***CITY OF GRAPEVINE, TEXAS***

***RFP 267-2024***
***REQUEST FOR PROPOSAL***
***CONSTRUCTION MANAGER AT RISK***
***WATER TREATMENT PLANT AND***
***WASTEWATER TREATMENT PLANT***
***ADMINISTRATION FACILITY IMPROVEMENTS***

***ADDENDUM 2***

Refer to following documents for:

1. Request for Proposal Questions
2. WTP/WWTP Administration Facility Improvements – Design Schedule
3. Water Treatment Plant Geotechnical Report

# REQUEST FOR PROPOSAL QUESTIONS

## City of Grapevine, Texas

| | | | |
|---|---|---|---|
| **PROJECT NAME** | **Water Treatment Plant and Wastewater Treatment Plant Administration Facility Improvements** | **DATE:** | **4/10/23** |
| **PROJECT MANAGER** | Cristin Turner | **RFP Number** | RFP 267-2024 |

| ITEM NUM | BY | QUESTIONS | CITY RESPONSE |
|---|---|---|---|
| 1 | Sedalco | Please provide a project GMP value for development of fee proposal form. | Anticipated project construction cost is to be $15,000,000 - $16,000,000. |
| 2 | Sedalco | Please provide an anticipated Notice to Proceed date for staffing evaluation and general conditions development. | Refer to attached schedule. |
| 3 | Sedalco | On the bottom of page 3, Section III Procedure – One Step Process, it mentions including the A133 and A201 contract forms with our submission. Those templates were already included in the RFP. Do we need to include those again in our response? Also, this section mentions other submittal requirements noted in section XII. I do not see a section XII included in the RFP. | Provide comments to the templates that were provided in the RFP.<br>Other submittal requirements are notes in section X, not section XII, please refer to section X. |
| 4 | Burns & McDonnell | What is the anticipated schedule for design deliverables? | Refer to attached schedule. |
| 5 | Burns & McDonnell | What is the anticipated construction NTP date? | Refer to attached schedule. |
| 6 | Fransen Pittman | What is the design schedule? | Refer to attached schedule. |
| 7 | Fransen Pittman | At what design milestone will the CMAR go to GMP? | 60% |
| 8 | Fransen Pittman | Will independent testing and inspections contract be under the CMAR or Owner? | Owner |
| 9 | Fransen Pittman | Will building permit fees be required for this project? | Building Permit Fees are waived for the WTP/WWTP Administration Facility Improvements Project |
| 10 | Fransen Pittman | For Dividers #7 and #8, are we to provide our own marked up AIA contract templates, or are we to provide comments to the AIA templates that were provided in the RFP? | Provide comments to the templates that were provided in the RFP. |
| 11 | Fransen Pittman | Can a budget be provided so we can provide costs required for the General Conditions that will be apples to apples with other bidding | Anticipated project construction cost is to be $15,000,000 - $16,000,000. |

# DESIGN REVIEW COMMENTS

| ITEM NUM | REVIEWER INITIAL | REVIEWER COMMENTS | FIRM RESPONSE |
|---|---|---|---|
| | | CMAR's? The budget is specifically needed to provide Insurance and Bond amounts. | |
| 12 | | Who carries the builder's risk? | CMAR to carry the All Risk Builder's Insurance. |
| 13 | | Is after hours work allowed? | Work hours are 7AM-7PM Monday – Saturday. No work on Sunday. |
| 14 | | Can previous Geotech reports be provided? | Yes, refer to attached Geotech report for previous site project. |
| 15 | | Is temporary fencing part of the general conditions? | Yes, it is a site management cost. |
| 16 | | Is the CMAR to coordinate with ONCOR during design phase for relocating utility? | Yes, CMAR to coordinate with ONCOR during the design phase for relocating the utility. |
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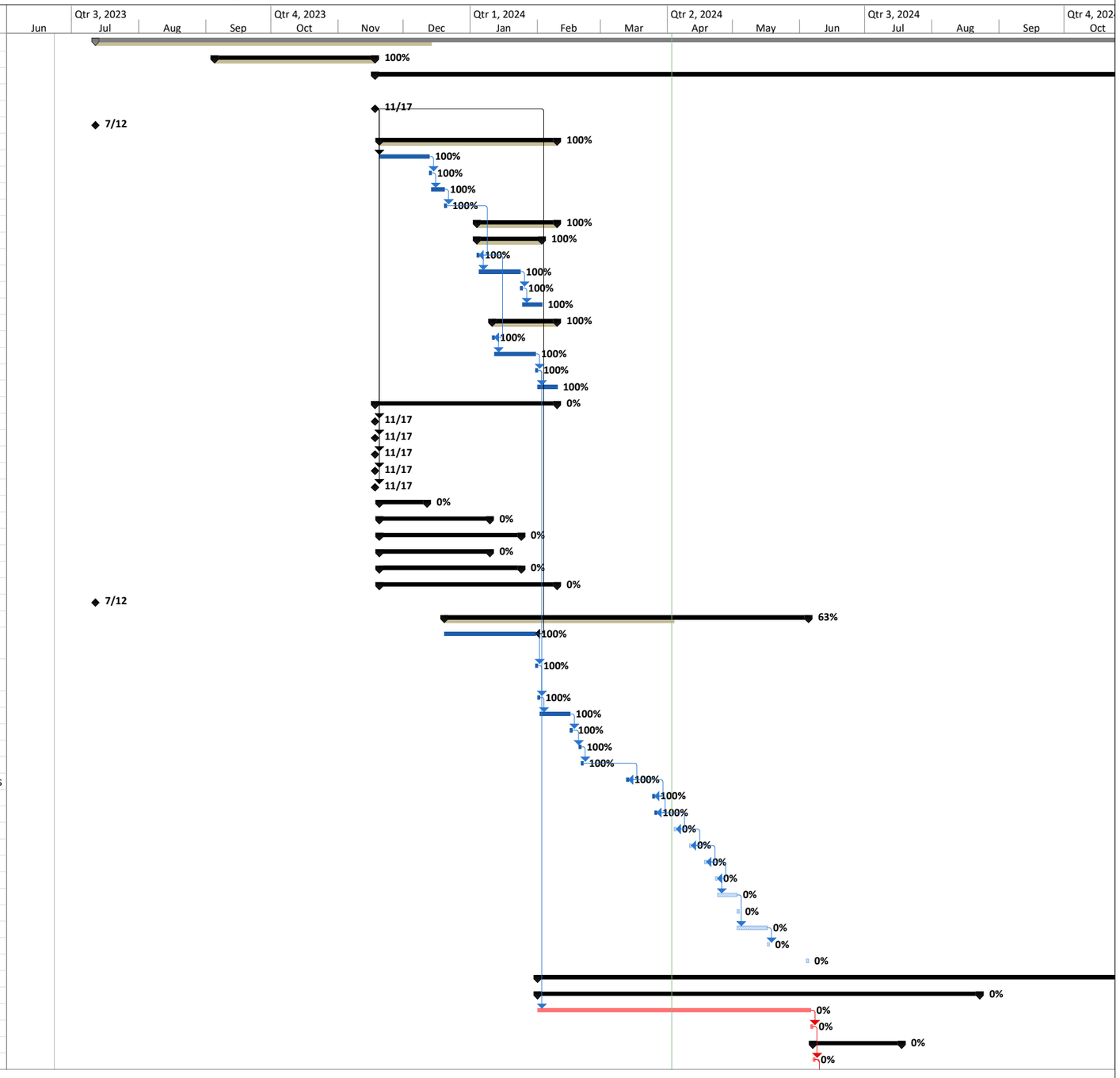
# Grapevine WTP and WWTP Admin Facility Improvements

