Session notes for
"How do the District's current and potential futures affect the Mad River?"
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These notes are intended to provide additional information that we were unable to fit into our 30 minute presentation.

Our approach to evaluate the potential environmental effects of the water use options was to:

- Identify the flows that would likely occur in the river under each option
- Create an effects evaluation table, with options/flows as column headers, and environmental resources as rows
- List the unknowns and areas of uncertainty that are important

From morning sessions, we learned that we have identified 2 options of water rights and 3 types of water uses:

1) License now and forfeit the unused water

2) Use our water right fully, which includes:

2A. Increase water use for instream purposes
2B. Increase water use within the HBMWD service area
2C. Increase water use outside of the HBMWD service area
2D. Combination of uses

(We are limiting ourselves to evaluating effects during summer because District operations have little hydrologic effect on winter flows.)

From the standpoint of flow in the river, the 5 scenarios are really only 3 because once the flow is diverted, the river doesn't "care" what happens to it, and because Use 2D is within the range of flows that would result from Uses 2A and 2B/2C. Therefore, the 3 options from the river's perspective are:

1. Store the water in Ruth Reservoir, and release only that flow needed for municipal use and minimum bypass flows.

2A. Release water from Ruth Reservoir for hydropower, instream beneficial use, and municipal use, with no flow being diverted by the District's surface diversion facility.

2B/2C. Release water from Ruth Reservoir for diversion down river at the District's surface diversion facility, for some type of consumptive use either in or outside of the District's service area as well as for diversion for municipal use and minimum bypass flows.

Based on the geography of the river and the District's operations, we view the river as two distinct reaches, 1) the "upper river" that is the 75 miles from Matthews Dam to Essex, and 2) the "lower river" that is the 9 miles from Essex to the ocean, including the estuary.

Units: when talking about the District's operations, we think in terms of MGD. But hydrologists generally use cubic feet per second (cfs) when talking about river flows. The attorneys use acre-ft per year. Conversion is MGD x 1.55 = cfs.

Table 1. Approximate flows due to District operations.

Type/purpose of flow	Flow in MGD	Flow in cfs
Maximum surface diversion at Essex	60	93
Flow used by municipalities via Ranney wells at Essex	20	31
Minimum bypass flow required by District's permits	16	25

Minimum bypass flows are set at "natural conditions" or 25 cfs whatever is less. For this analysis, we assume bypass flows are 25 cfs.

We present flows in a table and graphically (see PPT slides).

Table 2. How summer flows would change from current conditions under 3 water uses options. The District currently releases up to 31 cfs for municipal use plus ~25 cfs for bypass flow. **NOTE:** All flows are approximate because tributary flows and summer baseflows have not been considered; our purpose is to provide a general view of flow controlled by the District under these options.

Option	**Flow resulting from option in "upper river" from Ruth Reservoir to Essex**	**Flow resulting from option in "lower river" from Essex through the estuary**
1. Store the water in Ruth Reservoir, and release only that flow needed for municipal use and minimum bypass flows.	No change in current release from Ruth (~56 cfs)	No change in bypass flows (~25 cfs)
2A. Release water from Ruth Reservoir for hydropower, instream beneficial uses, and municipal use, with no flow being diverted to the District's surface diversion facility	Release 93 cfs to generate hydropower and instream flow including 31 cfs for municipal use, for a total of 124 cfs	Flow to lower river and estuary increased to ~62-118 cfs.
2B/2C. Release water from Ruth Reservoir for diversion down river at the District's surface diversion facility and Ranney wells as well as for bypass flows	Release an additional 93 cfs, plus 56 cfs for municipal and bypass flows, for a total of approx 149 cfs	No change in bypass flows (~25 cfs)

Important points from Table 1 and PPT slides:

- River "sees" no difference between 2B and 2C. Once water is diverted, river "doesn't care" if the use is local or outside of District service area.
- One option (Option 2A) can potentially affect the estuary
- Even under the "forfeit the unused water right" option (Option 1), the river still will flow in the summer because the District must supply the municipal customers and the minimum bypass flow requirement. So there will be no return to "natural" conditions when the upper river would become dry in the summer, and the mouth would close.

To systematically evaluate the potential ecological effects of these options, we created a table with the options as the column headers, and environmental resources that could experience effects (impacts and benefits) as the row headers.

