Kickoff Meeting

Innovative Water Management Technology to Reduce Environmental Impacts of Produced Water

DE-NT0005682

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Pittsburgh, PA

Project participants

- U.S. Department of Energy
  National Energy Technology Laboratory
- Clemson University
- Chevron

Presentation outline

- Background
- Objective
- Scope of work – tasks
- Milestones and schedule
- Decision points, success criteria, outcomes
- Risk management
- Deliverables and briefings
- Budget summary
- Personnel

Produced water issues

- Most produced water is managed by re-injection or transport and treatment
- Regulations for injection and discharge are becoming more stringent
- Volumes of produced water are expected to increase
- Produced water issues will limit energy extraction and increase energy cost
- Effective, lower cost treatment is needed

Constructed wetland treatment systems

- Typically cost 50 to 90% less than conventional treatment systems
  - Low construction cost
  - Low operating expense (O&M)
- Provide effective “wastewater” treatment (achieve NPDES requirements)
- Support of regulatory community
- Water conservation and reuse

Applications of constructed wetlands: point sources

Industrial wastewater

Applications of constructed wetlands: non-point sources

Constructed wetland treatment systems for water management

Systems carefully designed to “treat” (transfer or transform) constituents in impaired water in order to decrease the environmental risks these constituents may pose in receiving systems

Features of constructed wetland treatment systems

- Largely self-maintaining
- Treat multiple constituents; wide range of concentrations
- Design for seasonal variations
  - e.g., annual plant dieback renews sediment binding surfaces
- Permitted as “wastewater” treatment systems

Key concepts

- Goal: remove targeted constituents from aqueous phase and partition to sediments in non-bioavailable forms
- Method: replicate natural systems - biogeochemical processes in sediments
- Evaluation of performance: measure decrease in aqueous concentrations and perform toxicity tests

Approach

- Identify chemical, physical, and risk characteristics
- Determine reuse and discharge criteria
- Develop treatment performance goals
- Identify biogeochemical treatment processes (pathways) and conditions to achieve these processes
- Design and construct system
- Measure treatment performance

