



2016 IOGCC CHAIRMAN'S STEWARDSHIP AWARD
ENVIRONMENTAL PARTNERSHIP

Anadarko Petroleum Corporation
Award Submission in the Category of *Large Company*
Program Title – *Mitigation and Compatibility*

Nominee Information:

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Anadarko Petroleum Corporation
Award Submission in the Category of *Large Company*
Program Title – U.S. Onshore Compatibility Initiatives

As one of the world's largest independent oil and natural gas exploration and production companies, our employees are committed to safely finding and producing the vital energy we all need in a manner that protects the environment, public health and supports local communities. The company is also focused on investing in technology and resources that mitigate impacts such as noise and waste, managing resource use, and ensuring our operations are more compatible with communities.

WATER MANAGEMENT: Conserving Precious Resources

Anadarko recognizes that proper water management and conservation are essential in developing energy resources. The company works diligently to protect and conserve this resource through improved technologies and collaborative industry efforts, including water-recycling programs and closed-loop systems. Automation and underground pipelines also reduce truck traffic and surface use.

Marcellus Basin

When faced with the challenge of what to do with produced and flowback water, the Marcellus team began to capitalize on the spirit of innovation. The team recycled 100 percent of produced and flowback water while completing wells; increased modulation on their production; and, began collaborating with logistics sources to provide a secondary plan to manage future fluid levels with water movement by rail rather than trucks if necessary.

Maverick Basin

The Maverick Basin team installed, maintains and operates 256 miles of 18-inch and 20-inch water transfer lines to support drilling, completions and operations. In an effort to conserve water in the Carrizo Aquifer, the team utilizes the Rio Grande River as its water supply. In 2015, 78 percent of total water used was pulled from the Rio Grande River, while 22 percent came from the Carrizo Aquifer. Year-to-date 2016, the team has been able to source 100 percent of water from the Rio Grande, which aids in the conservation of the aquifer used by other industries and municipalities.

Additionally, the team works with the Wintergarden Groundwater Conservation District, allowing the district to test samples from drilled water wells and to track aquifer levels with the water well levels. The

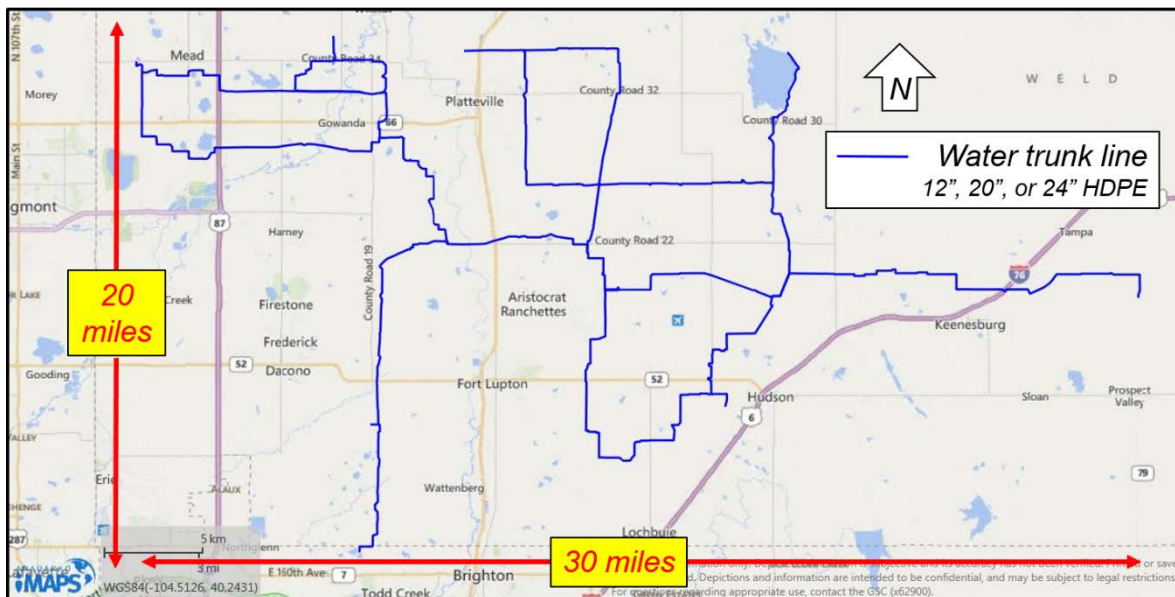
team also works with the Texas Commission on Environmental Quality (TCEQ) to track Rio Grande water usage.

