Oil or Animals:

An Analysis of a prospective oil pipeline project in the Arctic National Wildlife Refuge, Alaska

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1.011 Project Evaluation

Background Information

There are huge oil reserves in the Arctic National Wildlife Refuge in northeastern Alaska that are largely unexplored because the area is a federal wildlife refuge and the law prohibits its development. The Arctic National Wildlife Refuge (ANWR) was created in 1960 to be 8.9 million acres. The 800 mile Trans-Alaska Pipeline System (TAPS) was constructed in 1977 to bring oil from the Prudhoe Bay area of the North Shore to the southern Port of Valdez. In 1980 the Alaska National Interest Lands Conservation Act (ANILCA) was passed by Congress, expanding the refuge to 19.8 million acres. Section 1002 of ANILCA gave Congress the right to permit further oil and gas exploration, development, and production within the 1.5 million acre costal plain area of ANWR, known since as the 1002 area. In 1985 permission was given for an exploratory well to be drilled, and the results were kept confidential. Since then only explorations that don't physically alter the area have been allowed, leading to inaccurate and incomplete data about the size and location of oil reserves in the area. In 1987 a Final Environmental Impact Statement was submitted to Congress detailing the effects development would have on the 1002 Area. The details of this report were determined by careful study of the wildlife and environment in the area, and also by studying the environmental impact the trans-Alaska pipeline has had in a similar area. By early 1989 Congress was leaning toward ANWR development. However, on March 24, 1989, 11 million barrels of oil spilled in the Prince William Sound, causing an enormous and lasting environmental disaster. As a result, Congress did not pass legislation to allow drilling in ANWR. It has been a heavily debated issue since and has been brought to the floor in both Houses several times. In 1995 legislation was passed by both houses of Congress but vetoed by

President Clinton. No bill allowing for the development of ANWR has passed through both houses since. Most recently this Spring 2003 the House approved the drilling but it was voted down by the Senate. From the looks of things there is no way the current Senate is going to approve this. Generally, Republicans are in favor of allowing exploration and development and Democrats are against it. As always, though, there are exceptions and people whose views and votes don't align with that generalization. In any event drilling in ANWR is currently not allowed by federal law, specific legislation would need to be passed in order for it to be permitted, and with the current Senate it doesn't look like that is going to happen.

