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Improving Hydropower Benefits by Linking Environmental and Power System Tradeoffs Through Flow Release Decisions

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U.S. DEPARTMENT OF ENERGY

HydroWIRES
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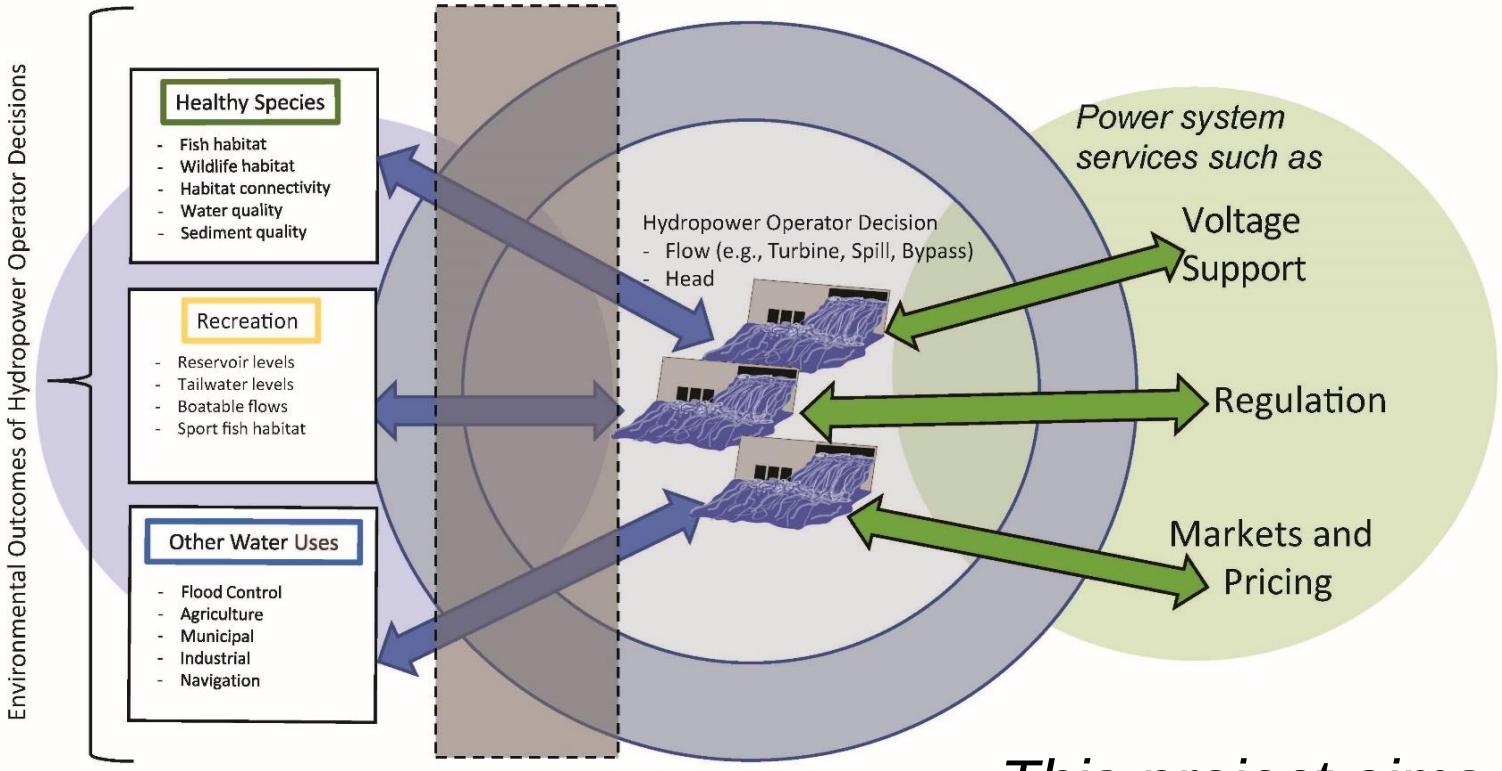
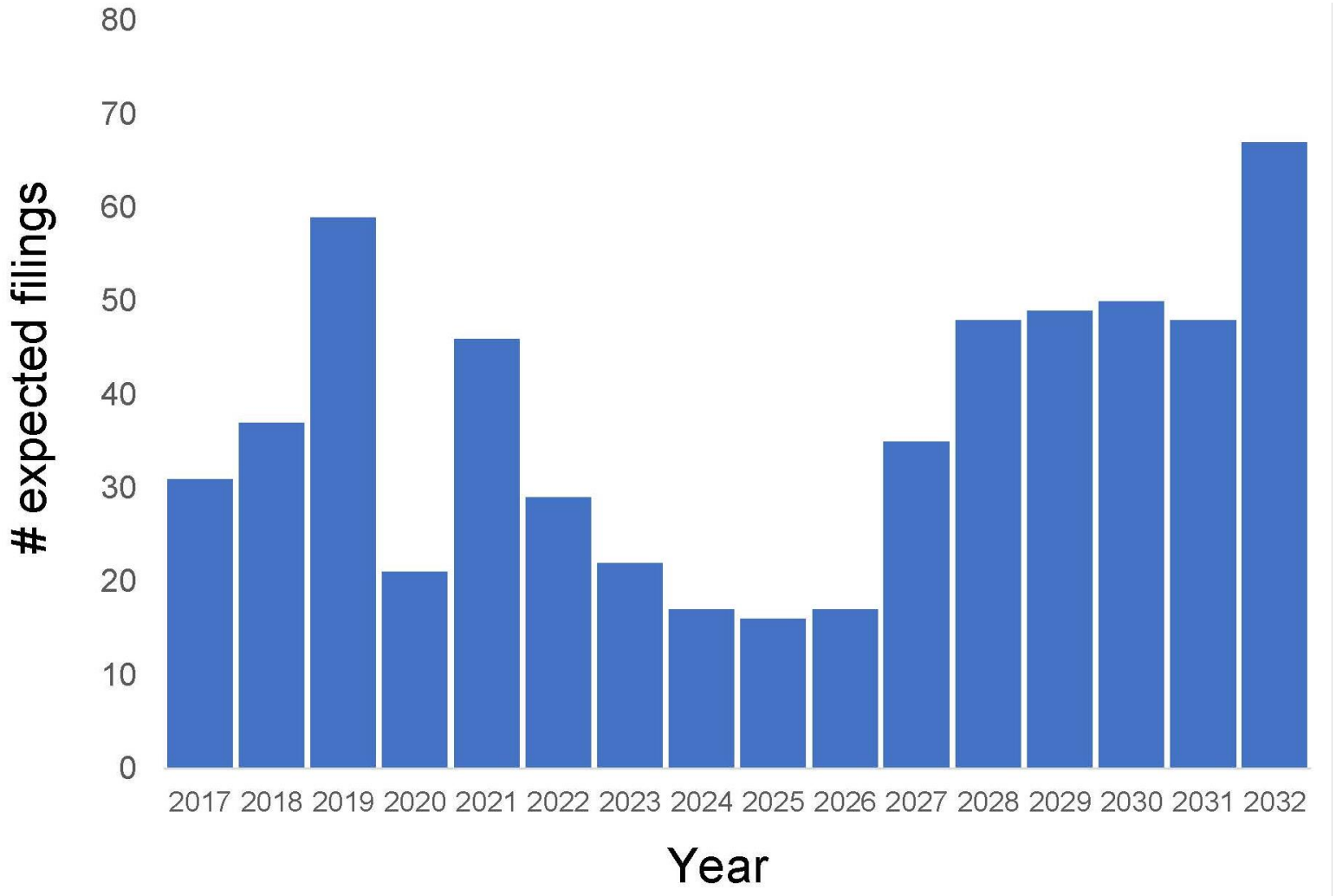


