native and non-native aquatic plants re-establish in the habitat. For Phases II and III, treatment sites will be assessed to determine the level of efficacy of the prescribed treatments and determine what follow up actions, if any, are needed for the following year.

4.1.5.3 Methods: Hydroacoustic Sampling

Hydroacoustic scans will be made along two parallel transects in each herbicide-treated area and, for Phase I, in similar untreated control sites. The scans provide an estimate of biovolume and plant canopy height. Canopy height will be reported as the estimated vessel hull clearance, or the depth of the water that allows unimpeded passage of boats. Vessel hull clearance is one of the measureable objectives used for the Project. This metric, as well as biovolume and relative abundance of plants, forms the basis to determine efficacy of the herbicide applications compared to baseline levels.

4.1.5.4 Methods: Point Sampling

To determine relative abundance and presence or absence of plants, physical point samples will be taken at 100 to 200-foot intervals along the same transects as the hydroacoustic sampling (Madsen 1999). An example of proposed sampling transects is shown in Figure 10. Along each transect, samples will be taken mid-channel and at approximately right angles toward the shore within 3 to 6 feet of the edge of the shore and at 2 to 4-foot depths. Figure 11 provides an example of the total array of plant sampling points. In less linear sites, transect contours will follow shoreline shape, but will still include mid-channel and areas near piers and floating docks.
Figure 10. Example of Plant Sampling Transects

Figure 11. Example of Point Sample Array
4.1.6 Monitoring Water Quality Parameters

Water quality will be monitored throughout the entire project in order to track the changes, if any, which occur due to the control of aquatic plants in the lagoons. Monitoring will be conducted for herbicide active ingredients, degradants (Phase I only), and in situ parameters.

4.1.6.1 Herbicide Monitoring

Water samples will be tested for herbicide residues using Enzyme Linked Immuno-Sorbent Assay (ELISA) or gas chromatograph testing. Samples taken in Phase I for herbicide degradants will be analyzed by EPA approved methods using a certified laboratory.

For Phase I of the Project, sampling stations will be established for herbicide active ingredient at three locations within each treatment site: one mid-site and one on each side of the site. Three sampling locations will be established outside the treated site at approximately 100-foot linear intervals. The provisional locations of sampling sites are shown in Figure 9. This sampling protocol will be followed at all 12 sites. However for the “within treatment site sampling”, only one set of samples will be analyzed for each type of herbicide. The unanalyzed samples from the other replicate treatments will be maintained and preserved frozen and archived as a contingency for later analysis. Archived samples will be analyzed if there is a loss of sample(s) from sites chosen for complete sample analysis, and/or to confirm mid-level and end (non-detect) residue levels times based on the results from sites where full analysis were made. Samples for all “outside edge” sample stations will be analyzed to determine if there is movement of the active ingredient from treatment sites.

For Phases II and III, sampling stations will be set up based on the total area treated that year. There will be at least one station inside the treated area and one outside of the treated area.

For Phase I, in addition to sampling locations within and near (but outside) the application sites, sampling stations will be established in the following areas: immediately adjacent to (and on the lagoon side of) the West Channel; at the mouth of the West Channel; and, to the east and west of the West Channel. Samples will also be taken at the three TKPOA water wells according to the schedule shown in Table 6. In the unlikely event that herbicide residues are detected within the West Channel, then additional contingency sampling will be conducted at sites 0.25 mile to 0.5 mile intervals extending from the channel in three directions: East, West and North (Figure 12). No monitoring for herbicides will be conducted in the control sites.

For Phase I, water samples for herbicide active ingredient analysis will be taken pre- and at the following post- application intervals: 6-hours, 24-hours, 72-hours, 7 days, 14 days and 30 days. Thereafter, sampling will continue at 60 days, 90 days, and 120 days, as needed, until herbicides are no longer detectable at any of the corresponding sampling stations. See Table 6 for summary of sample numbers and intervals for Phase I. Phase
II sampling will take place pre- and at the following post-application intervals: 24-hours after treatment and then once weekly until active ingredient levels are non-detect. Phase III sampling, where necessary, will follow the same schedule as Phase II. Sampling protocols and sites for Phase II and III of the Project may be altered based on information obtained from Phase I. A detailed monitoring plan including monitoring sites and schedule will be provided in the APAP for Phase II.

In the unlikely event that residues above those allowable by US EPA are detected in samples, or if at any time residues are detected adjacent to the West Channel, the sampling will continue an additional six days.

Water samples taken pre- and post-herbicide application will be collected at the surface (15-25 cm below surface), mid-depth, and 25-30 cm from the bottom for 6-hours, and 24-hours. Starting at 72-hours samples will be taken at mid-depth only. It is anticipated, based on past dye studies, that by this time the water column will have undergone complete vertical mixing and there will be no stratification of herbicide. Pre-application samples will be taken within 24 hours before applications are made. All samples will be documented and handled according to prescribed methods (EPA 2013, 2016a, 2016b).

