SUPPLEMENT TO
PRELIMINARY ENGINEERING REPORT

RESPONSES TO QUESTIONS FROM
THE BEAVER LAKE ASSOCIATION BOARD

January 2, 2007

By Snyder & Associates

QUESTIONS FROM BLA BOARD
Received December 19, 2006

The questions are presented as received. Snyder & Associates responses to the questions are in *bold italics*.

Location:

- What method and how did you determine that 2000 gallons per minutes (gpm) were needed.
  ***Response*: The flow rate was provided by the BLA.**

- Was normal yearly precipitation included in this calculation?
  ***Response*: It would not be expected that normal precipitation would be used in determining the flow rate needed to maintain the lake level during times of drought. What should be looked at is what would be required to maintain the lake at the desired level during drought periods.**

- You indicated in your report that other areas was excluded by location of private wells within 1,000 feet.
  - Using figure 1.1.1, could you point out the existing wells that are in that location?
    ***Response*: The wells are private wells used for residents along the county road. Residences can be seen on the USGS map included in the Attachment B, Phase 1 Environmental Assessment.**

  - The Wells that are within the 1000 feet mark.
    - Where you able to determine if any of those wells were abandon and available for re-opening?
      ***Response*: Making this determination was not in the scope of work for the report. Most or all of these existing wells are would have a very low capacity because they are for private residences.**

    - Where any of the wells presently being used? Could BL purchase those well.
      ***Response*: Making this determination was not in the scope of work for the report. It appears that all of the homes along the county road are occupied, therefore it is safe to assume that most or all of the private wells are currently being used.**

  - Where you able to determine if a well on the south side of the lake in the wetland area is possible. And if you didn't, is it possible to drill a well south of the lake.
    ***Response*: Layne-Western, which is a firm that specializes in hydro-geological studies and drilling of wells was asked to recommend possible locations where wells with high yield and good water quality would most likely be found. In addition, Layne-Western has a good deal of experience drilling test wells and production wells in the area around Beaver Lake. Based on the information available and Layne's experience in the Beaver Lake area, the area south of the lake was not**

recommended as a possible location for a well to meet the needs of Beaver Lake.

- Why did you select Layne-Western as the Well Driller? Is it because they are very familiar with the area and might know the best location for the well.
  Response: Layne-Western has not been selected as the well driller. Layne-Western was selected by Snyder & Associates to perform a study on possible locations for a well that would meet the criteria set by the BLA for yield and water quality. Snyder & Associates assumes that the BLA will put the well out for bid just as the transmission main will be put out for bid.

- In Layne-Western report they indicated that there is an alternative location for the well. Layne-Western said the cost would be less to the association, because of the length of the pip.
  - You have no mention of it in your report about this alternative well. Why was the alternative location omitted from your report?
    Response: The area was not omitted from the report. The report indicated that this was not a good alternative for BLA. Figure 1.1.1 (page 4 of 18) of the main body of the report shows the entire area delineated by Layne-Western in Attachment A of the report. The dark line around the outer boundary encompasses the study area recommended by Layne-Western. The cross-hatched area is the area where a well for BLA could not be located due to the 1,000-foot limit (distance that must be maintained between a public water supply well and any other wells) under the State of Nebraska regulations. The eastern portion of the study area is very small and is nearly the furthest point from the river and according to Layne, thus not nearly as likely to provide a high yield well. In summary, there are two reasons the area closest to the lake was not recommended as a possible well location: 1) Layne indicated that the best location for a high yield well is closest to the river; and 2) since the useable area closest to the lake was so small in size, there would never be an opportunity for drilling another well in the future, should an additional well be needed. Any future well would need to be near the river in the southern portion of the study and the pipeline would have to be extended to reach the future well.

  - When I review the Registered Groundwater Wells Data Retrieval, the size of the pump and the pump col dia is fare smaller then what we will use, is that the reason why the number of gpm is lower?
    Response: Yes, the wells are for serving a private residence. The required capacity is small (usually 5 to 10 GPM), therefore the

physical dimensions of the well are small compared to a well capable of delivering 2,000 GPM..

