WATER QUALITY 101: AN OVERVIEW OF THE ROLE WATER QUALITY TAKES IN U.S. ARMY CORPS OF ENGINEERS PROJECTS AND ACTIVITIES

A briefing by the HQ-USACE
Committee on Water Quality

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U.S. Army Corps of Engineers
Sacramento District (SPK)

17 July 2019

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Overview

- Purpose – An introduction to the Water Quality (WQ) work the USACE performs
- What is WQ?
- USACE National Committee on Water Quality (CWQ)
- Related USACE WQ Guidance
- Discussion of WQ as part of the USACE mission
- Work areas requiring WQ support
- Emerging WQ issues
- Summary

Introduction

- What is water quality?
- Definition of Water Quality - The physical, chemical, and biological characteristics of surface and ground water affecting abiotic and biotic conditions and interrelationships.
- Where do water quality efforts fit within USACE projects and activities?

USACE National WQ Groups

- We currently have 3 distinct Water Quality groups within USACE.
  - USACE National Committee on Water Quality
  - The Water Management Implementation Support Team (WMIST) Water Quality PDT
  - The USACE Water Quality sub-CoP (HH&C CoP)

HQ Committee on Water Quality

- ER 15-2-14 “Committees on Tidal Hydraulics, Channel Stabilization, Water Quality, and Hydrology”
  - April 24, 1992 document defines USACE Committee on Water Quality (CWQ)
  - The CWQ is comprised of water quality experts
  - The CWQ applies objectives to water quality issues at reservoirs, inland waterways, coastal, and estuarine water resource projects.
  - Objectives include:
    - Maintain and evaluate state of the art
    - Define problem areas, recommend studies and investigations, and research.
    - Disseminate pertinent information.
    - Render consulting services to USACE elements
    - Participate in development of guidance.

USACE CWQ Membership Roster

- Chandra Pathak - HQ USACE Proponent
- Erich Emery - CELRD-RB-W (Chair)
- Patrick Deliman - CEERD-EZT (Co-chair)

- John Baum - CESPK-ED-EE
- Marvin Boyer - CENWK-PM-PR
- Tony Clyde - CESWT-ODR-N
- John Hargrave – CENWO-EDH-A
- Michael L. Henry - CEMVS-EC-EQ
- Andrew Johnson - CELRH-EC-GW-W
- Steve Juul - CENWW-EC-H
- Jeremy Kellett- CEERD-RR-C
- Matthew Parish – CESAD-RBT
- Rose Reilly - CELRP- ECG-WQ
- Todd Steissberg - CEIWR-HEC-WRS
- Kathryn Tackley - CENWP-EC-HR
- Jeffrey Trulick - CECW-C

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Chief's Environmental Advisory Board

- Purposes:
  - Advise Chief of Engineers by providing outside, expert, and independent advice and recommendations on matters relating to environmental issues facing the Corps of Engineers.
  - Vehicle of communication to build partnerships, understandings, and cooperation with the environmental community and the general public.
- Membership:
  - 5-10 members. Eminent authorities in the field of natural (e.g. biological, ecological), social (e.g. anthropologist, community planner), and related sciences.
  - Multidisciplinary, with an equitable distribution of fields of interest as well as geographical location.

Related USACE WQ Guidance

- ER 15-2-14 “Committees on Tidal Hydraulics, Channel Stabilization, Water Quality, and Hydrology”
- ER 200-1-5 “Policy for Implementation and Integrated Application of the U.S. Army Corps of Engineers Environmental Operating Principles and Doctrine”
- ER 1110-2-8154 “Water Quality Management”
- ER 1110-2-240 “Water Control Management” – Recognizes water quality as potential authorized project purpose.
- ER 1110-2-1462 “Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects”
- ER 1105-2-100 “Planning Guidance Notebook”
- ER 1110-2-8160 “Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums”

Water Resources Reform and Development Act (WRDA)

- WRDA is the primary legislation by which Congress authorizes the Corps of Engineers' key civil works missions, including navigation, flood risk management and environmental restoration.
- The authorities provided in WRRDA help USACE continue to provide value to the nation in developing and maintaining the nation's waterways and harbors, reducing damages from storm events, and restoring the environment.

Water Quality at the U.S. Army Corps of Engineers

Data Management, Data Analysis, Data Collection, Use of Data

Engineering & Construction	Operations	Planning	Emergency Response
Maintaining Water Quality	Authorized Purposes	Fish & Wildlife	Potable Water
Construction Stormwater	Sustainable Rivers	Sustainable Rivers	Treatment of Wastewater
Military Installation Support	Dredging Impacts	ESA Consultation	Spills and Contamination
Water Treatment	ESA	Ecosystem Restoration	Illness Prevention
Dewatering	Hydropower	Evaluate potential impacts	Vector Control
Vector Control	Managing Facilities		
Design Evaluation/Selection	Addressing State Concerns		
	Project Modifications		

Emerging Issues: Hazardous Algal Blooms (HABs), Invasive Species, Climate Change, New Mineral Extraction Impacts, Fires, staff training.