For Phase I, water samples taken for degradant analysis will be collected from one site for each herbicide (total of three sites) at three stations within the treatment area and three stations outside the treatment area as described for the active ingredient sampling. Samples will be taken pre- and at the following post-application times: 24 hours, 72 hours, and 14 DAT. Sampling will continue at 30 and 60 DAT if detected in the prior sampling. Additionally, samples will be taken for degradant analysis from Lake Tallac at 14 DAT to confirm levels found in the Main Lagoon samples.
Figure 12. Additional Contingency Monitoring Stations for Phase I

*Samples for Herbicide will only be taken at these sites if herbicide residues are detected within the West Channel.
<table>
<thead>
<tr>
<th>Number of Samples, Time/Frequency of Sampling</th>
<th>Number of samples: Inside/Outside Herbicide site</th>
<th>Pre- Herbicide Applications</th>
<th>6 hr.</th>
<th>24 hr.</th>
<th>72 hr.</th>
<th>7 DATs</th>
<th>14 DAT</th>
<th>30 DAT</th>
<th>60 DAT</th>
<th>90 DAT</th>
<th>120 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide^1 (water)</td>
<td>3/3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>(X)^3</td>
<td>(X)</td>
<td>(X)</td>
</tr>
<tr>
<td>Herbicide degradant(s) (Phase I only)</td>
<td>3/3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>(X)</td>
<td>(X)</td>
<td>(X)</td>
<td></td>
</tr>
<tr>
<td>Herbicide (sediments)</td>
<td>3/3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Water Quality^2 (suite of variables)</td>
<td>3/3</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Biovolume (Metric: Biomass surrogate for Percent Control)</td>
<td>Continuous</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy height (Metric: Vessel Hull Clearance)</td>
<td>Continuous</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Species; point intercept transects (Metric: Target and beneficial plant frequency of occurrence)</td>
<td>20-24/20-24</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhodamine WT^4</td>
<td>Continuous (flow-through system)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Well Water: (Herbicides and RWT dye)</td>
<td>TKPOA Well Head: Duplicate samples per event; total= 16 samples</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1: *Surface, Mid-depth, and Bottom*
2: *DO, Temperature, pH, Redox, turbidity (Surface, mid-depth, 15-20 cm from bottom)*
3: ( ) = Contingency sampling: only sampled if prior sample is positive for "detection" of herbicide
4: RWT will be injected and monitored at one representative site for each herbicide used at the sites closest to the West Channel
5: DAT – Days After Treatment
6: Starting at 72 hours, all samples will be taken at mid-depth only
4.1.6.2  *In situ* Measurements for Other Water Quality Parameters

At three locations within each application site (one mid-, two near-shore), pre- and post-application, real-time water quality sampling will be conducted using a calibrated, logging device for the following parameters: dissolved oxygen, redox, pH, temperature, turbidity, and conductivity. Sampling will continue for 30 days after applications in treatment sites and at untreated control sites with similar characteristics. Real-time monitoring will take place three days each week, at mid-day, and at mid-depth of the water.

4.1.6.3  Monitoring Records

All monitoring activities and results will be recorded in both hard copy and digitally, and will include:

- Date, time, and GPS referenced location
- Name of individual performing the sampling and/or measurements
- Dates analyses were performed
- Laboratory and/or individual who performed analysis
- Results of real-time measurements and other sampling analyses

4.1.6.4  Sample Methods and Guidelines

This section describes methods and guidelines for obtaining samples to ensure consistency in sampling activities and reliability of the data obtained.

4.1.6.4.1  Sample Collection

Samples will be taken both within and outside treatment sites and, for Phase I, inside representative, untreated sites in a manner to provide a basis for comparing pre- and post-application conditions and to compare conditions in treated and untreated sites. Sampling for herbicide residues will be done using a battery powered, bilge pump system connected to flexible hose so that sample depth can be adjusted according to monitoring protocols. Between sampling stations and between separate depths, flow will be continued for 30 seconds to ensure that the water at the prescribed depth is correctly collected.

Samples will be placed in pre-labeled bottles and each label will document the date and time of sampling and be coded for location by site and station position. Durable labels and marking ink will be used.

4.1.6.4.2  Field Sampling Equipment

When taking water quality samples for analysis, a sampling kit will be prepared and utilized for the event. Each sampling kit will consist of the following:
Proper sampling bottles with required preservative (if necessary)
Appropriate sampling devices
Non-powdered plastic or nitrile gloves
Back up portable GPS unit
Field collection forms
Sample labels and appropriate permanent marker pens
Chain of Custody (COC) forms
Plastic storage bags for samples and COC forms
Ice packs and/or dry ice and insulated container for sample bottles

4.1.6.4.3  Procedures to Prevent Sample Contaminations

Vessels and personnel used to apply aquatic herbicide will not be used to collect monitoring samples. Personnel responsible for sample collection and monitoring will not be allowed to handle or come in contact with personal protective equipment (PPE) used by applicators and with anyone handling aquatic herbicide containers. During prescribed sampling, sampling equipment will be washed between treatment sites and separate sampling gear will be used for un-treated control sites than treated sites during Phase I. Sampling personnel will put on new gloves between sites and before the next round of sampling begins. Any actions that may compromise a sample or sampling event will be logged, explained, and signed by the person directing sampling at the time of the event.

4.1.6.4.4  Field Sampling Record Keeping

All sample actions will be documented in field log books that record each sample date, time, and coded location (by site and station). At the conclusion of the sampling period, the primary sampling staff will sign and date the page on which the records were written.

4.1.6.4.5  Sample Equipment Cleaning

All sampling equipment will be washed with clean tap water between sampling stations and events. The sampling system will be flushed for one minute with clean tap water between sampling stations and separate sampling systems will be used for the untreated control sites and the herbicide-treated sites during Phase I.