| ID | Task Mode | Task Name | % Complete | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|---|---|
| 0 | | **GPV WTP WWTP Admin Facility Improvements** | **13%** | **895 days** | **Wed 7/12/23** | **Wed 1/20/27** | |
| 1 | ✓ | **Proposal** | **100%** | **52 days** | **Tue 9/5/23** | **Fri 11/17/23** | |
| 6 | | **MILESTONES** | **0%** | **334 days** | **Fri 11/17/23** | **Tue 4/1/25** | |
| 7 | | Submit 100% FINAL to City | 0% | 0 days | Tue 4/1/25 | Tue 4/1/25 | 157 |
| 8 | ✓ | NTP for Design Services | 100% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 5 |
| 9 | ✓ | space | 100% | 0 days | Wed 7/12/23 | Wed 7/12/23 | |
| 10 | ✓ | **BOD Design Services** | **100%** | **50 days** | **Mon 11/20/23** | **Fri 2/9/24** | |
| 11 | ✓ | Project setup and prep for internal FNI kickoff | 100% | 14 days | Mon 11/20/23 | Tue 12/12/23 | 8 |
| 12 | ✓ | Internal project kick off meeting | 100% | 1 day | Wed 12/13/23 | Wed 12/13/23 | 11 |
| 13 | ✓ | Review Record Documents | 100% | 4 days | Thu 12/14/23 | Tue 12/19/23 | 12 |
| 14 | ✓ | Site Visit/ Client Kickoff Meeting | 100% | 1 day | Wed 12/20/23 | Wed 12/20/23 | 13 |
| 15 | ✓ | **Basis of Design Workshops and Plans** | **100%** | **26 days** | **Thu 1/4/24** | **Fri 2/9/24** | |
| 16 | ✓ | **Lab/ MEP BOD** | **100%** | **21 days** | **Thu 1/4/24** | **Fri 2/2/24** | |
| 17 | ✓ | Laboratory BOD TM Workshop with Client | 100% | 1 day | Thu 1/4/24 | Thu 1/4/24 | 14FF+5 days |
| 18 | ✓ | Prepare Laboratory BOD TM | 100% | 12 days | Fri 1/5/24 | Tue 1/23/24 | 17 |
| 19 | ✓ | Submit Laboratory BOD TM to City | 100% | 1 day | Wed 1/24/24 | Wed 1/24/24 | 18 |
| 20 | ✓ | Client Review of BOD TM submittal | 100% | 7 days | Thu 1/25/24 | Fri 2/2/24 | 19 |
| 21 | ✓ | **SCADA BOD** | **100%** | **21 days** | **Thu 1/11/24** | **Fri 2/9/24** | |
| 22 | ✓ | SCADA/Enterprise Network BOD TM Workshop | 100% | 1 day | Thu 1/11/24 | Thu 1/11/24 | 17FF+5 days |
| 23 | ✓ | Prepare SCADA/Enterprise Network BOD TM | 100% | 12 days | Fri 1/12/24 | Tue 1/30/24 | 22 |
| 24 | ✓ | Submit SCADA/Enterprise Network BOD TM to ( | 100% | 1 day | Wed 1/31/24 | Wed 1/31/24 | 23 |
| 25 | ✓ | Client Review of BOD TM submittal | 100% | 7 days | Thu 2/1/24 | Fri 2/9/24 | 24 |
| 26 | | **Sub-Consultants (to be verified)** | **0%** | **50 days** | **Fri 11/17/23** | **Fri 2/9/24** | |
| 27 | | ADA - RAS | 0% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 8 |
| 28 | | Cost Estimation - CCM | 0% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 8 |
| 29 | | Structural - JQ | 0% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 8 |
| 30 | | MEP - DFW | 0% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 8 |
| 31 | | It/Data - Datacom | 0% | 0 days | Fri 11/17/23 | Fri 11/17/23 | 8 |
| 32 | | **Site Survey** | **0%** | **13 days** | **Mon 11/20/23** | **Mon 12/11/23** | |
| 35 | | **Matterport - BIMOptimized** | **0%** | **28 days** | **Mon 11/20/23** | **Tue 1/9/24** | |
| 40 | | **Sanitary Sewer Inspection - Roto-Rooter** | **0%** | **37.5 days** | **Mon 11/20/23** | **Wed 1/24/24** | |
| 47 | | **SUE - Rios Group** | **0%** | **28 days** | **Mon 11/20/23** | **Tue 1/9/24** | |
| 52 | | **Hazardous Material - IHST** | **0%** | **37.5 days** | **Mon 11/20/23** | **Wed 1/24/24** | |
| 59 | | **Geotech** | **0%** | **50 days** | **Mon 11/20/23** | **Fri 2/9/24** | |
| 65 | ✓ | space | 100% | 0 days | Wed 7/12/23 | Wed 7/12/23 | |
| 66 | | **CMAR Procurement** | **63%** | **111 days** | **Wed 12/20/23** | **Tue 6/4/24** | |
| 67 | ✓ | Develop Draft Templates for CMAR RFP, CMAR pre-con phase services, and CMAR construction | 100% | 23 days | Wed 12/20/23 | Tue 1/30/24 | 8FF+42 days |
| 68 | ✓ | Submit Draft CMAR Procurement Templates to City for review | 100% | 1 day | Wed 1/31/24 | Wed 1/31/24 | 67 |
| 69 | ✓ | Draft CMAR Procurement Templates review meeting | 100% | 1 day | Thu 2/1/24 | Thu 2/1/24 | 68 |
| 70 | ✓ | Develop Final CMAR Procurement Templates | 100% | 10 days | Fri 2/2/24 | Thu 2/15/24 | 69 |
| 71 | ✓ | Submit Final Template to City for review | 100% | 1 day | Fri 2/16/24 | Fri 2/16/24 | 70 |
| 72 | ✓ | Final CMAR Procurement Templates review meeting | 100% | 1 day | Tue 2/20/24 | Tue 2/20/24 | 71 |
| 73 | ✓ | Issue CMAR RFQ | 100% | 1 day | Wed 2/21/24 | Wed 2/21/24 | 72 |
| 74 | ✓ | CMAR Pre-Submittal Meeting | 100% | 1 day | Wed 3/13/24 | Wed 3/13/24 | 73FF+15 days |
| 75 | ✓ | Addensum 01 - 2 Week Extension | 100% | 1 day | Mon 3/25/24 | Mon 3/25/24 | 74FF+8 days |
| 76 | ✓ | CMAR Second Pre-Submittal Meeting | 100% | 1 day | Tue 3/26/24 | Tue 3/26/24 | 75FF+1 day |
| 77 | | Last Day for CMAR Questions | 0% | 1 day | Thu 4/4/24 | Thu 4/4/24 | 76FF+7 days |
| 78 | | Answer CMAR Questions By | 0% | 1 day | Thu 4/11/24 | Thu 4/11/24 | 77FF+5 days |
| 79 | | CMAR SOQ Due | 0% | 1 day | Thu 4/18/24 | Thu 4/18/24 | 78FF+5 days |
| 80 | | Interviews | 0% | 1 day | Tue 4/23/24 | Tue 4/23/24 | 79FF+3 days |
| 81 | | Evaluation/ Selection | 0% | 7 days | Wed 4/24/24 | Thu 5/2/24 | 80 |
| 82 | | Grapevine Local Election -Saturday May 4th | 0% | 1 day | Fri 5/3/24 | Fri 5/3/24 | |
| 83 | | CMAR Negotiation | 0% | 10 days | Fri 5/3/24 | Thu 5/16/24 | 81 |
| 84 | | CMAR Kick-Off Meeting | 0% | 1 day | Fri 5/17/24 | Fri 5/17/24 | 83 |
| 85 | | City Council Meeting - CMAR Vote | 0% | 1 day | Tue 6/4/24 | Tue 6/4/24 | |
| 86 | | **Design and Const docs** | **0%** | **291 days** | **Thu 2/1/24** | **Tue 4/1/25** | |
| 87 | | **30% Package** | **0%** | **143 days** | **Thu 2/1/24** | **Thu 8/22/24** | |
| 88 | | HOLD, for CMAR | 0% | 88 days | Thu 2/1/24 | Wed 6/5/24 | 24 |
| 89 | | VE Meeting with CMAR | 0% | 1 day | Thu 6/6/24 | Thu 6/6/24 | 88 |
| 90 | | **Prepare Preliminary Design (30%)** | **0%** | **28 days** | **Fri 6/7/24** | **Wed 7/17/24** | |
| 91 | | Refine Revit Model based on site investigation | 0% | 1 day | Fri 6/7/24 | Fri 6/7/24 | 89 |




Wed 4/3/24

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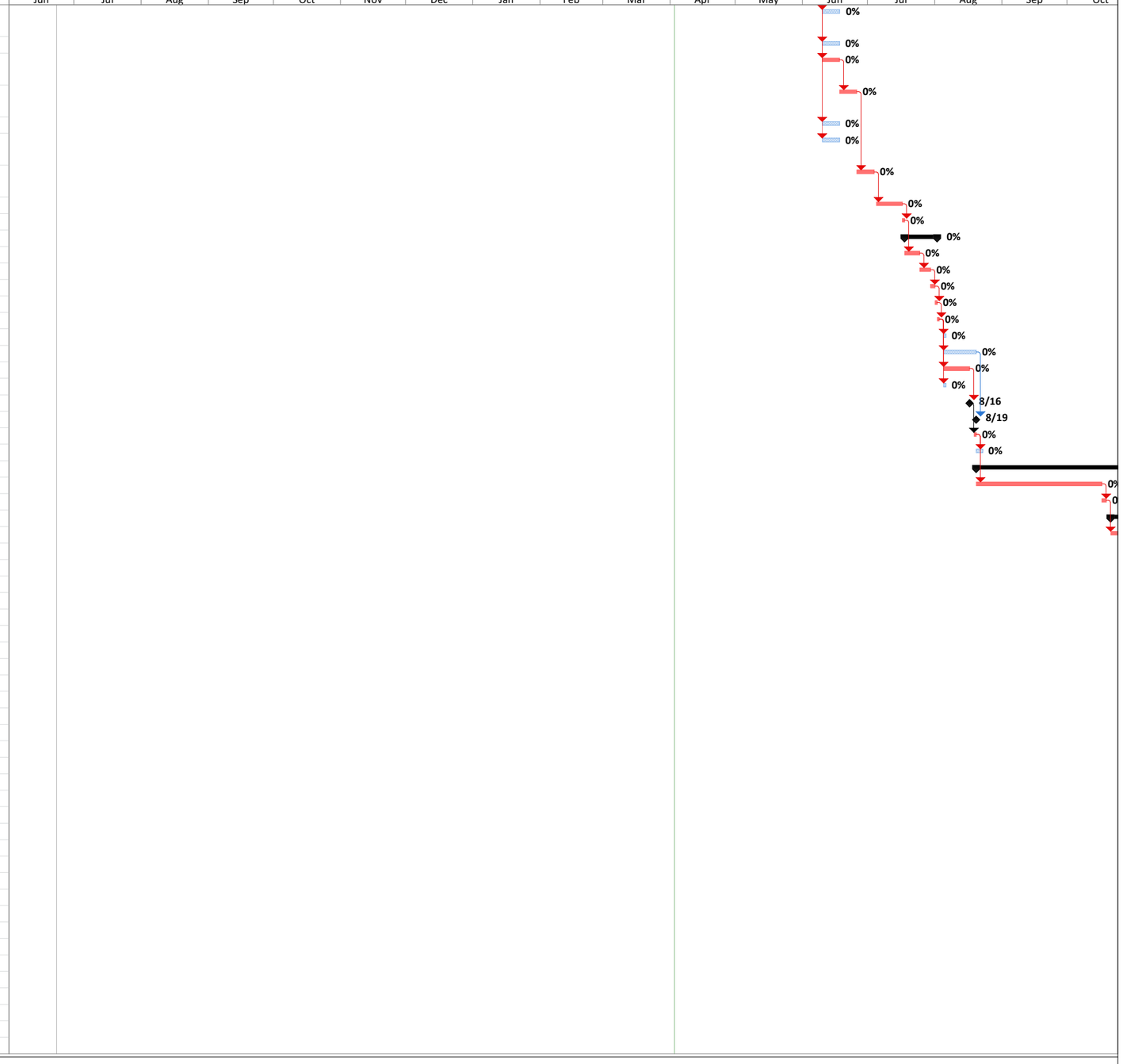
|---|---|---|---|---|---|---|---|
| Critical | Task | Manual Task | Duration-only | Baseline Milestone | Summary | External Tasks | Inactive Milestone |
| Critical Split | Split | Start-only | Baseline | Milestone | Manual Summary | External Milestone | Inactive Summary |
| Critical Progress | Task Progress | Finish-only | Baseline Split | Summary Progress | Project Summary | Inactive Task | Deadline |

