Appendix I – Lake Gregory Operations and Maintenance Manual

Lake Gregory Operations and Maintenance Manual

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MAY 2024

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1 Introduction

Lake Gregory is located in the unincorporated community of Crestline within the San Bernardino National Forest in San Bernardino County, California within Section 23, Township 2 South, Range 4 West and is included within the lands shown on the U.S. Geological Survey (USGS) — North quadrangle, 7.5 Minute Series topographic map. The San Bernardino County Regional Parks Department (Regional Parks) operates Lake Gregory as a regional park that offers recreational facilities to its patrons including seasonal swimming and year-round boating, shore and boat fishing, picnic facilities, exercise stations, a skate park, and a dog park. Beach areas including the North Shore and the South Shore are open to the public for swimming during summer months from Memorial Day weekend through Labor Day weekend. Lake Gregory Boat House is open year-round and offers rental for belly boards, aqua cycles, pedal boats, kayaks, stand-up paddle boards, row boats, and electric motorboats. The South Shore also offers covered picnic shelters for large group picnics year-round. In the summer of 2014, Lake Gregory began offering summer waterpark activities including an inflated 13,755 square foot water-play structure that floats in the lake swim cove.

The lake was created with the construction of an earthen dam built in 1938 along the northeast shoreline. It has an approximate 90-acre surface area. The water sources for Lake Gregory are direct rainfall, storm runoff, and snow melt from the 1,200-acre tributary watershed. Houston Creek East and Houston Creek West are the two major tributaries that deliver storm runoff to the lake. When the water surface reaches elevation 4,523.60 feet it discharges water from the lake through the primary lake spillway to Houston Creek North. The normal water level of the lake is at the ordinary highwater mark (OHWM) at elevation 4,526.0 feet. The maximum lake depth at the OHWM is approximately 56-feet. The water level of the lake can be increased to elevation 4526.6 feet with the installation of flashboards across the secondary spillway to store additional runoff in the lake during spring and summer months. Typically, the flashboards are removed on September 10th of each year. The normal water surface in the lake recedes approximately to elevation 4,518.6-feet during the dry season due to evaporation, evapotranspiration, and infiltration losses.

A debris basin was constructed on the west side of Lake Gregory Drive adjacent to the Crestline Library (the Library Debris Basin). It is characterized as a wetland with ponded water from snow melt and urban runoff, vegetation, and sediment. In the past, excessive vegetative growth in the basin has hampered maintenance activities and prohibited County maintenance staff from removing accumulated sediment and debris from the basin. The basin accessibility and debris trapping efficiency were improved as a part of the Sediment Management Project in 2016.

Historically, sediment would bypass the Library Basin and accumulate at the westerly tip of the lake near Lake Gregory Drive forming a sand delta in the lake (see Figure-1).

Figure 1. Lake Gregory Westerly Tip Sedimentation Pattern

Historically, sediment also accumulates at the southerly tip of the lake near Houston Creek South outlet to the lake adjacent to San Moritz Lodge and along the bank at the Houston Creek East outlet to the lake. The sediment accumulation in these areas has decreased the storage capacity/volume of the lake (see Figure-2).

Figure 2. Lake Gregory Southerly Tip Historic Sedimentation Pattern

2016 Lake Gregory Sediment Management and Bio-Retention Project:

In an effort to reduce the amount of sediment and silt entering the lake and to reduce the accumulation of sediment buildup along the shore where tributaries enter the lake, the San Bernardino County Special Districts Department (Special Districts) sponsored the Lake Gregory Sediment Management and Bio- Retention Project (sediment management project). The existing Library Debris Basin was re-constructed and improved. The southern portion of Lake Gregory was re-contoured to re-establish lacustrine area for enhancement of the surrounding riparian willow (Willow Island). A new in-line basin/channel was constructed to capture sediment and debris from Houston Creek South. An existing access road adjacent to the new basin/channel was improved for all-weather maintenance and vehicular access.

As a part of the sediment management project, the Library Debris Basin was improved. The improvements included clearing and grubbing existing vegetation, removal and disposal of accumulated sediment in the existing basin to the 4,524-feet elevation contour, re- grading of the basin side-slopes on the northeast and southeast comer; construction of a reinforced concrete weir box outlet; installation of an articulated concrete block mattress armoring for the basin invert, and an 8-feet wide access ramp with a maintenance equipment pad at the northeast corner adjacent to Lake Gregory Drive. Rip-rap energy dissipation aprons were added at the basin inflow locations. The improvements extend the lake body into the basin and allow the basin to function as a wet pond or extended dry detention basin, dependent upon the lake water level. Photos of the Library Basin are provided in Figure-3.

Figure 3. Improved Library Debris Basin

The Houston Creek South outlet to Lake Gregory located adjacent to the San Moritz Lodge was improved by constructing an in-line multi-cell debris basin and improving the existing access road by paving over it with a 14ft wide soil cement armoring along the northern and western perimeter of the existing baseball field for maintenance and vehicular access. This reach of Houston Creek South is frequently referred to as "The San Moritz Channel." The channel/basin invert and a portion of the side slope (half of the channel wall height) was lined with a 2-ft thick layer of light class rock riprap. The upper portion or half of the slope was planted with native vegetation and stabilized with turf reinforcement matting. Photos of the San Moritz Channel/Basin are provided in Figures-4, 5, and 6. Note the location of the fence along the easterly side of the San Moritz Channel access road as shown in Figure-5

Figure 4 San Moritz Channel/Debris Basin

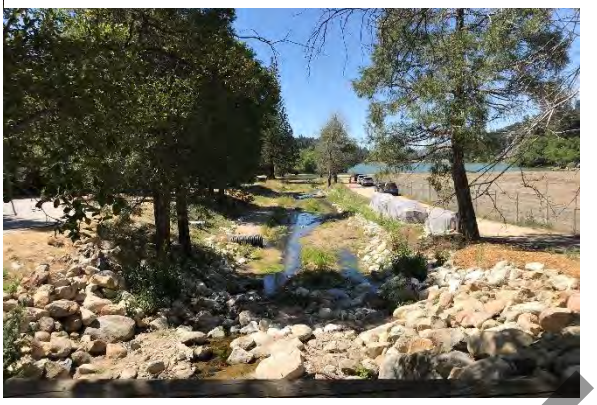

Figure 5 San Moritz Channel Access Road

Figure 6 San Moritz Channel Geotextile

The San Moritz Channel was designed to trap sediment within the segmented reaches where it can be removed at a lower cost compared to sediment that it is transported of the lake. Figure-7 shows a plan view of the San Moritz channel design segments and in-channel basin facilities. Note the plan shows a fence along the easterly edge of the access road creating a barrier between the tur field area and the channel access road.

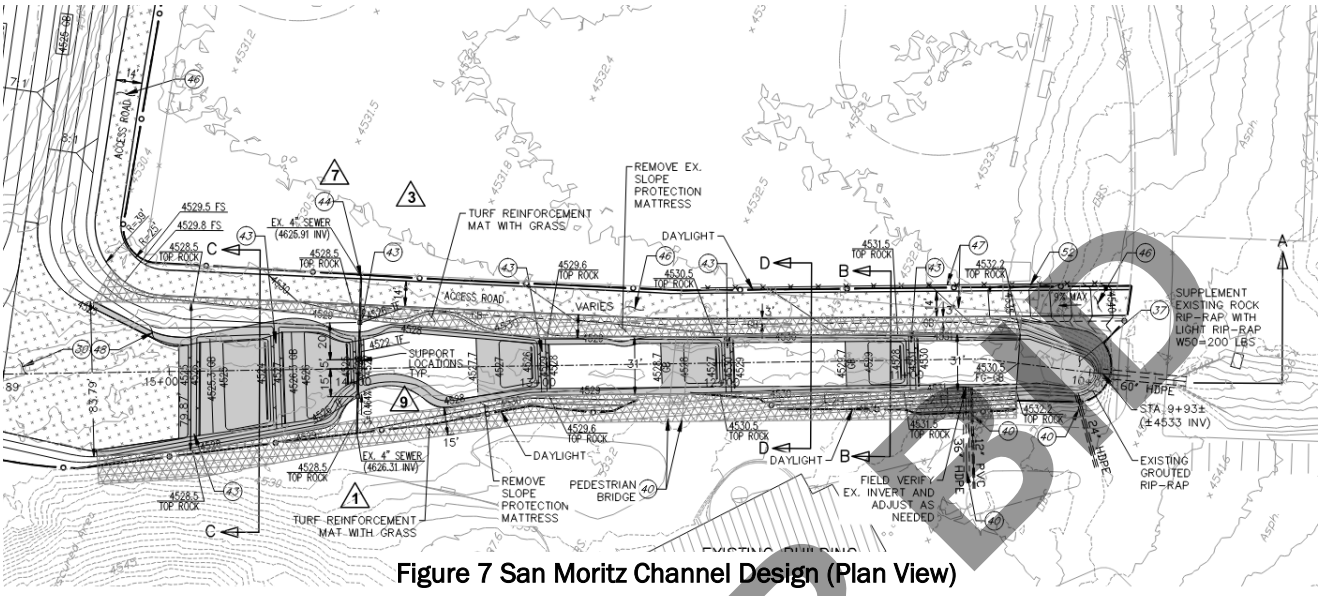

Figure 7 San Moritz Channel Design (Plan View)

Figure-8 shows a profile view of the San Moritz channel design segments and in-channel basin facilities.

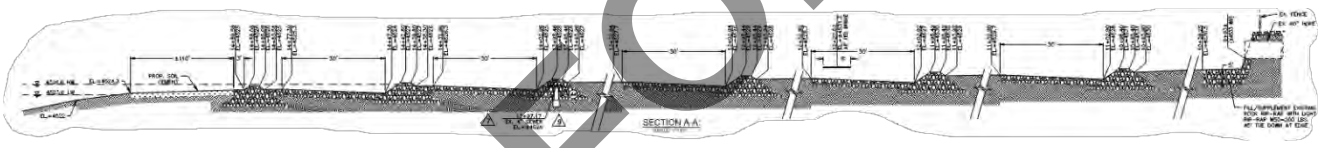

Figure 8 San Moritz Channel Design (Profile View)

It is not clear which storm frequency the San Moritz Channel inline basins were designed to handle. Currently, the inline basins are filled to capacity annually. This indicates that the inline basins were likely designed to trap sediment for storms corresponding to the 2-yr storm or smaller. Basin/channel facilities requiring semi-annual or annual cleanout require clear maintenance access to minimize disturbance to surrounding area improvements during maintenance. Since the time that the San Moritz Channel improvements were constructed the turf field area along the easterly bank of the channel was improved. As a part of the turf area improvement the access for the San Moritz Channel was redefined as a community trail/exercise path around the turf area. A fence was constructed along the westerly edge of the access road/exercise path between the San Moritz Channel and the access road/exercise path. The fence is a barrier to maintenance access and does not allow for ingress/egress access to the channel. As a result, the surrounding area is disturbed by construction and maintenance equipment accessing the San Moritz Channel using alternative access routes that were not designed for ingress/egress nor intended for that purpose. Figure-9 shows the current condition of the access road/exercise path and the barrier created by the fence between the San Moritz Channel and the access road/exercise path. It appears that if the split rail fence was removed the access road/exercise path could be used for dual purpose to allow maintenance access of the San Moritz Channel and community use of the exercise path. We recommend removing the fence to improve maintenance and operation of the San Moritz Channel facility.

