VII. Recommendations:

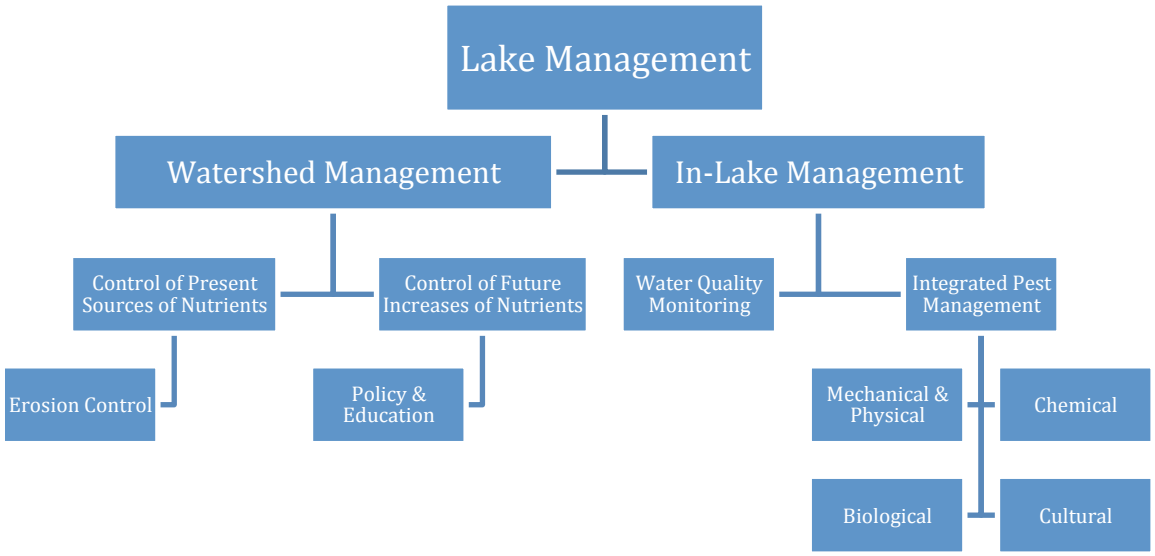


Figure 5: Management plan elements

As Figure 5 demonstrates, in-lake activity is only a part of a Lake Management Plan (LMP). The following recommendations provide strategies to control plant growth directly through the use of an Integrated Pest Management (IPM) approach but also to prevent their growth by implementing watershed management techniques that address eutrophication. In order to successfully achieve these goals, establishing a management structure and clear policies will ensure the best chances for long-term success.

Organization

A clear management structure and definition of its authority is paramount to effectively implement a plan and to enforce any rules created pertaining to the reservoir. The first and most important step is to formalize the structure of the Lake Action Committee and decide how that group interacts with, or oversees, other related committees. The M-24 HOA has had several committees whose objectives overlap substantially. For example, the Lake Beautification Committee is responsible for the perimeter of the lake, the Roads Committee is in charge of

drainages that feed the lake, and the Lake Action Committee is in charge of the water. At one point there was also a Lake Restoration Committee and a Lake Weeds Committee.

Whatever organizational structure is decided upon, committee members should be appointed for a minimum of 2-year terms and their appointments should be staggered to maintain the consistency of the vision, goals and long-term planning. This is also important to avoid the loss of institutional knowledge gained by the members of the LAC.

If possible, members should work exclusively for one committee and not split their time holding board positions or chairing other committees. Extensive time and energy may be required of a position on one of these committees, particularly in the spring and summer, during the growing season.

Below is a list of some suggested categories to organize the actions and record-keeping requirements of a Lake Action Committee. The subtopics will be addressed in subsequent recommendations.

- Lake Information Management
    - Historical data
    - Water quality & nutrient monitoring
- Watershed Management
    - Creek and drainage maintenance
    - Terrestrial vegetation control
- Aquatic Vegetation Management
    - Monitor aquatic plant species growth and distribution
    - Implement or contract out for plant & algae control services
- Policy & Oversight
    - Property owner education
    - Boat and equipment inspection for invasive species

Tasks to implement in the first year:

1. Request that LAC members obtain technical knowledge of lake management. This can be done by providing them with educational materials such as those listed in the bibliography of this thesis, or by designating funding for committee members to attend seminars, conferences and/or to consult with a professional limnologist or lake manager.