4.1.6.4.6  Sample Preservation

As necessary, water sample bottles will be immediately placed in coolers on ice or dry ice and kept out of sunlight until transferred to cold (frozen or refrigerated) storage or shipped for analysis. The specific preservation methods will be tailored to fit the EPA recommended protocol for each type of active ingredient. If delays in shipping are necessary, samples will be frozen and will be shipped frozen by overnight mail or will be physically picked up and delivered for analysis at certified laboratories.
4.1.6.4.7 Sample packing and shipping

All samples will be shipped, as is necessary, to a certified laboratory for analysis either the day of sampling or at prescribed intervals thereafter.

4.1.6.4.8 Sample Preservation and Transportation

As necessary and as noted above, samples will be shipped frozen with either ice packs or dry ice and required labeling for shipping.

4.1.6.4.9 Chain of Custody

At collection, shipping, storage, and at any transfer of samples, COC forms will accompany samples and will list the sample identification (code), number of samples, and signatures from both the recipient and provider of the samples. A copy of the COC forms will be retained by TKPOA in secure files on TKPOA property.

4.1.6.4.10 Laboratory Quality Assurance and Quality Control (QA/QC)

All laboratory analyses will be performed by a laboratory certified by the US EPA Code of Federal Regulations (CFRs), specifically title 40 CFR section 136, as specified in the Statewide General NPDES Permit. Furthermore, labs will also be certified by the SWRCB through the Environmental Laboratory Accreditation Program (ELAP). Laboratory precision and accuracy will be monitored and documented by a series of laboratory generated quality control samples. For samples analyzed by immunoassay, a separate set of coded duplicate samples will be analyzed in the alternative, by equally or more sensitive methods. These confirmation samples will represent 5% of total samples taken during a treatment season.

4.2 Reporting

In addition to the extensive monitoring described above, regular reporting will take place to continue the transparent management process that the TKPOA has been employing.

4.2.1 Reporting Procedures: Interim Reports, Year-end Reports, and Record Retention

Interim progress reports will be provided to LRWQCB by August 30 and October 30 of the herbicide application year. A final report for the reporting period of January 1 to December 31 will be prepared and submitted to the LRWQCB by March 1 of the following year.

The interim progress reports will contain a summary of results with a narrative and supporting tables, graphs, and charts that summarize monitoring and efficacy data collected. These reports will describe any problems that occurred during the treatment
and will propose solutions, as appropriate, to ensure that all measures for the protection of water quality are in place.

Year-end reports will contain an executive summary that discusses overall results, issues concerning compliance challenges, and effectiveness of the APAP. The report will summarize all monitoring data collected, and will describe any changes or improvements documented in water quality as a result of the use of the aquatic herbicides. All BMPs used will be described and recommendations will be given for improvements. It will also include a map showing location of each herbicide application and sampling locations. The amount and type of aquatic herbicide used will be described and the report will include a summary of the aquatic herbicide application logs.

### 4.2.2 Site Restoration and Biological Monitoring

In addition to reporting water quality parameters, TKPOA will report the progress of restoration of non-target species in the project area through the annual aquatic macrophyte survey. This survey is a requirement of the WDRs issued to TKPOA, which assesses and reports on the biovolume of aquatic plants and the composition of the aquatic plant populations in the lagoons. Pre-application levels of native, non-target plants in the treatment areas will be compared to post-application levels of these plants. Plant populations in areas not treated with aquatic herbicides will serve as controls or reference sites to determine the level of herbicide effectiveness and restoration.

The herbicides proposed for this demonstration project do not physically or chemically impair the benthic habitat and thus facilitate the growth of desirable native rooted plants, invertebrates, and normal functioning of the microbial populations once the invasive and nuisance aquatic plant population have been reduced. No testing of hydrosoil or sampling for benthic macroinvertebrates is proposed as part of the project, but will take place the year following the application of herbicides.

### 4.3 Peer Review Panel

In accordance with the Lahontan Basin Plan, the monitoring and reporting program will be submitted to a panel of independent experts for review. As stated previously, some of the members participated in review of the IMP but were not involved in the writing of the exemption application or the associated monitoring and reporting program.

The proposed members of the peer review committee consist of:

- Dr. Joe DiTomaso,
- Dr. Kurt Getsinger,
- Mr. Joel Trumbo,
- Mr. Mike Blankinship,
- Dr. John Madsen,
- Mr. Edward Hard,
- Ms. Angela Llaban, and
- Dr. John Rogers
Below are the qualifications for the above listed individuals that support TKPOA’s decision to include them as part of the Peer Review Committee.

Dr. DiTomaso is a professor of Plant Science at the University of California, Davis and was previously the Chair of the UC Davis Plant Science Department. Dr. DiTomaso has 30 years of experience including research in wildland, riparian, and aquatic weed management methods.

Dr. Getsinger is a current lead research scientist for the Chemical Control Team for the USACE, located out of Vicksburg, Mississippi. His qualifications for inclusion to the Peer Review committee include 35 years of laboratory and field research experience on aquatic weed control methods, including herbicide uses and assessments of efficacy.

Joel Trumbo is a Fisheries Scientist with the California Department of Fish and Wildlife with 25 years of experience in uses of aquatic herbicide, aquatic weed environmental impacts as well as the training of staff on aquatic herbicide uses, regulations and protocols.

Mike Blankinship is the CEO of Blankinship and Associates in Davis, California. He has 20 years of experience as the head of an environmental consulting company with special focus on Environmental Impact Reports (EIRs), aquatic and riparian plant control practices and regulatory matters related to use of aquatic herbicides.