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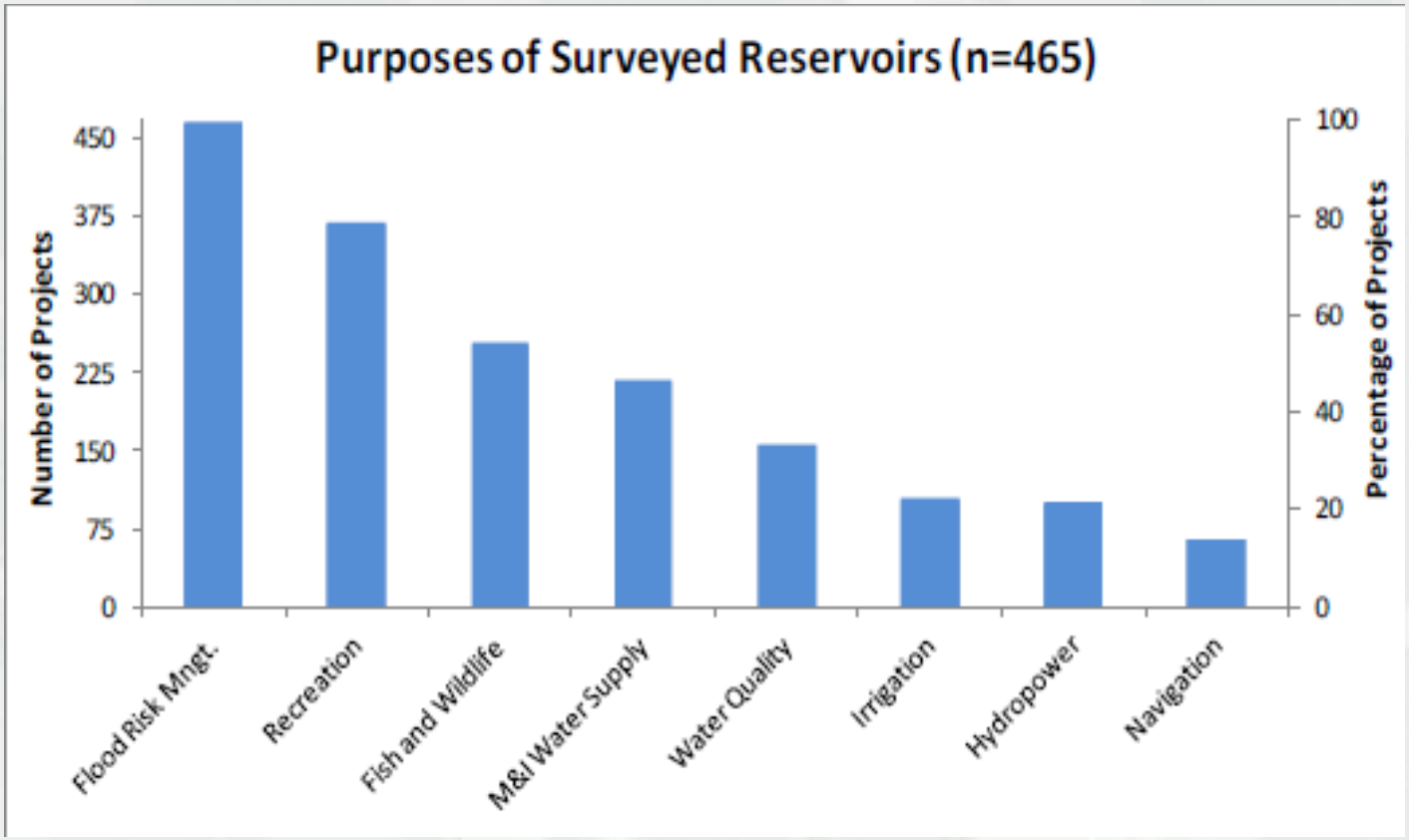
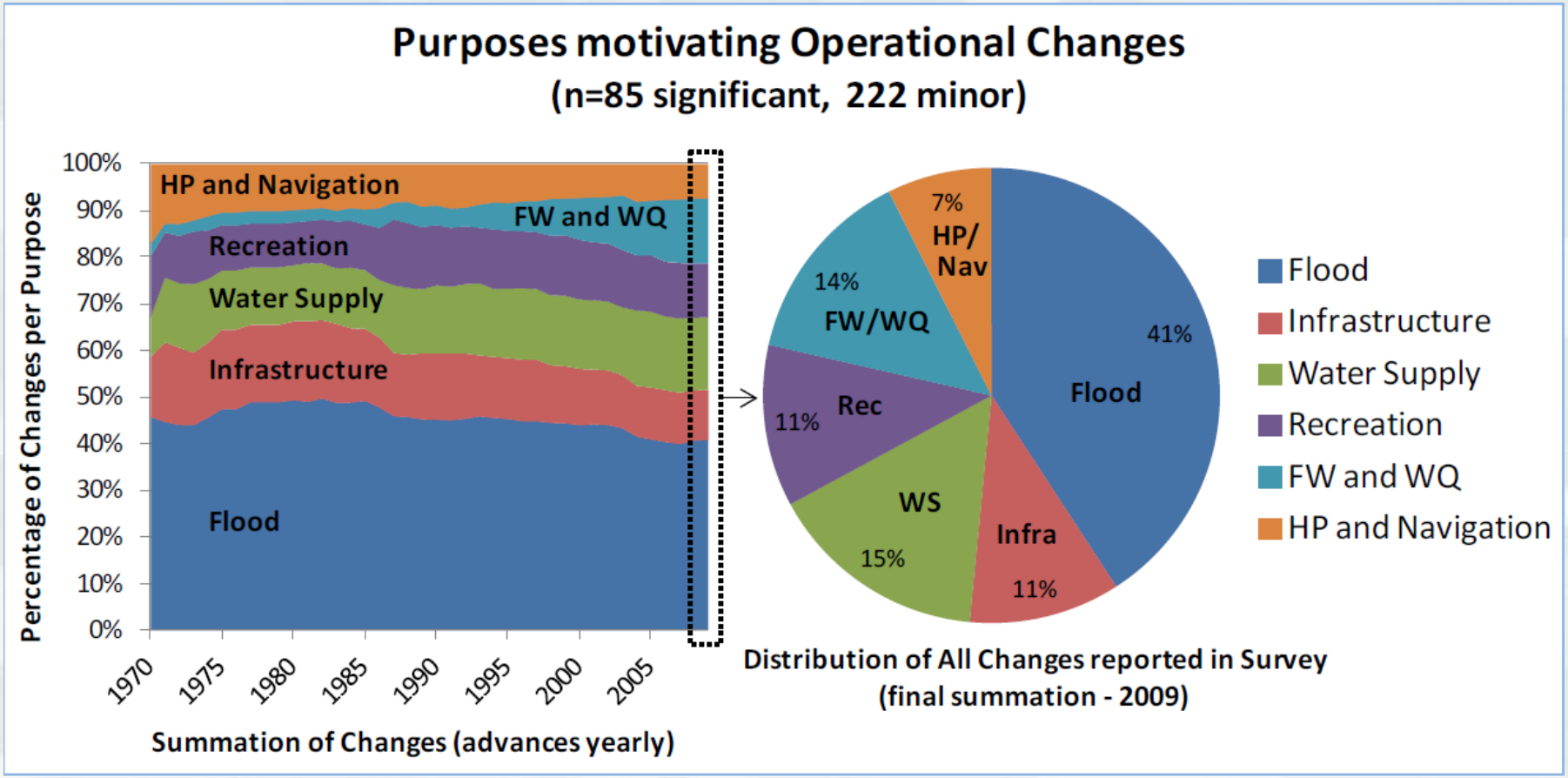
USACE Operated and Maintained Reservoir Projects



Source: National Portfolio for Reallocations Assessment of Data: Status and Challenges for USACE Reservoirs, 2016-RES-01, USACE Institute of Water Resources, May 2016

Water Quality Motivating Operational Changes



Source: National Portfolio for Reallocations Assessment of Data: Status and Challenges for USACE Reservoirs, 2016-RES-01, USACE Institute of Water Resources, May 2016

WQ is a Supportive Mission

- *WQ data is routinely collected for a wide variety of USACE programs, projects and activities.*
  - *Water Management*
  - *Planning*
  - *Dredging Operations*
  - *Hydropower*
  - *Ecosystem Restoration*
  - *Design and Construction*
  - *WQ model design and management.*
  - *HTRW*
  - *Military*
  - *Emergency Response*
  - *Natural Resource Management*
  - *Invasive Species*
  - *Emerging WQ issues*
  - *Fish and Wildlife*
  - *Endangered Species*
  - *Sustainable River Program*
  - *Other areas - Real Estate, Cultural Resources*

