**Attachment "L"**
**Construction Procedures**
Zelman#1 Injection Well

**PLAN TO DRILL**

1. Ensure all necessary state and federal permits, vendor contracts, and insurances are in order.

2. Post E&S plans, permits, and site ID Sign.

3. Construct Location per Erosion and Sediment Control Plan.

4. Set 8' of 24.5" (88#/ft) J55 conductor casing with back hoe; and cement to surface.

5. Hand grout with 15 sacks class A with 2 % CaCl.

6. Move in top-hole rotary drilling rig & rig up.

7. Nipple up on 24.5" casing.

8. Pick up 17 ½ Bit and drill to 180'.

9. Run 170'of 16" (65#/ft) H-40 grade casing with centralizer on each joint.
   Run Cement Basket 65'.

10. Cement 16" casing to surface with 130 sacks of class A cement with ½ # cello-flake and 2% Calcium Chloride per sack. Cement is to be mixed at 15.6 #/gal with a yield of 1.18 cu ft / sack. Calculated volume is based on 50% excess. See attached calculations.

11. Wait on Cement for 12 hours.

12. Nipple up on 16" casing, pick up 14 ¾" hammer bit, drill to 390' and trip out of hole.

13. Run 375' of 11 ¾" (42 #/ft) H-40 grade casing with a centralizer on each joint.
    Run cement basket at 160'.

14. Cement 11 ¾" casing to surface with 255 sacks of class A cement with ½ # cello-flake and 2% Calcium chloride per sack. Cement is to be mixed at 15.6 #/gal with a yield 1.18 cu ft/ sack. Calculated volume is based on 50% excess. See attached calculations.

15. Wait on cement for 12 hours.

16. Nipple up on 11 ¾" casing, pick up 10 5/8" hammer bit, drill to 1225'and trip out of hole.

17. Log well; Run G.R., caliper, SP, Dual Induction, Density and Neutron Porosity.

18. Run 1200' of 8 5/8" (32 #/ft) J-55 casing with a centralizer on every 2 joints. Run cement basket at 360'.

19. Cement 8 5/8" casing to surface with 315 sacks of class A cement with 1/4 # and 2% Calcium Chloride per sack. Cement is to be mixed at 15.6 #/gal with a yield 1.18 cu ft/ sack. Calculated volume is based on 30% excess. See attached calculations.

20. Wait on cement for 12 hours.

21. Install 11" 5M x 8 5/8 8 rd. wellhead

22. Rig down and move out top-hole rig.

23. Move in and rig up bottom hole rotary rig

24. Nipple up 11" 5M DR Blow out preventer and annular preventer.

25. Test stack to 4000 psi.

26. Pick up 7 7/8" hammer bit and trip in hole.

27. Drill to total depth in the Helderberg Limestone at an estimated 7388'.

28. Catch cutting samples every 30' from 6500'-7200'.

29. Catch samples every 10' from 7200' to TD.

30. Trip out of hole.

31. Run open hole logging suite to consist of Gamma Ray, Caliper, dual induction, neutron porosity, density porosity and temperature. Run logs from TD to surface casing seat with Gamma Ray log to surface.

32. Run 4 ½" (11.6 #/ft) N- 80 casing to bottom of Onondago Limestone at 7306' . Run centralizer on every 3 joints from 7306-5000'.

33. Set casing on cement packer shoe and cement casing back to 5000' ft with 340 sacks of class A with ½ # cello-flake and 2% Calcium Chloride per sack. Cement is to be mixed at 15.6 #/gal with a yield of 1.18 cu ft/sack.

34. Lift blow out preventer stack and set casing slips and wellhead assembly.

35. Wait on cement for 24 hours.

36. Run CBL log on 4.5" casing.

37. Trip in hole with 3 7/8" tri-cone on 2 3/8" work string and blow hole dry.

38. Drill out cement packer with air/foam.

39. Trip to bottom and clean hole.

40. Trip out of hole and Pick up Baker Oil Tools packer assembly.
    Baker model 45A4 "AL-2" Lok Set Casing Packer with on/off seal assembly

41. Trip in hole with 2 7/8" (6.4 #/ft) N-80 tubing and set packer at base of production casing at 7300'.

42. Pressure test 2 7/8" tubing x 4 ½" casing annulus to 4500 psi.

43. Rig down and move out rotary rig.

**Attachment "L"**
**Construction Procedures**
Zelman#1 Injection Well

The following is the proposed casing and cementing program for the Zelman #1 Injection Well.

| *Hole Size (In) | Casing Size (In) | Casing wt (#/ft) | Depth (Ft) | Cement Volume (Sacks) | Top of cement |
|---|---|---|---|---|---|
| 28 | 24.5 | 88 | 8 | 15 | surface |
| 17.5 | 16 | 65 | 170 | 130 | surface |
| 14 ¾ | 11 ¾ | 42 | 375 | 255 | surface |
| 10 5/8 | 8 5/8 | 32 | 1200 | 315 | surface |
| 7 7/8 | 4.5 | 11.6 | 7306 | 340 | 5000' |
| | 2 7/8 | 6.4 | 7300 | | Packer at 7300 |

Cement Volume Calculations:

Note: Annular volumes, volume between casings, casing capacities and cement slurry yields were obtained from Halliburton cementing tables.