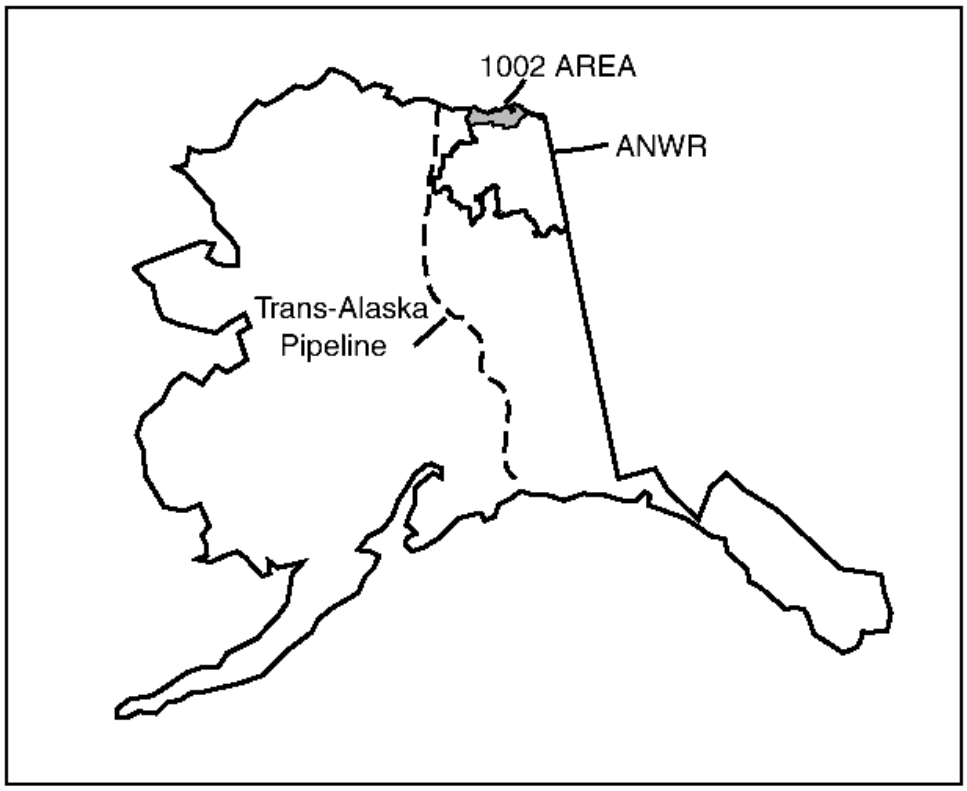


Figure 1A. Location map of the Federal 1002 Area in relation to the entire Artic National Wildlife Refuge and Alaska's North Slope.

Project Proposal

The project I am evaluating is the construction of an oil pipeline to transport oil from the oil fields in ANWR and bring it to the world market. In this section I will go through the logistics of the project and the qualitative issues, benefits, and problems that arise in its construction.

As I described, this project is not currently possible because it is illegal to drill for oil in ANWR. So, for my project and case study I am supposing that in the 2004 elections a few more Senators in favor of drilling (most likely Republicans) take office. President Bush will be reelected, or whoever replaces him will support this project. Very soon after the start of the new term legislation will be passed and signed into law allowing for oil exploration and drilling in ANWR, which will start on April 1, 2005 (the base year for my cost/benefit analysis).

My proposed project is to build oil wells in the coastal plain area of ANWR and construct a 100 mile oil pipeline connecting the 1002 Area of the Arctic National Wildlife Refuge to the Trans-Alaska Pipeline at its northernmost pump station. The oil would feed from my pipeline into the Trans-Alaska Pipeline and become part of the oil supply from Prudhoe Bay heading south to Valdez to be shipped out and sold. This diagram shows the route my proposed pipeline would follow.

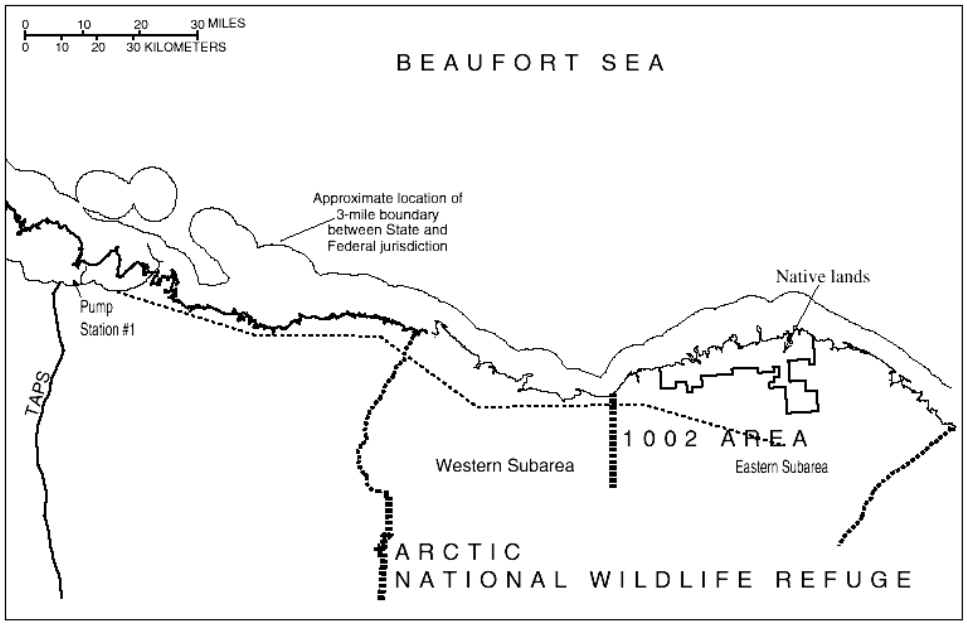
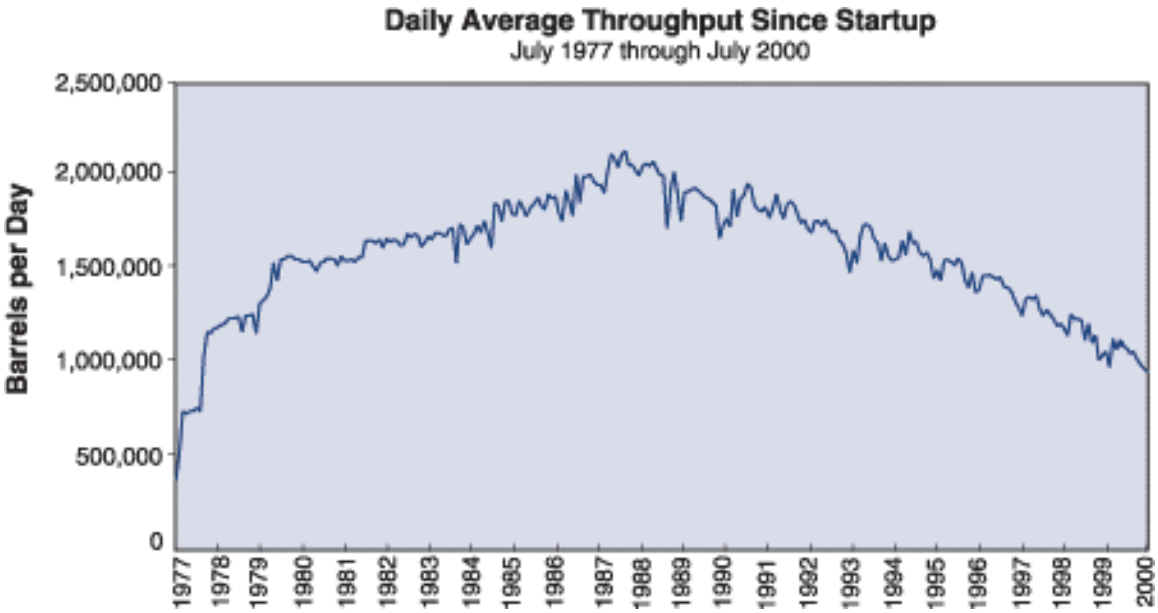