Dr. Madsen is currently a research biologist with the USDA-ARS. He has 30 years of experience including quantitative assessment of aquatic plant communities, efficacy of invasive plant management in the field, and management impact on non-target plant species and has also conducted trials utilizing various aquatic plant control management techniques.

Edward Hard is the Chief Environmental Program Manager for the California State Parks Division of Boating and Waterways, Aquatic Invasive Species Unit. He has 24 years of experience in the natural resource protection, water management, stewardship, community governance and land use planning fields.

Angela Llaban is the Senior Environmental Scientist for the California State Parks Division of Boating and Waterways, Aquatic Invasive Species Unit. Ms. Llaban has experience including operational aquatic plant management and operational programs on private as well as public waters.

Dr. Rogers is the Director of the Ecotoxicology Program at Clemson University. Dr. Rogers has 40 years of experience in biology and management of algae, aquatic environmental toxicology and general aquatic plant management approaches and their impacts.

Based on the above qualifications, TKPOA believes that the peer review group fulfills and exceeds the range of experience and expertise required to fully consider and advise on the biological and other monitoring aspects of the Basin Plan Amendment requirements for the proposed Project.
5.0 BEST MANAGEMENT PRACTICES

The prevention and contingency actions for the proposed project are multilayered and are based, in part, on the results of previous studies monitoring RWT dye releases in the lagoons (Anderson 2011, Anderson 2016). These studies showed that dye placed in the dead-end coves before early summer (early June) is not likely to reach the area south of the West Channel during typical snowmelt runoff periods when Lake Tahoe is filling. Once Lake Tahoe begins receding, the dye slowly migrates towards the West Channel, but is highly diluted by the large volume of water immediately south of the West Channel.

Several BMPs are proposed to ensure that no herbicides will reach Lake Tahoe proper. The BMP categories are prevention, containment, communication, and treatment. Together, these BMPs constitute a thorough and complete program that ensures the protection of the beneficial uses of Lake Tahoe and the waters within the lagoons.

5.1 Prevention

To prevent accidental spills, TKPOA has established the following guidelines to ensure that all aquatic herbicides are used in a safe, effective manner:

- Applications will only be made by QALs from the CalEPA-DPR.

The discharger, TKPOA, will hire the trained applicators. Applicators must demonstrate annual training in the safe handling, mixing, application, storage, and transport of aquatic herbicides. The staff working under the direction of the QAL must demonstrate knowledge on proper equipment loading, selection of application equipment, instrument calibration, and proper use so that the potential for spills is minimized and the precise application rates are used according to the label.

As a condition of contract, TKPOA shall receive written documentation and verification of training of the applicator and any staff used in this project. These documents will be in possession of the TKPOA before any application is made and will be made available to staff of the LRWQCB at least 30 days before applications are made.

- Applicator and staff will follow all instructions, precautionary steps, and appropriate handling procedures for each herbicide according to its label and in accordance with regulations and conditions of the EPA, CalEPA, LRWQCB, and TRPA.
- Applicators will mix only the amount of herbicide needed for each site.
- Application equipment (hoses, connections, pumps) will be inspected for proper function before herbicides are loaded on board.
- Applicators will have training in the use of and on-board access to absorbent materials.
- Spills, if they occur, will be isolated and the area cleaned according to label instructions. All spill equipment and materials will be properly disposed of in a manner consistent with federal and state requirements.
In the event of a spill into the water, LRWQCB will be notified immediately and the location will be documented and geo-referenced with GPS location information and time of spill.

To ensure the proper use rate, the Applicator or designated staff will perform site inspections and review plant surveys to confirm the species present and assess site conditions. Only if conditions are suitable and plant conditions appropriate will the application be made. No applications will be made outside the West Lagoon and no applications will be made directly adjacent to the West Channel that connects the Tahoe Keys West Lagoon with Lake Tahoe proper.

Sudden decreases in dissolved oxygen can lead to inadvertent fish kills. The proposed sites for Phase I are well separated and together constitute approximately only 8% of the total infested surface area of the Tahoe Keys lagoons, so the vast majority of fish habitat will not be treated. Phase II sites are also limited in area to help prevent indirect fish kills. All precautions provided on the label regarding potential indirect fish kills will be followed, including limiting the total area to be treated so that precipitous declines in dissolved oxygen do not occur. DO levels will be monitored at mid-water and bottom water zones in the treated areas three times per week for 30 days following herbicide applications.

5.1.1 **Containment**

West Channel: An air-driven bubble curtain will be in place across the West Channel and operational prior to application of aquatic herbicide in the treatment areas. The bubble curtain will remain in operation at least until the following criteria are met.

1. Bubble curtain to remain operational for a minimum of 14 days after last application of herbicides, and will only be turned off if the following conditions are met:
   a. No herbicide residues are detected within 500 feet of the actual application site.
   b. No herbicide residues are detected within 200 feet of the West Channel.

2. After discontinuing the bubble curtain, monitoring for herbicide residue (if any) will be conducted weekly for three weeks 100 feet from the West Channel (100 feet inside the West Lagoon).

5.1.2 **Communications**

The TKPOA will continue open and transparent communications with all regulatory agencies and stakeholders throughout the duration of the project. For specific communication plans, please see Chapter 6: Communication Plan.

5.1.3 **Rhodamine WT Dye Tracking**

RWT dye will be applied during the applications in the coves or other sites nearest to the West and/or East Channel. The dye will be tracked to determine if dye is moving toward
the channel. RWT dye may be injected at the location of other known herbicide residue locations to assist in determining movement and dissipation.