- I don't see any wells located in Section 17 which is east of the dam. Can a well be located in Section 17? And is that the section where Layne-Western selected for the alternative well location. Section 17 according to the Topographical has an abundant of water just below the surface and the map shows the ground is very similar to that by the river and the elevation is lower then that at the river.
  Response: Part of the Layne study area is in Section 17 and the reason it was not recommended for further consideration is discussed in a previous response.

- In the contract with your firm, you agreed to drill a test well. Have you drilled that test well?
  Response: A second test well has not been drilled. Approximately $1,900 dollars has been set aside in the study for this purpose. If this money is not used it will be turned back to BLA, or can be credited to design of the transmission main.

- Why wouldn't the pipe line head striate East and only cross Toman and Gregg's land, instead of heading North then heading back East so that it will cross Smiths land. Moving the pipe so it doesn't cross Smiths land could save us from negotiating with smith as well as 200 to 300 feet of pipe cost.
  Response: The proposed transmission main route takes the direction shown to avoid a bluff. The transmission main route shown is the easiest path for construction, and expected to be the most economical route.

Quality of water:

- Your report talks about there are three minerals that are of concern (arsenic, iron and manganese). You also said that as long as appropriate measures are taken, which, one of those measures is monitoring the arsenic levels in the lake *First Page*. On Page 10 you said 'If the concentration of the arsenic in the blend of well and lake water were to build up to near the 10 MCL (blended according to the table 1.3.1 is 8 MCL), use of the well would need to be ***curtailed*** until the concentration in the lake water returned lower levels'.
  - Question:
    - What state does Arsenic reside in? Does it float or will it silt to the bottom of the lake?
      Response: Arsenic is a metalloid (element that has metal and nonmetal properties) widely distributed in the earth's crust and present at an average concentration of 2 milligrams per kilogram

(mg/kg). It occurs in trace quantities in all rock, soil, water and air. Arsenic is widely distributed in surface freshwaters, and concentrations in rivers and lakes are generally below 10 µg/L, although individual samples may range up to 5,000 µg/L anthropogenic (caused by humans) sources such as mining and agriculture. Arsenic concentrations in groundwater average about 1 to 2 µg/L except in areas with volcanic rock and sulfide minerals. Arsenic in groundwater tends to be predominantly as arsenate (As^{+5}) and to a lesser extent arsenite (As^{+3}). Methylated arsenic (organic arsenic) can also be found in water. All three versions can be found in the water and in sediment. Arsenate is approximately 100 times less toxic than arsenite. [1, 2] ***Organic arsenic is thought to have a much lower toxicity than arsenate. Pre-oxidation, as called for the removal of iron and manganese in the well water, will tend to convert arsenite to arsenate.***

- No where in the report does it say if the WTP can reduce the MCL of Arsenic. Is that true?
  Response: The BLA Water Treatment Plant (WTP) is a conventional filter plant and can remove arsenic. Currently, the concentration of arsenic in the untreated lake water is 5 micrograms per liter (µg/L). The finished water (drinking water) leaving the WTP is below the analytical detection limit for arsenic indicating that most or all of the arsenic currently in the lake water is removed from the drinking water. What remains uncertain at this time is the concentration of arsenic that can be removed by the WTP.

- In your study you determined what the arsenic concentration level will be at 8 months of continues pumping but, what I don't see is, what will the concentration level be at the different times of continues pumping, (10 months, 12 months, 2 years). Do you know what the concentration level will be at these different times?
  Response: The assumption was that the longest continuous period the well would operate during a given year would be eight months, from March to November. At the end of this period, the level of the lake would be maintained within 10 inches of the spillway, assuming that the well has enough capacity to maintain the lake level, even during periods of extreme drought (that is no precipitation occurring during the eight month period. The well could be shut down for at least four months Losses from the lake during the winter months would be minimal due to extremely low evaporation rate to no evaporation during wintertime. If the well were used at all, it could be used to supply the WTP with raw water rather than taking the raw water from the lake, further minimizing water losses from the lake. The key

to keeping from operating the well year-round to maintain the lake level is to ensure that the capacity of the well is large enough to keep up with lake losses even during extreme drought periods.

