SUMMARY OF PREVIOUS STUDIES OF THE EFFECT OF SEISMIC SHOOTING ON WATER WELLS IN ALBERTA

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ABSTRACT

In 1978 several major studies were commissioned in Alberta to determine the effects of seismic shooting on water wells. Twenty areas were selected by The Alberta Research Council, The Alberta Department of Energy and Natural Resources and The University of Alberta. A basic objective was to establish seismic parameters such as charge size and setback distance which would demonstrably change the properties of a domestic water well. A down-the-hole TV camera was used to monitor physical damage in the wells.

All projects started with one or two kilograms of explosive at distances of 180 metres or more. This was then intensified by shooting increasingly larger charges closer and closer to wells. All wells were eventually subjected to bombardment which peaked at 22 kilograms only six metres from wells. In one study, a charge of 15 kilograms was detonated only 3.9 metres from a well.

No damage was ever observed, and, although some data suggested the possibility of slight changes in transmissivity following the huge close-in shots, no permanent changes were observed which would have been noticeable in a domestic well far less explain the catastrophic damage which constitutes most claims involving seismic activity.

REFERENCES

1. Vogwill R. L. J., An Evaluation of the Effect of Seismic Detonations on Water Wells, Alberta Research Council, April 1979, #1983-4.

2. Goble K. A., Project to Determine Effects of Seismic Activity on Water Wells, Exploration Review Branch, Mineral Resources Division, Alberta Energy and Natural Resources, Phase I - January 1980

3. Goble K. A., Project to Determine Effects of Seismic Activity on Water Wells, Exploration Review Branch, Mineral Resources Division, Alberta Energy and Natural Resources, Phase II - June 1980

4. Sneddon D. T., The Effects of Seismic Blasting on Water Wells, M SC Thesis, University of Alberta, OF-51, 1981.

SUMMARIES

Reference 1 : Vogwill, 1979

In the Alberta Research Council work, four water wells were installed at a single site near New Norway. They were completed in two separate aquifers with one slotted casing and one open hole in each aquifer.

Shooting started with 4.5 kg (10 lb) at 183 m (600 ft), followed by 4.5 kg at 61 m, 15 m and finally only 4.6 m, from the wells.

The down-the-hole camera indicated no damage in any of the wells. Extensive testing of the aquifers and wells indicated that the seismic detonations had little or no effect on the aquifers or on well characteristics (p. 46).

Reference 2 : Goble, January 1980

In phase I, Alberta ENR selected wells in the six areas shown in appendix I. These were areas prone to complaints and claims. Studies started at 600 ft. Since nothing was happening, distances were reduced and charge sizes increased in an attempt to induce failure, damage or change. At Barons, 5 lb, then 15 lb, was shot 50 ft from the well. At Drayton Valley, 30 lb was shot at only 13 ft from the well. At Vegreville, first 15 lb, then 30 lb, and then 50 lb was detonated at a distance of only 20 ft. At Barrhead, 20 lb was shot at 20 ft.

The conclusion was that “extensive testing of the aquifers and wells at the six sites had no appreciable permanent detrimental effects”. Of course, bombardment by very large charges at “close quarters” caused silty water which however cleared after a short period of pumping.

Reference 3 : Goble, June 1980

In phase II, nine areas were selected as per appendix II. As in phase I, studies soon escalated to very large charges very close to wells. Holes were often reloaded. For example, at Caroline 14 kg at 6 m was followed with 22 kg at 6 m.

Again the TV camera indicated no sign of damage. Again the heavy bombardment had no serious effect on aquifers or wells. In phase II, the author suggests that shooting very large charges extremely close to wells in some cases may have caused a small reduction in yield. It is not known however whether any reduction is due to the close-in detonations or to previous pumping tests which could reduce the pressure in an aquifer. The results are further confused by some "unexpected" increases in production following shooting. Given the blitzkrieg to which most wells were subjected, what is most significant is the total absence of damage or dramatic effect Perhaps this is not surprising since the systems being attacked were underground. It has always proved difficult to damage underground structures due to the constraints on movement, (zero degrees of freedom).

