GWB 19-28; S&R Septic - DP-465

Statement of Intent to Present Technical Evidence

1. Jerome B. Hansen
2. I oppose the renewal of the permit.
3. The only witness is me.
4. I expect that that the length of my direct testimony will be 25 minutes.
5. I will show a PowerPoint presentation of the figures shown in my letter to Jason Herman, which have already been accepted as evidence, as well as some new additional figures. This PowerPoint presentation is entitled "Objections to the Renewal of DP-465 S&R Septic Service Discharge Permit By Jerome B. Hansen." I will also include my resume as an exhibit to be offered into evidence at the hearing.
6. I have deep concerns about the integrity and efficacy of these sewage cells, particularly with regard to contamination of the ground water. While the site was remote when constructed during the late 1980ss, today it is surrounded by homes and businesses. The discharge site is underlain by highly permeable gravel deposits and basalt flows. The location and depth of the effluent plume are unknown, but may be close or into the Upper Servilleta Basalt, where it can move rapidly downward toward the water table. The effluent can contact the water table through faults and associated fractures, and through water wells, which are customarily gravel packed, and not cemented in the annulus between the borehole wall and the production casing. Historic images of the site through time were examined and indicate that effluent seepage and consequent ground surface subsidence may be occurring off-site. Renewal of the permit should be denied and clean up and reclamation operations commenced.

