Where is the report to the CEO?

SLCC - Math 1210 Pipeline Project Spring 2014 25+/30

The U.S. Interior Secretary recently approved drilling of natural gas wells near Vernal, Utah. Your company has begun drilling and established a high-producing well on BLM ground. They now need to build a pipeline to get the natural gas to their refinery. While running the line directly to the refinery will be the shortest distance and least amount of pipe, it would require running the line across private ground and paying a right-of-way fee. There is a mountain directly east of the well that must be drilled through if the company wants to run the pipeline due east around the private ground. Your company can also build the pipeline around the private ground by going 4 mile directly west and then 12 miles south and finally 36 miles east to the refinery (see figure below).

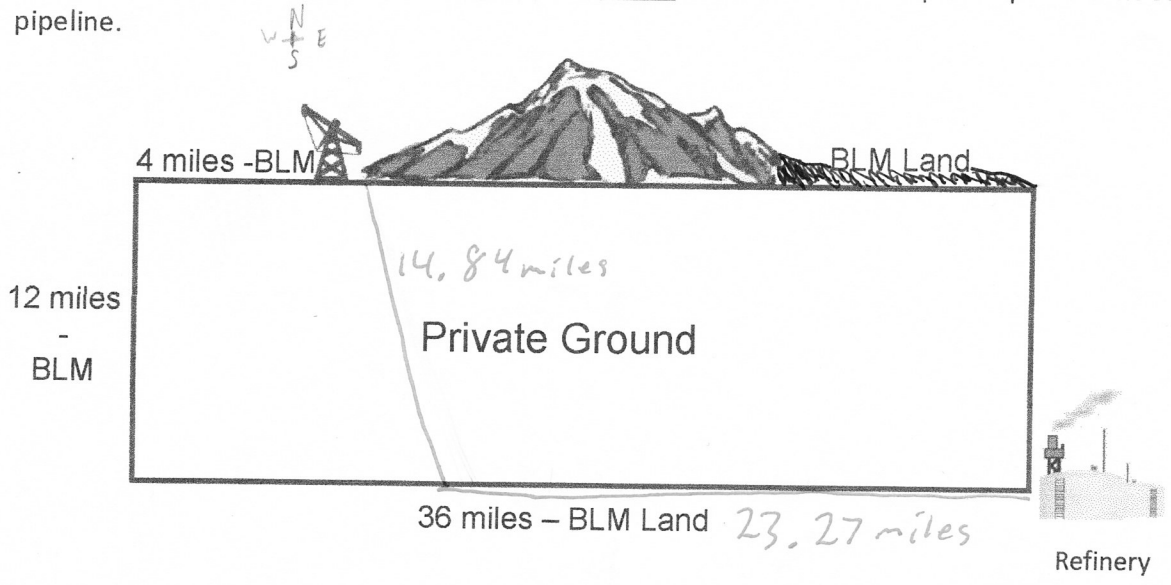
The cost for materials, labor and fees to run the pipeline across BLM ground is $500,000 per mile. For any pipeline run across private ground, your company incurs an additional $350,000 per mile cost for right-of-way fees. Cost of drilling through the mountain would add a flat fee of $2,000,000 to the normal costs of the pipeline itself. Also, the BLM will require an environmental impact study before allowing you to drill through the mountain. Cost for the study is estimated to be $320,000 and will delay the project by 4 months costing the company another $120,000 per month. Your company has asked you to do the following:

a) Determine the cost of running the pipeline strictly on BLM ground in two different cases:
   1- running west, then south, then east to the refinery.
   2- heading east through the mountain and then south to the refinery.

b) Determine the cost of running the pipeline across private ground:
   1- using the shortest distance between the well and refinery.
   2- using the shortest distance across the private ground (directly south) then east to the refinery.

c) Find a cost function for a pipeline that crosses the private ground and enters BLM land along the southern border of the private land and then runs the remaining distance east to the refinery.

d) Determine the optimal place to run the pipeline to minimize cost. Clearly show all work including drawing the pipeline on the figure below. Your bosses are engineers who know calculus too, so make it very clear how you use your knowledge of calculus to determine the optimal placement of the pipeline.



Continued on other side.

Write a well-written report of your findings to submit to your company's CEO. This report should include all steps for any math used to make determinations asked for above as well as statements as to the costs to be incurred by each scenario. Include any appropriate figures to make each scenario clear. This written report should be typed and submitted as part of your project.

Write a reflection in which you describe the things you have learned in your calculus class and how they may apply to the real world. Do you see calculus as a useful tool? What kinds of things have you learned that can be useful in your areas of interest? Please be specific and give some examples to back up your statements. This written reflection should be posted on your e-Portfolio page as an introduction to what you learned during this project. The project should then be uploaded as an example of your best work. **You will not receive a grade for the assignment unless it is uploaded to your e-Portfolio.**

a) 1- $26,000,000

$(4+12+36)(\$500,000)$

$52(500,000)$

2- $24,800,000

$(12+(36-4))(500,000)+2,000,000+320,000+(4\times 120,000)$

$44(500,000)+2,320,000+480,000$

$22,000,000+2,800,000$

b) 1- $29,049,612.73

$x=\sqrt{32^2+12^2}$

$x=4\sqrt{73}$

$(500,000+350,000)(4\sqrt{73})$

$850,000(4\sqrt{73})$

$29,049,612.73$

2- $26,200,000

$12(350,000+500,000)+(36-4)(500,000)$

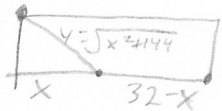
$12(850,000)+32(500,000)$

$10,200,000+16,000,000$

c) $C(x)=850,000\sqrt{x^2+144}+16,000,000-500,000x$

$C(x)=(350,000+500,000)(\sqrt{x^2+144})+500,000(32-x)$

well



Refinery

$x^2+12^2=y^2$ $\quad y=\sqrt{x^2+144}$

d) $\boxed{C(x_5)=\$24,248,636.25}$

$C'(x)=850,000\left(\frac{1}{2\sqrt{x^2+144}}\right)(2x)-500,000$

$C'(x)=\frac{850,000x}{\sqrt{x^2+144}}-500,000$

$0=\frac{850,000x}{\sqrt{x^2+144}}-500,000$

Very unique method!

Newtons Method:

$x_{n+1}=x_n-\frac{C(x_n)}{C''(x_n)}$

$C''(x)=850000x\left(\frac{-x}{(x^2+144)^{3/2}}\right)+\frac{850000}{\sqrt{x^2+144}}$

$x_1=10$

$x_2=10-\frac{C'(10)}{C''(10)}$ $\quad x_2=8.625$

$x_3=8.728$ $\quad x_4=8.728715$

$x_5=8.728715609$