5.1.4 Herbicide Residues

Water samples will be taken pre- and post-herbicide application to determine levels of active ingredients (see Section 4 above for the Monitoring and Reporting Program). In the event herbicide residues are detected near the West and/or East Channel, additional sampling and monitoring will take place.

5.2 Contingency Measures

5.2.1 Well Water Treatment

If monitoring detects herbicide residues at the Tahoe Keys Water Treatment facility, then TKPOA operators will be instructed to only use Well No. 2 for water supply, which is equipped with charcoal filters. Charcoal filters remove herbicides and other chemicals and will treat the potable water before entering the distribution system for the Tahoe Keys. Additional water demand will be met under the Mutual Aid Agreement with South Tahoe Public Utility District using the existing water system connection.

5.2.2 On-site Treatment: Mobile Filtration System

A mobile filtration system will be rented and placed on standby for possible use to treat localized areas if herbicide residues exceed allowable label use. The mobile filtration system will also be available to treat groundwater supplies if needed to support Well 2’s treatment system.

A summary of containment and contingency actions to protect the West Lagoon and public water supplies is given in Table 7.
### Table 7. Summary of Contingency Measures

<table>
<thead>
<tr>
<th>Actions:</th>
<th>Commentary:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Air-driven bubble curtain</td>
<td>An air-driven bubble curtain will be in place across the West Channel and operational prior to application of aquatic herbicide in the treatment areas.</td>
</tr>
<tr>
<td>2 Monitor Rhodamine WT Movement</td>
<td>At selected application sites, Rhodamine WT dye will be injected with application of herbicide to facilitate tracking in the Tahoe Keys lagoons.</td>
</tr>
<tr>
<td>3 Monitor Herbicide Residues</td>
<td>All treatment sites and adjacent receiving waters will be monitored, including the West Channel</td>
</tr>
<tr>
<td>4 Communications</td>
<td>Trigger: herbicide residue detected within 500 feet of West Channel.</td>
</tr>
<tr>
<td>LRWQCB and Water Purveyors</td>
<td>Trigger: Residues detected at well intake. Filters will remove herbicide residue.</td>
</tr>
<tr>
<td>5 Well Water Treatment (Well No. 2) (Activated Charcoal) and STPUD water system connection.</td>
<td>Trigger: Localized residue exceeds maximum permitted by label. Pump/filter system</td>
</tr>
<tr>
<td>6 Mobile Filtration System</td>
<td>Trigger: Localized residue exceeds maximum permitted by label. Pump/filter system</td>
</tr>
</tbody>
</table>
6.0 COMMUNICATION PLAN

This section describes the communication and notification plan to be implemented before, during, and after the project. Potentially affected parties who may use ground or surface waters for any beneficial use will be notified and the record of such notifications will be maintained by TKPOA. Notification to potentially affected parties will include any water use restriction or precautions as described on the registered product label.

6.1 Tahoe Keys Property Owners and Residents

TKPOA will post notifications of intent to apply herbicides and directly contact homeowners in the application and treatment areas. These notifications will include:

- Notification of intent to apply herbicide
- Notification of ongoing herbicide application
- Notice of completion of herbicide application

These communications to homeowners will contain information regarding the restrictions related to each tested herbicide, as summarized in Table 8, and will also include other important information such as dates, times of applications, and date of the end of any water use restriction, if any, as applicable.

At the conclusion of each application, the results will be summarized in report format for the Water Quality Committee of the TKPOA and for the LRWQCB. Highlights of this report will be posted on the TKPOA homeowner website.

Table 8. Safety Classification, Use Restrictions of Proposed Aquatic Herbicides*

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Hazard Classification (OSHA) for QAL</th>
<th>Water Use Restrictions (from Product Label)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProcellaCOR™ EC</td>
<td>Hazardous: Eye irritant</td>
<td>• No restriction on consumption of or contact with treated water for recreational purposes, including swimming and fishing</td>
</tr>
<tr>
<td>(florpyrauxifen-benzyl)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trichlopyr Acetic Acid</td>
<td>Hazardous: Eye irritant</td>
<td>• Minimum setback of 800 feet from potable water intake required for 1.0 ppm rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No restriction on contact with treated water for potable use or by livestock, pets or other animals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No restriction on consumption of treated water for recreational purposes, including swimming and fishing</td>
</tr>
<tr>
<td>Endothall</td>
<td>Hazardous: Toxic if inhaled</td>
<td>• Minimum setback of 600 feet from potable water intakes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do not use treated water for animal consumption for 14 days after application at 2.0 ppm rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No restriction on contact with treated water for recreational purposes, including swimming and fishing</td>
</tr>
</tbody>
</table>

*Please see product labels, MSDS or equivalent documentation in Appendix D for complete information on safety classifications and use restrictions.
6.2 Water Purveyors

No direct surface water intakes are located adjacent to the Tahoe Keys lagoons. The nearest intake of surface water for potable use in Lake Tahoe is near Lakeside Marina, approximately four miles east of the Tahoe Keys West Channel. In addition to the surface water intakes, there are two ground water purveyors, Tahoe Keys Water Company and Lukins Brothers Water Company, with wells located within or near the application sites that draw water from 150 to 430 feet below the ground. Because of the groundwater flow patterns in this region, waters derived from the wells originate to the south/southwest, and do not include water that percolates from the Tahoe Keys Lagoons (Bergsohn 2015, URS 2016).

