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S. 585 American Natural Gas Security and Consumer Protection Act

MPA in Environmental Science and Policy
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Disclaimer

This report is prepared for the fall semester course ENVP U9230 Workshop in Applied Earth Systems Management II as part of the MPA in Environmental Science and Policy program, Class of 2016. All information contained in this report is prepared from data and sources believed to be correct and reliable as of December 2015. The views, recommendations, and opinions in this report may not necessarily reflect those of Columbia University or any of its affiliates.

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Executive Summary

Since the early 2000s, the United States has been host to an unprecedented expansion in natural gas production from unconventional sources. Unconventional sources include all sources outside of straight drilling in an oil well, like shale drilling and drilling in tar sands. The expansion has facilitated the realization of U.S. energy independence from foreign sources, extremely low domestic natural gas prices, and a desire by production companies to export natural gas where prices are considerably higher than domestic prices.

A combination of novel extraction techniques and political factors led to the expansion, starting with the innovative process of directional horizontal drilling. The coupling of horizontal drilling with the process of hydraulic fracturing has allowed access to previously unrecoverable natural gas from shale formations deep in the earth's lithosphere. In 2005, Congress exempted natural gas extraction from traditional environmental regulations including the Safe Drinking Water Act, the Clean Water Act, and the Clean Air Act. Expanded natural gas extraction by unconventional methods has raised concerns about environmental impacts, notably chemical migration into water resources.

In an effort to address implications of increasing exports, Senator Edward Markey introduced the American Natural Gas Security and Consumer Protection Act (S. 585). The legislation requires the Secretary of Energy to define the public good in regards to increased pricing on U.S. consumers, environmental impacts of extraction projects on local communities, and contributions of methane production to global climate change before authorizing natural gas exports.

The legislation accounts for the unregulated negative externalities associated with natural gas production. Aside from increased consumer costs and threats to energy security potential negative environmental impacts present negative implications for human and ecosystem health in communities surrounding extraction sites; as well as detrimental contributions to global climate change.

This report provides background on the legislation and the science, but the primary focus is on the program design developed to implement the legislation's environmental aspects and minimize harm to the public from the natural gas extraction. The three key program elements are: chemical disclosure, chemical monitoring, and wastewater management. Each element has been designed to address specific environmental issues associated with the extraction process. The intent is not to be comprehensive, but to address the most critical environmental issues not yet addressed by the Environmental Protection Agency (EPA) or by state legislation.

As part of the program design this report includes a discussion of the organization and the relationship between the Department of Energy (DOE) and the EPA required to support the implementation. Budget and timeline requirements have also been addressed for the startup period, and a measurements system has been developed to monitor progress and ensure achievement of program objectives.

I. Introduction

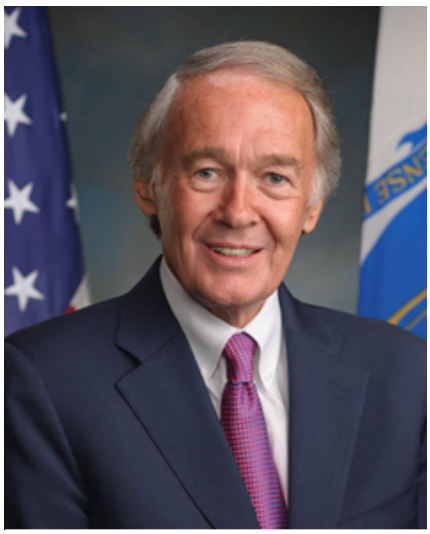

Figure II-1: Senator Edward Markey (D-MA)
Source - Edmarkey.com

Natural gas consumption is ubiquitous in much of the developed world, especially in urban areas and the United States. Many people use gas stoves for cooking. Some heat their homes and dry their clothing using natural gas. Many fleet vehicles such as buses and vans also run on natural gas. Most importantly, and invisible to most, when we turn on the lights in our homes, or plug in appliances, cell phones or laptops, a significant portion of the electricity comes from natural gas.

In the United States, about a third of the power generation for electricity is now provided by natural gas (EIAd, 2015). The United States is concerned about natural gas sources, domestic versus imported, because of energy security. Limiting dependency on other countries for supplies of fossil fuels is an important foreign policy strategy because these energy sources are essential in supporting the infrastructure and economy of the country.

The natural gas revolution in the United States began around 2005 with the aid of key political and technological factors. Politically, an element of the Energy Policy Act of 2005, which is is colloquially known as 'Halliburton Loophole' exempts the natural gas extraction industry, chiefly the hydraulic fracturing process, from regulation under the Safe Drinking Water Act, Clean Air Act, and the Clean Water Act. Halliburton is an oil industry services company that benefitted from the legislation. Simultaneously, improved drilling technologies permitted directional drilling in tandem with hydraulic fracturing, allowing expanded extraction of natural gas from shale formations.

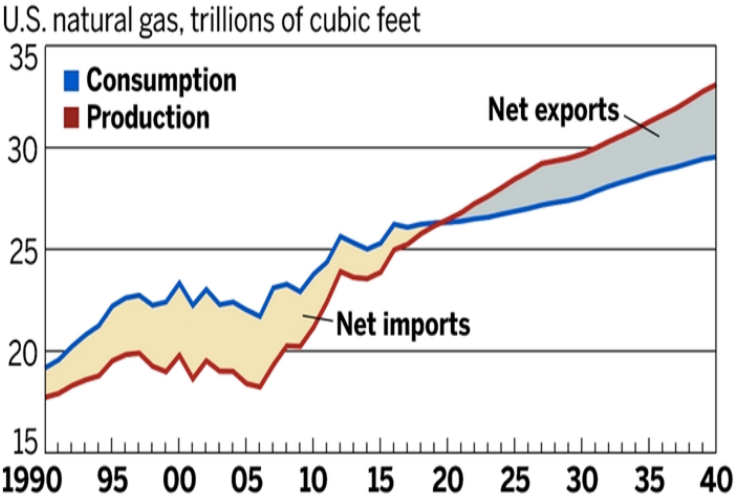

Figure I-1: U.S. Natural Gas Consumption and Production from 1990 to 2040.
Source: Chemical & Engineering News from EIA

The increase in natural gas production from shale formations began around 2005. Figure I-1 above shows actual and projected production and consumption of natural gas from 1990 to 2040. The dramatic increase in actual and projected natural gas production can be seen starting around the 2005 timeframe, with actual production rising from about 18 trillion cubic feet in 2005 to over 25 trillion cubic feet in 2015,

an increase of nearly 40% (EIAa, 2015). Consequently, in part, the U.S. net imports in natural gas began to shrink. The U.S. is projected to become a net exporter of natural gas around the year 2020.

Approximately 37% of natural gas in the United States is produced from hydraulic fracturing today, and that is expected to rise to more than 75% of domestic supply by 2035 (American Petroleum Institute, 2014). The EPA does not regulate well construction for injection of fracturing fluids under the Safe Drinking Water Act. Therefore, the oil and gas industry is the only industry that is allowed to inject known hazardous chemicals without monitoring of nearby water resources (Earthworks).

The result of the natural gas revolution was a significant improvement in the energy security of the United States. This is demonstrated by the abundance of supply in the market that has driven prices down from 2005 to the present (discussed below, see Figure II-4).

At the same time, however, the easing of restrictions from the Clean Air Act, the Clean Water Act, and the Safe Drinking Water Act have caused concerns for the public welfare with respect to clean air and water. There have been issues with chemical contamination of water, methane contamination of water, and wastewater management impacts, all of which are discussed in detail in the Science section. In order to protect the public interest in relation to projected increases in U.S. natural gas exports, including from the described environmental impacts, Senator Edward Markey introduced bill S.585, The American Natural Gas Security & Consumer Protection Act.

The purpose of this paper is to provide background on the S.585 legislation and give specific guidance to safeguard the public from potential environmental impacts in the natural gas production process. This will be followed by a detailed discussion of the programmatic requirements for implementation of the legislation, assuming the legislation has passed and that implementation begins on January 1, 2016.

II. Legislative Summary

i. Summary

The natural gas industry of the United States is a rapidly expanding segment of the energy sector. The United States Energy Information Administration (EIA) has estimated about 11.34 trillion cubic feet of natural gas was produced directly from shale and oil resources in the United States in 2013 (EIAd, 2015). There is room for growth with the EIA estimating that there are 2,276 trillion cubic feet of 'technically recoverable' natural gas reserves in the United States as of January 1, 2013 (EIAc, 2015). Major U.S. natural gas reserves are concentrated in Texas and Pennsylvania (Marcellus Shale), but large natural gas reserves are also found in other locations such as New York, Pennsylvania, North Carolina, and Arkansas (EIAh, 2015), see Figure II-2 below.

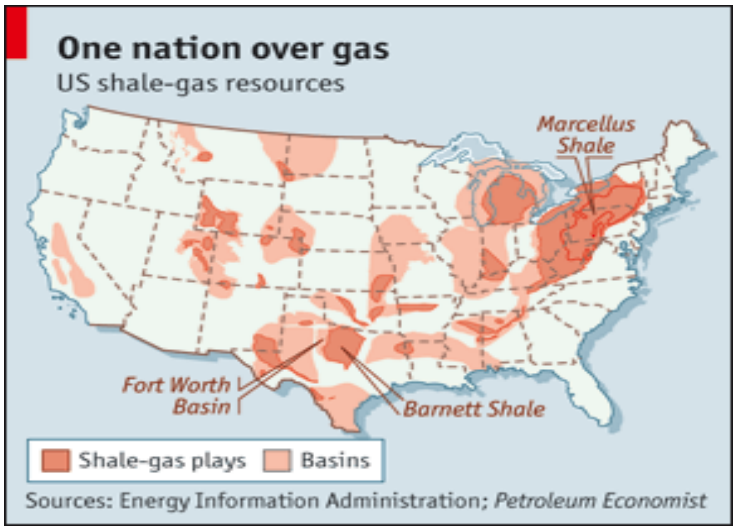

Figure II-2: Map of natural gas containing shale formations in the United States in 2014. *Source: The Economist from EIA and The Petroleum Economist*

The combination of directional drilling and hydraulic fracturing has allowed gas companies to extract marketed production of 75 billion cubic feet of natural gas per day in 2015, which is an increase of 45% over 2005 (EIAi, 2015), see Figure II-3 below. The booming supply has caused natural gas prices in the United States to reach historical lows, leading manufacturers and producers to look to the global market where they can trade at higher prices. Currently, prices for natural gas in the U.S. are at approximately $4 per million Btu while prices in the EU are closer to $10 per million Btu, and prices in Japan are near $16 per million Btu (World Bank, 2015), see Figure II-4 below. This dynamic is what makes exportation so attractive.

ii. Purpose of the Legislation

The American Natural Gas Security and Consumer Protection Act (S.585) seeks to prioritize the public interest in light of increased U.S. natural gas production. Senator Edward Markey (D-Mass.) introduced S.585 in 2015. The Department of Energy has the opportunity to acknowledge and take action on impacts of natural gas extraction on local communities before authorization of exports.

An Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) of 1969 shall be required as well as a summary of the extraction process impact on local communities where the extraction occurs (S.585). The EIS will evaluate possible negative effects of natural gas extraction on the surrounding environment and on human health, and offer mitigation strategies to control any negative effects.

