PEC
PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

MEMORANDUM

To: Steve Hewitt, City Manager, Clinton, OK

From: Jim Roberts, Hydrogeologist, PEC

Re: Performance of Preliminary Hydrogeological Mapping Study

Date: July 19, 2013

Copy: Ethan Edwards, PEC; Mike Kyser, PEC

Recently I have received inquiries about the idea of drilling a test well at the location of the proposed water treatment plant site. Based on the information PEC has in hand, the data suggests there is no more than about 30 to 35 feet of alluvium beneath that site. Such a thin accumulation of alluvium is likely to be grossly insufficient to justify completion of a well (or wells) to deliver the yield needed by the City of Clinton. Other locations/areas have been discussed as well, such as the [redacted] lands. However, to my knowledge none of the proposed locations have been thoroughly investigated from a hydrogeological or scientific perspective. Given the capital expenditures being contemplated and because groundwater pumped from the wells will be expected to meet the needs of the city for the next forty years, in my professional opinion it would be prudent for the city to move forward with evaluating and selecting water rights acquisition and potential well locations based on scientific data and hydrogeologic evidence.

In order to achieve well yields of 600 gpm or higher in the Washita alluvium OWRB records indicate that a minimum alluvial thickness of approximately 60 feet is needed, and of this total between 30% and 60% of the total section must be comprised of coarse sand and gravel. Consequently, to identify the best potential areas for acquisition of groundwater rights and locations to drill wells in the Washita River alluvial aquifer, I recommend that PEC be allowed to conduct a preliminary hydrogeological mapping study to delineate variations in gross alluvial thickness along the Washita River basin between Foss and Clinton. An example of the type of map that would be developed from such a study was shown to the city council during the work session meeting on July 2, 2013. A similar map could be developed for less than the cost of a test hole, which can provide a regional "birds eye" view of variations in alluvial thickness within the basin. This information can then be used as a template for guiding acquisition of water rights and ensuring placement of wells in optimum locations where productive yield has the best potential for being maximized.

To date, all efforts to locate wells and acquire water rights have been based on second hand or word-of-mouth information. Because aquifer conditions can (and often do) change abruptly within just a few tens of feet, data associated with one location may not indicate that similar conditions exist within a few hundred feet, much less a quarter of a

mile or more away. When working in the subsurface, conditions change or become modified in an almost exponential way with increasing distance away from a data point (well). Even if groundwater is known to be present beneath a specific spot, without evaluation of offset well and hydrogeologic data there is no way to forecast what conditions exist in the subsurface beyond a particular site and there is no way to predict, with reasonable certainty, what the productive potential of a well might be. This is why the collection and use of scientific hydrogeological data is recommended.

The petroleum industry knows this all too well. Before a well is ever drilled, a geological prospect is generated prior to the acquisition of leasehold. Lease acquisition efforts and selection of well locations are high-graded as more scientific information becomes available before a well is drilled. In short, the acquisition of leasehold and siting of wells is based on integration of scientific and engineering data.

This should be no less true when acquiring groundwater rights and drilling and completing water supply wells. Because the capital expenditures are too great and the city's budget is limited, it makes sense to base decisions on scientifically defensible data rather than word-of-mouth information. Furthermore, intense competition for the same or limited groundwater resources, regulatory permitting requirements, and water chemistry regulatory thresholds are making it increasing difficult to access and exploit groundwater supplies.

Performance of a hydrogeologic mapping study could be completed for approximately $11,000.00, could be completed within one month and would provide the following specific benefits:

- The map will show the location of "alluvial thicks". Thick accumulations of alluvial sediment represent locations of greatest saturated thickness and therefore greatest potential for completing high capacity wells.
- The information will provide a scientific basis for selecting lands that appear most favorable for acquisition of water rights, as acquisition of water rights can be focused only on those lands under which thick alluvial deposit accumulations are indicated to be present.
- Test well locations can be "high-graded" and selected based on scientific and hydrogeological evidence, not because the city owns a tract of land or a landowner has approached the city about leasing his water rights.
- Unnecessary costs associated with the time and expense related to acquisition of water rights and drilling test wells in bad locations can be avoided.
- Targeting "alluvial thicks" offers the best potential for drilling and completing high efficiency, high capacity wells, which minimizes the need for unnecessary investigation, optimizes the number of test wells required to adequately evaluate aquifer conditions and saves money.