2. Institute a water-quality monitoring program. Starting with data provided in this study (Appendix D), begin to establish a baseline for relevant parameters. This will allow the HOA to gauge the success of their management activities over time. Fluctuations in the trends could help monitors to recognize potential problems before they materialize or could help in identifying their source(s). Ideally, measurements should be taken once a month during fall & winter and twice a month during spring and summer (Holdren et al., 2001). At a minimum, samples should be taken monthly. Sample locations should be the same or similar to those shown in Map 2 – pg 13.
    - Visibility, using a Secchi disk or turbidity meter
    - DO Profile (measurements at the surface, middle, bottom)
    - Surface & Vertical Temperature Profile
    - Nutrients (Phosphorus, Nitrogen)
    - pH

The North American Lake Management Society (NALMS) provides valuable resources that can help to create this program *https://www.nalms.org/media.acux/65fb28ef-097f-4662-b052-255ef5ab1da4 (pg 40-43)*

3. Monitor aquatic plant species in the reservoir. Assign a committee member to record the locations and relative abundance of the species of concern. This information will inform whether the plants have or are expected to reach a nuisance level and will require control efforts. Pay special attention to the Curly Leaf Pondweed discussed in Map 12 – pg 47, this species is of little to no value in the ecosystem and may spread and grow rapidly. It is recommended that this plant be targeted for removal immediately. The HOA should consult a licensed Pest Control Advisor (PCA) to receive an official recommendation if they choose to use herbicides to control this species; typically a product with the active ingredient endothal is used.
4. Consider budgeting for a lake management professional to visit the lake at least annually. This person should be able to make recommendations to the LAC, to assess volunteer activity such as water quality monitoring, and to help M-24 members understand the variety of complex and interrelated issues surrounding the lake. Perhaps most

importantly, being independent from the HOA, their recommendations may avert the complications of reaching consensus amongst HOA membership.

Tasks to implement in following years:

1. Convince the HOA Board to require regular septic system inspection and maintenance for properties within the watershed. Leaky septic systems will not only increase the presence of fecal coliform bacteria, but high levels of nitrogen and other eutrophication-causing nutrients are present in these seepages.
2. Obtain Educational Materials for M-24 members, such as the "Your Lake & You" newsletter provided by the North American Lake Management Society (NALMS) http://www.nalms.org/home/publications/nalms-bookstore/book-store-and-subscriptions.cmsx
    a. Develop a list of preferred detergents and cleaning products for distribution to members.
    b. Include suggestions for lake friendly property improvements and practices for members.
3. Prevent invasive species from entering the lake. Institute a policy that requires people visiting the lake to clean their equipment (boats, equipment, fishing gear, boots and clothing) before they put them in the reservoir. At a minimum, consider putting up signage in a central location.

Watershed Management

The land area of the watershed is likely the most significant external source of phosphorus to Emery Reservoir; higher rates of phosphorus runoff typically correspond with a higher percentage of development within a watershed. For example, forested areas are typically five times lower in phosphorus runoff compared with a developed area (Holdren et al., 2001). As discussed, Emery Reservoir's watershed is comprised of approximately thirty percent barren soils (Map 3 – pg 24).

Reduce inputs of phosphorus

Control the present sources of phosphorus and other eutrophication-causing nutrients from flowing into the reservoir. It is not likely that M-24 members would be able to replant or repair all of the barren area within the watershed; rather, they should systematically identify

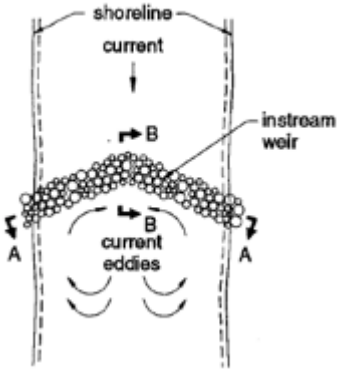
areas experiencing the most significant erosion and prioritize their restoration efforts. Consider using the hierarchy below.

1. Areas with the highest volume of runoff, such as from the largest creek, the headwaters of McKinney Creek: this is east of the reservoir and runs alongside Whitecap Road (Map 2 – pg 13)
2. Areas that are suspected of containing high levels of eutrophication-causing nutrients. Look for the volcanic soils of the Valley Springs formation (Map 4 – pg 26), specifically those around Lava Cap Road and White Rock Road where the highest volumes of runoff also occur. Their fine, silty soils (some white in color) are barren and brittle and are susceptible to erosion if disturbed.
3. All culverts, creeks, drainage ditches, driveways and roads around the reservoir.
4. Other private properties within the watershed.

Stabilize soils in these areas using vegetation, mulch and/or rocks (Picture 16). Slowing the flow of runoff by building check dams (Picture 17, Figure 6) and/or silt strainers (Figure 7) will allow suspended solids to settle out of the water before they reach the reservoir.

