SCHEDULE 1

DUBLIN ROAD WATER PLANT
TREATMENT CAPACITY INCREASE STUDY AND EVALUATION
SCOPE OF SERVICES

The primary objective of this scope of services is to evaluate the feasibility and changes required to increase the current design capacity of the Dublin Road Water Plant from 65 million gallons per day (mgd) to 90 mgd while maintaining water quality and compliance with existing and future regulatory requirements. This scope of services encompasses the following work tasks:

Task 1	Data Collection and Review
Task 2	Plant Process and Hydraulic Evaluation
Task 3	Treatment Chemical System Evaluation
Task 4	Pumping Station Evaluation
Task 5	Process Control Evaluation
Task 6	Electrical Distribution System Condition/Capacity Assessment
Task 7	Preliminary Structural Condition Assessment
Task 8	Identify Alternatives for Upgrade and Expansion to 90 mgd
Task 9	Flocculation/Clarification/Softening Alternatives Evaluation
Task 10	Filter Upgrade Evaluation
Task 11	Flocculation/Clarification/Softening/Filter Upgrade Technical Memorandum
Task 12	Pilot Study
Task 13	Prepare Draft Report
Task 14	Finalize Report
Task 15	Meetings and Site Visits
Task 16	Project Administration

A more detailed discussion of each task is presented below.

Task 1 Data Collection and Review

The Metcalf & Eddy (M&E) Team will review and tabulate available information and data related to the Dublin Road Water Plant as supplied by the City of Columbus (City). It is anticipated the City will furnish the following information:

- Civil, structural, architectural, mechanical, instrumentation, and electrical drawings of the original facilities and for the various facility improvement projects that have been implemented over the years
- Plant process design criteria
- Previous reports and treatability studies on proposed facility modifications
- Previous reports on existing condition assessments including soils/geotechnical investigation reports
- Raw water quality data for the last 5 years
- Treated water quality data for the last 2 years (including ICR data)
- Treated water production data for the last 2 years
- Facility operation and maintenance manuals

Task 2 Plant Process and Hydraulic Evaluation

Pinpointing capacity deficiencies will minimize facility changes. The unit processes and hydraulics of the Water Plant will be evaluated to determine the capacity of each facility component and thus the bottlenecks that must be upgraded to achieve a reliable production capacity of 90 mgd. This task will consist of the following subtasks.

2.1. Prepare a process flow schematic diagram depicting process elements of the plant.

2.2. Prepare a table describing the elements of the existing treatment process, including: number, age and nameplate data for equipment such as screens, pumps, mixers, chemical feeders, etc.; number, age, and physical dimensions of structures and tanks such as mix tanks, flocculators, sedimentation basins, filters, and clear wells, etc.; and diameter and age of piping, and related items such as valves, flow controllers, etc. M&E will gather as much information as possible in the field and then rely on the City's records to complete this task.

2.3. Tabulate unit process and process piping hydraulic criteria (e.g., theoretical detention time, actual detention time based on estimated T_{10}, actual surface loading, filtration rate, CT, velocity, etc.) based on 65 mgd and 90 mgd flow rates through the existing plant, and compare to the current industry standard design criteria.

2.4. Calculate and plot hydraulic profiles for plant production flows of 65 mgd and 90 mgd. Verify elevations of weirs, flumes, piping and other structures in the field prior to preparing these profiles. Identify areas of high headloss. Identify hydraulic restrictions or deficiencies in existing facility components that constrain capacity to a flow rate less than 90 mgd. Develop listing of alternatives to increase the hydraulic capacity of each component with an existing capacity less than 90 mgd. M&E's proprietary Plant Hydraulic Profile (PHP) model will be used to simulate the hydraulics and profile of multiple flow scenarios through the plant. An example of a hydraulic profile completed by M&E for another project is shown in Figure 1-2 of our technical proposal.