The San Moritz Channel/Basin Outlet, and Lake Gregory East Bank area was improved by removing 0.85 surface acres of the sand / sediment that formed a delta where the creek drains to the lake. Figure-10 shows the as-built condition

Figure 9 San Moritz Channel Geotextile

of the grading that was implemented in this area and will be restored again as part of the Sediment Management Project.

In 2023 the Special Districts office implemented a project to Manage Sediment in Lake Gregory. As a part of the Sediment Management project the Lake Gregory Waterpark and West Beach area will be improved to create a stabilized sand beach and an area that should have adequate water depth for the waterpark from Memorial Day to Labor Day. Figure-11 shows a cross section view of the proposed beach stabilization improvements for the West Beach area. A beach stabilization wall will be constructed to create a horizontal and vertical grade control marker defining the beach. Future maintenance crews can use the top of beach stabilization wall as a vertical marker to restore grades when grooming the beach sand in the beach area.

A portion of the lake invert in the vicinity of the West Beach will be graded to create a deepened area that will have a minimum 10ft of water depth at the typical lowest water level during the swim season when the water recedes to 4518.6 ft on Labor Day. The footprint and proposed grading of the waterpark area is shown in Figure-12. This area will need periodic inspection to ensure that deposition of material in the lake does not fill in the area and decrease the design to less than 10-ft minimum.

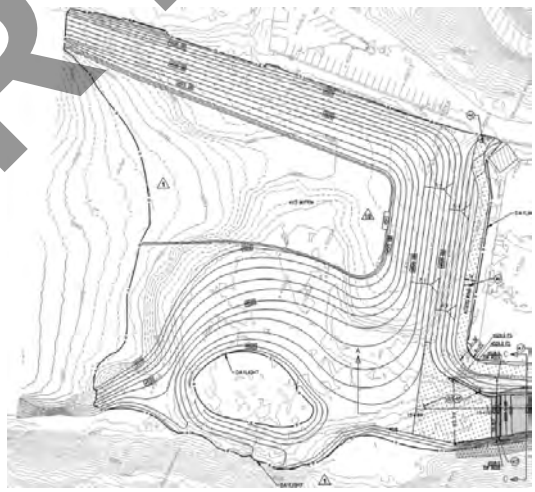

Figure 10 East bank Sediment Removal As-Built Grading

The lake dredging and grading operation that will occur as a part of the Sediment Management Plan will result in a grading cut of approximately 69,428 cubic yards of sediment from the lake bottom. Construction of the proposed swim beach improvements will result in a grading fill of approximately 8,932 cubic yards of soil. Approximately 4,312 cubic yards of the fill will be imported sand to create a high contrast sand surface in the swim beach area to improve visitor safety. Approximately 59,496 cubic yards of sediment will be exported from the site to a designated stockpile area near Camp Switzerland.

Twelve (12) of the thirty-four (34) existing storm drain outlets that discharge storm runoff to Lake Gregory from

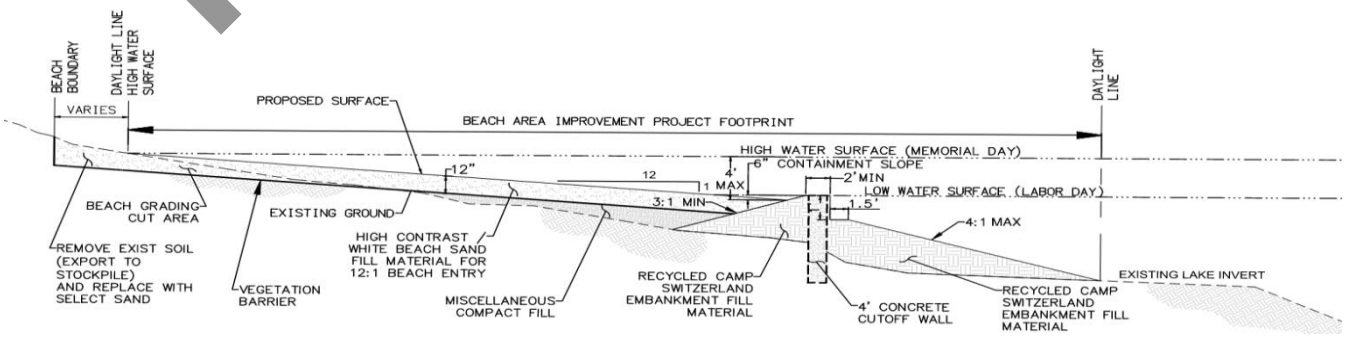

Figure 11 Lake Gregory Swim Beach and West Beach Grading and Beach Stabilization Detail

the tributary

watershed exhibit significant erosion at the stormdrain outlet; see Figure-13. In several cases the erosion is extreme and has completely undermined the stormdrain and created a potentially dangerous situation. In other cases, the erosion is not as dramatic, but still threatens to compromise the integrity of the stormdrain and lake bank. As a part of the Sediment Management Project these twelve stormdrain outlets will be reconstructed to remediate the erosion damage and install erosion control/protection measures that will limit future erosion damage. These locations along with the twenty-two (22) other stormdrain outlets should be inspected periodically and any noted necessary maintenance repairs implemented to prevent major erosion damage development.

Staff gauges will be installed in the Library Basin

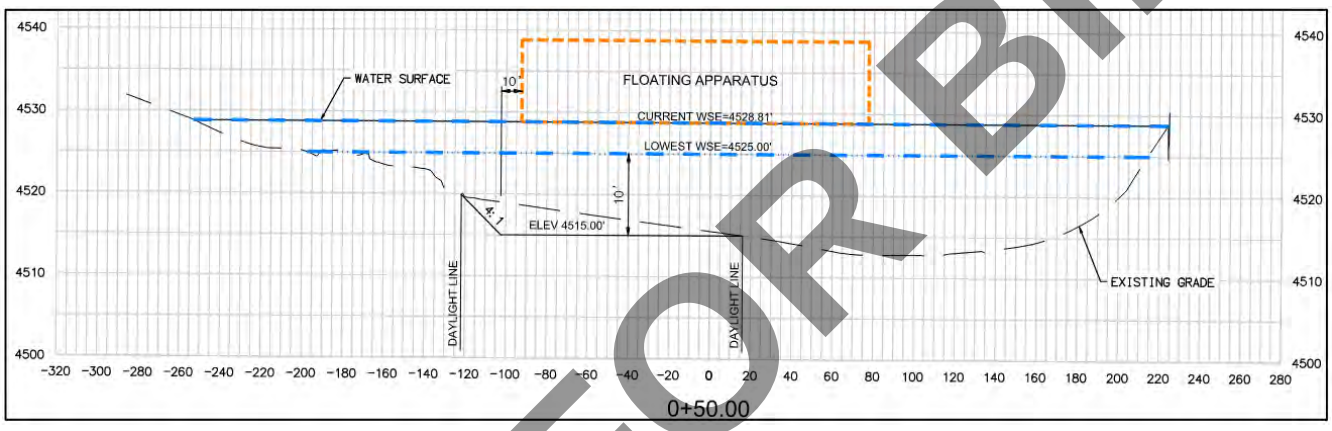

Figure 12 Lake Gregory Floating Waterpark Area Grading Detail

as part of the Sediment Management Project to provide a visual indication of the amount of sediment accumulated in the basin. The Library Basin can hold up to 3.5 feet of sediment from the basin invert elevation to the outlet weir elevation at 4,526.50-feet. When the basin sediment storage capacity is full to 3.5ft deep any additional sediment is then transported from the basin to Lake Gregory. The sediment storage function of the basin is short circuited, and sediment flows into Lake Gregory and deposited in the West Beach area. It is critical to monitor and maintain the basin storage capacity in order to significantly decrease sediment transport from the local watershed to Lake Gregory. West Houston Creek is the second largest individual sediment source for Lake Gregory. The proposed staff gauges will provide an accurate visual indicator of the current amount of sediment stored in the basin and the amount of storage capacity remaining. The staff gauges will have very simple markings that say, "HALF FULL", and "FULL". Table 3-1 provides the sediment storage rating at each elevation so that San Bernardino County

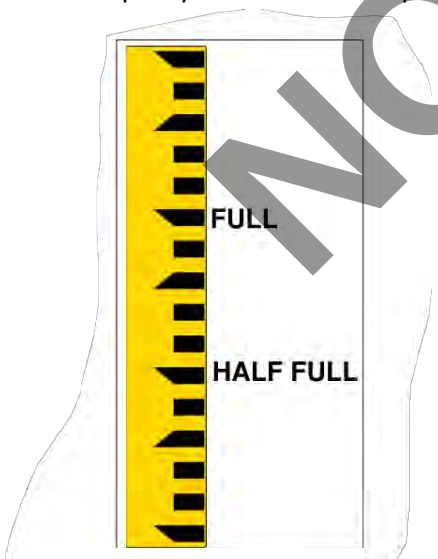

Figure 14 Library Basin Staff Gauge

Figure 13 Extreme Stormdrain Outlet Erosion

maintenance staff can determine how much sediment needs to be removed from the basin prior to initiating basin maintenance activities.

Lake Gregory Operations and Maintenance

This maintenance manual was prepared for San Bernardino County Regional Parks Department staff to use as a guidance document for maintenance activities at Lake Gregory and the associated debris basins and facilities. It provides specific maintenance requirements for the debris basins and general maintenance recommendations for the overall lake. This manual is divided into five (5) parts: Resource Agency Permit Compliance, Library Debris Basin Maintenance, San Moritz Lodge Basin/Channel Maintenance, Lake Gregory Waterpark and Westerly Beach Area Maintenance, and General Lake Gregory Operations and Maintenance.

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2 Resource Agency Permit Compliance

The lake and the adjacent riparian and wetland areas are within the jurisdiction of the California Department of Fish and Wildlife (CDFW), the Lahontan Regional Water Quality Control Board (RWQCB), and the U.S. Army Corps of Engineers (USACOE). There are three permits that cover O&M procedures for Lake Gregory and the associated facilities as follows: the Section 404 permit, the Section 401 permit, and the Fish and Wildlife Code 1602 permit. The following sections are guidelines for operation and maintenance of the lake and facilities, and they pertain to the permits. In addition to the permits mentioned above, there may be other special use permits required by the National Forest Service and the County of San Bernardino.

The 404, 401, and 1602 construction permits were obtained for the construction of the sediment management project improvements. Separate 401, 404, and 1602 permits must be obtained for long term operation and maintenance of sediment/debris basins. In addition, Special Use permits are required for removal of sediment/debris and vegetation control. When the permit applications are filed for a long-term period, the term for operations and maintenance should be specified for a minimum of 5 years or as necessary dependent on the resource agency terms.

2.1 United States Army Corps of Engineers Clean Water Act Section 404 Permit

The USACOE regulates ”discharge of dredged or fill material” in wetlands and Waters of the United States, which includes tidal waters, interstate waters, and "all other waters, interstate lakes, rivers, streams (including intermittent streams), mud flats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce or which are tributaries to waters subject to the ebb and flow of the tide" (33 C.F.R. 328.3(a)), pursuant to provisions of Section 404 of the Clean Water Act.

“Waters of the U.S.” are delineated based upon me "ordinary high-water mark" (OHWM) as determined by erosion, the deposition of vegetation or Debris, and changes in vegetation within rivers and streams. The normal water level at Lake Gregory is set by the dam spillway at 4,523.60 feet above mean sea level (AMSL). The locations proposed for maintenance sediment removal occurring below 4,523.60 AMSL would be subject to the jurisdiction of the USACOE. Additionally, the USACOE would assert jurisdiction over the tributary ephemeral channel in the San Moritz Lodge Debris Basin/Channel area and wetland resources In the Houston Creek West - Library Debris Basin. The existing Library Debris Basin located next to the library was determined to be a wetland under the jurisdiction of the USACOE. The site was identified to have wetland hydrology, hydric soils, and hydrophytic vegetation present. The delta and channel in the Houston Creek South project area were not identified to meet the three parameters for wetlands.

