Appendix F

Oil, Gas, and Mineral Development on the Allegheny National Forest

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Introduction

Ninety-three percent, or about 478,283 acres of the Allegheny National Forest (ANF) subsurface mineral estate is privately owned. In 1859, Colonel Drake struck oil at Oil Creek in Venango County, which is about 15 air miles southwest of the ANF. This strike started the worldwide commercial oil industry. Rapid development followed and spread to the northeast across the Allegheny Plateau, much of which was held in corporate ownership by large timber companies. During this period, developers purchased oil and gas rights from private landowners and began development. Some leases, particularly on the southwest corner of the ANF, date from the 1880s.

In l923, following passage of the 1911 Weeks Act, a determination was made by the Forest Service that national forest objectives could be achieved with the ownership of the mineral rights separated from surface ownership. Consequently, under most of the surface land acquired for the ANF, the subsurface rights are privately owned by a third party (outstanding rights) or reserved (reserved rights) by the seller.

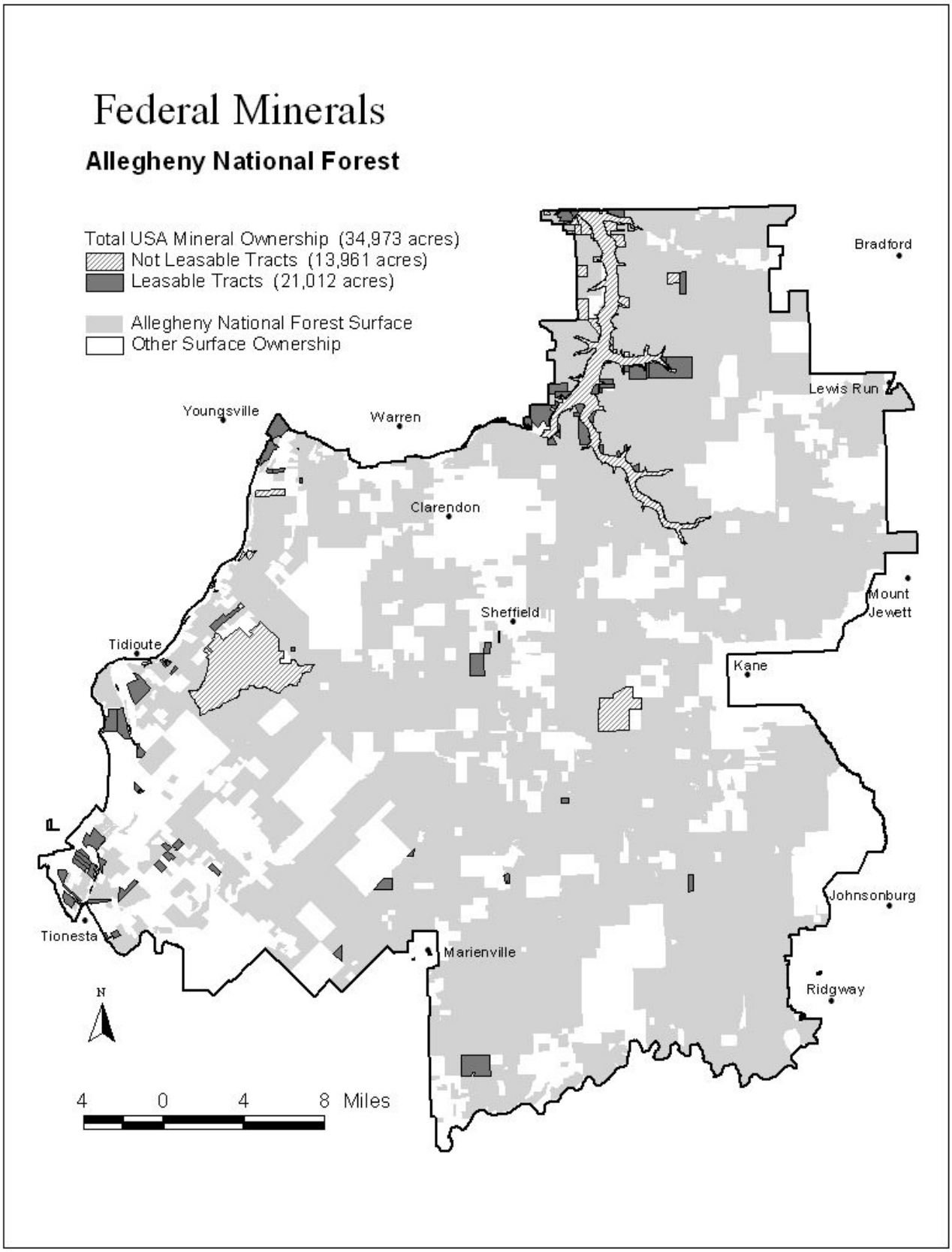
The subsurface mineral estate for the remaining 7 percent of the ANF, about 35,000 acres, is federally owned (Federal minerals). Of this total, 16,254 acres, or 46 percent, have been withdrawn from leasing. An additional 7,315 acres are not available for leasing. These areas include lands inundated by the Allegheny Reservoir. The following areas have Federal minerals withdrawn from leasing: Tionesta Research Natural Area (future development only), Hickory Creek and Allegheny Islands Wilderness Areas, and the Hearts Content Scenic Area. Presently, 4 areas of Federal minerals are leased, totaling 870 acres. A leasable mineral is one that is owned by the Federal government and leased by a private individual or corporation through the Bureau of Land Management (BLM) lease process. The BLM oversees all Federal mineral leases. The four Federal mineral leases on the ANF are not producing oil or gas at this time. One leaseholder is beginning the process of developing a lease. Six wells are currently planned.