- If the lake had a buildup of Arsenic, have you determined how long it will take and what method will be used to return the lake back to lower Arsenic level.
  Response: Normal inflow from springs, creeks and groundwater seepage will dilute the well water in the lake. The return of precipitation will cause the rapid dilution of the well water in the lake. To make a prediction of how long it will take is impossible without knowing what conditions will actually occur. To assume that the lake will become composed of all well water assumes that there is no groundwater entering the lake and there is no runoff from precipitation. This will not happen. Even after an extended drought period, the lake has shown that it will return to its normal condition within six months to one year.

  - Does it make a difference if the water is going over the dam or if not?
    Response: If water is going over the spillway, it is assumed that the well would be taken out of service. Assuming that the inflow maintained the level such that the lake would continue to overflow the spillway, dilution of the well water would only take a few months. If the level was just maintained near the spillway, it could take four to six months.

  - What will BL need to do, to return the lake back to lower levels of Arsenic?
    Response: See response above.

- Will we need to modify the WTP to remove any of the three minerals? And if so what will the cost be to BL.
  Response: No modification to the WTP is anticipated at the concentrations of arsenic, iron and manganese found in test well. The WTP is currently set up to remove iron and manganese found in the lake water during the summer (particularly manganese which is more difficult to remove than iron). These processes have also shown that arsenic is also removed by the WTP. The amount of arsenic found in the test well is 15 µg/L. Given the current results on arsenic removal by the plant, it is anticipated that the WTP treating only water from the test well, can remove arsenic down to levels well below the maximum contaminant level (MCL) of 10 µg/L.

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- In your report you recommend that pre-oxidation, aeration and detention tank be used prior to introduction into the lake.
    - What are the dimensions of the Cascade Aeration? Does the Association own enough land to support those dimensions?
      ***Response**: The transmission will be brought on to a lot that is owned by the BLA. Actual dimensions won't be available until the units are designed. However, the cascade unit will require less than 400 square feet (SF) and the detention tank will be approximately 1,500 SF and 7 feet deep (including side water depth and free board). The lot is more than adequate for these units.*

    - In your report you talk about a holding basin that will hold 60,000 gallons of well water. How large is that and what are the dimensions?
      ***Response**: See response above.*

    - You also say the well water must be held in the basin for 30 minutes. How will the association be sure when we are running the pumps continues that the well water is being held for that amount of time? Will that be part of the daily monitoring process?
      ***Response**: The assumed maximum flow rate of the well pump is 2,000 GPM. A detention time of 30 minutes at a flow rate of 2,000 GPM requires a tank of at least 60,000 gallons. The tank will be design to keep the flow through the tank in a serpentine pattern to prevent "short-circuiting" of the water. This is a design parameter. It does not require any monitoring with regard to detention time since the maximum flow rate has been taken into account.*

    - Would the holding basin be open air tank? And if so will there be a smell or and odor coming from that area.
      ***Response**: It is anticipated that the tank would be open. Given the quality of water from the test well, no noticeable odors are expected.*

    - Will there be a constant smell from the Cascade Aeration, a smell of rotten eggs.
      ***Response**: "Rotten egg" smell is associated with the presence of hydrogen sulfide in the water. There is no hydrogen sulfide present in test well water. No rotten egg smell is expected.*

- In your table 1.3.1 you list the water quality data samples as well as the calculated water quality for a blend of well and lake water after continuous pumping for up to **eight months** from the well into the lake.
    - I believe BL intentions are to use this well on an ongoing bases if needed for several months at a time, each year.
        - So in that case will there be a time when the concentration of the well water in the lake be higher then that of the natural lake water.