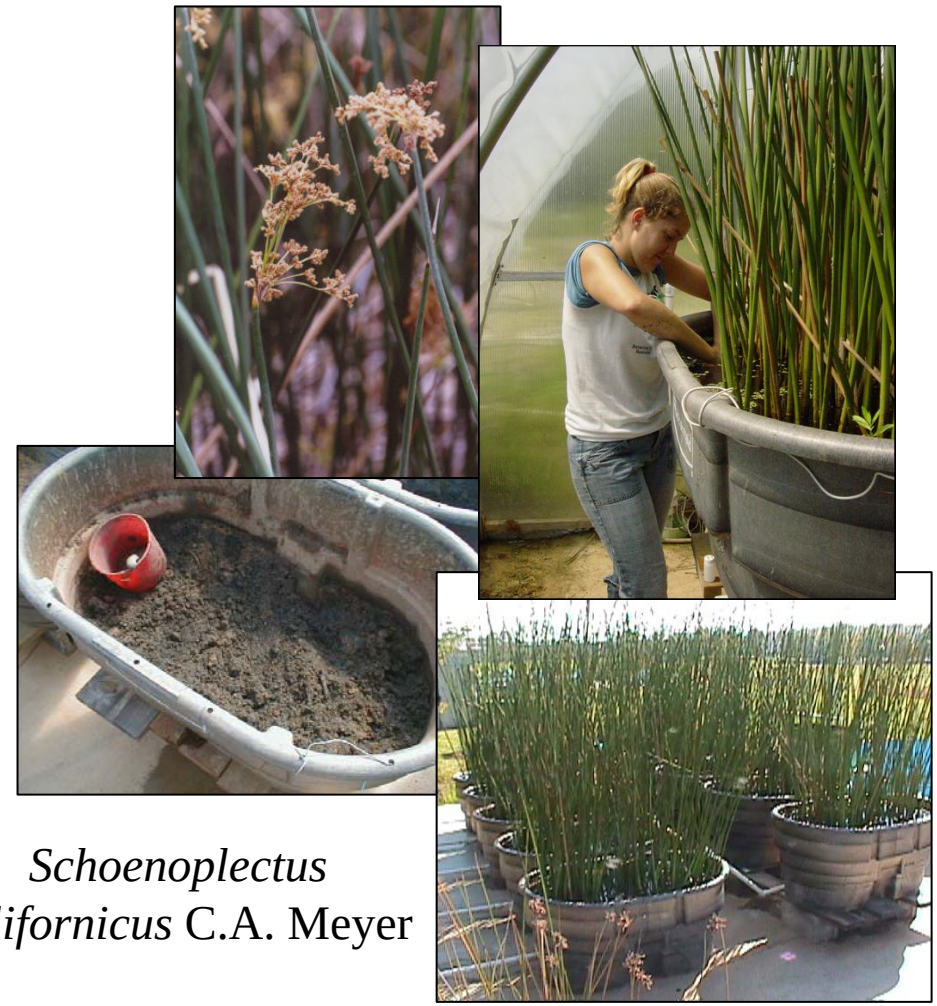
Treatment processes

- Transfers
  - Sorption
  - Volatilization
  - Precipitation/settling/sedimentation
  - Bioconcentration
- Transformations
  - Hydrolysis
  - Photolysis
  - Oxidation/reduction/speciation
  - Biotransformation/biodegradation

Rodgers and Castle (*Environmental Geosciences,* 2008)

Reducing pathway

- Eh ≤ -150 mV
- Organic-rich sediment
- Removal of metals via reductive pathways



Schoenoplectus californicus C.A. Meyer

Oxidizing pathway

- Eh > -50 mV
- Sandy sediment
- Removal of water soluble organics via oxidative pathways

Typha latifolia L.

Project objective

Develop constructed wetland systems for treatment and beneficial use of produced water, and conduct scientific studies to address ecological, environmental, and regulatory concerns that limit options for managing produced water, including surface discharge

Scope of work

- Phase I: Assess environmental factors associated with produced waters
- Phase II: Design, construct, and monitor pilot-scale wetland treatment system
- Phase III: Construct a demonstration-scale wetland treatment system and measure performance

Phase I

- Task 1: Project management plan
- Task 2: Identify chemical, physical, and risk characteristics of produced waters
- Task 3: Determine reuse and discharge criteria and develop treatment performance goals

Task 1

- Project management plan
  - completed

Task 2

- Identify and compile chemical, physical, and risk characteristics of produced waters
  - Include conventional and unconventional resources, particularly natural gas
  - Analyze samples of actual produced waters to confirm targeted constituents