The following table and map illustrate the mineral ownership underlying the ANF (source is lands status atlas, which varies from GIS data acreage).

Table F-1. Mineral Ownership and Status

Status	Acres
Federal minerals	
Withdrawn (Hickory Creek and Allegheny River Islands Wilderness Areas and National Recreation Areas)	16,254
Not available (under Reservoir)	7,315
Mineral ownership only (surface owned by third party)	4,297
Leased (4 current leases)	870
Available for lease	6,267
Total Federal minerals	**34,973**
Outstanding and Reserved Ownership	478,283
Total Acres (rounded to nearest whole acre)	**513,256**

Figure F-1. Federal Mineral Ownership on the ANF



Description of ANF Geology, Oil and Gas

Geomorphology

The ANF is located in the Northern Unglaciated Allegheny Plateau Section of the Appalachian Plateau Geomorphic Province. It is a maturely dissected plateau, characterized by sharper ridge-tops and narrower valleys than the glaciated portions of the plateau just to the north and west. Drainage is dendritic. Mass wasting, fluvial erosion, and transport deposition are the primary geomorphic processes. Broad, low amplitude, northeast to southwest trending folds tilt the horizontally bedded sedimentary layers approximately 6 degrees and lend a subtle grain to the topography.

Lithology/Stratigraphy

A veneer of unconsolidated materials overlay bedrock: residuum of flat and gently sloping uplands, colluvium at the base of steep hillsides, and alluvium in narrow valley bottoms. Thicker deposits of clay, silt, sand, and gravel are present in wider valleys. Beneath these sediments, the upper Devonian, lower Mississippian, and Pennsylvania bedrock is composed of a mixed siliciclastic sequence of sandstone, siltstone, shale, subordinate conglomerate, occasional limestone, and coal. By definition, a “shallow” well does not penetrate the boundary between the Middle and Upper Devonian Series, or the top of the Tully Limestone or its equivalent in Pennsylvania. This generally equates to well depths of between 500 and 5,000 feet. A “deep” well penetrates the boundary between these two series. Important source rocks for shallow oil and natural gas production include the Venango and Bradford Groups, and for deep reserves, the Onondaga, Oriskany and Medina Groups. Figure F-2 displays the known oil and gas fields underlying the ANF.