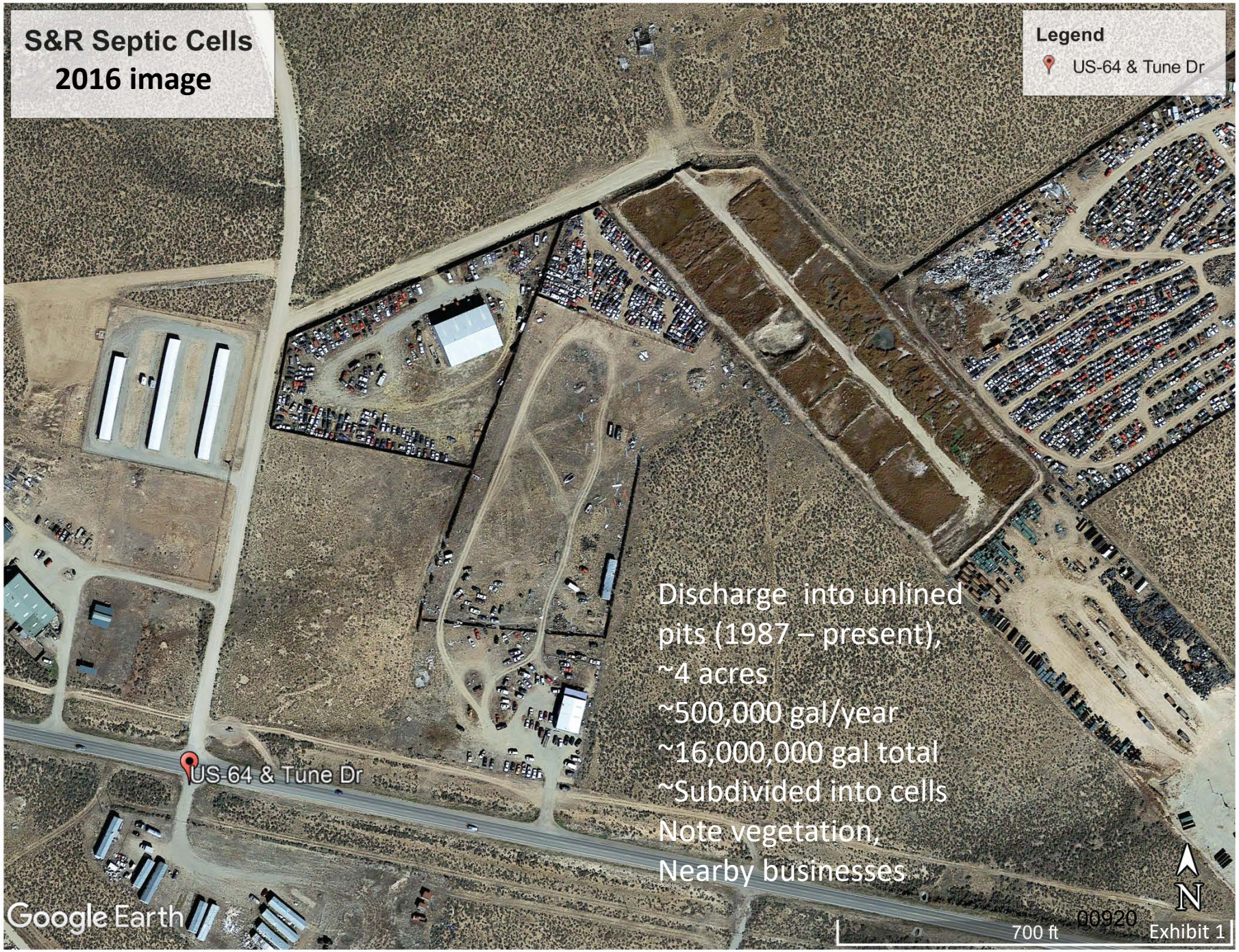
Jerome B. Hansen

Objections to the Renewal of DP-465 S&R Septic Service Discharge Permit

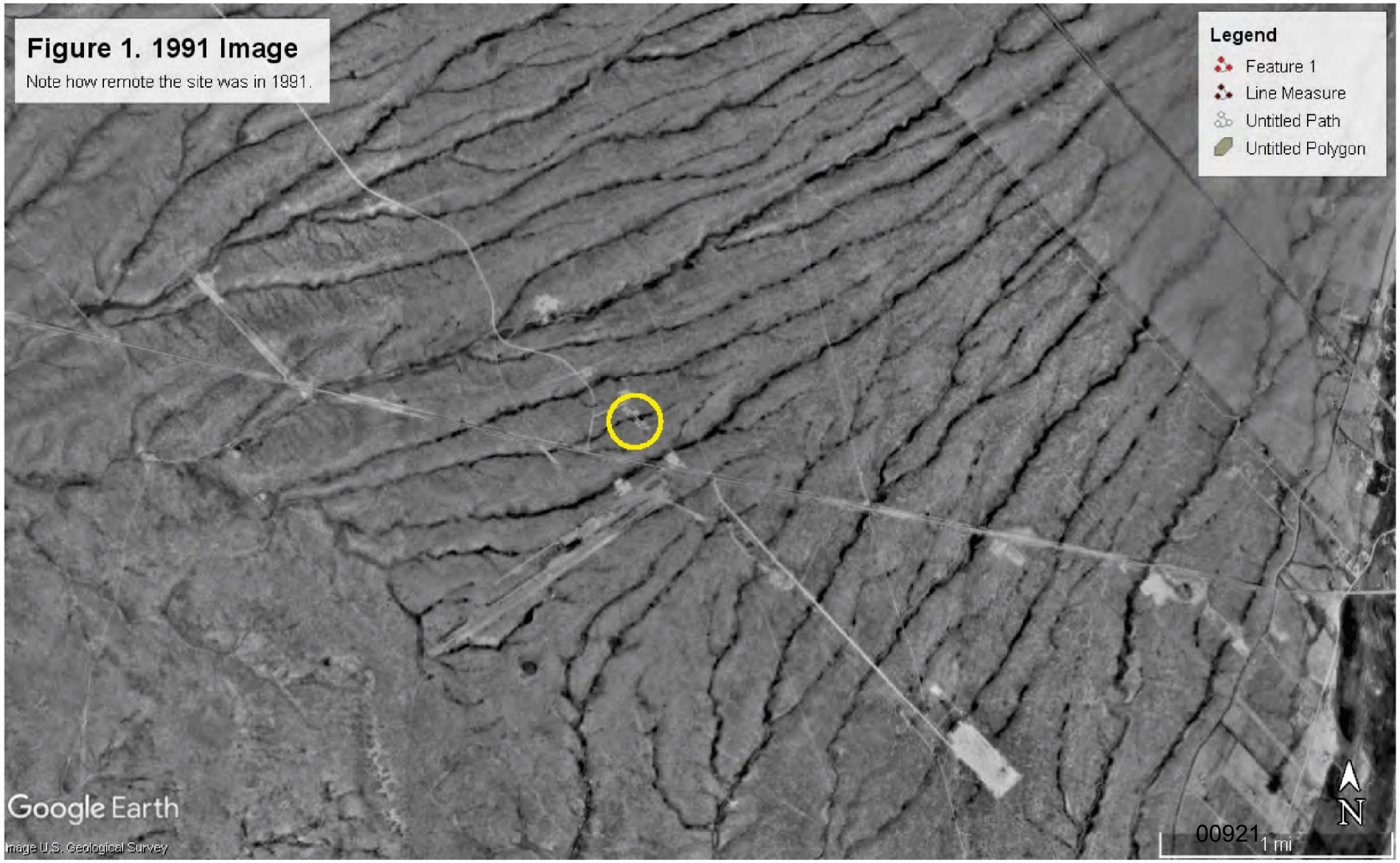
By Jerome B. Hansen

My experience

- My graduate studies and my career were focused on basin fill sedimentary sequences of the Great Basin in Nevada and Arizona
- These sediments are highly analogous to the basin fill of the Rio Grande Rift near Taos, and are what the sewage is being discharged into.
- I am not a hydrologist or civil engineer.
- I do have significant concerns about the integrity of these cells with regard to contamination of the groundwater.