Water Management

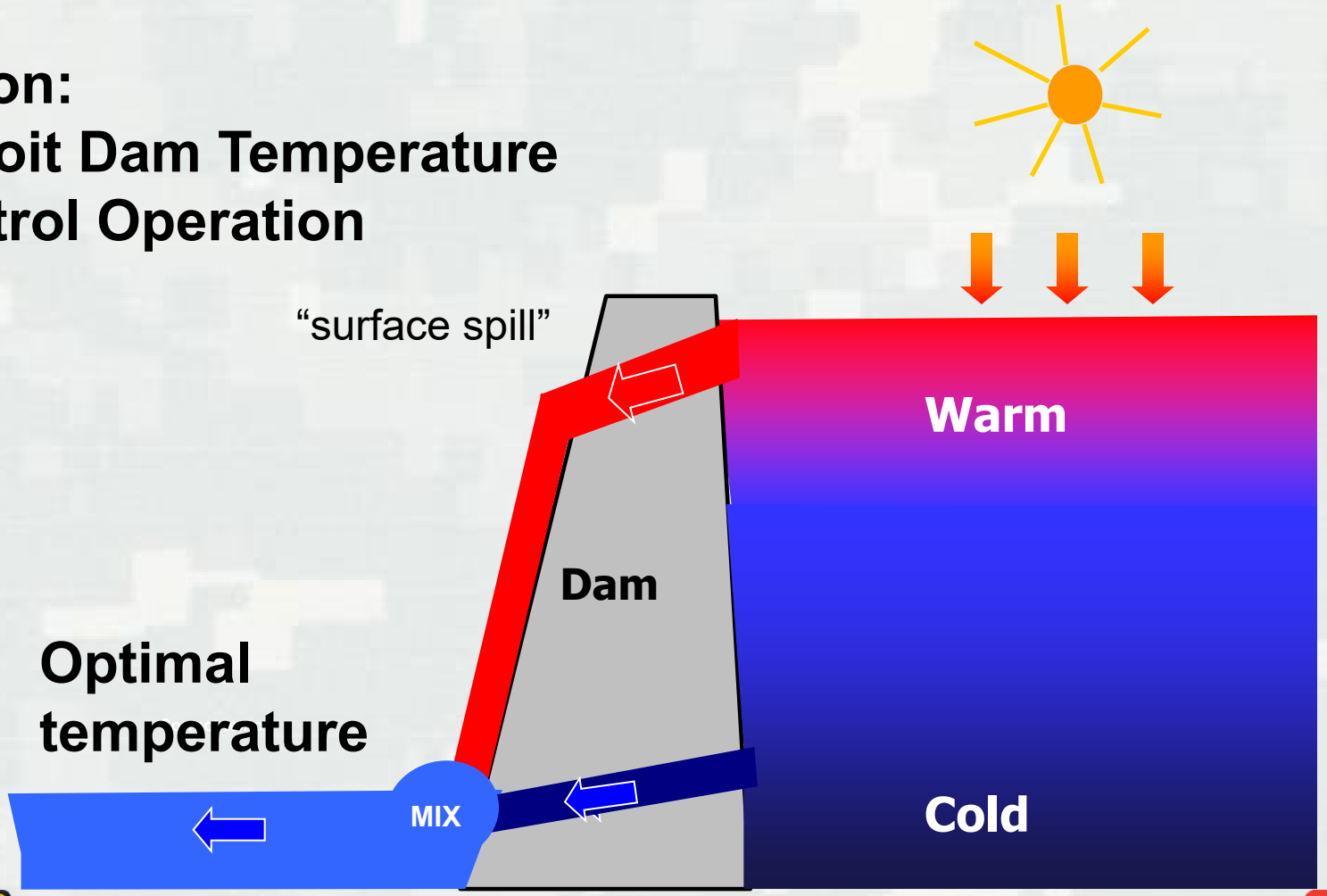
- Water Quality is an Authorized Purpose for many USACE projects.
- Water quality data assists in reservoir operations and other project activities.
- Collected data management (WMIST activities)

Englebright Lake, California

Perry Lake, Kansas

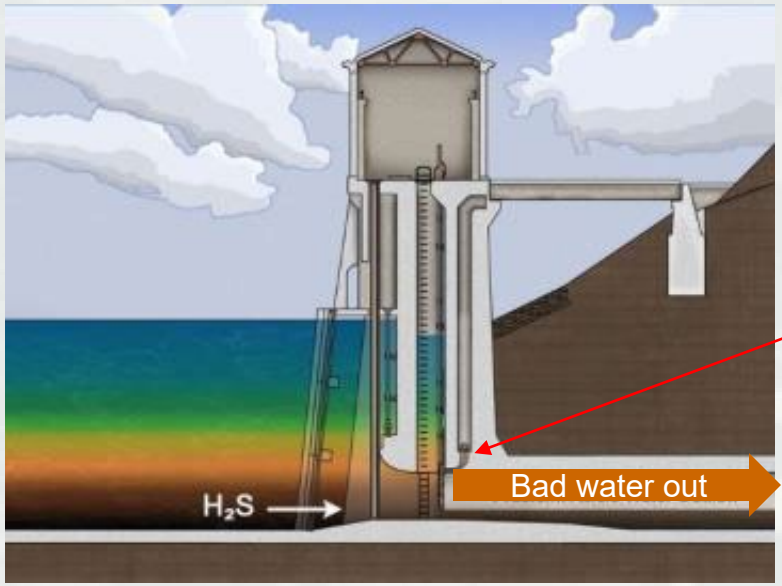
Water Management

Action:
Detroit Dam Temperature Control Operation



Water Management

- Water quality conditions can guide long term project management and maintenance.
- Example: modifications to limit corrosion.