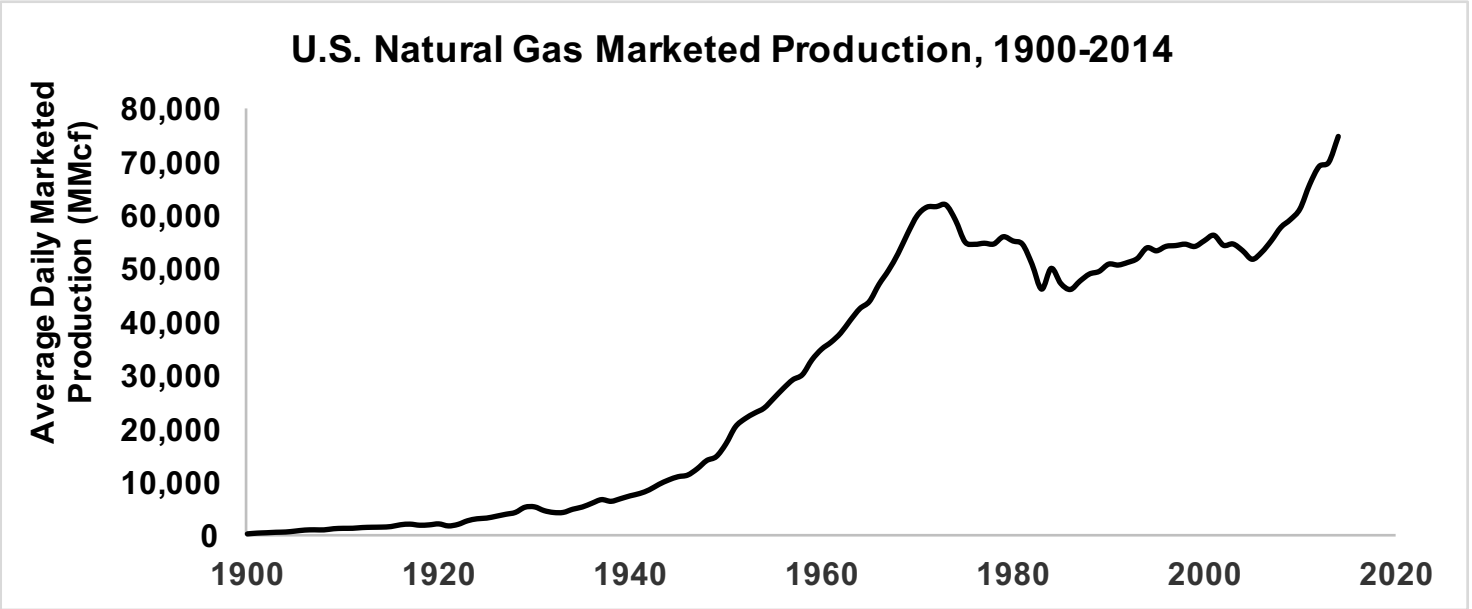

Figure II-3: U.S. Natural Gas Marketed Production, 1900-2014.
Source: EIA

Moreover, this legislation requires the EIS and consideration of the public interest. By addressing adverse environmental impacts, the EIS has a direct, positive effect on the public interest.

The combination of directional and horizontal drilling is new. Given the recent deployment, of hydraulic fracturing, many uncertainties exist in the process including:

- Impacts of groundwater contamination on surrounding communities
- Air pollution impacts to human health
- Occupational exposure to toxic chemicals at extraction sites

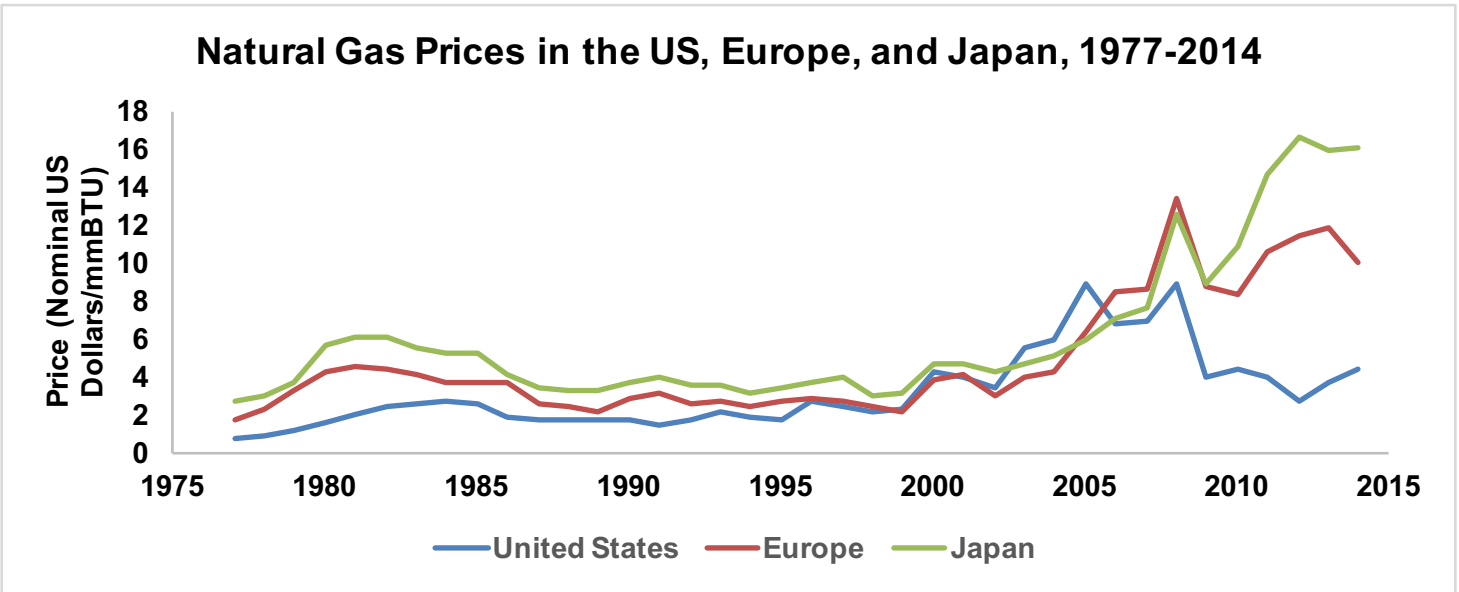

Figure II-4: Natural Gas Prices, 1977-2014.
Source: World Bank

These risks vary in magnitude depending on population density and proximity of extraction sites to community resources. Costs must be considered when determining benefits of projects such as increased employment opportunities.

Exemptions from the Safe Drinking Water Act and other environmental regulations exacerbate related uncertainties by restricting the EPA's ability to regulate clean air and clean water. The American Natural Gas Security and Consumer Protection Act seeks to address these shortcomings by requiring an EIS and corresponding Mitigation Action Plans (MAPs) for natural gas extraction projects intended for export in order to account for the public interest. Setting expectations, and providing accountability to industrial and political leaders, is inextricably linked to improved communication and reporting of environmental issues.

iii. Current Political Context

Notably, the main environmental concerns are water contamination, air pollution, and possible health effects. With the support of Senator Al Franken (D-MN), Bernie Sanders (I-VT), and Barbara Boxer (D-CA), Senator Edward Markey (D-Mass.) introduced the American Natural Gas Security and Consumer Protection Act on February 26, 2015. Senator Edward Markey argues that increasing natural gas exports will lead to natural gas price increases in the United States stating, "Massively exporting America's natural gas will undercut American manufacturers trying to create jobs…[raising] costs for consumers already paying high energy bills." However, there are several prominent Democratic and Republican officials who disagree (Markey, 2014). President Barack Obama's White House economic staff has reported that 65,000 jobs would be created with an increased export quota of natural gas, along with the United States having a successful 'geopolitical impact' around the globe (The Energy Revolution, 2015). The ongoing debate of this issue is intensifying in Congress with new legislation being discussed concerning U.S exports of natural gas.

III. Science

This science section addresses various aspects of the overall hydraulic fracturing process. The United States is not the only country with abundant shale geological formations although it is the only country with the geology and the technological skills to extract. The remainder of the science that will be addressed will be the environmental impacts associated with the processes that are addressed by the program.

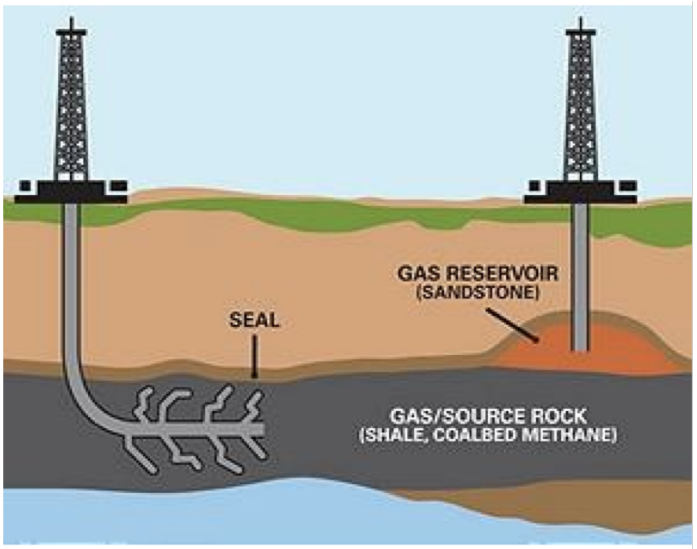

Figure III-1. Comparison of vertical and horizontal drilling for natural gas
Source: DTE Energy

There are two types of drilling used to extract natural gas: vertical and horizontal drilling. Vertical drilling has been used since the 1940s to extract natural gas from gas reservoir formations. Horizontal drilling is 3 to 5 times more productive in terms of the amount of natural gas produced than that of vertical drilling (Cho, 2014). However, high volume hydraulic fracturing using horizontal drilling, which took off in the early 2000s, is a newer more environmentally intensive method for extracting gas from low-permeability shale formations (EIAd, 2015).