Figure 2. Map shows partition of the 1002 Area into east and west subareas and assumed pipeline (dashed east-west line) to Pump Station # 1 of the Trans-Alaska pipeline (TAPS).

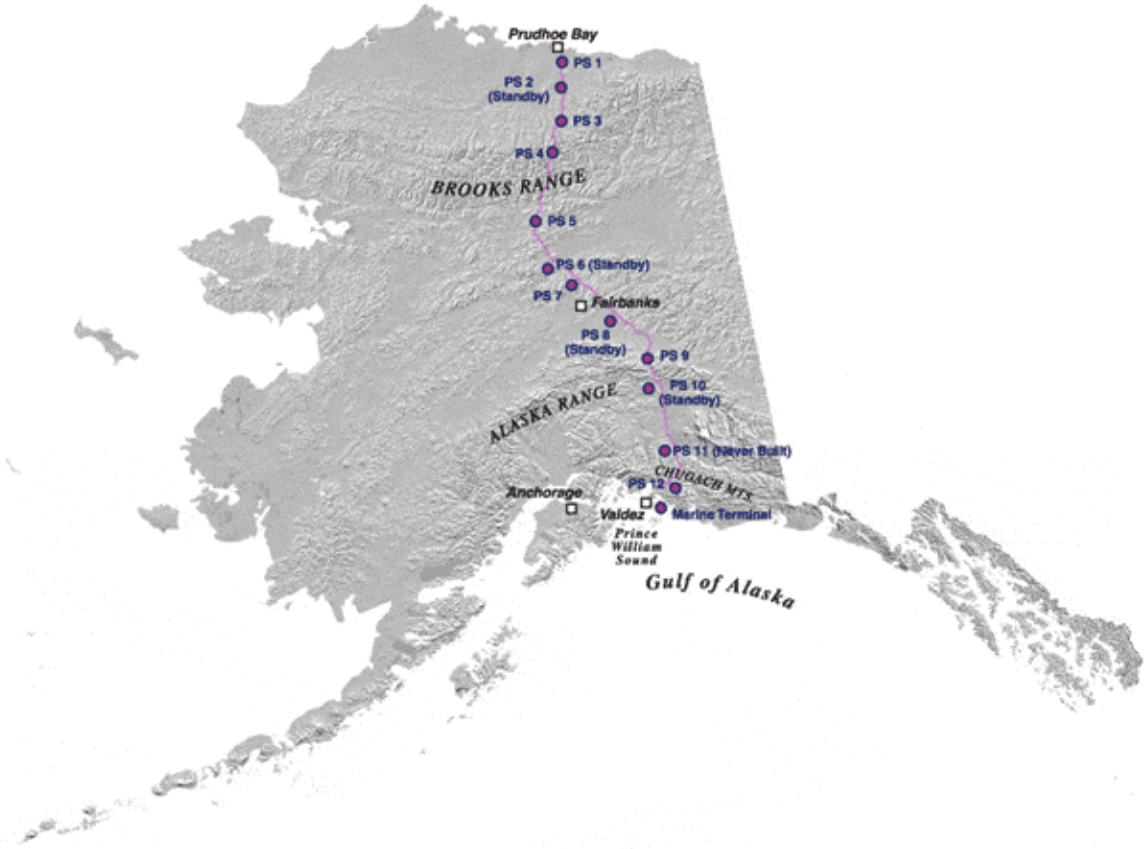
When the trans-Alaska pipeline was constructed, its 48'' diameter and $8 billion cost translated into a capacity of about 1.7 million barrels per day. Currently, its maximum capacity is about 2.1 million barrels per day. This is due to the advent of a substance called the Drag Reducing Agent (DRA). It is a long chain hydrocarbon polymer that is mixed into the oil and acts to reduce friction with the pipe so the oil can travel faster through the system and allow for higher capacity.