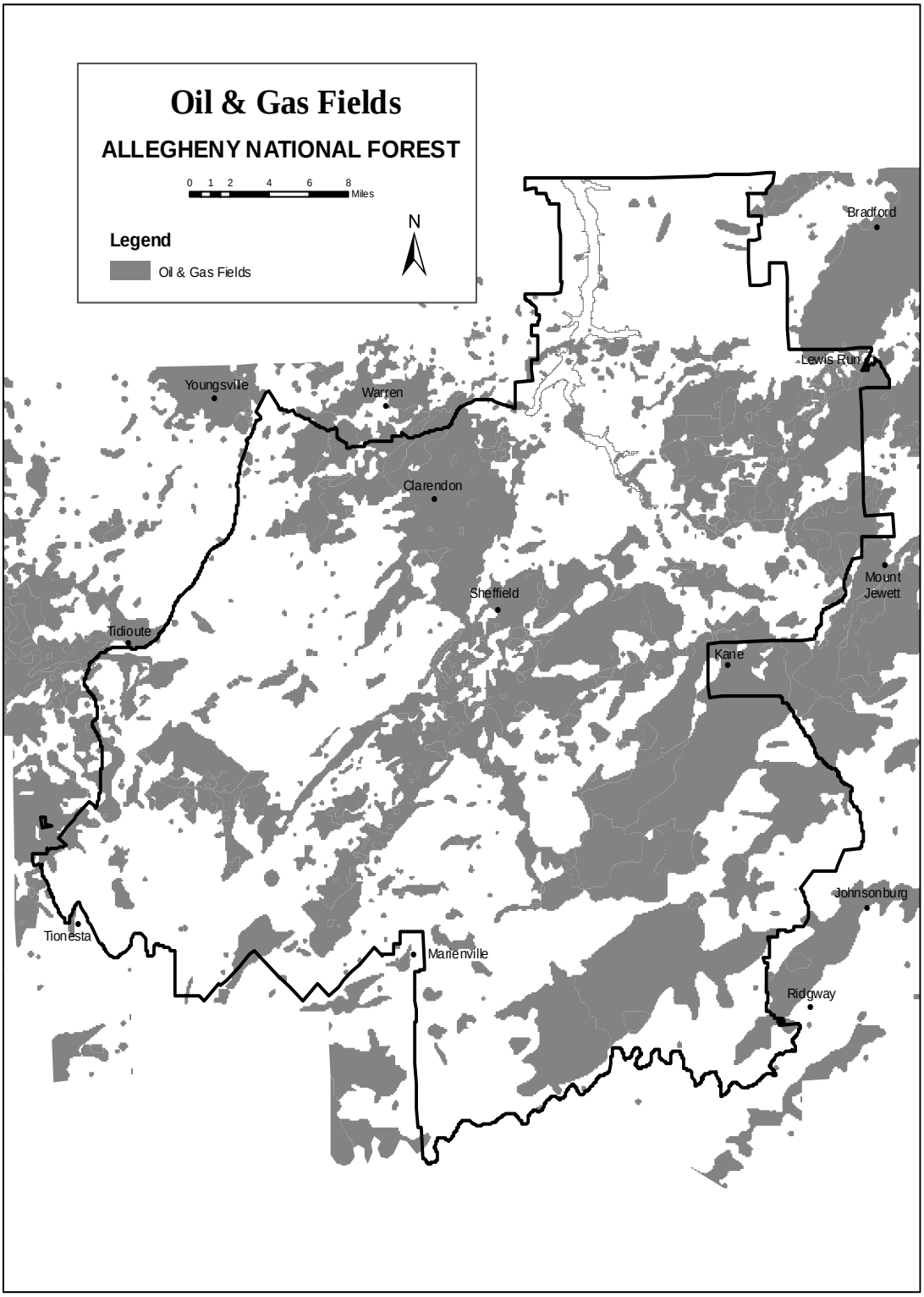
Some geologists project that there are deep (10,000 to 20,000 feet) oil and gas deposits in the Appalachian Basin, which includes the area of the ANF. To date, the existence of these reserves has not been proven, although a handful of deep wells have been drilled. If deep deposits are located and developed, a new oil boom for the Allegheny Plateau could follow.

