

Operation and Maintenance Plan

Dam Safety

Instructions

The Dam Safety Office (DSO) designed this template to aid dam owners in creating an Operations and Maintenance (O&M) Plan. For some simple earthen dams, completing this plan, or something equivalent, will satisfy the O&M Manual requirement under WAC 173-175-500. For other dams - like large concrete dams - a more comprehensive, detailed manual, which incorporates this plan, may be required by DSO. DSO will make this determination on a case-by-case basis after reviewing the completed dam template.

The template is a fillable-form and provides a wide variety of possible O&M elements. Most dams will not have every element listed here; and some dams may have elements that are not specifically listed in this template. Therefore, the owner should write N/A if an element doesn't apply and add elements in the blank spaces if needed.

More information and guidance on developing O&M documents can be found at <https://fortress.wa.gov/ecy/publications/SummaryPages/92021.html>, "Guidelines for Developing Dam Operation and Maintenance Manuals."

Although maintenance and repair work does not typically require a dam safety permit, some engineered solutions require DSO pre-approval. In addition, some of the assessment and repair work identified in this plan may require the services of a professional engineer (P.E.) and the use of specialized equipment. This could include concrete repairs and major component replacements. The owner should consult with the DSO if unsure which assessments and repairs require DSO approval and P.E. consultation. Maintenance activities should be logged on the owner's annual inspection report to DSO.

Worker safety should be paramount when implementing the plan. For instance, some working spaces require confined space entry training and protocols. Also, underwater work should be done by certified and skilled divers.

Finally, it is the owner's responsibility to comply with all other applicable federal, state, and local requirements including environmental review and permitting, if necessary.

Send copy of completed form to Ecology

Copies of completed O&M Plans should be sent to the Dam Safety Office.

Send by email to: damsafety@ECY.WA.GOV

Or by mail to: Department of Ecology
Water Resources Program
Attn: Dam Safety Compliance Technician
PO Box 47600
Olympia, WA 98504-7600

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Operation and Maintenance Plan Dam Safety

I. General Information

Project Data

Dam Name:	
Reservoir Name:	
Owner Name:	
Date:	County:
Dam Type: <input type="checkbox"/> Earthen <input type="checkbox"/> Concrete	Dam Number:

Responsible Individuals:

Operation:

Name:	Title:
Telephone:	Email:

Maintenance:

Name:	Title:
Telephone:	Email:

Inspections:

Name:	Title:
Telephone:	Email:

Monitoring of Instrumentation:

Name:	Title:
Telephone:	Email:

List of Hydraulic Elements for Controlling Inflow to or Outflow from Reservoir:

Check which elements exist and fill in the description, location, and dimensions of each. Add additional elements as needed.

Exists	Element	Description, Location, and Dimensions
<input type="checkbox"/>	Runoff inflow to reservoir from upstream watershed	
<input type="checkbox"/>	Inflow pipeline or channel (include gates, valves)	
<input type="checkbox"/>	Drop inlet spillway(s) (include gates, valves)	
<input type="checkbox"/>	Open channel or weir spillway (include gates, valves, stoplogs)	
<input type="checkbox"/>	Culvert spillway (include gates, valves, stoplogs)	
<input type="checkbox"/>	Storm pond flow control structure (include gates, valves, orifices)	
<input type="checkbox"/>	Low outlet pipeline – reservoir drain (include gates, valves)	
<input type="checkbox"/>	Low outlet pipeline – water supply (include gates, valves)	
<input type="checkbox"/>	Diversion channel to divert runoff away from or around reservoir	
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		

****Add drawing to Appendix A showing where all hydraulic elements are located.**

II. Project Operations

Rules and Procedures for Reservoir Operation:

How is the reservoir level controlled? _____

How do reservoir operations change during floods? _____

Is the reservoir level manually changed throughout the year? _____

When is the reservoir drawn down? _____

When is the reservoir filled? _____

Record Keeping

List of records to be kept. Check all that apply:

Maintenance records

Observations

Inspections

Monitoring records

Pool levels

Photos

Gate operations

Drawdowns

Location of records _____

Facility Security:

How do you prevent intentional damage to your facility by outside parties? _____

Describe any security monitoring equipment? _____

Owner Annual Inspections:

Per [WAC 173-175-510](https://www.wa.gov/leg/wac/default.aspx?cite=173-175-510), owners are required to do an overall inspection of their dam annually and to submit a copy of the report to the Washington State Dam Safety Office.