Requirements and Restrictions

The USACOE has issued permits to regulate the Sediment Management Project components pursuant to section 404 of the CWA: Library Basin — Nationwide Permit 43, Storm Water Management Facilities (SPL- 2016-00673-LRS); Waterpark and Westerly Beach Area- Nationwide Permit 16, Return Water from Upland Contained Areas, and Nationwide Permit 33, and San Moritz Lodge Basin/Channel — Nationwide Permit 43, Storm Water Management Facilities (SPL-2016-00643-LRS). Long term maintenance permits will be obtained from the USACOE that will establish specific regulations for typical maintenance activities. In general, it is expected that the long-term maintenance permits will include the following regulations:

Spawning Areas:

Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized. The fish spawning season is generally March through July.

Migratory Bird Breeding Areas:

The permittee is responsible for ensuring compliance with the Federal Migratory Bird Treaty Act and California Fish and Game Code which prohibit the "take" active bird nests, eggs, and fledglings. Specific nesting bird seasons, survey requirements, and reporting requirements will be set forth in the 404, 401 and 1602 permits, which must be implemented. Mitigation measure (BIO-1) adopted by San Bernardino County Regional Parks to address nesting birds in the Lake Gregory Sediment Management & Bioretention Program Initial Study (January 2014) sets forth the following requirements:

- **BIO-1:** Vegetation removal associated with the development of the proposed basin facilities, channel, and lake sediment removal shall be scheduled to occur outside of the bird nesting season (March – September). Should vegetation removal occur during the nesting season a nest clearance survey shall be conducted no more than 30 days prior to removal of vegetation/trees and the vegetation removal shall be monitored by a qualified biologist.

Migratory Birds and Bald and Golden Eagles:

The permittee is responsible for ensuring their action complies with the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The permittee is responsible for contacting appropriate local office of the U.S. Fish and Wildlife Service to determine applicable measures to reduce impacts to migratory birds or eagles, including whether "incidental take" permit is necessary and available under the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act for a particular activity.

Permitted Maintenance Restrictions

Any authorized structure or fill should be properly maintained, including maintenance to ensure public safety and compliance with applicable Nationwide Permit (NWP) general conditions, as well as any activity specific conditions added by the district engineer to an NWP authorization. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soft disturbance.

2.2 Regional Water Quality Control Board 401 Certification/Waste Discharge Requirements

The RWQCB regulates activities pursuant to Section 401(a)(1) of the federal Clean Water Act (CWA) as well as the Porter Cologne Act (Water Code section 13260). Section 401 of the CWA specifies that certification from the State is required for any project requesting a federal license or permit to conduct any activities Including, but not limited to the construction or operation of facilities that may result in any discharge into navigable waters. The Porter Cologne Act requires any person discharging waste, or proposing to discharge waste, within any region that could affect the waters of the state to file a report of discharge. Discharge of fill material into "waters" of the State which does not fall under the jurisdiction of the USACOE pursuant to Section 404 of the Clean Water Act, may require authorization through application of waste discharge requirement or through waiver of Waste Discharge Requirements.

The RWQCB with jurisdiction over the Lake is the Lahontan (6V) Regional Board. Lake Gregory is identified in the Water Quality Control Plan for the Lahontan Region (Basin Plan) as a waterbody within the Mojave Hydrologic Unit 628.00, Upper Mojave Hydrologic Area 628.20, and assigned the following beneficial uses: municipal supply (MUN); agricultural supply (AGR); groundwater recharge (GWR); navigation (NAV); contact and non-contact recreational uses (REC-1, REC-2); commercial and sport fishing (COMM); cold freshwater habitat (COLD); wildlife habitat (WLD) and spawning, reproduction, and development (SPWN).

Permitted Maintenance Restrictions

The locations proposed for maintenance sediment removal would be subject to a Section 404 Permit from the USACOE, and therefore were also require a 401 certification from the Lahontan RWQCB. Similarly, the Lahontan RWQCB would regulate long-term maintenance activities.

2.3 CEQA Compliance

San Bernardino County prepared an Initial Study and Mitigated Negative Declaration (IS/MND) for the Project. The IS/NND was prepared pursuant to the California Environmental Quality Act (CEQA Public Resources Code 21000, et seq.) and circulated under State Clearinghouse No. 2014011063. The IS/MND was certified on June 24, 2014, following public review.

The Water Board, acting as a CEQA Responsible Agency in compliance with CCR, title 14, section 15096, has considered the IS/MND for the Project and the potential water quality impacts. As a result of the analysis, the Water Board finds potential water quality impacts are less than significant.

The IS/MND also considered the impacts of operation and maintenance of the lake facility and found the impacts to be less than significant in each of the CEQA categories investigated including Aesthetics, Agricultural and Forest Resources, Air Quality, Biological Resources, Cultural Resources, Geology and Soils, Greenhouse Gas Emissions, Hazards and Hazardous Materials, Hydrology and Water Quality, Land Use and Planning, Mineral Resources, Population and Housing, Public Services, Recreation, Transportation and Traffic, and Utilities and Service Systems.

2.4 California Department of Fish and Wildlife Streambed Alteration Agreement

The CDFW is responsible for conserving, protecting, and managing California's fish, wildlife, and native plant resources. To meet this responsibility, the law requires any person, state or local governmental agency, or public utility to notify the CDFW before beginning an activity that will substantially modify a river, stream, or lake. A section 1602 permit was issued by the CDFW for this project.

Impacts associated with culvert maintenance and sediment removal are not defined and would occur on an as-needed basis as determined by the park operations staff. All culvert pipe repair and maintenance activities would be performed year-round as needed to maintain restore proper function of storm drain outlets prior to storm events and to repair them after storm damage. All culvert maintenance should be conducted using equipment situated outside of the lake's OHWM.

Permit Maintenance Requirements

An agreement was obtained from the CDFW for the following maintenance activities:

Library Debris Basin

- Sediment removal
- Cleaning trash and Debris
- Weir box maintenance
- Access ramp maintenance

San Moritz Lodge Debris Basin/Channel

- Channel clearing/vegetation management
- Sediment removal
- Diversion structure - rock weir maintenance

Reporting of Maintenance Activities

San Bernardino County Regional Parks (Regional Parks) is required to submit a report to CDFW annually for the term of this agreement that describes the maintenance activities conducted within the permittee-maintained facilities during the previous calendar year. The report should include: (a) a map identifying the locations where maintenance activities were conducted; (b) a summary of the annual maintenance activities conducted, including: location, type of activity, time of year activities that were conducted, duration of activities, methods/equipment used to conduct activities, quantity of sediment removed, quantity and type of vegetation removed, and total area of impact for each location; and (c) a list of avoidance and minimization measures implemented during maintenance activities to protect fish and wildlife resources. The report summarizing annual maintenance activities is due to CDFW for the calendar year no later than January 31st of the following year.

3 Debris Basin Maintenance

3.1 General Debris Basin Maintenance

Regular and normal basin maintenance activities should be conducted between June and November. The following activities should be conducted as determined necessary by Park management/staff to ensure proper function of the debris and sediment basins.

All debris basin side slopes should be maintained during the Fall season each year (prior to the winter rain/snow season) to preserve invert accessibility for maintenance vehicles and equipment. The tasks to be completed during this period include periodic tree and shrub pruning and removal(s) adjacent to the access ramps and working areas to maintain ingress/egress paths and working areas in the basins. Accumulated sediment removal at the designated locations would be completed by mechanical means including wheeled and tracked vehicles in October of each year and following significant storm events.

Maintenance of the basins will require permits from the state and federal resource agencies (Section 1602 Streambed Alteration Agreement, 404 Authorization, and 401 Water Quality Certification). These permits must be reviewed in January of each year to ensure that they are still valid for the upcoming year's maintenance. In order to avoid permit violations, all sediment removal should be completed while equipment is located above the lake's OHWM in designated working areas or on the designated side slope access ramp(s). Care should be taken to preserve the side slope vegetation as much as practical to provide enhanced riparian and wetlands habitat.

3.2 Specific Basin Maintenance

3.2.1 Library Basin Maintenance

Houston Creek West enters the lake through the Library Basin on the west side of Lake Gregory Drive adjacent to the Crestline Library. Improvements to this basin constructed in 2016 included removal of accumulated sediment, construction of a maintenance equipment pad and access ramp, and construction of a weir box outlet to improve sediment retention. There are twelve (12) inlet pipes that discharge to the basin. Riprap is installed near all basin inlets to prevent erosion. Historically the majority of the debris entering the basin consists of sand and silt. The basin weir box outlet structure is intended to retain sediment in the basin and decrease the likelihood of it flowing through the basin into Lake Gregory.

The basin weir wall has eight (8) 6-inch diameter orifice holes cored through it that are buried below a gallery of gravel to act as a low-flow outlet from the basin to Lake Gregory. The inverts of the orifice holes are at elevation 4,523.45-feet. This is 1.45 feet above the basin invert elevation at 4,523.00-feet. The basin could have 1.45-feet of standing water below the low-level outlet. As designed, the basin can store up to 3.5 feet of sediment from the basin invert elevation to the outlet weir elevation at 4,526.50-feet. The maximum volume of debris/sediment that can be stored in the basin below the weir outlet elevation is 1,740 cubic yards. The outlet weir structure (weir box) discharges to the existing three 60-inch reinforced concrete pipe (RCP) culvert which drains to Lake Gregory beneath Lake Gregory Drive. The basin functions as either a wet pond or extended dry detention basin. When the lake water surface reaches elevation 4,523.45-feet the lake will reverse flow through the weir box low-flow orifice openings and flow into the basin. Lake Gregory can reach a maximum safe water surface elevation of 4,526.60-feet. This exceeds the weir elevation and provides sufficient depth for fish to leave the main body of Lake Gregory and swim into the

basin. Maintenance of the basin will require periodic field inspections. Basin maintenance needs should be based upon visual inspections and observations. A Visual Inspection Checklist for the Library Basin is provided in Appendix-A. The checklists are intended to be used for guidance on post storm maintenance activities.

3.2.1.1 Debris Removal

Accumulated debris within the bed of this existing debris basin should be removed by mechanical means including wheeled and tracked vehicles when necessary following major storm events (>1" precipitation) in the watershed, or at a minimum annually. Permit restrictions require that no wheeled or tracked vehicles be allowed on the vegetated basin side slopes except on the designated access ramp(s). Care should be taken to preserve the side slope vegetation as much as practical to protect enhanced riparian and wetlands habitat.

Staff gauges were not installed as a part of the basin improvement project. Staff gauges should be installed in the basin at three locations to give an accurate reading of the sediment depth that can allow for an accurate calculation of the sediment volume. Auxiliary staff gauges should be installed in the locations indicated on the Basin Modification Map provided in Appendix-B. Post storm maintenance is required in addition to normal periodic maintenance when debris levels in the basin exceeds the staff gage mark that indicates the basin sediment depth is at or greater than 2-feet deep. As designed, the basin can store up to 3.5 feet of sediment from the basin invert elevation to the outlet weir elevation at 4,526.50-feet. The maximum volume of debris/sediment that can be stored in the basin below the weir outlet elevation is 1,740 cubic yards. When there are 2-feet of debris uniformly across the invert of the basin, the removal volume will be approximately 1,000 cubic yards. When there is 1-foot of debris uniformly across the invert of the basin, the removal volume will be approximately 500 cubic yards. Table 3-1 shown below provides the depth-storage relationship for the Library Basin so that the basin debris volume can be estimated quickly with depth readings from the staff gauges that are to be installed.

