BROWN AND CALDWELL

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Technical Memorandum

Prepared for: Butte County Department of Water Resource Conservation (BCDWRC)

Project No: 138604

County of Butte Contract Number: 18050

Technical Memorandum No.2

Subject: Monitoring Well Installation Work Plan

Date: August 13, 2010

To: Field Personnel – Brown and Caldwell

Cc: Tim Godwin, BC Field Manager; Paul Gosselin, BCDWRC, Kelly Staton, DWR; Debbie Spangler, DWR

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1. INTRODUCTION

This Technical Memorandum 1 (Tech Memo 1) presents the Work Plan for the installation of monitoring wells for the Lower Tuscan Aquifer Monitoring, Recharge, and Data Management Project (Project).

The scope of work includes the installation of 3 triple completion monitoring wells. These wells are located within Butte County as illustrated on Figure 1 and are designated MW-HKT-1, MW-M&T-1 and MW-CSU-1. Each location was reviewed and cleared as part of the Initial Study. Brown and Caldwell will obtain the necessary permits, including a well drilling permit from Butte County. Following procuring the permits and prior to drilling, the Underground Service Alert (USA) will be contacted for clearance of underground utilities.

This Work Plan presents the methods and procedures to be used during the drilling, construction, and development of the monitoring wells for the project. The Work Plan also presents a description of the technical deliverables to be produced at the end of the project documenting the final implemented as-built drawings and lithologic logs.

2. METHODS AND PROCEDURES

This section presents the methods and procedures to be implemented during the construction and development of the monitoring wells.

2.1 Drilling and Well Installation

Field work will be conducted under the direct supervision of a Brown and Caldwell California Professional Geologist. Three monitoring well nests will be installed using a combination of the dual-wall reverse circulation and mud-rotary drilling methods. The approximate locations and well designations are shown on the attached Figure 1. Actual well design specifications will be based on the data collected from the drilling of the pilot boring, including lithologic data and estimated water production as recorded during drilling as discussed in Section 2.2. As such, the actual depth of drilling and well completion details can only be estimated at this time. Anticipated well specifications based on drillers' logs in the vicinity of the proposed locations are detailed in Table 1.

At each of the three drilling locations, a pilot boring will be drilled to total depth using the dual-wall reverse circulation drilling method. The pilot boring will then be enlarged to 12-inches using mud-rotary drilling methods. Once the desired depth of the borehole has been obtained, well installation methods will be consistent with Chapter 23B of the Municipal Code of Butte County. Well casing (blank and screen) will consist of 2.5-inch diameter (outside diameter), schedule 80 PVC. Triple completion well screens and casing will be located in the borehole using centralizers. Gravel pack will be placed at each screen interval and the well surged to settle the gravel pack around the well screen and continue until the gravel pack stops settling. Additional gravel pack will then be added to the desired depth. A bentonite seal at least 2-feet thick will be placed immediately above the gravel pack. A volume calculation will be conducted to estimate the volume of a bentonite based grout or bentonite chip/sand mixture needed to place between the lower screen and upper screen. Fine mesh

sand will then be placed to 1 foot below the next screen interval and the process for placement of gravel pack and bentonite seal repeated as discussed above for the remaining completions. The upper most annular space will then be grouted with a bentonite or cement grout to approximately 2-feet bgs. The well heads will be completed within a steel locking stickup and protected by steel cement filled bollards.

2.2 Logging and Sampling

During drilling of the pilot boring, the lithology will be recorded continuously on a geologic boring log and depth-discrete disturbed grab samples will be collected at 5-foot intervals or change in lithology and bulk samples will be collected at a minimum of every 10-foot interval. A photographic log of this material will also be prepared and presented with the final geologic boring log presented in the Field Investigation Report. Bulk samples will be collected in 10-inch by 17-inch sample bags and, if requested, portions of the bulk samples will be provided to State and local agencies. Each sample will be logged by a California Professional Geologist proficient in the methods described in ASTM D2488-84 and geologic formation contacts as described in Brown and Caldwells Technical Memorandum No. 1 dated August 12, 2010. Selected lithologic samples will be submitted to a geotechnical laboratory for mechanical analysis to support the final well design. Also during drilling, estimates of water production with depth will be recorded on the geologic boring log and field measurements of temperature, electrical conductivity, and pH will be recorded at a minimum of every 20 feet.

