INTRODUCTION

This case was called by the Commission on its own motion to determine whether fresh water resources in the San Juan Basin of New Mexico are vulnerable to contamination by the surface disposal of produced water from oil and gas operations. If such threats of contamination are found to exist, the Commission has the duty to take action to regulate such disposal.

This hearing process was convened under the mandate contained in the Commission's "Enumeration of Powers" found at NMSA 70-2-12(15) (1978), which provides that the Commission is authorized to "... direct surface or subsurface disposal of [produced] water in a manner that will afford reasonable protection against contamination of fresh water supplies..." While some of the testimony and other evidence presented at the hearing of this case relates to regulations and standards promulgated pursuant to the Water Quality Act, NMSA 74-6-1 et. seq. (1978), it was emphasized in testimony that in this particular situation the requirements set forth in the regulations of the New Mexico Water Quality Control Commission are referred to only

as standards and the hearing was not called pursuant to any authority contained in the Water Quality Act.

It is clear from the evidence introduced at the hearing on this matter that some of the components of produced water are toxic, (Boyer, Tr. 2/20/85, P. 58-60), while others, if introduced into ground water, will result in its degradation. No witness disputed this evidence. Moreover, the introduction of these substances into ground water designated by the State Engineer as "fresh water resources" in quantities that would cause the ground water to exceed water quality standards is strictly prohibited in other situations. Sections 3-101 and 3-103 (A) and (B), Water Quality Control Commission Regulations. So even though this hearing was not called pursuant to the OCC's delegated power to enforce Water Quality Control Regulations, any contemplated action should be viewed in light of these regulations and the water quality standards contained therein.

The evidence is also clear that much of the produced water that is dumped into unlined pits in Northwest New Mexico necessarily goes directly into the ground. (Boyer, Tr. 2/20/85, P. 69-71, Baca, Tr. 2/20/85, P. 148). And because of the shallow depth to ground water and the alluvial, unconsolidated nature of the soils in the San Juan

Basin, most of the water that is absorbed into the ground eventually reaches the ground water.

Given this essentially uncontroverted evidence, the primary question to be addressed by the Commission prior to entering an order in this case concerns the final disposition of organic hydrocarbons and dissolved minerals (TDS) contained in this produced water. Testimony by the opponents of a "no-pit" rule that disposal of produced water onto the ground will have no adverse consequences to ground water is simply not credible. Although several industry witnesses were produced in an attempt to disarm the concern expressed by the Commission in initiating this case, none of them controverted the evidence produced by the Division that produced water contains toxic substances and that such water, if put into unlined pits, enters the ground and mixes with ground water. And in spite of the fact that industry representatives testified that because of the action of various mechanisms of attenuation, deleterious substances in the produced water do not contaminate ground water supplies, their own studies clearly showed high levels of benzene, a constituent of produced water that does not occur naturally in ground water, contaminating areas under produced water pits (Geoscience Exhibit 3, see especially results of monitoring Tenneco's Eaton A-1E).

Following is a brief synopsis of the relevant evidence. It demonstrates conclusively that the unregulated disposal of produced water should cease.

I. SUBSTANTIAL EVIDENCE WAS PRESENTED REGARDING THE POTENTIAL FOR GROUND WATER CONTAMINATION BY ORGANIC CONTAMINANTS

Modeling using acceptable hydrologic methods has shown the potential for ground water pollution by organic contaminants. In particular, "Random Walk" simulations which include a retardation factor for sorption show levels of benzene exceeding standards at a distance from the source. Standards are exceeded at all discharges of five barrels per day and at most intermediate values of discharge down to 1/2 barrel per day. Other than dilution, the mechanisms of attenuation (volatilization, sorption, evaporation and biodegradation) have not been shown to be effective at all places under all circumstances. This is especially true for biodegradation which requires the presence of oxygen or long adaptation times to be effective. Therefore, the potential for ground water contamination by volatile organic hydrocarbons cannot be discounted. Given the toxicity of the contaminants and health concerns related thereto, and the concommitant potential for ground water contamination, the Commission should protect ground water by limiting discharges of produced water into unlined pits to no more than one-half barrel per day. Since ancillary pits receive similar fluids, especially in the event of separator malfunction, or where separators are not present, discharges to such pits should also be limited to one-half barrel per day.

II. TESTIMONY IS CLEAR AS TO THE IMPORTANCE OF THE VADOSE ZONE AS AN ATTENUATION MECHANISM

Witnesses for both sides testified as to the importance of the vadose zone in preventing contamination of ground water from organics in the produced water discharge. Mr. Boyer mentioned in his direct testimony that the likelihood of volatilization is greater in the vadose zone than in the ground water (Boyer, Tr. 2/20/85, p. 84).

In their direct testimony, industry representatives also referred frequently to the importance of the vadose zone as a major attenuation mechanism. Dr. Schultz discussed the importance to organic volatilization of partially saturated flow and the air space in the pores. He testified that aromatics are volatilized into the soil gas and transferred to the atmosphere. This is one of the removal mechanisms of attenuation (Schultz, Tr. 4/3/85, p. 152-155). To have soil gas aid in volatilization, unsaturated or partially saturated flow must occur in the vadose zone (Schultz, Tr. 4/3/85, p. 169, 180-182).