Pennsylvania is located at the northeastern end of the Appalachian Coal Basin. The ANF is at the extreme northern part of the Main Bituminous Coal Field, with sporadic and thin coal beds underlying the surface. The coals underlying the forest are considered low rank, high-volatile bituminous, meaning that they contain less than 69 percent fixed carbon. In contrast, the high rank, anthracite beds of eastern Pennsylvania contain up to 98 percent fixed carbon content. Thick beds of high rank coal are much preferred and are more economical to mine than the lower quality, thin beds located underlying the ANF. Of the four counties (Warren, Elk, McKean, and Forest) which the ANF occupies parts of, only Elk County produced coal in 2002, the most recent year that Pennsylvania coal data is currently available. None of the production was on the ANF.

Common variety minerals present on the ANF include unconsolidated sand and gravel deposits and pit run stone. Pit run stone is used for road surfacing on the ANF. There are approximately 500 rock pits on the ANF. Two hundred are closed and three hundred are open. Approximately 140,000 cubic yards of pit run stone is used per year for road surfacing.

Figure F-2. Oil and Gas Fields on the Allegheny National Forest

(Source: PA DCNR Bureau of Topographic and Geologic Survey. Oil and Gas Fields and Pools of Pennsylvania. GIS shapefile of ANF Region, received November 2005, Pittsburgh, PA).



Description of Surface Oil, Gas, and Mineral (OGM) Activity

The mineral estate owner has the right to access his minerals. The Pennsylvania Bureau of Oil and Gas Management of the Pennsylvania Department of Environmental Protection (PA-DEP) is the regulatory agency overseeing oil and gas operations in Pennsylvania. The role of the Forest Service is to negotiate with the OGM operator to protect surface resources, while respecting the rights of the OGM operator and the regulatory requirements of PA-DEP.

OGM operators build their roads in accordance with standards set forth by PA-DEP. In regards to soil erosion, sedimentation, and water quality issues, PA-DEP is the regulatory authority, not the Forest Service. PA-DEP has been given primacy by the Federal Government for carrying out the provisions of the Federal Water Quality Act of 1965 via the Pennsylvania's Clean Streams Law (PA Clean Streams Law of 1937, as amended). The Forest Service works with PA-DEP and the mineral estate owner to correct problems associated with private oil and gas roads. Oil and gas operators also utilize ANF system roads.

New development proposals are reviewed by the Forest Service and a letter to proceed is issued by the District Ranger. The final development plan reflects mitigation measures negotiated by the Ranger. The 2001 Pennsylvania Oil and Gas Act applies to private rights development projects on the ANF and provides regulatory control over the development. The Forest Service and PA-DEP provide administrative oversight during development and operation of the project. The Forest Service issues road use permits to OGM developers for the hauling of oil and brine on Forest Roads and for equipment access for new lease developments. Special use permits are also required for pipelines placed outside the mineral estate on the ANF.

For each new well drilled, approximately 0.3 acres are cleared for each well pad, one acre is cleared for roads (0.25 miles times 35 feet clearing width). Gathering pipelines are generally buried within the width of the road clearing. The lines may feed into a larger distribution line, or may be connected to a tank battery. Tank batteries store the oil and brine before it is hauled offsite in tanker trucks. The new surface disturbance figures differ slightly from the 1986 Forest Plan due to additional field information gathered.

An estimated 1,250 miles of private OGM roads exist on the ANF surface. Many new wells are drilled using access provided by existing Forest Roads. Approximately 191,000 to 241,000 acres on the ANF are subject to future development.

Most people are unaware of natural gas storage areas, as the areas are underground at depths of 2,000 to 8,000 feet. These areas typically are depleted natural gas pools that are then used much like a storage tank. Surface indicators of gas storage areas are compressor stations, meters, and pipelines.

Description of OGM Development to Date

From fiscal year 1986 to 2005, 4,493 new wells were drilled on ANF, an average of 225 new wells per year for the 20-year period. In FY2006, 985 wells were drilled, the highest total since 1986.

The formations which contain oil and gas reserves underlying the ANF have low permeability and effective porosity. To maximize production of such formations, close well spacing of 400 to 500 feet is utilized. This equates to approximately one well drilled per every five acres in these OGM developments.

