

Zebra Mussel Impacts to Wolf Creek Generating Station

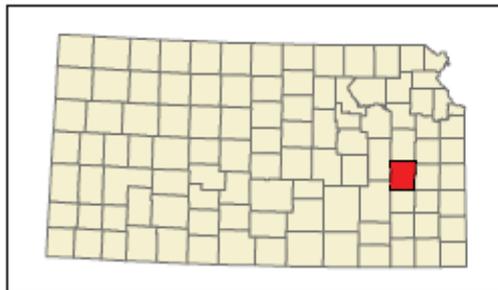
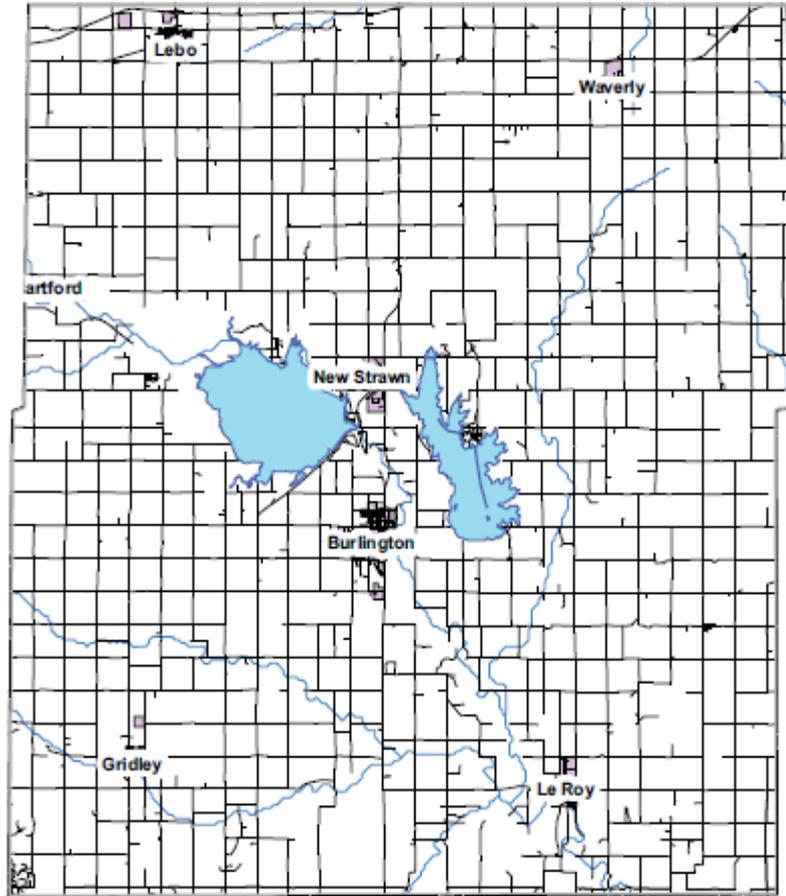