Reference 4 : Sneddon, 1981

Prior to the Alberta studies, work by Bond in Montana suggested that there is no demonstrable effect by detonating up to 50 kg from 8 m to 300 m from water wells, but improvement in performance is described by detonating charges at the bottom of wells.

Sneddon made an interesting study of complaints. The most common claim was a "drastic yield reduction or a complete loss of production". One hundred fifty complaints filed with the Exploration Review Branch of ENR were selected at random. Complaints not related to wells or related to spurious claims (crew not set up, crew under suspension, shots not yet fired, no activity closer than 8 km etc.), were not coded. The 82 cases remaining were subjected to statistical analysis for correlation to seismic parameters such as charge size, distance from the well, depth of hole etc. No correlation could be found and it would be worthwhile to study well failures with seismic activity as a "dummy variable" to determine the effect of presence or absence of activity on the failure pattern.

The sites studied are shown in appendix III. The Spruce Grove site was used solely to determine the effect of repeated pumping tests on well performance. Considerable variance was noted, but no trend was apparent However, the transmissivity at this location was unusually high, so the results must be viewed with caution.

Sneddon used charges of 1, 2.25, 4.5 and 9.0 kg. Shots started at 180 m. A series was carried out at 125 m, 62.5 m, 31.3 m and finally 16 m. Holes at 16 m were reloaded with 4.5 kg. Minor changes in transmissivity (both positive and negative) were reported but the observed changes would be unnoticeable in a domestic well As in previous studies, no indication of catastrophic effects was detected.

3. TEST SITES

The following is a list of the well sites that have been tested to date (see Figure 1):