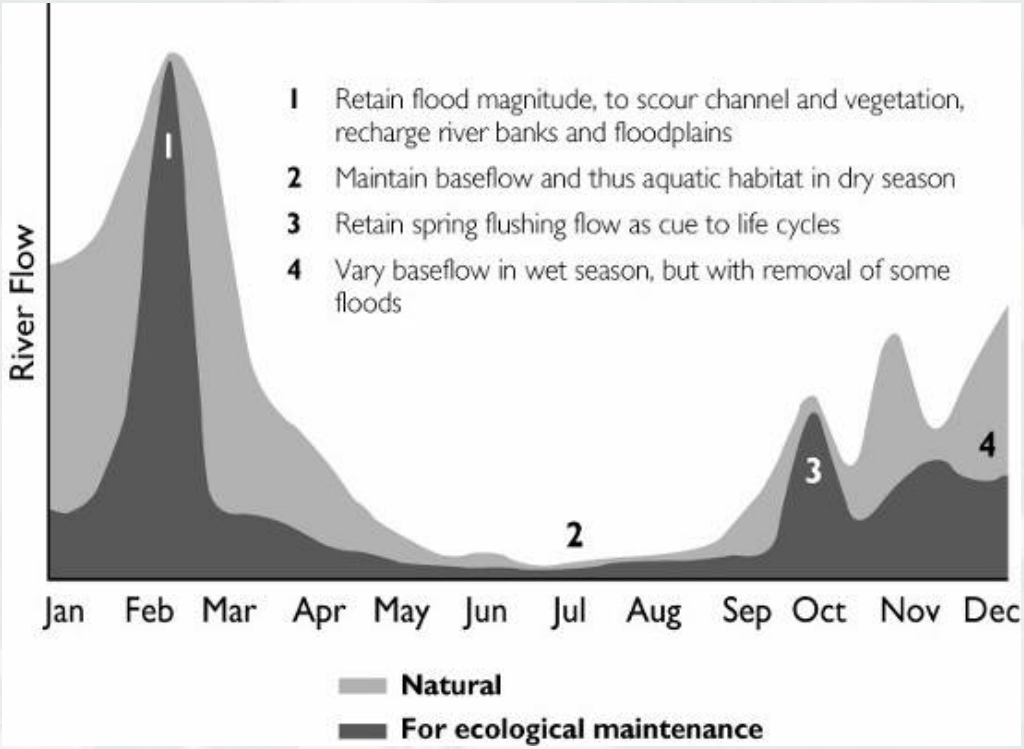


Deteriorating concrete in Tappan Lake tunnel liner – exposed aggregate

Tappan Lake H2S production issues were having structural impacts.

Sustainable Rivers Program

- "The goal is *not* to create optimal conditions for all species all of the time; rather, adequate conditions *enough* of the time" The Nature Conservancy.
- The USACE has a Sustainable Rivers Program.
- Active in many Districts working to achieve water quality goals.



Allegheny River Sustainable Rivers Project, TNC

Fish & Wildlife

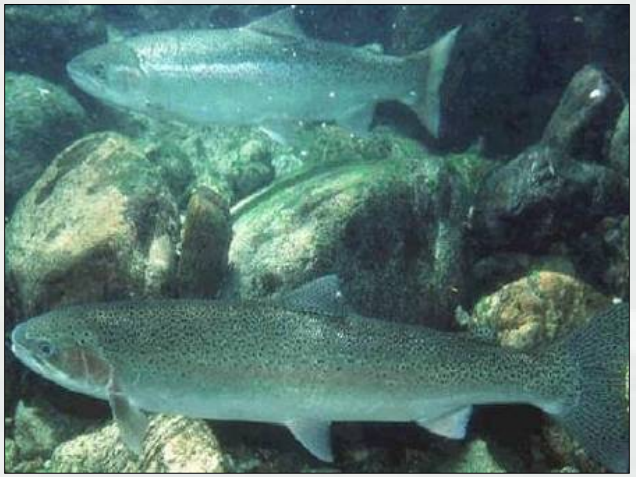
- Fish and Wildlife management is interlinked with water quality.
- Within our reservoirs and headwaters
- Downstream
- WQ data can be used to inform and improve fish and wildlife and project operations.

Real time monitoring, Detroit Reservoir, OR.

Draw down for juvenile fish passage at Fall Creek Reservoir, OR.

Endangered Species

Spring Chinook Salmon on the Upper Willamette River, OR



Winter steelhead on the Upper Willamette River, OR

Paddlefish during fishery survey at Allegheny Reservoir, PA & NY

ESA- Listed resident fish in the Willamette Basin

Planning

- WQ is addressed through GI / CAP projects (Ecosystem Restoration, Sec 1135, Sec 206;
  - Dissolved oxygen converted to habitat units (E-S SWT);
- WQ is addressed through ESA consultation;
  - Columbia River Basin – temperature and total dissolved gas (TDG);
  - Willamette Basin – temperature and TDG;
  - Missouri River – temperature impacts;
  - Ohio River – Dredging impacts on mussel species.

Planning

- WQ is addressed through Environmental Compliance activities
  - 404(b)1 / State WQ certificate
    - Missouri River – habitat creation / restoration PIR's;
      - Instrumental in continuing habitat creation projects in MO, IA, NE.
  - HSI model variables (e.g., temperature, dissolved oxygen, turbidity)
  - Engineering with Nature.

Ecosystem Restoration

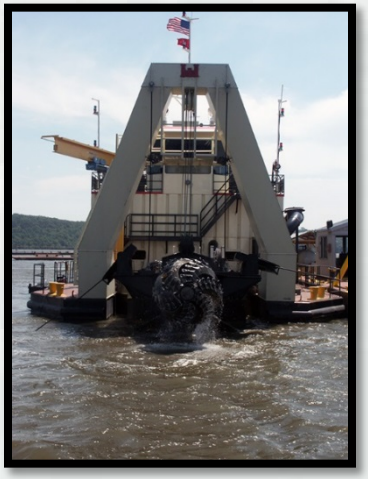
- Water quality is frequently a consideration on Ecosystem Restoration Projects.
- Meeting WQ criteria is incorporated within project goals.

Dredging Operations

- State water quality certification or a waiver thereof is required by the Clean Water Act of 1977 prior to discharge of dredged or fill material into waters of the United States.
  - Water Quality monitoring efforts are typically performed prior to certification in order to define conditions and areas of concerns.
  - Section 401 CWA – process can be used to define dredging monitoring requirements
- Endangered Species Act (ESA)

Dredging Operations

Wilmington District Dredging Efforts



Hydraulic Dredging and upland placement along the Sacramento Deep Water Ship Channel, CA