Currently, due to the gradual depletion of the oil fields in Prudhoe Bay, the daily throughput of the trans-Alaska pipeline is about 1 million barrels. At its peak production in the late 1980s, over 2 million barrels of oil were extracted from Prudhoe Bay and transported through the pipeline system each day. The steadily declining output leaves a lot of excess capacity for the pipeline. This graph shows the actual data to illustrate this point. Clearly there is enough excess capacity for the oil from ANWR to take advantage of. The ability to use this and get transportation of the oil all the way to the port for almost no cost not only increases the efficiency of the current pipeline, but also reduces the cost of this project tremendously and gives it a much better chance for profitability.



When the trans-Alaska pipeline was built, there were 12 planned pump stations. They are spaced every 50-100 miles along the pipeline route and they serve to push the oil through the pipeline faster and increase the throughput. However, station 11 was never built, and station 5 is for pressure relief only. Of the 10 remaining stations, three

were closed in 1996 and 1997 in response to the decrease in oil flow through the pipeline. They were no longer needed and operating cost of the pipeline was reduced by halting their operation. Without these three stations online the maximum capacity is decreased to 1.7 from 2.1 million barrels per day, so included in this project is the reopening of these stations. Following is a map of all the pump station locations.



Issues and Problems

The actual construction of the pipeline raises some environmental issues. The costs and conditions for construction are very similar to those faced in the construction of the trans-Alaska pipeline, as the landscape is very similar. The biggest issue is the wildlife in the area. The oil found in the coastal plain is not concentrated in one large oil field. It is found in slightly smaller deposits and is more spread out, which requires more drilling sites. A system of roads and oil pipelines is necessary to connect all of the sources into the main pipeline heading west to the trans-Alaska pipeline. A lot of construction vehicles and sites will be needed to accomplish this, which will unavoidably affect the environment. Noise, vibrations, and other disturbances threaten the populations of caribou, muskoxen, polar bears, birds, and other species. The animals would be displaced, possibly away from their natural habitats and food sources, decreasing their birthrate and population. One of the steps that would have to be taken to minimize the harmful effects of this project would be to do construction only during the winter when many animals including the caribou, the most threatened species, are not present in the area. However, this is still a risk to wildlife as some animals such as including muskoxen, polar bears, wolverine, arctic fox, and arctic graying, remain in the area during the winter. Also, winter exploration and construction can also impact vegetation (for example, by altering natural drainage paths), also possibly affecting animals secondhand. The introduction of garbage as an inconsistent food source can increase predation. Contamination of water and soil in the area can have negative effects on all forms of life. Undertaking a major construction project in the winter in Alaska is not an easy task, and the cost is very high. Machinery has to be kept running 24 hours a day in order for it to

stay operational. If construction is to be stopped for the summer everything has to be removed and brought back in as this will undoubtedly take more than one winter to finish.