Task 3

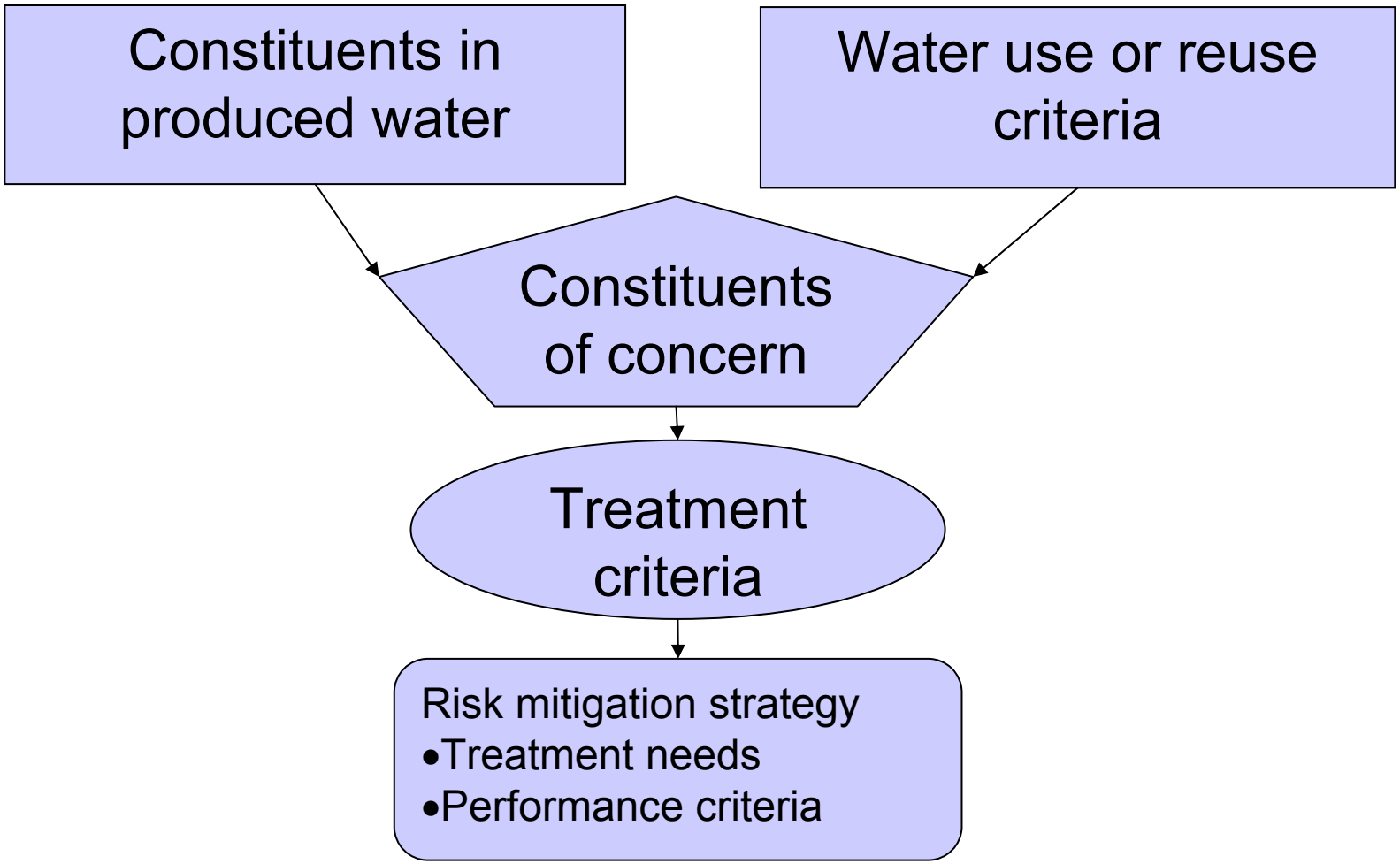
- Determine reuse and discharge criteria
  - Reuse criteria – agriculture

    Seed germination and seedling growth
  - Reuse criteria – industry

    Scaling and biofouling
  - Discharge criteria

    Toxicity testing to measure risk
- Identify constituents of concern
- Develop treatment performance goals

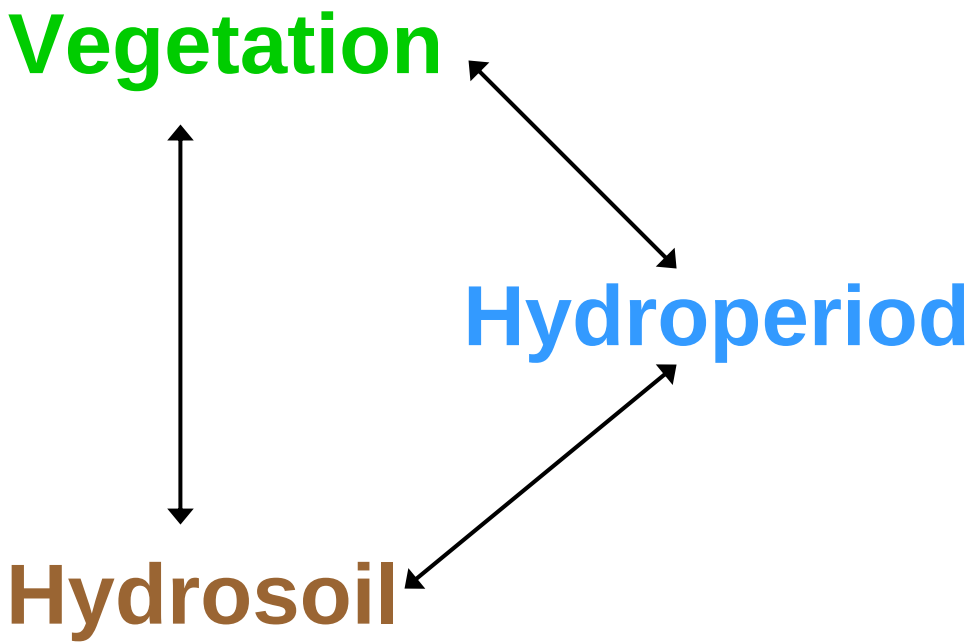
Risk mitigation strategy (Tasks 2 & 3)



