

LIFECYCLE WATER MANAGEMENT SERVICES FOR THE UPSTREAM OIL & GAS INDUSTRY



Offering turnkey wastewater management services for oil, natural gas and coalbed methane fields

Lifecycle Water Management Services

Scope of Services – Wastewater Resources Inc. and Black & Veatch, a leading global architectural and engineering firm, have teamed up to offer **Lifecycle Water Management Services** to the Upstream Oil & Gas Industry. From assessing local water resources to constructing site improvements to recycling treated wastewaters, we manage all facets of the water strategy over the life of oil, natural gas, and coalbed methane reservoirs.

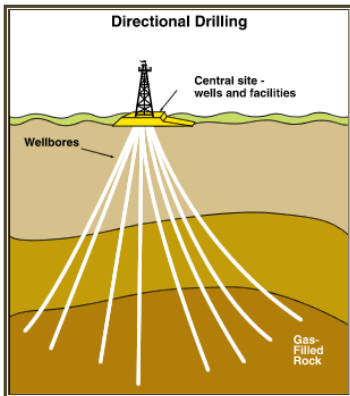
Turnkey Services – Our team relieves producers of the complex and risky job of managing water and wastewater (i.e., drilling fluids, frac flowback and produced water). We specialize in water permitting, procurement, and hauling, as well as wastewater recovery, treatment, and recycling. Our full suite of services provides a turnkey solution for managing wastewaters in an increasingly regulated environment.

Business Case – By integrating all facets of water management under one vendor, producers can increase returns on investment and reduce risks by adopting our **100% Water Recycle Model**. This sustainable practice minimizes or eliminates excessive water hauling costs and truck trips by recycling all wastewaters onsite for additional drilling and completion operations, which greatly improves community relations.

Water Management by Design – We design, construct, and operate complete water management systems for the lifecycle of oil, gas, and CBM reservoirs:

- Feasibility studies
- Site design & construction
- Facilities design & construction
- Water procurement & waste disposal
- Onsite treatment technology & installation and
- System integration, operation & maintenance.

Feasibility Studies – The first step is to conduct a feasibility study which identifies local water rights, resources, and regulations governing groundwater, surface water, and wastewater to develop an overall water management strategy. For early freshwater needs in the field, the



study determines local water resources for withdrawals, and permitting, acquisition, and hauling costs. A needs assessment is performed for onsite water collection, storage, and distribution systems to minimize truck trips and improve logistics.

The team also studies the quality and volume of wastewaters, including bench scale testing, to aid in the selection of the best treatment technology. Typically, mobile pretreatment plants are first deployed to clean and recycle flowback and then early volumes of produced water. They are later transitioned to central wastewater

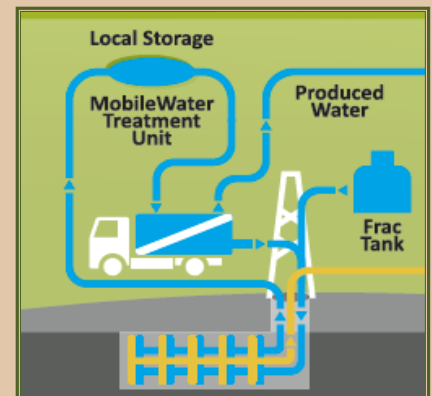
treatment plants as the volume of produced water increases during the development of new reservoirs. Finally, the feasibility study identifies reporting requirements of state and federal regulators governing water withdrawals and wastewater streams.

We offer a broad scope of services:

- Lifecycle water management strategy
- Full suite of water-related services
- State-of-the-art treatment plants and
- A 100% Water Recycle Model

We reclaim, treat, and recycle drilling fluids, flowback, and produced water from oil, natural gas & coalbed methane fields.

*Our **100% Water Recycle Model** reduces water acquisition and hauling expenses by keeping treated wastewater in the field for additional drilling and completion operations.*



Feasibility Studies:

- Water Rights
- State & federal regulations
- Water acquisition & hauling
- Wastewater quality & volume
- Waste hauling & disposal
- Regulatory reporting

Wastewater Resources Inc.