Using the information collected above during the drilling of the pilot boring, a California Certified Hydrogeologist will develop the final well design to include screen intervals, slot size, and gravel pack size and gradation. We anticipate that at either well MW-HKT-1 or MW-M&T-1(Figure 1), one of the screen intervals within the well will be located within an identified aquitard unit directly above the Lower Tuscan aquifer zone for use in assessing leakage from this unit during the aquifer pump tests that will be conducted during calendar year 2011. Prior to construction, the finalized well design will be provided to BCDWRC for approval and the DWR for review.

2.3 Well Development

No earlier than 24-hours after the grout placement, the well(s) will be developed using one or more of these methods: surging, air lifting, over pumping, and bailing. Generally, each well will be developed until it is free of suspended sediment and turbidity values are less than 10 NTU. After completion, the wells will be surveyed by NorthStar Engineering. In addition, each well will be equipped with battery operated pressure transducer-data loggers provided by BCDWRC.

3. RESULTS AND REPORTING

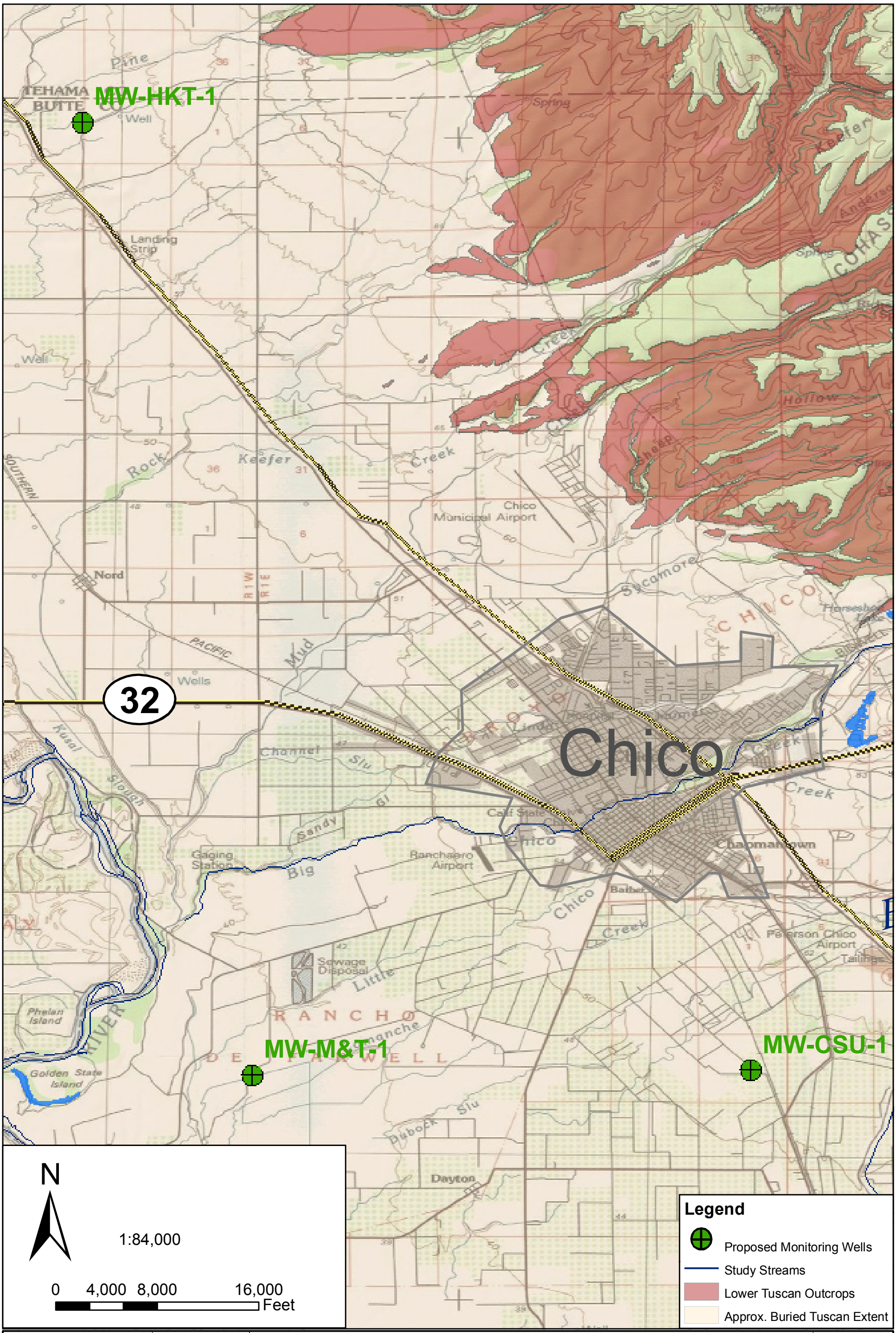
After completion of the well installation program, the Field Investigation Report will be prepared summarizing the methods used and results of the program. The report will be finalized after receiving comments from BCDWRC and will include an inspection and certification by a California Professional Hydrogeologist that the project has been completed in accordance with submitted final plans and specifications in accordance with the contract. The geodatabase will also be updated with the information collected from this program.