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Coffey County, Kansas

With permission from KBS



0 1 2 4 6 8 Miles

Coffey County Lake

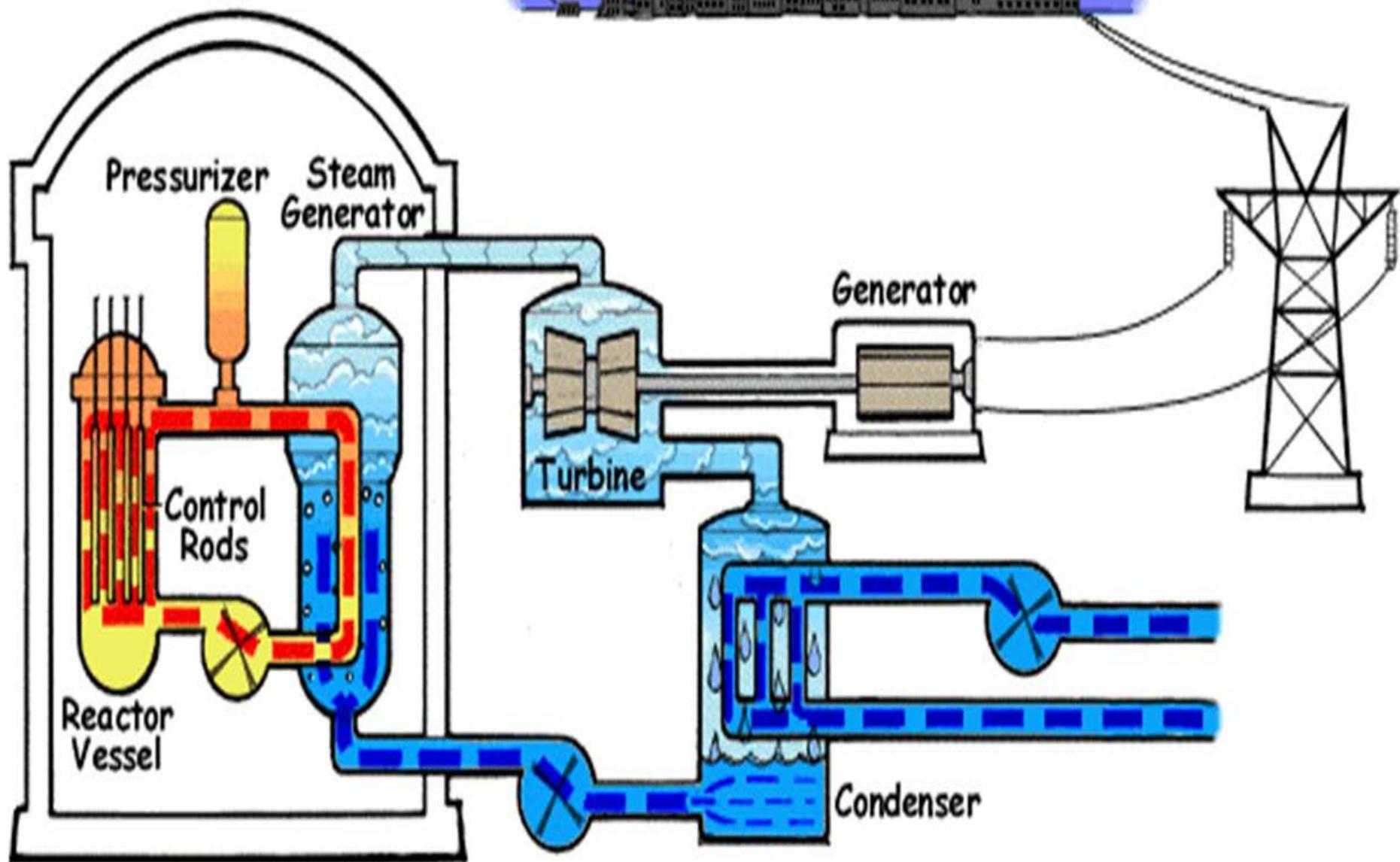
- Construction completed in 1982
- 19.5 square mile watershed
- 11,500 acre feet average makeup to CCL
- 5,090 surface acres
- 113,061 acre feet at full pool
- Public Fishing

