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Proposal for Saint Paul Regional Water Services

# Engineering Services for the the Structural Assessment of the McCarrons Water Treatment Plant

December 2015

## Section 4 – Detailed Explanation of Project Approach

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### Project Understanding

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The St. Paul Regional Water Service (SPRWS) recently completed a Master Plan for the McCarrons Water Treatment Plant (WTP) and other production facilities, which identified the need for a condition assessment at the treatment plant. SPRWS anticipates that the WTP will remain in service for the foreseeable future, and therefore realizes the importance of having a complete understanding of the plant's current condition. Additionally, SPRWS plans on making significant investments to the plant within the next 10 years, including new softening basins, new recarbonation basins, and a new ozone treatment system.

The WTP was originally constructed in 1921, with multiple large additions constructed in 1937, 1955, 1958, and 1997. Portions of the WTP are planned to be phased out over the coming years and the evaluation will be focused on the remaining areas identified in Exhibit 2 of the RFP.

The WTP consists of reinforced concrete structures founded primarily on timber piles, with the exception of the chemical building and laboratory building additions constructed in 1955. These additions were noted to be constructed on concrete piles in the drawings provided by SPRWS. It is unclear what type of piling was used during the 1958 improvements.

In addition to the foundation investigation, SPRWS has observed concrete deterioration and cracking in portions of the reinforced concrete superstructure. Specifically, concrete deterioration was identified within the Figure 8 structure which is highlighted in Exhibit 3 of the RFP.

As noted above, SPRWS is planning future investments at the WTP and intends on continued use of the plant for the next 40 years. To develop an understanding of the longevity of the existing structures at the WTP, a detailed structural and foundation condition assessment needs to be performed. GEI has developed detailed objectives for this assessment as outlined in the section below.

### Objectives and Approach

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GEI understands the critical importance of the McCarrons WTP to SPRWS and has developed the following objectives that provide the basis of our investigative approach. Based on our understanding of the project as described above, information shared at the pre-bid meeting, the RFP (dated November 9, 2015), and Addendum 1 (dated November 24, 2015), GEI has developed the following approaches to meet each of the key objectives:

- *GEI Objective – Obtain an understanding of existing foundation soils supporting the various structures at the WTP site.*
  - The RFP did not contain any geotechnical information for the WTP site. GEI understands there may be additional information available from the various design phases at the site. However, to ensure that we have the geotechnical information needed to conduct an appropriate evaluation of the foundation system, GEI proposes to perform three soil borings at the site, unless SPRWS can locate prior relevant geotechnical reports for the site. Additional information on the soil borings is discussed below in Task 2.
- *GEI Objective – Obtain an understanding of the current and historic groundwater elevations and seasonal fluctuations at the WTP site.*
  - Research shows that the rate of decay of untreated timber piles is highly dependent on the historic groundwater elevation in relation to the top of the piles. The limited oxygen available in a submerged condition inhibits the growth of fungi, thus limiting and slowing biological deterioration. As a result, GEI proposes to install three monitoring wells at the WTP to provide accurate water level information near the existing pile supported structures.

Additionally, GEI will perform a desktop analysis of the surrounding area to estimate the historic groundwater fluctuations that may have occurred. The information obtained from the monitoring wells and historic groundwater data research will inform us on the potential fluctuations in groundwater that the piles may have experienced.