Delaware Basin

A dedicated water team was formed in 2015 to overcome current and future water challenges in the Delaware Basin. The team has focused on providing cost-effective water sourcing solutions and expanding regional disposal capacity. The team also progressed long-term system plans with an emphasis on flexibility and mitigation of potential risks. In 2015, Anadarko partnered with Energy Water Solutions, the Texas Railroad Commission, Texas A&M AgriLife Research and Gibson Energy for the [Produced Water Irrigation Project](#). The project evaluated using recycled produced water to irrigate a cotton crop in nearby Pecos, Texas. [See study details.](#)

Greater Wattenberg Area/DJ Basin

The Greater Wattenberg Area (GWA) team redefined water management with a water on demand (WOD) project, building a network of more than 150 miles of pipeline to source and transport water to drilling and completions crews. This project supports more than four completion crews, has saved millions of gallons of diesel fuel, eliminated more than 2,000 truck trips per day since its inception and eliminated more than 7 million truck-traffic miles in 2015 alone.





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MITIGATION EFFORTS: Investing in Compatibility

Our employees work and live in our core areas of operations. We recognize our obligation to protect our environment, public health and our communities, while finding ways to mitigate impacts and make our operations more compatible.

"We achieve sustainability by living our core values of integrity and trust, servant leadership, open communication, people and passion, and commercial focus, all of which guide our activities and decisions."

Al Walker
Chairman, President & CEO

Mozambique

Anadarko is advancing the Mozambique liquefied natural gas (LNG) project – one of the world's largest LNG developments – in a sustainable manner and with a commitment to maximizing local content, improving the country's educational and training opportunities, and protecting its unique environment and local communities. Laying the foundation for the sustainable development of this tremendous natural resource is of great importance. We are focused on investing in health, education, safety, conservation and more in the communities surrounding our operations and the future home of the LNG facility.

"The natural gas resources we are developing in Mozambique are among the best and largest in the world. We are strongly committed to moving this world-class project forward to provide a cleaner energy resources for the world and contribute meaningfully to the long-term prosperity of Mozambique, its people and our partnership."

Mitch Ingram
Executive Vice President, Global LNG



An extensive analysis was undertaken to review and evaluate mitigation opportunities around roads, roles and responsibilities, vessel loading, drivers and trucks and equipment handling and more.

Mozambique Mitigation Opportunities
Drivers and trucks will include a mandatory inspection, driver training on all key aspects, ensure trucks are equipped with speed and location devices, convoy arrangement supported with two pilot convoy and no night driving.
Road surveys will be completed and include an overall assessment of road conditions, driving speeds, bridge locations and position of safety personnel.
Barge and vessel loading will include jetty security and illumination, loading of barges in accordance with stowage plan and barge dock operation on high tide only.
Equipment handling will include "toolbox talks," use of certified slings and handling gear, best practices for bundling and rigging and completing a lifting inspection report.

Maverick Basin

Simultaneous Operations

As the industry and shale development have grown, many operators have turned towards simultaneous operations (SIMOPS) to maximize efficiencies during ongoing operations. During the development phase it is common to have multiple completion companies working within close proximity to drilling and production locations. One of Anadarko's biggest considerations is ensuring proper well control at an offset location relative to a hydraulic frac operation.

Over the last few years, Anadarko established a risk-assessment criteria matrix to protect locations in close proximity to completion operations and to ensure the safety and protection of our personnel, the environment and equipment. This internal protocol enables us to assess risk of an offset operation and have a set procedure to protect our equipment from offset fracturing pressures. Our operations team has implemented additional protocols to monitor wells for vital shut in and pressure communication, which has enabled Anadarko to open up wells in timely manner to maximize our production. Anadarko has collaborated with 10 offset operators to share knowledge of drilling and completions plans, and schedules are communicated and reciprocated on a bi-weekly basis. The team's goal is to mitigate all

possible well control events and facilitate ease of scheduling and communication by all parties, enhancing our social license to operate and strengthening stakeholder relationships.

Forward-Looking Infrared (FLIR)

The Maverick Basin FLIR program is guided by the SAP Preventative Maintenance Plan. FLIR surveys enable proactive detection of potential problems in the operation of equipment and facilities by thermally detecting fugitive gases. FLIR surveys are conducted on all facilities, wellheads, flowlines, after startup on new or repaired equipment, and on DOT rights of way and above ground valve sets. Any deficiencies are documented through a work order, which is closed upon repair. Reoccurring releases detected with the FLIR camera can be proactively addressed before an incident. In 2015, a total of 2,151 FLIR surveys were performed in the Maverick Basin area.

GWA/DJ Basin

Anadarko believes it is essential to plan and implement socially compatible operations to ensure oil and natural gas and urban populations can coexist in a sustainable way that allows for the economic benefits in Colorado and all of our operations.

Feedback we have received through our Anadarko Colorado Response Line indicates noise generated by operations is the primary concern of surface owners and stakeholders.