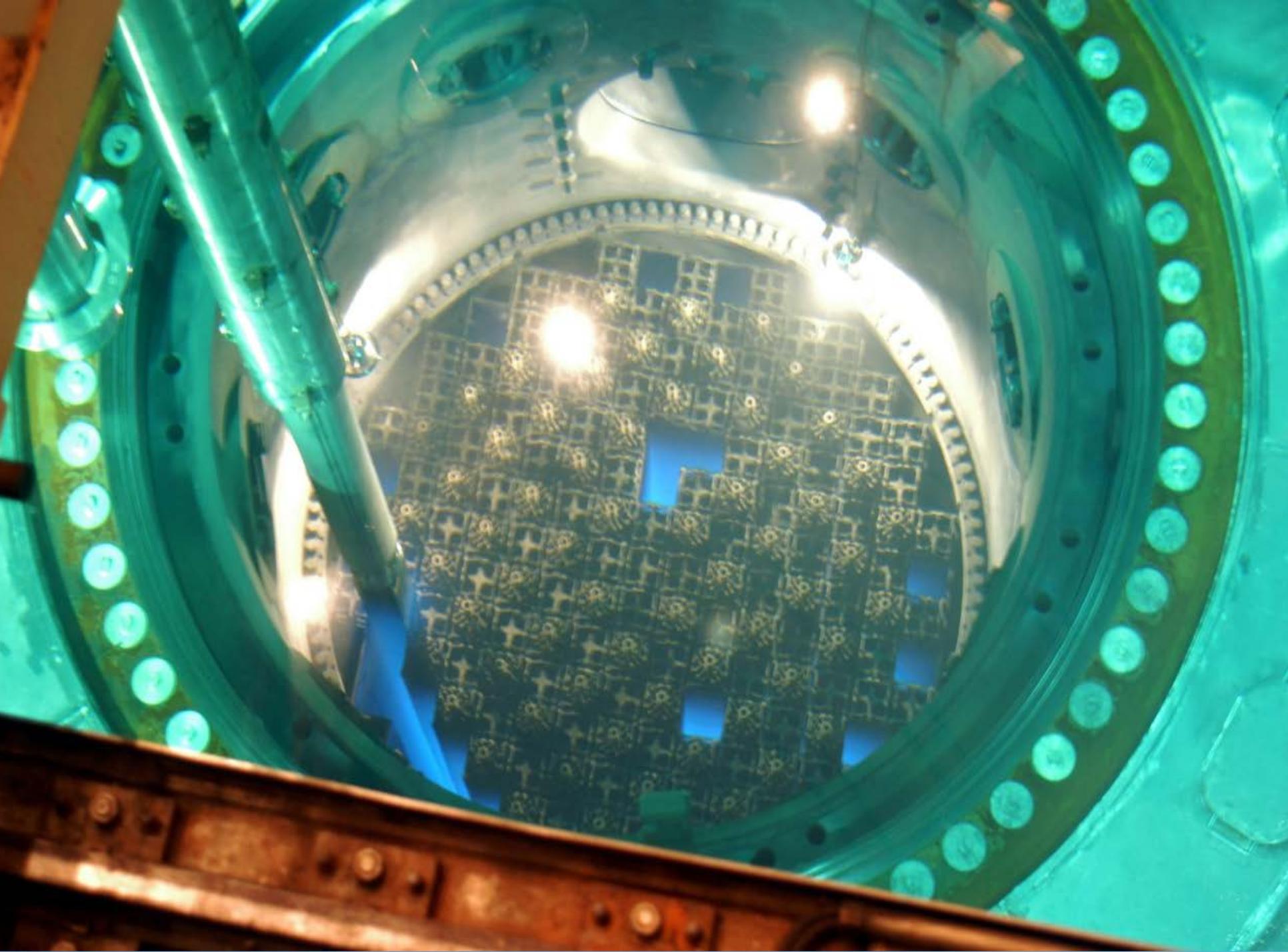
How WCGS uses CCL

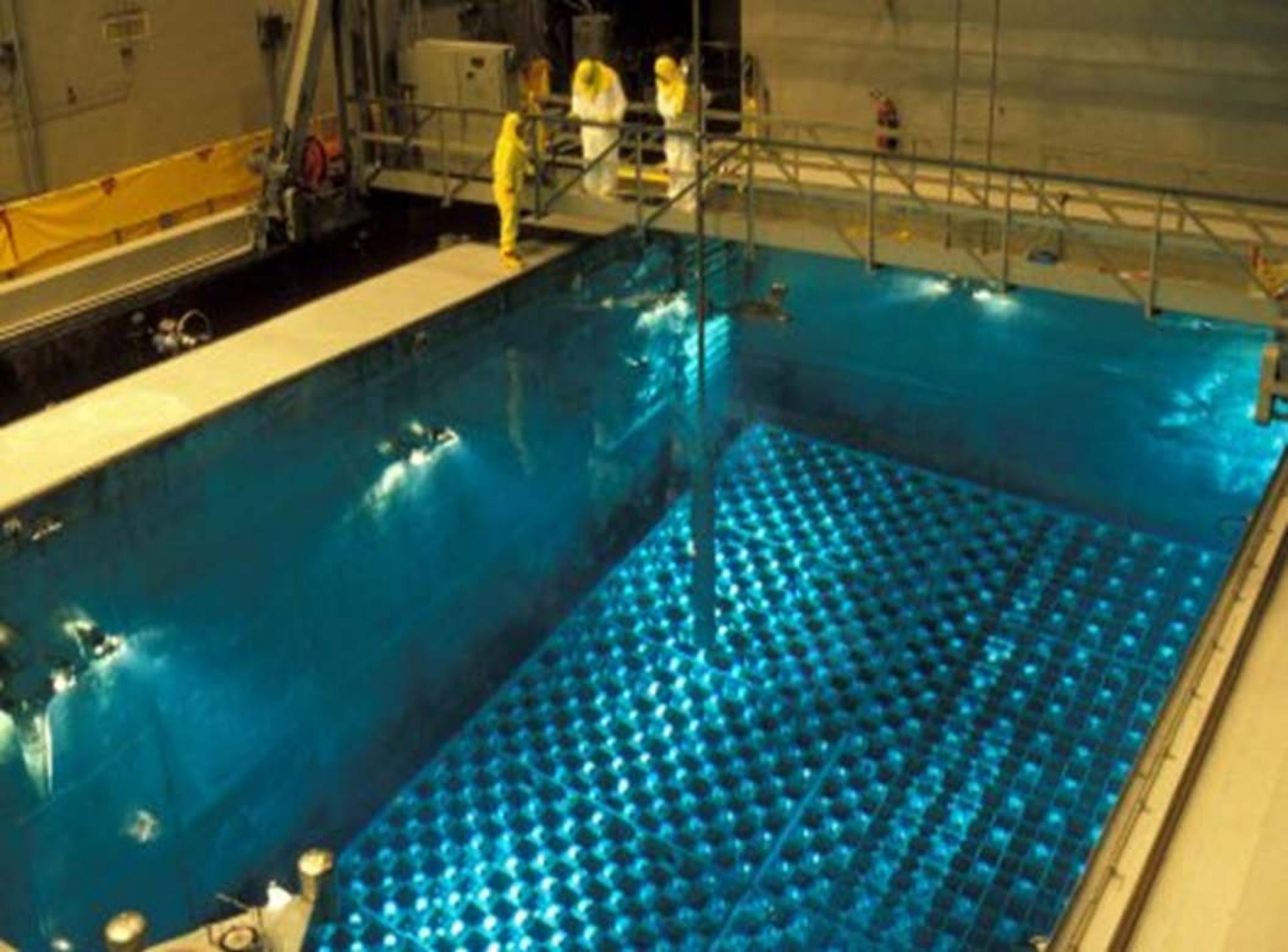
- Nuclear power generating station
- Generates 1,200 megawatts of electricity, enough to power more than 800,000 homes