# Grapevine WTP and WWTP Admin Facility Improvements

| ID | Task Mode | Task Name | % Complete | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|---|---|
| 92 | | MEP, FP IT and Struct systems brainstorming mtgs to define space needs | 0% | 6 days | Mon 6/10/24 | Mon 6/17/24 | 91 |
| 93 | | Building load simulation & Calcs (Mech) | 0% | 6 days | Mon 6/10/24 | Mon 6/17/24 | 91 |
| 94 | | HVAC develop type of systems along with life-cycle cost analysis | 0% | 6 days | Mon 6/10/24 | Mon 6/17/24 | 91 |
| 95 | | Electrical to develop major electrical systems based on HVAC system chosen | 0% | 6 days | Tue 6/18/24 | Tue 6/25/24 | 94 |
| 96 | | Fire alarm development, code review | 0% | 6 days | Mon 6/10/24 | Mon 6/17/24 | 91 |
| 97 | | Plumbing to develop major plumbing systems based on floor plan layout | 0% | 6 days | Mon 6/10/24 | Mon 6/17/24 | 91 |
| 98 | | Revit plan development based on major systems development (Arch) | 0% | 6 days | Wed 6/26/24 | Wed 7/3/24 | 95 |
| 99 | | Prepare preliminary design | 0% | 8 days | Fri 7/5/24 | Tue 7/16/24 | 98 |
| 100 | | Print and upload 30% to Bluebeam for QC | 0% | 1 day | Wed 7/17/24 | Wed 7/17/24 | 99 |
| 101 | | **Quality Check** | **0%** | **11 days** | **Thu 7/18/24** | **Thu 8/1/24** | |
| 102 | | QC 30% | 0% | 5 days | Thu 7/18/24 | Wed 7/24/24 | 100 |
| 103 | | Pick up comments | 0% | 3 days | Thu 7/25/24 | Mon 7/29/24 | 102 |
| 104 | | Backcheck | 0% | 2 days | Tue 7/30/24 | Wed 7/31/24 | 103 |
| 105 | | Compile 30% | 0% | 1 day | Thu 8/1/24 | Thu 8/1/24 | 104 |
| 106 | | Submit 30% to Client | 0% | 1 day | Fri 8/2/24 | Fri 8/2/24 | 105 |
| 107 | | Submit 30% to estimator | 0% | 1 day | Mon 8/5/24 | Mon 8/5/24 | 106 |
| 108 | | Update OPCC based on 30% submittal | 0% | 11 days | Mon 8/5/24 | Mon 8/19/24 | 106 |
| 109 | | Client Review of 30% submittal | 0% | 10 days | Mon 8/5/24 | Fri 8/16/24 | 106 |
| 110 | | CMAR comments on 30% due | 0% | 1 day | Mon 8/5/24 | Mon 8/5/24 | 106 |
| 111 | | City Comments due | 0% | 0 days | Fri 8/16/24 | Fri 8/16/24 | 109 |
| 112 | | Submit 30% OPCC at rvw mtg | 0% | 0 days | Mon 8/19/24 | Mon 8/19/24 | 108 |
| 113 | | Design Review Meeting | 0% | 1 day | Mon 8/19/24 | Mon 8/19/24 | 111 |
| 114 | | AE respond to comments and revise docs | 0% | 3 days | Tue 8/20/24 | Thu 8/22/24 | 113 |
| 115 | | **60% Package** | **0%** | **85 days** | **Tue 8/20/24** | **Fri 12/20/24** | |
| 116 | | Prepare 60% | 0% | 40 days | Tue 8/20/24 | Wed 10/16/24 | 113 |
| 117 | | Print and upload 60% to Bluebeam for QC | 0% | 2 days | Thu 10/17/24 | Fri 10/18/24 | 116 |
| 118 | | **Quality Check** | **0%** | **13 days** | **Mon 10/21/24** | **Wed 11/6/24** | |
| 119 | | QC 60% | 0% | 6 days | Mon 10/21/24 | Mon 10/28/24 | 117 |
| 120 | | Pick up comments | 0% | 4 days | Tue 10/29/24 | Fri 11/1/24 | 119 |
| 121 | | Backcheck | 0% | 2 days | Mon 11/4/24 | Tue 11/5/24 | 120 |
| 122 | | Compile 60% | 0% | 1 day | Wed 11/6/24 | Wed 11/6/24 | 121 |
| 123 | | Submit 60% to Client | 0% | 1 day | Thu 11/7/24 | Thu 11/7/24 | 118 |
| 124 | | Submit 60% to estimator | 0% | 1 day | Fri 11/8/24 | Fri 11/8/24 | 123 |
| 125 | | Update OPCC based on 60% submittal | 0% | 11 days | Tue 11/12/24 | Tue 11/26/24 | 124 |
| 126 | | Client Review of 60% submittal | 0% | 10 days | Fri 11/8/24 | Fri 11/22/24 | 123 |
| 127 | | CMAR comments on 60% due | 0% | 0 days | Fri 11/22/24 | Fri 11/22/24 | 126FF |
| 128 | | Client Comments due | 0% | 0 days | Fri 11/22/24 | Fri 11/22/24 | 126 |
| 129 | | Submit 60% OPCC at rvw mtg | 0% | 0 days | Tue 11/26/24 | Tue 11/26/24 | 125 |
| 130 | | Design review Meeting | 0% | 1 day | Mon 11/25/24 | Mon 11/25/24 | 128 |
| 131 | | AE respond to comments and revise docs | 0% | 3 days | Tue 11/26/24 | Fri 11/29/24 | 130 |
| 132 | | CMAR submits proposed GMP | 0% | 1 day | Mon 12/2/24 | Mon 12/2/24 | 131 |
| 133 | | Review of proposed GMP | 0% | 7 days | Tue 12/3/24 | Wed 12/11/24 | 132 |
| 134 | | Negotiation on GMP | 0% | 7 days | Thu 12/12/24 | Fri 12/20/24 | 133 |
| 135 | | **90% Package (Pre-Final)** | **0%** | **60 days** | **Tue 11/26/24** | **Wed 2/26/25** | |
| 136 | | Prepare 90% | 0% | 30 days | Tue 11/26/24 | Wed 1/15/25 | 130 |
| 137 | | Print and upload 90% to Bluebeam for QC | 0% | 2 days | Thu 1/16/25 | Fri 1/17/25 | 136 |
| 138 | | **Quality Check** | **0%** | **13 days** | **Mon 1/20/25** | **Wed 2/5/25** | |
| 139 | | QC 90% | 0% | 6 days | Mon 1/20/25 | Mon 1/27/25 | 137 |
| 140 | | Pick up comments | 0% | 4 days | Tue 1/28/25 | Fri 1/31/25 | 139 |
| 141 | | Backcheck | 0% | 2 days | Mon 2/3/25 | Tue 2/4/25 | 140 |
| 142 | | Compile90% | 0% | 1 day | Wed 2/5/25 | Wed 2/5/25 | 141 |
| 143 | | Submit 90% to Client | 0% | 1 day | Thu 2/6/25 | Thu 2/6/25 | 138 |
| 144 | | Client Review of 90% submittal | 0% | 10 days | Fri 2/7/25 | Thu 2/20/25 | 143 |
| 145 | | CMAR comments on 90% due | 0% | 1 day | Fri 2/7/25 | Fri 2/7/25 | 143 |
| 146 | | Client Comments due | 0% | 0 days | Thu 2/20/25 | Thu 2/20/25 | 144 |
| 147 | | Design review Meeting | 0% | 1 day | Fri 2/21/25 | Fri 2/21/25 | 146 |
| 148 | | AE respond to comments and revise docs | 0% | 3 days | Mon 2/24/25 | Wed 2/26/25 | 147 |
| 149 | | **100% FINAL** | **0%** | **27 days** | **Mon 2/24/25** | **Tue 4/1/25** | |
| 150 | | Prepare 100% | 0% | 15 days | Mon 2/24/25 | Fri 3/14/25 | 147 |




Wed 4/3/24

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Critical | Task | Manual Task | Duration-only | Baseline Milestone | Summary | External Tasks | Inactive Milestone |
| Critical Split | Split | Start-only | Baseline | Milestone | Manual Summary | External Milestone | Inactive Summary |
| Critical Progress | Task Progress | Finish-only | Baseline Split | Summary Progress | Project Summary | Inactive Task | Deadline |