2.5. Review available raw water quality data for the last 5 years and summarize primary treatment concerns. Review available treated water quality data for the last 2 years (including ICR data), and compare to current and possible future regulatory compliance and treatment goals. Review and discuss with plant staff available treatability studies or reports previously conducted and those that are planned to be conducted. We have already reviewed the pilot study recently conducted for membrane filtration. Evaluate the ability to meet regulatory requirements, i.e., primary and secondary regulations, disinfection by-products (DBPs), Interim Enhanced Surface Water Treatment Rule (IESWTR), CT requirements, and proposed future regulations. Identify limitations of existing treatment process to meet regulations and treatment goals.

2.6. Review the filter backwash water system and identify potential deficiencies. Review filter backwashing procedures with plant staff, and determine adequacy of existing surface and backwash water systems to clean the filter medium. Evaluate the control of backwash water flow rates and backwash efficiency. Identify potential improvement to the current method and control of backwashing.

2.7. Review gallery piping and valves and filter control procedures, both design intent and present operation.

2.8. Review and document operation and maintenance requirements for disposal of spent washwater and clarifier residuals. The current practice of recycling spent washwater to the head of the plant will be reviewed in accordance with the Filter Backwash Rule recycle requirements. Included in this task will be a review of the present sludge pumping station and transfer pipeline that extends to the quarry.

2.9. Prepare summary of process and hydraulic deficiencies that currently constrain production capacity to less than 90 mgd.

Task 3 Treatment Chemical System Evaluation

Chemical systems are in place for adding alum, lime, caustic soda, soda ash, zinc orthophosphate, fluoride, activated carbon, potassium permanganate, carbon dioxide and chlorine. Many of the chemicals are delivered by tank trucks in either dry or liquid form. The chemical storage, handling, metering and application systems will be evaluated with regard to current condition and ability to deliver required dosages and provide sufficient storage for a 90 mgd flow. The chemical unloading stations will be reviewed for optimization of unloading activities to reduce or eliminate conflicts. This task will consist of the following subtasks:

3.1. Review current chemical dosages and evaluate any required changes in chemical dosages for raw water quality based on a 90 mgd production capacity.

3.2. Assess condition of existing chemical storage and feed systems. Identify adequacy of storage requirements to meet regulatory requirements for 30 days of storage based on projected dosages at 90 mgd. Review containment structures for bulk-storage chemicals. Compare firm capacity of existing chemical feed systems to dosage requirements at 90 mgd.

3.3. Identify locations of chemical dosing points and evaluate their impact on the treatment process based on a 90-mgd flow.

3.4. Examine safety aspects of each installation of chemical storage and feeders. Identify impact of Occupational Safety and Health Administration (OSHA) regulations on installation of existing chemical storage and feed facilities, and enclosed spaces.

3.5. Prepare summary of treatment chemical system deficiencies that must be addressed to meet capacity, performance, reliability, and safety needs.

Task 4 Pumping Station Evaluation

The objective of this task is to review and assess the condition, operation and capacity of the existing raw water and finished water pumping stations. This task will consist of the following subtasks.

4.1 Inspect the existing raw water and finished water pumping units and associated exposed piping and valves at the Water Plant. Review pump operation, and control with plant personnel. Discuss availability of spare parts and recent maintenance issues.

4.2 As systems age, pipe friction coefficients are reduced due to sediment accumulation, pipe encrustation, etc. These changes in system characteristics affect pump performance and capacity.

To evaluate potential changes in system characteristics, M&E will obtain various points of flow versus pump discharge pressure at known pump speeds and tank water levels. These points will be used to develop system curves for the pumps. It is planned that pumping station personnel will assist M&E in obtaining this data (i.e., flow, pressure and tank water level), and that appropriate flow meter(s) and pressure gauges currently exist.

To evaluate potential changes in pump performance, M&E will obtain the manufacturer's pump curves (to be provided by the City) and compare points on the manufacturer's pump curve to actual points of flow versus total dynamic head (TDH) at known pump speeds. To obtain TDH readings, M&E will utilize existing pump suction and discharge pressure gauges. If pressure gauges do not exist in the appropriate location(s) to obtain the necessary data, it is planned the City will install calibrated pressure gauge(s) in the location(s) recommended by M&E. It is also planned that plant personnel will assist M&E in pump testing and will verify actual pump speed.