Containment Structure









MUSH

CWSH



ESW



- Observation
- Preparation
- Adaptive Management



Observation in Kansas



Location	Year	Detection Method
Council Grove City Lake	2010	Public
Arkansas River @ Syracuse	2010	Sample
Jeffrey Energy Center Lakes	2011	Sample
Kanopolis	2011	KDWPT
Melvern	2011	Sample
Wyandotte County Lake	2012	Sample
Chase SFL	2012	Sample
Lake Shawnee	2013	Public
Lake Wabaunsee	2013	Public
Glen Elder	2013	Public
Clinton	2013	KDWPT
Pomona	2014	USACE
Paola City Lake	2015	Public
Wellington City Lake	2015	City

Pre-Large Scale Plankton Sampling		
El Dorado	2003	Public
Winfield City Lake	2006	Public
Cheney	2007	Sample
Perry	2007	Public
Marion	2008	Public
Afton	2008	KDWPT
Wilson	2009	Boat Mechanic
Milford	2009	Public

Down-stream (expected) Infestations		
John Redmond	2010	Sample
Council Grove Reservoir	2011	Sample
Wolf Creek	2012	Sample





Observation

- 1995 Zebra Mussel searches at river and lake
- 2002 Zebra Mussel searches by gate keepers
- 2003 Zebra Mussels found in El Dorado
- 2003 Additional training provided to gate keepers
- 2008 they were found in Marion Reservoir, upstream in the Neosho Basin
- Found veligers at MUSH in 2010 and CWSH in 2012
- Found adults in CCL July 18, 2012



Zebra Mussel Search Check-Lists

Wolf Creek Nuclear Operating Corporation Boat Inspection and Treatment Requirements

To prevent zebra mussels or invasive aquatic weeds from entering Coffey County Lake, boat owners must:

1. Drain water from all live wells
2. Drain water from all bilges
3. Lower boat motors to drain all water from lower units.
4. Spray all live wells, bilges, and lower units/prop exhaust area with a mixture of 10% Clorox and 90% water at gatehouse during inspection.
5. Remove all vegetation and mud from boat and trailer.
6. Allow boat to be inspected for zebra mussel and aquatic weeds.
7. Bait bucket water must not be placed in the lake.

These steps must be completed prior to launching a boat into Coffey County Lake. Boat owners must complete this no matter when or where the boat was used previously. No exceptions.

Zebra mussel inspection checklist Coffey County Lake

Boat Owner: _____ Date: _____

The purpose of this inspection is to prevent the introduction of zebra mussels into Coffey County Lake by boats. Zebra mussels have the potential to cause adverse impacts to the lake's fishery and to the efficient operation of Wolf Creek Generating Station.

