Decision Alternatives

1. **Remove dam:** dam is removed completely from the river, allowing water to flow freely
2. Improve fish passage: some type of fish passage technology is installed (e.g., state-of-the-art fish lift/elevator, eel ladder, etc).
3. **Improve hydropower generation:** (e.g., install turbines, upgrade turbines, or expand power capacity): hydropower generation capacity is increased, whether by installing new capacity or by upgrading turbines to larger power capacities or higher efficiency ratings; includes powered and non-powered dams.
4. **Improve hydropower generation AND fish passage:** some type of fish passage technology is installed AND hydropower generation capacity is increased.
5. **Keep and maintain dam:** this is the do-nothing option, where the dam remains in place and minimal costs are incurred to ensure dam structural integrity and safety compliance.

Removal: When a dam is removed, water is allowed to flow more freely downstream, creating greater connectivity for fish passage and river recreation, bolstering sea-run fish populations, and improving benthic (riverbed) aquatic communities. Dam removal may increase local water quality, regulate water temperature, and provide additional tourism/fishing opportunities. The river and its tributaries will likely return to their "natural" flows. However, dam removal may also create temporary mud flats as the reservoir empties, and/or release toxic or harmful impounded sediments. Dam removal eliminates lake-dwelling wildlife habitat and local flatwater recreation opportunities, reduces overall reservoir storage volume, and lowers total annual hydropower generation. Costs are typically high for dam removals, with no payback in terms of direct market returns.

Improve Fish Passage: Improvements to a dam's fish passage may increase survival for one or more sea-run fish species within the watershed and improve angling in the river. Improvements to fish passage may even provide learning opportunities for citizens and students. However, annual electricity generation may be diminished (depending on the technology selected to pass fish), and fish passage costs are typically high. Fish passage improvements may be required by law depending on the species migrating in the waterway, and additional improvements may become required as other species become threatened or endangered. In the case where the owner is required to improve passage for sea-run fish species, the owners must bear the cost or risk surrendering the dam operation license.

Improve Hydropower Generation: When new turbines are installed on existing non-powered dams, or hydropower capacity is increased at a powered dam, annual hydropower generation increases. Similarly, upgrading or replacing turbines may increase annual generation and improve longevity for a hydropower dam. Increases in hydropower generation may reduce greenhouse gas emissions that contribute to climate change. Costs may be recouped through market returns over the project's lifetime, and the change in the dam's operation may even present opportunities for whitewater recreation downstream (dam releases are popular for river rafting). However, installing turbines or expanding existing power capacity may alter flows and confuse sea-run fish species. Fish may become caught in the grates protecting system intakes, or even be killed by turbine blades or rapid changes in pressure if they are small enough to move through the powerhouse. Actual reservoir storage may change based on overall hydropower operations.

Improve Hydropower Generation AND Fish Passage: When hydropower generation improvements AND fish passage improvements are made to a dam (powered or non-powered), they may increase survival for sea-run fish species within the watershed. However, installing turbines or expanding existing power capacity may also alter flows and confuse sea-run fish species, who may

be attracted to the water moving through the system intake. Fish may become caught in the grates protecting the system intake, or even killed by turbine blades or rapid changes in pressure if they are small enough to move through the powerhouse. Annual electricity generation will increase overall, and revenue may help recoup costs over the project's lifetime. Increases in hydropower generation may reduce greenhouse gas emissions that contribute to climate change. Turbine operation may be less efficient with fish passage (depending on the technology selected), and fish passage costs are typically high. Fish passage may be required by law depending on the species migrating in the waterway, and additional improvements may become required as other species become threatened or endangered.

Keep and Maintain Dam: Keeping and maintaining the dam is the closest to a "do-nothing" option included in this tool. It is generally the lowest-cost option in the near-term. Keeping and maintaining the dam may appeal to parties interested in preserving the area's industrial history, preserving the community identity for local residents (if community identity is closely tied to the dam), or preserving the aesthetic value of the impoundment. Maintenance costs may be recouped somewhat if the dam is powered; however, refurbishment, restoration, or maintenance to a non-powered dam presents no direct opportunity for cost offset. Keeping the dam will likely have no impact on reservoir storage volume, river recreation area, annual electricity generation, or number of properties abutting the reservoir. The impoundment will continue to present a barrier to sea-run fish species, thereby negatively impacting their survival. And, in the long run, the dam is a temporary piece of infrastructure that may need to be removed.