The resulting information will be used to preliminarily evaluate the hydraulic limitations of the pumps and to identify alternatives for increasing firm capacity to 90 mgd. It is noted that accurately determining current system characteristics and evaluating alternatives to increase capacity will require detailed hydraulic modeling of the piping systems. Consideration should also be given to the impact of future distribution system modifications (such as line cleaning which would increase the pipe friction factor) on system characteristics. M&E will utilize existing hydraulic models of the distribution system, if available. If not available, M&E can provide detailed modeling of the distribution system as well as an assessment of future distribution system modifications on system characteristics as part of the Study.

4.3 Prepare summary of identified water pumping system deficiencies that will need to be corrected to achieve a firm pumping capacity of 90 mgd. Identify and describe the proposed alternatives for increasing firm capacity to 90 mgd. Redundancy requirements for pumps in relation to maintenance activities will be considered in determining the required pumping capacities.

Task 5 Process Control Evaluation

The process control system consists of the instrumentation and control equipment used to monitor and control the treatment process and related equipment including the raw water and finished water pumping systems. The objectives of this task are to: (1) identify and evaluate existing process control system components and associated limitations or deficiencies; (2) identify alternatives for automation; and (3) coordinate this evaluation with any City system-wide SCADA plans. This task will consist of the following subtasks:

5.1. Prepare functional description of the existing process control systems. Include a summary of deficiencies or limitations and identify areas where additions or modifications to the system could enhance process monitoring and/or control.

5.2. Conduct discussions with the City to gain a clear understanding of the overall SCADA plan for the City.

Task 6 Electrical Distribution System Condition/Capacity Assessment

The electrical distribution system will be evaluated to determine its condition and capacity. This task will consist of the following subtasks.

6.1. Conduct a field survey to review existing design and specification documents to ascertain a clear understanding of the electrical distribution systems. Meet with plant personnel to determine background and operational features of the facilities. Visually inspect the existing electrical distribution systems at the plant and review compliance with National Electric Code, National Electrical Manufacturers' Association, and National Fire Protection Association codes and evaluate the future expected service life of the electrical equipment.

6.2. Review the existing single line diagrams and compare current conditions and arrangements to the existing documentation. Conduct an analysis of the existing electrical load and projected future potential loads. Conduct an analysis of the electrical supply system including the primary substation to determine capacity and capability for expansion.

6.3. Evaluate the capacity of the existing electrical distribution system. This evaluation will include close coordination and input from both the American Electric Power Company and the Columbus Division of Electricity. Determine the current maximum demand and prepare load consumption graphs to illustrate power use. Work with the power companies to determine capacity of the existing power source and availability of additional power to accommodate additional loads.

6.4 Prepare a report documenting the findings of the electrical distribution system condition/capacity assessment.

Task 7 Preliminary Structural Condition Assessment

The objectives of this task are to perform a preliminary structural condition assessment of all structures that may be affected by the increase in treatment plant capacity. At this time we anticipate these structures will include the flocculation and settling basins.

7.1. Perform an on-site review of the existing facilities. The purpose of this on-site review will be to observe the structural condition of the facilities. The on-site inspection will be limited to visual observation of the exposed portions of the structures to (1) evaluate current conditions and (2) evaluate evidence of structural modification, weakness of members and/or connections, deterioration of materials, settlement or foundation problems and other unusual structural conditions.

7.2. Identify the need for additional inspections, testing, and/or evaluations to confirm current conditions, determine the appropriate remedial measures, or to estimate useful remaining life.

7.3 Prepare a report documenting the findings of the structural condition assessment. The report will include a description of the evaluation process, observations resulting from the on-site review, and recommendations regarding the need for particular actions including more detailed evaluations.

