1 Introduction

City Water Technology (CWT) is pleased to submit the following proposal to Warrumbungle Shire Council for upgrade works at Mendooran Water Treatment Plant. This proposal outlines the scope of work for the concept design and technical specification of several upgrade packages.

It should be noted that in 2015, CWT performed a plant audit on Mendooran WTP for NSW Health. This audit addressed design limitations and provided several recommendations that can be re-evaluated in this project.

1.1 Background

The township of Mendooran forms part of the Warrumbungle Shire Council (WSC) local government area. The Mendooran WTP supplies treated water to the Mendooran and Coolabah areas. The plant was built in 2009 and has a capacity of ~1.0 ML/day.

Water is pumped from Castlereagh River and backup bores to feed the WTP, where the major treatment processes of the plant are the following:

- Aeration (cascade);
- Manganese & iron removal with potassium permanganate ($KMnO_4$);
- Coagulation with polyaluminium chloride (PACl);
- Settling in sedimentation lagoons;
- Filtration using coal/sand gravity filters;
- Disinfection using liquid chlorine (NaOCl); and
- Fluoridation.

In 2017, a boiled water alert was issued from NSW Health for Mendooran and neighbouring Coolabah region due to consistent E-coli detections. It was discovered that the current WTP has several operational issues including;

- Insufficient remote control, automation and dosing capabilities;
- Insufficient data collection and trending;
- WTP design deficiencies; and
- Insufficient barriers to prevent future water incidents.

The following proposal outlines the project methodology, deliverables and fees to undertake the work as specified in the scope to rectify and improve the operation of the WTP.

2 Methodology

2.1 Appreciation of Brief

We understand that the goal of this project is to develop several small work packages to complete the following tasks:

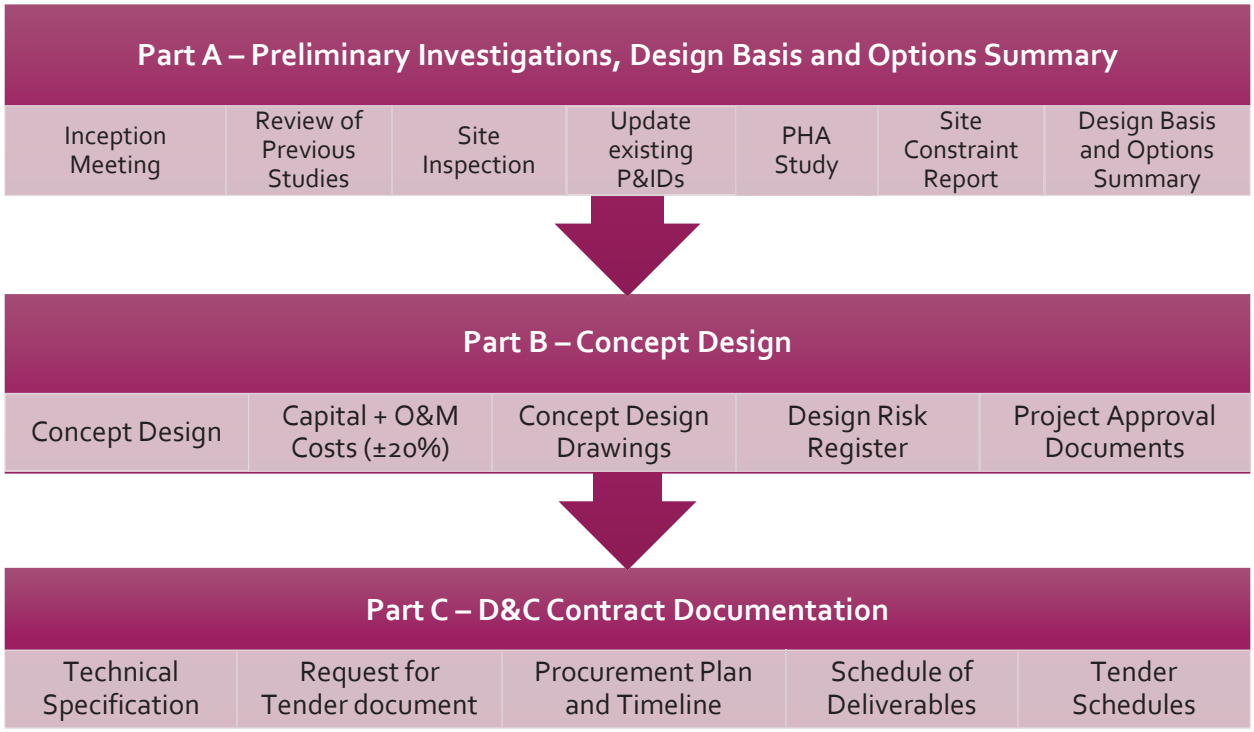
- Rectification of deficiencies in plant operations and chemical dosing by:
  - Reconfiguring potassium permanganate and polyaluminium chloride dosing by separating these dosing locations to ensure adequate delay time between dosing points for improved oxidation and coagulation;
  - Adding additional capability to dose chlorine in the filter feed to establish an oxide coated media process for enhanced manganese removal;
  - Performing a hazard assessment and resolving all issues identified;
  - Rectifying issues to enable blending of all source waters and improve treatability; and
  - Re-establishing reservoir integrity.
- Improving disinfection and network residuals by:
  - Installing a new twin 70kg chlorine gas dosing system;
    - It is anticipated that Mendooran will require greater storage capacity for the chlorine dosing system. This will be confirmed during the design stage.
  - Removing existing unreliable sodium hypochlorite system;
  - Installing an inline booster pump at the outlet of the standpipe reservoir to provide mains cleaning;
  - Re-designing the chlorine dosing system at Coolabah reservoir site to allow for automation and improved chlorine residual control; and
  - Reviewing and re-designing the reticulation system and storage operations to decrease water age and ensure adequate network residuals.
- Monitoring and instrumentation upgrades with:
  - Installation of additional online instrumentation including turbidity meters on each filter and post treated water monitoring, i.e. pH and turbidity.
  - Configuration of appropriate feedback control to PLC/SCADA including the shutdown of clear water pumps when low chlorine residuals are detected in the clear water tank and backwash initiation of the filters when the CCP is breached.
  - Control and automation improvements for items including filter backwash sequences, flow control valves, interlocks and alarms, and start/stop operation of the WTP.

