

SCOPE OF WORK AND TIMELINE

PURPOSE

The purpose of EXHIBIT B is to outline the Scope of Work associated with the Texas Water Development Board Research and Planning Fund Research Grant (TWDB Contract No. 1148321310)

BACKGROUND

Under the current Texas Administrative Code, low- and high-pressure membranes are considered innovative technologies for water treatment. To implement new membrane models and technology, municipalities and water districts are, therefore, required to perform full-scale acceptance pilot testing. Approval for a single membrane type may cost between \$750,000 - \$1 million. While this may be possible for larger entities, the fact remains that pilot testing is an expensive endeavor, possibly negating the potential cost savings from switching to a more energy efficient membrane system. Therefore, it is imperative that a new procedure be developed to allow for greater ease of changing membrane systems to take advantage of rapidly changing technology.

Advances in membrane technology means that an ever-greater number of products will be available to plant operators and provide opportunities to reduce full-scale plant pumping pressures, decrease clean-in-place (CIP) intervals, and increase membrane life. All of these facets of operation will lead to a reduction of water production costs and a savings to the individual ratepayer without sacrificing the quality of treated water. The development of alternative means for State acceptance of membrane alternatives may, therefore, further increase cost savings to the utility.

Ultimately, the goal of this project is to develop a guidance document for alternative pathways to acceptance of new membrane systems. To reach this goal, we will compare model and pilot data (single-element and demonstration-scale) to actual plant data to demonstrate that other methods of predicting full-scale plant performance with various membrane types may be achieved without expending hundreds of thousand of dollars in pilot testing costs.

SCOPE OF SERVICES

PROJECT MANAGEMENT AND COORDINATION

CONTRACTOR will provide project management to coordinate, conduct, and manage the work including budget and schedule. The project manager will make staffing allocations, manage quality, monitor budget versus progress and approve project invoices. Quarterly progress reports will be submitted to TWDB as an attachment to invoices in accordance with TWDB guidelines.

Within the first 60 days of the commencement of this CONTRACT, CONTRACTOR will consult with TWDB staff to prepare a list of entities that potentially may be affected by the results of this RESEARCH PROJECT. With the FINAL REPORT, the CONTRACTOR will provide an updated list of entities to TWDB staff that potentially may be affected by the results of this RESEARCH PROJECT.

Deliverables:

- *Quarterly Progress Reports*
- *A list of entities to TWDB staff that potentially may be affected by the results of this RESEARCH PROJECT.*

1.0 LITERATURE REVIEW

1.1 Literature Search

CONTRACTOR will perform a literature search by analyzing published reports and documents related to pilot studies of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis in peer-reviewed journal articles and published or located (but not limited to) in university studies. The following are potential topics to be considered in executing the literature search:

- a) General information on the current state of membrane technology including pending advances and schedule of implementation in the membrane market.
- b) Legal implications of the pilot testing of various membrane processes.
- c) Historical costs of membrane pilot testing in the State of Texas.
- d) Past studies determining the accuracy of membrane prediction models.
- e) Past studies determining the accuracy of other screening methods for membrane selection including flat sheet testing, single-element pilot testing, etc.
- f) Review of regulations from other states relevant to pilot testing membrane processes

1.2 Component A of Draft Final Report

The literature review (including legal issues) will be summarized by the CONTRACTOR as Component A of a Draft Final Report. Component A will be submitted to the TWDB for review. It is assumed that TWDB will have 30 days to review Component A, after which the CONTRACTOR and TWDB will meet to discuss review comments. Component A of the Draft Final Report will be submitted to TWDB as part of the Final Report (Task 5.1) with an appendix listing the TWDB review comments and how the CONTRACTOR addressed them.

Task 1 Deliverables:

Draft Final Report Component A – Summary of Literature Review

2.0 PILOT TESTING ALTERNATIVES EVALUATION

2.1 Pilot Testing Alternatives Evaluation

CONTRACTOR will develop plausible alternatives to pilot testing of membranes using our experience from the design of membrane facilities and results from the literature review. Some initial alternatives that will be considered include:

- a) Desktop modeling
- b) Flat sheet testing
- c) Single element pilot testing
- d) Modified pilot testing

Other alternatives may be developed based on information gathered during the literature review (Task 1.0). CONTRACTOR will forward a preliminary list of alternatives for pilot testing to the TWDB and TCEQ for a basis of discussion at one of the regularly scheduled progress meetings. Once there is agreement on the list of alternatives, a detailed analysis of the alternatives will proceed in Task 2.3.