Dr. Miller's testimony also emphasized the importance of the vadose zone. The percentage rate of aromatic hydrocarbon degradation in the unsaturated zone is eight times greater than in saturated material (Miller, Tr. 4/22/85, p. 23). Miller felt that there was concern if the pit was in ground water since degradation processes that

occur in the unsaturated zone would not be present to provide adequate safety to ground water quality (Miller, Tr. 4/22/85, p. 68).

Since benzene and toluene are most rapidly degraded under aerobic conditions (Miller, Tr. 4/22/85, p.22) and these conditions are most always prevalent in the vadose zone, this zone must be maintained. Miller also stated that recent studies indicated that toluene and possibly benzene degrade in anaerobic conditions (Miller, Tr. 4/22/85, p. 26). ~~Therefore~~, aerobic conditions must be maintained to ensure maximum possible benzene mineralization.

The most active zone of degradation is immediately beneath the pit for a depth of about one foot, but that thickness has to be protected from ground water interception of the pit bottom (Miller, Tr. 4/22/85, Tr. p. 69). Under cross-examination, Dr. Miller stressed the importance of preserving the vadose zone between the pit and the water table, and stated that direct introduction of produced water into ground water utilized as drinking water would take away the safety margin and be the worst case (Miller, Tr. 4/22/85, Tr. pp. 94, 104-105).

Since pits are commonly five to eight feet in depth at well sites, depth to ground water would have to be deeper to provide the necessary vadose zone protection advocated by

both OCD and industry witnesses. Seasonal ground water variations due to the rise in river levels, or percolating irrigation waters, can cause ground water levels to move up or down several feet during a year. Frequent large discharges can move unsaturated or partially saturated conditions toward saturation and cause ground water mounding. Therefore, to provide the necessary vadose zone protection, unlined pits in areas where the depth to ground water is less than ten feet should be prohibited. Since pits and trenches dug to bury piping require use of mechanical equipment, the presence of water at depths up to ten feet can be easily ascertained. Therefore this determination will not pose any additional burden on industry.

III. RESULTS OF TDS STUDY

Values of total dissolved solids (TDS) found in produced water in the San Juan Basin are generally ~~much~~ less than in Southeast New Mexico. Modeling using the Random Walk program shows that discharges of 10,000 mg/l salts do not significantly increase TDS levels at low discharge volumes (OCD post hearing submittal 5/23/85). Discharge volumes of ~~1/2~~ bbl/day did not cause large increases for any of the simulations using the range of hydraulic conductivities found in alluvium in the area (25-2500 ft/day). Discharges of five barrels per day, however, caused unacceptable increases at all hydraulic conductivity ranges. The increases were judged unacceptable because the discharges would cause the NM WQCC ground water standard of 1000 mg/l TDS to be exceeded when added to existing concentrations in the vulnerable area. Intermediate discharge volumes at 10,000 mg/l TDS may or may not pose a problem depending on the availability of sufficient ground water flow to allow mixing and dilution.

Since the affect on ground water quality cannot be determined with sufficient accuracy without site specific hydrogeological information being available, the Commission should allow a maximum discharge of up to one-half barrel per day to provide necessary ground water protection. Since

TDS is a composite of individual contaminants, some of which can cause health or other problems, limiting TDS discharges should also mitigate most problems caused by individual contaminants (i.e. chloride, sulfate, and others).

IV. THE VALIDITY OF THE HYDROLOGIC INVESTIGATION PERFORMED ON THREE PITS IN THE VULNERABLE AREA IS QUESTIONABLE

In his testimony, Mr. Hicks asserts that his studies of three well sites show that small volume discharges are not a threat to ground water. Even if the drilling and sampling results of the site investigations are assumed correct, these results should not be interpreted as being representative of the entire vulnerable area population of 1300 wells, or of the sample of 300 wells of Amoco and Tenneco. The reason is that these three locations were evaluated and chosen from a list of 21 sites. The 21 sites were chosen separately and apparently prior to the selection of the 50 to 60 wells chosen at random from the Amoco/Tenneco population of 300. Even though some of the 21 sites were also listed in the random selection of 50-60 wells, the selection of the 21 apparently was not random and cannot be considered a representative random sample (Hicks, Tr. 4/22/85, pp. 127, 130).

At the three monitoring sites selected, volumes of water produced were stated by Mr. Hicks as being three and four barrels per day for the Tenneco wells and 1/4 barrel per day for the Amoco well. Official OCD records (Form C-115) show, however, that the Tenneco sites in question never have produced water from any of Dakota, Mesaverde, and Chacra completion intervals. The Amoco well has OCD-reported volumes similar to the 1/4 barrel per day shown

in the report. Therefore, if the volumes of water produced by Tenneco wells and utilized in the Geoscience study are high and not representative of actual site discharges, this could explain the low values of benzene found in the pits and ground water. If this is the case, the modeling and conclusions presented by Mr. Hicks that wells discharging 3-4 bbls/day do not represent a hazard to ground water are completely invalid.