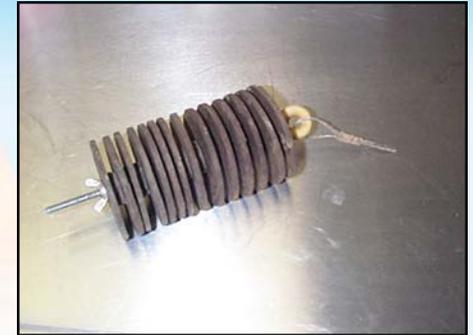
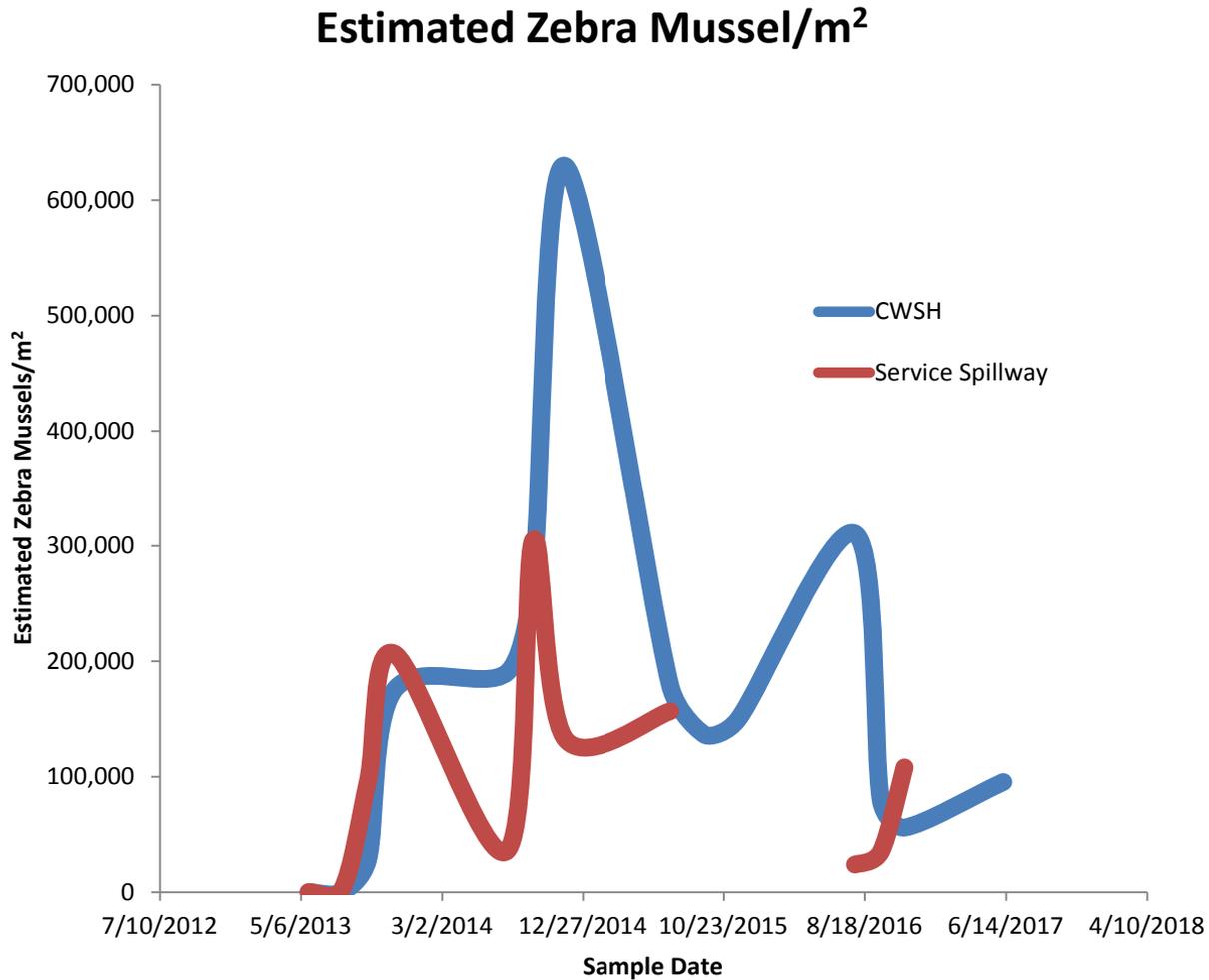
What water-body has the boat been in last? _____

- When?
1. a. Are all live wells dry and treated? _____ Yes ___ No ___
 b. If no, then owner **must** follow preventive methods recommended by the Kansas Department of Wildlife and Parks (KDWP) before launching. See current Fishing Regulations Summary or available brochure.
 2. a. Is the bilge dry and treated? _____ Yes ___ No ___
 b. If no, then owner **must** follow preventive methods recommended by the KDWP before launching.
 3. a. Is the trailer free of attached vegetation or debris? _____ Yes ___ No ___
 b. If no, owner **must** remove before launching.
 4. a. Has the engine cooling system been drained and lower unit treated? _____ Yes ___ No ___
 b. If no, then owner **must** follow preventive methods recommended by the KDWP before launching.
 5. a. Is the boat hull and motor free of attached zebra mussels? _____ Yes ___ No ___
 b. If no, do not allow boat to be launched. Contact the KDWP as directed in the current Kansas Fishing Regulations Summary or brochures, and inform WCNOC 364-8831, ext 4672.
 6. a. Remind anglers that Coffey County Resolution 620 prohibits the placing or dumping of bait buckets into the lake. _____ Yes ___ No ___