Task 8 Identify Alternatives for Upgrade and Expansion to 90 mgd

In this task, alternatives will be identified for modifying, improving and/or replacing portions of the existing facilities to correct the hydraulic, treatment and physical limitations identified in Tasks 1-7. Included in this effort will be the identification of alternatives to accomplish the additional clarification, softening, and filtration capacities that appear to be needed. At this time, preliminarily, we anticipate the following alternatives will be evaluated:

- Install tube settlers in the Stage 1 and Stage 2 settling basins followed by higher rated filters.

- Install a new Stage 1 clarifier along the east side of the plant and convert the Stage 1 settling basin to a softener unit followed by higher rated filters. High rate Actiflo® clarifiers and DensaDeg® softeners will be considered along with standard softeners and clarifiers and solids contact units.

- Convert the recarbonation basin to a Stage 2 settling basin and install a new recarbonation basin on the east side of the plant followed by higher rated filters. Install tube settlers in the Stage 1 settling basin.

The Actiflo® clarification process is a microsand-enhanced clarification process, which uses polymer and microsand to attach to the coagulated solids enabling the process to operate at very high surface loading rates of up to 35 gallons per minute per square foot (gpm/sf). For this reason it is a very compact process which is highly effective for plant expansions and upgrades where there are site constraints, as at Dublin Road.

The DensaDeg® softener clarifier is a very high rated reactor-clarifier-thickener with tube settlers that operates at up to 10 gpm/sf surface loading rate and produces very high solids softening residuals. Being very high rated, minimal land space is required resulting in the DensaDeg® softener being very advantageous for plant expansions that are site constrained.

Both processes can easily be retrofitted into existing clarification or softening basins such as at Dublin Road or constructed in stand-alone basins nearby. Both clarification processes would require piloting to obtain approval in Ohio.

Task 9 Flocculation/Clarification/Softening Alternatives Evaluation

For each alternative, the following tasks will be performed:

9.1 Evaluate expected performance and reliability based on operating experience at other facilities.

9.2 Prepare preliminary mechanical layout drawings, including modifications required to existing structures, equipment, piping and channels.

9.3 Evaluate impact on the existing hydraulic profile.

9.4 Evaluate operations and maintenance requirements and relative complexity. To assist in this evaluation, as part of Task 15, site visits will be made with City personnel to one tube settler installation, one Accelator® solids contact installation, one Actiflo® facility and one DensaDeg® facility.

9.5 Evaluate extent to which an overall capacity increase to 90 mgd could be phased-in over time.

9.6 Evaluate construction impacts on existing operations and feasibility of keeping plant on line during construction. Identify resulting construction staging requirements.

9.7 Identify additional treatment systems, such as ultraviolet light (UV), that may be required to meet the future regulations previously referenced. Identify how these systems could be phased into the above layouts in the future as the regulations are promulgated.

9.8 Determine the necessary capacity of the sludge and dewatering pumping station and transfer line that extends to the quarry. Prepare preliminary layout drawings of the pump station and for any new transfer line that may be required. A new transfer line would require a river crossing.

9.9 Prepare preliminary estimates of capital and operating cost for each alternative using life cycle cost analyses. A 20-year time period will be used for the analyses. The target level of accuracy for the preliminary cost estimates will be ±25 percent.

9.10 Contact the Ohio Environmental Protection Agency (Ohio EPA) to review potential process trains and confirm piloting requirements.

The changes required to the chemical storage and application systems, electrical and instrumentation systems will be included in the evaluation.

Task 10 Filter Upgrade Evaluation

This task will consist of the following:

10.1 Consider the possibility of achieving higher rated filters by performing a full-scale demonstration for Ohio EPA. If achieving a higher rating with the existing filter media does not appear to be feasible, evaluate feasibility and benefits of changing the existing filter medium to a higher rate medium.

10.2 Evaluate extent to which piping, valves, actuators and flow meters in the filter gallery should be replaced. Evaluate regulatory requirements and feasibility of adding a filter-to-waste capability. Determine size requirements for 90 mgd.

10.3 Develop planning-level capital cost estimates for recommended improvements. Target level of accuracy for planning-level cost estimates is ±25 percent.