6.2.1 Pre-project Planning and Communication with Water Suppliers

Water purveyors in the Lake Tahoe area will be notified of the proposed herbicide use described in this application.

Due to the concerns of some water suppliers that divert raw water directly from Lake Tahoe, TKPOA will hold a workshop and informational meeting with representatives of Tahoe Water Suppliers Association (TWSA) at least 45 days before herbicide applications are made. Through TWSA members, water customers will be informed of the application plan and dates of application.

6.3 LRWQCB and Other Stakeholders

LRWQCB staff in addition to numerous other stakeholders including the TRPA, TWSA, League to Save Lake Tahoe, TRCD, Sierra Club, and the Lake Tahoe AISCC have been working continuously with the TKPOA on the IMP and this herbicide exemption application for more than three years. Multiple planning and review meetings have taken place to identify and document the concerns set forth by LRWQCB and other stakeholders.

Several official communications with the LRWQCB will take place throughout the duration of Phase I including:

- Supplying Applicator and associated staff training certifications at least 30 days prior to herbicide application
- Interim reports in August and October with a final report submitted by March 1 the following year
- Written notification within 24 hours in the event herbicide residue is detected within 500 feet of the West Channel
- Oral notification within 1 hour in the event of a spill with a written report of the incidence provided within 5 days

All other stakeholders will be notified either in conjunction with LRWQCB notification or within one week of official notification to the LRWQCB. An updated communication plan, based on the results of Phase I, will be developed and submitted to the LRWQCB and TRPA for approval before starting Phase II of the project.
6.4 General Public

Throughout the course of the IMP and NPS Plan developments, the TKPOA has been actively communicating and engaging the general public. An IMP website is maintained and regular press releases are supplied to local news outlets to inform the public on field activities, plan status, and herbicide exemption application activities. In addition, public meetings have been held to better inform the public and provide a forum for questions and answers.

During the course of the proposed project, TKPOA will continue its public outreach efforts using multiple media. The IMP website will continue to be updated with project information, and press releases will be issued at key points in the planning and permitting process so that the public can remain up to date throughout the course of the project. The IMP website is included below:

www.keysweedsmanagement.org

6.4.1 Pre-project General Public Communications

Because portions of the lagoons may be blocked off during application of the herbicides, which will restrict homeowner and rental boat access, TKPOA will design and carry out a homeowner, renter, and rental agency information campaign to give advance notice on the restrictions during the test period. This will include use of e-mails, flyers, direct correspondence by USPS, TKPOA’s periodical (The Breeze), and media. In addition, adequate signage will be displayed around demonstration areas to inform property owners and potential visitors about the project and current status of waterways.

Announcements and project summaries will be prepared and distributed a minimum of two months in advance, as well as two weeks prior to the start of any herbicide application.
7.0 CEQA, TRPA, AND REGULATORY COMPLIANCE

The table below outlines the anticipated permits, approvals and/or requirements associated with each of the aquatic invasive species control methods proposed as part of the Project.

Table 9. Anticipated Permits, Approvals, and/or Requirements

<table>
<thead>
<tr>
<th>Aquatic Invasive Species Control Method</th>
<th>LRWQCB</th>
<th>TRPA</th>
<th>CDFW</th>
<th>USACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide Treatment</td>
<td>• Basin Plan Pesticide Prohibition Exemption • NPDES Individual Permit • Antidegradation Analysis consistent with state and federal antidegradation policy</td>
<td>• Environmental Improvement Program (EIP) approval</td>
<td>• Section 1602 Lake Alteration Agreement</td>
<td>• NA</td>
</tr>
<tr>
<td>Bottom Barriers</td>
<td>• Up to 5 acres currently permitted under TKPOA’s WDRs</td>
<td>• EIP approval</td>
<td>• Section 1602 Lake Alteration Agreement</td>
<td>• Nationwide Permit</td>
</tr>
<tr>
<td>Diver Assisted Removal</td>
<td>• Currently permitted under TKPOA’s WDRs</td>
<td>• EIP approval</td>
<td>• Section 1602 Lake Alteration Agreement</td>
<td>• Nationwide Permit</td>
</tr>
<tr>
<td>UV Light Treatment</td>
<td>• TKPOA seeking approval, likely a 401 Water Quality Certification (WQC) or general order</td>
<td>• EIP approval</td>
<td>• Section 1602 Lake Alteration Agreement</td>
<td>• NA</td>
</tr>
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</table>

7.1 LRWQCB Basin Plan Prohibition Exemption

LRWQCB has primary permitting authority for the Project by considering this application for an exemption to the Water Quality Control Plan for the Lahontan Region (Basin Plan) prohibition on the use of pesticides, in the case of this project, the specified aquatic herbicides. Exemption criteria and the findings that LRWQCB must make in order to grant an exemption are described in the Basin Plan, Chapter 4, Section 4.1, Waste Discharge Prohibitions – Exemption Criteria for Controlling Aquatic Invasive Species (AIS) and Other Harmful Species. LRWQCB must make the following findings in order to grant an exemption for the use of aquatic herbicides:

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6 From the Basin Plan, Chapter 4.1, Waste Discharge Prohibitions, pg. 4.1-1: “A discharger seeking an exemption from a waste discharge prohibition must file project information sufficient to demonstrate that it meets the applicable criteria. Discharges subject to a prohibition cannot commence until such time as the Regional Board has provided written concurrence that the applicable criteria are met.”
a) The discharge of waste will not, individually or collectively, directly or indirectly, adversely affect beneficial uses, and
b) There is no reasonable alternative to the waste discharge, and
c) All applicable and practicable control and mitigation measures have been incorporated to minimize potential adverse impacts to water quality and beneficial uses.