You have mentioned in your report that if that happens pumping must be stopped. Is that true?
Response: Yes, it was stated that way. However, stating that the well pump "must be stopped" is not correct. What it should have said is that the well could be stopped if it was desired to keep the blended well and lake arsenic level below the MCL. This would be up to the WTP personnel to determine if the well pump needs to be stopped. The only reason for stopping the well pump to maintain the arsenic concentration below the MCL is if the WTP cannot remove the arsenic. All indications are that the WTP will remove the arsenic in the drinking to well below the MCL. The calculation in the report for concentration of arsenic, after eight months of pumping the well into the lake, indicated that there would be about 8 µg/L in the blended well and lake water. The calculation did not consider any surface runoff water. The calculation assumed a worst case scenario, which is that no precipitation occurs for eight months. Under more normal circumstances there will always be some precipitation, therefore a higher dilution factor from the lake to mitigate the effect of the well water.

In the very unlikely event that the blended well and lake water concentration of arsenic becomes higher than the MCL of 10 µg/L, BLA has two choices:

1. ***Continue to pump well water into the lake as long as long as the WTP removes it from the drinking water. A concentration of 10 to 15 µg/L in the lake will not have any detrimental affect its recreational use for swimming or fishing.***
2. ***Stop the well pump to maintain arsenic level in the lake water below the MCL.***

- Will the bending of the well water with the lake water, over many years, every get to the point where the volume of lake water is less then the volume of well water.
  - Will there be a problem at the point in time?
  - Will we need to stop pumping?
  - What will the recover time be, before pumping can start again?

Response: See response above.

- Will the lake water ever have a high enough concentration of Iron, Manganese or Arsenic that will cause an odor in the lake water? A smell that can be detected in the air around the lake.
  Response: No.

- Will the concentration of well water be more in the cover where the well water is introduced to the lake? Does that cove have enough motion to disperse the well water into the main lake?
  ***Response*: The well water can make up a significant portion of the water in the cove when the well is being pumped. The flow water will from the cove will be enough to mix in with the lake water at the point of entry in the lake.**

- In your report you indicate that the Beaver Lake customers may notice a slight increase in the use of salt for regeneration of the water softeners during the period when well water is added to maintain the lake level.
  - Are you suggesting that each resident will need to purchase a water softener to reduce the hardness in the water?
    ***Response*: No, this was not suggested.**

  - What is your recommendation for those residents for health reason are unable to have a water softener?
    ***Response*: This is not in the scope of work for the study.**

  - For those that don't have a water softener currently, what will the additional cost be to purchase one and the ongoing cost to run and maintain the softener?
    ***Response*: This is not in the scope of work for the study.**

- In your report you indicated that when the water level is more than 30 inches below the spillway, the WTP personnel report that the water quality deteriorates with the increases in organics and taste and odor. The last report from Troy indicated that the lake is 31 inches below the spillway, but I have not noticed any difference in the quality of the water. I did not see in your report a test to verify this information.
  ***Response*: The drop in water level does tend to increase in organics and taste and odor is in the raw water, which makes it more challenging to treat. This is confirmed by WTP personnel. However, the water quality of the drinking water does not have problems this because WTP personnel are doing a good job in removing the organics and taste and odor from the raw water and they have more treatment tools at their disposal to control these problems.**

- In your Environmental Study you indicate that there is no guarantee that hazardous substances or conditions do not exist at the site. In fact you do say because of time and budget restraints an exhaustive search was not performed and that potential hazards may exist at the site. The association will be spending almost $2 million dollars on this project, so is there anyway to get a more definitive commitment from the engineers.
  ***Response*: The environmental study completed was a Phase 1 Environmental Site Assessment. A Phase 1 study is a cursory study to indicate if there are environmental data available that indicate that there are or could environment**

issues related to the well and transmission main construction. This included review of state and federal environmental record sources and site history, along with a visual inspection of the site to identify any recognized environmental conditions associated with the property. The study included a site reconnaissance and written report. This is part of a due diligence to determine if there are indications in the available government records and field observations that there may be environmental conditions which require further investigation. What the study indicated is that there was nothing was found in EPA and State of Nebraska records, and by site observation to indicate the project will have environmental impacts. However, it does not guarantee that someone has not buried hazardous materials or that some antiquities are not buried in the project area which have yet to be discovered. In order to guarantee that such things do not exist, there would have to be a much more detailed and costly investigation (Phase 2 and/or Phase 3 Study). The Phase 1 study found that further investigation was not indicated.

