GEOTHERMAL WELL DRILLING

Source Unknown

Drilling, testing, and development of high capacity geothermal wells can, if not properly managed, result in significant sediment pollution to receiving surface waters. This is especially true where well fields are installed, either during initial construction or as a retrofit to an existing site. Providing access to drill sites, as well as staging areas, should be addressed using the standards provided in Chapters 3 and 4.

The large volumes of water produced from each well can be quite turbid depending upon aquifer and surface conditions. Therefore care should be taken to protect surface waters during construction and development of geothermal wells.

A fact sheet describing typical erosion control BMPs during well drilling has been developed by the Department and is included in this manual as Appendix K. The standards set forth in that fact sheet should be incorporated into all water well drilling operations, including geothermal wells. Since the volumes of water produced by geothermal wells are typically much greater than for water supply wells, some additional precautions may be necessary depending upon discharge rates, sediment content, and site conditions.

On sites where a sediment basin or sediment trap is available to receive the discharges, these may be used as long as the water level within the basin or trap does not rise above the sediment clean-out elevation. Where sediment basins or traps are not available, control BMPs specific to the well drilling should be provided. Stormwater detention and/or retention ponds that are functioning as such may not be used as sediment removal BMPs for well drilling. Where flocculants are needed to meet effluent requirements, they may be approved on a case-by-case basis.

It is recommended that a test well be drilled with appropriate sediment removal BMPs in place in a proposed well field to determine the anticipated flow rate for each well in the well field. BMPs for the well field should then be designed to provide treatment for the total number of wells being drilled at any one time (i.e. test well flow rate X number of wells). It should be noted that flow rates will likely vary significantly from one well to the next. Therefore, the capacity of the BMPs provided should exceed the calculated required capacity by at least 1.5 times. Large well fields may require several test wells.

Designers should meet with conservation district staff prior to submitting applications that involve geothermal well testing and drilling in order to discuss site constraints and to develop an appropriate E&S plan. It is also recommended that well drilling contractors meet with conservation district prior to beginning drilling operations in order to discuss proper implementation of the E&S plan.

Special attention should be given to wells drilled in sensitive geologic formations, such as karst. Wells drilled in proximity to an active spring can, under some conditions like bedrock fracturing, cause a sediment discharge from the spring. Wherever such a discharge occurs, drilling operations should cease immediately and the regional office of the Department should be notified. Drilling operations should not resume until the Department is satisfied that the necessary precautions have been implemented to prevent future turbid discharges.

Likewise, should any test well or production well encounter a potentially toxic material like pyrite, the regional office of the Department should be contacted to determine what, if any, additional measures should be implemented. Depending upon the type of potential discharge, an individual NPDES permit may be required.

Design Considerations

1. The site terrain, vegetative cover, soil types, geology, slopes, drainage areas, proximity to wetlands and waterways and other relevant site conditions should be investigated. This information should be provided on plan sheets submitted as part of the permit application.
2. Each well site area should be clearly shown on the plan maps as well as the limits of the well drilling area(s).
3. The sequencing of the drilling and installation of the wells will play a significant role in sizing the BMPs. The more wells that are drilled at one time, the larger the BMPs will need to be.
4. For large well fields, multiple test wells within the identified area should be drilled in order to get an overall average flow rate in gallons per minute (gpm) of water coming from the wells and to also know how deep the wells should be drilled. Appropriate temporary BMPs should be utilized as applicable while the test wells are being drilled. The number of test wells required will depend upon site conditions. Larger sites will need more test wells due to the potential for variations in groundwater flows. It is the designer's responsibility to make sure the BMPs are adequately sized to handle the flows coming from the wells. Too few test wells could result in underestimating the total flow and the BMPs being undersized. Retro-fitting the BMPs to compensate may be costly.
5. Once the following have been determined, the E&S BMPs should be designed accordingly: number and size of the geothermal wells, the number of wells being drilled at any one time, the maximum total rate of flow coming from the well field to each drainage area, and the stabilized method of conveyance.
6. A stabilized method of conveying treated water to a surface water should be provided. Appropriate precautions should be taken to prevent accelerated erosion in the receiving waterway or the approaches to it.

BMP Sizing

Well (or Total Well Field) Flows Less Than 200 gpm

A sump pit, as shown in Standard Construction Detail # 3-17, tank truck, or other approved method of pre-treatment as well as a pumped water filter bag, as shown in Standard Construction Detail # 3-16, should be provided for each well. Water from the well casing(s) should be directed through the sump pit, tank truck, or container prior to entering the pumped water filter bag so that well cuttings can be removed before entering the bag. The volume of the sump should be equal to the volume of water coming from each well in a 1 minute time period. All pump intakes should be floating and screened.

Pumping rates to any pumped water filter bag should not exceed ½ the maximum recommended by the manufacturer unless the bag is placed on a gravel bed.

Well (or Total Well Field) Flows Greater Than 200 gpm

If the discharge volume can be controlled by the method described above for flows < 500 gpm, that method may be employed here as well. High volume flows which exceed that which can be controlled by pumped water filter bags should be directed to a higher volume BMP, such as a compost sock trap shown in Standard Construction Detail # 3-11, after well cuttings are removed. The trap should be designed to have a discharge rate through the socks of twice the combined pumping rates from all wells discharging to the trap. Storage volume for the trap should be at least 1.5 times that of the sump. If at any time, the water level in the trap rises to within 6 inches of the top of the trap, drilling should stop immediately. Discharges should then be directed to an alternate or replacement trap.

Wherever limited space or other constraints make it impossible to construct large BMPs to treat the well discharge, a manifold system using several smaller BMPs at once may be approved. A method of pretreatment as described above is required prior discharging to the selected BMPs. Then a number of E&S BMPs in parallel, such as pumped water filter bags, compost filter sock traps, sediment traps, etc., may be used. Prior approval by the conservation district or Department should be obtained before use.

In all cases sediment removal BMPs should be located between the well drilling activities and the receiving surface water(s). The flow path between the sediment removal BMP and the receiving surface water should be well-vegetated or otherwise stabilized (e.g. geotextile or gravel bed) extending from the BMP location to the receiving surface water. A vegetative filter strip may be considered a stabilized flow path.

Soil limitations, weather conditions, and unforeseen circumstances may necessitate additional measures be employed beyond the BMPs described above. One such measure is the use of soil binders. Erodible soils tend to have finer soil particles that may become locked in suspension. However, this consideration should be taken into account as early in the planning process as possible since these items are site specific. Refer to chapter 11 “Soil Binders” for additional information.

Where it has been shown that water contained in the sump pit, tank truck, or alternative storage container meets effluent standards for the receiving surface water without further filtration, it may be discharged directly to the receiving water so long as a stable method of discharge is provided and all Chapter 105 authorizations have been obtained.

If at any time the actual total flows exceed anticipated flows, the erosion and sediment control measures are found to be inadequately sized, or a sediment pollution event occurs, the drilling operation should shut down immediately and not resume until more appropriate E&S BMPs are provided. The conservation district or Department regional office should be contacted at this point. If it is determined that a reduced drilling program can be adequately treated by the existing BMPs, that may be authorized until a revised plan is approved.