We filled out the table based on 1) the District's approved Habitat Conservation Plan (the "HCP"), and 2) on personal communications with scientists and engineers with specific experience on the Mad River. The scientists and engineers who generously gave time and thought to potential effects are:

- Neal Carnam, Winzler & Kelly
- Randy Klein, Redwood National Parks
- Bill Trush, McBain & Trush
- Frank Shaughnessy, Humboldt State University
- Dennis Halligan, Stillwater Sciences
- Phillip Bairrington, California Department of Fish and Game

Any errors in these session notes are ours, not theirs!

In our presentation, we focused on the most important or surprising findings, but we present the complete evaluation tables here. We evaluated possible effects by location, the upper river (Table 3) and the lower river and estuary (Table 4).

Assumed:

- Continued operation of Matthews Dam and Ruth Reservoir to supply municipal customers
- Winter flows remain relatively unaffected by Matthews Dam and Ruth Reservoir (our concerns are primarily summer flows and effects)

Table 3. Possible environmental effects from water use options on the "upper river" of the Mad River

Environmental resources potentially affected	1.Release only that flow needed for municipal and minimum bypass flows. No surface diversion.	2A. Release for hydropower, instream flow beneficial uses, and municipal use. No surface diversion.	2B/2C. Release for surface diversion and municipal use wells and minimum bypass flows.
Hydrology	Releases to supply municipal Ranney wells (31 cfs) and minimum bypass flows (25 cfs), summing to 56 cfs	Would have higher flows than current or natural conditions during summer. The approximate maximum release from Ruth Reservoir is 124 cfs.	Dependent on flows required for the surface diversion, but range would be a maximum of 149 cfs
Geomorphology	No major geomorphic changes expected because geomorphic changes result primarily from large winter flows.	Again, no major geomorphic changes expected because geomorphic changes result primarily from large winter flows.	Again, no major geomorphic changes expected; any changes would be within range of those resulting from Options 1 to 2A.

Salmonid access to tributaries	Less flow and/or dry conditions would decrease access. Could exacerbate fish decline if tributary conditions are poor	Unknown if higher summer flows could significantly increase access between mainstem and tributaries, or allow summer steelhead to migrate farther up river than RM 53.	Any changes would be within range of those resulting from Options 1 to 2A.
Salmonid mainstem rearing habitat (District augments natural flow June through Oct, spawning occurs Nov through April)	Under natural hydrology the river above RM 61 often dried up. Any flow greater than natural flow will increase mainstem habitat area and depth of summer steelhead holding pools	Additional flow may increase mainstem habitat, but other habitat requirements need to be met such as substrate, cover, lack of predation, over-fishing. Higher flows could negatively affect pool thermal stratification, affecting adult summer steelhead and rearing juvenile salmonids.	Any changes would be within range of those resulting from Options 1 to 2A.
Riparian habitat area and quality	Riparian zone fairly narrow due to channel confinement. No change is expected with 56 cfs released from Matthews during the low flow season.	Additional summer flow is not expected to increase riparian area in upper confined reach but in the unconfined reach near Blue Lake, riparian habitat could increase.	Any changes would be within range of those resulting from Options 1 to 2A.
Water quality, especially temperature and algae	Water released from Matthews Dam will have a limited effect on water temperature downriver. Released water warms as if flows down 75 mi reach. Increased flows likely inhibit toxic algae growth.	Water released from Matthews Dam will likely have a limited effect on water temperature downriver even with additional flow. Released water warms as if flows down 75 mi reach. Increased flows would continue to inhibit toxic algae growth.	Any changes would be within range of those resulting from Options 1 to 2A.
Non-salmonid freshwater and riparian species of concern such as red-legged frog, green sturgeon, lamprey, willow flycatcher.	No change is expected with 56 cfs released from Matthews during the low flow season.	Additional flow could benefit some species, but many other factors affecting them. Currently, these species are declining even though the District has provided more summer flow since 1962, than under pre-District natural conditions.	Any changes would be within range of those resulting from Options 1 to 2A.
Invasive species of concern such as bullfrogs, New Zealand mudsnail	Negative effects on bullfrogs would be beneficial to red-legged frogs and juvenile salmonids. Timing of flows might be able to benefit red-legged frogs at expense of bullfrogs.	Higher flows could increase bullfrog habitat with no other control measures, which would negatively affect salmonids, red-legged frogs, and other native species.	Any changes would be within range of those resulting from Options 1 to 2A.