S&R Septic Cells
2016 image
Legend
US-64 & Tune Dr
Discharge into unlined pits (1987 – present),
~4 acres
~500,000 gal/year
~16,000,000 gal total
~Subdivided into cells
Note vegetation,
Nearby businesses
US-64 & Tune Dr
Google Earth
N
700 ft
00920
Exhibit 1

In 1987, the site was remote (1991 image)



By 2019, there are 90+ new homes and businesses in the area. (2016 image)

Exhibit 1

Depth to Water

- One condition of the permit is that the depth to water is estimated to be greater than 500 feet, and therefore it would take a long time for surface effluent to reach the underground water source.
- There are two problems with this:
  - 1. Some nearby wells are actually less than 500 ft.
  - 2. This doesn't take into consideration the types of rock layers that comprise the 500 ft.

Nearest water well to the site and the 3 rock types in the Shallow Aquifer

100’ of alluvium
100’ of Upper Basalt
70’ of gravel
230’ of Middle Basalt

DEPTH TO WATER = 500’
(TOP OF THE SHALLOW AQUIFER)

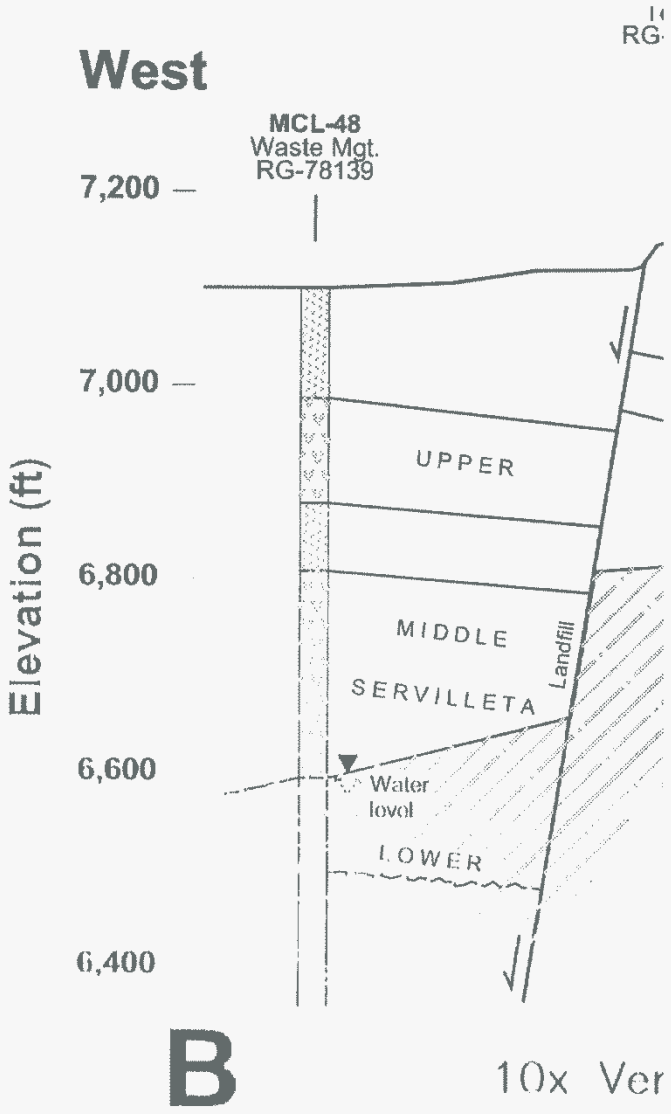


Figure 3. The Waste Mgmt well near the site.
(From Benson, 2004)

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Exhibit 1

Basalts are often highly permeable rocks

- Some of the best water wells in this area (50 gpm) are completed in fractured basalt
- I have seen flow rates near 300 gpm from a similar basalt in Nevada
- If the rock can give up water at a high rate, it can also accept fluid (e.g. effluent) at a high rate also
- Permeability is from vertical fractures (columnar joints) and interbedded gravel
- Result: If effluent percolates down to the top of the upper basalt and encounters a zone of high permeability, it can move rapidly through the basalt downward toward the water table

ALLUVIUM

Duke Engineering and Services 2000 study of the "Taos Impoundment Site"

- Measured the concentration of nitrate (a proxy for effluent)
- Developed mathematic models
- Interpolation of the data says penetration to 84', but for gravelly sand it would be deeper --- ~100'

100' is the top of the upper basalt

Once effluent makes it to the Upper Servilleta Basalt, it might move rapidly through it toward the water table.