10.4 Evaluate potential effects on filter run time and backwash frequency due to increased filter loading rates and include this in the analysis of filter backwash pumping capability and redundancy. Evaluate and project future operation and maintenance (O&M) cost for filter backwash and residuals handling.

Task 11 Flocculation/Clarification/Softening/Filter Upgrade Technical Memorandum

M&E will prepare a Technical Memorandum presenting the results of the flocculation/clarification/softening alternatives evaluation and filter upgrade evaluation. The expected performance along with O&M advantages and disadvantages of each alternative will be discussed. Preliminary mechanical arrangement drawings will be presented identifying the associated facility modifications for each alternative. Life cycle costs of the various alternatives will be presented for comparison purposes. The costs developed will be planning-level costs useful for comparing the alternatives only.

M&E will prepare a matrix comparing the advantages and disadvantages of each alternative. A sample matrix completed by M&E for another project is included in Appendix A of our technical proposal.

The Technical Memorandum will be submitted to the City for review and comment. Following review, a project workshop will be conducted as part of Task 15 to discuss the Memorandum. The goal of the project workshop will be to reach a consensus on the alternative(s) to be piloted, discuss the pilot study scope, and identify the items of work the City can provide during construction and operation of the pilot plant.

Task 12 Pilot Study

M&E developed a preliminary flow diagram and layout of the pilot plant based on current knowledge of the Water Plant and discussions with the City regarding processes to be evaluated. The flow diagram and layout have been used to develop a preliminary cost estimate to construct the pilot plant and to perform the pilot studies. The layout and cost estimate may change as Tasks 1-11 are completed and as a result of input from the Ohio EPA and the City. Once the scope of the pilot study is finalized, M&E will prepare a revised scope and cost estimate for City approval. On the basis of the approved pilot study plan and revised cost estimate, this Contract will be amended accordingly.

The following discussion outlines the anticipated scope of services for the pilot plant design, construction, operation and demobilization. M&E has budgeted funds in this Contract to cover the pilot study effort through the design phase. A contract modification will be needed to cover M&E's costs for the construction and operation phases.

M&E will provide design, mobilization, start-up, operation and demobilization of the pilot plant for four seasons of piloting and perform the following associated tasks:

12.1 Design and construct a pilot structure to house the pilot equipment. M&E anticipates providing a 4,500 square foot pre-engineered metal building for this purpose.

12.2 Provide the necessary electrical services, instrumentation, heating and ventilation equipment associated with the pilot equipment and pilot structure. Provide suitable lighting and electrical outlets within the pilot structure.

12.3 Provide raw water piping, treated water piping and waste piping to/from the pilot equipment and pilot structure and the water treatment plant. The City will supply the raw water and receive treated water and residuals from the pilot process into the water treatment plant process in accordance with M&E's identified quantities.

12.4 Provide the necessary treatment chemicals for the pilot processes throughout the pilot study.

12.5 Collect water samples and perform the necessary analytical work, except for those analyses the City wishes to perform.

12.6 Provide pilot testing equipment to pilot test the following:

- Dissolved air flotation
- Actiflo® clarifiers
- Tube and/or plate settlers
- DensaDeg® softeners
- Ultrafiltration membrane treatment
- Reverse osmosis membrane treatment
- Rapid sand filter

12.7 Pilot test dissolved air flotation, Actiflo® clarifiers and tube or plate settlers for high rate clarification ahead of softening. This equipment will operate continuously in parallel over a twelve-month period. While the flow from one clarification process is being treated through softening, the flow from the other two clarification processes will be wasted. Over the entire year, flow from each type of clarifier will be alternatively directed to softening to capture water quality variations for each process.

12.8 Pilot test a DensaDeg® softener following high rate clarification. A pilot-scale rapid sand filter will be evaluated following DensaDeg® and proceeded by recarbonation. The pilot-scale rapid sand filter design will be similar to the existing Water Plant filter and tested for a filtration rate that will achieve 90 mgd.

12.9 Pilot test reverse osmosis membrane treatment following the high rate clarification, softening and rapid sand filter processes. This testing will evaluate removal efficiencies for the following constituents: nitrates, atrazine and disinfection by-product precursors.