Presently, an estimated 8,000 oil and gas wells are active. Due to the nature of area geology, wells can remain in production for 25 to 30 years and even far longer in some cases. The number of wells drilled on the ANF annually is cyclic and is driven by the price of oil and natural gas on the local and regional markets. When oil and natural gas prices are high, the number of new wells drilled is also constrained by the availability of drill rigs, service equipment, and personnel in the private sector. Table F-2 shows the number of wells drilled and plugged on the ANF by fiscal year between 1986 and 2005.

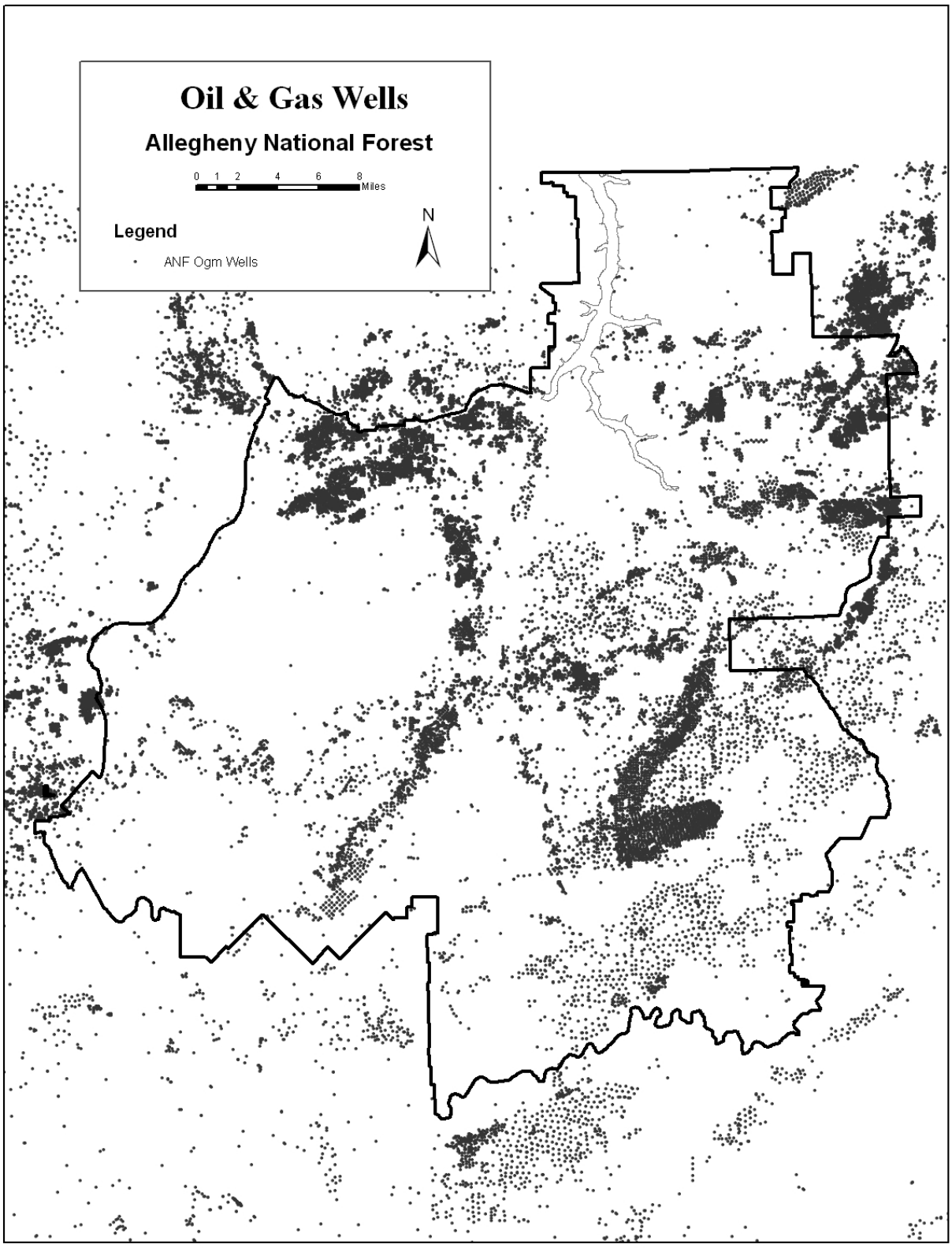
The number of wells drilled per year is market driven. When oil and gas prices are high, drilling activity increases.