When water, hydraulic fracturing fluid, and sand are injected down a wellbore and into the target rock formation at high pressures, some small explosions and fractures are created. After the pressure is decreased, fracturing fluid and naturally occurring water from the shale formation, often called produced water, flow back to the surface. The composition of the flow back fluid changes as a function of the amount of time in contact with the formation as well as its location. When minerals and dissolved organic compounds from the formation are combined, a brine, or salinized, solution is created (Gregory, 2011). Flow back water is collected at the surface for disposal, treatment, or reuse. Most flow back water from oil and gas production is disposed of through deep underground reinjection (Gregory, 2011). The flow back water can contaminate groundwater and its management poses concerns due to the chemical composition of the water and the possible human health and environmental impacts. This makes it necessary to construct specific treatment plants for hydraulic fracturing waste (Gregory, 2011).

i. Chemical Contamination of Water

As discussed in the Introduction and shown in figure I-1, hydraulic fracturing has allowed the United States to increase natural gas production, from 18 trillion cubic feet in 2005 to over 25 trillion cubic feet in 2015, an increase of

nearly 40%. Unfortunately, however, the process itself poses many risks to nearby water supplies (EIAe, 2015). There are approximately 1,000 chemicals that have been used in hydraulic fracturing fluid; however, there are only 453 chemicals for which we know their properties (EPA, 2015). Some fracturing fluid, however, contains dangerous chemicals including carcinogens such as diesel, naphthalene, xylene, or toluene, which come into contact with humans through air and water contamination from hydraulic fracturing sites (Ridlington and Rumpler, 2013). FracFocus, a voluntary chemical disclosure registry, indicated that one-third of all hydraulic fracturing projects use at least one carcinogenic chemical with the potential to enter drinking water supplies from a well, the immediate area around the well, or during the wastewater disposal process as transportation vehicles leave the drilling site (Ridlington and Rumpler, 2013). How the chemicals interact with one another and their accumulated health risks is unknown (EPA, 2015).

ii. Methane Contamination of Water

One of the consequences of hydraulic fracturing is that methane can contaminate water, which can be combustible if the concentration is high enough. This can be dangerous to surrounding communities. When the concentration of methane is above 28 milligrams per liter, it should be vented. It could explode if it is triggered (NPR, 2015). Methane can migrate into local aquifers through three major pathways:

- Leaky gas-well casings (Osborn et al., 2011)
- New and existing fractures, above depleted shale formations (Osborn et al., 2011)
- Natural conductive pathways that allow fluids and methane to migrate into shallow aquifers (Warner, 2011)

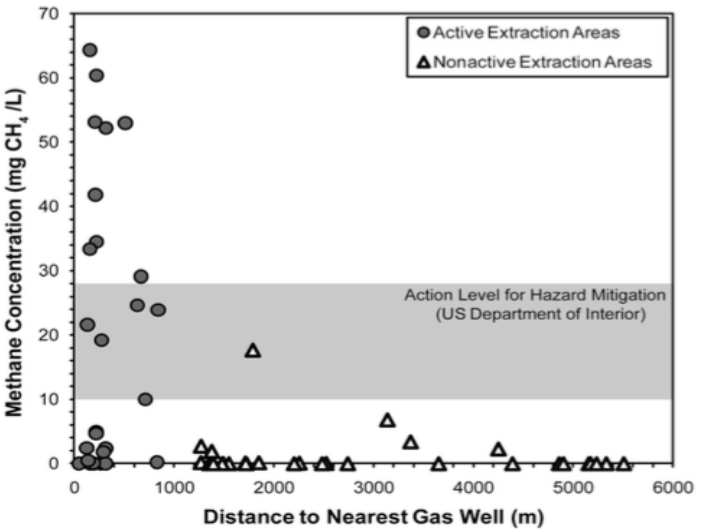

Figure III-2: Methane concentration in water by distance to nearest gas well.
Source: Osborn et al., 2011

As shown in Figure III-2, there is a correlation between proximity of gas wells and methane concentration. The circles on the graph represent active extraction areas while the triangles represent non-active extraction areas. This figure illustrates that areas closer to the nearest gas well correspond with a higher concentration of methane in the water (Osborn et al., 2011).

iii. Wastewater Management Impacts

In 2012, over 280 million gallons of wastewater was produced from hydraulic fracturing in the U.S. (Ridlington and Rumpler, 2013). Wastewater can either be re-injected into disposal wells (similar to the well shown in Figure III-1), pretreated and sent to wastewater treatment plants, or it can be sent directly to treatment plants.

Reinjection of wastewater is associated with seismic activity, particularly in places such as Oklahoma (Rubinstein and Mahani, 2015). As shown in Figure III-3, between 1973 and 2008, Oklahoma experienced 858 magnitude 3 or

above earthquakes, whereas between 2009 and April 2015, there were 1,570 magnitude 3 or above earthquakes (Rubinstein and Mahani, 2015).

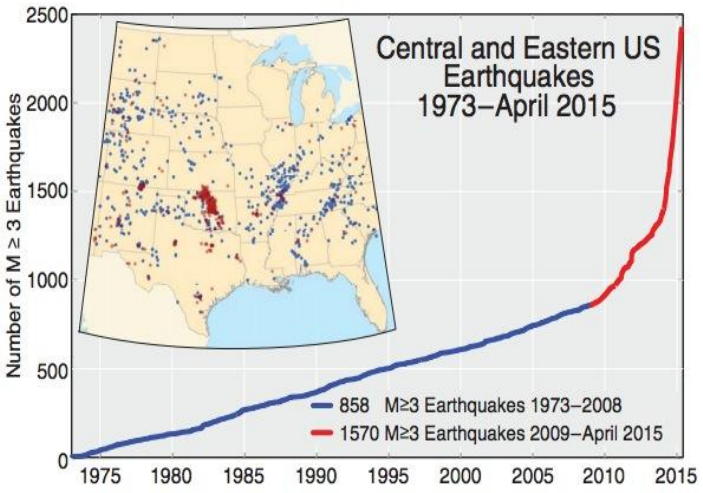

Figure III-3: Central and Eastern U.S. Seismic Activity Trends, 1973- April 2015.
Source: Rubinstein and Mahani, 2015

Prior to pretreatment, wastewater is often held in containment ponds (see figure III-4) near the extraction site. This wastewater can potentially leak into the surrounding soil, groundwater aquifers, and/or surface water due to infrastructure failure or through naturally occurring chemical migration underground over extended periods of time (Ridlington and Rumpler, 2015).

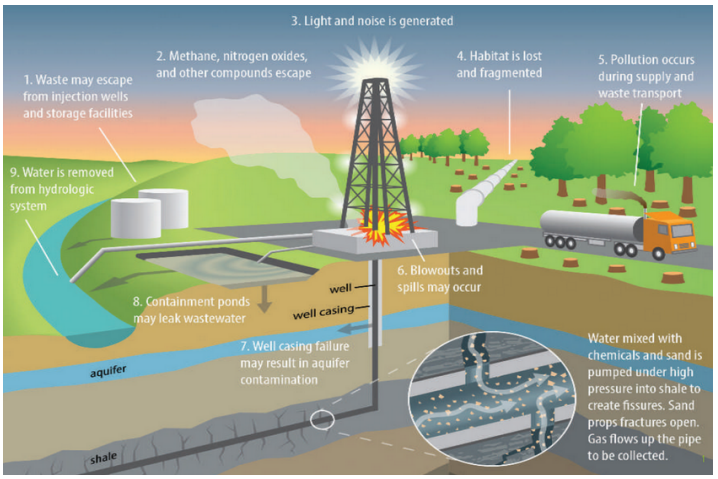

Figure III-4: Wastewater Process.
Source: Souther et. al., 2014

In the absence of proximal underground injection wells, wastewater is pretreated and then discharged to local wastewater treatment plants; however, there is no federal water quality standard. Many states do not have an estimate of produced wastewater due to a lack of local or federal regulations (U.S. Army Corps of Engineers, 2015). Absent of wastewater regulations, increased natural gas production could increase the risks of groundwater contamination (Ridlington and Rumpler, 2015).

Hydraulic fracturing operations in the United States have used over 708 billion liters of water between 2005 and 2012, over which time the U.S. also produced 172,994 billion cubic feet of marketed natural gas (EIAe, 2015, Kondash and Vengosh, 2015, and Figure III-5). The water used in hydraulic fracturing is thus an added stress to the local water supply. For example, one of the highest regions of water withdrawal includes the Barnett Shale in Texas that consumes as much as 9% of the Dallas' (population of 1.3 million) annual water use: 308 million cubic meters (Nicot and Scanlon, 2012).

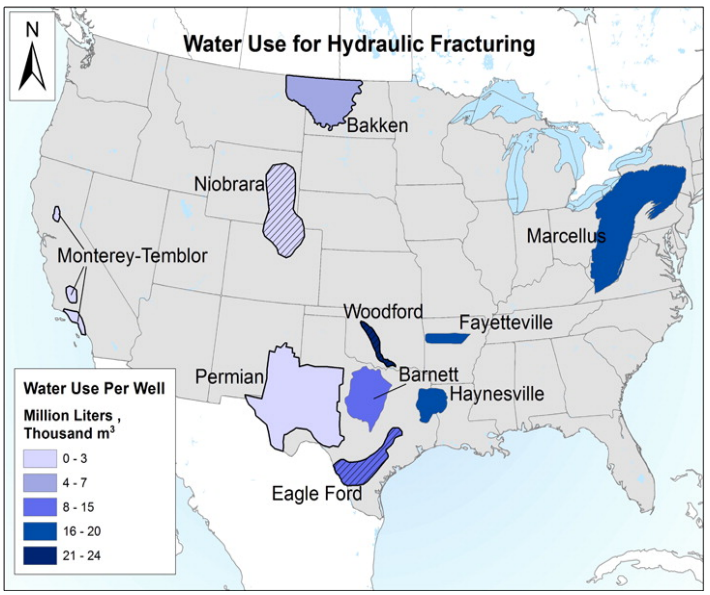

Figure III-5: Water use for hydraulic fracturing.
Source: Kondash and Vengosh, 2015

IV. Program Design

The program design was created with the objective of minimizing harm from chemical migration and wastewater management to the public from the natural gas extraction process. Under this bill, the Secretary of Energy will not grant export permits for natural gas companies until the project has received an approved Environmental Impact Statement.

It is important to note that this bill covers exports only, and does not address hydraulic fracturing for the purpose of domestic sales. However, a company that is drilling for the purpose of selling both domestically and for export must abide by these regulations or demonstrate their ability to concretely separate the two. As indicated in the Introduction section, the export market is potentially lucrative given the higher prices of natural gas in the EU and Japan.

Not every environmental issue will be addressed by this program. For example, the EPA has provided guidelines and rules that address methane leakage from the hydraulic fracturing process. The guidelines address methane leakage from leaky valves and old pumps, and recommend green completion instead of flaring or just allowing the methane to leak freely into the air (James et. al, 2013).

The program design was informed by the Resource Conservation and Recovery Act, subtitle C, part 264 regulations, the requirements for groundwater monitoring systems sampling and analysis program. This program provides for temporary permitting, testing background water quality in the uppermost aquifer, and quarterly sampling thereafter (Nielsen, 2006).

A key component of EISs are Mitigation Action Plans. MAPs outline the steps that will be taken to prevent potential environmental issues from occurring during the project. As part of the program, a team will be established within the DOE Office of NEPA Policy and Compliance (note: NEPA is the National Environmental Policy Act) to create policies, guidance, and support structures related to MAPs for natural gas extraction projects.

From an industry perspective, the export permit application must be submitted to the DOE's Export Office, and the draft EIS (with MAPs included) must be submitted to the DOE Office of NEPA Policy and Compliance. Once these documents are reviewed, the EIS will be sent to the EPA Regional Office for a 30-day public comment period. The EIS will then be returned to the DOE Office of NEPA Policy and Compliance for finalization, after which point it will be opened for a final 45-day public comment period. Once completed, the final EIS will be approved or rejected by the EPA. Upon approval, the EIS will be attached to the export permit application for approval by the Secretary of Energy.

Each EIS contains the three key MAPs:

- Chemical disclosure
- Chemical monitoring
- Wastewater management

To prevent delays in exports, companies that are interested in the program will be provided temporary bridge permits allowing them to begin exporting natural gas immediately upon entering the program. The temporary permits could last

for as long as two years, until the EIS has been completed and approved.

i. Chemical Disclosure Program

Natural gas companies applying for export permits will be required to disclose all of the chemicals used in their fracking fluid to the DOE and the Environmental Protection Agency.