Time of year annual inspection will be performed: _____

An owner may use their own format, or they can use one of Ecology's Dam Owner Annual Inspection Form templates located online.

Earthen dams: <https://fortress.wa.gov/ecy/publications/SummaryPages/ECY070572.html>

Concrete Dams: <https://fortress.wa.gov/ecy/publications/SummaryPages/ECY070613.html>.

****Add a blank inspection form to Appendix B which the owner will use to document the inspections.**

Other Owner Inspections:

Describe any other routine or special circumstances inspections outside of the annual inspection. This might include post-earthquake or post-storm event inspections to conduct damage assessments:

III. Instrumentation and Monitoring

List of Instrumentation:

Check which instrumentation exist and fill in the table. Add additional instrumentation as needed.

Exists	Instrumentation	Location of Instrumentation	Frequency of Monitoring	Method of Record-keeping
<input type="checkbox"/>	Weirs, flumes, pipes and other means to measure seepage flow			
<input type="checkbox"/>	Monitoring/Observation wells to measure water levels			
<input type="checkbox"/>	Piezometers to measure pore pressures within embankment/foundation			
<input type="checkbox"/>	Staff gauges to measure reservoir levels			
<input type="checkbox"/>	Flumes, weirs, and/or gauges to measure reservoir inflow/outflow			
<input type="checkbox"/>	Rain gauge to measure precipitation			
<input type="checkbox"/>				
<input type="checkbox"/>				
<input type="checkbox"/>				

****Add drawing to Appendix C showing where all instrumentation is located.**

IV. Maintenance

List of Items Requiring Periodic Maintenance with Frequency and Description:

Earthen Dams and Embankments

Fill in the frequency. Add elements as needed.

Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)
Vegetation control		Remove weeds and mow native grasses as needed to allow visual surveillance of the embankment surface and abutments. Remove and/or control woody vegetation.
Control of burrowing animals		Control burrowing animal population to alleviate the problem long term. Repair animal burrows by compacting fill into the excavated areas. If burrowing is extensive, seek the advice of a professional engineer, as fill must be replaced to original grades and densities.
Maintain crest design elevation		Fill any ruts or minor depressions with similar fill material to designed grade. Repair erosion. If extensive, seek the advice of a professional engineer and contact the Ecology Dam Safety Office.
Erosion control on upstream and downstream slopes		Repair rills and gully erosion. Reseed with native grasses or install appropriate erosion control measures such as wattles, net wire diversions, gravel fill, etc. Fill large rills and gullies with compacted fill. If erosion is extensive, seek the advice of a professional engineer and contact the Ecology Dam Safety Office.
Drain outfalls		Keep free of obstructions and open to allow free drainage. Control vegetation at outfall so outfall can be located and accessed for observation and inspection. Monitor seepage through drains. Include photographic documentation.

Concrete Dams and Impoundments

Fill in the frequency. Write N/A if not applicable to dam. Add elements as needed.

Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)
Dam structure		Monitor for cracks, spalling, exposed re-bar or other deterioration of the concrete. Record locations of cracks, crack lengths and widths, dates of observations. Include photographic documentation. With P.E. supervision, repair as needed.
Dam abutments and foundation		Control vegetation at abutments and toe of structure so abutments and foundation can be located and accessed for observation and inspection. Monitor for seepage at abutments and at toe of structure. Include photographic documentation.
Drain outfalls		Keep free of obstructions and open to allow free drainage. Control vegetation at drain outfalls so outfalls can be located for observation and inspection. Monitor seepage through drains. Include photographic documentation.
Parapet walls		Keep concrete joints and surfaces free of vegetation. Monitor for cracks, spalling, exposed re-bar or other deterioration of the concrete. Repair concrete surfaces and joints. Include photographic documentation.

Closed Water Conveyance Systems (i.e., Pipelines, Culverts, Drop Inlet Spillways)

Fill in the frequency. Write N/A if not applicable to this dam. Add elements as needed.

Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)
Pipe or spillway entrance or intake		Keep free of obstructions and open to the reservoir. Remove debris and vegetation that could interfere with flow capacity.
Trash rack and log boom		Remove debris and vegetation from trash rack, log boom, and spillway (port and weir) openings.
Drop inlet riser or flow control structure		Keep low outlet pipe(s) free of obstructions. Remove debris that could interfere with flow capacity.
Sediment level at inlet riser		Assess sediment level at riser. If sediment is nearing intake, the sediment must be removed to prevent sediment from entering or clogging the riser.
Concrete surfaces, joints and structures		Keep concrete joints and surfaces free of vegetation. Monitor for cracks, spalling, exposed re-bar or other deterioration of the concrete. Repair concrete surfaces and joints. Include photographic documentation.
Gates		Test gates to ensure they are in working order. Grease gates and replace gate seals as needed. If gates have not been operated for an extended period of time, retain the services of an experienced consultant to inspect the gates/valves before operating them.
Valves		Test valves to ensure they are in working order. Lubricate valves and replace seals per manufacturer's instructions. If valves have not been operated for an extended period of time, retain the services of an experienced consultant to inspect the gates/valves before operating them.
Maintain metal pipeline features		Remove mineral deposits and paint or galvanize metal features as needed. Restore corroded metal to original condition by replacing or welding on new metal and painting to prevent corrosion. Severely corroded CMP pipe may require slip-lining. If corrosion is extensive, seek the advice of a professional engineer and contact the Ecology Dam Safety Office.
Inlet structure		Repairs surfaces and joints and remove any blockages.
Inlet conduit		Repair any corrosion, leakage, or other significant problems. Remove blockages.
Principal spillway outlet structure		Remove visible and accessible obstructions to flow (e.g. debris, vegetation, etc.) Repair cracks in concrete as necessary. Replace or repair riprap, gabion baskets, shotcrete and other armoring materials to prevent movement or removal by flow events. Reshape channel as necessary to maintain channel geometry shown on the as-built drawings.
Principal spillway outlet channel		Repair erosion and other defects. Remove any obstructions, including debris, small trees and bushes or any other material that could affect flow now or in the future.
Drain outfall for filter drain diaphragm		Keep free of obstructions and open to allow free drainage. Control vegetation at drain outfall so outfall can be located and accessed for observation and inspection.
Pipeline outfalls		Keep free of obstructions and open to allow free discharge. Control vegetation at pipe outfall so outfall can be located and accessed for observation and inspection.
Energy dissipation at pipeline outfall		Keep free of obstructions and open to allow free overflow to downstream channel. Control vegetation at pipeline outfall so energy dissipation features can be located and accessed for observation and inspection. Replace or repair riprap, gabion baskets, shotcrete, concrete and other armoring materials to prevent movement or removal by flow events.

Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)

Open Water Conveyance Systems (i.e. Channels, Ditches, Weir Spillways)

Fill in the frequency. Write N/A if not applicable to this dam. Add elements as needed.