While there is no universal solution for sound mitigation at this time, Anadarko has been diligently searching for solutions and partnering with vendors inside and outside of the oil and natural gas industry, including attempting to reduce sound created by equipment as well as developing tools to be used in addition to standard equipment at existing locations.

Below are several examples of tools used to mitigate sound:

- Straw bale walls
- Sound walls
- Sound panels





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- Sound blankets
- Mufflers
- Modifications to rigs and fleets

Additionally, our Wattenberg Completions team began testing an electric completions fleet in 2015. The partnership with US Well Services (USWS) supports our mitigation efforts and has seen a reduction in energy costs up to 80 percent. Noise reduction, up to 69 percent was an added benefit realized in the first-generation fleet.

Anadarko began its electric fracture fleet pilot with USWS on a 12 well pad in the DJ Basin in September 2015. The electric power is generated from fuel gas sourced from nearby Anadarko pipelines. In an effort to fully test the electric concept, we also partnered with Schlumberger in using their electric wireline unit on that particular pad. Going forward, design changes can further reduce CO₂ emissions by a factor of 10. In the first-generation technology there was an added benefit of noise reduction 6 dBA and 2 dBC observed versus conventional fracture fleets. Further reductions are anticipated with the release of the third-generation.

The GWA team also piloted an electric drilling rig to significantly offset the light and noise that typically accompanies drilling. Using innovative engineering techniques and working in partnership with local utilities, we have been able to connect the rig to a high-voltage power line 500 feet away. This project has been positive for local communities and Anadarko with CO₂ emissions reduced by nearly 13 metric tons per day, and costs associated with generator fuel and maintenance have been reduced by approximately \$1,900 a day.

All of these efforts help enhance our social license to operate and are supported by industry and stakeholder tours, political constituent tours and knowledge sharing, environmental and stakeholder benefits, and substantially lower emissions in ozone precursor emissions (NO_x, VOC).

WASTE TO PROFIT: Eliminating Waste Improves Bottom Line

Anadarko began evaluating life-cycle costs associated with various types of waste, including produced water. Costs associated with waste can make up a large portion of the environmental budgets for operations. Examples of such costs are:

- Underground injection

- Landfill disposal
- Treatment and discharge to surface waters
- Incineration
- Evaporation
- Trucking

To reduce risk and cost, Anadarko's Health, Safety and Environmental (HSE) teams have begun to ask whether "zero waste" can be achieved and waste can be viewed as a material. Eliminating wastes can also reduce liability for the company around landfills, social license to operate and cleanup or remediation.

Wyoming

Anadarko began using a wood-straw product on restoration projects in Wyoming in 2014. This product is one of the best tools for restoration efforts available in the Western U.S. today. The use of waste-wood in Anadarko's restoration projects has replaced other products that previously had to be disposed of in landfills. The wood-straw also recycles material from pine beetle killed trees, is completely natural and does not contain any residual agricultural chemicals. The product reduces erosion and sedimentation, retains moisture to enhance vegetation growth and naturally decomposes over five to seven years while vegetation is establishing, providing additional organic matter to the soil as well as reducing soil compaction.



Marcellus

Our Marcellus team began working on ideas to find ways to recycle Plastic Containment barriers. On average, each of our pads contain 4,500 pounds of plastic containment barriers, which are very expensive to take to landfills. Rather than throw them away, the team decided to reuse them instead. In 2014 alone, we recycled 64,800 pounds of plastic, keeping it out of the landfills and put back to work protecting the surface.



GWA/DJ Basin

To reduce costs associated with traditional waste disposal options and to reduce trucking emissions and waste-disposal footprint, Anadarko built two centralized waste-processing facilities in the GWA. Another benefit of these facilities is that they also provide materials for construction and completions at no cost that previously would have had to have been purchased elsewhere.

Aggregate Recycle Facility

Anadarko's aggregate recycle facility is a processing facility that collects muds, slurries, and/or tank cleanouts that were previously taken to a third party for disposal. Water is stripped out of the waste stream via coagulation, flocculation and mechanical/gravity separation for re-use in completions operations.



Slurry Treatment Yard

The slurry treatment yard collects bore mud and slurry that were previously taken to a third party for disposal. The fluids are dried out and land applied or collected for reuse as backfill or for the construction of well pads.



About Anadarko

Anadarko's mission is to deliver a competitive and sustainable rate of return to shareholders by exploring for, acquiring and developing oil and natural gas resources vital to the world's health and welfare. As of year-end 2015, the company had approximately 2.06 billion barrels-equivalent of proved reserves, making it one of the world's largest independent exploration and production companies. For more information about Anadarko, please visit www.anadarko.com.



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Supplemental Materials:

[Anadarko Healthy, Safety, Environment and Sustainability Overview 2015](#)