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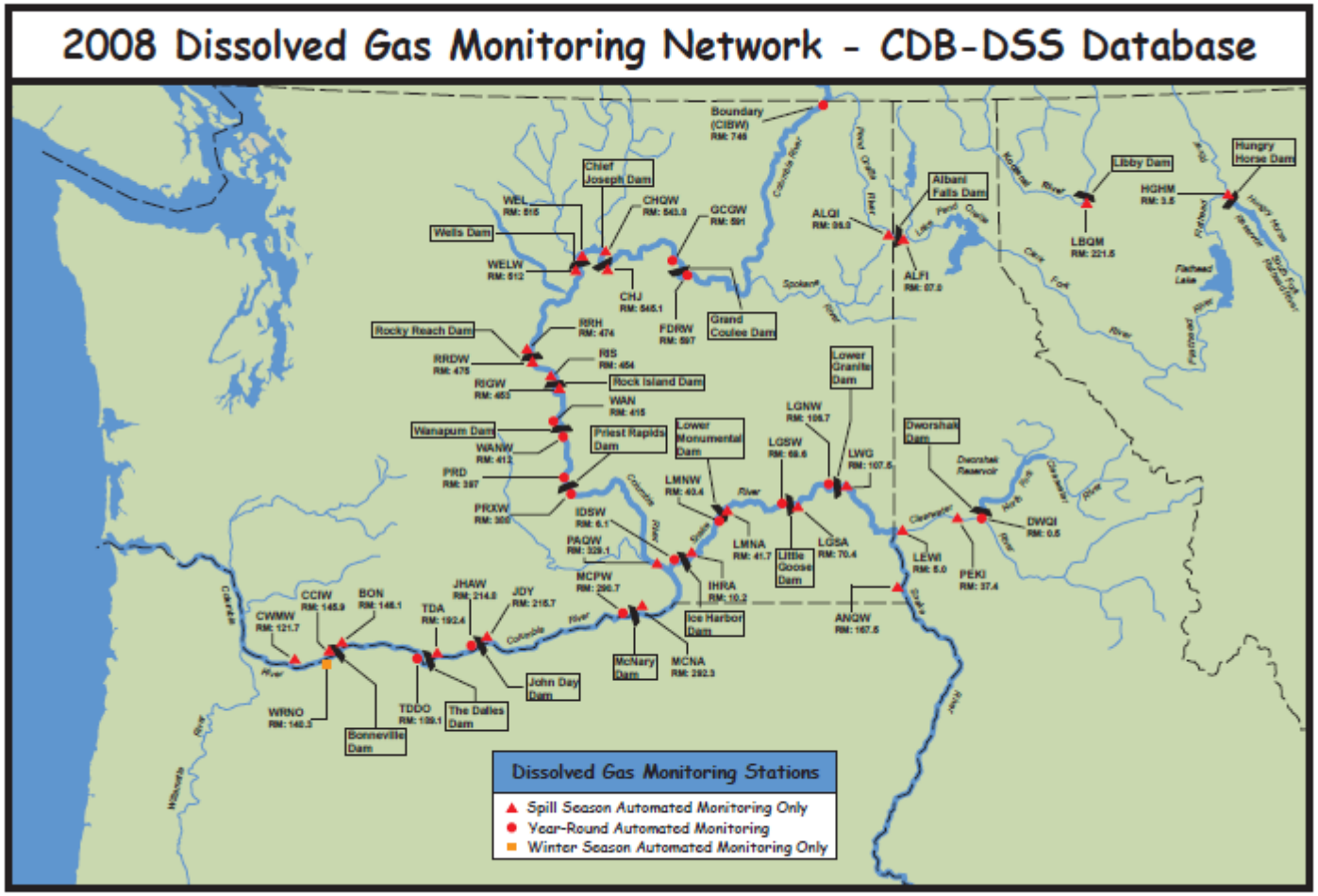
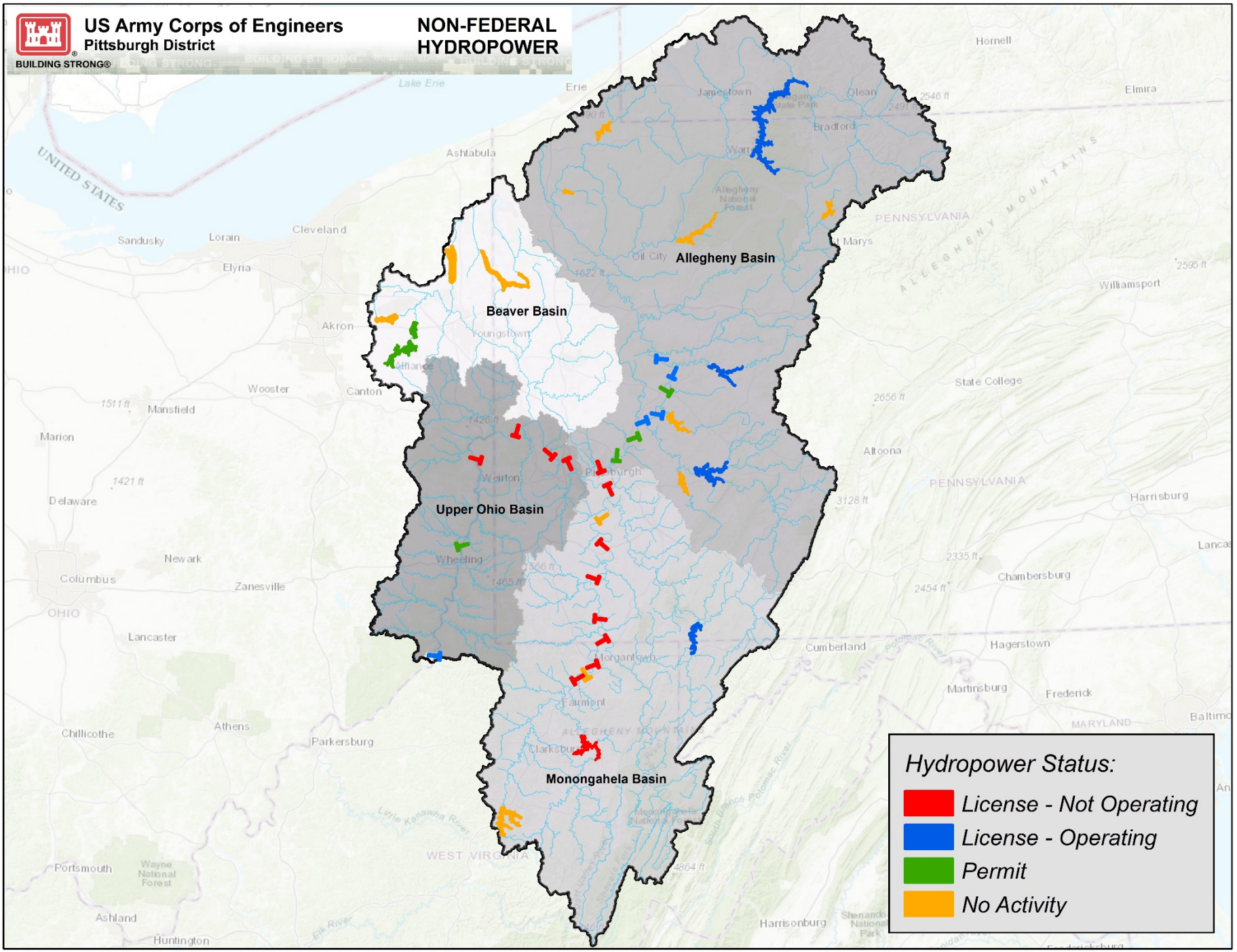
Hydropower

- ER 1110-2-1462 Water Quality and Water Control Considerations for Non-Federal Hydropower Development at Corps of Engineers Projects
- Hydroelectric power systems have to address water quality as part of their operation, dissolved gas and temperature can be parameters of concern.