Inspector: _____

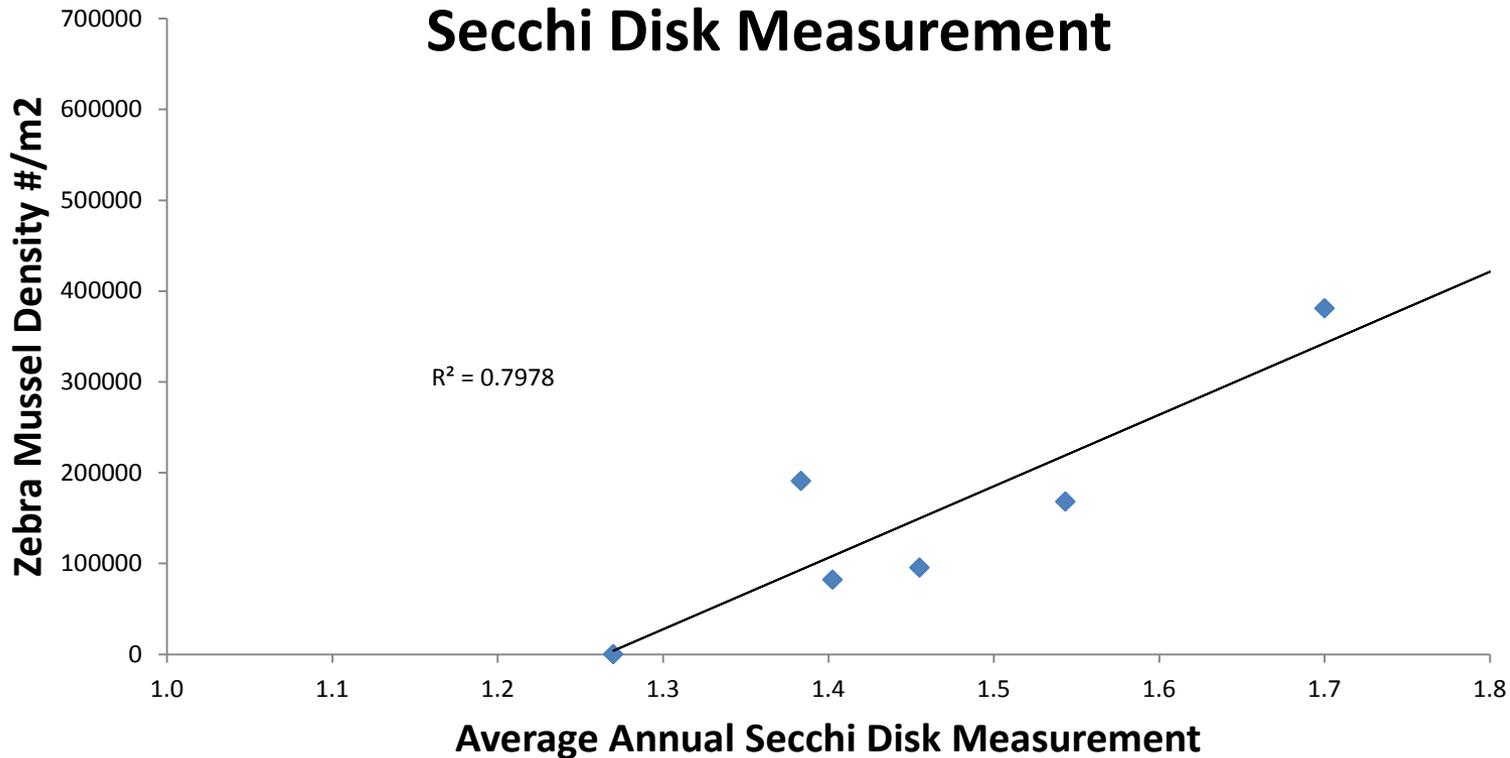


Observation



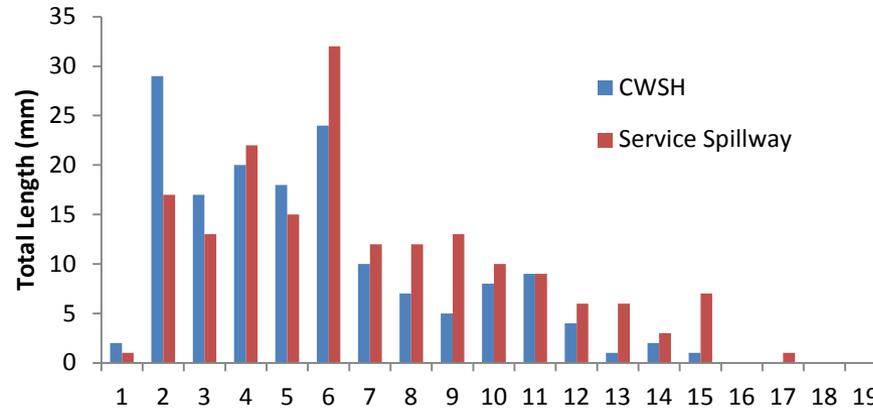
Observation

Zebra Mussel Density and Average Annual Secchi Disk Measurement

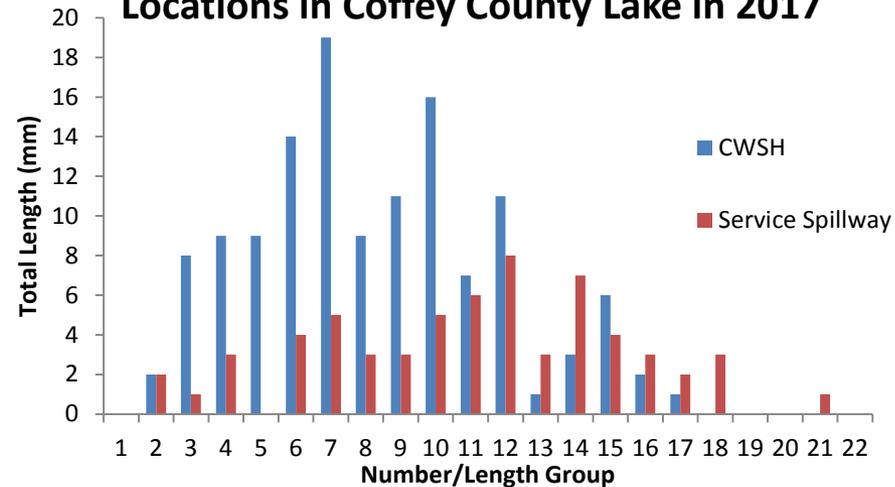


Observation

Zebra Mussel Length Frequency at two Locations in Coffey County Lake in 2016



Zebra Mussel Length Frequency at two Locations in Coffey County Lake in 2017



- Observation
- **Preparation**
- Adaptive Management



Preparation

Chemical Treatments

- Benchmark the industry and vendors
- Oxidizing biocides – chlorine and bromine are fast acting, longer lasting, and can prevent biofilm development. Used to control veliger's/juveniles. Once shells are developed zebra mussels can resist oxidizing biocides.
- Non-oxidizing biocides –are highly effective and do not irritate respiratory membranes.