TABLES

Table 1 – Anticipated Monitoring Well Specifications

Well I.D.	MW-HKT-1	MW-M&T-1	MW-CSU-1
Total Depth	600 feet bgs	850 feet bgs	550 feet bgs
Screen Interval (approximate)	570 to 620 feet bgs 520 to 530 feet bgs 450 to 480 feet bgs	820 to 850 feet bgs 705 to 735 feet bgs 660 to 690 feet bgs	520 to 550 feet bgs 440 to 470 feet bgs 390 to 420 feet bgs
Casing Diameter	2.5-inches	"	"
Screen Material	Machine slotted Schedule 80 PVC	"	"
Screen Slot Size	0.010 to 0.030 inches	"	"
Blank Casing	Schedule 80 PVC	"	"
Filter Pack Material	Tacna 6 by 12 or as appropriate for Screen Slot Size	"	"
Filter Pack Interval	568 to 600 feet bgs 518 to 530 feet bgs 448 to 480 feet bgs	818 to 850 feet bgs 703 to 735 feet bgs 658 to 690 feet bgs	518 to 550 feet bgs 438 to 470 feet bgs 388 to 420 feet bgs
Fine Sand Interval	530 to 533 feet bgs 480 to 483 feet bgs	735 to 738 feet bgs 690 to 693 feet bgs	470 to 473 feet bgs 420 to 423 feet bgs
Bentonite Seal	533 to 566 feet bgs 483 to 516 feet bgs	738 to 816 feet bgs 693 to 701 feet bgs	473 to 516 feet bgs 423 to 436 feet bgs
Bentonite Pellet Seal	566 to 568 feet bgs 516 to 518 feet bgs 446 to 448 feet bgs	816 to 818 feet bgs 701 to 703 feet bgs 656 to 690 feet bgs	516 to 518 feet bgs 436 to 438 feet bgs 386 to 388 feet bgs
Grout	Surface to 446 feet bgs	Surface to 656 feet bgs	Surface to 386 feet bgs
Centralizers	Every 30 feet from bottom of screen to top of well	"	"

FIGURES



BROWN AND CALDWELL	PROJECT 138604	SITE Butte County, California	Figure 1
	DATE 7-30-2010	TITLE Proposed Monitoring Well Locations	

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