- When Omaha dumps there raw sewage in the river during the year, will we need to stop pumping at that time to avoid any possible chance of introducing raw sewage into our lake? Omaha ***does not*** pre-announce this event before the dumping starts.
  Response: No, during these events from the Omaha wastewater plants pumping from the well can continue. The well will be constructed far enough from the river and deep enough, that the raw sewage events will not compromise the quality of the well water.

- **How will the Engineers guarantee the quality of the Lake water 10 years into the future?**
  Reponse: The quality of the lake can be kept from being compromised by following good operation and maintenance practices for the well and lake. This will involve a monitoring program for the well, lake and drinking water to ensure that there are no regulatory issues with the State of Nebraska and aesthetic water quality issues related to iron and manganese. It will require having routine maintenance performed on the well and pump periodically (this is especially important to prevent iron bacteria from forming in the well).

Cost:

- You indicated in your report that the BL WTP will be able to remove the additional minerals that will be introduced. Have you also determined, will the Infrastructure cost increase to performing this process?
  Response: No, this will be done during the design phase.

- You have said in your report that the Iron, manganese in the well water will need to be removed by way of pre-oxidation, aeration and detention tank prior to introduction into the lake. What will this cost the association.

***Response**: The cost of the pre-oxidant chemical may be around $50 per day when the well pump is operating.*

- Your Engineer's Estimate is around $1.4, what is included in that estimate and according to your report it does it include contingence. How sure are you of that cost?
  ***Response**: Yes, it does include a contingency. We are reasonably certain that the probable cost estimate will cover the cost to construct the project. However, there are uncertainties such as the cost of materials and possible unknown construction conditions. PVC pipe cost has fluctuated about 25 percent over the last four months. Once the design is completed, the confidence level of probable cost is higher.*

- In your report there was no mention of additional staff to maintain or monitoring on a daily bases. Will we need to increase the number of staff, more then the current staff number minus the two that Troy hired in August 2006?
  ***Response**: No additional staff is required.*

- What will it cost, for the additional chemicals that will be used on the well water before the well water is introduced to the lake?
  ***Response**: See response above regarding pre-oxidant cost.*

- Have you determined what the Yearly maintenance Cost will be for this project?
  ***Response**: This will be done during the design.*

- I didn't see any information in the report on the size or number of pumps needed for this project. Will the number of pumps also increase the daily maintenance cost?
  ***Response**: This will be determined during the design.*

- Carter Lake estimates it will cost them $2 million, they plan to connect to an existing pip, there distance is closer to the river, why is Carter Lakes cost higher then ours. Have the engineers talked to the Carter Lake engineers to determine the method that they will use?
  ***Response**: It was not in the scope of work for this report to compare what Carter Lake is proposing to do to Beaver Lake. However, to briefly address the question, Carter Lake has different issues that impact the lake quality than does Beaver Lake. Carter Lake has issues with low lake level, excessive algae, and contaminated sediments on the lake bottom.*

- Will the infrastructure cost increase because of additional back flushing that will need to accrue because of additional minerals being introduced to the WTP?
  ***Response**: By "back flushing" it is assumed that the question is in regard to filter backwashing. There will be no increase in suspended particulate due to well water. In fact, the well water will have less suspended particulate than the lake water. No additional cost for the filters is expected.*

QUESTIONS FROM BLA BOARD
Received December 19, 2006

Engineering Questions

Well Location:

The test well near the river seems to be in the Missouri River alluvial aquifer. Is the Rock and Squaw Creek site in the same aquifer as the test well or is it in a different alluvial aquifer? Is there any difference in water quality between these two sites, i.e. Arsenic, Iron, and Manganese?
Response: In Attachment A, Layne-Western's Ground Water Source Evaluation, on page 3 Layne refers to the study area as which includes Rock Creek, Squaw Creek and the Missouri River as alluvial aquifers indicating that Rock and Squaw Creeks are in a different alluvial aquifer than the area along the Missouri River. Water quality can vary, sometimes significantly, from aquifer to aquifer. One cannot know for certain what the water quality will be without drilling a test well and pumping.