- *GEI Objective – Quantify the condition and remaining service life of the McCarrons Water Treatment Plant superstructure.*
  - GEI will perform an extensive visual internal and external inspection of the exposed foundation and concrete walls in the areas of concern. The results of the superstructure inspection will identify any concerns regarding concrete deterioration, cracks, or settlement of the structure. This information will be used to prepare recommendations for long term maintenance and rehabilitation of distressed areas, as deemed appropriate.
- *GEI Objective – Quantify the condition and remaining service life of the timber pile foundation system.*
  - Using the information obtained from Tasks 1 and 2 (described below), GEI will work with SPRWS to evaluate the need for excavating test pits to expose the timber piles (i.e. is there strong evidence that the piles are submerged or not). If exposing the piles is deemed helpful in our evaluation, GEI will work with SPRWS staff to finalize the proposed test pit locations at the site. Two preliminary test pit locations have been identified along the perimeter of the Pump and Filter Building as identified in the attached Figure 1. The test pits will be used to expose a total of eight (8) perimeter timber piles for further examination and testing described in Task 3 below. This information will be used to estimate the remaining life of the piles and future risks to the foundation system.
- *GEI Objective – Discuss the probable remaining service life of the concrete pile foundation system.*
  - Using the information obtained from Tasks 1 and 2 (described below), GEI will evaluate the information available and discuss the likelihood of concrete pile deterioration under those portions of the building supported by concrete piles. This information will be used to estimate the remaining life of the piles and future risks to the foundation system.
- *GEI Objective – Evaluate alternatives for prolonging the service life of the WTP structures and provide recommendations for future improvement options.*
  - Using the information obtained in Tasks 1-3 (described below), GEI will provide a discussion of various options to prolong the life of the superstructure and foundation systems (options to consider will include no major improvements with regular inspection and pro-active maintenance). GEI will rely on its vast experience in concrete rehabilitation and foundation improvement systems to develop recommended improvement options.

To achieve the objectives above, GEI will execute the work in a phased approach as outlined in the tasks below. We are confident that this approach will provide the information needed to allow SPRWS to make informed improvement decisions at the WTP.

## Scope of Services

To achieve the objectives and implement the approaches described above, GEI proposes to perform the following tasks (generally structured to align with those outlined in the RFP).

1. Kick-off Meeting, Data Collection, and Review
2. Superstructure Inspection and Groundwater Well Installation
3. Test Pit and Timber Pile Examination (Optional Task)
4. Structural Assessment with Recommendations and Final Reporting

These tasks are discussed in detail in the following sections.

### *Task 1 – Kick-off Meeting, Data Collection, and Review*

In addition to the information provided in the RFP and Addendum 1, GEI proposes to work with SPRWS to identify any other design drawings and specifications, as well as existing construction photographs that better detail the construction of the WTP. Specifically, GEI would like to gather more information on the pile installation, such as tip depth, refusal criteria, wood species, and potential wood treatment specifications, as well as concrete strength, concrete reinforcing, and other properties of the concrete piles. The drawings included within the RFP reference pile installation record books and GEI proposes to assist SPRWS staff with examining historical records for relevant information. This information will be thoroughly reviewed and used for refinement of the field inspection program. GEI has developed a preliminary field inspection and instrumentation plan outlined below in Task 2, based on our review of the available information.

This task also includes attending a kickoff meeting. We anticipate this meeting will be a face-to-face meeting at the McCarrons WTP. GEI will prepare the meeting agenda and bring the draft field inspection and investigation plan to the meeting for review with SPRWS staff. One goal of this meeting is to finalize the field inspection and groundwater instrumentation plan. We anticipate this meeting to be held the day prior to the superstructure inspection.

 **Deliverables** – For this task, GEI will provide kick-off meeting agenda and minutes; a detailed plan for observation, testing, and monitoring; a list of potential impacts to the treatment plants from our site visit; and a proposed project schedule.

### *Task 2 – Superstructure Inspection and Groundwater Well Installation*

Following the kickoff meeting, GEI will conduct the inspection of the superstructure in the areas of concern, both exterior and interior. GEI will perform an exterior inspection at ground level around the perimeter of the structures. The exterior inspection will focus on identifying any cracks or signs of distress on the exterior faces of the buildings. Also, the interfaces of the historic additions/expansions will be examined for signs of differential settlement. The interior of the buildings, in the areas of concern, will be visually inspected.

Existing drawings will be used to document the location of any notable structural deficiencies. The following information will be gathered during the inspection:

1. Visual inspection of concrete foundation and concrete walls. Any areas of visible concrete deterioration or exposed reinforcement will be noted. Hammer soundings will be completed as appropriate. Representative and specific photographs will be taken during the inspection for review during our evaluation and to include in our final report.
2. Visual inspection and measurement of significant cracks (if present).
3. Visual observations of settlement (if present).
4. Visual evidence of groundwater infiltration (if present).

In addition to performing a general visual inspection of the exposed concrete foundation walls, GEI proposes to visually inspect portions of the flocculation bays that are able to be dewatered. These bays qualify as confined spaces and will be managed accordingly. A subsection below further details GEI's approach to

the health and safety aspects of this project. These bays will be thoroughly inspected using the same techniques as discussed above.