During the application process, companies will be required to submit information regarding their site locations, the chemicals that they are planning to use, and the processes used to develop unique chemicals as well as those used in the creation of the chemical mixture. With the testing of all sites that will occur in the chemical monitoring process, it is important that the EPA understands all chemicals so that they can test for those them.

Once completed, the chemical disclosure report will be uploaded to the DOE's database as part of the export permit application process. Information is kept in the digital database and is accessible by both the EPA and the DOE immediately after submission. Disclosure records will be maintained by the DOE and will be used by the DOE and the EPA for evaluation during the EIS process. This process will be led by the DOE MAPs Team whereas the Chemical Disclosure Unit will handle the creation of the online application and database.

In order to ensure that companies are properly disclosing the chemicals used in their fracking fluids, the EPA will randomly test the chemical content in 10% of wells once the hydraulic fracturing process has begun. If the EPA determines that incorrect data had been provided in the disclosure, fines will be levied. The schedule of fines will be defined by the Chemical Disclosure Team as part of their development of the chemical disclosure regulations.

After the disclosure data is compiled, a website will be built to disclose all chemicals to the public.

ii. Chemical Monitoring Program

The Environmental Protection Agency will implement the chemical monitoring process to ensure that chemicals do not migrate from a hydraulic fracturing well. The general program design involves performing baseline testing of water located near the hydraulic fracturing site before drilling begins, followed by periodic testing thereafter. The testing is performed by the natural gas companies and the EPA will audit their findings.

Baseline testing is performed by natural gas companies prior to the start of drilling. At every site, 20 test locations will be randomly selected within a half mile radius of the hydraulic fracturing well. The test locations will include surface water like rivers and streams, as well as watersheds, groundwater, and wells. The EPA will validate the test results by performing its own random tests at 10% of the locations selected by the companies. Baseline tests will be performed to obtain measurements prior to the start of hydraulic fracturing so that the EPA can compare the natural concentrations of chemicals in the water with the concentrations after hydraulic fracturing has begun. The information will be stored in an EPA database, noting the following information: site location, site area sampling techniques, chemical substance measurements, and date of sampling. This information will pre-reviewed and assessed by the EPA for feedback on the Mitigation Action Plans for each production site.

Periodic testing begins after hydraulic fracturing has begun. For locations where continuous monitoring has been set up, companies should report results on a monthly basis. For all other locations, periodic testing should be performed quarterly. The EPA will validate the data

provided by the companies by randomly sampling data in 10% of the locations each time the company reports. Results will be compared to the baseline measurements to determine if any chemicals have migrated into local waterways. If any chemical is determined to have migrated into any of the test locations, then the export permit for that location will be withdrawn and hydraulic fracturing will cease immediately. The reason for the harshness of the penalty is that if one chemical has migrated, others may follow. Some of the chemicals used in hydraulic fracturing are benign, while others are dangerous and some are even carcinogenic, such as benzene and toluene.

iii. Wastewater Management Program

In accordance with the Mitigation Action Plan outlined in the Environmental Impact Statement, all natural gas companies that apply for export permits must account for all water that is produced in the hydraulic fracturing process regardless of disposition in pretreatment or in reinjection.

To accomplish this, companies must measure the water flow at the well-head to report the amount of wastewater produced.

- If the water is ultimately pretreated, the company must report on the amount of water that is ultimately delivered to the municipal wastewater treatment plants after pretreatment.
- If the water is ultimately reinjected, the amount of water reinjected must be reported regardless of location.

In either event, a minimal amount of spillage is expected in the process. However, significant loss may trigger either a penalty in the case of an accident, or withdrawal of the permit in the case of negligence. The specific regulations regarding the fines will be determined by the Wastewater Management Team. In all cases, the EPA will randomly test 10% of the amounts reported. The rules of pretreatment must follow existing EPA guidelines.

V. Program Staffing Plan

i. Organizational Process

The three programs, chemical disclosure, chemical monitoring and wastewater treatment, will provide guidance for the EIS and development of the Mitigation Action Plans. Currently, the Office of NEPA Policy and Compliance within the DOE is a focal point for the DOE National Environmental Policy Act implementation. However, because natural gas production sites are not subject to NEPA, there is no team within the Office of NEPA Policy and Compliance, which is responsible for providing guidance on MAPs for natural gas export production sites.

As the American Natural Gas Security and Consumer Protection Act passes Congress, a natural gas export permit process will be implemented as follows: gas companies that plan to export natural gas from the U.S. have to seek an export permit from DOE Export Office. The export office will forward export permit information to the Office of NEPA Policy and Compliance. After receiving export permit information, the Office of NEPA Policy and Compliance will provide guidance for MAPs for each natural gas production site to the EPA Regional Offices according to the legislation. Based on this guidance, EPA Regional Offices will determine whether they approve the EISs prepared by the gas companies.

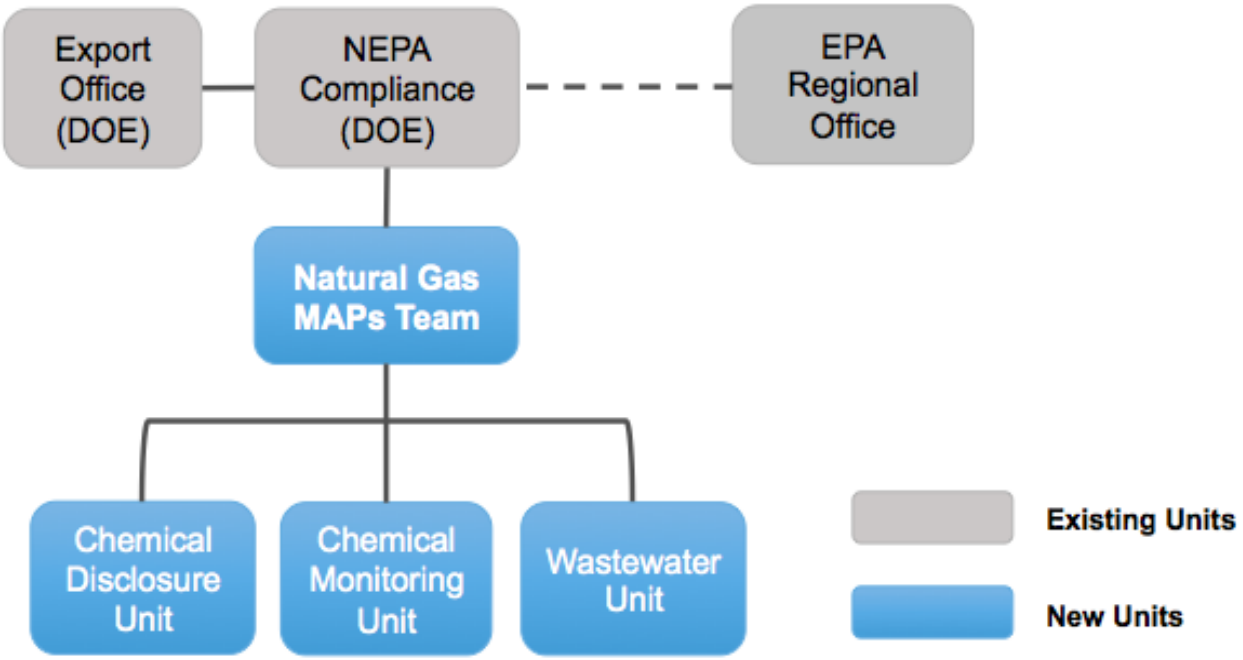

Figure V-1: The Organizational Chart of Program Design
Source: Team Research

In order for the Office of NEPA Policy and Compliance to draft MAPs, the Natural Gas MAPs team is being established as an internal unit. In addition, three new units are being established under the MAPs team to implement chemical disclosure, chemical monitoring, and wastewater management programs (for the first-year implementation plan of our program, see VI. Program Calendar section).

ii. MAPs Team

The MAPs team will oversee the three units that will lead the three main programs being implemented:

- Chemical disclosure
- Chemical monitoring
- Wastewater management

The MAPs Team will include a Team Leader (GS-13) and an Administrative Professional (GS-7) who will oversee the three units. This team will closely communicate with the Director of the Office of NEPA Policy and Compliance to set up the three units within the MAPs Team. After establishing the units, the MAPs Team will start coordinating policies within the three units by having weekly meetings. The team will start collecting export permit data and information from gas companies via the DOE export office. This will be followed by a press release regarding establishment of the Rules for Exportation of Natural Gas to the general public as well as the dissemination of a natural gas permitting application and associated process on the DOE website. Details can be found in the Appendix in Table X-1.

iii. Chemical Disclosure Team

Current extraction methods for natural gas use many chemicals that are currently undisclosed by the natural gas companies. The disclosure of chemicals used is critical in understanding if the chemicals are impacting the environment and health of local communities. In order to monitor water resources and ensure that chemicals are not migrating from natural gas extraction operations into these sources, the chemicals used must be disclosed.

The Chemical Disclosure Unit will establish policies related to chemical disclosure, and the requirements will be included in the Mitigation Action Plans. The Chemical Disclosure Unit will also establish a database of chemicals that are used for all sites submitting an EIS.

On January 4, 2016, the process will begin with the creation of the rules and regulations for chemical disclosure that companies must abide by in order to obtain permits for exportation of natural gas. This responsibility will fall under a Management and Policy Specialist (GS-11).

On April 1, 2016, the team will hire another Management and Policy Specialist (GS-9) and two IT contractors for the chemical disclosure unit, tasked with the creation, design, and data management of the export permit application and process, which will be integrated with the existing DOE website.

On October 1, 2016, we will start the process of developing MAPs guidance. This responsibility will fall under the newly hired Environmental Protection Specialist (GS-9). At the same time, the EPA will begin the inspection process to validate whether the chemical information provided by the companies is accurate.

iv. Chemical Monitoring Team

The implementation of chemical disclosure provides the ability to implement chemical monitoring, tracking and reporting. Monitoring will determine if chemicals are migrating into local water. If the chemicals are determined to be migrating into local waters, natural gas export permits will be withdrawn. This level of scrutiny will help the Secretary of the Department of Energy ensure

that natural gas production is in line with the 'public interest.'

The Chemical Monitoring Unit will establish detailed regulator for chemical monitoring requirements that will be included in the Mitigation Action Plans. The Chemical Monitoring Unit will also establish a database of chemicals for all sites for which an EIS is submitted. On January 4, 2016, writing the regulations that companies must abide by in order to obtain permits for exportation of natural gas. This responsibility will fall to a Management and Policy Specialist (GS-11).On April 1, 2016, the team will hire another Management and Policy Specialist (GS-9) and two IT contractors for the chemical monitoring unit who will be tasked with the creation, design, and data management of the export permit application and process, which will be integrated with the existing DOE website. On October 1, 2016, we will start the process of developing the MAP guidance. This responsibility will fall under the two newly hired Environmental Protection Specialists (GS-9). Around the same time, the EPA will begin the inspection process to validate whether the chemical migration information provided by the companies is accurate.

v. Wastewater Management Team

The Wastewater Management Unit requires tracking, monitoring, and reporting of all produced water. The objective is to minimize water loss. Some of the produced water will be pretreated before being sent to municipal wastewater treatment plants, and the remainder will be re-injected. The pretreatment process is subject to existing EPA guidelines.

The Wastewater Management Unit will establish policies related to wastewater management to be included in the Mitigation Action Plans.