# Grapevine WTP and WWTP Admin Facility Improvements

| ID | Task Mode | Task Name | % Complete | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|---|---|
| 151 | | print and upload 100% to Bluebeam for QC | 0% | 2 days | Mon 3/17/25 | Tue 3/18/25 | 150 |
| 152 | | **Quality Check** | **0%** | **8 days** | **Wed 3/19/25** | **Fri 3/28/25** | |
| 153 | | QC 100% | 0% | 2 days | Wed 3/19/25 | Thu 3/20/25 | 151 |
| 154 | | Pick up comments | 0% | 4 days | Fri 3/21/25 | Wed 3/26/25 | 153 |
| 155 | | Backcheck | 0% | 2 days | Thu 3/27/25 | Fri 3/28/25 | 154 |
| 156 | | Compile submittal, print | 0% | 2 days | Mon 3/31/25 | Tue 4/1/25 | 152 |
| 157 | | Submit 100% FINAL to Client/ CMAR | 0% | 0 days | Tue 4/1/25 | Tue 4/1/25 | 156 |
| 158 | | space | 100% | 0 days | Wed 7/12/23 | Wed 7/12/23 | |
| 159 | | **Construction** | **0%** | **471 days** | **Wed 4/2/25** | **Wed 1/20/27** | |
| 160 | | CMAR issues docs to trades for bidding | 0% | 1 day | Wed 4/2/25 | Wed 4/2/25 | 157 |
| 161 | | CMAR receives bids | 0% | 1 day | Wed 4/30/25 | Wed 4/30/25 | 160FF+20 days |
| 162 | | CMAR evaluates bids | 0% | 10 days | Thu 5/1/25 | Wed 5/14/25 | 161 |
| 163 | | City NTP for Construction | 0% | 1 day | Wed 6/25/25 | Wed 6/25/25 | 162FF+30 days |
| 164 | | Construction | 0% | 410 days | Thu 6/26/25 | Wed 1/20/27 | 163 |
| 165 | | Substantial Completion | 0% | 0 days | Wed 1/20/27 | Wed 1/20/27 | 164 |


Wed 4/3/24

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|---|---|---|---|---|---|---|---|---|---|
| Critical | Task | Manual Task | Duration-only | Baseline Milestone | Summary | External Tasks | Inactive Milestone |
| Critical Split | Split | Start-only | Baseline | Milestone | Manual Summary | External Milestone | Inactive Summary |
| Critical Progress | Task Progress | Finish-only | Baseline Split | Summary Progress | Project Summary | Inactive Task | Deadline |

# GEOTECHNICAL STUDY

# WATER TREATMENT PLANT EXPANSION

# GRAPEVINE, TEXAS

# GEOTECHNICAL STUDY
# WATER TREATMENT PLANT EXPANSION
# GRAPEVINE, TEXAS

* * *

Report To

CITY OF GRAPEVINE
c/o Freese and Nichols, Inc.
Fort Worth, Texas

* * *

BY

BAKER-SHIFLETT, INC.
Geotechnical and Material Engineers
Fort Worth, Texas

August, 1988

BAKER-SHIFLETT, Inc.
Geotechnical, GeoEnvironmental, Engineering Geology, Construction Materials Engineers

August 30, 1988
Report No. 882398

City of Grapevine
c/o Freese and Nichols, Inc.
811 Lamar Street
Fort Worth, Texas 76102

Attn: Mr. Mike G. Morrison, P.E.

Re: Geotechnical Study
Water Treatment Plant Expansion
Grapevine, Texas

Gentlemen:

Attached is our report on geotechnical design values for the expansion to your existing water treatment plant. This work has been performed as you authorized on July 27, 1988, transmitted on August 4, 1988 and received in this office August 8, 1988.

The technical concepts and work has been coordinated through Mr. Samuel K. Naumann, P.E. of Freese and Nichols. We appreciate being given the privilege of providing this geotechnical service. As we can be of additional help, please call.

Very truly yours,

BAKER-SHIFLETT, Inc.

Michael M. Shiflett

Michael M. Shiflett, P.E.
Texas 43763

MMS/dr

Copies Submitted: (10)

# TABLE OF CONTENTS



## APPENDIX



## ILLUSTRATIONS

## 1.0 INTRODUCTION

The City of Grapevine proposes to enlarge the existing Water Treatment Plant. This report presents the results of a geotechnical study made for the new structures. The plant expansion will include:

- An above ground clearwell which will be a welded circular tank;
- A clarifier which will be a circular concrete structure;
- A flocculator which is a cast-in-place concrete tank;
- Chemical Feed Building which is a masonry building normally supported on a slab-on-grade foundation; and
- Reconstruction of plant access road and construction of new plant road.

Elevations of final and existing grades are presented with the detailed foundation recommendations for each structure.

The purpose of this report has been to explore subsurface conditions and to make recommendations concerning foundation systems and design.

## 2.0 FIELD EXPLORATION AND LABORATORY TESTING

Subsurface materials at the site were explored by four (4) borings drilled to depths of 20 to 25 feet in the areas of the proposed structures and two (2) borings to five feet along the plant access road. The borings were staked at the site by Mr. Samuel K. Naumann,

P.E. of Freese and Nichols, and this writer, and were measured from the chain-link fence surrounding the existing plant area and at two selected points along the access roadway. The four borings around the plant were later located by a survey crew and designated within the plant coordinate system, and elevations determined. The borings were drilled on August 12 and 15, 1988 at the approximate locations shown on the Plan of Borings Plate 1 in the Illustration Section. The boring logs are included in the Illustration Section on Plates 2 through 7, and a key to terms and descriptions on the logs is provided.

Laboratory soil tests were performed on samples recovered from the borings to verify visual classification and to determine the pertinent engineering properties of the soils encountered. In addition to the classification properties, tests were performed to establish the shear strength properties of the foundation soils, and absorption pressure-swell tests were conducted to determine swell characteristics. Results of the laboratory testing made for this study are presented in the Appendix.

## 3.0 SUBSURFACE CONDITIONS

### 3.1 Geology

Based on available geological maps and field observations, this site is underlain by the Woodbine Geological Formation. Sands, clays, sandstones and shales generally compose this formation. Iron oxides, lignite, gypsum, and pyrite are also found throughout the formation.

Dense and irregular shaped masses or hard sandstone occur at random throughout the formation and are commonly referred to as "boulders." Structurally, the Woodbine is quite complex in that it contains numerous small faults, lenticular masses and consequent divergent dips. It is often difficult, if not impossible, to trace a particular bed for any distance. Water is found at various levels in the formation, some as perched tables in sand lenses. The outcrop of the Woodbine Formation is generally marked by sandy surface soils which support a dense growth of oak trees.

Numerous boulders lie piled on top of the ground just to the north of the plant fenced area. It appears as though the rock may have been excavated during previous plant construction, and taken to their existing location. These hard sandstone boulders are consistent with the geology, with the stratigraphy revealed by the core borings drilled for this study, and with previous experience in the general area.

## 3.2 Stratigraphy

The stratigraphy encountered by the four borings within the plant area is quite complicated. The subsurface is generally consistent with the previous core borings by Mason-Johnston and Associates, Inc. drilled during June, 1977 for previous plant construction.

3.2.1 Borings 1 and 2

The uppermost 6 to 8 feet consists of clayey sand, sandy clay and clay, varying in color from brown to tan to tan and gray. Sandstone fragments and cemented sand seams occur within this depth.

From 6 to 12-1/2 feet in Boring 1, and 8 to 11-1/2 feet in Boring 2, sandstone, clay-shale and sand exist. The materials vary in occurrence, cementation, and consistency, as encountered by the borings.

Below 12-1/2 feet in Boring 1, and 12 feet in Boring 2, the strata become sand, tan to gray, with dark gray shale seams, and some cementation.

3.2.2 Borings 3 and 4

In these two borings, a surficial "caprock" was encountered down to the 3-1/2 foot depth. This is a very hard layer of tan calcareous sandstone, and is a cementation of fine to coarse grains and fossils. A thin covering of brown clayey sand overlies the sandstone at Boring 3. The hard rock zone extended to only 3-1/2 feet in both borings.

From 3-1/2 feet to 12 feet in Boring 1, and 14 feet in Boring 2, layers of sandy clay, clay-shale, sand and sandstone occur. As previously stated, these materials are variable in horizontal and vertical extent.

Below 12 feet and 14 feet in Borings 3 and 4, respectively, sand, brown and gray, with shale seams occurred down to the termination depth of the borings. The sand layer is clayey due to the shale seams, and contains varying degrees of cementation being poorly to moderately cemented.

### 3.2.3 Borings 5 and 6

The two shallow borings drilled along the existing plant access road encountered dense clayey sand, tan to reddish brown in color. In Boring 5, the upper 2 feet of soil classified as sandy clay, and is a borderline soil between sandy clay and clayey sand.

### 3.2.4 Stratigraphic Summary

The predominant material at the site is sand and sandstone, which includes clay or shale seams. Portions of the sand are cemented to varying degrees, and are very dense and friable. The sandstone occurs where cementation is of sufficient effect to produce a solid mass or rock. The sandstone can be extremely hard and difficult to penetrate or excavate during construction.

The clay-shale material is a clayey zone, generally exhibiting a hard consistency regarding soil consistencies. The clay-shale and clays are much softer zones than the sands and sandstones.

3.3 Groundwater

Seepage was not noted within the borings above the sandstone and clay-shale. Water was used as drilling fluid to core the more consolidated units. The core borings were bailed of drilling fluid upon completion of the drilling and sampling. Temporary PVC piezometers were placed in Borings 1, 2 and 3.

Specific notes regarding groundwater observations are given on the individual Logs of Borings.

Although the water observations are not conclusive, it appears that if subsurface moisture is occurring at the site, it is in the form of seepage. Willow trees and cottonwood trees exist around the plant site which are often times indicators of subsurface moisture.

Additionally outside the fenced area, to the northwest, and near the sewage lift station, surface water and wet conditions existed at the time of this field exploration. Whether this is seepage or effects of the lift station have not been determined by this study.

Due to the fact that this field exploration and study have been performed during a dry climatic period, one should anticipate that during wet periods, different subsurface moisture conditions might be present.

Water traveling through the soil (subsurface water) is often unpredictable. This could be due to seasonal changes in groundwater and due to the unpredictable nature of groundwater paths. Therefore, it is necessary during construction for the contractor to be observant for groundwater seepage in excavations in order to assess the situation and make necessary changes and/or recommendations.