LRWQCB, as the lead agency under CEQA, is also responsible for analyzing the potential environmental impacts of the Project before considering whether, and under what conditions, to approve TKPOA’s exemption application.

7.2 LRWQCB Individual NPDES Permit

The filing of the NPDES permit application with the SWRCB for the herbicides proposed in this Exemption Application includes the required submittal of a Report of Waste Discharge (RWD – see Appendix A) and an Aquatic Pesticide Application Plan (APAP – see Appendix B). TKPOA is submitting the NPDES permit application with RWD and APAP simultaneously with the submittal of this Exemption Application to the LRWQCB. The APAP includes requirements for monitoring, reporting, and BMPs that will help ensure the project is completed according to current regulatory guidelines that provide measures for environmental protection.

7.3 LRWQCB Antidegradation Analysis

The SWRCB and the USEPA have adopted antidegradation policies intended to protect existing high quality waters. Both the state and federal antidegradation policies, which are independently enforceable, require the high quality of these waters to be maintained unless otherwise provided by the policies. In 1968 the SWRCB adopted California’s antidegradation policy by Resolution 68-16, “Statement of Policy with Respect to Maintaining High Quality of Waters in California.” The state policy applies to surface water and groundwater whose quality meets or exceeds water quality objectives and establishes the intent to maintain high quality waters of the State to the maximum extent possible. Resolution 86-16 provides that whenever existing water quality is better than the quality established in applicable policies or plans that the high water quality must be maintained unless it can be demonstrated that any change in water quality will have the following results.

1. Will be consistent with the maximum benefit to the people of the State.
2. Will not unreasonably affect present and anticipated beneficial uses of such water.
3. Will not result in water quality less than that prescribed in applicable water quality control policies or plans.

Further, any activity that results in a discharge to high quality waters must use the best practicable treatment or control necessary to avoid a pollution or nuisance and to maintain the highest water quality consistent with the maximum benefit to the people of the state.
The previously submitted and rescinded exemption application submitted by TKPOA for the Integrated Methods Test included a qualitative antidegradation analysis completed by TKPOA. That analysis has been updated for this application and is included as Appendix G. Per conversations with LRWQCB, TKPOA expects that LRWQCB will oversee completion of a quantitative antidegradation analysis associated with this application. The antidegradation analysis shall consider all relevant information to determine if the Project would unreasonably affect the water quality of the Tahoe Keys lagoons or adversely affect the designated beneficial uses of the Tahoe Keys lagoons.

7.4 LRWQCB Water Quality Certification

Water Quality Certification (WQC) under Section 401 of the Clean Water act is needed for any dredge or fill activities which require a Clean Water Act Section 404 permit from USACE. Though the use of bottom barriers and diver assisted hand removal both trigger the need for a Section 404 permit from USACE, LRWQCB Board Order No. R6T-2014-0059, WDID NO. 6A090089000, Water Quality Certification and Waste Discharge Requirements provides TKPOA with a WQC that allows for diver assisted hand removal and up to five acres of bottom barriers, and so TKPOA would not need to seek an additional 401 WQC for those activities unless bottom barrier use exceeds five acres. TKPOA may need to seek a 401 WQC from LRWQCB for use of UV light treatment. UV light treatment remains in an experimental stage in Lake Tahoe. If the treatment is feasible and permissible, TKPOA will pursue the appropriate LRWQCB permitting for that control method.

7.5 TRPA Environmental Improvement Program Permit

TRPA is the primary permitting agency in the Basin and the lead agency under the TRPA Compact. The project must comply with TRPA’s Code of Ordinances to receive a permit for implementation. TKPOA’s is seeking TRPA approval for the Project with an Environmental Improvement Program (EIP) permit. To initiate TRPA’s review of this Exemption Application and the Project’s potential effects on the Threshold Standards, TKPOA has prepared and presents in Appendix C TKPOA’s application for an EIP permit.

TRPA, pursuant to TRPA’s Compact and Code of Ordinances, must analyze the potential environmental impacts of the Project relative to Threshold Standards for the Lake Tahoe Basin before considering whether, and under what conditions, to approve TKPOA’s Project with an EIP permit.
7.6 California Department of Fish and Wildlife Lake or Streambed Alteration Agreement

California Fish and Game Code section 1602 requires notification for any activity that may:

- Substantially divert or obstruct the natural flow of any river, stream or lake;
- Substantially change or use any material from the bed, channel or bank of any river, stream, or lake; or
- Deposit debris, waste or other materials that could pass into any river, stream or lake.

Subsequent to this requirement, TKPOA anticipates a Lake or Streambed Alternation Agreement (LSA Agreement) will be needed from CDFW prior to Project implementation. TKPOA will seek a LSA Agreement that permits each aquatic invasive species control activity: herbicide application, use of bottom barriers, use of diver assisted hand removal, and UV light treatment. CDFW has already issued an LSA Agreement for bottom barriers and diver assisted hand removal in Lake Tahoe, and is working with other local marinas on issuance of an LSA Agreement for UV light treatment. TKPOA currently implements bottom barriers and diver assisted hand removal under an LSA Agreement between CDFW and TRCD.