One more construction concern is the lack of water in the area. And estimated 8-15 million gallons of water is needed to drill, develop, and contrast ice roads. In the winter only 9 million gallons of liquid water may be available in the entire 1002 area, which is enough for only 10 miles of ice roads. This problem can be solved by building gravel roads instead, but gravel generates dust and would impact a larger area around the immediate boundaries of the road than ice roads do, killing off vegetation.

However, the effect the pipeline will have on wildlife is the most controversial issue pertaining to this project. Not only are there concerns about how the construction will affect the area but also how the pipeline system will natural habitat. These two issues are the reason why this project has not yet been implemented. After construction is completed, there will be drilling sites and a pipeline added to the landscape of the area. The 1987 Final Environmental Impact Statement submitted to Congress assed that this project would result in "widespread, long-term change in habitat availability or quality which would likely modify natural abundance or distribution of species." Predicted impacts on the Caribou include reduced forage, exposure to higher predation, and the altering of ancient migratory patterns. In order to minimize these things, the current trans-Alaska pipeline has 579 animal crossings in its 800 mile length. The underground portions have been insulated to stop the heat from the pipeline from destroying the permafrost. Similar measures would be taken in construction of the new pipeline. Pictures of the trans-Alaska pipeline illustrate the controversy over the effect the pipeline will have on the wildlife. On one hand these photos show how unnatural and seemingly harmful a man made pipeline is to these animals. On the other hand is the argument that the wildlife coexists with the pipeline and there is nothing wrong or harmful about it.

The drilling sites and systems connecting them are the other lasting physical impact this project will have on the landscape. This is a big issue because as I described before, the oil in ANWR is not concentrated in large reserves. Fortunately, technology now allows drilling in up to a seven mile radius from the wellhead. Even so, it is estimated that about 35 oil wells will be needed in the area. And they will need to be connected by a system of roads and pipelines. There is no clear consensus on how much physical area will be affected by this. Estimates range from 2,000 acres (which is about .13% of the 1002 area) to 11% of the area, which amounts to 165,000 acres. In any event, the size of the footprints of the drilling sites has a large impact on this number. Technology has made this drill site smaller and more

environmentally friendly. When the Prudhoe Bay oil fields were first tapped in the late 1970's, the drill sites required were very large compared to what they are now. This is just one example where technology allows us to minimize the harmful effects of a project like this.

Benefits

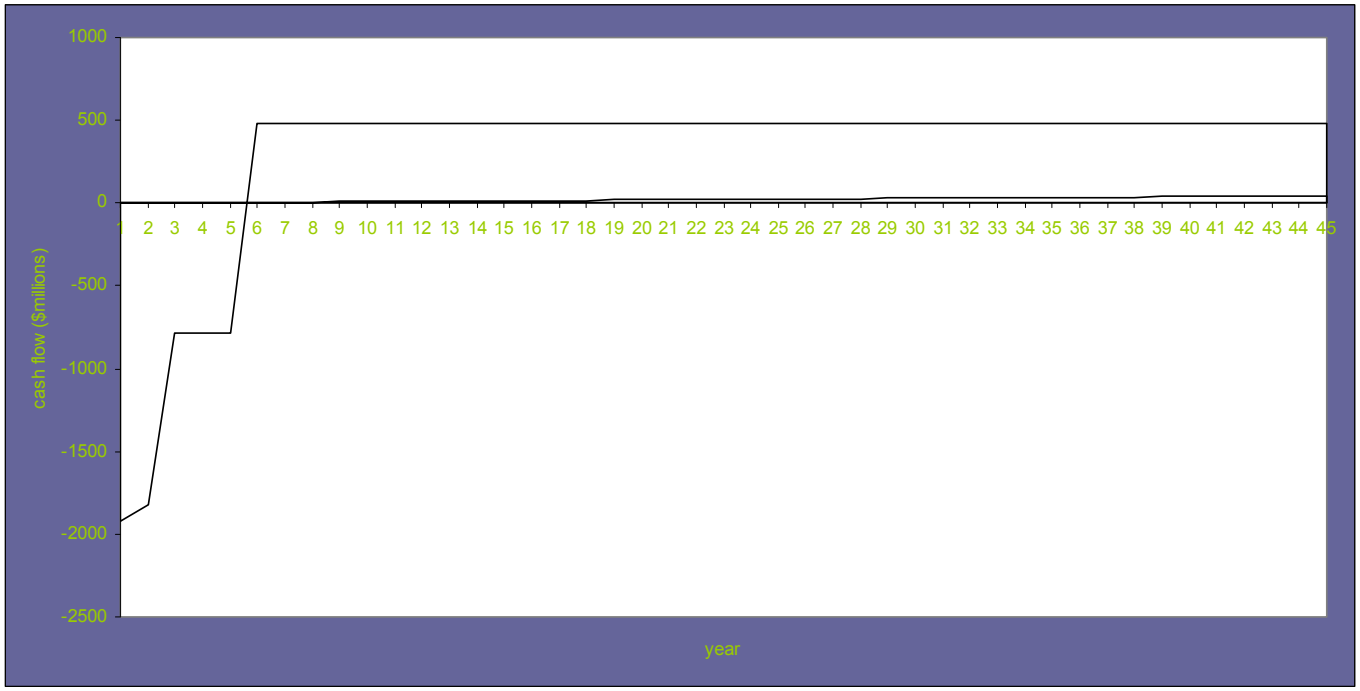
In addition to its financial prospects that I will describe later, there are many benefits to implementing this project. The first is for increased national security. Americans use 19 million barrels of oil per day, which amounts to 7 billion barrels per year. This demand has been steadily increasing over time while domestic oil production has been decreasing. Imported oil accounts for over 50% of the U.S. trade deficit. With