The Wastewater Management Unit will also establish a database of wastewater management data (such as pre-treatment water discharge data, location and type of wastewater plant used etc.) for which an EIS is submitted.

On January 4, 2016, the process will begin with the writing the regulations for wastewater treatment that companies must abide by in order to obtain permits for exportation of natural gas. This responsibility will fall under a Management and Policy Specialist (GS-11).

On April 1, 2016, the team will hire another Management and Policy Specialist (GS-9) and two IT contractors for the wastewater management unit who will be tasked with the creation, design, and data management of the export permit application and process, which will be integrated with the existing DOE website.

On October 1, 2016, we will start the process of developing MAP guidance. This responsibility will fall under a newly hired Environmental Protection Specialist (GS-9). Around the same time, the EPA will begin the inspection process to validate whether the wastewater management information provided by the companies is accurate.

VI. Program Calendar

The program calendar is based on our program design, organizational and staffing plan, and program budget for the newly passed American Natural Gas Security and Consumer Protection Act. The master calendar delineates a number of tasks and subtasks involved in carrying out the program and provides an understanding of the relationship among these tasks.

To be specific, the master calendar sets a proposed one-year timetable for the program by breaking down each task and sub-task into allotted time periods and deadlines, assuming that the program starts on January 4, 2016. It also assumes that the funding for the program is secured in the previous year. Furthermore, it takes into account seasonal adjustments including holiday and vacation delays within the EPA and DOE. Figure VI-1 below shows the breakdown of the first-year tasks of the program design.

The detailed master calendar of each program can be found in the Appendix.

- X-1: Chemical Disclosure Unit
- X-2: Chemical Monitoring Unit
- X-3: Wastewater Management Unit

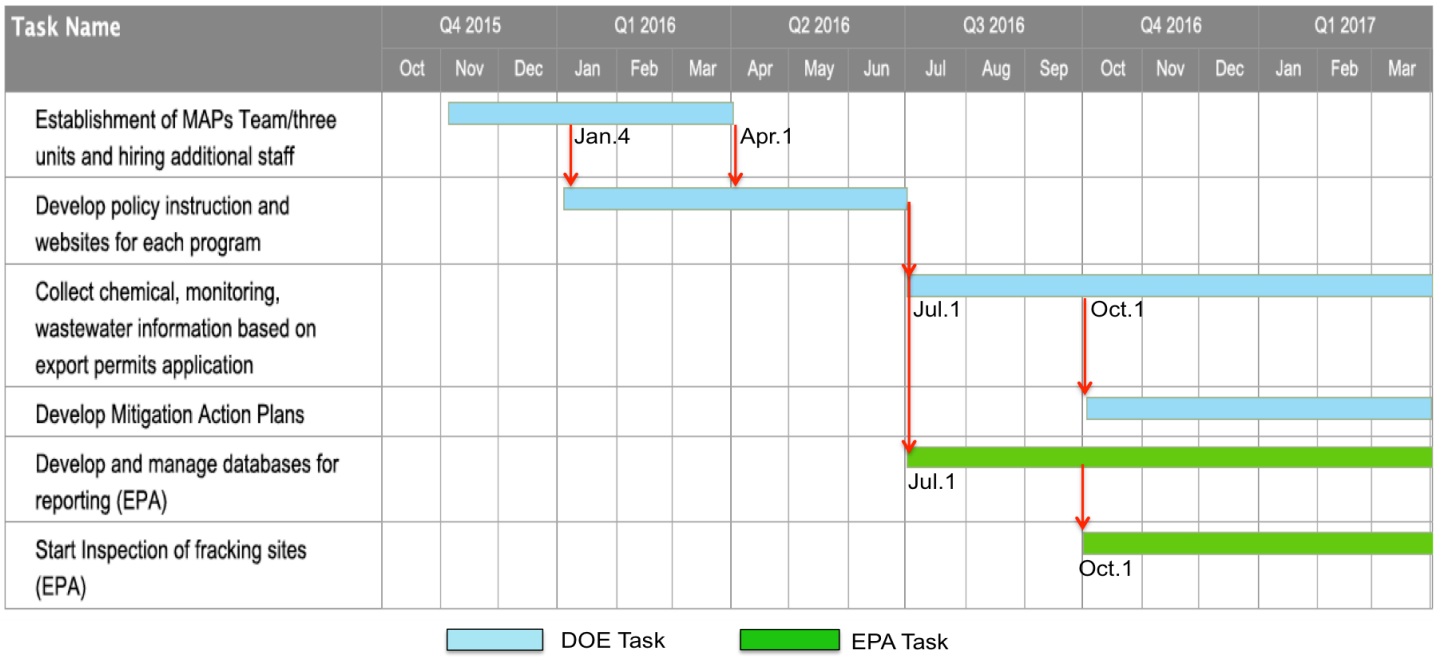

Figure VI-1: The First-year General Master Calendar
Source: Team Research

The program is divided into six phases in the first year of program implementation. These tasks include:

1. Establish MAPs team, three units and hire staff
    - Chemical Disclosure Unit
    - Chemical Monitoring Unit
    - Wastewater Management Unit
2. Develop policy instruction, regulation, and websites for each program and make information available to appropriate companies
3. Collect chemical and wastewater information based on the export permit application
4. Develop Mitigation Action Plans
5. Develop and manage databases for reporting
6. Start inspection of the hydraulic fracturing sites

The DOE is in charge of implementing tasks 1 through 4, whereas the EPA is in charge of implementing tasks 5 and 6. In 2016, by the end of the first quarter, the DOE will need to establish the MAPs Team within the Office of NEPA Policy and Compliance. It will also create the three units within the MAPs Team. During the same period, each unit will start developing regulations and instructions for each program. On January 4, 2016, the MAPs Team will appoint one Management and Policy Specialist for each unit in order to develop policy regulations and instructions. In the second quarter, on April 1, the MAPs Team will hire another Management and Policy specialist and two IT contractors for each unit in order to begin developing external websites for reporting and helping with the policy development. In the third quarter, the MAPs Team and its three units will start collecting the data for export permits from the DOE's Export Office. Around the same time, the EPA will develop and manage a database for reporting based on the information that the DOE provides. In the fourth quarter, the EPA will begin inspecting to validate whether the information provided by the companies is accurate.

VII. Budget

i. Line Item Budget

The methodology of the line item budget divides the overall expenditure into personnel services costs and non-personnel service costs.

The personnel services portion of the budget is composed of the salary for employees and contractors in the three units and in the overarching MAPs team. The salary is decided by their title, salary grade, hiring period in the standard of 2015 General Schedule (GS) Locality Pay Tables.

The non-personnel services fees are mainly the working capital fund, and construction fees for the webpage and database. The working capital fund includes badging, security, facilities, copying, and communication costs which are estimated at $1,000 per person per month.

Currently not accounted for in the budget is the system of fines, which will be developed as part of the development of the regulations.

1. Natural Gas MAPs Team Budget

The Natural Gas MAPs Team, which will be located in the DOE's Office of NEPA Policy and Compliance, will coordinate the EIS development, specifically for natural gas export applications.

Created in January 4, 2016, the Natural Gas MAPs Team consists of one team lead and one administrative professional. The Natural Gas MAPs Team Lead is a highly experienced senior environmental policy analyst who can provide guidance and coordination for the operations of the chemical disclosure, chemical monitoring, and wastewater pretreatment units. The administrative professional performs administrative tasks vital to the overall operations of the Natural Gas MAPs Team.

The budget for the operation of the newly created Natural Gas MAPs Team is mainly the salary and working capital fund for one team lead (GS-13) and one administrative professional (GS-7). According to the 2015 General Schedule Locality Pay Tables, the annual salary of GS-13 Step One is $73,115 and the annual salary of GS-7 Step One is $34,662. The working capital fund is estimated to be $1,000 per person per month.

1.1 Chemical Disclosure Unit Budget

The Chemical Disclosure Unit consists of two Management and Program Specialists, two Information Technology contractors, and one Environmental Protection Specialist.

The Management and Program Specialists are responsible for the development of policy instructions for chemical disclosure as a key component of EISs. The GS-11 level Management and Program Specialist is an experienced policy maker who will be hired at the beginning of the first calendar year to help develop the policy requirements. The GS-9 level Management and Program Specialist will assist the GS-11 Management and Program Specialist in developing policy requirements beginning in the second quarter and will continue working and offering programmatic support to export application seekers.

PERSONNEL COST							
Function / Title	**#**	**Salary Grade**	**Annual Salary**	**Start Date**	**End Date**	**2016**	**2017**
Team Lead	1	GS -13	$73,115	1/4/2016	N/A	$73,115	$73,115
Administrative Professional	1	GS - 7	$34,662	1/4/2016	N/A	$34,662	$34,662
Total	2					**$107,777**	**$107,777**

NON-PERSONNEL						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Working Capital Fund ($1,000/person/month)	$6,000	$6,000	$6,000	$6,000	**$24,000**	$24,000

TOTAL COST						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Personnel Costs	$26,944	$26,944	$26,944	$26,944	$107,777	$107,777
Non-Personnel Costs	$6,000	$6,000	$6,000	$6,000	$24,000	$24,000
Total Cost	$32,944	$32,944	$32,944	$32,944	**$131,777**	$131,777

Table VII-1: Natural Gas MAPs Team Budget Plan - 2016
Source: Team Research

The two IT contractors are responsible for building the webpage for policy instruction, and the database for monitoring and reporting. One of the IT contractors will be in place for the second and third quarters of the first calendar year to develop the webpage and database. The second IT contractor will support the webpage and database construction and will continue working on webpage and database maintenance.

The Environmental Protection Specialist is responsible for analyzing data and preparing reports related to chemicals disclosed at natural gas extraction sites. The Environmental Protection Specialist will be hired starting in the fourth quarter of the first calendar year.

The personnel service budget for the operation of the newly created Chemical Disclosure Unit includes staff salary and the Working Capital Fund costs for the staff described above.

According to the 2015 General Schedule Locality Pay Tables, the annual salary of GS-11 Step One is $51,298 and the annual salary of GS-9 Step One is $42,399.

The non-personnel service budget for the operation of the newly created Chemical Disclosure Unit is primarily the server fees for the webpage and database. The Working Capital Fund cost is estimated to be $1,000 per person per month.

The overall budget in 2016 for the Chemical Disclosure Unit is $194,373. Details can be found in the Appendix in Table X-2.

1.2 Chemical Monitoring Unit Budget

The Chemical Monitoring Unit consists of two Management and Program Specialists, two Information Technology contractors, and two Environmental Protection Specialists. The organizational chart and staff plan of the Chemical Monitoring Unit is similar to the

Chemical Disclosure Unit expect for one additional Environmental Protection Specialist. The chemical monitoring requires more on-site scrutiny to ensure the accuracy of the information provided by the natural gas companies. The responsibility and the corresponding detailed personnel costs can be referred to in the previous section, chemical disclosure.

The personnel service budget for the operation of the newly created Chemical Monitoring Unit includes staff salary for the staff described above. According to the 2015 General Schedule Locality Pay Tables, the annual salary of GS-11 step 1 is $51,298 and the annual salary of GS-9 step 1 is $42,399.

The non-personnel service budget for the operation of the newly created Chemical Monitoring Unit is primarily the server fees for the webpage and database. The Working Capital Fund cost is estimated to be $1,000 per person per month.