### **Geotechnical Soil Boring and Groundwater Monitoring Well Installation**

No geotechnical information was provided as part of the RFP or Addendum No. 1, although evidence of historic test pits is referenced on the 1921 drawings. While this information may be discovered during Task 1, GEI proposes to gather new geotechnical information at the site.

The historical geotechnical information (if available) collected during the various design stages may not include the appropriate soil characterizations that are important for analyzing the pile supported foundation, such as Standard Penetration Test (SPT) blow count data, soil classifications, soil density, etc. GEI proposes to gather this information by performing three (3) SPT borings at the site as shown in Figure 1 in **Appendix B**. GEI proposes to subcontract with AET, a local geotechnical drilling company, who will mobilize one truck-mounted drill rig to the site. For the purposes of this proposal, the borings depths have been assumed to extend to 30-feet below the existing grade. Based on the information gathered during Task 1 on the length of the timber/concrete piles, these proposed depths will be adjusted as necessary. Representative soil samples will be obtained at 5-foot intervals to the termination depth. Soil samples will be obtained by means of split barrel and/or Shelby tube sampling methods in general accordance with ASTM D1586 and 1587, respectively. Laboratory testing is proposed, including organic content, water content, dry weight, estimation of percent saturation, pH, and particle size distribution. This information can be used to not only evaluate the allowable geotechnical capacity of the piles, but to evaluate environmental factors that may have an impact on the pile's longevity.

As discussed above, the location of the groundwater table plays an important role in the longevity of timber piles. Local groundwater conditions may be estimated using various methods, however, site specific groundwater monitoring wells will provide reliable data at locations immediately adjacent to the wood pile foundations. GEI proposes to convert the soil boring holes into permanent groundwater monitoring wells. The wells will be constructed with 2-inch diameter PVC pipes and screened to intersect the upper aquifer at the site. The PVC risers will each have a 4-inch-diameter steel protective casing with a locking cap. The location of the proposed soil borings/monitoring wells are identified on Figure 1.

GEI proposes to conduct the soil borings and install the monitoring wells during the same week as the kickoff meeting and superstructure inspection. The early installation of the wells will provide additional monitoring time to observe any potential seasonal fluctuations of the groundwater table. After the wells are installed, GEI proposes to obtain water samples for laboratory testing of pH, chemistry, and dissolved oxygen concentration. GEI proposes to perform water level readings of the wells every two weeks with the assistance of SPRWS staff. Furthermore, the groundwater monitoring wells will continue to provide an indication of water levels moving into the future. This ongoing monitoring effort may be critical for evaluating the continued health of the wood piling.


GEI will perform a desktop analysis of the surrounding area to estimate the historic groundwater fluctuations that may have occurred. The information gathered may include correlations with surrounding lake elevations, nearby offsite groundwater wells, and any other available historic data from the surrounding area.

### **Health and Safety Plan**

The health and safety of our staff and those around us is a top priority for GEI. Prior to mobilizing to the site, GEI will prepare a site-specific Health and Safety Plan (HASP). The HASP will address the hazards for both the internal and external inspections, as they pose different risks to the inspection team.

GEI considers the inspection of the dewatered flocculation bays an OSHA Permit required confined space. GEI has extensive experience working in confined spaces and will work to eliminate or manage the environmental risks associated with confined space entry. All GEI personnel involved with the field inspection will have completed the GEI confined space training program prior to mobilization to the site. GEI will provide air monitoring equipment for the inspectors entering confined spaces. Rescue

tripods/winchies will be setup over each planned entry for emergency extraction purposes, as GEI will be prepared to perform self-rescues. GEI staff will wear harnesses at all times while accessing and inspecting the flocculation bays. GEI plans on using ladder rungs if available or will request a ladder to be provided by SPRWS staff for accessing each bay. GEI will follow SPRWS lock-out-tag-out procedures and requests that SPRWS personnel are on site during the inspections.

 **Deliverables** – GEI will document the field inspection findings within a field inspection report, with figures and digital photographs. The draft field inspection report can be provided within 2-weeks of the inspection in PDF format. GEI will also develop the soil boring and well installation logs. The laboratory test results for the soil and water samples will be discussed in the final assessment report (Task 4) and included within an appendix to the report along with the boring and well installation logs. The final field inspection report will be included as an appendix in the final assessment report.