As a result of varying reporting requirements and varying data collection methods over the years, an unknown number of inactive wells have been plugged. Most of the wells being plugged are abandoned wells that are not counted in the current estimate of 8,000 active wells. Well plugging is also done to ensure safety and resource protection in existing OGM developments when additional wells are drilled.

Table F-2. Wells drilled and plugged fiscal years 1986-2005

Fiscal Year	Wells Drilled	Wells Plugged
1986	250	no data
1987	250	no data
1988	196	80
1989	139	599
1990	139	268
1991	176	108
1992	160	201
1993	188	261
1994	112	113
1995	109	104
1996	68	114
1997	102	no data
1998	199	no data
1999	275	no data
2000	345	no data
2001	315	no data
2002	259	64
2003	202	11
2004	321	37
2005	688	15
Total	**4,493**	**1,993**
Annual Average	**225**	**153**

Figure F-3. Oil and Gas Wells Drilled on the Forest Since 1986



While rare, oil spills occasionally occur. Five reportable spills have occurred in the last 10 years. A spill that results in oil leaving the well pad is considered reportable. Although these spills pose a threat to water resources, the Commonwealth has not listed any streams within the ANF on the 303(d) List due to oil and gas activities (PA-DEP 2006). The FEIS did not address oil spills because their occurrence, severity, and size are not predictable. Oil and gas operators are required to comply with the PA-DEP spill prevention plan and the Federal Clean Water Act.

Produced brine is disposed of at private brine disposal facilities, or may be reinjected into the formation if the operator has an Underground Injection Control permit. The U.S. Environmental Protection Agency has primacy for this program. Operators are not allowed to dispose of brine by surface spraying Forest Service or OGM roads for dust abatement.

Future Development

Private Minerals

Using the 20-year average during the 1986 Forest Plan period, 225 wells were drilled on the forest each fiscal year. This equates to approximately 293 acres of ground disturbance annually (68 acres for the construction of well pads and 225 acres cleared for road construction). OGM development has occurred throughout the forest, and recent increased development in the Hastings and Salmon Creek areas is outside known historic oilfields.

Projecting from the average stated above, about 56 miles of new OGM road construction could be expected per year. There are approximately 1,250 miles of OGM roads on the ANF.

If the oil and gas market remains strong, it is possible that development may increase beyond that projected by historic averages. A high-quarter scenario of 800 wells drilled per year is possible. This equates to approximately 240 acres of ground disturbance for the construction of well pads and 200 new miles (800 acres) of OGM roads.

Extrapolating this information to year 2020 results in an estimated 3,375 new wells using the historic trend approach, or 12,000 new wells using the high-quarter scenario (see Table F-3). This estimate does not include any allowance for plugging wells. Approximately 100 to 200 wells are plugged by private operators per year on the ANF. However, as discussed previously, most of the wells being plugged are abandoned wells or wells in close proximity to new wells, not wells counted in the current estimate of 8,000 active wells.

Table F-3. Estimated number of wells and miles of road thru 2020

Scenario	Measure						
	Existing Wells	Additional Wells (2020)	**Total Wells**	Existing OGM Roads (mi)	Additional OGM Roads (mi) (2020)	**Total Roads (mi)**	Additional Acres of Clearing (2020)
Historic Trend 1986 to 2005 (225 wells/year)	8,000	3,375	**11,375**	1,250	850	**2,100**	4,600
High Quarter (800 wells/year)	8,000	12,000	**20,000**	1,250	3,000	**4,250**	15,600
Average Future Projection (Average of High Quarter and Historic Trend: 512 wells/year)	8,000	7,680	**15,680**	1,250	1,920	**3,120**	9,980

The average future projection of 512 new wells per year for the next 15 years is the midpoint between the high-quarter scenario and historic trend taken from the 20-year period between 1986 and 2005. As mentioned previously, drilling activity has always been cyclic. Although 2006 levels were well above the 20-year average, past periods of high activity have never lasted for more than a few years. As this projection blends the historic average with the recent increase in OGM development, it is used to project future activity during the next 15 years and the cumulative effects of that activity.