The overall budget in 2016 for the Chemical Monitoring Unit is $213,972. Details can be found in the Appendix in Table X-3.

1.3 Wastewater Management Unit Budget

The Wastewater Management Unit consists of two Management and Program Specialists, two Information Technology contractors, and one Environmental Protection Specialist.

The organizational chart and staff plan of the Wastewater Management Unit is identical to the Chemical Disclosure Unit. The detailed personnel cost can be referred to in the chemical disclosure section.

The personnel service budget for the operation of the newly created Wastewater Management Unit includes salary for the staff described above. According to the 2015 General Schedule Locality Pay Tables, the annual salary of GS-11 Step One is $51,298 and the annual salary of GS-9 Step One is $42,399.

The non-personnel service budget for the operation of the newly created Wastewater Management Unit is primarily the server fees for the website and database. The Working Capital Fund cost is estimated to be $1,000 per person per month.

The overall budget in 2016 for the Wastewater Management Unit is $194,373. Details can be found in the Appendix in Table X-4.

2. Program Budget

The budgets for the chemical monitoring unit, the chemical disclosure unit, and the wastewater management units are identical. Since the Natural Gas MAPs Team is an overarching team that directs the operation of the three units, its budget is less than that of the other three units.

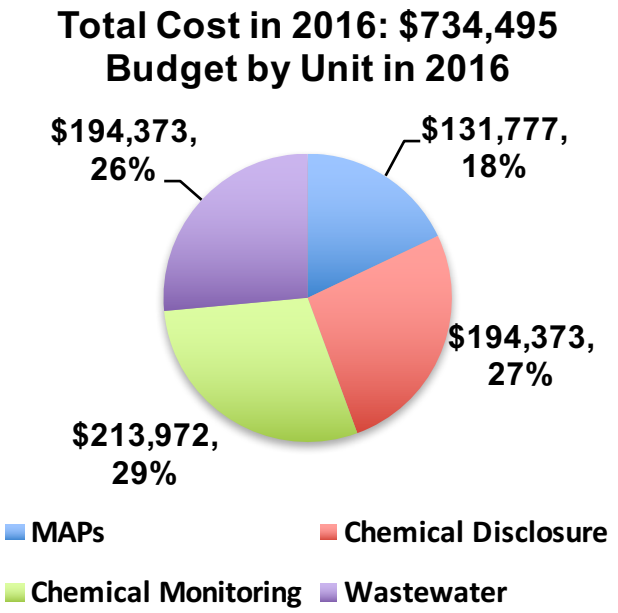

Figure VII-1: Total Cost by Unit in the Year 2016
Source: Team Research

The 2016 budget increases in the second quarter due to the completion of the hiring procedure. The budget will decrease in the last quarter due to the completion of the policy requirements, and website and database construction in the first three quarters.

The cost of personnel services far outweighs the cost of non-personnel services. The main purpose of our program is to monitor and report the environmental performance of natural gas extraction, which heavily depends on the analysis from environmental protection analysts and the database function maintained by IT contractors. According to Figure VII-4, the program budget in 2017 is slightly higher than in 2016.

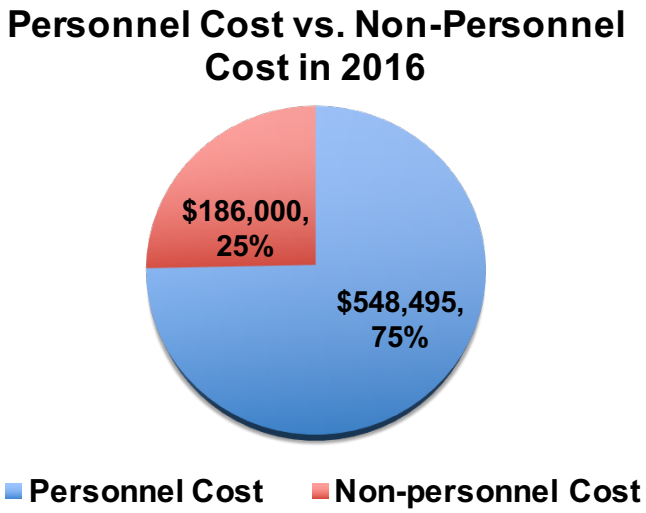

Figure VII-3: Total Cost by Personnel and Non-personnel Cost in 2016
Source: Team Research

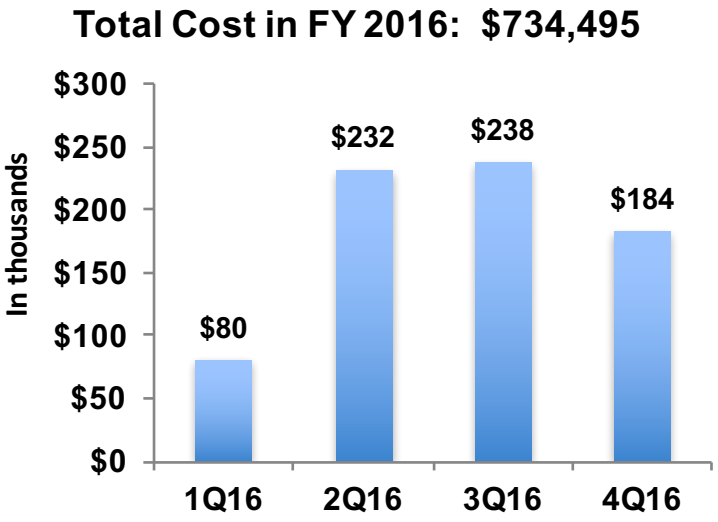

Figure VII-2: Total Cost by Quarter in 201
Source: Team Research

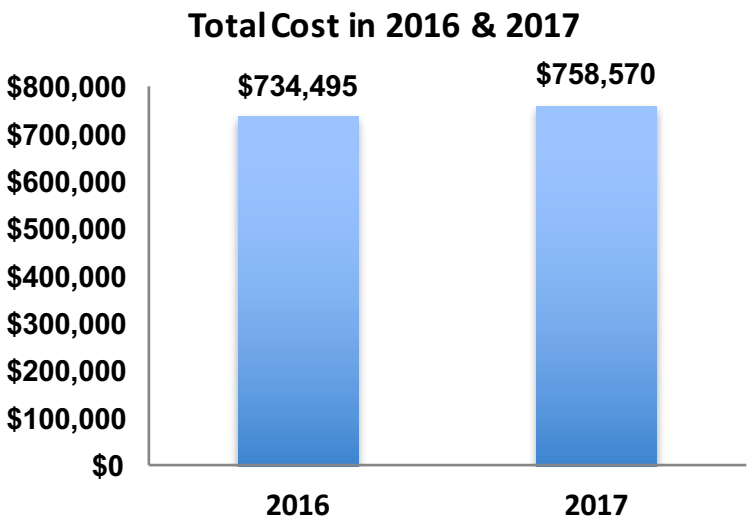

Figure VII-4: Projections of Total Budget in the First and Second Calendar Year
Source: Team Research

VIII. Performance Management

The Performance Management Plan serves to create indicators of program success. There are four main components of the Performance Management Plan:

- Measuring
- Collecting
- Reporting
- Feedback

Each of these components is described within the framework of: chemical disclosure, chemical monitoring, and wastewater management.

The measurement component defines the input, process, and feedback mechanisms of data collection.

The collection component details how the data is reported and how frequently the companies must report information to the governmental database. The companies will be reporting specific chemical substance information as well as wastewater pretreatment levels within the EIS, and the DOE will compile this information. Unless specified otherwise, all indicators will be collected and reported by the MAPs team on a monthly basis. If any issues are uncovered, they will immediately be reported to management in the DOE and the EPA. Otherwise, management reports to the DOE and in the EPA will be provided quarterly, with annual summaries at year end.

The reporting component describes the governmental organizational process on how the incoming data is assessed.

Finally, the feedback component defines how governmental organizations regulate the program, along with providing audits to make sure the incoming chemical and wastewater data is consistent and accurate.

i. Chemical Disclosure Performance Management

1. Measurement

According to Table VIII-1, the measurement process is divided into three parts: input (collection), process and feedback.

Input	Process	Feedback
Site location, chemical structure, and chemical creation process.	Company required to disclose all chemical information (type, dosage, and frequency) to EPA/DOE during the exportation permitting application process via the DOE website.	DOE/EPA uses information to incorporate into MAPs and subsequently EIS. Also, uses information to go into EIS. 10% of sites will be tested to confirm validity of company's reporting, false information will result in fine system being enforced.

Table VIII-1: Chemical Disclosure Performance Management/Indicators
Source: Team Research

Collection: Companies are required to disclose all chemicals used in their hydraulic fracturing operations during the exportation permitting application process. This process will be led by the DOE MAPs team, whereas the Chemical Disclosure Office will handle the creation of the online application and database.

Reporting: Before applying for an export permit, companies will be required to test a sample of their wells by sending a sample to a third party laboratory. This baseline report will be uploaded to the application when companies apply for permits. Information is kept in a digital database and is accessible by the EPA and DOE.

Feedback: The DOE will have authority over the process during chemical disclosure and permitting, handling any mid-course corrections, special conflicts, and staffing demands. The DOE will share responsibility with the EPA Regional Offices in testing 10% of wells on site to confirm validity of the reports and information submitted by companies during the application process. Inaccurate information provided will result in a fine for all companies for each violation. With the testing of all sites during the process, there should not be any unknown chemicals used in the extraction process. If the companies provide inaccurate information on multiple occasions, and three fines are levied, then at that time the export permit may be rescinded. Companies with rescinded permits will have to wait a probationary 2-year period before reapplying for an export permit.

2. Indicators

Performance indicators: The chemicals observed at hydraulic fracturing sites must match with the chemicals that are disclosed. The objective is to ensure comprehensive regulatory practice by having companies list their use of chemicals. If chemicals are found in the site that are not disclosed prior by the companies, then fines will be enforced. The system of fines will be developed as part of the regulation process.

Database indicators: Verify the chemical disclosure lists by the companies, ensuring that every production site is reporting and compliant with the program.

Outcome indicators: Allow for increased transparency from a chemical standpoint, the government can oversee the extraction with an informational database containing all the chemical substance information.

ii. Chemical Monitoring Performance Management

1. Measurement

All natural gas companies that want an export permit are required to sample streams, rivers, watersheds, and soil in 20 locations within a half mile radius around each production site. The half mile radius is currently selected to account for chemical migration, and will be adjusted accordingly after program evaluation in 2 years. The companies will report the toxicities of the disclosed chemical substances to the DOE while filing for the export permit. These companies will periodically test sample locations three times annually. From an auditing standpoint, the EPA will randomly sample 10% of the 20 production sites every year, allowing for a 'sanity check' for monitoring consistency. The EPA will also test the company's chemical samples three times annually. Lastly, the companies will be required to monitor surface waters continuously for chemicals but report measurements once a month.

The key agenda is to make sure that there is no chemical migration from the hydraulic fracturing site. The process is described in the Program Design section. The following table outlines the input, process, and feedback for the measurement system:

Collection: Information will be collected by the companies on an annual basis, and then reported to the respective government entities.