Considering the above, CWT acknowledges that the project scope will only consider the following items:

- Chemical dosing systems;
- Reservoirs;
- Raw water blending;
- Reticulation system; and
- Instrumentation and control systems for the WTP;

A separate budget has been provided to review, propose upgrades and provide technical specifications as needed for all other process units at Mendooran WTP.

2.2 Proposed Task Breakdown



2.2.1 Part A – Preliminary Investigations, Design Basis and Options Summary

The Preliminary Investigations, Design Basis and Options Summary phase is to include the following tasks:

- Task A1: Inception Meeting;
  - Allowance for a 1.5-hour teleconference to provide opportunity for both project teams to gain a better understanding of the project drivers and deliverables.
  - The inception meeting shall be used to discuss specific project requirements, communications protocols, and initial requests for information.
- Task A2: Review of previous studies and documentation to perform the following subtasks:
  - Task A2.1: Propose locations for the coagulation and oxidation dosing points and with the following design criteria:
    - Enough delay time between the dosing points;
    - Optimised order of chemical addition; and
    - Maximum and minimum polyaluminium chloride dosing capacity.
  - Task A2.2: Identify any issues with water blending from the various water sources and propose solution if required (i.e. any issues with pipework from the backup bores to the rising main);
  - Task A2.3: Determine the required capacity and dosing rates for a new chlorine dosing system (with removal of the existing sodium hypochlorite system);

- Task A2.4: Review the current status of the reservoirs and CWT;
- Task A2.5: Review the reticulation system design and storage operations to identify opportunities to decrease water age and ensure adequate network residuals;
- Task A2.6: Review the existing chlorine dosing system at the Coolabah reservoir and propose redesign if necessary, considering the following criteria:
  - An automated system with a set chlorine residual; and
  - Relocation of the dosing point, control protocol and mixing, if required.
- Task A2.7: Review the existing monitoring scheme and instrumentation and determine if upgrades are required for feedback control to PLC/SCADA;
- Task A2.8: Review water quality data of the emergency bores and alternate river off take to determine the suitability of these sources in terms of volume and quality;
- Task A2.9: Review and propose updates to the Critical Control Points (CCPs) based on recommendation from the Department of Health and DI Water.