## 4.0 ANALYSIS AND RECOMMENDATIONS

### 4.1 Clearwell

The clearwell will be a circular steel structure, with a finished floor elevation of 548.5. The ground surface at Boring 1 was 549. Immediately south of Boring 1 is a drainage ditch which will be rerouted as a portion of the plant expansion. The flowline elevation adjacent to Boring 1 is 547.

Approximately one foot of soil at Boring 1 will be cut. The drainage ditch will require fill. It is recommended that the circular ring beam for the clearwell be founded within undisturbed, firm soil, and below the present flowline of the ditch. A net allowable bearing capacity of 2.5 kips per square foot (ksf) should not be exceeded when sizing the bearing surface of the beam at an elevation at least one foot below the flowline of the ditch.

Although a much deeper beam would be required, the circular ring beam could extend down to the surface of the gray sandstone (6 feet in

Boring 1). The gray sandstone with gray shale seams would provide a much firmer and consistent surface upon which to bear the structural load. The ring beam placed approximately six inches into the gray sandstone could then be sized using a net allowable bearing capacity of 6 ksf.

Portions of the sandy clay and clay which will lie beneath the clearwell are expansive soils. Generally, some movement within the bottom of a steel tank is acceptable. A swell test on a soil sample from Boring 2 indicated 1.2 percent swell, which is generally an acceptable magnitude of movement for a steel tank. If the design structural engineer for the tank desires, Baker-Shiflett can discuss alternatives for removing or treating the expansive soils.

## 4.2 Clarifier

### 4.2.1. Foundation

The finish floor elevation for the clarifier will be 544.6. The ground surface of Boring 2 was 548, requiring a cut of approximately 4 to 5 feet to achieve rough grade. Below elevation 544 in Boring 2, plastic tan and gray clay occurs. It is recommended that this expansive, plastic clay be removed from below the clarifier foundation and replaced with crushed limestone base material or equivalent. This will require 3 to 5 feet of soil removed from the bottom of the excavation, to expose the dark gray clay-shale and/or sand.

The perimeter footing of the clarifier, placed within compacted base material may be sized based upon 4 ksf bearing allowable, factor of safety of 3. The limestone base material should be compacted to no less than 95 percent of Modified Proctor (ASTM D 1557) density.

The base of the excavation should be observed to confirm that the tan and gray clay has been removed, prior to placing the base material. Additionally, it is important that the excavation be backfilled with proper material such as the crushed limestone that will not be porous and will prevent moisture from seeping into the underlying clay-shale, if the clay-shale is not removed.

Although the clay-shale is a suitable bearing material as long as protected from severe drying and wetting cycles, the material will dry and desiccate if opened to a dry atmosphere, or can become soft if given free access to moisture. Therefore, the length of time the excavation is open exposing the clay-shale is a critical period. In order to help protect the bearing surface, a mud slab could be placed in the bottom of the foundation excavation as soon as practical. The mud slab would consist of lean concrete placed over the entire excavated bottom. Alternatively, the crushed limestone could be placed within the foundation excavation soon after excavation which would provide the protection to the bearing surface. Once again, the intent is to protect the bearing surface from atmospheric conditions and severe drying and/or wetting.

4.2.2 Lateral Soil Loads

At least a portion of the clarifier will be below grade, and will therefore be subjected to lateral earth pressure. Rock which will be removed during excavation should not be used as backfill against structures. The plastic clays which exist on site should also be used in less critical areas of general fill, and should not be used as backfill against structures. The following lateral earth pressures for horizontal backfill may be used for design.

1. Granular backfill for reduction of loads, k = 0.30 or an equivalent fluid pressure of 38 pounds per square foot per foot of wall height (psf/lf) above the maximum probable water level (water table or inundation), and 19 psf/lf below the water table.

2. On site sandy clay (CL) used as backfill, k = 0.50 or an equivalent fluid pressure of 63 psf/lf above the water table and 32 psf/lf below the water table.

Hydrostatic pressures must be added below the maximum probable or design water level. The design values have been based on a wet unit weight of soil of 125 pounds per cubic foot.

4.3 Construction Excavation

The side slopes of excavations through the overburden soils should be made in such a manner to provide for their stability during construction. Existing structures, pipes, etc. (if present), should be protected from loss of end bearing or lateral support. It is recommended that temporary construction slopes of 1.0 (horizontal) to

1.0 (vertical) or flatter be used as a safety measure since exposure weakens cohesive soils and can erode granular materials resulting in sloughing of material. This slope also is recommended such that the below grade walls can be backfilled with free-draining, select material. If steeper slopes are needed, some type of temporary earth retention system should be utilized.

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosional protection is provided instead of allowing surface water to flow down unprotected slopes. The cut face of excavations may require some type of slope protection during construction. This may entail the use of an asphaltic emulsion material sprayed onto the slope or the use of shotcrete. The intent is to prevent loss of moisture within the soils. Alternating drying and wetting cycles could produce additional shrinkage cracks within a plastic soil, and a slope failure could occur.

Surcharge loads, either static or dynamic, should not be applied to the slope, particularly at the top of the slope. Construction equipment should be prevented from traveling along or near the top of the excavation slope. Monitoring of temporary slopes, trenches, and dewatering during construction should be undertaken by the contractor to detect early warnings of movement within slopes, structures, pavements, etc.

4.4 Flocculator and Chemical Buildings

Borings 3 and 4 were drilled within areas of the proposed Flocculator and the Chemical Building. Each boring has a ground surface elevation of 546.7 and 546.8 respectively, and encountered the hard tan calcareous sandstone within 6 inches of the ground surface.

The flocculator will require an excavated subgrade level of about 546, with top of slab being 546.8. This may require cutting into the sandstone. The lateral extent of the sandstone has not been determined. However, estimating that the hard sandstone boulder may be penetrated by grade beams, it is recommended that grade beams be sized based upon the bearing allowable of the underlying sandy clay and clay-shale, or 4.0 ksf. If the grade beams and slab are placed within the hard rock zone, this bearing allowable is conservative. However, at this time the thickness and lateral extent of the sandstone has not been determined throughout the area of the flocculator.

If the sandstone layer is fully penetrated by the excavation, then a zone of expansive clay-shale is exposed. Admitting moisture to the clay-shale, should there be leakage from the flocculator tank, could cause swelling within the clay-shale. In order to protect the structure from swelling soil, the structure could be supported atop drilled shafts founded within the underlying gray sand and shale.

At this time however, the slab-on-grade system is being presented. The clay-shale will not be exposed according to the sandstone thickness of

Boring 3. The excavation should be observed at the time of construction to determine actual conditions.

The Chemical Building will use a slab-on-grade foundation system. The ground surface at Boring 4 was 546.9 and a finish floor elevation of 550 to 551 is proposed. The area around Boring 4 will therefore receive 3 to 4 feet of fill to achieve final grade. It is recommended that the soil above the shallow sandstone be removed anywhere present within the proposed building area. Non-expansive, compacted select fill should provide a firm, uniformly placed pad within which to pound the grade beams.

The bottoms of the grade beams may be supported within the compacted and tested select fill, or may conform to the exposed surface of the sandstone. The sandstone is exposed at the ground surface in the general vicinity of Boring 4.

The grade beams for the Chemical Building may be sized based upon a suitable bearing capacity of the select fill, that being 3.0 ksf. This bearing capacity is appropriated for a uniformly placed, compacted, and tested select fill building pad.

4.5 Site Drainage

It is important to provide adequate surface drainage during and after the construction. Ponding water can result in expansive soil movements

if allowed access to the clay zones. A slope of 1.5 to 3 percent should be provided, such that the soil slopes away from the structures.

### 4.6 Thrust Blocking

Thrust blocks which will be used to transmit hydraulic induced loads within piping systems into the soil may be sized based upon:

1. 1 foot to 3 feet below ground surface - allowable soil loading of 1.5 ksf
2. Sandy clay and clay greater than 3 feet below the ground surface but above the clay-shale, sandstone and sand - allowable soil loading of 3 ksf
3. Clay-shale, sandstone and sand greater than 6 feet below the ground surface - allowable strata loading of 5.5 ksf

These values are suitable for thrust blocks resisting lateral or vertical loads.

## 5.0 EARTHWORK

### 5.1 Site Preparation

The building site and areas to be paved should be stripped of vegetation, roots, old construction debris, and other organic material. It is estimated that the depth of stripping will be on the order of 4 to 6 inches. The actual stripping depth should be based on field observations with particular attention given to old drainage areas, uneven topography, and excessively wet soils. The stripped areas should be observed to determine if additional excavation is required to

remove weak or otherwise objectionable materials that would adversely affect the fill placement.

The subgrade should be firm and able to support the construction equipment without displacement. Soft or yielding subgrade should be corrected and made stable before construction proceeds. The subgrade should be proof rolled to detect soft spots, which if exist, should be reworked. Proof rolling should be performed using a heavy pneumatic tired roller, weighing 25 to 50 tons. The proof rolling operations should be observed by a geotechnical engineer or his representative. Prior to fill placement, the subgrade should be scarified to a depth of approximately 6 inches, its moisture content adjusted, and recompacted to the density specified herein for fill.

5.2 Placement and Compaction

Fill material should be placed in loose lifts not exceeding 8 inches in uncompacted thickness. The fill material should be uniform with respect to material type and moisture content. Clods and chunks of material should be broken and the fill material mixed by disking, blading, or plowing, as necessary, so that a material of uniform moisture and density is obtained for each lift. Water required for sprinkling to bring the fill material to the proper moisture content should be applied evenly through each layer.