Table 4. Possible environmental effects of water use options on the "lower river" and estuary of the Mad River

Environmental resources potentially affected	1. Release only that flow needed for municipal and minimum bypass flows. No surface diversion.	2A. Release for hydropower, instream flow beneficial uses, and municipal use. No surface diversion.	2B/2C. Release for surface diversion and municipal use.
Hydrology	Approx 56 cfs before Ranney wells at Essex, and 25 cfs after the wells (minimum bypass flows are 25 cfs)	Assuming no surface diversion, but subtracting the 31 cfs for municipal uses, could be as high as 93 cfs.	Dependent on instream flow released but range could be a approximately 25 cfs.
Geomorphology	Minimum bypass flows required downstream of Essex is natural flows or 25 cfs whichever is lower. Estuary would remain open	Mouth would remain open. Possible deepening of channel. Pool habitat unlikely to increase substantially. Indirect geomorphic changes could result if higher flows support riparian forests or adjacent wetlands.	Any changes would be within range of those resulting from Options 1 to 2A.
Salmonid access to tributaries	Less flow and/or dry conditions would decrease access. Could exacerbate fish decline if tributary conditions are poor	Increased flow could allow easier early season upstream migration. Unknown if higher summer flows could significantly increase access between mainstem and tributaries.	Any changes would be within range of those resulting from Options 1 to 2A.
Salmonid mainstem rearing habitat	Under natural flows, freshwater to the estuary was minimal. The mouth would often close in late summer when freshwater inflow is minimal or non-existent. Bypass flows increase freshwater inflow, improve water quality, and keep the mouth open.	Additional flow may increase mainstem habitat, but other habitat requirements need to be met such as substrate, cover, lack of predation, over-fishing. May allow early season migration. Possible increase in benthic invertebrates, more food for juveniles.	Any changes would be within range of those resulting from Options 1 to 2A.
Riparian habitat area and quality	No change is expected with 56 cfs released from Matthews during the low flow season.	Additional flow throughout the summer could increase riparian habitat with a higher water table.	Any changes would be within range of those resulting from Options 1 to 2A.

Environmental resources potentially affected	1. Release only that flow needed for municipal and minimum bypass flows. No surface diversion.	2A. Release for hydropower, instream flow beneficial uses, and municipal use. No surface diversion.	2B/2C. Release for surface diversion and municipal use.
Water quality, especially temperature, salinity, and algae	Water released from Matthews Dam will have a limited effect on water temperature downriver. Increasing flow above natural levels maybe diluting nutrient levels and maintaining water quality to prevent toxic algae "blooms" in the Mad River	Increased flow would likely inhibit toxic algae growth. Higher flows could negatively affect pool thermal stratification, affecting adult summer steelhead and rearing juvenile salmonids. Depending on instream flow released, would likely decrease salinity and potentially reduce brackish water habitat	Any changes would be within range of those resulting from Options 1 to 2A.
Non-salmonid freshwater and riparian species of concern such as red-legged frog, green sturgeon, lamprey, willow flycatcher.	No change is expected with 56 cfs released from Matthews during the low flow season.	Additional flow could benefit some species, but many other factors affecting their habitat and populations. Currently, these species are declining although the District provides more water during summer than under pre-District natural conditions.	Any changes would be within range of those resulting from Options 1 to 2A.
Estuarine species of concern long fin smelt and tidewater goby	No change is expected with 56 cfs released from Matthews during the low flow season.	Additional flow will likely increase estuary habitat area, move the salt-fresh water boundary farther down river, reduce salinity and increase dissolved oxygen levels.	Any changes would be within range of those resulting from Options 1 to 2A
Invasive species of concern such as bullfrogs, New Zealand mudsnail	Negative effects on bullfrogs would be beneficial to red-legged frogs and juvenile salmonids. Timing of flows might be able to benefit red-legged frogs at expense of bullfrogs.	Higher flows could increase bullfrog habitat with no other control measures, which would negatively affect salmonids, red-legged frogs, and other native species; likely have no affect on New Zealand mud snails.	Any changes would be within range of those resulting from Options 1 to 2A.

Important points of Tables 3 and 4:

- The District’s water management has increased summer flows; reaches would go dry prior to District releases.
- Under the hydropower/instream flow option, more freshwater will reach estuary, affecting the location and extent of the salt wedge. Extent of effects (negative and beneficial) on various species are unknown but would have to be considered further under any option selected.
- Increased summer flows may increase salmonid habitat area but whether that would translate to higher numbers of fish is unknown. Many other factors besides flow determine salmonid production.
- Increased summer flows improve water quality, which may explain why the Mad River does not experience blue green algae blooms, but the Van Duzen and Eel rivers do.
- In any change in water management, but particularly the hydropower/instream flow option, we will need to consider that some species might be “winners” and others “losers” because their habitat requirements vary.

Citations for photographs:

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