PHASE I - 1978

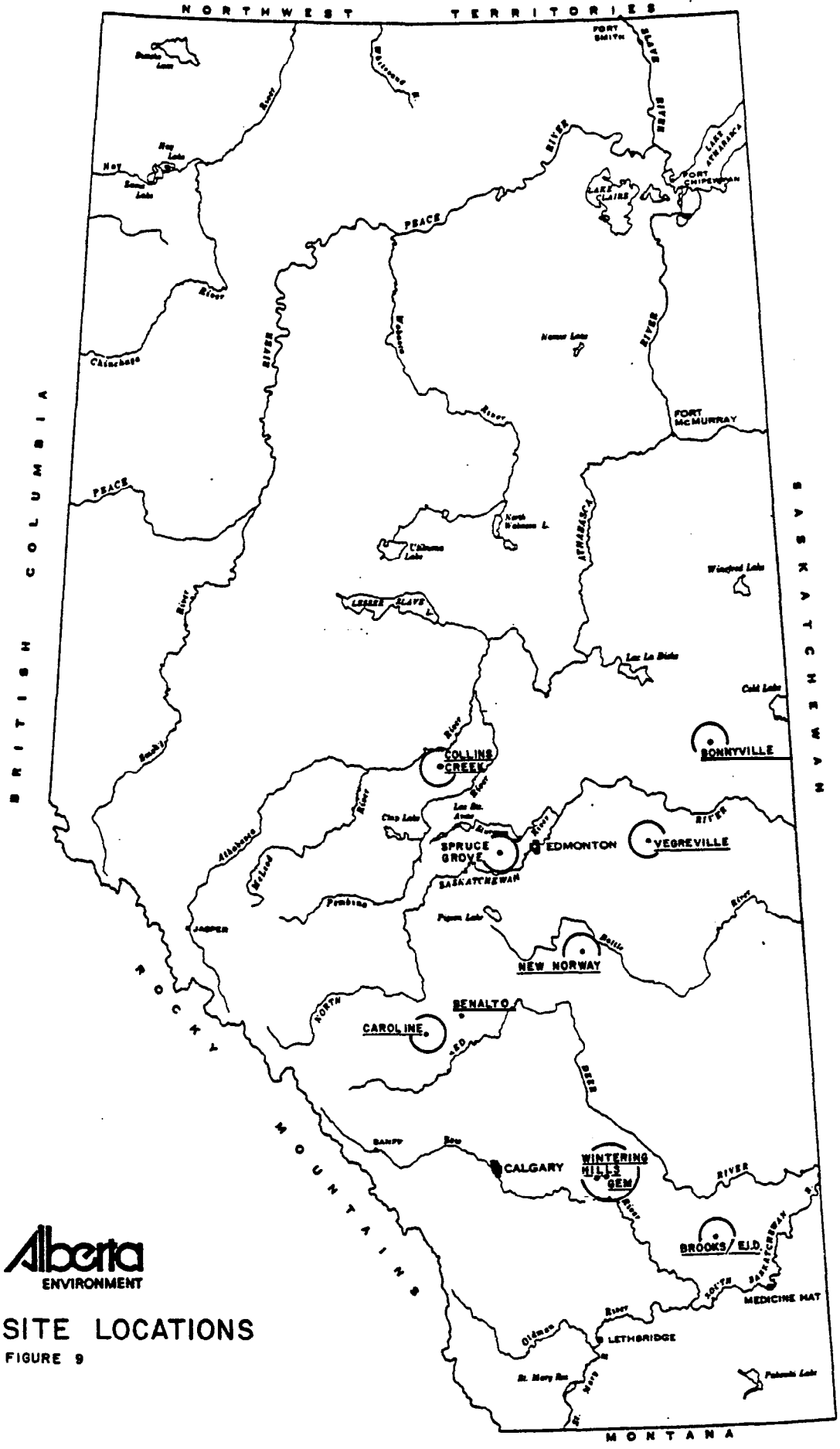
TEST SITE	OWNER	WHEN DRILLED	USE	PROJECT COMMENCED	PROJECT COMPLETED
1. Barons Area	Alta. Environment	1967	Groundwater research	Aug. 1, 1978	Aug. 5, 1978
2. Skiff Area	A. Haraga Farmer	1968	Domestic	Aug. 4, 1978	Aug. 8, 1978
3. Drayton Valley Area	E. & N. R.	1978	Rig Camp Well	Sept. 5, 1978	Sept. 10, 1978
4. Vegreville Area	Alta. Environment	1978	Test Project	Oct. 30, 1978	Nov. 1, 1978
5. New Norway* Area	E. & N. R.	1978	Test Project	Oct. 17, 1978	Dec. 19, 1978
6. Barrhead Area	E. & N. R.	1978	Test Project	Nov. 28, 1978	Mar. 10, 1979

* Test Site #5 completed by Alberta Research Council - see report by R. Vogwill, April, 1979

PHASE 11 - 1979

TEST SITE	OWNER	WHEN DRILLED	USE	PROJECT COMMENCED	PROJECT COMPLETED
7. Brooks Area	Eastern Irrigation District	1977	Grazing Lease	July 15, 1979	July 21, 1979
8. Barrhead Area	E. & N. R.	1978	Test Project	July 25, 1979	July 30, 1979
9. Bonnyville Area	W. Woycenko Farmer		Domestic	July 31, 1979	Aug. 3, 1979
10. Vegreville Area	Alta. Environment	1978	Test Project	August 3, 1979	Aug. 5, 1979
11. New Norway Area	E. & N. R.	1978	Test Project	August 5, 1979	Aug. 7, 1979
12. Caroline Area	E. & N. R.	1978	Rig Camp Well	Sept. 10, 1979	Sept. 21, 1979
13. Gem Area	Eastern Irrigation District	1977	Grazing Lease	August 25, 1979	Aug. 29, 1979
14. Wintering Hills Area	Eastern Irrigation District	1977	Grazing Lease	August 29, 1979	Aug. 31, 1979
15. Gull Lake Area	R. Jarvis Farmer	1960	Domestic	November 23, 1979	Dec. 5, 1979

*Test Site #13 and 14 completed by Alberta Environment (see report by D. Prosser).



SITE LOCATIONS

FIGURE 9