**24.5" casing job (Class A with 2% CaCl)**

| | |
|---|---|
| Hole size = | 28" |
| Casing size = | 24.5" |
| Annular volume = | 1.0022 cu. ft. / lin. ft. |
| Length of cement column = | 8 lin. ft. |
| Percent excess = | 100% |
| Excess factor = | 2 |
| Slurry yield = | 1.18 cu. ft. / sack |

Sacks required = ((Annular Volume between casing and open hole) (length of cement column) (excess factor)) / slurry yield

Sacks required = ((1.022 cu. ft. / lin. ft.) (8 lin. ft.) (2))/ 1.18 cu.ft. / sack

**Sacks required** = 13.86 sacks = **15 sacks**

**16" casing job (Class A with 2 % CaCl & ½ #/sack cello-flake)**

| | |
|---|---|
| Top of cement = | surface |
| Hole size = | 17.5" |
| Casing size = | 16" |
| Outer Casing size = | 24.5" |
| Annular volume between casing and open hole = | 0.2741 cu. ft. / lin. ft. |
| Annular volume between casings = | 1.7062 cu. ft. / lin. ft |
| Length of cement column in open hole = | 162 lin. ft. |
| Length of column between casing = | 8 lin. ft. |
| Casing capacity = | 1.2684 cu ft. / lin. ft. |
| Shoe joint length = | 32 lin. ft. |
| Percent excess = | 50% |
| Excess factor = | 1.5 |
| Slurry yield = | 1.18 cu. ft. / sack |

Sacks required = (volume in shoe joint +annular volume in open hole + annular volume between casings) (excess factor) / yield
Sacks required = ((1.2684 cu. ft. / lin. ft.) (32 lin. ft.)+ (0.2741 cu. ft. / lin. ft.) (162 lin. ft.)+ (1.7062 cu. ft. / lin. ft.) (8 lin. ft.)) (1.5) / 1.18 cu.ft. / sack

**Sacks required** = 125.46 sacks = **130 sacks**

**11 ¾"casing job (Class A with 2 % CaCl & ½ #/sack cello-flake)**

| | |
|---|---|
| Top of cement = | surface |
| Hole size = | 14 ¾" |
| Casing size = | 11 ¾" |
| Outer Casing size = | 16" |
| Annular volume between casing and open hole = | 0.4336 cu. ft. / lin. ft. |
| Annular volume between casings = | 0.5154 cu. ft. / lin. ft |
| Length of cement column in open hole = | 205 lin. ft. |
| Length of column between casing = | 170 lin. ft. |
| Casing capacity = | 0.6700 cu ft. / lin. ft. |
| Shoe joint length = | 32 lin. ft. |
| Percent excess = | 50% |
| Excess factor = | 1.5 |
| Slurry yield = | 1.18 cu. ft. / sack |

Sacks required =(volume in shoe joint +annular volume in open hole + annular volume between casings)(excess factor) / yield
Sacks required =((0.6700 cu. ft. / lin. ft.) (32 lin. ft.)+ (0.4336 cu. ft. / lin. ft.) (205 lin. ft.)+ (0.5154 cu. ft. / lin. ft.) (170 lin. ft.)) (1.5) / 1.18 cu. ft /sack

**Sacks required** = 251.61 sacks = **255 sack**

**8 5/8"casing job (Class A with 2 % CaCl & 1/4 #/sack cello-flake)**

| | |
|---|---|
| Top of cement = | surface |
| Hole size = | 10 5/8" |
| Casing size = | 8 5/8" |
| Outer Casing size = | 11 ¾" |
| Annular volume between casing and open hole = | 0. 2100 cu. ft. / lin. ft. |
| Annular volume between casings = | 0. 2643 cu. ft. / lin. ft |
| Length of cement column in open hole = | 825 lin. ft. |
| Length of column between casing = | 375 lin. ft. |
| Casing capacity = | 0.3422 cu ft. / lin. ft. |
| Shoe joint length = | 32 lin. ft. |
| Percent excess = | 30% |
| Excess factor = | 1.3 |
| Slurry yield = | 1.18 cu. ft. / sack |

Sacks required = (volume in shoe joint +annular volume in open hole + annular volume between casings) (excess factor) / yield

Sacks required = ((0.3422 cu. ft. / lin. ft.) (32 lin. ft.)+ (0.2100 cu. ft. / lin. ft.) (825 lin. ft.)+ (0.2643 cu. ft. / lin. ft.) (375 lin. ft.))(1.3) / 1.18 ft. sack

**Sacks required** = 312.12 sacks = **315 sacks**

**4.5"casing job (Class A cement)**

| | |
|---|---|
| Top of cement = | 5000 ft. |
| Hole size = | 7 7/8" |
| Casing size = | 4.5" |
| Outer Casing size = | 8 5/8" |
| Annular volume between casing and open hole = | 0.2278 cu. ft. / lin. ft. |
| Length of cement column in open hole = | 2306 lin. ft. |
| Casing capacity = | 0.872 cu ft. / lin. ft. |
| Percent excess = | 10% |
| Excess factor = | 1.1 |
| Slurry yield = | 1.71 cu. ft. / sack |

Sacks required = (annular volume in open hole) (excess factor) / yield

Sacks required = (0.2278 cu. ft. / lin. ft.) (2306 lin. ft.) (1.1) / 1.71cu.ft./ sack

**Sacks required** = 337.92 sacks = **340 sacks**