From the governmental side, the Chemical Monitoring Unit has two components, policy and enforcement. The monitoring enforcement team in the EPA Regional Office will have a Senior Technical Officer and three subject matter technical experts, tasked with enforcing the testing requirements that companies will be required to abide by and collecting the data. The information will be stored in an EPA database, noting the following information: site location, site area sampling techniques, chemical substance measurements, and date of sampling. This information will pre-reviewed and assessed for the EPA feedback on the Mitigation Action Plans for each production site.

If the chemical samples from the company are still showing inconsistencies with the samples tested by the EPA, then an initial fine will be levied. A system of fines will be developed as part of the regulations. By the third infraction, the company's export permit may be rescinded. Both the DOE and the EPA will incorporate the national environmental guidelines and reporting procedures, along with maintaining strict accountability standards. Strong communication is required between the EPA and DOE to allow for clarity in the reporting, collection, and assessment of the input data from the natural gas production companies. The indicators for the entire process is summarized below.

Feedback: Final authority and jurisdiction over the process is given to the DOE in overseeing the entire process. The DOE will handle mid-course corrections under circumstances of special conflicts or if extra staffing is required.

Input	Process	Feedback
20 site samples for each production site from the natural gas companies applying for an export permit.	Companies are required to disclose this information for the purposes of the DOE and EPA gathering informational data for the MAPs in the EIS.	DOE/EPA uses information to incorporate into MAPs and subsequently EIS. Also, uses information to go into EIS.

Table VIII-2: Chemical Monitoring Performance Management/Indicators
Source: Team Research

Reporting: The DOE in collaboration with the technical experts in the EPA Regional Offices are responsible for updating the chemical substance monitoring database when new export permits get filed and also for daily database integration/maintenance. If there are instances where the chemical substance numbers of EPA's random samples of the production sites are over +/- 25% of the numerical chemical figures reported by the companies, then an additional 5 samples will be required at the particular site.

2. Indicators

Performance indicators: 20 baseline tests and two baseline validation tests; 20periodic tests and two periodic validation tests for each site with a radius of a half a mile.

Database indicators: Verify the baseline/periodic and validation tests for each site, and relevant comparison for each sites.

Outcome indicators: Provide export permits, levy fines for late or inaccurate data, and withdraw permits if periodic data is not equal to baseline data.

ii. Wastewater Management Performance Management

1. Measurement

Measurement: In accordance with the Mitigation Action Plan outlined in the Environmental Impact Statement, all natural gas companies that want an export permit must track the amount of wastewater generated, the chemical substances that are removed during the pre-treatment process, and where pre-treated water is sent for disposal/reuse. The companies will report this data to the DOE while filing for the export permit. From an auditing standpoint, the Environmental Protection Agency will randomly sample the pre-treated water of 10% of the each production site every year, allowing for a 'sanity check' for monitoring consistency. *Collection:* Companies will measure the amount of wastewater that is generated at each natural gas production site. These companies will measure how much wastewater is re-injected, pretreated, put in storage tanks/ponds, and goes straight to a municipal wastewater treatment plant.

The information should then be put into a DOE database. The Wastewater Pretreatment Unit, within the DOE will be tasked with compiling and analyzing the data to report it to the EPA.

Reporting: Once the information is in the DOE's database, the information will be transmitted to the EPA for further analysis to ensure that leaks are minimized and that wastewater that is either reinjected back into the ground, or pretreated prior to being sent to a municipal wastewater treatment plant.

Feedback: If the EPA determines that there are leaks in the process that exceed 5% of the pre-treated water volume, then there would be a standard fine imposed. The EPA has joint authority with the DOE in overseeing the entire process, such as jurisdiction over handling mid-course corrections under circumstances of special conflicts, extra staffing required etc.

2. Indicators

Performance indicator: Account for all the pre-treated water during the natural gas production process, along with clear database on chemicals removed from the wastewater.

Database indicators: Input data consists of every production site's quantity of wastewater produced, chemical substance information of the pre-treated wastewater, and the location of wastewater disposal sites.

Outcome indicators: Maximum reduction of wastewater spillage in the pre-treatment process.

Input	Process	Feedback
20 site samples for each production site from the natural gas companies applying for an export permit.	Companies are required to disclose this information for the purposes of the DOE and EPA gathering informational data for the MAPs in the EIS.	DOE/EPA uses information to incorporate into MAPs and subsequently EIS. Also, uses information to go into EIS.

Table VIII-3: Wastewater Management Performance Management/Indicators
Source: Team Research

IX. Conclusion

The natural gas revolution has caused production to rise dramatically since 2005 (see figure I-1). Although the dramatic rise will aid in the United States' energy security, it has also come with a price. That price is the externalities such as contaminated wastewater migration that have essentially been ignored to date. To address these issues, Senator Edward Markey introduced The American Natural Gas Security & Consumer Protection Act (S.585), to provide protection for the public interest through the export permitting process.

A comprehensive implementation process has been developed for this bill. The implementation includes the structuring of the new Natural Gas MAPs team, under the Department of Energy's Office of NEPA Policy and Compliance. The new team includes three units that specifically address chemical disclosure, chemical monitoring and wastewater management. The detailed processes associated with the three units address the externalities by reducing the potential impacts of hydraulic fracturing, while protecting the public interest.

The detailed process includes the requirements of all parties including the DOE, the EPA, and the natural gas companies. Staffing and budgeting needs have been addressed, a timeline has been put in place, and a measurement system has been defined to assess progress. Within the next two years, program implementation will begin, allowing for the DOE and EPA to gather the key chemical and wastewater disposal information needed to minimize environmental impacts as a result of the hydraulic fracturing industry.

The program described in this report aims to protect the public interest, from an energy security perspective, as well as an environment and health perspective. With this process in place, people can continue to cook on their gas stoves, heat their homes, turn on the lights and plug in appliances, confident that the natural gas has been extracted in a safer manner than before.

X. APPENDIX

V. Program Design

Unit	Title	Salary	Description
Natural MAPs Team	Team Lead (1)	GS-13	Provide guidance and coordination for the operations for the three units
	Administrative Professional (1)	GS-7	Perform administrative tasks
Chemical Disclosure Unit	Mgmt and Program Specialist (2)	GS-11 and GS-9	Develop policy instructions for chemical disclosure
	IT Contractor (2)	NA	Construct the webpage for policy instruction and the database for monitoring and reporting
	Env Protection Specialist (1)	GS-9	Analyze data and prepare reports
Chemical Monitoring Unit	Mgmt and Program Specialist (2)	GS-11 and GS-9	Develop policy instructions for chemical monitoring
	IT Contractor (2)	NA	Construct the webpage for policy instruction and the database for monitoring and reporting
	Env Protection Specialist (2)	GS-9	Analyzing data and prepare reports
Wastewater Management Unit	Mgmt and Program Specialist (2)	GS-11 and GS-9	Develop policy instructions for wastewater pretreatment
	IT Contractor (2)	NA	Construct the webpage for policy instruction and the database for monitoring and reporting
	Env Protection Specialist (1)	GS-9	Analyzing data and prepare reports

Table X-1: The Detailed Staffing Plan
Source: Team Research

VI. Program Calendar≈

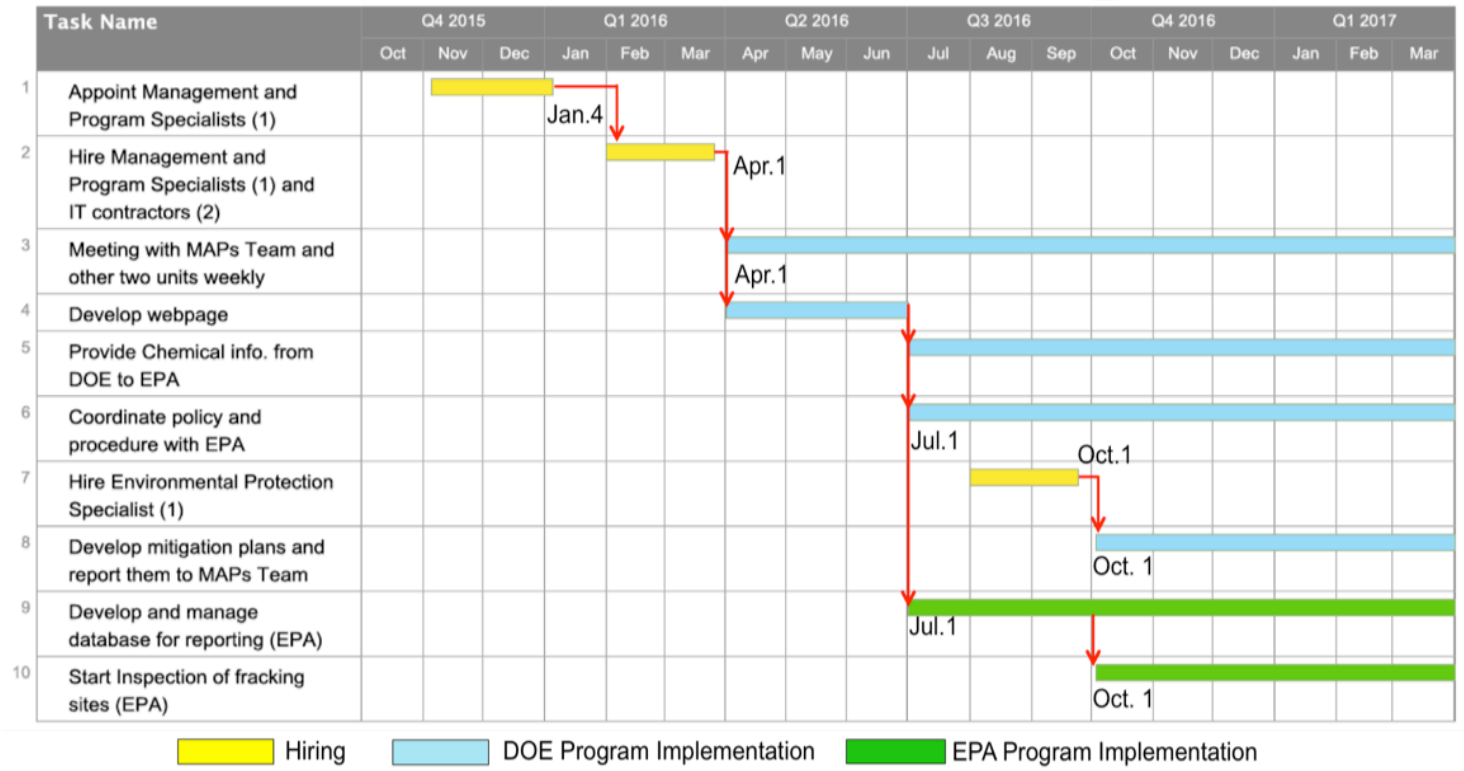

Figure X-1: The Detailed Master Calendar of the Chemical Disclosure Unit
Source: Team Research