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

August 6, 2012

City of Clinton
415 Gary Blvd
Clinton, OK 73601

Attention: Mr. Steve Hewitt, City Manager

Reference: Hydrogeological reconnaissance & mapping

Dear Mr. Hewitt:

This letter is written to serve as an agreement between the City of Clinton, Oklahoma, (CLIENT) and Professional Engineering Consultants, P.A. (PEC) to perform professional services to assist the City of Clinton in identifying locations favorable for acquisition of groundwater rights and siting of exploratory borings and water supply wells, hereinafter called the PROJECT.

Specifically, PEC proposes to perform the Scope of Services as outlined in Paragraph A below.

A. Scope of Services:

1. Collect public information archived with the Oklahoma Water Resources Board (OWRB), U.S. Geological Survey (USGS), Oklahoma Geological Survey (OGS), as well as subsurface and pump test data held by [redacted] and other private citizens, as available.
2. Utilize published and private data to develop a subsurface map to illustrate the distribution and thickness of Washita River alluvial sediment from Foss Reservoir dam to the eastern limits of the City of Clinton. Based on a cursory review of available well data archived with the OWRB, it appears that detailed mapping along the entire reach between Foss Dam and the eastern limits of Clinton is not possible. This means that mapping will be more detailed across some areas, and less detailed across others. Because the selection of well locations and areas for acquisition of water rights is an iterative process, the purpose of the proposed mapping project will be to develop a map that can be used as a guide for selecting potential exploratory boring/test well locations and areas which appear favorable to acquisition of groundwater rights. Based on mapping results, appropriate recommendations for further action will be developed and presented to the City.
3. Utilize published and private data to estimate aquifer hydraulic properties if applicable.
4. Provide preliminary cost opinions to evaluate aquifer conditions at the sites recommended for evaluation.

5. Prepare a Technical Memorandum summarizing the findings of Items 1-5 above.
6. Present the findings of the mapping project to the City Manager and all interested city officials for purposes of engaging in dialogue and allowing the city to make comments and ask questions.

B. Responsibility of CLIENT:

The CLIENT agrees to provide the following items pursuant to PEC accomplishing the Scope of Services outlined herein:

1. Provide available data such as well, aquifer and pump test data if available.
2. Provide timely review and comments of interim information prepared by PEC for the CLIENT for review.
3. Provide other information requested by PEC to assist in the development of the final deliverable.

C. Exclusions:
The following items are specifically excluded from the Scope of Services provided by PEC:

1. Design, bidding and construction phase services
2. Surveying and geotechnical services.
3. Water quality analysis
4. Test well drilling

D. Payment Provisions:

PEC proposes to perform the Scope of Services described above, for a lump sum amount of $11,000.

Unless otherwise agreed upon, billings will be made monthly based on completion of the items listed above.

Taxes are not included in stated fees. CLIENT shall reimburse PEC for any sales, use and value-added taxes, which apply to these services.

E. Time of Performance:

PEC proposes to begin work on the PROJECT within five (5) business days following receipt of an executed copy of this agreement and to complete the Scope of Services in accordance within forty-five (45) business days, exclusive of any delays beyond the control of PEC.

This letter and the Standard Conditions attached hereto comprise the entire agreement between the CLIENT and PEC. They may be altered only by written supplemental agreement agreed to by both parties. Furthermore, this agreement may be canceled by CLIENT, for any reason, by providing PEC with thirty (30) days prior written notice.

Thank you for contacting us to provide professional services on the subject PROJECT. Should you have questions or need additional information, please do not hesitate to call. Return receipt of an executed copy of this letter will serve as our contract and notice to proceed with the work.

Sincerely,

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

James W. Roberts
Hydrogeologist
Municipal Division

Attachment: PEC Standard Conditions

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

By: _____
Ethan J.L. Edwards, P.E.

Date: _____

City of Clinton, Oklahoma

By: _____

Title: _____

Date: _____

ATTEST:

By: _____