This project aims to ***quantify hydropower operational flexibility given non- flow requirements***

Large numbers of hydropower projects are expected to be relicensed in the coming years



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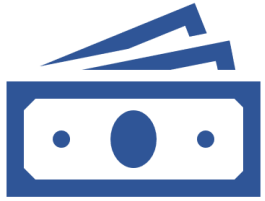
U.S. Hydropower Regulatory Process

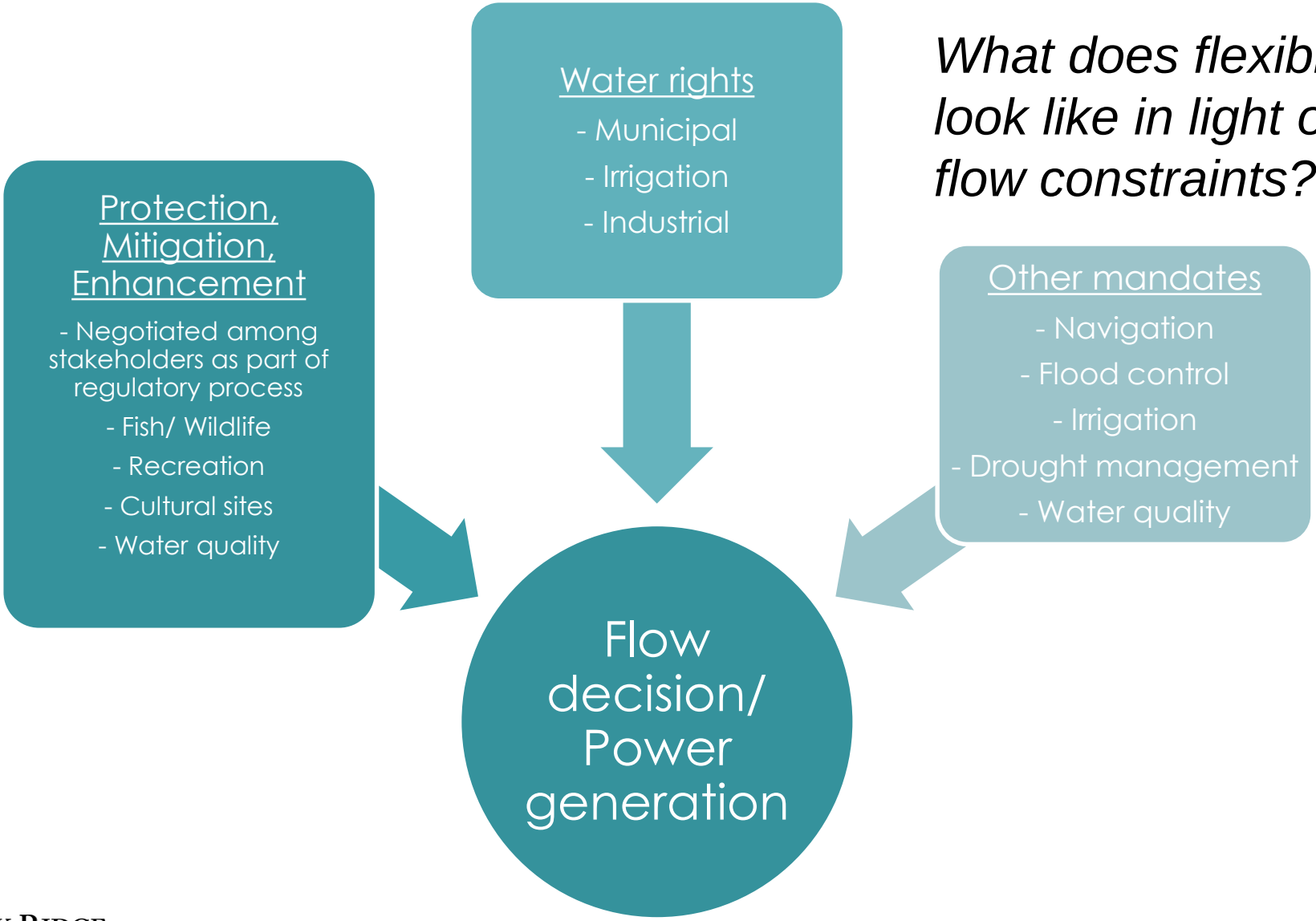
- Regulatory process stakeholder-driven
  - Environmental
  - Recreational
  - Developers
  - Investors
  - Tribal
  - State
  - Federal
- Stakeholders help determine Protection, Mitigation, and Enhancement measures like environmental flow requirements