Mr. Hicks stated that Pictured Cliffs wells do not have produced water pits or separator pits since no water is produced (Hicks, Tr. 4/22/85, p. 136, and Exhibit 3). Review of OCD records show, however, that such wells represent about one-third of the 45 wells in the vulnerable area with production of 5 bbls/day or more of produced water. Therefore, they are an important factor contributing to water discharges in the vulnerable areas and cannot be ignored.

OCD SUMMARY

The following conclusions can be drawn from the testimony:

1. Certain aromatic organic contaminants (especially benzene) have high potential to contaminate ground water when discharged even in small volume quantities with produced water. The mechanisms of attenuation, especially biodegradation, cannot be counted on to provide protection at all times and in all locations and situations. Therefore blanket small volume discharges not exceeding one-half barrel per day should not be allowed to unlined produced water and ancillary pits.

2. Both OCD and industry testimony stressed the importance of the vadose zone in attenuation of the organic contaminants. Especially necessary is the presence of air in pore spaces to allow volatilization and biodegradation to occur. To provide the lnecessary buffer zone, and because pit depths are on the order of five to eight feet, discharges to unlined pits should be prohibited where ground water is at a depth of ten feet or less.

3. From the standpoint of total dissolved solids, discharges of five barrels per day at concentrations of

10,000 mg/l TDS also cause the New Mexico Water Quality standard to be exceeded. Limiting the discharge to unlined pits to one-half barrel per day will provide the necessary TDS protection and mitigate deleterious effects of other contaminants which are TDS components.

4. The study conducted by GeoScience Consultants is inconclusive because the three sites chosen for intensive study cannot be considered representative of vulnerable area conditions, and because of discrepancies in the volumes of water actually discharged at two of the sites.

Since the Oil and Gas Act requires the reasonable protection of fresh water from contamination by such activities, the limits recommended by the Division in its proposed order will provide such protection and are necessary and prudent.

CONCLUSION

The opponents to regulation of produced water disposal have made much of the fact that no water wells have been proven to have been contaminated by produced water. Tenneco, in its Memorandum of Law filed herein even goes so far as to assert that "...we have yet to experience the first confirmed case of contamination of ground water by the use of unlined surface production pits" (at p.24). Clearly, the facts in this case contradict this statement. Tenneco's own witnesses showed concentrations of benzene in ground water underlying surface pits. (Geoscience Exhibit 3). In fact, one of Mr. Hick's own samples exceeded ground water standards for benzene as set by the New Mexico Water Quality Control Commission (Geoscience, Exhibit 3, relating to Tenneco's Eaton A-1E well).

The mandate of the Commission is not to protect only existing water wells. It is to protect all fresh water resources with potential for future use. Other states have not been so reticent or tardy in protecting water resources. Both Oklahoma and Texas have had ~~strict~~ "no-pit" rules for many years. Yet the opponents of regulation of produced water in New Mexico vow a fight to the finish. Do they really believe that New Mexico regulators are so uninformed and intimidated as to continue to permit such an obviously

outdated practice as totally ~~regulated~~ surface disposal of produced water? Oklahoma has had a "no-pit" order since 1969. Disposal in unlined pits is allowed only upon a conclusive showing that surface or subsurface water will not be polluted. Such a burden is almost impossible to meet. Consequently, surface disposal is almost non-existent. Texas has a similar rule.

The producers make many arguments as to why no rule should be adopted. Tenneco claims that imposition of a "no-pit" rule would entail an unconstitutional taking of private property because in the past it has operated its wells without having to line pits and no regulation to date has referenced the possibility that at some future time pits might be required to be lined. (Tenneco Oil Company's Memorandum of Law and Arguments, p. 18). This argument is patently ridiculous. Simply because an entity has not been required to take preventative measures in the past does not mandate that, given proper notice and due process, it cannot be required to take those measures at a future time. If Tenneco's position were the law, virtually no advance in human health and safety or environmental regulation would be possible because government would be required to absorb the entire cost of such improvements through legal proceedings claiming unconstitutional takings.

The water resources of New Mexico are a scarce and valuable natural resource, much like petroleum. And while the cost of the two is not now comparable, if fresh water resources are not protected for future use, water may eventually come too expensive for many uses.

In New Mexico, approximately 95% of water used for domestic purposes is ground water. This is due primarily to the fact that such little surface water exists in comparison to other areas of the country. Because we are so dependent upon ground water, it is necessary that adequate measures be taken to protect existing supplies. The staff of the OCD believes that its recommendations regarding disposal of produced water are best suited to guarantee protection of these fresh water resources. We have presented a case which demonstrates that produced water, which contains toxic contaminants, is now disposed of in Northwest New Mexico by being dumped into unlined surface pits. Much of this water is absorbed into the ground where it eventually reaches and combines with ground water. In small quantities, this degrades existing fresh water supplies. In larger quantities, it leads to contamination.

The Commission has an obligation to protect fresh water resources. In order to carry out this duty, the Commission must prohibit unregulated disposal of produced water except in quantities of less than one-half barrel. Any other

action would be to ignore the evidence produced at the hearings in this matter, including that of the opponents to regulations.

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