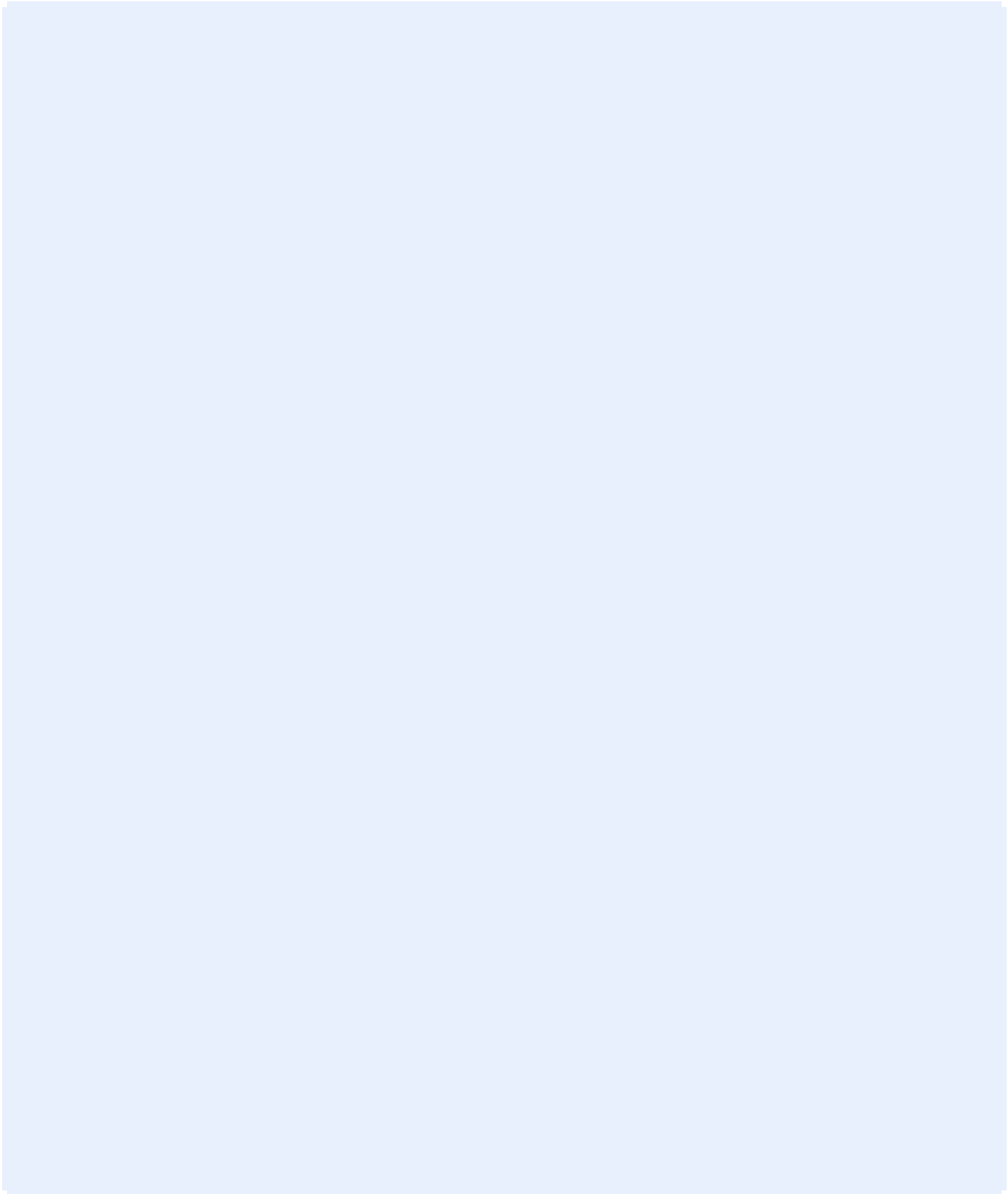
Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)
Earthen spillways		Keep free of obstructions and vegetation to maintain channel hydraulics. Repair erosion damage and gullies by removing loose material and replacing it with compacted fill. Gravel and properly sized riprap should be added to the damaged area as appropriate to prevent future erosion. Replace or repair riprap, gabion baskets, shotcrete, concrete and other armoring materials to prevent movement or removal by flow events.
Concrete and hardened spillways		Keep free of obstructions to maintain channel hydraulics. Keep concrete joints and surfaces free of vegetation. Monitor for cracks, spalling, exposed re-bar or other deterioration of the concrete. Repair concrete surfaces and joints. Include photographic documentation.
Spillway entrance or approach channel		Keep free of obstructions and open to the reservoir. Remove debris and vegetation that could interfere with flow capacity.
Trash rack and log boom		Remove debris (and vegetation, if any) from trash rack or log boom.
Weir structure		Keep weir structure free of obstructions. Remove debris that could interfere with flow capacity.
Gates and gate support structures		Test gates to ensure they are in working order. Grease gates and replace gate seals as needed. Inspect spillway radial gates for surface corrosion, repair as needed. Monitor concrete support structures for cracks, spalling, exposed re-bar or other deterioration of the concrete.
Stoplogs or weir boards		Make sure stoplogs or weir boards can be installed or removed as needed for reservoir operations or to increase spillway capacity for dam safety purposes.
Underdrains for concrete-lined channel		Keep drain outfalls free of obstructions and open to allow free drainage. Control vegetation at drain outfalls so outfalls can be located and accessed for observation and inspection.
Spillway outfall		Keep free of obstructions and open to allow free discharge. Control vegetation at outfall so outfall can be located and accessed for observation and inspection.
Energy dissipation at spillway outfall		Keep free of obstructions and open to allow free overflow to downstream channel. Control vegetation at pipeline outfall so energy dissipation features can be located and accessed for observation and inspection. Replace or repair riprap, gabion baskets, shotcrete, concrete and other armoring materials to prevent movement or removal by flow events.