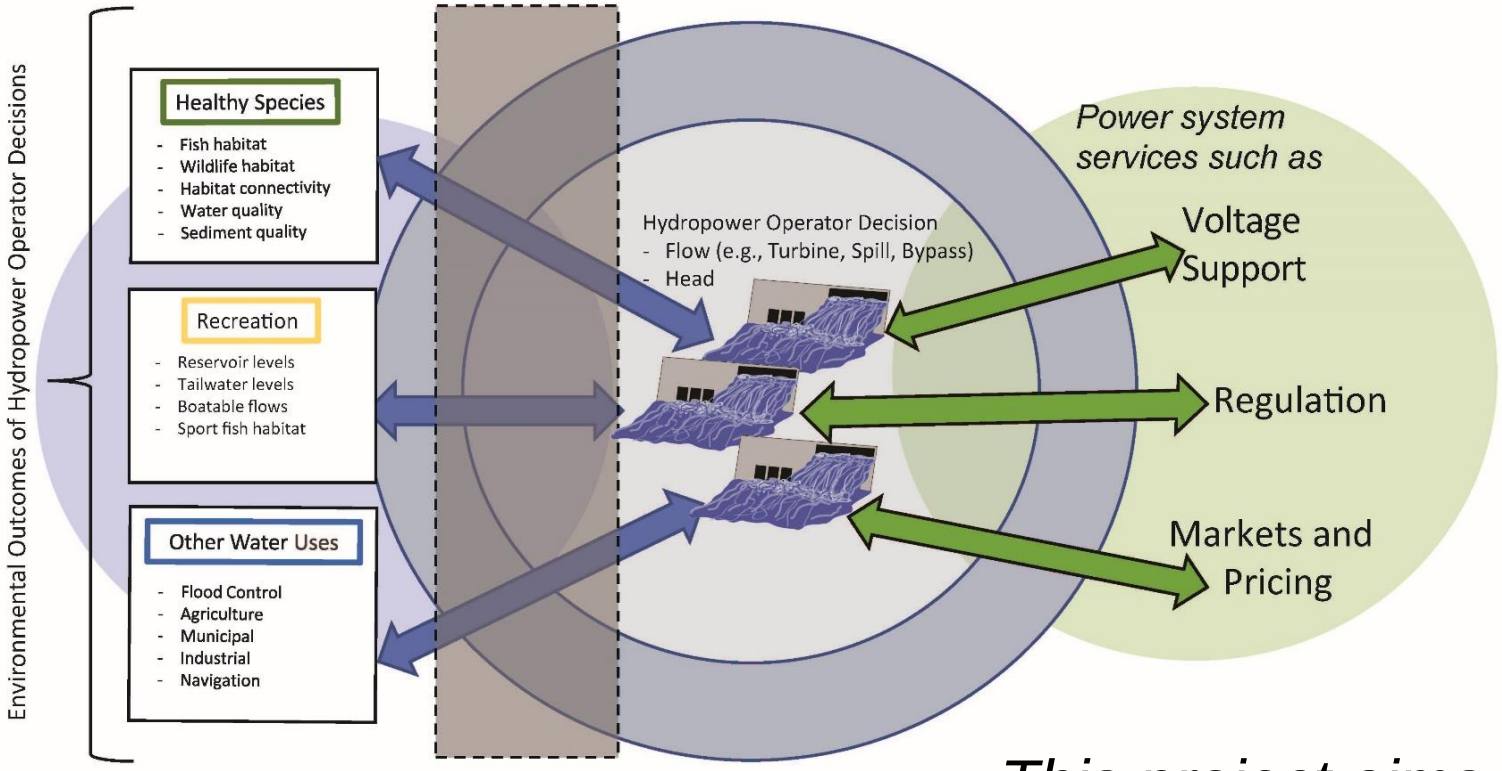





Non-power constraints on flexibility



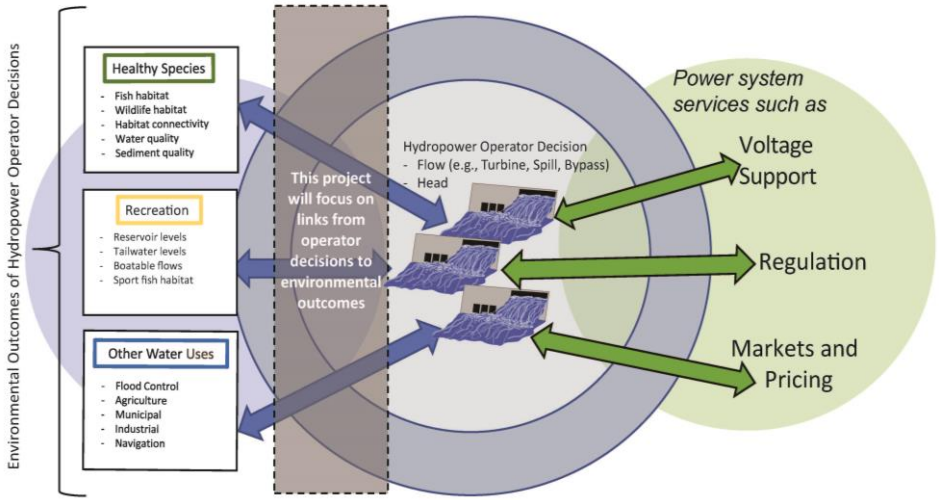
What does flexibility look like in light of flow constraints?



This project aims to ***quantify hydropower operational flexibility given non- flow requirements***

Project approach

- Quantify hydropower operational flexibility given non-power flow requirements by linking power system and environmental outcomes through the common hub of flow decisions