2.2 Model, Pilot, and Full-Scale Data Acquisition

CONTRACTOR will acquire the RO model, pilot, and full-scale data from membrane manufacturers and original equipment manufacturers (OEMs) to be used for analysis and validation of alternative testing approaches in Task 2.3.

2.3 Data Analysis

Once the data has been collected in Task 2.2, CONTRACTOR will evaluate and compare the RO model, pilot, and full-scale plant data with respect to hydraulic, water quality, and other RO performance parameters. Statistical data analysis software will be used for this evaluation with the goal of assigning levels of confidence of each alternative testing approach to predict full-scale performance for various brackish groundwater sources.

2.4 Component B of Draft Final Report

The membrane performance comparison will be summarized by the CONTRACTOR as Component B of a Draft Final Report. Component B will be submitted to the TWDB and TCEQ for review. It is assumed that TWDB will have 30 days to review Component B, after which our team, TCEQ, and TWDB will meet to discuss review comments. Component B of the Final Report will be submitted to TWDB as part of the Final Report (Task 5.1) with an appendix listing the TWDB review comments and how the CONTRACTOR addressed them.

Task 2 Deliverables:

Draft Final Report Component B – Summary of the Membrane Performance Data Evaluation

3.0 TCEQ COORDINATION

CONTRACTOR will coordinate with the TCEQ to inform them of the planned approaches to tasks and solicit comments and questions to be addressed in each task. CONTRACTOR will coordinate quarterly review meetings with TWDB and TCEQ. These meetings may be conducted via conference call. CONTRACTOR will provide drafts of the Components A and B of the Final Report and the Guidance Document as appropriate for their review.

4.0 COST ANALYSIS

CONTRACTOR will estimate the costs associated with conventional pilot testing as compared to the alternatives. Cost estimates for each possible alternative will be developed using the following components, as appropriate:

- a) Upfront engineering design
- b) Obtaining vendor quotes for all major treatment process components or use recent project data for a similar process.
- c) Obtaining latest, and average, utility rates in the State of Texas
- d) Estimated costs for new structures or pilot testing infrastructure
- e) Estimated demolition costs, where required
- f) Estimated analytical costs
- g) Estimated reporting costs

For potential construction costs, CONTRACTOR will provide cost estimates in Microsoft Excel 2007 format. Costs will be based on a planning level estimate. A summary of the cost analysis will be included as part of Component B of the Draft Final Report.

5.0 REPORTING/GUIDANCE DOCUMENT

5.1 Draft and Final Report

During Tasks 1.0, 2.0 and 4.0, CONTRACTOR will prepare draft components (A and B) of the Final Report which will focus on the literature review, analysis of collected data, and cost estimates. Once comments have been received from TWDB and TCEQ on the drafts of Components A and B, they will be incorporated as applicable in the Final Report.

5.2 Draft and Final Guidance Document on Alternatives to Membrane Pilot Studies for TCEQ Acceptance and Outreach

CONTRACTOR will develop the guidance document based on the Final Report. The guidance document will include a description of RO membrane evaluation approaches, implementation strategies for each approach, and expected RO membrane evaluation costs. CONTRACTOR will prepare a Draft Guidance Document for review and submit to the TWDB and TCEQ for comments. It is assumed that a 30-day review cycle will be provided. After receiving comments from the TWDB and TCEQ, CONTRACTOR will hold a workshop with representatives from both agencies to discuss the results. Once comments have been received from TWDB and TCEQ on the draft guidance document they will be incorporated as applicable in the final version.

The final version of the Guidance Document will be used as the basis for outreach. Up to five one-hour seminars will be conducted by CONTRACTOR to target different water planning groups in Texas.