- Task A3: Complete a site inspection to highlight any other issues not addressed in Task A2;
  - CWT has been involved in the writing of the Good Practice Guide to the Operation of Drinking Water Supply Systems for the Management of Microbial Risk (2015), which is currently being revised as a new 2019 edition. The new edition includes an auditing template which can be used to help highlight additional issues at the plant.
- Task A4: Update the existing P&IDs:
  - Task A4.1: For the WTP; and
  - Task A4.2: For the reticulation system.
    - Note: This task is performed based on the assumption that no civil or geotechnical surveys are required, and that Council will provide all the necessary information needed to draft the P&IDs.

Deliverable: Updated P&IDs for the WTP and reticulation system

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- Task A5: Perform a Preliminary Hazard Analysis (PHA) study;
  - Task A5.1: A PHA workshop will go through all steps of the treatment process from catchment to tap, to identify high risk deficiencies in the WTP design. This workshop can be performed over teleconference.
  - Note: Only a PHA will be performed at this stage, rather than a combined PHA and CHAIR workshop as per Warrumbungle's *Brief for the Provision of Consultancy Services*. A CHAIR (Construction Hazard Assessment Implication Review) workshop is typically performed with the project constructors to minimise construction, maintenance, repair and demolition safety risks. To perform this, a tenderer and a design will already need to be selected. This is outside the consultancy scope of this project, and CWT involvement in a CHAIR assessment can be added on at additional rates once a tenderer is selected.

- Task A5.2: Prepare a Draft PHA Report, which can be submitted to Council for comment within two weeks of the workshop (as requested).
- Task A5.3: Finalise PHA Report.
- Task A5.4: Develop preliminary Project Risk Management Plan (PRMP).

Deliverable: PHA Workshop and Report, Project Risk Management Plan

- Task A6: Produce a Site Constraint Report;
  - This report will summarise the documents reviewed, general site constraints identified and their implications, and document any issues found in Task A2, A3, A4 and A5.
  - Task A6.1: Prepare Draft Site Constraint Report and submit to Council for comment.
  - Task A6.2: Final Site Constraint Report.

Deliverable: Site Constraint Report

- Task A7: Produce a Design Basis and Options Summary Report, involving the following:
  - Task A7.1: Review water quality and capacity data;
  - Task A7.2: Confirm a process design envelope, identifying the recommended WTP improvement options based off the review of previous documents and site inspection;
  - Task A7.3: Develop design criteria for the individual process units identified in the envelope;
  - Task A7.4: Provide an options summary covering:
    - Chemical Dosing System Upgrades
    - Raw Water Supply Upgrades
    - Reticulation and Storage Upgrades
    - Automation, Monitoring and Instrumentation Upgrades
    - Operation
    - Maintenance
    - Indication of cost for each option (i.e. low/medium/high) to enable comparison

    Note: The optioneering task has been moved from Part B as per Warrumbungle's *Brief for the Provision of Consultancy Services* to Part A of the project. This has been done so that the preferred upgrade options can be selected prior to the Concept Design Phase.
  - Task A7.5: Produce Draft Design Basis and Options Summary Report;
  - Task A7.6: Facilitate a Design Basis and Options Summary Workshop to discuss and review the draft report with stakeholders. Teleconference allowance provided for this task;
  - Task A7.7: Finalise the Design Basis and Options Summary Report; and

- Task A7.8: Update the Project Risk Management Plan.