The fill material should be compacted to a minimum of ninety-five (95) percent of the maximum dry density determined by the Standard Proctor test ASTM D 698. In conjunction with the compacting operation, the fill material should be brought to the proper moisture content, not less than optimum moisture nor greater than 4 percentage points above optimum (0 to +4).

Each lift should be compacted, tested, and approved before another lift is added. The purpose of the field density tests is to provide some indication that uniform and adequate compaction is being obtained. The actual quality of the fill, as compacted, should be the responsibility of the contractor and satisfactory results from the tests should not be considered as a guarantee of the quality of the contractor's filling operations.

5.3 Non-Expansive, Select Fill

Select fill material should be a clayey sand or a lean sandy clay with a Liquid Limit (LL) less than thirty (30), and a Plasticity Index (PI) between four (4) and twelve (12). The select fill should be placed in loose lifts not exceeding eight (8) inches in uncompacted thickness, and be uniformly compacted to a minimum of ninety-five (95) percent of the maximum dry density determined by Standard Proctor (ASTM D 698). The moisture content of the fill at the time of compaction should be from minus two (2) to plus three (3) percentage points of optimum. The moisture content and density of the in-place select fill should be

maintained from the time the pad is completed until placement of the slab.

## 6.0 ACCESS ROAD

### 6.1 General

It is proposed to reconstruct the access road and to build a new plant road. It was determined to base the road thickness calculations upon a loaded truck volume of one fully loaded tractor trailer per week. This yields 4.5, 18-kip single axle load applications (SALAS) per truck or 234, 18-kip SALAS per year. A 20-year design life is 4,680 18-kip SALAS, or 5 x 10(3), total 18-kip SALAS.

Using the soil types encountered within Borings 5 and 6, an estimated CBR of 15 to 20 has been made. This estimate of CBR assumes that the new subgrade will contain some sandstone fragments or gravel from the existing roadway so as to not be strictly sand or clay, but somewhat gravelly.

### 6.2 Pavement Thickness

For a flexible base pavement, using the AASHTO Interim guide for Design of Pavement Structures, 1972, a Structural Number less than 1.5 is obtained (Figure II-2 pg. 23). This will yield a pavement section of 2 inches of hot mix asphaltic concrete, 6 inches crushed limestone base material and 6 inches compacted subgrade. However, for truck traffic, a minimum pavement section should be

2 inches hot mix asphaltic concrete surface course,
8 inches crushed limestone base material,
6 inches compacted subgrade.

As the rough grading occurs, if areas of soft subgrade are encountered, the soft material should be overexcavated to remove the soft zone, and recompacted to proper density. Areas of questionable subgrade stability can also use thickened sections of base material.

For the wet area near the sewage lift station, the soft, wet soils should be removed down to firm ground. The water should be rerouted or prevented from wetting the roadway subgrade in some manner. Consideration should be given to using a geotextile between the exposed subgrade and the crushed limestone base material, and also using more than eight inches of base. If the water persists during construction, an open graded crushed stone may be placed between the base material and geotextile to provide an underdrain beneath the roadway.

The pavement materials may be specified to be

1. Hot Mix Asphaltic Concrete Surface Course - SDHPT Item 340, Type D

2. Crushed Limestone Base Material - SDHPT Item 249, Type A, Grade 2 of better. The material should be compacted to a minimum of 98 percent of TEX-113-E, at or slightly above optimum moisture.

3. Compacted Subgrade - Scarify the existing soils after removing vegetation and achieving final grades, and, recompact to a minimum of 95 percent of the maximum dry density determined by the Standard Proctor test (ASTM D 698) at or slightly above optimum moisture.

## 7.0 REPORT CLOSURE

The borings made for this report were located in the field by surveyed locations tied to the site coordinate system. Elevations of the borings were provided to us by Freese and Nichols.

The boring logs shown in this report contain information related to the types of soil encountered at specific locations and times and show lines delineating the interface between these materials. The logs also contain our field representative's interpretation of conditions that are believed to exist in those depth intervals between the actual samples taken. Therefore, these boring logs contain both factual and interpretive information. It is not warranted that these logs are representative of subsurface conditions at other locations and times.

With regard to groundwater conditions, this report presents data on groundwater levels as they were observed during the course of the field work. In particular, water level readings have been made in the borings at the times and under conditions stated in the text of the report and on the Boring Logs. It should be noted that fluctuations in the level of the groundwater table can occur with passage of time due to variations in rainfall, temperature and other factors. Also, this report does not include quantitative information on rates of flow of

groundwater into excavations, on pumping capacities necessary to dewater the excavations, or on methods of dewatering excavations. Unanticipated soil conditions at a construction site are commonly encountered and cannot be fully predicted by mere soil samples, test borings or test pits. Such unexpected conditions frequently require that additional expenditures be made by the owner to attain a properly designed and constructed project. Therefore, provision for some contingency fund is recommended to accommodate such potential extra cost.

The analyses, conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our field investigation and further on the assumption that the exploratory borings are representative of the subsurface conditions throughout the site, that is, the subsurface conditions everywhere are not significantly different from those disclosed by the borings at the time they were completed. If, during construction, different subsurface conditions from those encountered in our borings are observed, or appear to be present beneath excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between submission of this report and the start of the work at the site, if conditions have changed due either to natural causes or to construction operations at or adjacent to the site, or if structure locations, structural loads or finish grades are changed, we urge that

we be promptly informed and retained to review our report to determine the applicability of the conclusions and recommendations, considering the changed conditions and/or time lapse.

This report has been prepared for use in developing an overall design concept. Paragraphs, statements, test results, boring logs, diagrams, etc., should not be taken out of context, nor utilized without a knowledge and awareness of their intent within the overall concept of this report. The reproduction of this report, or any part thereof, supplied to persons other than the owner, should indicate that this study was made for foundation design purposes only and that verification of the subsurface conditions for purposes of determining difficulty of excavation, trafficability, etc., are responsibilities of the contractor.

This report has been prepared for the exclusive use of the City of Grapevine and Freese and Nichols Consulting Engineers for specific application to design of foundations in the expansion of the Grapevine Water Treatment Plant. The only warranty made by us in connection with the services provided is that we have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, expressed or implied, is made or intended.

* * *

# APPENDIX

## SUMMARY OF LABORATORY TESTS

Water Treatment Plant Expansion
Grapevine, Texas
Report No. 882398

| Boring No. | Sample Depth, ft. | Liquid Limit | Plastic Limit | Plasticity Index | Minus 200 | Unit Dry Weight, pcf | M.C. % | U.C. tsf |
|---|---|---|---|---|---|---|---|---|
| B-1 | 0.0 - 1.5 | - | - | - | 18 | 108 | 4 | 4.0 |
| B-1 | 1.5 - 3.0 | - | - | - | 25 | - | - | - |
| B-1 | 3.0 - 4.5 | 39 | 16 | 23 | 53 | - | 22 | - |
| B-1 | 4.5 - 6.0 | 39 | 15 | 24 | 73 | - | - | - |
| B-1 | 7.3 - 8.5 | 36 | 16 | 20 | 76 | 128 | 16 | 4.0 |
| B-1 | 11.3 - 11.9 | - | - | - | - | 160 | 3 | 143.2 |
| B-2 | 0.0 - 1.5 | 28 | 14 | 14 | 30 | - | - | - |
| B-2 | 1.5 - 2.5 | - | - | - | 12 | - | - | - |
| B-2 | 2.5 - 4.0 | 26 | 13 | 13 | 54 | - | - | - |
| B-2 | 4.5 - 6.0 | - | - | - | - | - | 18 | - |
| B-2 | 6.0 - 7.0 | 52 | 19 | 33 | 82 | 108 | 21 | 1.5 |
| B-2 | 8.2 - 8.9 | 37 | 14 | 23 | 68 | 121 | 18 | 1.9 * |
| B-2 | 11.6 - 12.2 | - | - | - | - | 112 | 18 | - |
| B-2 | 19.5 - 20.0 | - | - | - | - | 112 | 18 | 18.8 |
| B-3 | 3.5 - 4.0 | - | - | - | - | 113 | 18 | 1.5 * |
| B-3 | 4.0 - 4.9 | 45 | 18 | 27 | 88 | 120 | 19 | 2.9 |
| B-3 | 6.6 - 7.4 | 43 | 15 | 28 | 84 | 126 | 17 | 4.7 |

* Failure occurred on slickensided surface.

## SUMMARY OF LABORATORY TESTS

Water Treatment Plant Expansion
Grapevine, Texas
Report No. 882398

| Boring No. | Sample Depth, ft. | Liquid Limit | Plastic Limit | Plasticity Index | Minus 200 | Unit Dry Weight, pcf | M.C. % | U.C. tsf |
|---|---|---|---|---|---|---|---|---|
| B-4 | 3.5 - 5.0 | 59 | 24 | 35 | 84 | - | - | - |
| B-4 | 6.0 - 7.5 | - | - | - | - | 105 | 27 | 1.9 |
| B-4 | 7.5 - 8.2 | - | - | - | - | - | 19 | - |
| B-4 | 11.1 - 11.6 | - | - | - | - | 154 | 5 | 183.3 |
| B-5 | 0.0 - 1.0 | 37 | 14 | 23 | 52 | 129 | 9 | 10.9 |
| B-5 | 2.5 - 3.0 | - | - | - | 18 | - | 7 | - |
| B-5 | 3.5 - 4.9 | - | - | - | 25 | - | 10 | - |
| B-6 | 0.0 - 1.5 | 34 | 13 | 21 | 46 | 126 | 9 | 11.4 |
| B-6 | 1.5 - 3.0 | - | - | - | 38 | - | 12 | - |
| B-6 | 3.0 - 4.0 | - | - | - | - | 105 | 9 | - |
| B-6 | 4.0 - 5.0 | 29 | 15 | 14 | 29 | 99 | 9 | 0.9 |