Bonneville Dam, Powerhouse, & Turbines-Columbia River, OR

Hydropower


2008 Dissolved Gas Monitoring Network - CDB-DSS Database
Boundary (CIBW) RM: 746
Chief Joseph Dam
WEL RM: 515
CHOW RM: 543.0
GCGW RM: 591
Wells Dam
WELW RM: 512
CHJ RM: 545.1
FDRW RM: 597
Grand Coulee Dam
Rocky Reach Dam
RRH RM: 474
RRDW RM: 475
RIS RM: 454
RIGW RM: 453
Rock Island Dam
WAN RM: 415
Wanapum Dam
WANW RM: 413
Priest Rapids Dam
PRD RM: 397
PRXW RM: 309
Lower Monumental Dam
LMNW RM: 40.4
LMNA RM: 41.7
Little Goose Dam
LGSW RM: 69.6
LGSA RM: 70.4
Lower Granite Dam
LGNW RM: 108.7
LWG RM: 107.5
IDSW RM: 6.1
PAOW RM: 339.1
MCPW RM: 290.7
IHRA RM: 10.2
Ice Harbor Dam
McNary Dam
MCNA RM: 292.3
CCIW RM: 145.9
CWMW RM: 121.7
BON RM: 146.1
JHAW RM: 214.0
JDY RM: 215.7
TDA RM: 192.4
John Day Dam
TDDO RM: 109.1
The Dalles Dam
WRNO RM: 140.3
Bonneville Dam
Albeni Falls Dam
ALQI RM: 96.8
ALFI RM: 87.0
Libby Dam
LBQM RM: 221.5
HGHM RM: 3.5
Hungry Horse Dam
Dworshak Dam
Dworshak Reservoir
DWQI RM: 0.5
LEWI RM: 5.0
PEKI RM: 37.4
ANQW RM: 167.5
Dissolved Gas Monitoring Stations
Spill Season Automated Monitoring Only
Year-Round Automated Monitoring
Winter Season Automated Monitoring Only


US Army Corps of Engineers
Pittsburgh District
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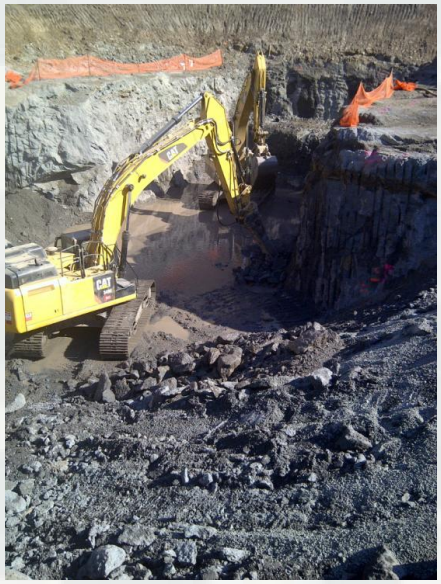
NON-FEDERAL
HYDROPOWER
Allegheny Basin
Beaver Basin
Upper Ohio Basin
Monongahela Basin
Hydropower Status:
License - Not Operating
License - Operating
Permit
No Activity

Hydropower



Dorena Dam – Private Hydropower Construction, OR.

PRECONSTRUCTION ENGINEERING AND DESIGN AND ENGINEERING DURING CONSTRUCTION

- EM 1110-2-38
- All project features are designed so that the visual and human-cultural values associated with the project will be protected, preserved, or maintained to the maximum extent practicable. Specific ecological considerations include actions to preserve critical habitats of fish and wildlife; accomplish sedimentation and erosion control; maintain water quality; regulate streamflow, runoff and groundwater supplies; and avoidance or mitigation of actions whose effect would be to reduce scarce biota, ecosystems, or basic resources.

Design and Construction

- Civil and Military Activities
- CWA 401 permit compliance
  - In water work
  - Dewatering
  - Salinity monitoring and modeling
- Construction storm water permit compliance.
- Quality Control efforts