  - **Task 1: Linking flow decisions to environmental outcomes**
  - **Task 2: Linking power system needs to flow decisions**
  - **Task 3: Case studies demonstrating co-optimization of power system and environmental outcomes**



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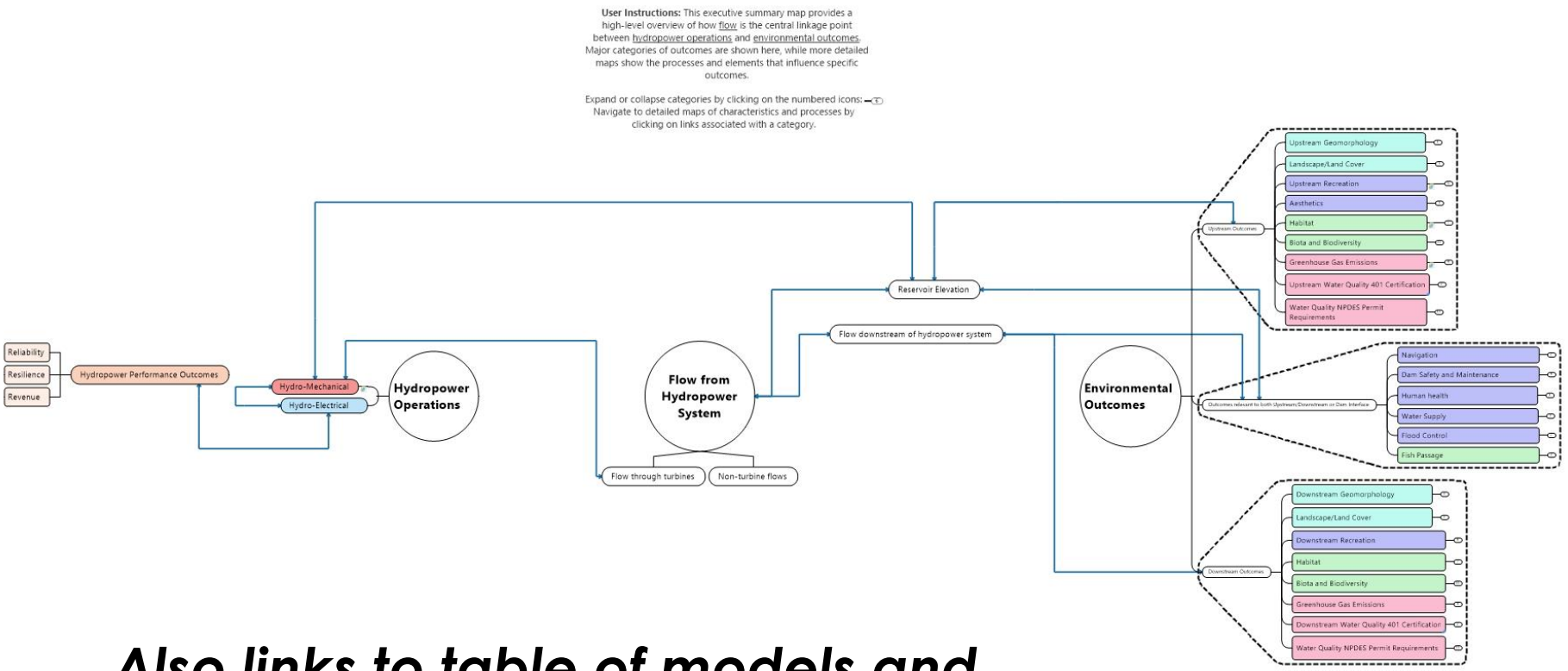
Power system to environment linkage map