It appears that these four wells (G138752, G138263, G140979, G136185) are the wells closest to Rock and Squaw Creeks. Are they still being used? Is the use for home drinking or to water animals? Are these wells 1000 ft apart from each other? Is rural water available in this area?
Response: The four wells refer to above are only the registered wells. There are many more residences along the county road than four.

One assumes that since the residences are occupied, that the wells are being used.

It was not in the scope of work to determine type of usage for the wells, but it would appear that most are for drinking water.

These are private wells and do not have to meet the 1,000-foot requirement that wells for public water supplies are required to meet.

What would the savings in cost be if we located the well in the SW area, identified as Best probable location for Wells, as apposed to the test well at the river?
Response: The southwest area of the study area shown in Figure 1.1.1 on page 4 of 18 of the Preliminary Engineering Report was not identified as the best probable location, the site along the Missouri River has been identified as such. The southwest area was identified as the closest to the lake and would require the shortest transmission main, if the area was determined to meet the other criteria for a well location.

Water Quality:

The Synder letter states that the river is the best location for quantity and quality of water. Is the quality of water being compared to river water or other wells?
Response: The test well along the Missouri River has been pump and water samples were taken and analyzed. The results of the analyses are given on page 6 of 18 in the

Preliminary Engineering Report. The water quality of the well is good compared to many other water supply wells in southeast Nebraska which tend to have a much higher total hardness and total dissolved solids than the water in the test well.

Over time there will be a reduction of Arsenic, Iron and Manganese at the well. What actual reduction levels will we see and how long will this take?
Response: The reduction may occur in a short period of time, it may take several years, or it may not occur at all. Since the proposed well location is close to the river, much of the recharge for the aquifer will come from the Missouri River. The river is lower in arsenic, iron and manganese concentrations than the water samples from the test well indicate. Based on this, there should be a tendency to see lower concentrations of arsenic, iron and manganese after extensive pumping. We will not know for certain until the well is drilled and put into production.

Iron and Manganese will be lessened by 1. Pre-oxidation (potassium permanganate at well site), 2. Aeration (Cascade) 3. Detention Tank (60,000 gal tank baffled to restrict flow to 30 minutes inlet to outlet). Are the costs of these systems contained in the existing bid? How big is the cascade and what will it look like? How big is a 60,000 gal tank? What will it look like, and where will it be installed? Is there enough land space for these systems?
Response: The probable cost for each these facilities is included. See Table 1.6.1, page 18 of the Preliminary Engineering Report.

The cascade unit will look similar to the one shown in Figure 1.5.1. The exact size will be determined in the design phase.

The questions about the detention tank and land requirements were previously asked and answered in this questionnaire.

After the well water goes through these systems what will the levels of Arsenic, Iron and Manganese be? Will there be any discoloration and/or odors after these treatments?
Response: The pretreatment is specifically for iron and manganese reduction. It is expected to reduce the iron and manganese by about 90 percent. The iron and manganese will be reduced to levels that will not impact the lake water. Some arsenic may be removed by the pretreatment process, but the intended purpose is not for arsenic removal. The arsenic level in the well water will not impair the quality of the lake for swimming and fishing.

Is there any chance of developing Iron Algae in the lake?
Response: The chances for producing iron bacteria in the lake are very remote. Normally healthy lakes will not promote the growth of iron bacteria. It is possible that iron bacteria could be introduced into the lake from the well. However, the level of iron in the lake water would not sustain the growth of iron bacteria. In addition, iron bacteria should not develop in the well if normal precautions are taken during drilling

and development of the well, and if the well is maintained properly on a regular schedule to prevent iron bacteria from developing.