the current global political situation, especially the instability in some oil exporting countries, decreased demand for foreign oil is desirable. President Bush has urged Congress to pass a bill that "encourages an increase of supply here at home so we're less dependent on foreign sources of crude oil." The project will also create revenues to the State and Federal Treasury that number in the billions from bonus bids, lease rentals, royalties, and taxes. These things would not only be good for the U.S. economy, but would also take some pressure off of international relations with oil exporting countries.

Is it estimated that this project would create 736,000 domestic jobs in all 50 states, which is desirable as our economy is faltering and unemployment is high. In Alaska, current employment reduction due to the economic situation and also the declining oil industry there are having severe negative effects on industry investment and the area's economy (which is largely based around oil production). For this reason over 75% of the local people greatly support legislation that will allow drilling in ANWR, including the Inupiat Eskimos who live near ANWR's coastal plain. In fact, the Legislature of Alaska passed a resolution that was sent to the 106th Congress and to the President stating that "the Alaska State Legislature is adamantly opposed to further wilderness or other restrictive designation in the area of the coastal plain of the Arctic National Wildlife Refuge, Alaska," and "urging the United States Congress to pass legislation to open the coastal plain of the Arctic National Wildlife Refuge, Alaska, to oil and gas exploration, development, and production." Oil production leads to huge benefits in the area that the people want to see more of it.

Cost/Benefit Analysis

My numerical evaluation of this project is based almost completely on estimates. Since this project has never been formally proposed, no formal costs and revenue estimates have been made. However, I collected data from estimates that have been made pertaining to ANWR, and also numbers from the trans-Alaska pipeline. I used a mean of 10 billion barrels of oil to be found recoverable in ANWR over a period of 40 years by 35 drill sites. The net present value I computed for this is around $9 billion. Below is a cash flow diagram that corresponds to the values on my spreadsheet, which is included in the following pages.