- file://ornldata.ornl.gov/Home/HydroWIRES/Case%20studies/ExecutiveSummaryMap%20(2).html



Also links to table of models and tools needed to create linkages

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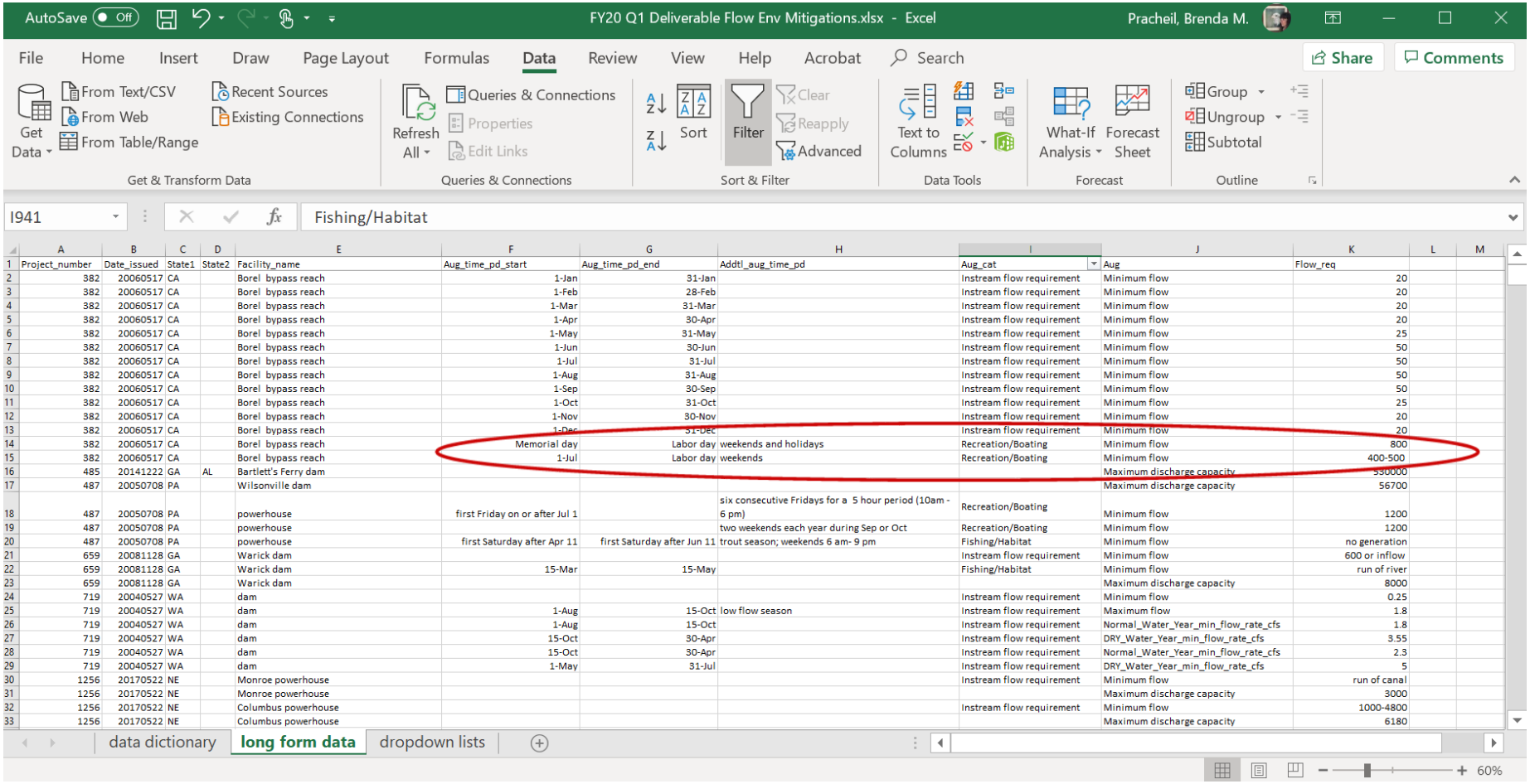
Dataset of environmental flow requirements