Predicting development scenarios after 2020 is very speculative. At some point in time, a saturation level for oil development on the ANF would occur. An analysis was conducted to estimate what this saturation level could be (See Table F-4). Several factors influence this analysis.

First, the number of acres that could potentially be developed needs to be considered. Three approximations were used to address this variable. The first approximation assumed the entire ANF minus Federal minerals would be developed (506,000 minus 35,000 equals 471,000 acres). The second approximation assumed only the areas currently identified as oil and/or gas fields would be developed (PADCNR 2005). GIS data indicates 191,000 acres may potentially be developed. A third approximation was used that assumed inclusions within the existing identified oil and gas fields and some development outside the existing oil and gas fields would occur (an additional 50,000 acres for a total of 241,000 acres).

The second factor that influences this analysis is the well spacing. Well spacing is determined by the OGM operator's petroleum engineer or geologist based on a myriad of factors, including depth to producing layers, number of producing layers, estimated production, cost of wells and roads. Well spacing varies from one area of the ANF to another. For this analysis, three areas were examined to determine well spacing. The first area was Salmon Creek. This area is currently being developed. The well spacing is approximately 1,000 feet. The second area considered is Sackett. This area was developed in the 1980s. The well spacing is approximately 800 feet. The third area is along FR 456 near Red Bridge. This is a new development. The well spacing is 660 feet. Based on these variables (acres developed and well spacing), Table F-4 was developed.

In Table F-4, the number of wells was calculated by estimating the number of acres per well for the given spacing. As an example, for a 1,000 foot well spacing, an area 1,000 feet by 1,000 feet, or 23 acres, has one well. Therefore, 471,000 acres divided by 23 yields approximately 21,000 wells.

The total miles of roads was calculated by multiplying the amount of road miles per well for a given spacing scenario times that total number of wells. Acres were calculated based on 0.3 acres impacted per well and 4.2 acres per mile of road. An average road width of 35 feet was used to calculate the acres cleared per mile of road.

Based on this analysis, it can be seen that the number of wells identified in the high-quarter scenario is feasible.

Table F-4. Long-term potential wells, roads, and acres cleared*

Well Spacing	First Approximation 471,000 acres developed			Second Approximation 191,000 acres developed			Third Approximation 241,000 acres developed		
	wells	road (mi)	acres	wells	road (mi)	acres	wells	road (mi)	acres
660 Feet	47,000	5,900	39,000	19,000	2,400	16,000	24,000	3,000	20,000
800 Feet	31,000	4,900	30,000	13,000	2,000	12,000	16,000	2,500	15,000
1,000 Feet	21,000	3,900	22,000	9,000	1,600	9,000	11,000	2,000	12,000

* Wells and acres round to the nearest 1,000 and road miles to the nearest 100.

The three approximations indicate a range of different saturation levels based on the assumptions described previously. As the analysis suggests, the range of likely saturation is between 11,000 and 47,000 active wells. A comparison between the estimated number of wells in Table F-3 and the potential number of wells identified for Table F-4 suggests that if development occurs at 512 wells per year, a total of 15,680 wells could be present at the end of the plan period. Depending on where the saturation point is relative to the three approximations described, this projected development for the plan period would represent saturation for two of the three spacing assumptions in the second approximation and saturation for two of the three spacing assumptions in the third approximation.

For purposes of long-term effects analysis, saturation is estimated to be 20,000 wells. This is just above the tight spacing level in the second approximation and midway between the first two levels of spacing for the third approximation. The likelihood of much greater development beyond the projected level for the plan period would occur only for the tighter spacing of the first and third approximations. The likely prospect is that old wells will be plugged and intensive new drilling will occur in historic oil fields with improved technologies, keeping the ultimate number of active wells within one of these saturation points.

For cumulative analysis within the ANF proclamation boundary, it can be assumed that OGM reserves are evenly spread over all ownerships.