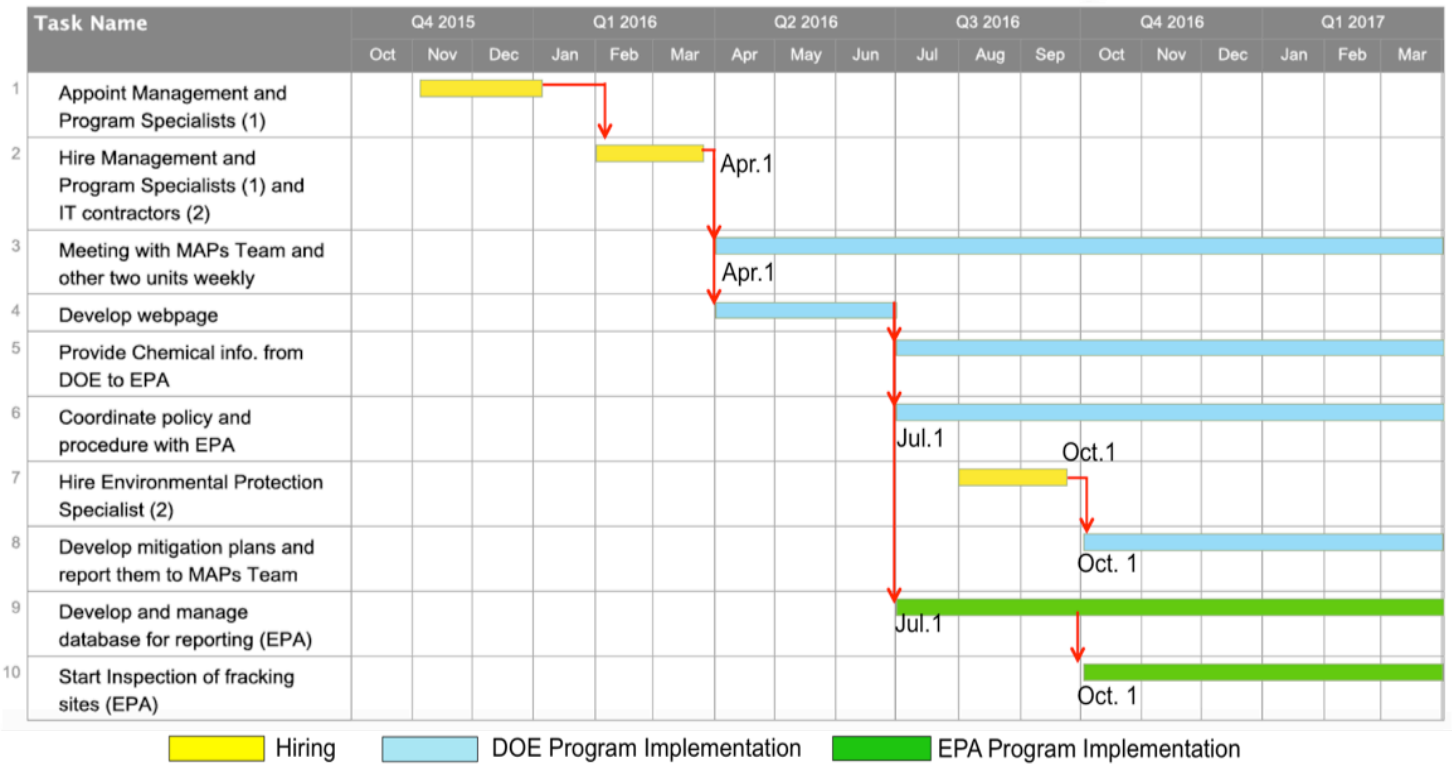

Figure X-2: The Detailed Master Calendar of the Chemical Monitoring Unit
Source: Team Research

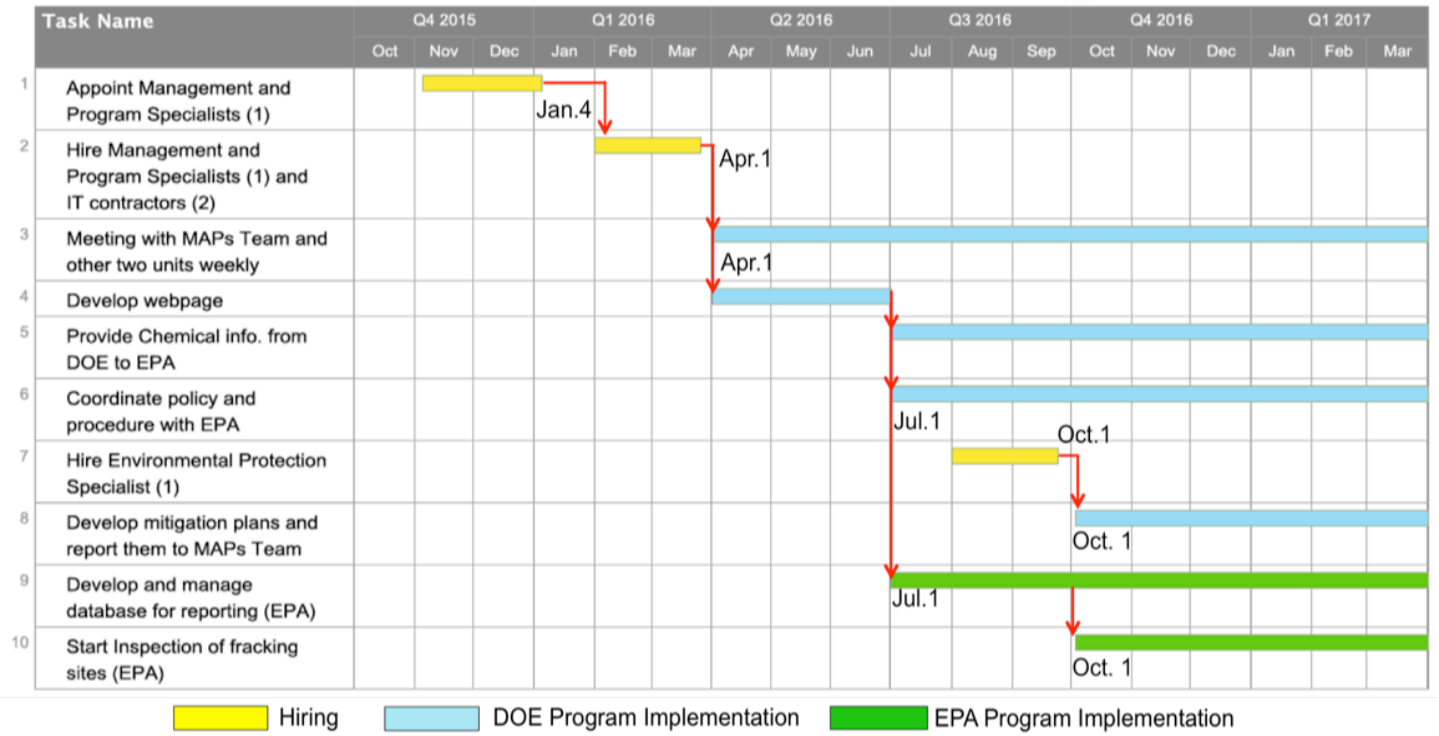

Figure X-3: The Detailed Master Calendar of the Wastewater Management Unit
Source: Team Research

VII. Budget

PERSONNEL COST							
Function / Title	**#**	**Salary Grade**	**Annual Salary**	**Start Date**	**End Date**	**2016**	**2017**
Management and Program Specialist	1	GS -11	$51,298	1/4/2016	10/1/2016	$38,474	$0
Management and Program Specialist	1	GS - 9	$42,399	4/1/2016	N/A	$31,799	$42,399
Environmental Protection Specialist	1	GS - 9	$42,399	10/1/2016	N/A	$10,600	$42,399
IT Contractor	1	N/A	$50,000	4/1/2016	10/1/2016	$25,000	$0
IT Contractor	1	N/A	$50,000	4/1/2016	N/A	$37,500	$50,000
Total	**5**					**$143,373**	$134,798

NON-PERSONNEL						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Working Capital Fund ($1,000/person/month)	$3,000	$12,000	$12,000	$9,000	$36,000	$36,000
Database and Website Server	$0	$6,000	$6,000	$3,000	$15,000	$24,000
Total	$3,000	$18,000	$18,000	$12,000	**$51,000**	$60,000

TOTAL COST						
	1Q16	2Q16	3Q16	4Q16	2016	2017
Personnel Costs	$12,825	$48,424	$48,424	$33,700	$143,373	$134,798
Non-Personnel Costs	$3,000	$18,000	$18,000	$12,000	$51,000	$60,000
Total	$15,825	$66,424	$66,424	$45,700	**$194,373**	**$194,798**

Table X-2: Chemical Disclosure Unit Budget - 2016
Source: Team Research

PERSONNEL COST							
Function / Title	**#**	**Salary Grade**	**Annual Salary**	**Start Date**	**End Date**	**2016**	**2017**
Management and Program Specialist	1	GS -11	$51,298	1/4/2016	10/1/2016	$38,474	$0
Management and Program Specialist	1	GS - 9	$42,399	4/1/2016	N/A	$31,799	$42,399
Environmental Protection Specialist	2	GS - 9	$42,399	10/1/2016	N/A	$21,200	$84,798
IT Contractor	1	N/A	$50,000	4/1/2016	10/1/2016	$25,000	$0
IT Contractor	1	N/A	$50,000	4/1/2016	N/A	$37,500	$50,000
Total	6					**$153,972**	$177,197

NON-PERSONNEL						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Working Capital Fund ($1,000/person/month)	$3,000	$12,000	$18,000	$12,000	$45,000	$48,000
Database and Website Server	$0	$6,000	$6,000	$3,000	$15,000	$12,000
Total	$3,000	$18,000	$24,000	$15,000	**$60,000**	$60,000

TOTAL COST						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Personnel Costs	$12,825	$48,424	$48,424	$44,299	$153,972	$177,197
Non-Personnel Costs	$3,000	$18,000	$24,000	$15,000	$60,000	$60,000
Total	$15,825	$66,424	$72,424	$59,299	**$213,972**	**$237,197**

Table X-3: Chemical Monitoring Unit Budget - 2016
Source: Team Research

PERSONNEL COST							
Function / Title	**#**	**Salary Grade**	**Annual Salary**	**Start Date**	**End Date**	**2016**	**2017**
Management and Program Specialist	1	GS -11	$51,298	1/4/2016	10/1/2016	$38,474	$0
Management and Program Specialist	1	GS - 9	$42,399	4/1/2016	N/A	$31,799	$42,399
Environmental Protection Specialist	1	GS - 9	$42,399	10/1/2016	N/A	$10,600	$42,399
IT Contractor	1	N/A	$50,000	4/1/2016	10/1/2016	$25,000	$0
IT Contractor	1	N/A	$50,000	4/1/2016	N/A	$37,500	$50,000
Total	**5**					**$143,373**	$134,798

NON-PERSONNEL						
	1Q16	**2Q16**	**3Q16**	**4Q16**	**2016**	**2017**
Working Capital Fund ($1,000/person/month)	$3,000	$12,000	$12,000	$9,000	$36,000	$36,000
Database and Website Server	$0	$6,000	$6,000	$3,000	$15,000	$24,000
Total	$3,000	$18,000	$18,000	$12,000	**$51,000**	$60,000

TOTAL COST						
	1Q16	2Q16	3Q16	4Q16	2016	2017
Personnel Costs	$12,825	$48,424	$48,424	$33,700	$143,373	$134,798
Non-Personnel Costs	$3,000	$18,000	$18,000	$12,000	$51,000	$60,000
Total	$15,825	$66,424	$66,424	$45,700	**$194,373**	**$194,798**

Table X-4: Wastewater Management Unit Budget - 2016
Source: Team Research

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