### *Task 3 – Test Pit Exploration and Timber Pile Examination*

As discussed above, GEI will evaluate the need for conducting test pit explorations for timber pile examination, in conjunction with SPRWS staff, using the results from Tasks 1 and 2. While submersion in water is known to limit fungal attack on wood, it is not considered an absolute means of preserving wood, especially if the history of groundwater submersion is in question.

GEI proposes to conduct two (2) external test pits along the perimeter foundation of the Pump and Filter Building constructed in 1921 for the timber pile examination. These locations were chosen due to relatively shallow excavations required to reach the piles, the apparent limited underground utility conflicts based on the historical drawings provided by SPRWS, and room to perform an unsupported, open cut excavation meeting OSHA requirements. As the oldest portion of the foundation system, the 1921 piles are also a prime candidate for examination.

GEI proposes to work with our subcontractor, Rayco Excavating, Inc., to perform the test pits using an excavator. The test pits are estimated to be approximately 12-15 feet deep and 12-feet wide at the interface with the structure. Hand excavation will be used to clear the soil around the individual piles for further examination and testing. We anticipate exposing four (4) perimeter piles per excavation, given the 4-foot spacing identified on the historical drawings. The test pits will be backfilled with the excavated soils and compacted in lifts. The site is proposed to be restored using seed and mulch.

Below is a summary of the proposed field measurements and tests for each pile:

- Perform visual inspection of the exposed piles;
- Measure the pile perimeter or circumference;
- Perform surface probing of the timber piles using a screwdriver. The probing is proposed to be conducted at four points around the circumference of the pile and every 6-inches vertically of the exposed pile. Approximately 3-feet of the pile is planned to be exposed;
- Obtain a minimum of one 1/8-inch diameter core from each timber pile for laboratory testing. The core sample will be sent for testing and examination to help determine geometry, nature and extent of any pile deterioration for potential future repairs. All core holes will be plugged with treated timber plugs so that the structural integrity of the piles is maintained;
- Perform hammer sounding of the concrete piles. The sounding is proposed to be conducted at four points around the circumference of the pile and every 6-inches vertically of the exposed pile; and
- Perform concrete coring through the foundation concrete pile cap to confirm pile cutoff level and pile top condition for the portion embedded within the existing concrete caps. This will be performed once at each test pit. The 4-inch diameter core from each concrete footing will be visually inspected and sent in for laboratory testing of the compressive strength. All core holes will be filled with grout so that the structural integrity of the pile cap is maintained.

In addition to the pile examinations and tests, the observed soil and groundwater conditions will also be documented within each test pit, along with the visible condition of the concrete foundation.


The results of the inspection and testing conducted on the piles and concrete foundation will be used to estimate the remaining service life of the foundation. The laboratory test results will be used to identify the wood species, which will aid in determining the remaining useful life of the piles.

### Inspection Limitations

Only a small portion of the existing timber pile foundation system is proposed to be examined during this investigation. Depending on the results of Tasks 1-3, future investigation work may be recommended for a better understanding of the overall foundation system on site. However, given the observed condition of the WTP during the pre-bid walkthrough and no apparent indications of settlement observed during our short visit, the foundation system appears to be performing adequately at this time and does not warrant a further intrusive investigation proposal without obtaining more field information. This investigation, and subsequent analysis detailed in Task 4, will provide SPRWS additional direction needed to evaluate potential repair options or further investigation options if recommended.

At this time, we do not feel it is necessary to expose the concrete piles below the chemical building, unless the soil borings or test pits reveal soil conditions that may have a negative effect on the longevity of the concrete. If exposing the concrete piles is considered prudent based on the site information obtained during Tasks 1-3, we can perform more test pits for an additional cost.

Furthermore, this investigation is limited to the locations and structures identified in the RFP. It is our understanding that the other structures (i.e. north and south clarifiers, final sedimentation basins, clarifier basins, etc.) have not been included in the scope of this assessment because they are planned to be phased out of the current operations.