Picture 16: Resident lines a creek bed with boulders

Picture 17: Check dams built by residents



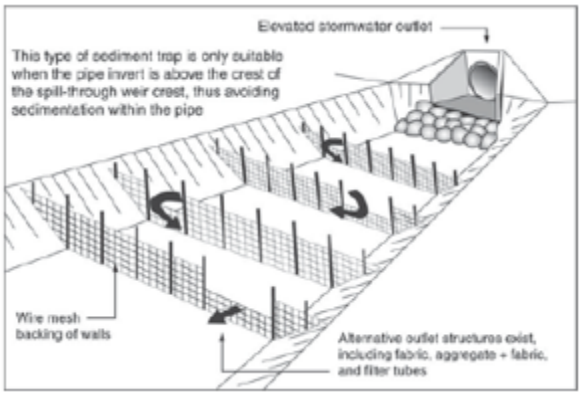


Figure 6: Conceptual design of a check dam Figure 7: Silt strainer sediment trap

Divert runoff to retention ponds or other areas to redirect sediment before it reaches the reservoir. Silt strainers and retention ponds seem similar but they serve different purposes. Unlike the silt strainer depicted in Figure 7, a retention pond would redirect sediment-laden water to a pond alongside a creek or drainage ditch to allow it to settle out as the water soaks into the ground. It is important to measure the buildup of sediment to predict the quantity deposited over time in order to plan accordingly for re-excavation as needed.

Figure 8: Conceptual design of sedimentation reduction plan.

After actions to control the **present sources** of nutrients from the watershed have been initiated, the committee or committees responsible should communicate their actions to the membership and educate them on how they can better manage their own properties to **control current and future increases.**

Promote and maintain a healthy vegetative buffer

Like check dams and silt strainers, vegetation provides a natural way of reducing the amount of eutrophication causing nutrients that enter the reservoir. Vegetation stabilizes the soil from washing away; its foliage reduces the impact from precipitation that can erode barren soils. Like a silt strainer, some plantings can slow runoff thereby allowing sediment to settle out of the water, which may encourage the uptake of the nutrients by the plants before it enters the reservoir and becomes available for algae and aquatic plants to use. In short, a healthy vegetative buffer functions to reduce erosion, sediment and nutrient runoff (LWTF, 1978).

Picture 18: Creekside signage Picture 19: Rip rapped shoreline

If landscaping activities will be performed around the lake, prevent the grass clippings, leaves and other organic debris from entering the reservoir. Lake managers should leave enough plants behind to stabilize the soils or replant areas with a more desirable species or by rip-rapping (placing rocks to protect denuded areas).

There are numerous plants that could be used to stabilize the soils around the reservoir. Choosing native plants is often the best approach because they are well suited for the climate and therefore more likely to survive and become established. Additionally, non-native species may

out-compete the existing vegetation leading to a monoculture that could negatively impact the food sources of local wildlife.

There are several organizations that run nurseries in the Sierra Foothills, such as the California Native Plant Society (CNPS). Their staff can help to choose the best species suited for the purpose and desired look. CNPS offers classes, field trips, and seminars in the nearby city of San Andreas and other foothill communities.

Record actions and evaluate progress

Evaluation of the membership's efforts can be done by taking measurements of sediment accumulation in specific areas (like silt strainers and retention ponds), or by observing the amounts of erosion. Measuring any changes in the concentration of phosphorous in the reservoir will be the best indicator of success. Submitting an annual report to the HOA to make recommendations for new policies that govern future development on private properties, community roadways and easements will help to monitor progress. A report should also discuss the priorities for continual restoration activities in the coming year(s).

In-Lake Management (IPM)

In-lake activities should be addressed via an Integrated Pest Management (IPM) approach that relies on a host of tools tailored to the specific plants and characteristics of the reservoir. Just as ridding oneself of a rodent problem involves common sense preventative actions like removing sources of food and water, or blocking means of entry, an IPM for aquatic weeds also relies heavily on proactive means of eliminating the problem at its source – the prevention of plant propagation and limiting access to nutrients.

Should an infestation of plants occur in the future, reliance on this IPM approach will mean assessing whether harvesting, biological controls (such as the introduction of herbivores, insects, or microbial bacteria), the use of herbicides, physical modifications to the reservoir or some combination of methods should be employed.

Nutrient Reduction

Use alum or other brand name product to inactivate phosphorus. These products work by binding with phosphorus to form a precipitate that sinks to the reservoir's bottom, making it unavailable for plants and algae. The resulting layer of precipitate on the bottom eliminates or retards phosphorus release from sediments for a period of years. This should not be done until

phosphorus-rich runoff from the watershed has been reduced as much as possible, otherwise new deposits can soon bury the precipitate layer over the sediments. The application of these products should be applied by a trained professional who is familiar with the concentrations required for the specific conditions of Emery Reservoir.