The Engineering Study indicates that the only way to take care of Arsenic is by dilution. With blended water the arsenic level will be .008 mg/L. If the EPA MCL goes down to .003 mg/l will the use of the well be suspended until another source of water dilutes it? Does recreational use of the lake get suspended also?
Response: The MCL is for drinking water only. As long as the WTP can reduce the arsenic level below the MCL in the drinking water, the lake can be used as a drinking water source. With regard to recreational uses, the arsenic level in the lake could be many times higher than the current MCL before there should be any concern about swimming or fishing. Exactly what that level is, is not apparent in the literature on arsenic in water. Arsenic is only a health problem when it is ingested or inhaled. There is no indication in literature that arsenic is absorbed into the body through the skin. Nor is there a published arsenic concentration limitation for water that state people should no longer use water for recreation. Obviously, if a water body is near a mining, smelting, or chemical manufacturing plant and subject to receiving drainage water from one or more of these types of facilities, it would be wise to refrain from using the water body for recreation.

Misc. Questions:

Are there any savings by putting the transmission line in the lake instead of going around the lake?
Response: Generally, putting pipe into the water is more expensive because of the cost of equipment to place the pipe in water and anchorage of the pipe to the bottom so it won't float when the pipe is empty. It has been done in many places, but usually when it greatly reduces the length of pipe or when there is no other route available.

Will the one pump at the well will be sufficient to pump the water out of the ground and through the transmission line to the lake at 2000 gals/minute?
Response: Layne-Western information indicates that at least 1,700 GPM is expected. Since the proposed location is near the river, the potential for higher yield than 1,700 GPM is good.

What are the approximate monthly costs of adding the pre-oxidant to the well water?
Response: This was previously asked and a response given in this questionnaire.

What kind of degradation will the well water have on the transmission system? What is the expected useful life of the pump, transmission lines and valves?
Response: The proposed transmission main material is PVC. The well water will basically have no effect on the pipe.

The useful life of the well equipment is 15-20 years before the well casing and/or pump need to be changed. The well, with regard to the aquifer will last until the aquifer fails

to produce water, which is nearly impossible since the well is so close to the river. The transmission design life is 40 to 50 years. Typically, the transmission main will provide a service life much longer than that.

BEAVER LAKE ASSOCIATION BOARD MEETING

Beaver Lake Association Community Center
December 19, 2006 @ 7:00 PM

Questions from BLA Board Meeting

1. Letter/report/? from Nebraska Department of Health and Human Services indicates lake water will be completely replace lake water with well water after extensive pumping. Will this be the case?
   Response: This does not seem possible. In order for that to occur there would be no other waters entering the lake (ie., springs and precipitation). This would not be the case.

2. Will arsenic in the concentrations found in the well water cause a problem with production of gaseous arsenic compounds during periods when the lake water temperature is highest?
   Response: No. The concentration found in the well water is very minute compared to the arsenic concentrations needed to for any appreciable amount. In addition, the lake is out in the open. If there were any formation, it would be dispersed by air currents very quickly. Poisoning with arsine gas typically occur in industries such as smelting operations, and to a lesser extent galvanizing, etching, and lead plating operations where significant amounts of arsenic material are available and come in contact with acid in an enclosed area.

3. If there are iron bacteria in the well water, could the iron bacteria be carried over into the lake?
   Response: Yes. If iron bacteria are present in the well water, it would be possible for the bacteria to be carried over to the lake. Iron bacteria being carried over to the lake can be prevented by:
   - ***a. Preventing iron bacteria from being introduced into the well during drilling of the well.***
   - ***b. Routine monitoring of the well water for iron bacteria during pumping.***
   - ***c. Routine maintenance of the well ensure that iron bacteria does not have the opportunity to develop.***
   - ***d. Selection of materials for well and transmission pipe that do not contribute to iron to the water through corrosion.***
   - ***e. Iron and manganese removal prior to introducing well water into the lake of the well through pre-oxidation, aeration, and detention (to allow oxidized iron and manganese to settle out).***