 **Deliverables** – GEI will document the test pits and pile examination findings within a field inspection report, with figures, and digital photographs. A draft field inspection report can be provided to you in PDF format, within 2 weeks of the inspection. GEI will also develop individual pile inspection logs for inclusion into the draft report. The laboratory test results for the timber and concrete core samples will be discussed in the final assessment report and included within an appendix to the report. The final test pits and pile examination field report will be included as an appendix in the final assessment report.

### *Task 4 – Structural Assessment and Final Reporting*

Upon completion of Tasks 1-3 described above, GEI will prepare a structural assessment report that will include the following:

- Identification of the current condition of the existing concrete foundation and superstructure, with specific attention to any significant deficiencies (deterioration, cracking, settlement, exposed reinforcement, etc.);
- Identification of the current condition of the existing timber piles, with specific attention to the pile cap interface, type and extent of deterioration, pile diameter, etc.;
- Interpretation of inspection data and assessment of areas of concern;
- Summary and interpretation of soil, water, concrete, and wood laboratory test results;
- Soil boring and monitoring well logs;
- Discussion of risks associated with the timber pile conditions observed and consequences of foundation failure;
- Discussion of risks associated with the likelihood of concrete pile deterioration and consequences of foundation failure;
- Assessment of the remaining service life for the timber pile supported foundation and reinforced concrete superstructure;
- Recommendations of future inspection details and interval frequency, including groundwater monitoring; and


- Options for improvements to the WTP, including operational improvements/maintenance recommendations, and major repairs with associated cost estimates.

The final structural assessment report will include a detailed summary of the field inspection findings and the notable deficiencies will be identified as electronic markups on the existing PDF copies of the record drawings that were provided by SPRWS. These figures will be included in the appendices of the assessment report. A photo log will also be produced for the inspections, providing visual documentation that supports the inspection findings summarized within the report. After a thorough discussion of the significant findings from the inspections, we will provide an evaluation of the areas of concern. This evaluation will discuss the potential causes of the noted defect and the risks associated in these areas.

GEI will perform a structural assessment of the timber piles. The assessment will include the evaluation of the pile section loss, available strength, and estimate of the pile allowable compressive capacity based on the identified wood species, soil properties, and current condition. Note that additional information on the pile tip elevations will be required to properly evaluate the allowable geotechnical capacity of the piles. The allowable compressive capacity can then be compared to the demand load, which GEI will estimate using the existing drawings and knowledge of the structure obtained during the field inspection.

Using the results of the field inspections, laboratory tests, and structural assessments, GEI will evaluate the reliability of the WTP for continued use over the next 40 years. This evaluation will consider the risks associated with the concrete and timber piles and consequences of failure.

The results of this assessment may include recommendations for short and long-term reliability improvements to the foundation and/or concrete superstructure. The report will summarize the available options, and associated preliminary cost estimates for consideration. GEI has experience working with various foundation improvement technologies for timber and concrete supported structures and will draw on this vast experience to develop creative and cost effective solutions for this project. Schematic drawings will be used to illustrate the major identified defects and the potential repair options. The report will summarize the available options, recommended timeline for performing the improvements, and preliminary cost estimates for consideration.

 **Deliverable** – GEI will prepare the structural assessment report following completion of the structural analysis work. The report appendices will include representative structural analysis calculations and supporting documentation. The report will include plan drawings and documents that detail the field inspection results. The report will make clear conclusions regarding the remaining useful life of the WTP and will provide recommendations and options for possible improvements to the system, including rehabilitation, maintenance programs, or major repairs. GEI will provide engineer's cost estimates for the improvement options presented. GEI will issue a draft of the report for SPRWS review prior to finalizing. GEI will conduct a conference call meeting to review the draft report with SPRWS. We anticipate submitting both hard and electronic copies of the final report.



## Section 5 – Proposal Cost

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In accordance with the RFP, GEI will perform the services described above on a time and materials basis with a not-to-exceed cost of **\$59,000**. These costs and estimated labor hours and expenses are broken down by task on the attached Estimated Cost and Schedule Table in **Appendix C**. If additional services are required beyond those identified above, they will be performed on a time-and-expenses basis in accordance with the attached Fee Schedule in **Appendix C**, subject to prior approval by SPRWS.