Task 5 Deliverables:

Final Report Component A

Final Report Component B

Draft Guidance Document

Final Guidance Document

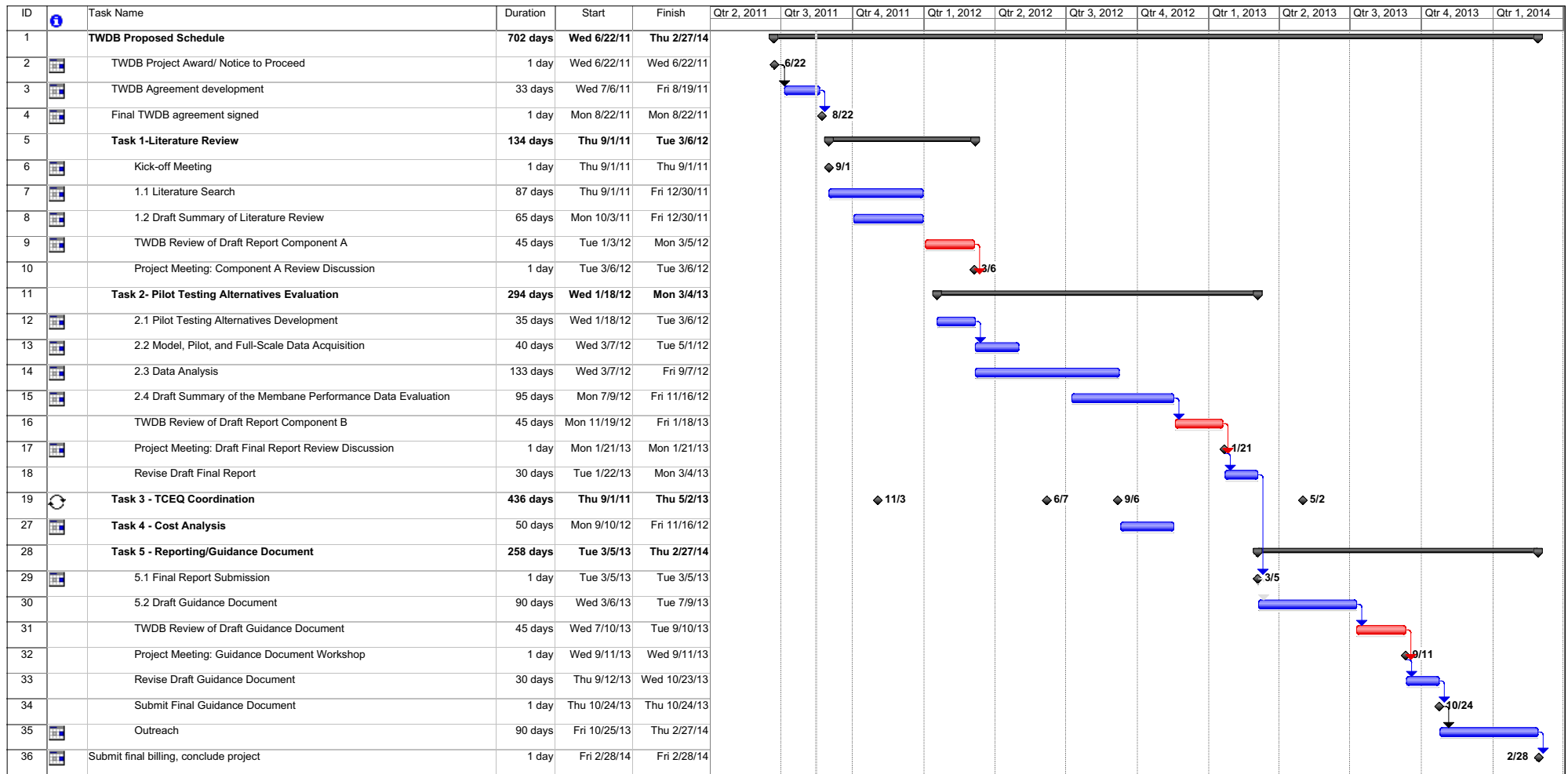


Exhibit B Date: Mon 8/15/11
 Anticipated Project Schedule
 TWDB - Membrane Pilot Alternatives

Task Progress Summary External Tasks Deadline

Split Milestone Project Summary External Milestone