## ABSORPTION PRESSURE SWELL TEST

Water Treatment Plant Expansion

Grapevine, Texas

Report Date: August, 1988 Report No.: 882398

Boring No.: B-2 Sample Depth: 6.0 - 7.0
Material Description: Tan clay w/sand
Classification (USC): CH

| | | | | |
|---|---|---|---|---|
| Liquid Limit (LL): | 52 | Initial Moisture Content: | 21.0 | % |
| Plastic Limit (PL): | 19 | Final Moisture Content : | 22.9 | % |
| Plasticity Index (PI): | 33 | Unit Dry Weight : | 107.2 | pcf |
| Minus #200 Sieve: | 82 % | | | |

| Absorption Pressure | Absorption Swell |
|---|---|
| 0.50 tsf | 0.3 % |
| 0.25 tsf | 0.6 % |
| 0.13 tsf | 0.8 % |
| 0.06 tsf | 1.2 % |

## ABSORPTION PRESSURE SWELL TEST

Water Treatment Plant Expansion

Grapevine, Texas

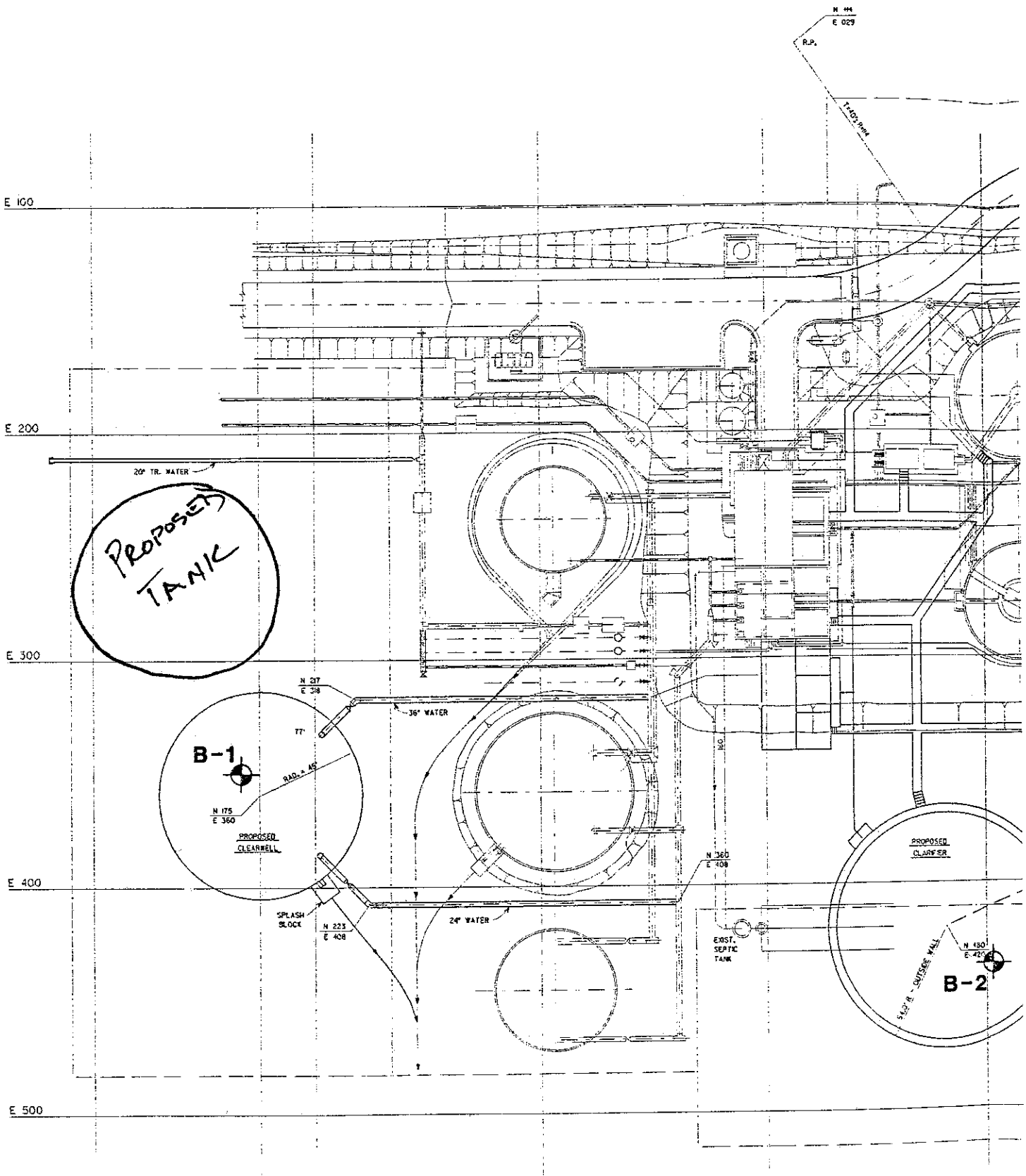
Report Date: August, 1988 Report No.: 882398

Boring No.: B-4 Sample Depth: 3.5 - 5.0
Material Description: Tan & gray clay w/sand
Classification (USC): CH

| | | | | |
|---|---|---|---|---|
| Liquid Limit (LL): | 59 | Initial Moisture Content: | 23.5 | % |
| Plastic Limit (PL): | 24 | Final Moisture Content: | 25.2 | % |
| Plasticity Index (PI): | 35 | Unit Dry Weight: | 100.6 | pcf |
| Minus #200 Sieve: | 84 % | | | |

| Absorption Pressure | Absorption Swell |
|---|---|
| 0.35 tsf | 0.0 % |
| 0.18 tsf | 0.4 % |

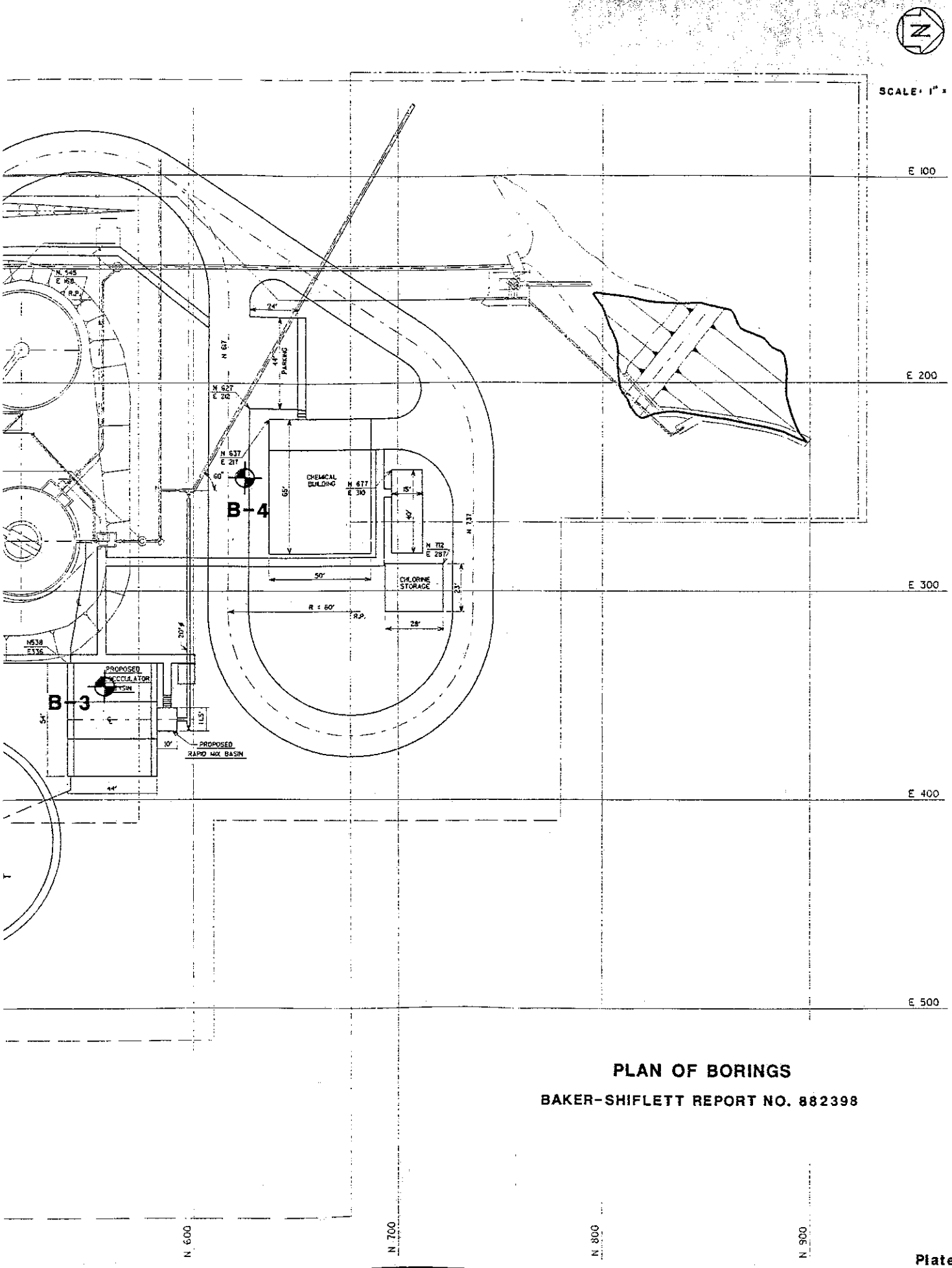
# ILLUSTRATIONS




**NOTE: BORINGS 5 AND 6 DRILLED SOUTH OF PLANT ALONG ACCESS ROAD.**

N 100 N 200 N 300 N 400 N 500

| | | | | |
|---|---|---|---|---|
| | DESIGNED | JOB NO. | FREESE AND NICHOLS, INC. | 4.0 MG |
| | DRAWN | DATE | CONSULTING ENGINEERS | |