Deliverables: Design Basis and Options Summary Report, Updated Project Risk Management Plan

2.2.2 Part B – Concept Design

A Concept Design is required for the development of the Design and Construct contract (D&C). The Concept Design will be based on the preferred option selected in Task A7.6 and will include the following design works:

- Task B1: Process Design:
  - Task B1.1: Process equipment sizing;
  - Task B1.2: Utilities requirement;
  - Task B1.3: Process flow diagram including mass and flow balance;
  - Task B1.4: Process and instrumentation diagrams;
  - Task B1.5: Hydraulic profile; and
  - Task B1.6: Operation and control philosophy.
- Task B2: Civil, Structural and Mechanical Design:
  - Task B2.1: General arrangement drawings of major structures and mechanical equipment;
  - Task B2.2: Preliminary design and selection of key process equipment including new chlorine dosing systems at the Mendooran WTP and at the Coolabah Reservoir;
  - Task B2.3: Preliminary foundation design based on geotechnical investigation; and
  - Task B2.4: General arrangement drawings of pipework (both underground and above ground).
- Task B3: Electrical and SCADA Design:
  - Task B3.1: Site single line diagram;
  - Task B3.2: Motor and instrumentation list;
  - Task B3.3: Control and telemetry architecture;
  - Task B3.4: Power upgrades requirements;
  - Task B3.5: Requirement for standby generator; and
  - Task B3.6: Control system, alarms and communication philosophy.
- Task B4: Provide capital, O&M cost estimate (±20%) and NPV for all work required for the construction of the upgrade components, including temporary works
  - Note: To ensure ±20% cost estimates are accurate for concept design level, CWT will liaise with suppliers to obtain quotes for consideration in the cost estimation process.
- Task B5: Prepare concept design drawings suitable for use as a basis in detailed design. Two revisions will be submitted:
  - Task B5.1: 80% draft, to be submitted with the Draft Concept Design Report; and

- Task B5.2: Issued for Tender, together with the final Concept Design Report.
- Note: Task B5 includes the Concept Design PFDs, P&IDs, GA drawings, and electrical drawings which are detailed in other subtasks.

Deliverables: Concept Design Drawings (2 x revisions - 80% Draft and Issue for Tender)

- Task B6: Produce the Concept Design Report.
  - Task B6.1: Create a Draft Concept Design Report including results of Task B1, B2, B3, B4 and B5;
  - Task B6.2: Facilitate a Concept Design Workshop to discuss and review the draft Concept Design Report and associated drawings with stakeholders;
  - Task B6.3: Finalise the Concept Design Report; and
  - Task B6.4: Review and update the Project Risk Management Plan.

Deliverables: Concept Design Report, Updated Project Risk Management Plan

- Task B7: Safety in Design Assessment:
  - Task B7.1: Create and maintain a Designer Risk Register throughout the Concept Design phase (created at the beginning of the Concept Design phase);
  - Task B7.2: Meeting at the CWT office (Sydney) or teleconference to perform the Safety in Design Assessment.

Deliverable: Designer Risk Register

- Task B8: Gather documents required for project approval (i.e. Section 60 submissions, liaison with DI Water, business case in accordance with NSW Government guidelines)

Deliverable: Documentation required for project approval

2.2.3 Part C – D&C Contract Documentation

The required D&C Contract Documentation works required of this project includes:

- Task C1: Preparing the technical specifications for the proposed upgrade items as per the Concept Design including:
  - Task C1.1: General Specification;
  - Task C1.2: Detailed Specification;
  - Task C1.3: Process and Mechanical Specification;
  - Task C1.4: Civil Specification;
  - Task C1.5: Electrical Specification; and

- Task C1.6: Automation and Control Specification.

Deliverable: Technical Specification

- Task C2: Preparing the Request for Tender documentation including conditions of tendering and conditions of contract (while in liaison with Council) based on AS4300;
  - Note, it has been advised in the Scope of Works that Council will prepare the Conditions of Tendering and the General Conditions of Contract.
  - Task C2.1: Preparing Request for Tender document;
  - Task C2.2: Procurement plan and timeline;
  - Task C2.3: Schedule of deliverables;
  - Task C2.4: Tender schedules that align with the agreed procurement plan.
    - The Request for Tender, Procurement plan and timeline and Schedule of Deliverables will require significant input from Council as they are highly dependent on Council requirements and preferences.

Deliverable: Request for Tender document, including Procurement Plan and Timeline, Schedule of Deliverables and Tender Schedules

2.3 Deliverables

In summary, the proposed deliverables as discussed in the section above are the following:

2.3.1 Preliminary Investigations, Design Basis and Options Summary Deliverables

- Updated P&IDs (WTP and reticulation);
- PHA study;
- Site Constraint Report;
- Design Basis Report (2 x revisions, Draft and Final); and
- Updated Project Risk Management Plan.