4. The maximum allowable arsenic concentration in drinking water is 0.010 milligrams per liter (mg/L). What is the arsenic concentration in the lake water where it would be detrimental to recreational activities?
   ***Response**: As stated previously, a published limitation for arsenic in recreational waters was not found. Arsenic is taken into the body by inhalation and ingestion. There are no publications that suggest arsenic is absorbed into the skin. A search of the literature did not find information on a limit for arsenic in water bodies used for recreation. Water with arsenic at a concentration of 15 µg/L (0.015 mg/L) poses no threat whatsoever for swimming or fishing.*

5. How much of the iron and manganese in the well water will be removed by the pre-treatment process (pre-oxidation, aeration and detention) before the well water is mixed into the lake?
   ***Response**: It expected that up to 90 percent of the iron and manganese will be removed by pre-treatment.*

6. Is the well location near the Missouri River which was recommended in the report the closest location the well can be to the lake?
   ***Response**: Yes it is when considering the following:*
   a. ***The best location for a high capacity well is near the river.***
   b. ***The maximum aquifer recharge will occur near the river.***
   c. ***Most of the other locations to the north and west of the area of study recommended by Layne-Western are within 1,000 feet of existing private wells, thereby ruling out the locations in the north and west of the study area.***

7. Is the Beaver Lake Association well capacity of 2,000 gallons per minute (GPM) really required, or could a lesser well capacity meet the need of maintaining the lake level during dry periods?
   ***Response**: The attached spreadsheet shows the effect of precipitation on the lake level and the pumping rate need to keep up the lake loss during periods of lower than average to no precipitation. At 500 or 1,000 GPM, a well pump would not be able to maintain the lake level during extremely dry periods (see shaded area under columns for 500 and 1,000 GPM. The calculations indicate that a well with an available pumping rate of 1,500 GPM would be able to maintain the lake at the desired lake level. However, there other considerations that support providing a well with a capacity of 2,000 GPM. The parameters for the calculations and the conditions supporting a well with at least 2,000 GPM are given below. .*

   1. ***The calculation uses averages for runoff and lake losses based on average conditions. The actual numbers can differ based on a given set of conditions. For example, during the summer months, if the temperatures are extremely high, sunny, low humidity, and/or the wind***

velocity is high, the evaporation rate would be much higher and the resulting daily water loss in the lake would be more. Conversely, if the temperature is usually low for the summer, cloudy, high humidity and/or low or nor wind, the evaporation loss and lake loss would be much lower. It is nearly impossible to consider all of the variable conditions by calculation, so average numbers were assumed and used to make the calculations.

2. ***The calculation assumes that once the lake level falls 10 inches below the spillway the well pump would be operated to main the lake at this level.***
3. ***The calculation does not take into account allowing the lake level to drop to a much lower level and then trying to recover (e.g., starting at 30 inches blow the spillway and bringing it back to within 10 inches of the spillway). If the lake level was allowed to drop to 30 inches before starting a pump, and the precipitation rate was at 12 inch per year rate, it would take about 84 days to bring the lake level back to within 10 inches of the spillway pumping at 1,500 GPM. For the same precipitation rate and drop in lake level, it would take 63 days to bring the lake level up to within 10 inches of the spillway.***
4. ***The calculation does not take into account wear on the pump impeller. As the impeller wears, the pump output decreases. Over time the output of the well pump can decrease.***
5. ***The calculation does not consider for increased demand for water in the future. The WTP is capable of producing up to 1.0 million gallons per day in anticipation of future demand. Currently, the average daily production rate for the treatment plant is less than 300,000 gallons per day. The water used by the WTP is part of the water losses used in the calculations on the attached spreadsheet.***

Snyder & Associates recommends that the well pump capacity be at least 2,000 GPM. For a 2,000 GPM capacity, a pipe size of at least 14 inches in diameter is recommended.

References

1. Environmental Health Criteria 224 – Arsenic and Arsenic Compounds, second edition; http://www.inchem.org/documents/ehc/ehc/ehc224.htm
2. J Bacteriol. 2003 January; 185(1): 135-141. doi: 10.1128/JB.185.1.135-141.2003. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=141815