The excavation test pit costs include labor and equipment to excavate and backfill the test pits, plus restoration and cleanup to conditions similar to the pre-test pit condition. For the purposes of this proposal, we have budgeted two, 8-hour days onsite to perform the two test pits. We feel this is a conservative estimate, given the depth of the foundation and anticipated soil conditions. Note, however, that due to the unknowns associated with performing an excavation, additional fees will be requested if the duration of the test pit program exceeds two consecutive days. An hourly rate of \$260/hour will be used for an excavator, operator, and laborer. Onsite GEI staff will be billed based on the rates on the attached fee schedule. If a second mobilization of the excavation contractor is required, a fee of \$900 will be charged.

As an option to reduce the overall project costs, GEI is willing to work with SPRWS staff directly to perform the excavation for the test pits. If SPRWS can provide the excavation and backfill services directly, a reduction in the total project cost of \$6,000 would be realized.

The proposed fees will be effective if this proposal is accepted by SPRWS with 60 days of the date of this proposal. Invoice amounts will be based on actual units used at the rates shown on the attached fee schedule, and will include other expenses incurred by GEI in rendering the services described. GEI will submit invoices monthly. Note that GEI will use a modified version of the Estimated Cost and Schedule Table to provide a monthly update of the project costs compared to the estimate contained within this proposal. The updated table will be included with the monthly invoices. This would allow the SPRWS Project Manager to easily identify where our efforts have been focused for any given month.

## Section 6 – Ability to Meet Project Deadlines

GEI is prepared to begin work as soon as we have a Contract Agreement and formal Notice-to-Proceed is issued. The proposed milestone schedule is summarized in the following table and in the attached Estimated Cost and Schedule Table in **Appendix C**.

The early October schedule for the test pit program was established to allow for collecting additional groundwater elevation data. If desired by SPRWS or deemed necessary during the execution of Tasks 1 and 2, the test pit and pile examinations can be conducted in the late spring or early summer of 2016 to advance the project schedule. The final reporting and associated project completion date would also be accelerated.

### *Project Schedule Summary*

Task	Milestone	Anticipated Completion Date (2016)
1	Project Award	Week of January 11 <sup>th</sup>
1 & 2	Kickoff Meeting, Superstructure Inspection, & Well Installation	Week of January 25 <sup>th</sup>
2	Submit Draft Field Superstructure Inspection Report	Week of February 8 <sup>th</sup>
2	Continue to Collect Groundwater Elevation Data	January - October
3	Conference Call Meeting to Discuss Test Pit Program with SPRWS	September
3	Perform External Test Pit and Pile Examinations	Week of October 3 <sup>rd</sup>
4	Submit Draft Assessment Report to SPRWS	Week of November 28 <sup>th</sup>
4	Draft Report Review Meeting with SPRWS	Week of December 12 <sup>th</sup>
4	Submit Final Assessment Report to SPRWS	Week of December 19 <sup>th</sup>

## Section 8 – Project Assumptions

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Our scope of services and not-to-exceed fee are based on SPRWS performing or providing the following support:

- Assign a designated representative with complete authority to transmit instructions and information, receive information, interpret policy, and define decisions;
- Provide access to the project site and an operator to accompany the on-site GEI staff, as needed;
- Provide timely review and turnaround of all draft submittals;
- Provide available and needed background information including record drawings, shop drawings, construction photographs, construction specifications, groundwater well information, maintenance records, etc.;
- SPRWS staff will be able to dewater the flocculation bays for visual inspections;
- SPRWS staff will be available during the inspection to provide lock-out-tag-out assistance, assist with tending egress points as needed, and provide access assistance including ladders;
- SPRWS staff to provide bi-weekly monitoring of the two groundwater monitoring wells installed by GEI. The monitoring program is anticipated to occur from late January to early October. GEI will provide the electronic water level monitoring meter for use by SPRWS;
- Provide the location of underground utilities at the site prior to performing the soil borings and test pit;
- Provide snow clearing services for drill rig access at the proposed locations if needed; and
- Provide access to the historic files for GEI's review. A total of 4 hours has been assumed for reviewing and identifying relevant historical information.

In addition, we assume the following:

- The 2 external test pits can be completed within 2 consecutive work days;
- Services for fully developed repair designs and details (Drawings and Specifications) are not included within the proposed scope of services, but can be conducted as needed and requested by SPRWS;
- Dewatering well point system for performing an excavation below the groundwater table is not included; and
- Four (4) hard copies of the final report will be produced.