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Project_number	Date_issued	State1	State2	Facility_name	Aug_time_pd_start	Aug_time_pd_end	Addtl_aug_time_pd	Aug_cat	Aug	Flow_req		
2	382	20060517	CA		Borel bypass reach	1-Jan	31-Jan		Instream flow requirement	Minimum flow	20		
3	382	20060517	CA		Borel bypass reach	1-Feb	28-Feb		Instream flow requirement	Minimum flow	20		
4	382	20060517	CA		Borel bypass reach	1-Mar	31-Mar		Instream flow requirement	Minimum flow	20		
5	382	20060517	CA		Borel bypass reach	1-Apr	30-Apr		Instream flow requirement	Minimum flow	20		
6	382	20060517	CA		Borel bypass reach	1-May	31-May		Instream flow requirement	Minimum flow	25		
7	382	20060517	CA		Borel bypass reach	1-Jun	30-Jun		Instream flow requirement	Minimum flow	50		
8	382	20060517	CA		Borel bypass reach	1-Jul	31-Jul		Instream flow requirement	Minimum flow	50		
9	382	20060517	CA		Borel bypass reach	1-Aug	31-Aug		Instream flow requirement	Minimum flow	50		
10	382	20060517	CA		Borel bypass reach	1-Sep	30-Sep		Instream flow requirement	Minimum flow	50		
11	382	20060517	CA		Borel bypass reach	1-Oct	31-Oct		Instream flow requirement	Minimum flow	25		
12	382	20060517	CA		Borel bypass reach	1-Nov	30-Nov		Instream flow requirement	Minimum flow	20		
13	382	20060517	CA		Borel bypass reach	1-Dec	31-Dec		Instream flow requirement	Minimum flow	20		
14	382	20060517	CA		Borel bypass reach	Memorial day	Labor day	weekends and holidays	Recreation/Boating	Minimum flow	800		
15	382	20060517	CA		Borel bypass reach	1-Jul	Labor day	weekends	Recreation/Boating	Minimum flow	400-500		
16	485	20141222	GA	AL	Bartlett's Ferry dam					Maximum discharge capacity	530000		
17	487	20050708	PA		Wilsonville dam					Maximum discharge capacity	56700		
18	487	20050708	PA		powerhouse	first Friday on or after Jul 1		six consecutive Fridays for a 5 hour period (10am - 6 pm)	Recreation/Boating	Minimum flow	1200		
19	487	20050708	PA		powerhouse			two weekends each year during Sep or Oct	Recreation/Boating	Minimum flow	1200		
20	487	20050708	PA		powerhouse	first Saturday after Apr 11	first Saturday after Jun 11	trout season; weekends 6 am- 9 pm	Fishing/Habitat	Minimum flow	no generation		
21	659	20081128	GA		Warick dam				Instream flow requirement	Minimum flow	600 or inflow		
22	659	20081128	GA		Warick dam	15-Mar	15-May		Fishing/Habitat	Minimum flow	run of river		
23	659	20081128	GA		Warick dam					Maximum discharge capacity	8000		
24	719	20040527	WA		dam				Instream flow requirement	Minimum flow	0.25		
25	719	20040527	WA		dam	1-Aug	15-Oct	low flow season	Instream flow requirement	Maximum flow	1.8		
26	719	20040527	WA		dam	1-Aug	15-Oct		Instream flow requirement	Normal_Water_Year_min_flow_rate_cfs	1.8		
27	719	20040527	WA		dam	15-Oct	30-Apr		Instream flow requirement	DRY_Water_Year_min_flow_rate_cfs	3.55		
28	719	20040527	WA		dam	15-Oct	30-Apr		Instream flow requirement	Normal_Water_Year_min_flow_rate_cfs	2.3		
29	719	20040527	WA		dam	1-May	31-Jul		Instream flow requirement	DRY_Water_Year_min_flow_rate_cfs	5		
30	1256	20170522	NE		Monroe powerhouse				Instream flow requirement	Minimum flow	run of canal		
31	1256	20170522	NE		Monroe powerhouse					Maximum discharge capacity	3000		
32	1256	20170522	NE		Columbus powerhouse				Instream flow requirement	Minimum flow	1000-4800		
33	1256	20170522	NE		Columbus powerhouse					Maximum discharge capacity	6180		