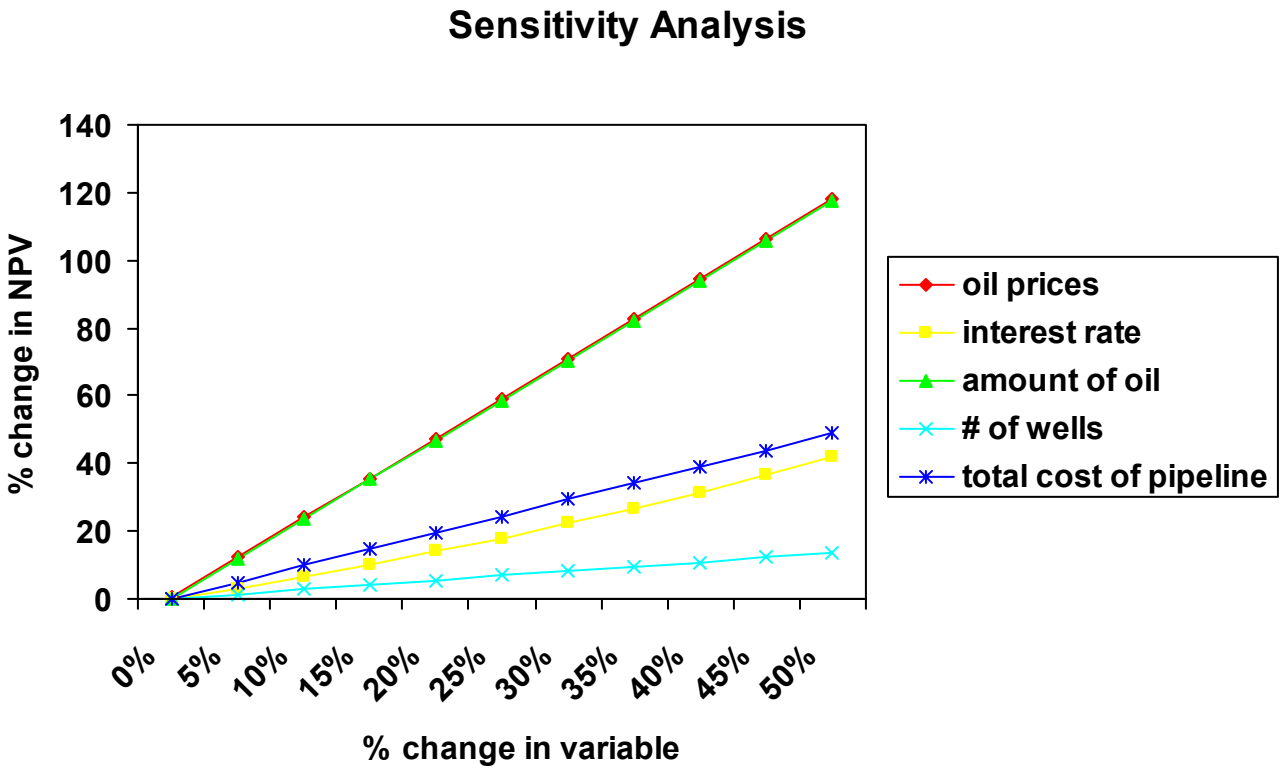


Sensitivity Analysis

This project has numerous risks and uncertainties associated with it. As most of the figures are estimates, in doing my sensitivity analysis I noticed that the net present value of this project is fairly unstable. It fluctuates a lot with small changes in some of the major variables. This is partially due to the fact that the planning of this project is still in its very early stages and these variables have not been fully evaluated, so the margin for error in my calculations is very high. The amount of oil that will be found and extracted is unknown, as is the number of oil wells that will be need, and the interest rate that can be obtained on a loan to fund the construction. It is also due to the nature of this project and the uncertainty of external variables such as world oil prices.

The biggest uncertainty in this project is the amount of recoverable oil that exists in ANWR. Aside from one small exploratory well, no drilling has been done to determine the amount of oil in the ground. Other forms of analysis are purely estimation and there is no accurate way of knowing how much oil is there until the further exploration is done, and possibly until the drilling begins. There is a very small marginal cost associated with extracting more oil and pumping it through the pipeline system once the wells and pipelines are in place. So any additional revenue gained from increased output translates directly into profits. Current estimates for the amount of recoverable oil in ANWR range from 5.7 billion barrels to 16 billion barrels, and possibly more. As you can see this is a huge range, and produces a very wide range of expected revenues in the cost/benefit analysis. As you can see in the graph below, the net present value of the project is very sensitive to the amount of oil extracted from the reserve. It is probably a good idea, therefore, the do some more evaluating of the area before this project is begun, in order to

obtain more accurate figures and be able to get a better idea of the expected revenues for the project.



This diagram illustrates the percentage change in the net present value (NPV) of the project due to a percentage change in one of the input variables. As you can see, the net present value is the most sensitive the changes in the selling price of oil or the amount of oil sold. The total cost of the pipeline and the interest rate on the loan have a fairly large effect on NPV, while the number of wells drilled makes slightly less of a difference.