Table 3-1. Library Basin Debris Storage Volume

Library Basin Sediment Storage Volume			
Basin Invert Elevation (ft)	***4523.0-ft***		
Elevation (ft)	***Debris Depth (ft)***	***Surface Area (sq-ft)***	***Stored Debris Volume (cy)***
4523.0	0.0	10,800	-
4523.5	0.5	11,557	249
4524.0	1.0	12,314	498
4524.5	1.5	13,071	747
4525.0	2.0	13,829	996
4525.5	2.5	14,586	1,245
4526.0	3.0	15,343	1,494
4526.5	3.5	16,100	1,744
4526.5	**Outlet Weir Elevation = Max Debris Storage Volume**		

Maintenance Requirements

The basin can store 1.45-feet of water below the low-level outlet. Static pools of water less than 2-ft deep with very little or no wave action are breeding grounds for mosquitos. This basin should be stocked with mosquito fish

(Gambusia affinis) on a regular basis and/or treated with BTI mosquito control pellets periodically by San Bernardino County Vector Control staff.

Reverse flow from Lake Gregory into the basin will likely displace gravel from the gravel gallery at the basin side of the weir box wall low level outlet. This gravel gallery should be re-established such that the orifice holes should be completely covered with approximately 1.5 feet of gravel.

Sediment removal should be conducted on a semi-annual basis and after large storm events at minimum. Accumulated sediment within the debris basin should be removed to the basin invert at the surface of the articulated concrete block mattress. The estimated total volume of sediment removal is approximately 1,400 cubic yards per year corresponding to common annual storms (1-year return interval). For estimation of the accumulated sediment associated with certain forecast rainfall events, refer to Table 3-3.

Trees and/or shrubs adjacent to the basin access road and on the basin side slopes below the weir elevation (4,526.50-feet) should be pruned/trimmed/removed as determined necessary to maintain vehicular and equipment access. . Sapling trees should be removed adjacent to maintenance access areas to maintain clear access. If vegetation and tree removal is deemed necessary during the nesting season, a nest clearance survey should be conducted no more than 30 days prior to removal of vegetation/trees and vegetation removal should be monitored by a qualified biologist.

Sediment removal and tree and shrub pruning can be performed outside of the bird nesting season for raptors and passerines without any nest survey requirements. If activities involving vegetation removal or pruning is conducted within the nesting bird season, a preconstruction nest survey must be conducted within 30-days prior to initiation of the work to ensure there is no take of active nests, eggs, or fledglings. The nesting season is defined as March through September under Mitigation Measure Bio-1 in the adopted IS/MND.

Maintenance of Access Road and other Appurtenances

Maintenance of the access road is required. The constructed clear area and width and length of the access road should be maintained clear for safe ingress/egress and maintenance. In addition, maintenance activities will require clearing and trimming of brush and debris removal activities to maintain access and or restore access to parking and turnaround areas, basin outflow structure(s), and reconstruction or repair of fences/gates, access railings and stairs, inlet pipe structures/outlets, riprap, facing slabs, and staff gauges (to be installed in the future). Basin structures may require periodic graffiti removal.

Storm Damage Repair and Restoration Projects

Storm damage repair and restoration of existing structures back to pre-storm conditions includes eroded or damaged slopes and embankments, down drains, inlet and outlet pipes and related structures, rock riprap, and other on-site structures.

If sediment removal activities will be conducted when the basin has ponded or flowing water, appropriate Best Management Practices (BMPs) are required prior to starting the work consistent with California Stormwater Quality Association (CASQA) construction BMPs for stormwater pollution prevention plans (SWPPP).

3.2.1.2 Maintenance Equipment

A maintenance pad adjoins the parking lot north of the debris basin should serve as the staging area for equipment required to maintain the debris basin. A list of anticipated heavy equipment necessary for basin maintenance is provided below. The anticipated process of debris removal would utilize a small skid steer such as a Bobcat skid steer accessing basin invert via the 8-feet wide access ramp. The *Bobcat* would stage debris in the northeasterly corner of the basin within the reach of an excavator situated on the maintenance equipment pad. The excavator would then load the debris into dump trucks for disposal of the materials at designated location. Heavy equipment access shall be restricted to the access ramp, basin invert, and equipment pad. No heavy equipment should be used to traverse the basin side slopes for regular maintenance.

Anticipated Heavy Equipment Needs

- Tracked excavator with minimum reach of 30-ft
- Wheeled or tracked *mini-skid steer (Bobcat)*
- Three-axle 10-yd dump truck

3.2.2 Tributary Stormdrain Maintenance

The stormdrains tributary to the Library Debris Basin will require regular maintenance. The stormdrain inlets should be inspected on a quarterly basis year-round and before each forecast storm. The anticipated maintenance will require trash and debris removal to ensure the inlet is clear . This can be accomplished with hand tools, a Bobcat with a material loading bucket, and truck to haul away debris.

3.2.3 Visual Inspections

Basin maintenance requires periodic inspection as the trigger to initiate supplemental vegetation trimming and removal and Debris removal in addition to normal scheduled cyclical maintenance. Visual inspection should be conducted on a quarterly basis to prevent excessive vegetation growth or debris accumulation between normally scheduled basin maintenance. In addition to quarterly inspections, inspections should be scheduled following significant storm events; storm events with greater than 1-inch of precipitation. Visual inspections should note the following.

1. depth of debris deposition at the staff gauge near the weir box
2. presence of fallen and dead trees
3. the amount of vegetation undergrowth

All normal basin maintenance activities including debris removal, tree trimming, and brush clearance, should be conducted outside of the bird nesting season and to reduce risk of fire hazard, when possible. A preconstruction nesting bird survey will be required within 30-days prior to any work conducted in the nesting bird season that involves tree and vegetation trimming or clearing or would involve passing through an area that is outside of the designated access path

3.2.4 San Moritz Lodge Debris Channel/Basin Maintenance

The San Moritz Lodge Debris Basin/Channel is located near the southeast corner of the lake near the athletic fields and the San Moritz Lodge. A basin was developed on the south side of the Houston Creek East inlet to the lake. Accumulated sediment was removed, and additional riprap was provided to stabilize the streambed and protect the bank protection. The existing channel was reconstructed and regraded to restore flow capacity. The debris basin is an inline multistage linear basin within Houston Creek East. During the summer months when the lake flashboards are in place, the higher water surface submerges the basin, and it is not readily visible. When the flashboards are removed and the water level recedes, the channel / basin is visible. The improved channel section/debris basin includes a combination of riprap and vegetation to provide slope protection. The channel was constructed as a staircase type channel with relatively flat reaches joined by a small vertical drop. The basins are constructed on each tier of the channel drops. An adverse slope was created on each tier to create a small storage basin on each tier. Low flows and debris get trapped in the various tiers of the basin. Higher flowrates overtop the basin high point (berm) and spill to the next tier and ultimately out to the lake.

A soil cement access road was constructed to provide access for maintenance equipment and vehicles to the eastern side of the basin and along the southern edge of Lake Gregory. Some time after construction of the channel maintenance access road, a split rail fence was installed between the access road and the channel (see Figure-9), and the access road was repurposed as a community trail/exercise path. The access road/community trail no longer provides ingress/egress for small equipment to access the San Moritz Channel. However, it can still be used by larger equipment such as an excavator which can reach over the fence between the San Moritz Channel and the access road/community trail from the access road / community trail without damaging the fence. The basin should be inspected quarterly for as-needed debris and sediment removal, and restoration of the rock weirs, earthen bottom, and reinforced side slopes. During the summer, with the flash boards installed, the water level elevation in the lake rises to an elevation of 4,526.6 feet (NGVD 29) for recreational use. During winter, the flash boards are removed and the water level in the lake drops to the lake spillway elevation of 4,523.6 feet (NGVD 29).

3.2.5 Debris Removal

Accumulated debris within the bed of the debris basin/channel should be removed by mechanical means using a tracked excavator when necessary following major storm events (>1” rainfall) in the watershed, or at minimum semi-annually. The basin has vegetated side slopes stabilized by a turf reinforcement mat (TRM). The slopes are part of the mitigation area established for the Sedimentation Project. Mechanical equipment cannot be driven on the slopes. However, an excavator which can reach over the fence between the San Moritz Channel and the access road/community trail from the access road / community trail can be used to remove debris from the San Moritz Channel without damaging the fence. A dump truck staged on the access road to receive material retrieved from the channel would be needed to haul away excavated material.

The San Moritz Channel Basins are very small and shallow. The maximum storage depth of each cell in the basin is 2-ft. Staff gages are not necessary in a very shallow basin. However, elevation markers are proposed to be installed as part of the Sediment Management Project in order to aid maintenance staff in restoring the design shape/depth/volume of the basin(s) during debris removal procedures. Elevation markers will be installed in the basin at key locations to give an accurate indication of the original elevation at that point so that heavy equipment operators have a visual indicator of their target grades. Elevation markers will be installed in the locations indicated on the Sediment Management Project Improvement Plans. Post storm maintenance is required in addition to normal periodic maintenance when debris levels in the basin reaches the maximum storage depth and

fills up to the weir elevation marker for each basin which indicates the basin sediment depth is at 1-feet deep. As designed, the basin can store up to 1.0 feet of sediment from the basin invert elevation to the weir outlet for each cell of the basin. The maximum volume of debris/sediment that can be stored in the basin below the weirs is 423 cubic yards. When there is 1-feet of debris uniformly across the invert of each of the six levels of the channel/basin, the removal volume will be approximately 423 cubic yards. When there is 0.5-foot of debris uniformly across the invert of the basin, the removal volume will be approximately 128 cubic yards. Table-3.2 shown below provides the depth-storage relationship for the San Moritz Lodge Channel/Basin so that the basin debris volume can be estimated quickly with depth readings elevation markers that are to be installed.

Table 3-2. San Moritz Lodge Channel / Basin Storage Volume

San Moritz Lodge Channel/Basin Sediment Storage Volume				
	Elevation (ft)	*Depth (ft)*	*Surface Area (sq-ft)*	*Stored Debris Volume (cy)*
Stage 1	4525.0	0	1,133	-
	4525.5	0.5	1,649	25.75
	4526.0	1	2,164	61
Stage 2	4526.0	0	892	-
	4526.5	0.5	1,343	20.69
	4527.0	1	1,793	50
Stage 3	4527.0	0	1,834	-
	4527.5	0.5	2,436	39.54
	4528.0	1	3,038	90
Stage 4	4528.0	0	1,677	-
	4528.5	0.5	2,129	35.24
	4529.0	1	2,580	79
Stage 5	4529.0	0	1,718	-
	4529.5	0.5	2,190	36.19
	4530.0	1	2,662	81
Stage 6	4530.0	0	1,021	-
	4530.5	0.5	1,666	24.88
	4531.0	1	2,310	62
San Moritz Lodge Basin/Channel Total Maximum Storage Volume				**423**

Maintenance Requirements

Sediment removal should be conducted on an annual basis in October at minimum as routine maintenance. Accumulated sediment within the debris basin should be removed from the basin invert. The estimated total volume of sediment tributary to the San Moritz Channel/Basin is approximately 2,760 cubic yards per year. The basin can only store 15% of the expected annual debris production from the tributary watershed. Approximately 2,337 cubic yards of debris will flow through the channel/basin into Lake Gregory annually. It is expected that the debris that is not captured in the San Moritz Channel/Basin will accumulate in the lake and form a delta near the interface between the channel and lake as it has historically. For estimation of the accumulated sediment associated with certain forecast rainfall events, refer to Table 3-3.