Phase II

- Task 4: Design and construct pilot-scale constructed wetland treatment systems
- Task 5: Measure treatment performance of pilot-scale constructed wetland systems
- Task 6: Assess pilot-scale performance

Design components



Monitoring

- Does it work? (performance)
- How does it work? (function)
  - Mass balances
  - Reaction rates
  - HRT/MRT
  - Loading rates
  - Seasonal influences (temperature, rainfall)

Phase III

- Task 7: Design and construct demonstration-scale constructed wetland treatment system
- Task 8: Measure treatment performance of demonstration-scale constructed wetland system
- Task 9: Apply results to water management and technology replication
- Task 10: Technology transfer
- Task 11: Final report

Milestones

Completion of:	Milestone Description
Task 2	Data for identifying constituents for treatment, which will be used for designing systems that provide treatment for water discharge or reuse and that mitigate risks
Task 3	Target levels for treatment and risk mitigation (treatment goals)
Task 4	Pilot-scale systems needed for monitoring and evaluating treatment
Task 6	Results needed for design and construction of the demonstration system (Task 7) and success criteria for moving ahead to the next phase of the project
Task 7	Demonstration-scale system needed for monitoring and evaluating onsite treatment at a field location
Task 9	A basis for constructing wetland treatment systems at other sites of conventional and unconventional oil and gas production

Schedule

	Task	Project Milestone Description	Project Duration - Start: Nov. 3, 2008 End: Nov. 2, 2011												Planned Start Date	Planned End Date
			Project Year (PY) 1				PY 2				PY 3					
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4		
I	1														11/3/08	1/2/09
	2	data for design													12/3/08	5/2/09
	3	treatment goals													5/3/09	11/2/09
II	4	construct pilot systems													11/3/09	1/2/10
	5														1/3/10	9/2/10
	6	results for demo scale													9/3/10	11/2/10
III	7	construct demo system													11/3/10	1/2/11
	8														1/3/11	9/2/11
	9	basis for replication													9/3/11	11/2/11
	10														9/3/11	11/2/11
	11														9/3/11	11/2/11

Decision points, success criteria, outcomes

Decision Point	Success Criteria	Outcome
End of Phase I	Determination of produced water characteristics, identification of reuse and discharge criteria, and assessment of constructed wetland systems for treating produced water	Project will move ahead to Phase II if it is determined that constructed wetland systems offer a feasible approach for treating produced water
End of Phase II	Treatment performance of the pilot-scale constructed wetland system in treating produced water, including ability to meet criteria for water reuse and discharge	Project will move ahead to Phase III upon achieving performance of the pilot-scale constructed wetland system in treating produced water
End of Phase III	Treatment performance of the onsite demonstration wetland treatment system	The technology will be ready to apply to other sites for full-scale treatment of produced waters

Risk management

- Reasonable project schedule
- Experienced personnel
- Compliance with environmental health and safety
  - Training
  - Chemical use protocols
- Other – e.g. weather

Deliverables

- Project management plan (Task 1)
- Topical report with details from Phase 1
- Topical report with details from Phase 2
- Final report (Task 11)
- Other reports in accordance with the Federal Assistance Reporting Checklist

Briefings/technical presentations

- Project kick off meeting
- Technical papers at DOE/NETL Annual Contractors Review Meeting
- Annual detailed briefings to DOE Project Officer

Budget summary

	Phase I (Tasks 1-3)	Phase II (Tasks 4-6)	Phase III (Tasks 7-11)	Total
DOE Share	$203,853	$262,191	$223,488	$689,532
Cost Share	$51,119	$66,020	$224,302	$341,441

Personnel

- Clemson University
  - Jim Castle, PI
  - John Rodgers, PI
  - Graduate students: Alex Beebe, Bethany Alley
- Chevron
  - Jim Myers
  - Cindy Murray Gulde
- DOE-NETL
  - Sandy McSurdy, Project Manager

Questions and discussion