World oil prices are an external factor determined by the world oil market, completely out of the control of the investors in this project. World oil prices are determined by international and domestic supply and demand for oil. World demand for oil has been steadily increasing over time due to increases in technology and world

population. Supply of oil is very much determined politically, and due to the fairly unstable political situation in many oil producing countries, large fluctuations are very possible. Iraq, Saudi Arabia, Mexico, and Venezula are among those countries with a high propensity for changing the amount of oil they export. Currently world oil supply is restricted by many of these countries in order to keep prices up. It is possible for at least one of these countries to increase supply at any time, and others might follow, changing the dynamics of the market and potentially driving down prices. The other extreme would be a rise in world oil prices due to further restricted supply. This could be caused by war, as we saw a short time ago. I think there is a cap on world oil prices toward this extreme, however, due to the opportunity cost of oil use. At some point, if oil prices rise high enough, we will spend more money to look for alternate ways to get oil, alternative fuels, and might even turn to government mandated consumption. As shown in the graph above, these factors are crucial to the profitability of this project, making it a fairly risky venture. The international political situation is never perfectly stable, but is especially unstable currently in the Middle East. By April of 2005 things may be different, but if they are not it may be a good strategy to wait a little while and see what the forecast for oil supply and prices looks like once things are closer to being resolved in the Middle East. However this may be useless as predictions for prices may not change and the project should move forward, taking this as a risk of the investment. It is also important to keep in mind that world oil prices will not be constant over the entire 40 year lifetime of this project. They will fluctuate throughout that time, and the number I used is just a projected average. Ups and downs in prices that last short periods of time will even out, and the uncertainty lies in a steady and lasting increase or decrease.

The total cost of the pipeline is also unknown, as is the number of wells needed to extract the oil. I think both of these will be determined more accurately when a formal survey of the area is done after it is approved by Congress. The interest rate that can be obtained for the project will be known prior to its implementation. The loan is among the first things that need to be obtained for construction to being so the uncertainty of this will be eliminated. This is true unless, of course, the interest rate on the loan is dependent on federal interest rates, in which case it may change throughout the life of the project and be an additional cost uncertainty. If it is not, and interest rates fall during the life of the project, the loan can be refinanced at the lower rate and costs will decrease.

I also looked at special scenarios for the project that would affect the costs or benefits. One thing I look at was the effects of damage to the pipeline. If the pipeline is blown up at any point during the project, I estimate that it will have to be replaced for a cost of around $1 billion (in 2005 dollars) over a couple years of construction to rebuild it, and the revenue would go to zero for those years because no oil could be sold. No matter when this happens, the project will still be profitable. In fact, if it happens twice and or three times, depending when they are, the project still has a large positive net present value.

I realize that the sensitivity analysis I did above is pretty unrealistic, as I isolated one variable and neglected to acknowledge that changing one variable will change others as a result. In reality, all of the variables are dependent on each other. For example, if more oil was found in the refuge than I estimated, it would have effects on things other than revenues. The cost per well to drill would probably increase. Operating costs would rise, as would maintenance costs. The increase in oil supply might cause a decrease in

prices. This works with every variable that I analyzed. However, it is still very true that there are a few variables who value can have a large impact on the profitability of this project. This makes it a fairly risky project because these variables have large uncertainties.

Conclusion and Recommendations

This project has very good prospects for being very financially profitable. In order to ensure this, further exploration and analysis should be done before a final version of the project is proposed and implemented. Due to the nature of this project, cost/benefit analysis is not the only thing to be considered. There are several other factors that need to be considered that have at least as big of an impact on deciding whether or not to implement this project. National security and the desire to reduce dependence on foreign oil, as well as the stability of the world oil supply situation are high on the list. The environmental impact of this project is the mostly hotly debated issue. There is a lot of concern for the well being of the wildlife in the area, which is countered by a desire to reap all the benefits associated with the project. Possibly the best solution, at least in my mind, is phrased best by the Alaskans, that "by doing development right, we can have good jobs and a growing economy while protecting our environment. Development and environmental protection don't conflict. In fact, they depend on each other."

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5%				NET PRESENT VALUE OF PROJECT			$9355051604		
15%						approximately	$9	billion	
$200000	# of wells in ANWR	35		price per barrell		$2.30			
100	cost/well to explore	22000000		average # of barrells per day		600,000			
	cost/well build & dri	8000000		average # of barrels per year		219,000,000			
$4000000000									
construction	cost of oil wells	other	operating	average repairs and			year's net	total loan	
cost		starting costs	cost	maintenance	revenue		expenditures	amount	interest
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