Channel/Basin Lake Delta Dredging

The San Moritz Lodge Channel/Basin can only store 15% of the expected annual debris production from the tributary watershed. Approximately 2,337 cubic yards of debris will flow through the channel/basin into Lake Gregory annually. It is expected that the debris that is not captured in the San Moritz Channel/Basin will accumulate in the lake and form a delta near the interface between the channel and lake as it has historically. The debris will need to be removed annually to prevent an excessive build up and loss of storage volume in the lake. The majority of the debris will likely be stored in the lake below the OHWM (4525.0-feet). A permit will be required to remove sediment/debris from the lake below the OHWM. Debris should be removed from this area of the lake between Labor Day and March 1st. The lake swim season concludes on Labor Day and fish spawning season is from March through July. The annual sediment removal from this area of the lake is expected to be approximately 2,337 cubic yards. The sediment removal operation will depend on the water surface elevation at the time of removal. If the water surface remains high between Labor Day and March 1st dredging will need to be accomplished with a boat dredge. If the water surface recedes significantly, then dredging may be accomplished with conventional construction equipment such as wheel loaders. The dredging operation will require approximately 240 truck trips with three-axle 10-yard dump trucks to transport the sediment from the lake to the designated storage site.

Maintenance of Access Road and other Appurtenances

Maintenance of the access road is required. The constructed clear area and width and length of the access road should be maintained clear for safe ingress/egress and maintenance. In addition, maintenance activities will require mowing of grass and clearing or trimming of nearby brush and to maintain access to the channel/basin. The access road is underlain with turf reinforcement matting (TRM). Care must be taken to only mow when the soil is firm and can support the weight of the mower to prevent scalping of grass and damage to the TRM. Grass should be cut to no less than a 4-inch stand height to protect the TRM. Grass mowing shall be conducted as needed.

Storm Damage Repair and Restoration Projects

Storm damage repair and restoration of existing structures back to pre-storm conditions includes eroded or damaged slopes and embankments, related structures, rock riprap, and other on-site structures.

Normal Debris removal maintenance activities should not be conducted during the active season of the park while the basin is submerged. If maintenance will be conducted during the off-season and there is flowing water, in the channel appropriate Best Management Practices (BMPs) are required prior to starting the work consistent with California Stormwater Quality Association (CASQA) construction BMPs for stormwater pollution prevention plans (SWPPP).

3.2.6 Maintenance Equipment

A list of anticipated heavy equipment necessary for basin maintenance is provided below. The anticipated process of debris removal would utilize a tracked excavator situated on the access road adjacent to the basin. The excavator would then remove debris from the basin bottom and load the debris into dump trucks for disposal of the materials at designated location. No heavy equipment should be used to traverse the basin side slopes for regular maintenance nor enter the lake below the OHWM without a permit.

Anticipated Heavy Equipment Needs

- Tracked excavator with minimum reach of 30-ft
- Wheeled loader with 3-yard bucket
- Three-axle dump truck

3.2.7 Tributary Stormdrain Maintenance

The stormdrains tributary to the San Moritz Lodge Channel/Basin will require regular maintenance. The inlets to the stormdrain tributary to the basin] will require regular visual inspection and removal of debris. The stormdrain inlets should be inspected on a quarterly basis year-round and before each forecast storm. The anticipated maintenance will be trash and debris removal to clear each inlet. This can be accomplished with hand tools or by hand.

3.2.8 Visual Inspections

Basin maintenance requires periodic inspection as the trigger to initiate supplemental vegetation trimming and removal and Debris removal in addition to normal scheduled cyclical maintenance. Visual inspection should be conducted on a semiannual basis to prevent excessive vegetation growth or Debris accumulation between normally schedule basin maintenance. In addition to quarterly inspections, inspections should be scheduled following significant storm events; storm events with greater than 1-inch of precipitation. Visual inspections should note depth or elevation of Debris deposition relative to the outlet weir, presence of fallen and dead trees, and the amount of vegetation undergrowth. All normal basin maintenance activities including Debris removal, adjacent tree trimming, and brush clearance, should be conducted during the off-season period in October, to avoid the bird nesting season. Basin maintenance conducted between March 1st and Labor Day should only be conducted for special needs such as an emergency, fire hazard, or nuisance to the public, or conditions that are hazardous to public health or safety.

3.2.9 San Moritz Lodge Channel/Basin Mitigation Area Maintenance

In order to mitigate the permanent impacts associated with the improvement to the West Basin, the County re-established/created/enhanced a riparian willow habitat area (Willow Island). The mitigation area is located on the banks of the San Moritz Lodge Channel/Basin adjacent to San Moritz Lodge and adjacent to the soil cement access road. According to the mitigation plan, San Bernardino County is responsible for the implementation, performance, and long-term management of the mitigation area.

Maintenance Requirements

Maintenance of the mitigation site includes removal of non-native vegetation, removal of trash and debris, and maintenance of the temporary irrigation system. Normal maintenance should be conducted during the offseason on an annual basis in November before nesting season begins. A qualified biologist or restoration ecologist should be on site to observe and advise maintenance staff regarding removal of nonnative vegetation. The mitigation area should not contain more than 5% non-natives and nonnative vegetation should be removed for a 5-yr period. This 5-year period begins after the channel is seeded/planted in accordance with the specifications set forth in the resource agency approved Habitat Mitigation and Monitoring Plan.

Maintenance of Access Road and other Appurtenances

Maintenance of the access road is required. The constructed clear area and width and length of the access road should be maintained clear for safe ingress/egress and maintenance. In addition, maintenance activities will require clearing and trimming of brush and debris removal activities to maintain access to the area.

Maintenance Equipment

A list of anticipated heavy equipment necessary for mitigation area maintenance is provided below. The anticipated process of vegetation trimming, and tree removal would utilize hand tools and manual laborers to load cuttings into a chipper/shredder. A box truck would then remove chipped cuttings from mitigation area. No heavy equipment should be utilized in the mitigation area.

Anticipated Heavy Equipment Needs

- Chipper/shredder
- Box truck

3.2.10 Debris Production

In natural and developed watersheds storm runoff produces sediment through the forces of erosion and produces debris by mobilizing debris in the watershed. In stormwater nomenclature sediment, trash, and other deleterious materials are frequently referred to as "Debris." Debris production or Debris yield from watershed is very difficult to accurately determine. Several empirical methods have been developed for estimating the Debris production in a watershed for specific storm events and for average annual watershed yield. The Debris yield for the watershed tributary to Lake Gregory has been estimated for specific design storms and average annual volume.

Specific Storm Debris Production

Debris production analyses were performed to determine the debris produced in the watershed tributary Lake Gregory (*Albert A. Webb, 2013*) for large storm events. The debris yield for each watershed was determined using the USACOE Los Angeles District Debris Estimation Method. The soil loss from sheet and rill erosion is specific to storm intensity. The sediment yield was computed for the 1-hour duration storm event corresponding to the 2-yr through 10-yr storm intensity. Calculated estimated storm sediment yields are provided in Table-3-3 provided below.

Table 3-3. Sediment Yield Summary using USACOE LA District Method

Basin ID	Watershed Area(ac)	Debris Yield (cy)		
		0.92 inches (2-yr, 1hr)	*1.21 inches (5-yr, 1hr)*	*1.46 inches (10-yr, 1hr)*
A	415	3,782	4,560	5,161
B	853	11,122	13,305	14,953

Debris production analyses were performed to determine the debris produced in the watershed tributary Lake Gregory (*Albert A. Webb, 2014*) for large storm events. The debris yield for each watershed was determined using the National

Resource Conservation Service (formerly SCS) Revised Universal Soil Loss Equation (RUSLE). The RUSLE equation estimates watershed soil loss from sheet and rill erosion on an annual basis. Calculated estimated annual sediment yields are provided in Table-3-4 provided below.

Table 3-4. Average Annual Soil Loss/ Sediment Using the RUSLE Equation

Basin ID	Watershed Area (ac)	Annual Debris Yield (cy)
A	415	1,400
B	853	2,760

4 Lake Dredging

4.1 General Dredging Discussion

Lake dredging should not be required as a part of regular and normal lake maintenance activities. Dredging should only be conducted when sufficient sediment has accumulated in the lake to hinder normal lake operations or reduced the capacity of the lake sufficiently to necessitate removal of the sediment. Dredging should be conducted between Labor Day though Memorial Day outside of the fish spawning season. The following activities should be conducted when lake dredging is deemed necessary by Park management/staff to ensure proper functioning of the lake.

Lake dredging can be accomplished with either a boat mounted dredge or conventional construction equipment such as a wheeled-loader and excavator. The water surface elevation at the time of dredging would be the indicator for determining which equipment to use for the lake dredging operation. If the water surface is high and the subject dredging area(s) are below the water surface, then a boat dredge would likely be required. If the water surface is low, and soil is firm/dry enough to support equipment weight, then conventional construction equipment could be used to dredge. Additionally, a contractor could dewater portions of the lake by building a temporary coffer dam or berms and dewatering the work area while the temporary berms hold water back from the work area. During the dredging operation, the sediment that is removed from the lake will need to be temporarily stockpiled near the lake and dewatered. Both the dredging operation and the dewatering operation will require a water quality control plan or similar plan to guide implementation of Best Management Practices (BMPs) to protect the water quality of the lake from turbidity. There are numerous measures that can be implemented to protect the lake water quality during the dredging, stockpiling, and dewatering operations. A few recommended measures are described below.

4.2 Dredging BMPs

During the dredging process sediment is stirred up from the bottom of the lake and put into suspension in the water column. Depending on the specific gravity of the sediment particles it can stay in suspension for a short time or a very long time. We recommend that a floating turbidity barrier be deployed around the dredge area to contain suspended sediment in the work area and prevent migration of a sediment plume into the main body of the lake

4.3 Stockpiling BMPs

Depending upon the techniques used to accomplish the dredging the stockpile operation may effectively be a grading operation moving saturated sediment with earth moving equipment or it may be pumped to the stockpile area. In either case, the appropriate BMP is to provide full containment of the work area with a barrier such as gravel bags and/or silt fence.

4.4 Dewatering BMPs

Dewatering of the sediment stockpile will also depend on the technique used to dredge the material. If a dredge barge is employed the boat could pump the saturate sediment slurry to a slurry sock which will capture the sediment and allow the water to seep out. If conventional earth moving equipment is employed then a full

containment berm or barrier would be required to desilt water before it drains back to the lake. In either case, the appropriate BMP is to provide full containment of the dewatering area with a barrier such as gravel bags or silt fence.

4.5 Export of Dredge Material

The sediment material removed from the lake will be temporarily stockpiled adjacent to the lake to dewater the material prior to transport to an appropriate permanent location. The permanent location of sediment removed from the lake will be dependent upon availability of a location at the time of dredging. The permanent location will likely be a county owned facility such as Camp Switzerland which currently functions as a stockpile for debris removed from the lake and debris basins. However, there are also opportunities to broker the material for a nearby earthwork project or an active landfill that is accepting soil. There are also soil brokers that coordinate suppliers and buyers that could facilitate removal of the material from the site. In any case, the soil will need to be loaded into 10 cubic yard capacity 10-wheel dump trucks and trucked off site. The loading operation will be accomplished with a wheeled loader. The trucks will be staged on site and will traverse back and forth between the loading site and the receiving site.