Columbia River Estuary Habitat Restoration, OR

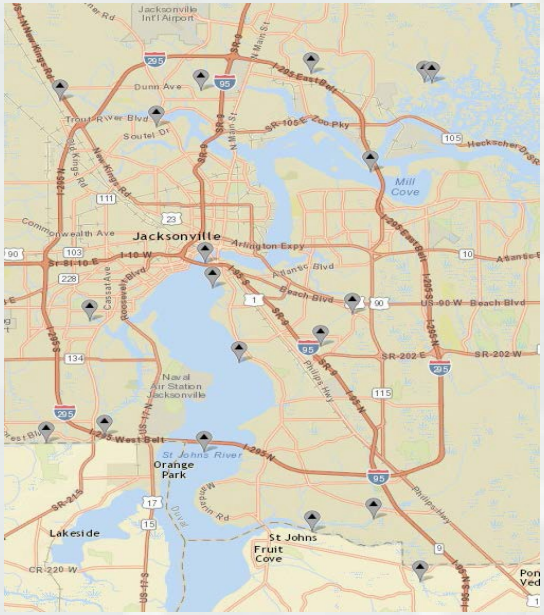
Napa River Flood Protection Project, CA

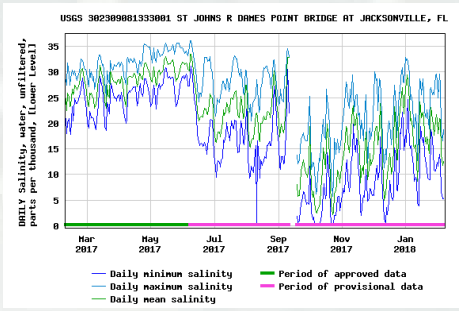
Design and Construction

Salinity Monitoring and Modeling

Jacksonville Harbor Deepening

Salinity Monitoring Stations



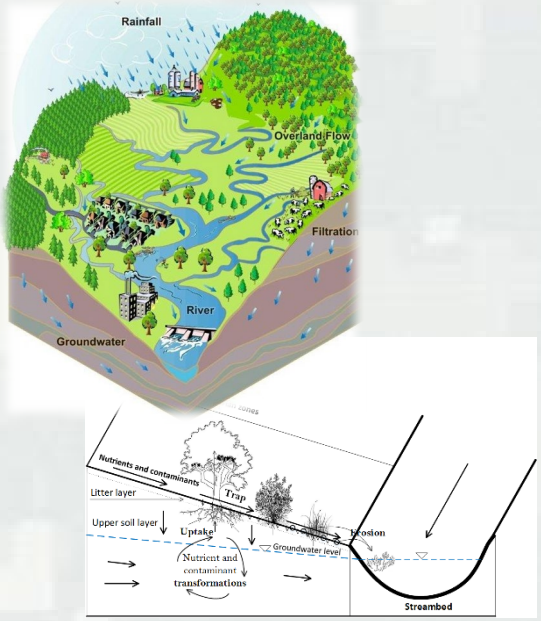


Salinity Monitoring Station Locations and Results

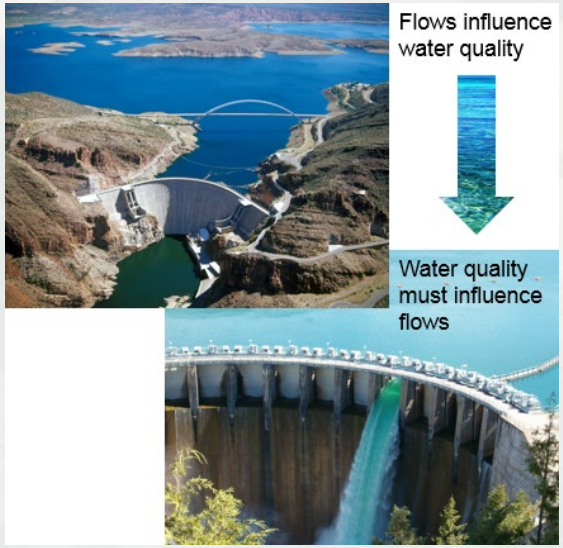
EFDC Salinity Model Grid

Model Design and Management

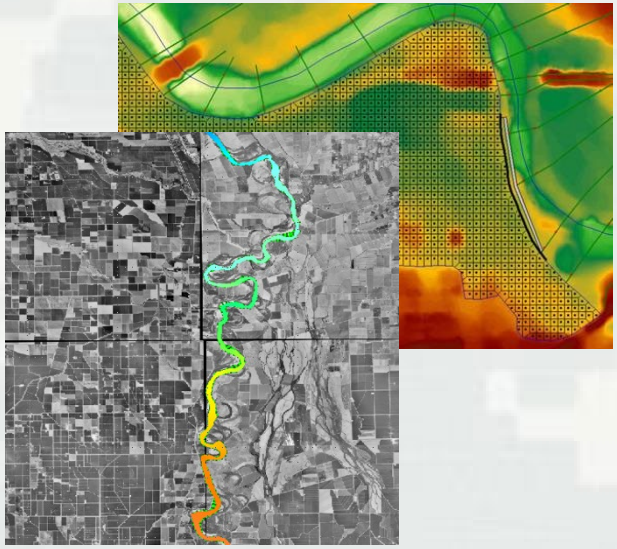
HEC-HMS



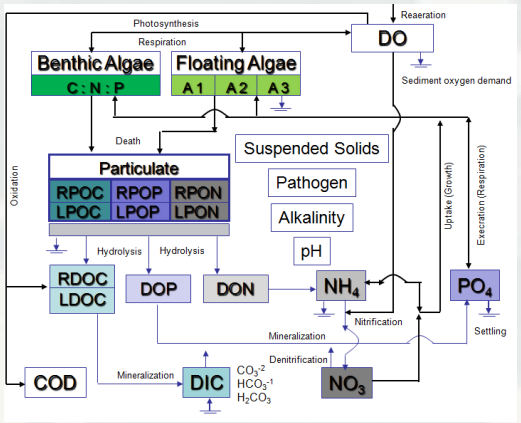
HEC-ResSim



HEC-RAS



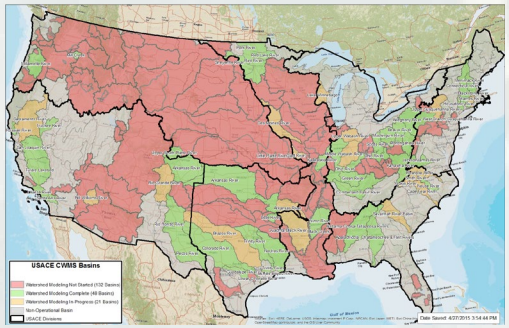
NSM



- Ongoing water quality development for real-time modeling and impacts assessment
  - HEC-HMS: Runoff water quality
  - HEC-ResSim: Reservoir water quality
  - HEC-RAS: River water quality & riparian vegetation
  - NSM: Water quality reactions and cycles for HEC-HMS, HEC-ResSim, and HEC-RAS

Model Design and Management

- CWMS (Corps Water Management System) provides real-time decision support for water management
- 700+ Multi-purpose reservoirs, flow control structures, levees, etc.
- Features:
  - Real-time data acquisition
  - Database storage
  - Flow forecasting of watershed runoff
  - Reservoir operation decision support
  - River profile modeling
  - Inundated area determination
  - Consequence/damage analysis
  - Information dissemination
- Implementation: 201 CWMS systems by 2022

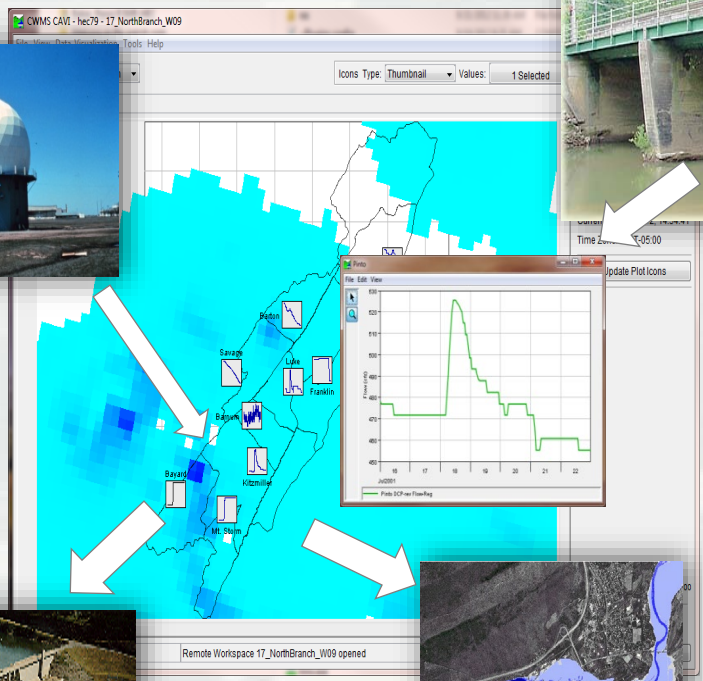


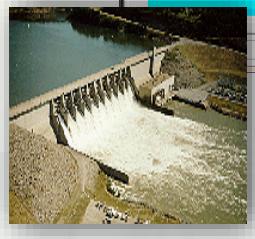
- Water quality development in HEC-ResSim, HEC-RAS, and HEC-HMS will provide real-time WQ decision-making capability in CWMS

Real-Time Fully Integrated Hydrologic Models

NWS Forecasts

Streamgage Data





Operational Decisions

Inundation Mapping

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HTRW

- Hazardous, Toxic, and Radiological Waste (HTRW) activities have WQ concerns to address
  - Formerly Used Defense Sites (FUDS)
  - Base Realignment and Closure (BRAC) locations
  - US EPA and external agency support
  - Military Munitions Response Program (MMRP)

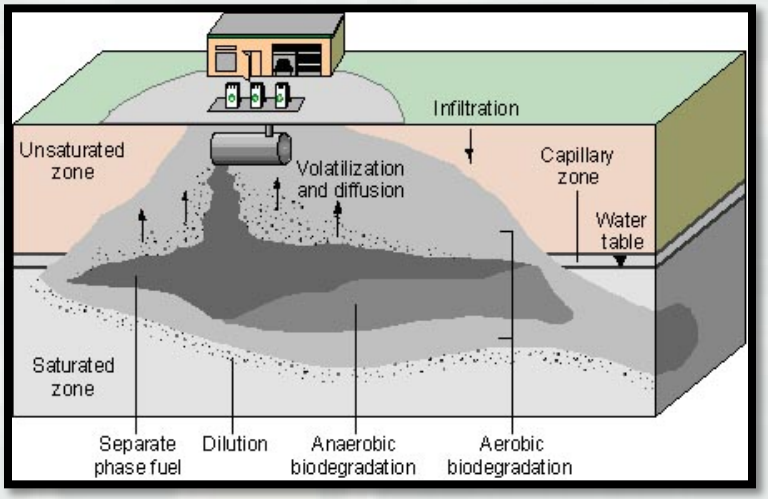


Image Sources: U.S. Environmental Protection Agency.