9318 N. 95th Way, Suite 102

Scottsdale, Arizona 85258

Office (480) 391.9939

Website www.h2oreuse.com

Site Design & Construction – With your drilling and facilities staff, our team prepares site development plans for the water management strategy. After plan approval, they pull permits for roads, water lines, utilities, and water and wastewater storage. The team also assists with right of way acquisition for ingress and egress and water lines, and provides project management services for the construction of site improvements.

Facilities Design & Construction – Our team will draw the plans and acquire permits for the water treatment plants, as well as the civil work associated with buildings and process equipment. Again, they provide project management services for facilities construction, and the pumping, storage, and energy solutions required to operate the water treatment plants.

Water Provision & Waste Disposal – In conjunction with your drilling and facilities staff, our team identifies water volumes and schedules required for drilling and completion operations, and secures water permits and hauling contracts. After wastewater treatment, they manage sludge disposal, whether offsite or onsite, as well as billing and reporting requirements.

Treatment Technology & Installation – A key component of the overall water management strategy is the selection of wastewater treatment technology. The choice of treatment technology is based on quality and volume of wastewaters generated in the field, as well as

the end use specifications for treated wastewaters. The team ensures permitting of the wastewater treatment plants and deploys mobile pretreatment plants to the field. Later, they strategically erect central wastewater plants for the advanced treatment of produced water based on its end use.

The team selects wastewater pretreatment plants (coagulation, flocculation and clarification solutions) to reduce total suspended solids (TSS), advanced

wastewater treatment plants (filtration, ion exchange and thermal solutions) to reduce total dissolved solids (TDS), and post-treatment technology (UV and ozone) to polish effluents prior to reuse. If needed, they can deliver brine concentrators and crystallizers to reduce salts prior to disposal. They also select and install the process equipment (pumping, screening, chemical and material handling) to support the wastewater treatment plants.

System Integration & Operation – Under water service agreements, our team integrates and

operates wastewater treatment plants, and manages chemical handling and waste disposal. System integration includes instrumentation and control devices (flow meters, pressure gauges, etc.), control logic and programming, and system hardware. Our wastewater treatment plants are fully automated. They come equipped with user-friendly programming and color touch screens for local system monitoring and management, and Internet connectivity with full reach-back capabilities for remote monitoring and management of the treatment plants.

Return on Investment – Our integrated water management strategy brings a full suite of water services and equipment to your oil, natural gas, and coalbed methane fields to:

- Provide an overall water management strategy
- Reduce or eliminate freshwater acquisition and hauling costs
- Recycle and reuse treated wastewaters for beneficial uses
- Reduce environmental footprints and regulatory risks
- Promote good stewardship of all natural resources and
- Increase IRR's over the life of oil and gas reservoirs.

Site Design & Construction:

- Site plans, permits & construction
- Road plans, permits & construction
- Water collection & distribution systems
- Water storage tanks & impoundments
- Project management

Facilities Design & Construction:

- Facilities plans & permits
- Facilities construction
- Power generation system
- Power distribution system
- Project management

Water Provision & Waste Disposal:

- Water supply contracts & permits
- Managing water hauling contracts
- Managing waste disposal contracts
- Regulatory reporting

Wastewater Treatment:

- Selecting effective technology
- Permitting treatment plants
- Wastewater pretreatment systems
- Advanced treatment systems
- Post treatment systems
- Support & processing equipment
- Wastewater plant operations

System Integration & Operation:

- Instrumentation & control devices
- Flow meters & pressure gauges
- Control logic & programming
- Commissioning & startup
- System performance reporting

Through an integrated wastewater management plan, we can reduce costs and risks associated with handling water and wastewater, and increase your returns across the life of oil and gas fields.

Contact Randall Finrock at WRI (520.664.8600) or Brady Hays at Black & Veatch (913.626.1134) for more details.

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