7.7 USACE Nationwide Permit

USACE evaluates and issues permits for activities that occur in the Nation’s waters, including wetlands. Placement of bottom barriers and diver assisted hand removal trigger USACE permitting review under Section 10 of the Rivers and Harbors Act, which regulates all structures and work in, over, and under navigable waters, as well as under Section 404 of the Clean Water Act, which regulates the placement of dredged or fill material in waters of the US. Based on previous conversations between TKPOA and USACE representatives, TKPOA anticipates submitting a pre-construction notification (PCN) form seeking approval under Nationwide Permit (NWP) #27, Aquatic Habitat Restoration, Establishment, and Enhancement Activities, and subsequently receiving a verification letter from USACE affirming the activities meet the terms and conditions of NWP 27.

7.8 Other Responsible and Cooperating Agencies

The Project must comply with the federal Endangered Species Act (ESA), California Endangered Species Act (CESA), and Migratory Bird Treaty Act (MBTA), though no impacts are anticipated to any special status species or migratory birds as a result of Project implementation. If the environmental analysis (EIR/EIS) identifies any potentially significant biological impacts to special status species or migratory birds, additional regulatory permits may be sought from the California Department of Fish and Wildlife, NV Department of Environmental Protection, and/or, U. S. Fish and Wildlife Service.
7.9 Combined CEQA, TRPA Environmental Document and Public Review Process

LRWQCB, as the lead agency under CEQA, is responsible for analyzing the potential environmental impacts of the Project before considering whether, and under what conditions, to approve TKPOA’s exemption application. CEQA requires lead agencies to consider physical environmental effects that may occur with approval of a project and to avoid or substantially lessen significant effects on the environment when feasible. When a project may have a significant effect on the environment, the agency with primary responsibility for carrying out or approving the project (the lead agency) is required to prepare an EIR.

TRPA is also a lead environmental review agency for the project, pursuant to Article VII of the TRPA Compact and the TRPA Code of Ordinances. TRPA must analyze the potential environmental impacts of the Project relative to the nine Threshold Standards for the Lake Tahoe Basin before considering whether, and under what conditions, to approve TKPOA’s Project with an EIP permit. In accordance with the Code of Ordinances, TRPA may not approve a project if any of the nine TRPA Threshold Standards for the Lake Tahoe Basin would be exceeded. If a project would exceed an identified threshold, mitigation must be imposed to reduce the impact and maintain the threshold. Section 1.4.3 of Article VII of the TRPA Compact details the key provisions of TRPA policies relevant to the use of an EIS.

TKPOA consultations with LRWQCB and TRPA over the past several years indicate that these agencies will jointly prepare an environmental document, and jointly consult with other agencies and the public in their environmental review of the project. Based on the preliminary environmental review conducted for the Integrated Methods Test (for which TKPOA submitted an exemption application to LRWQCB and an EIP application to TRPA in 2017), TKPOA anticipates that LRWQCB and TRPA will prepare a joint CEQA compliant document (an Environmental Impact Report) combined with a TRPA-equivalent document (an Environmental Impact Statement), to evaluate the environmental effects of the Project. Such joint documentation and public/agency review processes are provided for and encouraged under both CEQA and TRPA regulations and guidelines.
### 8.0 ACRONYMS AND ABBREVIATIONS

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<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AF</td>
<td>Acre Foot</td>
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<tr>
<td>AIS</td>
<td>Aquatic Invasive Species</td>
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<td>AIS Plan</td>
<td>Lake Tahoe Aquatic Invasive Species Management Plan</td>
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<td>APAP</td>
<td>Aquatic Pesticide Application Plan</td>
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<td>Best Management Practices</td>
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<td>California Environmental Protection Agency</td>
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<td>COC</td>
<td>Chain of Custody</td>
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<td>DO</td>
<td>Dissolved Oxygen</td>
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<td>FIFRA</td>
<td>Federal Insecticide Fungicide and Rodenticide Act</td>
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<td>Global Positioning System</td>
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<td>Herbicide Validation Study</td>
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<td>IMP</td>
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<td>IS</td>
<td>Initial Study</td>
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<td>MSDS</td>
<td>Material Safety Data Sheet</td>
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<td>National Pollutant Discharge Elimination System</td>
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<td>Non-Point Source Water Quality Management Plan</td>
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<td>Occupational Safety and Health Administration</td>
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<td>Personal Protective Equipment</td>
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<td>Quality Assurance and Quality Control</td>
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<td>Qualified Applicator Certificate Holder</td>
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<td>WDRs</td>
<td>Waste Discharge Requirements</td>
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9.0 REFERENCES


Aquatic Environments 2017 (June 15). Proposal Response to the TKPOA Request for Proposals for Aquatic Invasive Weed Control – Methods Test for the Tahoe Keys: Rotovating Trial.


Bellis, James 2017 (July 10). Big Bear Municipal Water District, Big Bear Lake, Lake Manager. San Bernardino, CA. Personal communication. Phone call with Patricia Sussman.


Holse, James. 2016. Personal Handwritten Communication to SEA.


Public Utility District No. 1 of Pend Oreille County Newport, WA. 2005 (December). Aquatic Plant Management Plan for the Box Canyon Hydroelectric Project, FERC No. 2042. Prepared by EES Consulting, Inc, Bellingham, WA

RO Anderson. 2016 (December) Treatment Options and Engineering Controls for Aquatic Invasive Plant Mitigation. Prepared for Tahoe Keys Property Owners Association, South Lake Tahoe, CA