Military Installation Activities

- Storm water compliance
  - Installation MS4 permits
  - EISA 438
- New Military Construction
- Water treatment – drinking & wastewater

Storm water quality and quantity evaluation prior to new construction at the Presidio of Monterey (POM), Monterey, California

Wastewater treatment lagoon Sharpe Army Depot, Lathrop California

RAMS

- Restoration of Abandoned Mine Sites (RAMS) Program
- Program evaluates old mining sites in order to address related water quality problems.

RAMS program project sites near Winnemucca, NV

Emergency Response

- Disaster Response
  - Drinking water
  - Wastewater
  - Illness prevention
  - Habitat impacts
  - Fires
- Spills
  - Equipment leaks
  - Mining dam breaks
- Fish Kills

The 2017 Northern California Fire Disaster. Potential movement of contaminants and debris by storm water and stream impacts were a significant concerns.

A HAB caused a fish kill at Black Butte Lake, near Orland, CA

Emerging WQ Issues

- Hazardous Algal Blooms (HABs)
- Long term invasive species impacts
- Climate change impacts
  - Variable weather.
  - Droughts
- Training future staff
- Eutrophication
- Fires within watersheds
- WQ data management
- New Mineral extraction impacts

Algal Bloom on John Day River, OR.

Tributary to Loyalhanna Creek Lake, PA

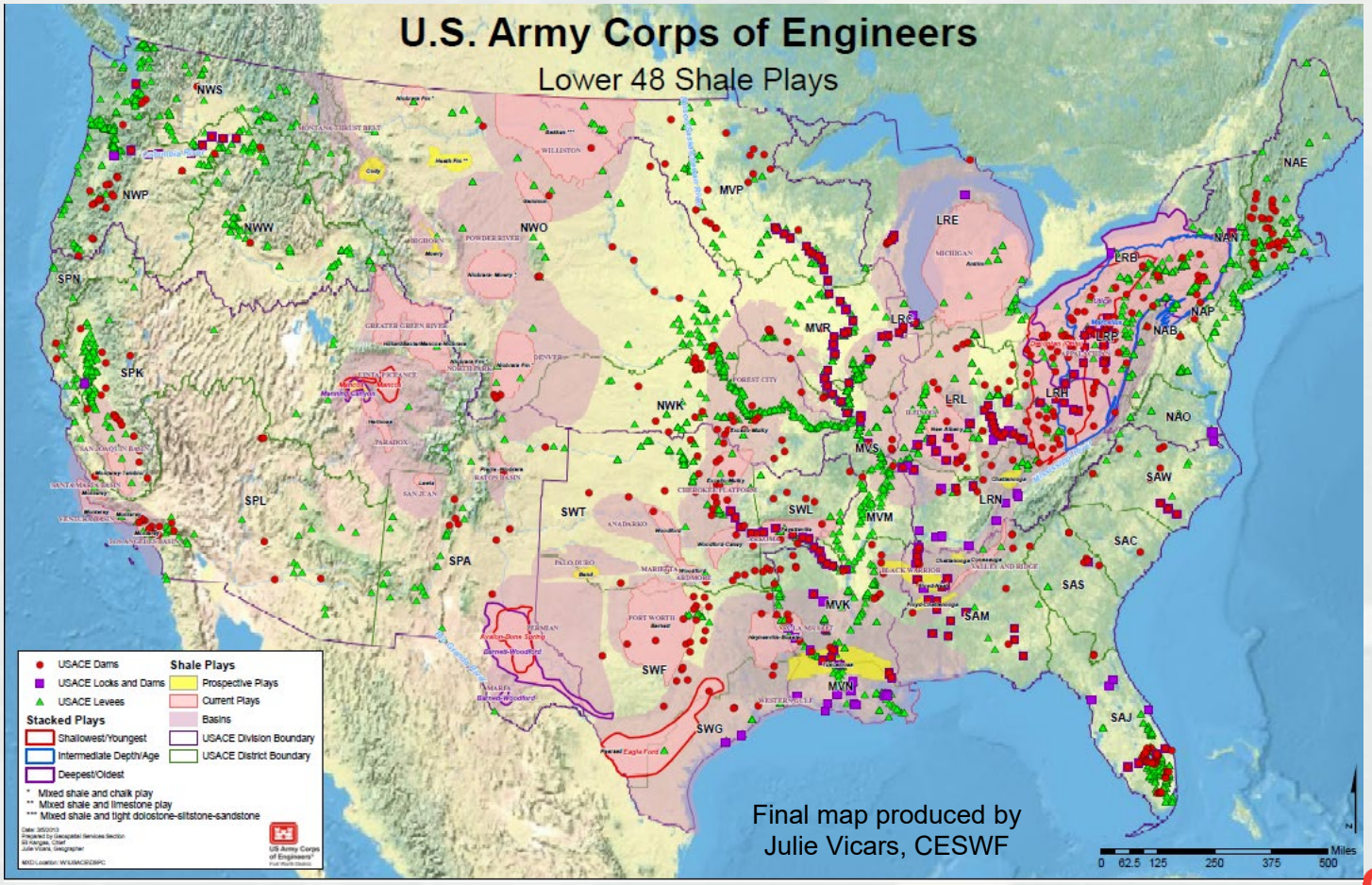
Invasive Species

- Increasing problems with non-native species introduction
- Historical ecosystem balance is changed.
- Ecosystem shifts alter water quality.

Eurasian Milfoil. Photo - USGS

Asian Carp. Photo – USACE Jacksonville District

Shale Gas Overlain by USACE Infrastructure



Base map http://www.eia.gov/oil_gas/rpd/shale_gas.jpg;

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Water Quality at the U.S. Army Corps of Engineers

Data Management, Data Analysis, Data Collection, Use of Data

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Emerging Issues: Hazardous Algal Blooms (HABs), Invasive Species, Climate Change, New Mineral Extraction Impacts, Fires, staff training.

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Summary

- The USACE **DOES** water quality!
- Small program with a big mission!
- …and it is growing…

Questions?

Marion Reservoir, Kansas SWT – Tony Clyde photo.

Model Design and Management

- Todd is looking to develop one summary introductory slide.
- Model development 1-2 model summary slides.
- A2W other related pieces

Model Design and Management

- HEC-WAT (Watershed Assessment Tool) links models and data for watershed studies
- Water quality development in HEC-ResSim, HEC-RAS, and HMS-HMS will provide integrated environmental impacts assessment capabilities