CW Discharge Structure

CWSH

582,000gpm
1,297cfs

15,000 X 2 gmp
2 X 33 cfs

ESW Pumphouse





UHS

WCGS ONCE THROUGH COOLING WATER SYSTEMS

ESW Warming Line Flow
6,000 gpm Lake < 40 deg. F

CW Warming Line 30,000 gpm Lake < 50 deg.F

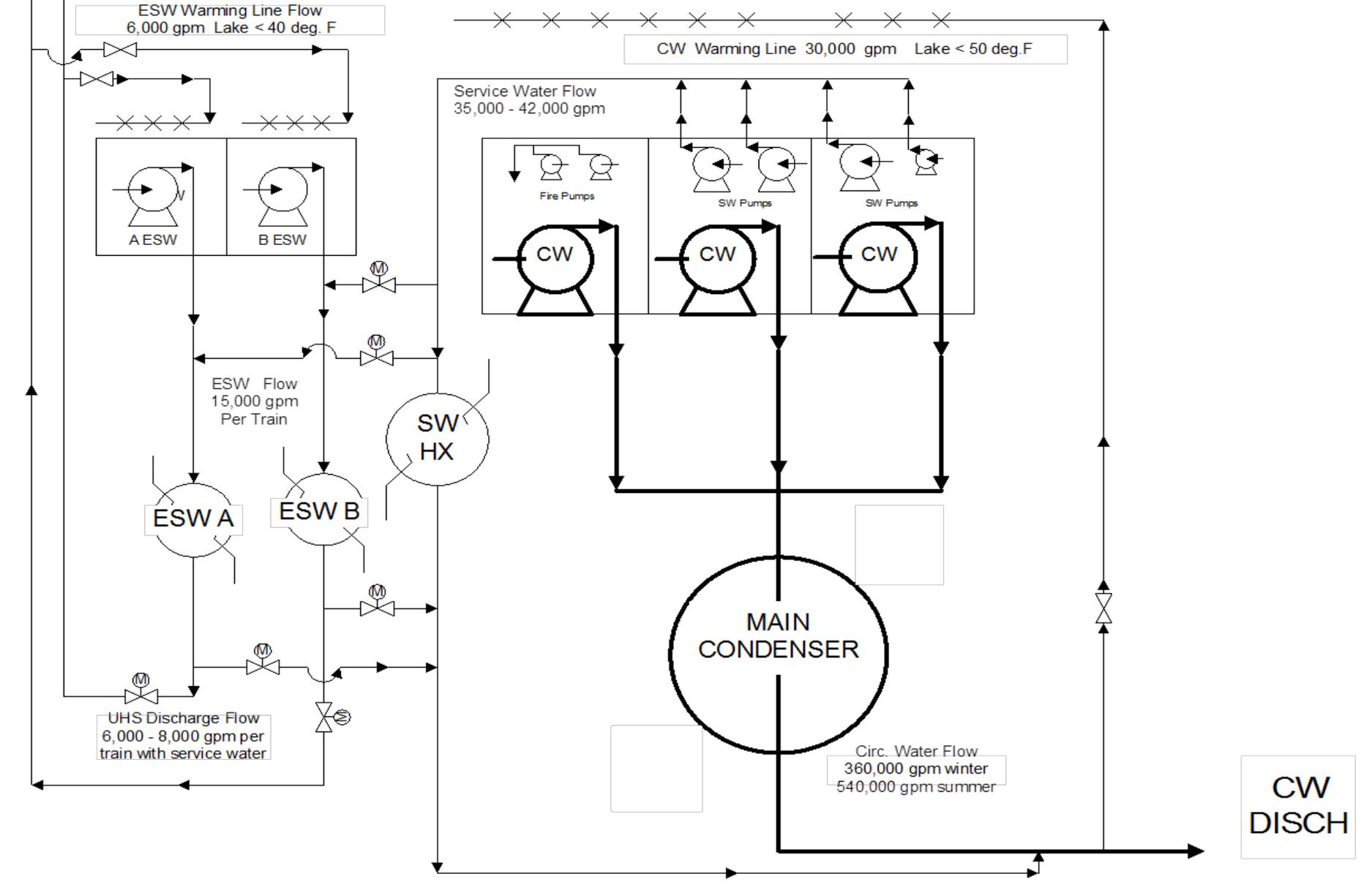
Service Water Flow
35,000 - 42,000 gpm

ESW Flow
15,000 gpm
Per Train

UHS Discharge Flow
6,000 - 8,000 gpm per
train with service water

Circ. Water Flow
360,000 gpm winter
540,000 gpm summer

CW
DISCH



System Preparation

- ESW
- CWSH
- Service Water
- Fire Protection
- MUSH



ESW Preparation

- Adjusted inspection and cleanings from 18 months to 12 months.
- Weekly rotate traveling screens
- Monthly treated with both in front of the traveling screens
- Three times per year treat with Non-oxidizing biocide not to exceed 4 hrs at 4ppm
- Monthly treat for 1 hr at 4ppm with non-oxidizing biocide
- Monthly treat for 1 hr with an oxidizing biocide at 0.1-1ppm, target is 0.3ppm



CWSH Preparation

- A and C bays inspected and cleaned annually
- B bay inspected and cleaned during planned refueling outage every 18 months, as well as the outside (lake side) A, B, C trash racks.
- Continuous auto slow screen rotation based on engineering recommendations
- **Circulating Water System treated with Oxidizing biocide for 1.75 hrs 0.1 ppm**
- Low colonization rates at flow rates higher than 5'/s and temperatures greater than 95 degF







Service Water Preparation

- Quarterly non-oxidizing biocide 12-24 hrs 4 ppm
- Oxidizing biocides 12 hrs/day 0.2-0.35 ppm



Fire Protection System Preparation

- Monthly (May through November) non-oxidizing biocides for 1.5 hrs
- Standby pumps treated with non-oxidizing biocides for 24 hrs once/week at 13.7 ml/min
- Standby pump columns are left in wet lay-up weekly (above 50 degF)



MUSH Preparation

- Adjusted from every three years to a two year inspection and cleaning
- Weekly rotate traveling screens



- Observation
- Preparation
- **Adaptive Management**



Adaptive Management

- BIO BOX

- Monthly monitored for attachment



- CLAM CONDO

- Live zebra mussels are placed inline before the non-oxidizing biocide treatment.



Adaptive Management

- Service water oxidizing treatments have been adjusted from 6 hrs to 18 hrs to 12 hrs based on exchange of information with other nuclear plants.
- Mush inspection and cleanings adjusted from every three years to annually back to every two years



Adaptive Management

- Evaluate Zequanox for fire protection systems
- Copper Ion Generator
- Chemical treating the intake bays
- UV lights, steam cleaning, hot air dryers, coatings, fire protection system pulling from tanks of clean water



- Observation
- Preparation
- Adaptive Management



Macro Fouling Control: Some Factors to Consider

- Types of invertebrates
- Environmental constraints
- Severity of problem
- Corrosion concerns
- Current treatments for MIC, corrosion, microbio
- Mixing zone allowance
- In-plant dilution
- Water temperature
- Plan for removal of relics
- SWS design, problem areas, equipt rotation
- Available injection points
- Oxidizing, non-oxidizing or combination
- Timing of treatments
- Economics
- Location of demineralizer/RO
- Treatment half life (HPFPS)
- Demand from turbidity, TSS

Inside the plant oxidizing biocides are used to control juveniles and non-oxidizing biocides to control adults