12.10 Set up the pilot plant equipment and piping within the pilot plant structure. Coordinate with the City and the vendors to connect vendor-supplied equipment to the pilot processes. Perform jar testing on site, prior to the start of pilot testing.

12.11 Start up the equipment and stabilize treatment prior to the start of the pilot runs. Provide one engineer for eight hours per day, seven days per week for twelve months to operate the pilot equipment and perform required sampling.

12.12 Demobilize the pilot equipment at the completion of the twelve months of pilot testing. The pilot equipment and piping will be removed from inside the pilot plant building which will remain for the City's use.

On the basis of a project workshop, the piloting plan and schedule will be further developed and finalized. The pilot plan will confirm the scope of piloting required and elaborate on the equipment required, the potential location of the piloting plant and connection details for influent and effluent flows. This task will include discussions with Ohio EPA to confirm piloting requirements and will include the following subtasks.

12.13 Prepare and submit a draft pilot study plan to the City for review and comment. As a part of Task 15, meet with the City to review comments. Following the meeting, M&E will incorporate City comments into the pilot study plan, and meet with Ohio EPA to present the pilot study plan and review any questions or additional requirements they may have. The meeting with Ohio EPA will be performed as part of Task 15.

12.14 Revise the pilot study plan to incorporate Ohio EPA's comments and develop a cost estimate to conduct the pilot studies. The final pilot study work plan will be provided to the City.

12.15 Conduct monthly progress meetings with the City during the pilot study. Prepare and submit a monthly progress memorandum prior to each meeting.

12.16 Meet with the City and Ohio EPA after each piloting season to review the piloting results.

12.17 Prepare and submit five copies of a Technical Memorandum, which summarizes the results of the first season of pilot testing. Submit the report to the City. Meet with the City to discuss the Technical Memorandum. Incorporate the City's comments into the pilot study report.

12.18 Prepare and submit five copies of a draft pilot testing report, which will detail the results of the pilot testing program. On the basis of the pilot tests, M&E (in conjunction with a project workshop conducted with the City) will recommend one or more process(es) for implementation. M&E will submit the draft report to the City for review. M&E will incorporate any City comments into the report and forward a copy to the Ohio EPA for review and approval.

12.19 Meet with the City and Ohio EPA to review comments, to discuss the implementation plan and to obtain regulatory approval for the pilot test report. Final copies of the report will be forwarded to the City and Ohio EPA.

Task 13 Prepare Draft Report

Work performed in the previous tasks will be presented in a draft report and submitted to the City for review. The individual tasks will have separate deliverables where noted.

Following the City's review, a meeting will be held as part of Task 15 to discuss any comments or questions the City may have and achieve consensus on the recommendations presented in the draft report.

Task 14 Finalize Report

Following the meeting to discuss the draft report, a final Treatment Capacity Increase Study report will be prepared, which addresses the City's comments and which reflects the consensus reached during the meeting. Copies of the final report will be provided to the City.

Task 15 Meetings and Site Visits

15.1 Two site visits to the Dublin Road Plant will be conducted to confirm existing conditions and meet with plant personnel.

15.2 Four site visits to other plant facilities will be made to evaluate O&M requirements of four alternative processes: Tube settlers, Accelator® solids contact clarifiers, Actiflo® and DensaDeg®.

15.3 It is anticipated that M&E will attend seven meetings during the course of the project (in addition to informal meetings that may occur during the site visits and the meetings that are associated with performing the pilot study under Task 12). These meetings will include:

- Kick-off meeting
- Plant existing conditions report review meeting
- Process upgrade alternative review meeting
- Flocculation/clarification/softening/filter upgrade technical memorandum workshop
- Pilot study plan review meeting with City
- Pilot study plan review meeting with Ohio EPA
- Draft report review meeting.

Task 16 Project Administration

16.1 M&E will submit invoices on a monthly basis. A monthly progress status report will be submitted with each invoice.

16.2 Quality control will be accomplished through use of an in-house technical advisory team to perform senior review and technical oversight at critical points in the project.