Federal Minerals

From the high of nearly 5,000 acres leased in the early 1990s, interest in leasing has steadily declined. Where Federal mineral rights exist, the Forest Service has more discretion in both what areas to lease and the stipulations to attach. All standards and guidelines applied to special use areas in the LRMP could be applied to federal leasing conditions. Currently, four areas are leased, totaling 870 acres. None of the leases are currently producing, but one leaseholder has begun the process of developing his lease. Six wells are initially planned.

Due to the long lease process, which may take years, and the availability of private minerals both on and off the ANF, leasing is not a particularly attractive option for potential developers.

If energy prices remain high or new reserves are discovered, it is possible that the interest in leasing Federal minerals on the ANF may increase.

Lease-Specific Oil and Gas Stipulations

The following two stipulations are in addition to the standard lease terms for Federal oil and gas leases (BLM Form 3110-11). The stipulations are necessary to protect specific resource values on the lease area.

1. NO SURFACE OCCUPANCY STIPULATION

The described area of this application has within it environmentally sensitive lands which would be adversely impacted by earth disturbing activities. No surface occupancy is allowed for oil and gas well site construction, or construction of related facilities.

2. LIMITED OCCUPANCY STIPULATION

The described area of this application has within it lands that would not be adversely impacted by reasonable and prudent surface occupancy for oil and gas exploration and development. The areas are also suited for the construction of access roads, utility corridors, and related facilities. This occupancy condition allows for reasonable and necessary use of the land for exploration and extraction of oil and gas.

Economic Impact Estimates

Most new wells are drilled in known oil and gas fields, therefore there are virtually no dry holes drilled. As the deposits are commingled, many wells produce both oil and natural gas.

An “average” well costs approximately 60,000 dollars to drill, and will produce between 80,000 and 100,000 dollars in income over the first two years. Production then falls off and the well can be expected to produce 18,000 to 36,000 dollars per year in income. An oil well may produce for over 40 years. Historically, gas wells in Pennsylvania have a productive life span of between 10 and 100 years.

After a short lived initial flush, oil wells can be expected to produce one to two barrels of oil per day. Using the latest available information (FY 2004) from the Department of Energy, an average gas well in Pennsylvania produces approximately 4.2 million cubic feet of gas per year.

The price of oil and natural gas tend to be closely linked. Historically, the average annual value of natural gas produced from wells on the ANF approximates the value of oil produced. As of November 2005, natural gas prices for four user types (residential, commercial, industrial, electric power generation), ranged from 13 to 16 dollars per thousand cubic feet (Pennsylvania Energy Statistics–U.S. Government).

Cumulative Effects Estimates within ANF, Proclamation Boundary, and 4 County Region

Table F-5. Cumulative OGM Development by 2020

Scenario	Measure						
	Existing Wells	Additional Wells	**Total Wells**	Existing OGM Roads (mi)	Additional OGM Roads (mi)	**Total Roads (mi)**	Additional Acres of Clearing
Average Future Projection (512 wells/year) on ANF (506,000 ac)	8,000	7,680	**15,680**	1,250	1,920	**3,120**	9,980
Average Future Projection (512 wells/year) within Proclamation Boundary (740,000 ac)	11,700	11,200	**22,900**	1,825	2,800	**4,625**	14,560
Average Future Projection (512 wells/year) within 4 County Region (1,743,500 ac)	27,565	26,410	**53,975**	4,300	6,600	**7,750**	34,330

* Assumption is made that existing and projected OGM development on other lands is evenly proportionate to that on ANF lands. This is based on the roughly proportionate level of known oil fields displayed in Figure F-2.

Factors used to calculate estimates on all lands from existing data on NFS lands:

- Existing wells equals 1 well per 63.25 acres
- Existing OGM roads equals 0.156 miles of road per well
- Additional wells equals 1.01 per 1,000 acres annually for 15 years
- Additional OGM roads equals 0.25 miles of road per well
- Additional acres of clearing equals 1.3 acres per well
- Total wells equals Existing plus Additional
- Total roads equals Existing plus Additional
- Plugging of abandoned wells would not reduce projected future active wells