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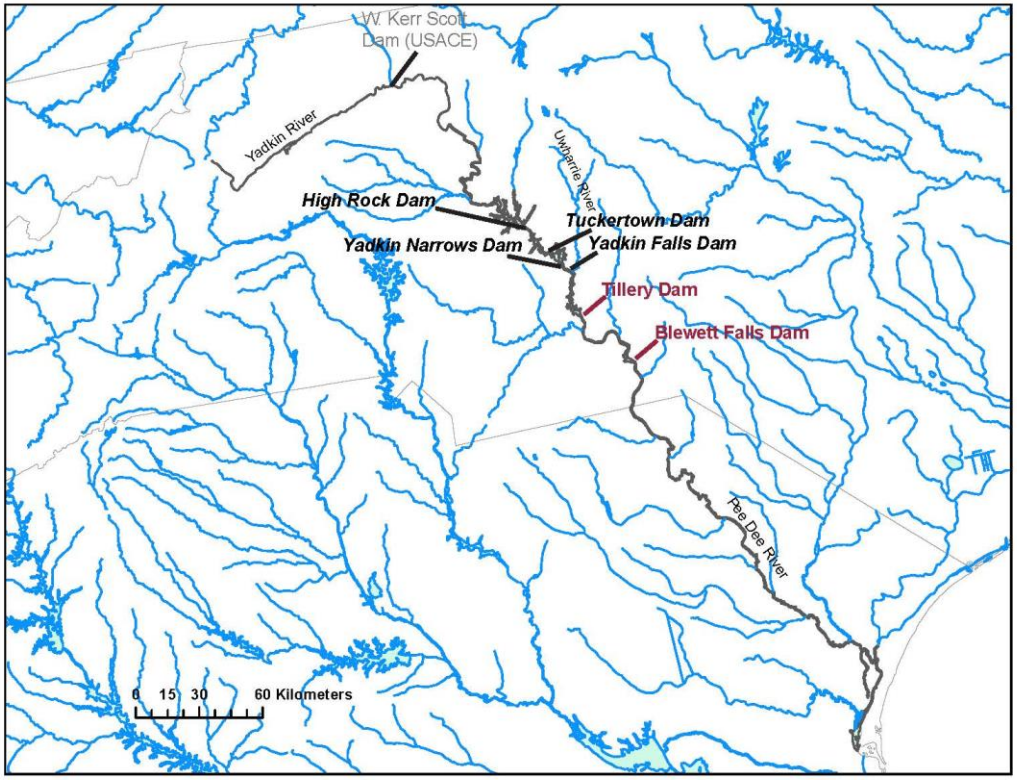
Examples of environmental flow requirements

- Walleye spawning flows*
  - **800 cfs minimum flow beginning when water temp is ≥ 4°C for 4 consecutive days after Mar 15 to 30 days after water temp is ≥ 10°C for 4 consecutive days**
- Whitewater flows*
  - **Up to 70 hr of 525 cfs releases/ year to support whitewater races**
- Maximum flows*
  - **When inflow is 200-399 cfs, releases ≤ 1.5 times inflow from July 1-15**

Above requirements all from FERC hydropower licenses

Case studies

Yadkin-Pee Dee River Basin
- *Energy- environment trade-offs*
- *Two producers*



Also focused case studies on:
1. *economic valuation of hydro flexibility (Poe Project, California)*
2. *new modeling techniques to assess environment tradeoffs with hydro flexibility (Glen Canyon Dam, Arizona)*

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