5 Lake Gregory Operations and Maintenance

This Lake Gregory Operations and Maintenance Manual provides guidance and recommendations for each distinct area of the lake including the debris basins and creek outlets into the lake. Each area has unique physical characteristics that require ongoing operations and maintenance. Each area is addressed separately for clarity, although some of the operations and maintenance activities are common to several areas. Visual observation checklists have been prepared for maintenance staff to use as guidance documents to determine thresholds at which certain maintenance activities should be initiated.

Lake and Shoreline Operations and Maintenance Activities

The Lake Gregory Water Park operational season is from Memorial Day through Labor Day each year. From Labor Day through Memorial Day the waterpark is closed to the public and is non-operational. Maintenance of Lake Gregory will entail a number of maintenance activities that are limited to the park non-operational period only for health and safety reasons. While some maintenance activities are required to be conducted during the park operational season.

The process of keeping the lake aesthetically and functionally optimal consists of a number of operational and maintenance procedures. In essence, operational procedures are used to maintain good water quality in the lake. Water quality is a broad assessment of a variety of physical, biological, and chemical characteristics of the water in the lake. In general, good quality is judged by the absence of elements that interfere with the intended use or enjoyment of the lake. For example, clean, clear water with little or no algae or weed growth is generally regarded as a good quality for aesthetic viewing, but it may not be a good quality for fish growth. Fish cannot survive in sterile water because they require food and oxygen to survive. In addition, organic matter in the water (fish feces, plant Debris, such as weeds and leaves, etc.) cannot degrade acceptably without bacteria and sufficient oxygen. Suspended material causing turbidity (such as clays, silts, organic Debris, etc.) or floating Debris in a lake is aesthetically unacceptable. Excessive plant growth (algae, aquatic weeds, and vegetation) and floating Debris are generally undesirable and cause more complaints from lake users and visitors than all other indicators of water quality. Though objectionable to lake visitors, some plant blooms are inevitable and may be beneficial to the lake ecosystem. In essence, the lake must operate as a nearly balanced ecosystem to satisfy the majority of its users or visitors at a reasonable cost. It is a difficult task to satisfy every person who uses or visits the lake because each user applies different measures of water quality depending upon their intended use of the lake. For example, a casual park visitor or lakeshore observer typically wants clear, clean water, free of odors, free from nuisance bugs (mosquitoes, midges, and others), free from floating algae and Debris, and with no visible weeds. However, the angler wants to catch trophy sized fish with no aquatic weeds to tangle his lines. Anglers often regard aquatic plants, both emergent and floating, as an indicator of good water quality. These conflicting opinions and uses must be resolved or mutually informed to coexist and to achieve a successful lake; a lake that meets the intended goals/purpose(s).

5.1 Lake Management Goals at Lake Gregory

Lake Gregory is a dedicated manmade community recreational lake that has many intended uses to serve xxxx annual visitors. The uses for Lake Gregory include full body contact uses such as seasonal swimming, and year-round partial body contact uses such as boating and fishing. In addition, the lake offers shoreline cabanas, picnic areas, a marina, lodging, and wedding venues. Currently, Lake Gregory is not a drinking water supply facility. The management goal for the lake is to provide a lake that will support recreational uses with a minimum disturbance to active and passive lake users and other park visitors.

In order to ensure that the intended use objectives for the lake are met, specific minimum standards or goals for lake operation should be established. Periodic corrective action may require time to accomplish them. In these cases, lake maintenance staff should diligently pursue the cause of any deviation from the minimum standards, assess the problem with regard to lake uses, initiate corrective action, and inform responsible personnel of the progress in meeting standards. The recommended lake water surface/operational standards are as follows:

1. Floating Debris - Floating Debris (trash, leaves, fish etc.) should be held to a minimum by daily collection during routine patrol of the lake each working day.
2. Water Clarity - A Secchi Disk reading of two (2) or more feet should be maintained. Should the water turbidity be less than this standard, immediate steps should be taken to determine the cause and corrective action should be taken. Rapid changes in the readings are an indication of developing problems.
3. Dissolved Oxygen - A minimum of five (5) milligrams of oxygen per liter (mg/l) is desirable to protect the fishery and aquatic life in the lake. Should oxygen levels drop below the minimum as indicated by routine monthly monitoring, the cause should be determined, and corrective action initiated.
4. Algae - Some algae growth is essential in maintaining a balanced ecosystem in the lake. Objectionable growths of algae (those that interfere with the intended uses of the lake or cause odors and unsightly conditions) should be identified and controlled by appropriate action.
5. Aquatic Plant Growth - Aquatic plant growth is good for wildlife, the fishery, and the lake ecosystem. However, if aquatic plant growth interferes with any of the intended uses of the lake should be identified and controlled by appropriate action, physical removal and cutting rather than chemical controls.
6. Vector Control-A Lake vector identification and control program should be developed. An effective lake vector control program will control shoreline vectors such as rats, mice, gophers, squirrels, etc. In addition, flying inset vectors such as mosquitoes, midge flies, house flies, hornets, etc. need to be controlled as well. We recommend natural vector control methods through creating and supporting a balanced ecosystem where there is a balance of food sources, predators, and prey at each level of the food chain.
7. Waterfowl Population Control - Excess waterfowl can be devastating to lake water quality. Waterfowl produce more waste per unit body weight than bovine. An effective resident waterfowl population control program should be developed.
8. Water Level Control - The lake water level should be maintained within normal limits to preserve the shoreline conditions.
9. Rule Enforcement and Lake Patrol - All rules and regulations pertaining to the use of the lake and maintenance of the lake's quality should be enforced by routine patrol of the lake by authorized personnel. Violations of rules should be entered in a Lake Log and reported to the Lake Manager for action.
10. Lake Log-A Lake log should be maintained by the lake management staff. The objective of a log is to establish a chronological record of all pertinent data relative to lake quality and rule violations, such as,

but not limited to water clarity, plant growth, water level, water temperature, oxygen content, insect infestations, waterfowl population growth, rule infractions, trespass, equipment malfunctions, etc.

Periodic inspections, especially immediately following significant runoff events aquatic plant weed control via mechanical weed removal or cutting in February prior to opening of the waterpark and before fish spawning season.

Swim beach area lake bottom footfall and/or foot contact grooming below the water line to a depth of six (6) feet based on current elevation. Grooming will be accomplished manually and mechanically. Workers with landscape and Debris rakes will manually groom the lake bottom surface, removing foreign objects and decaying plant material to an approximate depth of three feet while ensuring a consistent, contoured, and safe foot contact area for swimmers. A power boat pulled drag will be used at low speed to accomplish the same tasks and minimize turbidity to an approximate depth of six (6) feet. All material removed from the lake will be disposed of in a safe and legal manner.

Proposed on-going maintenance activities would be conducted as necessary and limited to the Park Non-operational (off-season) period of September through March. The following activities will be conducted as determined necessary by Park management/staff to ensure protection of the lake, the fishery, and the recreational resources available at Lake Gregory Regional Park.

Sediment removal at local stormdrain outlet locations - Sediment removal should be completed by either hand tools or mechanical means where local stormdrains discharge to the lake at various locations around the lake perimeter. Access and topography vary by location; therefore, excavation methods would be site-specific to each of the outlet locations. Approximately 31 pipe outlets have been identified around the lake perimeter. Regular maintenance is required at each lake outlet. Lake outlets vary in size from 4-inches to 36-inches in diameter and contribute to lake sediment accumulation at varying rates. Lake sediment removal at the stormdrain outlet locations is proposed to occur in October before the beginning of the traditional rainy season and in April at the end of the traditional rainy season, and as determined necessary by the park maintenance staff based upon quarterly inspections.

Sediment removal would occur under the following conditions:

a) Sediment removal: accumulated sediment removal at the designated locations would be completed by mechanical means including wheeled and tracked vehicles when necessary. All sediment removal will be completed while equipment tracks/wheels are located above the lake's OHWM.
b) Culvert pipe repair: sediment loads travelling through inlets to the lake have resulted in clogged inlets in the past. When an inlet is observed to be clogged or flow is observed to be obstructed by sediment by the Park's management/staff, culvert outlet cleaning and grooming will be scheduled. All culvert pipe repair and maintenance activities would be limited to occur during the Off-Season. Access and topography vary at each of the culvert inlets; thus, maintenance methodologies may vary by location; however, this maintenance will not require any equipment to be situated below the lake's OHWM.

Lake Sediment Removal at Outlets - Sediment removal will be completed by mechanical means. Access and topography vary by location; therefore, removal methods would be site- specific to each of the outlet locations.

Stormdrain Repair: sediment loads travelling through inlets to the lake have resulted in clogged inlets in the past. When an inlet is observed to be clogged or flow is observed to be obstructed by sediment by the park's operating personnel, culvert outlet cleaning and grooming will be scheduled. All culvert pipe repair and maintenance

activities would be limited to occur during the Off-Season. Access and topography vary at each of the culvert inlet; thus, maintenance methodologies may vary by location. However, all culvert maintenance should be conducted using equipment situated outside of the lake's OHWM.

Figure X - Lake Outlet Sediment Removal Locations

Stormdrain Outlet Sediment Removal

Stormdrain outlet sediment removal should occur under the following conditions:

1. All sediment removal should be completed by mechanical means including wheeled and tracked vehicles when necessary with equipment located above the lake's OHWM at elevation 4,525-feet.
2. Equipment access areas will be marked to define the work area and minimize impacts to adjacent habitat to the greatest extent practicable.
3. Outlet pipe repair and maintenance, as necessary, should be scheduled during the off-season.

5.2 Lake Ecology Control

As the science of aquatic ecosystem management has matured with new information, it became evident that eradication of a nuisance organism should not be the only management goal to pursue. Better methods of controlling the source or cause of the problem have been developed. The first primary producer by photosynthesis in a lake is algae. Algae blooms are the result of excessive nutrients, sunlight, and carbon dioxide in the water in the absence of a natural algae predator, i.e., zooplankton. If the algae population is "eradicated" with an algaecide, then there would be no food for zooplankton to develop, and therefore no food for higher aquatic species. Gradually, emphasis was placed on the control of nutrients to reduce the algae growth rate to an acceptable level and provide an environment suitable for algae predators. In turn, to keep the zooplankton populations within reason, fish are required to graze on the zooplankton, and so on up the aquatic ecosystem pyramid to the top consumers. In other words, the best aquatic management techniques involve control of nutrients with the establishment of a competitive ecosystem.

Unfortunately, nutrient control is not a complete singular solution. Certain aquatic organisms can still grow out of proportion and restrict the uses of a lake. All aquatic organisms have a limited life cycle, and dead and decaying organisms settling to the bottom of a lake can cause other problems in the overall management of a lake. If the dissolved oxygen is not sufficient in the lake water column for aerobic decomposition by aerobic bacteria, anaerobic bacteria take over with undesirable byproducts (such as, hydrogen sulfide and methane) which can cause odor problems and death of desirable aquatic organisms. In addition, anaerobic decomposition of bottom deposits releases "trapped" nutrients to the water column to grow more algae and macrophytes (higher forms of aquatic plants).

Nutrients can be tied up in desirable aquatic plants and animals in the lake. Certain types of organisms are not as objectionable to the lake user as others. Aquatic vegetation can be grown in controlled containers or locations in the lake to bind nutrients in the lake and provide oxygenation of the lake, food for insects and animals, and shade for fish. Conventional water quality control methods include chemical controls. JS&TM strongly recommends avoiding the use of chemical controls. Lake Gregory is in the Lahontan Region. Chemical controls are not allowed in jurisdictional lakes in the Lahontan Region. The use of chemical controls is outdated and often leads to much larger long term lake water quality problems through the accumulation of adverse side effects from their use.