## PLAN OF BORINGS

**BAKER-SHIFLETT REPORT NO. 882398**

Plate 1

CITY OF GRAPEVINE, TEXAS
MGD WATER TREATMENT PLANT EXPANSION

GENERAL LAYOUT

# LOG OF BORING NO. B-1
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

SURFACE ELEVATION: 549.0 LOCATION: See Plate 1
N167.42, E350.64

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R Q D, % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | 4.5 | | | CLAYEY SAND, light olive brown to tan, medium dense, w/iron stains (SC) |
| 2.5 | | 19 | | | SANDY CLAY, tan and reddish tan, hard, w/iron stains (CL) |
| 5 | | 59 | | | CLAY w/sand, gray and tan, hard, w/iron stains (CL) |
| | | | 92 | 63 | SANDSTONE, gray, well cemented, w/dark gray shale seams, calcareous |
| 7.5 | | | | | CLAY-SHALE, dark gray, w/sandstone partings and seams |
| 10 | | | 97 | 63 | SANDSTONE, gray, very hard, w/dark gray shale seams w/fossils, calcareous |
| 12.5 | | | | | SAND, gray, poorly to moderately cemented, w/dark gray shale seams |
| 15 | | | 65 | 0 | |
| 17.5 | | 100/1" | | | |
| 20 | | | | | Note: Sampled w/dry drilling techniques to 6'. Water used as drilling fluid to core. Upon completion, bailed to 14½'. 2-inch PVC set as temporary piezometer. On 8-15-88, water at 15'; on 8-18-88, 15'. No change on 8-29-88. |
| 22.5 | | | | | |
| 25 | | | | | |

Completion Depth: 20'
Date: 8-12-88

LOG OF BORING NO. B-2
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

SURFACE ELEVATION: 548.0 LOCATION: See Plate 1
N502.32, E436.59

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R.Q.D., % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | 4.5+ | | | CLAYEY SAND, brown to reddish/brown, medium dense, w/sandstone fragments, w/cemented sand seams, w/iron stains (SC) |
| 2.5 | | 4.5 | | | |
| | | 33 | | | SANDY CLAY, tan and gray, hard, w/sandstone fragments, w/cemented sand partings and seams, w/fossils (CL) |
| 5 | | 4.5 | | | CLAY w/sand, tan and gray to tan, stiff to very stiff, shaly, w/calcite crystals, w/iron stains (CL-CH) |
| | | 4.5 | | | |
| 7.5 | | | | | CLAY-SHALE, dark gray, w/fossils, sandy, jointed |
| 10 | | | 96 | 41 | SAND, tan, moderately cemented, w/iron stains |
| | | | | | SAND, tan, w/cemented seams, w/dark gray shale partings, w/iron stains |
| 12.5 | | | | | SANDSTONE, gray, w/dark gray shale partings, calcareous |
| | | | | | SAND, tan, w/dark gray shale partings and seams, w/iron stains |
| 15 | | | 92 | 12 | SAND, dark gray, w/occasional shale seams, poorly to moderately cemented |
| 17.5 | | | | | |
| 20 | | 100/1" | | | |
| 22.5 | | | 94 | 0 | Note: Sampled w/dry drilling techniques to 4'. Water used as drilling fluid to core. Upon completion, bailed to 22'. 2-inch PVC set as temporary piezometer. On 8-18-88, water at 16½'. No change on 8-29-88. |
| | | 100/½" | | | |
| 25 | | | | | |

Completion Depth: 25'
Date: 8-15-88

# LOG OF BORING NO. B-3
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

SURFACE ELEVATION: 546.7 LOCATION: See Plate 1
N556.43, E345.91

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R Q D, % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | CLAYEY SAND, brown, medium dense, w/roots (SC) |
| | | | | | SANDSTONE, tan & gray, calcareous, very hard, fine to coarse grains, fossiliferous |
| 2.5 | | 4.5+ | | | SANDY CLAY, gray, stiff, shaly, w/iron stains (CL) |
| 5 | | | 100 | 63 | CLAY-SHALE, dark gray, sandy, jointed |
| 7.5 | | | | | |
| | | | | | SAND, dark gray, clayey & shaly |
| 10 | | | 96 | 23 | SANDSTONE, gray, calcareous, well cemented |
| 12.5 | | | | | CLAY-SHALE, dark gray, sandy |
| | | | | | SAND, dark gray, poorly to moderately cemented, w/shale |
| 15 | | 100/1" | 92 | 0 | |
| 17.5 | | | | | |
| | | 100/1/2" | 87 | 0 | |
| 20 | | | | | |
| | | | | | Note: Water used as drilling fluid to drill & core. Upon completion, bailed to 18'. 2-inch PVC set as temporary piezometer. On 8-15-88, water at 13.8'; on 8-18-88, 14.5'. No change on 8-29-88. |
| 22.5 | | | | | |
| 25 | | | | | |

Completion Depth: 20'
Date: 8-12-88

BAKER-SHIFLETT, INC.

LOG OF BORING NO. B-4
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

SURFACE ELEVATION: 546.9 LOCATION: See Plate 1
N625.23, E245.42

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R Q D, % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | | | | SANDSTONE, tan & gray, calcareous, very hard, fine to coarse grain, w/fossiliferous |
| 2.5 | | | | | |
| | | 4.5 | | | CLAY W/SAND, tan & gray, stiff to very stiff, blocky, jointed, w/calcite crystals |
| 5 | | | | | |
| | | 4.5 | | | (CH) |
| 7.5 | | | | | CLAY-SHALE, dark gray, sandy |
| | | | | | SANDSTONE, gray, calcareous |
| | | | 94 | 43 | |
| 10 | | | | | CLAY-SHALE, dark gray, sandy |
| | | | | | SANDSTONE, gray, w/dark gray shale partings & seams, calcareous |
| 12.5 | | 100/1" | | | SAND, tan & dark gray, poorly to moderately cemented, w/shale seams, w/iron stains |
| 15 | | | | | |
| | | | 100 | 0 | |
| 17.5 | | | | | |
| | | 100/1/2" | | | |
| 20 | | | | | |
| 22.5 | | | | | |
| 25 | | | | | |

Completion Depth: 20'
Date: 8-12-88

BAKER-SHIFLETT, INC.

# LOG OF BORING NO. B-5
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

SURFACE ELEVATION: LOCATION: See Plate 1

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R Q D, % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | 4.5+ | | | SANDY CLAY, tan & gray, hard, dry, w/sandstone fragments, w/iron stains (CL) |
| | | 40 | | | |
| 2.5 | | | | | CLAYEY SAND, reddish tan, dense, w/iron stains |
| | | 50/11" | | | (SC) |
| 5 | | | | | |
| 7.5 | | | | | |
| 10 | | | | | |
| 12.5 | | | | | |
| 15 | | | | | |
| 17.5 | | | | | |
| 20 | | | | | |
| 22.5 | | | | | |
| 25 | | | | | |

Completion Depth: 5'
Date: 8-15-88

LOG OF BORING NO B-6
WATER TREATMENT PLANT EXPANSION
GRAPEVINE, TEXAS
REPORT NO. 882398

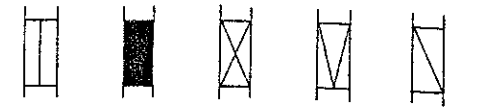
SURFACE ELEVATION: LOCATION: See Plate 1

| Depth, Ft. | Samples | Penetrometer, TSF / Penetration Resistance, Blows/Ft. | Recovery, % | R Q D, % | MATERIAL DESCRIPTION |
|---|---|---|---|---|---|
| | | 4.5+ | | | CLAYEY SAND, reddish tan & gray, dense, dry, w/iron stains (SC) |
| 2.5 | | 4.5 | | | CLAYEY SAND, light olive gray & reddish tan, dense, w/iron stains (SC) |
| 5 | | 4.5+ | | | |
| 7.5 | | | | | |
| 10 | | | | | |
| 12.5 | | | | | |
| 15 | | | | | |
| 17.5 | | | | | |
| 20 | | | | | |
| 22.5 | | | | | |
| 25 | | | | | |

Completion Depth: 5'
Date: 8-15-88

# SYMBOLS AND TERMS USED ON BORING LOGS

## SAMPLER TYPES
(Shown in sample column)




## TERMS DESCRIBING CONSISTENCY OR CONDITION

| Penetration Resistance blows per foot | Relative Density | Unconfined Compressive Strength, tsf | Consistency |
|---|---|---|---|
| 0 - 4 | Very Loose | Less than 0 25 | Very Soft |
| 4 - 10 | Loose | 0 25 to 0 50 | Soft |
| 10 - 30 | Medium Dense | 0 50 to 1 00 | Firm |
| 30 - 50 | Dense | 1 00 to 2 00 | Stiff |
| Over 50 | Very Dense | 2.00 to 4.00<br>4 00 and higher | Very Stiff<br>Hard |

## TERMS CHARACTERIZING SOIL STRUCTURE

*Slickensided* - having inclined planes of weakness that are slick and glossy in appearance.
*Fissured* - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.
*Laminated* - composed of thin layers of varying color and texture
*Interbedded* - composed of alternate layers of different soil types.
*Calcareous* - containing appreciable quantities of calcium carbonate.
*Well graded* - having wide range in grain sizes and substantial amounts of all intermediate particle sizes.
*Poorly graded* - predominantly of one grain size, or having a range of sizes with some intermediate size missing.

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

## DEGREE OF WEATHERING

*UNWEATHERED* - Rock in its natural state before being exposed to atmospheric agents.

*SLIGHTLY WEATHERED* - Noted predominantly by color change with no disintegrated zones.

*WEATHERED* - Complete color change with zones of slightly decomposed rock.

*SEVERELY WEATHERED* - Complete color change with consistency, texture, and general appearance approaching soil