Set Goals

Setting clear goals for the management of aquatic plants should be the first step when implementing the IPM. This means identifying which plants should be targeted for control and which should be tolerated, and discerning the thresholds that will trigger action to be taken. A reservoir devoid of vegetation is not a realistic goal, nor is it in the best interest of the reservoir or the property owners. Vegetation provides food and shelter for the aquatic organisms and attracts an assortment of waterfowl, birds and other terrestrial wildlife. Perhaps more importantly, the plants compete with algae for nutrients, thereby keeping the water clear and reducing the potential for algal blooms and unsightly and smelly floating algae mats.

Picture 20: Algae mat floating on the surface of a lake

Cultural Controls - Determine Where to Control Plants

One important aspect of the IPM is to designate certain areas to control the growth of plants (docks, beaches, recreation areas, etc.). Focus effort, time and money on these designated areas and decide which unused/less-used areas of the lake can behave naturally. One way to do this is by installing substrate modifications such as weed barriers with sand over them to prevent a plant's ability to root. This has already been done successfully in several areas around the

reservoir. This method of control is damaging to an ecosystem and should be used sparingly in areas that are used heavily as recreation entry points into the lake.

Another cultural control method that has been discussed by the HOA is drawdown whereby the reservoir is drained of most of its water to kill the plants. The reservoir has the infrastructure to release most of the water within it making this a viable option. This could be done in the Fall before the rainy season. Once lowered, residents could use additional methods of control such as solarization (as proposed by Duck Ponds Unlimited). Excavating the lakebed, as was attempted in 2007, may be effective but would require obtaining a "Lake or Streambed Alteration Agreement" with California Department of Fish and Wildlife. The cost of excavation is prohibitive for large areas of the lake and may not result in the removal of the targeted plants because their fragments would likely be left behind. Also, the nutrients that were buried in the sediment would again become available to plants, and they would quickly take root in the exposed areas.

Mechanical or Physical Controls - Harvesting

Aquatic harvesting of plants and/or algae is a more laborious and often a more expensive method of control because of the equipment required, but it provides several advantages over other methods. The collection of biomass through harvesting removes nutrients from the reservoir thereby reducing the total amount available to be reused by other plants and algae. For this to hold true, the collected material must be transported outside the watershed where it cannot reenter the reservoir as fragments or as decayed debris washing their nutrients back into the reservoir during a rain event.

If timed properly, repeated cutting of the tops off plants can stress them enough to kill them. Furthermore, if the plants can be removed before they go to seed, there is a potential to reduce their abundance over time (Druckrey, 2010). As discussed previously, some plants like Watershield should not be selected for this method because of their ability to regenerate from fragments unless a method were devised to collect or kill any fragments. Some species of pondweed present in the reservoir, like Sago Pondweed, are less likely to regenerate from fragments, especially if cut during specific times in their growth cycle (Kris et al., 2006).

Chemical Controls - Herbicides

Herbicides can be a very effective tool to control aquatic plants and in cases of extreme overgrowth may be the only cost effective solution. There are some important considerations when choosing this as a method. After a treatment, if large quantities of the dead plants are allowed to settle to the bottom, increases in the decomposition may lead to anoxic conditions, which could be lethal to fish or other organisms (Jewell, 1971). Another drawback to herbicide use is that the plants' nutrients are not removed from the reservoir and would be available for use by other plants or algae (Hill, 1979). Reduction in aquatic plants therefore, is likely a tradeoff for an increase in algae.

Additional considerations need to be taken over the residual elements that may linger in the waterbody or the sediments. While labels may indicate that the active ingredients do not persist for long periods of time, California law still requires the monitoring of these chemicals in many waterbodies. If herbicides are used, it is likely a National Pollutant Discharge Elimination System (NPDES) permit or waiver from the County Agricultural Commissioner would need to be obtained and water quality and chemical concentrations would need to be monitored. A person with a license or certificate from the California Department of Pesticide Regulation should perform the application of the chemicals to ensure water quality parameters are suitable for the chosen herbicides and that they are applied correctly according to label requirements. Failure to follow pesticide label directions could result in a fine up to $5000 (Division 6. Pesticides and Pest Control Operations, Chapter 1. Pesticide Regulatory Program, Subchapter 3. Agricultural Commissioner Penalties, Article 1. Guidelines).

The use of herbicides is a highly contentious issue among stakeholders (in general) and can often result in their active disengagement from decision-making efforts. Making a concerted effort to find a negotiated middle ground through an IPM plan can encourage stakeholders to stay involved and participate in the management of the lake.