No singular method or technique will solve all of the problems in an aquatic ecosystem. To achieve a reasonably balanced ecosystem in a lake, the lake manager needs to use a variety of overlapping and complementary techniques to effectively manage, or the varied conditions present in an active lake ecosystem. The selection of a technique(s) should be based on specialized training on the part of the system manager or a knowledgeable consultant following a good monitoring program that pin-points the problem. The recommended monitoring program is discussed in the next item and operational procedures for carrying out the selected program will follow.

5.3 Monitoring Program

The goal of the monitoring program is to provide information that will assist in achieving a balanced aquatic ecosystem and an aesthetically pleasing lake with minimal insect infestations, no fish kills, and minimal uncontrolled algae blooms. All management decisions should be based on sound data and observations. Periodic water quality tests and environmental observations are vital in aquatic ecosystem management. Changes in test results are indicative of potential problems that may be averted by prompt action. The proposed monitoring program is shown in Table 5-1. An explanation of the various monitoring items can be found in Table 5-2. The first couple of years in the monitoring program may show that the number of testing stations and/or frequency of tests may need adjustment. In addition, rapid changes in the physical condition of the lake may require additional tests. A Lake Monitoring Location Map was prepared to show the approximate target locations for lake maintenance personnel to take monitoring readings. The Lake Monitoring Location Map is provided in Appendix-C.

Table 5-1. Monitoring Program

Physical Parameters	**Frequency**
Temperature Profile	M
Secchi Disk Depth	M
pH	M
Suspended Solids	SA
Observation of Algae & Macrophyte Growth	Q
Weather (mean air temperature)	W
Water Level	M
Lake Activities, Remarks	M
Equipment Performance (check)	M
Biological Activities	**Frequency**
Algae Density and Composition	Q
Aquatic Macrophyte Identification	Q
Zooplankton Identification	Q
Midge Counts	SA
Chemical Parameters	**Frequency**
Dissolved Oxygen Profile (DO)	M
Nitrogen (Ammonia, Nitrite, Nitrate)	M
Phosphorus (ortho)	M
General Mineral Analysis	SA

Table 5-1. Monitoring Program

Physical Parameters	Frequency
Sediment Analysis	SA

Symbols

L General Observation of Lake
D Daily
WO Where Observed
W Weekly
Q Quarterly
SA Semi Annually
M Monthly
A Annually

Table 5-2. Explanation of Monitoring Items

Temperature	Lake temperature should be monitored to determine suitability of the lake water for introduction of various aquatic organisms. Determining the vertical temperature profile indicates the cycle of thermal stratification and mixing, which influences the lake oxygen content, nutrient distribution, and organism dynamics. Use portable DO/TEMP meter from boat.
Secchi disk depth	The Secchi depth indicates the relative transparency of the water. A transparent lake is often desirable on an aesthetic basis, but may lead to excessive algae growth and development of submerged macrophyte populations because of the availability of light for photosynthesis. Use disk from boat.
pH	The pH value of water is important for aquatic organism survival. The potential aquatic toxicity of many naturally produced chemicals in the lake (e.g., heavy metals) is influenced by pH. Use pH meter.
Suspended solids	The amount of suspended material in the lake influences lake clarity, development of aquatic plants, and input of particulate nutrients that accumulate in the sediment and become available during lake turnover.
Dissolved oxygen	A minimum dissolved oxygen concentration must be maintained in the lake to protect aquatic life. This will become particularly crucial when balancing and predatory organisms are introduced into the lake. The oxygen distribution also indicates the level of vertical mixing of the water column and the status of temperature and chemical stratification. Maintenance of aerobic water above the sediment protects against the release of potentially toxic unionized dissolved gases and prevents release of many nutrients that accumulate in the sediments.
Nitrogen and Phosphorus species	Ammonia, nitrate, and ortho-phosphate are forms of nutrients that are readily available to aquatic plants. When nutrient levels are high, the potential exists for a subsequent alga bloom. When the amount of suspended phosphate (total minus ortho) and organic nitrogen (total Kjeldahl nitrogen minus ammonia) are high, assimilation of nutrients is indicated. Nutrient availability is often seasonal, and patterns can be defined and used to predict when management action may be needed before unsightly conditions are allowed to develop.

Table 5-2. Explanation of Monitoring Items

Mineral Analysis	A more complete mineral analysis should be made to establish changes in water chemistry other than nutrients. Tests should include carbonate, bicarbonate, chlorides, sulfates, total hardness, calcium, sodium, iron, and total dissolved solids (TDS). Heavy metals and other items may be required by public agencies. Tests can be made by service companies, consultants or testing laboratories.
Algae density and composition	The density of algae strongly influences the aesthetic appeal of the lake system. Monthly monitoring can establish spatial and temporal patterns of algae growth and timing of appropriate management actions. Identification of the species of algae is important in the selection of the appropriate means of physical or biological control.
Zooplankton density	The numbers of zooplankton in the lake indicate the level of balance in the aquatic ecosystem. Zooplankton feed on planktonic algae and serve as a natural control mechanism. They also provide a source of food for many fish species, especially during the fish's early life stages. The forms of zooplankton present serve as indicators of the degree of eutrophication of the lake.
Midge fly larvae quantification	Because of potential problems with nuisance densities of emergent midges in the area surrounding the lake, constant monitoring of the abundance and distribution of the organisms is necessary. The seasonal pattern of abundance can be determined to measure the success of biological and physical control strategies. Water column assessment (performed concurrently with the zooplankton analysis) can indicate when midge pupation is occurring, and emergence is anticipated.
Aquatic macrophyte quantification and identification	The substratum should be routinely checked for development of submerged aquatic plants. In other lakes in the area, macrophytes have completely covered a lake bottom in a relatively short period of time (one to two years) and have been considered aesthetically unacceptable. The species of the plant must be known to determine what management action would be appropriate for control.
Sediment analysis	Sampling the bottom sediments for general quantity and composition (inorganic, organic, organisms) and phosphorus should be conducted in selected lake areas at least semi-annually. Analysis for heavy metals may be required by public agencies. Tests are of value in determining if a dredging program is necessary.

5.4 Lake Water Surface Maintenance

All lakes tend to collect floating debris, oil, grease, and trash in certain areas. This material generally collects in coves or in vegetation along the leeward shoreline. The debris will normally build up on the prevailing windward side of the lake, but other areas will catch Debris because of changing wind and water current patterns. Surface debris will typically consist of aquatic plant fragments, terrestrial vegetation (leaves, twigs, grass clippings, etc.) and trash (paper, cans, plastic bottles, tennis balls, and petroleum products). The amount and nature of the debris will depend on user activities in the park and activities in the watershed as well as natural vegetation and landuses in the watershed.

The principal tasks are removal of floating debris from the surface of the lake and removal of Debris from the bottom of the lake. Typically, floating debris can be removed at the shoreline using nets on long reach poles and a debris/trash can. Larger pieces of flotsam may be removed by hand netting. Bottom debris removal will depend on the type of debris involved. It may be removed with nets, rakes, or by hand. Hydrosoil, which will develop on the bottom of the lake, will consist of soil, dead algae, and other organic debris.

5.5 Algae, Aquatic Plant and Turbidity Control

The growth of algae and aquatic plants depends on nutrient availability, carbon dioxide, and sunlight. Some algae forms are required for a balanced ecosystem. Beneficial algae in water are objectionable only when it grows out of proportion (such as an algae bloom). Filamentous alga (blue green) is objectionable because it forms a heavy scum that floats, attracts flying insects, causes odors, and is somewhat toxic to fish and other marine organisms. Periodic plankton counts and identification tests should be conducted by lake operation personnel or supporting consultants. When undesirable forms or quantities of algae are detected, the lake should be evaluated to determine the source of excess nutrients. Often times the source of excess nutrients is waterfowl excrement and waterfowl feeding from the public. It is of paramount concern to manage the waterfowl population and remove excess waterfowl to protect and restore the lake water quality.

Every effort should be made to achieve a reasonably balanced aquatic ecosystem without the use of chemical treatment that treats symptoms instead of cause. Removal or deactivation of nutrients may be more satisfactory and economical than algaecide or herbicide treatments. See Section 4.14 for a discussion of the use of chemicals in lake ecology.

5.6 Insect Control

Eutrophic lakes are often plagued with large plant growth (macrophyte) and aquatic insect infestations. These two problems often go hand-in-hand, but they can occur separately. Macrophytes are aquatic plants that typically are attached to the bottom, float on the surface, or rest on the bottom. They may be rooted and extend above the water level such as cattails or tules, or they may be soft bodied and submerged such as hydrilla or cattails.

Macrophytes are particularly troublesome in shallow water areas where light can penetrate to the bottom, and where the bottom has not been hardened with soil cement or concrete. Floating macrophytes are generally more of a problem in areas, such as coves, where water currents are reduced, and wind patterns tend to keep the plants in place. Dense growths of macrophytes can cause problems by providing protective shelter for nuisance insects, by creating an area for trash to accumulate. Uncontrolled dense beds of these plants can be unattractive and detract from the aesthetic appeal of the lake water surface.

Mosquitoes can exist in very large numbers in floating or attached algae or in macrophyte growth. They can be eliminated in most cases by controlling macrophyte growth and by introducing mosquito fish (Gambusia affinis) to a lake. Lake systems are usually the first source blamed for the appearance of mosquitoes. Mosquito larvae and midges develop in still water less than 2-feet deep. Other insect midges develop as larvae in the bottom muds, mainly in water less than six (6) feet in depth. At times they will hatch and create nuisance conditions for lakeside users. These insect populations can be reduced by stocking bottom feeding fish (such as catfish and fathead minnows), and/or by disturbing the hydrosoil on the hardened slope (motorboat wake) so that the fish can eat the larvae. Chemical control should be avoided. Encouraging growth of a resident bat population or providing habitat for bats is an effective complementary means of mosquito and insect control along with other methods. Some bat species feed heavily on mosquitoes and can be effective at controlling populations of adult flying mosquitoes

5.7 Erosion Control

Landscaped areas around the lake are generally erosion resistant. If erosion occurs, the water can become turbid and undesirable bottom sediments will form. Damaged landscape areas should be repaired as soon as possible to prevent further damage.

5.8 Employee Training and Emergency Conditions

Employees responsible for lake maintenance and lake patrol should be trained to do the routine cleaning operations necessary, and to spot any pending problems. To do this, the employee should have access to this manual and other literature on ponds, lakes, and ecology.

Every effort should be made to prevent emergencies, but project maintenance personnel should be trained in rescue operations, and know where to get help quickly. They should also be trained to enforce safety rules to prevent accidents. All maintenance personnel should be familiar with the location and operation of equipment to detect and correct malfunctions.

Parents should encourage their children to observe all rules and regulations, and all personnel should inform violators of the rules.

5.9 Trash Collection

Trash containers should be provided in the lake area. Trash thrown on the ground can be unsightly, or it can be blown into the lake. Periodic pick-up by the lake maintenance crew will help, but trash accumulation between pick-ups could be rather unsightly and a nuisance. If everyone cooperates by properly disposing of trash, the lake area will remain more aesthetically enjoyable for all. Floating trash in the lake should be removed by authorized persons only to minimize exposure to untrained persons. Local community members and visitors to the park should not place wood or other floatable material in the lake.

New animal-proof trash bins with lids should be provided at no less than 300-foot intervals around the perimeter of the lake accessible to pedestrians and near all shade structures, walkways, and parking areas.