Other Elements

Fill in the frequency. Write N/A if not applicable to dam. Add elements as needed.

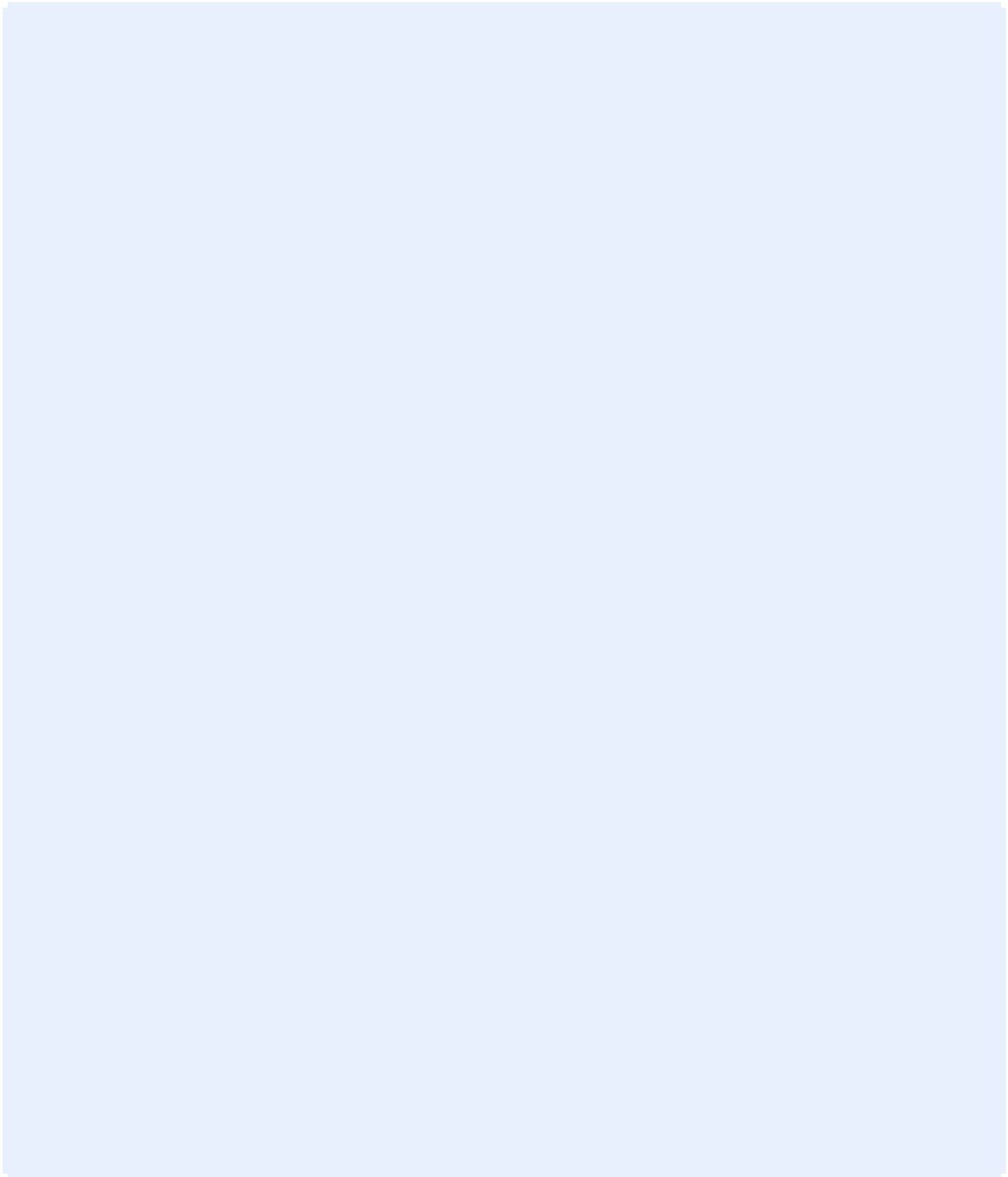
Element	Frequency (i.e. weekly, monthly, annually, after large storm events, after seismic events)	Maintenance Activity Description (Modify descriptions as necessary)
Fences		Make repairs to fences and gates as needed.
Safety signs and barriers		Repair and replace safety signs and barriers as needed.
Pond liner		Repair holes, tears and other damage as needed.
Reservoir Area		Keep reservoir area clear of debris and vegetation that could clog spillway intakes. Maintain log boom.
Security Equipment		Repair or replace damaged, stolen, or out-of-date equipment
Fish passage ladders and equipment		