2.3.2 Concept Design Deliverables

- Concept Design Drawings (2 x revisions - 80% Draft and Issue for Tender);
- Concept Design Report (2 x revisions, Draft and Final);
- Designer Risk Register;
- Documentation required for project approval; and
- Updated Project Risk Management Plan

2.3.3 D&C Contract Documentation Deliverables

- Technical Specifications; and

- Request for Tender documentation, including:
  - Procurement Plan and Timeline
  - Schedule of Deliverables
  - Tender Schedules.

2.4 Contractor Engagements

Third party contractors will be engaged to provide the below scope of work. Allowances have been provided for these items which are listed in the Fee Schedule of Section 7.6 :

Preliminary Investigations, Design Basis and Options Summary

- Site inspection; and
- P&IDs for reticulations system.
  - 2 drawing allowance.

Concept Design:

- General arrangement drawings for equipment and pipework;
  - 2 drawings have been allowed for the equipment GAs (80% draft and Final); and
  - 4 drawings have been allowed for the pipework GAs (above and below ground, 80% draft and Final).
- Geotechnical investigation for preliminary foundation design; and
- Site single line diagram;
  - 2 drawing allowance (80% draft and Final).

Technical Specification:

- Civil specification; and
- Electrical specification.

2.5 Assumptions, Items Not Included and Optional CWT Involvement

Note that the scope of work includes the following assumptions:

- The project scope for the main bid (see Section 7.2) only considers the following items: Chemical dosing systems, reservoirs, raw water blending, reticulation system, instrumentation and controls for the WTP. A separate budget has been provided in Section 7.3 to propose upgrades and provide concept design and technical specification for all process units at Mendooran WTP.
- Tasks are performed based on the assumption that no civil or geotechnical surveys are required, and that Council will provide all the necessary information needed to draft the P&IDs and other documentation/drawings as required.

- 1 round for client review with a 1-week duration is allowed for each deliverable. This is to ensure timely project scheduling and budget determination. If the client review periods exceed the allowance, the project completion date will be extended.

Items not included are the following:

- Conditions of Tendering and General Conditions of Contract – this was outlined in Warrumbungle's *Brief for the Provision of Consultancy Services* to be prepared by Council.
- Tender review – CWT can provide technical expertise and assistance in the tender review process at additional rates on request by Council.
- CHAIR workshop – A CHAIR is to be performed with the selected constructors to minimise construction, maintenance, repair and demolition safety risks. To perform this, a tenderer and a design will already need to be selected, this typically occurs during the design phase of a D&C Contract. CWT have deemed that this is outside the scope of the existing project. However, CWT involvement in a CHAIR assessment can be added on at additional rates once the tenderer is selected.
- A HAZOP workshop during the Concept Design phase – This can be provided at additional rates on request by Council. However, a Hazard Assessment workshop has been allowed for.

2.6 Documents Received

- *Concept Design for Mendooran Water Supply System Upgrade, Warrumbungle Shire Council, JULY 2019*
- *Mendooran WTP, Mendooran Water Treatment Plant Audit Report, CWT MAY 2015*
- *Mendooran ASAM Project Management System Report; ASAM RT; NOVEMBER 2015*
- *Mendooran WTP, Filter Service / "15 Point Check"; Warrumbungle Shire Council; Hunter H2O, MARCH 2018*
- *Water Quality Incident Review; Warrumbungle Shire Council, NSW Health; Hunter H2O, NOVEMBER 2017*
- *Mendooran WTP; Site Inspection and DWQMP Implementation Update; NSW Health; Hunter H2O, JUNE 2017*
- *Mendooran WEARS Reservoir Inspection Report; AUGUST 2017*
- *Mendooran Visual Inspection Report; Water Infrastructure Services; FEBRUARY 2019*
- *Mendooran WTP - Site Inspection and Remote Alarming Options, NSW Health; Hunter H2O; MARCH 2018*
- *Mendooran WTP Emergency Ops Support Report, NSW Health; Hunter H2O APRIL 2019*
- *Mendooran Reservoir Upgrade Report; Wears Australia; JUNE 2019*