5.10 Rules and Regulations

We have provided a few suggested rules and regulations concerning lake activities to provide a safer lake environment. All Rules and Regulations should be formally adopted by San Bernardino County. It is sometimes difficult to enforce when the general public has access to the facility, but some rules and regulations are required for good management. Posted rules and regulations will also aid peace officers in enforcing the rules. The following are suggested:

General Lake Rules

1. Tampering with lake or dock equipment is strictly prohibited.

2. No swimming, wading, scuba gear, floating objects (remote control boats are permitted), littering, drinking alcoholic beverages, or glass ware.
3. Fish (such as goldfish, Koi, carp, etc.) should not be placed in the lake.
4. No animals in the lake.
5. Boats, windsurfers, jet skis, jib sails and other similar crafts are prohibited on the lake.
6. Do not drink the lake water.
7. Small children at play in the lake area should be supervised by a responsible adult.
8. Do not throw refuse, rubbish, or trash in the lakes.
9. Fishing is allowed only by permit issued by the State of California.
10. No fish cleaning in the lake areas.
11. Do not feed the waterfowl.
12. Pieces of wood or other floating objects should not be placed in the lake.
13. Rubber, plastic, or wood rafts are not allowed.

5.11 Safety

Every precaution is taken in the design and rehabilitation of the lake to make this project safe and enjoyable. Since safety is a prime consideration, a general discussion of water safety features is in order to establish the basic features of this water feature design. Accidental drowning prevention is, of course, the main objective.

Arbitrary depth restrictions in man-made (or natural) bodies of water are not generally effective in drowning prevention. Drownings can and do occur in very shallow depths of less than six (6) inches. Drownings generally occur when the victim is unable to cope with a given situation. The victim may stumble into a “hole” or drop off while wading. In most cases, the victim suddenly and unexpectedly finds himself in water over his head and panics. Drownings seldom occur when a potential victim gradually enters deeper water because natural instincts warn him that danger is present. For example, non-swimming children playing in the water at a “natural” beach will not venture into water much above their waistline. This instinctive action, coupled with good design in man-made bodies of water, should greatly decrease the accidental drowning potential.

The following minimum features should be used in all man-made lake and ponds to ensure maximum safety with good ecological control:

1. Swimming access should only be allowed in designated areas. No swimming, wading, full body contact activities should be permitted outside of the designated areas. There should be no large abrupt changes in water depth in areas with controlled access.
2. Designated swim areas should be posted, have lifeguards on duty during permitted swimming hours and should have a high contrast bottom that provides stable footing to allow better identification of potentially distressed persons needing assistance
3. Slopes should be controlled and gradual to ensure good footing for people in the water, in areas where entry to the lake can be anticipated. Underwater slopes should not exceed a slope of 4:1 (H:V).
4. All slope areas should be designed and constructed to prevent or restrict weed and insect growth with minimum turbidity problems.
5. Shoreline erosion and sinkholes should be repaired to preserve safe footfall area conditions

6. Circulation of water in the lake is a necessity to prevent dead spots that can become stagnant due to excessive buildup of contaminates. In Lake Gregory, the water is likely circulated sufficiently by wind action and temperature gradients.
7. Trash must be removed from the lake.

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Appendix A

Library Debris Basin Inspection Checklist and San Moritz Lodge Channel / Basin Inspection Checklist

Library Debris Basin Inspection Checklist

☐ Wet Season ☐ Dry Season ☐ Pre-Rain ☐ Post-Rain ☐ Other_____

Inspector:_____Date(s) of Inspection:_____Inspection Time:_

Instructions: *Complete checklist while surveying the basin. For action items, contact*_____

Weir Box, Low-Flow Orifices, Culvert(s)

What is the depth of accumulated sediment inside the weir box?		ft.
What is the average depth of accumulated sediment inside the culvert pipes?		ft.
Is the gravel gallery covering the Low-Flow Orifices in place?	Yes	No
Is there litter and debris in the weir box?	Yes	No

Notes:

1. If sediment in the culvert pipes and weir box is greater than 6 inches during the **off-season**, initiate maintenance procedures to remove sediment using hand methods or combine with sediment removal from the basin invert. During the recreational season, schedule sediment removal as early as possible at the onset of the off-season.
2. Remove all litter and debris in the weir box as early as possible, regardless of the season.
3. Clear the weir wall orifice openings and replace displaced gravel at the face of the orifices regardless of the season.
4. Record any damage to the weir box, low-flow outlet riser, and culvert pipe and entrance.

Record Observations: _____

Debris Basin

Record the elevation of accumulated sediment shown on the staff gauge at the weir box?		ft.
Are there fallen or dead trees in the basin invert?	Yes	No
Is there vegetation undergrowth in the basin invert?	Yes	No
Is there debris and sediment clogging any of the basin inlet pipes?	Yes	No
Is there flotsam (branches and dead vegetation) and litter in the basin invert?	Yes	No
Is there damage to basin inlet pipes?	Yes	No

Notes:

1. If the elevation of accumulated sediment in the basin is one foot below the top of weir (Elev. 4528 ft.) during the **off-season** (October to March), initiate maintenance procedures to mobilize equipment for removal of sediment from the basin as early as possible. During the recreational season (April to September), schedule sediment removal as early as possible at the onset of the off-season.
2. Remove fallen or dead trees during sediment removal and/or annually at the onset of the off-season. If there is significant number of fallen or dead trees in the basin, remove them before the next storm event.
3. Remove significant vegetation undergrowth during sediment removal and/or annually at the onset of the off-season.
4. Record the level of sediment and/or debris clogging the basin inlet pipes.
5. Record any damage to basin inlet pipes.

Record Observations: _____

☐ Wet Season ☐ Dry Season ☐ Pre-Rain ☐ Post-Rain ☐ Other_____

Inspector:_____Date(s) of Inspection:_____Inspection Time:_

Instructions: *Complete checklist while surveying the basin. For action items, contact*_____

Basins, Weirs, Inlet Pipes, Vegetated Side Slopes

What is the depth of accumulated sediment inside the basin?		ft.
What is the average depth of accumulated sediment inside the inlet pipes?		ft.
Are the rock rip-rap weirs visible and in-place	Yes	No
Is there litter and debris on the banks?	Yes	No

Notes:

1. If sediment in the inlet pipes is greater than 6 inches, initiate maintenance procedures to remove sediment using hand methods or combine with sediment removal from the basin invert. Schedule sediment removal as early as possible.
2. Remove all litter and debris from the banks as early as possible, regardless of the season.
3. When sediment in the basin reaches 1.0-ft in depth commence sediment removal operations as early as possible
4. Replace displaced rocks and re-establish weirs as early as possible after basin sediment removal operations.

Record Observations: _____

Debris Basin

Record the elevation of accumulated sediment shown on the staff gauge at the weir box?		ft.
Are there fallen or dead trees in the basin invert?	Yes	No
Is there vegetation undergrowth in the basin invert?	Yes	No
Is there debris and sediment clogging any of the basin inlet pipes?	Yes	No
Is there flotsam (branches and dead vegetation) and litter in the basin invert?	Yes	No
Is there damage to basin inlet pipes?	Yes	No

Notes:

6. If the elevation of accumulated sediment in the basin is one foot below the top of weir (Elev. 4528 ft.) during the **off-season** (October to March), initiate maintenance procedures to mobilize equipment for removal of sediment from the basin as early as possible. During the recreational season (April to September), schedule sediment removal as early as possible at the onset of the off-season.
7. Remove fallen or dead trees during sediment removal and/or annually at the onset of the off-season. If there is significant number of fallen or dead trees in the basin, remove them before the next storm event.
8. Remove significant vegetation undergrowth during sediment removal and/or annually at the onset of the off-season.
9. Record the level of sediment and/or debris clogging the basin inlet pipes.
10. Record any damage to basin inlet pipes.

Record Observations: _____

San Moritz Lodge Channel / Basin Inspection Checklist

☐ Wet Season ☐ Dry Season ☐ Pre-Rain ☐ Post-Rain ☐ Other_____

Inspector:_____Date(s) of Inspection:_____Inspection Time:_____
Instructions: *Complete checklist while surveying the basin. For action items, contact*_____

Debris Basin

Record the elevation of accumulated sediment shown on the staff gauge at the weir box?		ft.
Are there fallen or dead trees in the basin invert?	Yes	No
Is there vegetation undergrowth in the basin invert?	Yes	No
Is there debris and sediment clogging any of the basin inlet pipes?	Yes	No
Is there flotsam (branches and dead vegetation) and litter in the basin invert?	Yes	No
Is there damage to basin inlet pipes?	Yes	No

Notes:

1. If the elevation of accumulated sediment in the basin is one foot below the top of rip-rap weir between each channel reach during the **off-season** (October to March), initiate maintenance procedures to mobilize equipment for removal of sediment from the basin as early as possible. During the recreational season (April to September), schedule sediment removal as early as possible at the onset of the off-season.
2. Remove fallen or dead trees during sediment removal and/or annually at the onset of the off-season. If there is significant number of fallen or dead trees in the basin, remove them before the next storm event.
3. Remove significant vegetation undergrowth during sediment removal and/or annually at the onset of the off-season.
4. Record the level of sediment and/or debris clogging the basin inlet pipes.
5. Record any damage to basin inlet pipes.

Record Observations:_____

_____

_____

_____

_____

☐ Wet Season ☐ Dry Season ☐ Pre-Rain ☐ Post-Rain ☐ Other_____

Inspector:_____Date(s) of Inspection:_____Inspection Time:_____
Instructions: *Complete checklist while surveying the basin. For action items, contact*_____

Basins, Weirs, Inlet Pipes, Vegetated Side Slopes

What is the depth of accumulated sediment inside the basin?		ft.
What is the depth of accumulated sediment inside the inlet pipes?		ft.
Are the rock rip-rap weirs visible and in-place	Yes	No
Is there litter and debris on the banks?	Yes	No

Notes:

6. If sediment in the inlet pipes is greater than 6 inches, initiate maintenance procedures to remove sediment using hand methods or combine with sediment removal from the basin invert. Schedule sediment removal as early as possible.
7. Remove all litter and debris from the banks as early as possible, regardless of the season.
8. When sediment in the basin reaches 1.0-ft in depth commence sediment removal operations as early as possible
9. Replace displaced rocks and re-establish weirs as early as possible after basin sediment removal operations.

Record Observations: _____

Debris Basin

Record the elevation of accumulated sediment shown on the staff gauge at the weir box?		ft.
Are there fallen or dead trees in the basin invert?	Yes	No
Is there vegetation undergrowth in the basin invert?	Yes	No
Is there debris and sediment clogging any of the basin inlet pipes?	Yes	No
Is there flotsam (branches and dead vegetation) and litter in the basin invert?	Yes	No
Is there damage to basin inlet pipes?	Yes	No

Notes:

10. If the elevation of accumulated sediment in the basin is one foot below the top of weir (Elev. 4528 ft.) during the **off-season** (October to March), initiate maintenance procedures to mobilize equipment for removal of sediment from the basin as early as possible. During the recreational season (April to September), schedule sediment removal as early as possible at the onset of the off-season.
11. Remove fallen or dead trees during sediment removal and/or annually at the onset of the off-season. If there is significant number of fallen or dead trees in the basin, remove them before the next storm event.
12. Remove significant vegetation undergrowth during sediment removal and/or annually at the onset of the off-season.
13. Record the level of sediment and/or debris clogging the basin inlet pipes.
14. Record any damage to basin inlet pipes.

Record Observations: _____

Appendix B

Lake Gregory Sediment Management Project
As-Built Plans

J. SMITH & T. MULI