Appendix A
Drawing showing locations of hydraulic elements



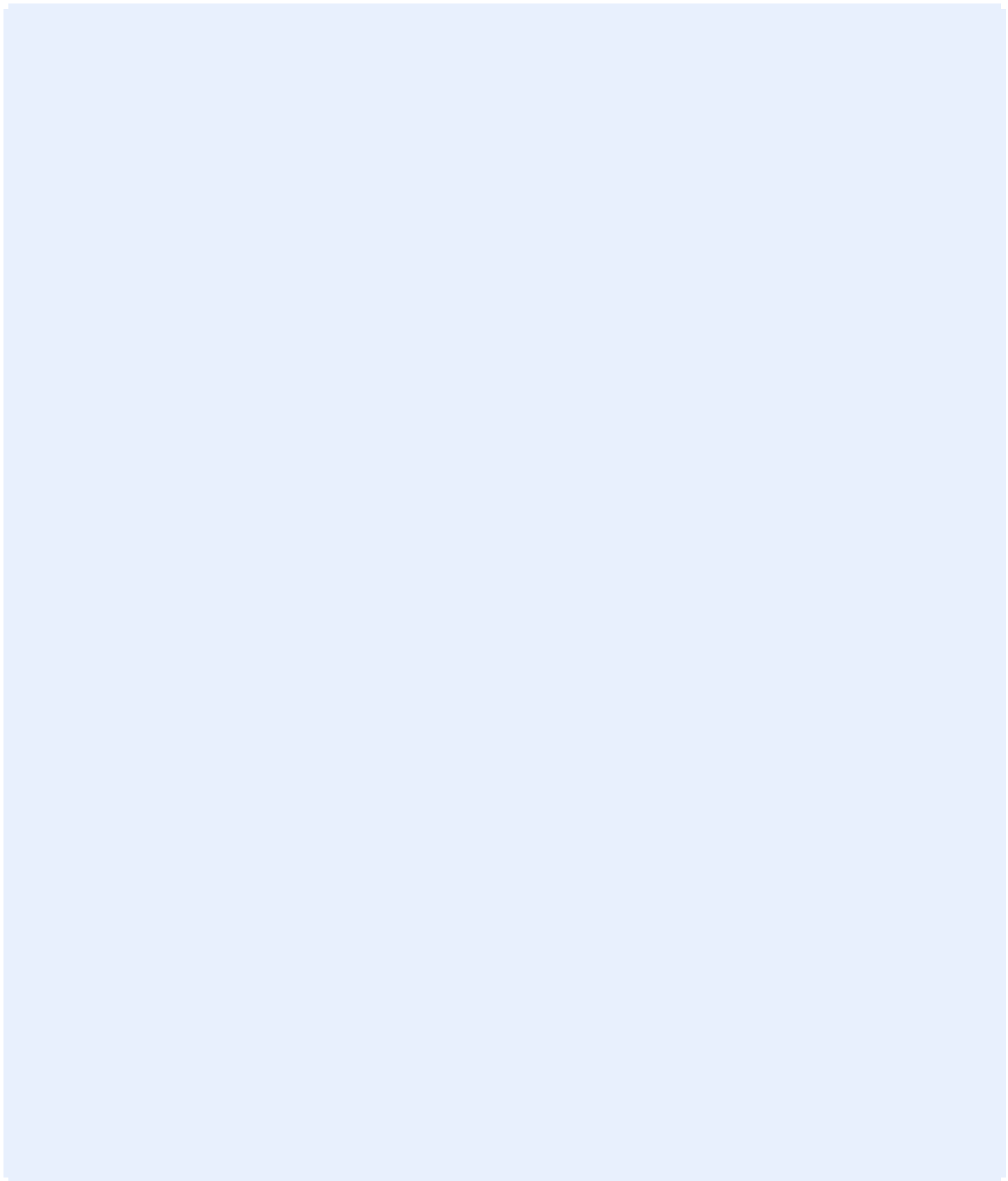
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Appendix B
Owner Annual Inspection Form



Insert blank form here.

Appendix C
Drawing showing locations of instrumentation



Insert drawing here.