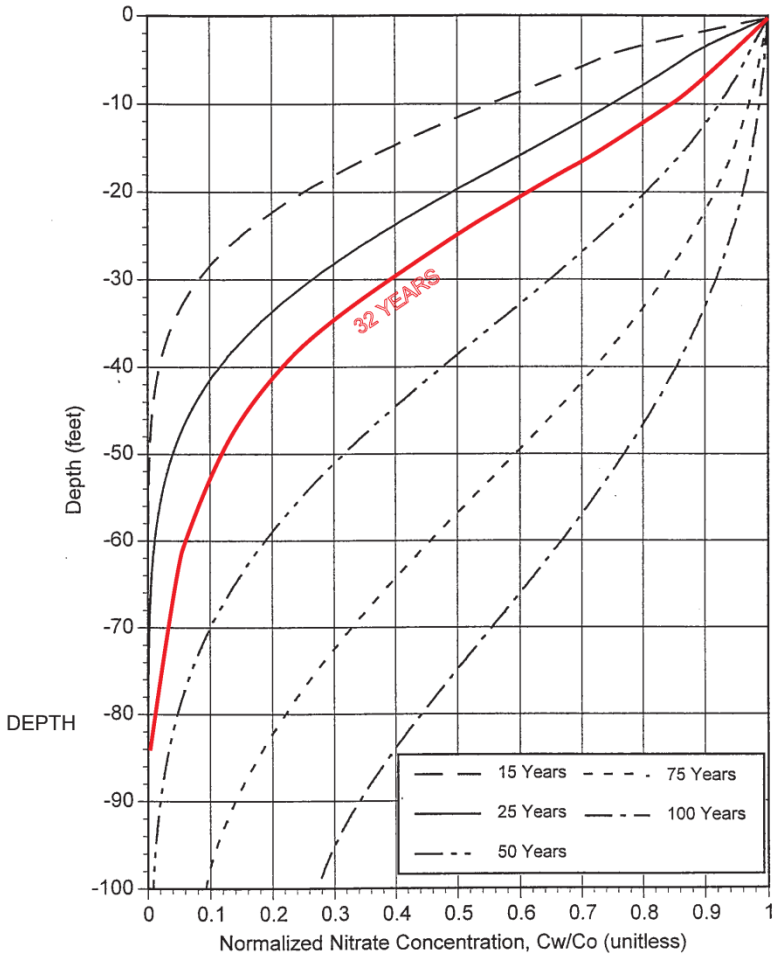

Figure 17. Predicted Normalized Concentration of Nitrate, for Septage Impoundment on a Fine-Grained Surface Layer Overlying Coarse Sand Sediments.

Figure 4. The 32 year line has been interpolated onto the "fine sediment above coarse sand" chart. Effluent depth is ~ 84'. Fine sediment over gravelly sand would be deeper, maybe 100-110'.

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Rough estimate of depth of effluent based on pore volume

Appendix (revised 8/2019)
A rough estimate of the depth of the effluent plume in the alluvium, based on pore volume analysis

Given:	**Area of site = 4.83 acres (planimetered including potential seepage)**
	43560 sq ft per acre
	7.8 gal per cubic foot
Assumptions:	**The site has been filled at a rate of 500,000 gal/ year for 32 years =16,000,000 gal**
	30% porosity in the alluvium
	25% of the alluvium section is effectively permeable
	80% of the effluent has moved downward
	Evaporation = Precipitation

So, $0.80 \times 16{,}000{,}000 = (\text{Area} \times 43560) \times D \times 7.8 \times 0.30 \times 0.25$

$D = 0.80 \times 16{,}000{,}000 / (4.83 \times 43560 \times 7.8 \times 0.30 \times 0.25)$

$D = 104$ feet

104 feet represents a uniform downward movement of the effluent over the 4.83 acres.
If the effluent "fingers" downward in one main conduit, or if the discharge is greater than the permitted capacity, the depth of the effluent plume is even deeper.

The Duke Engineering modeling and my crude pore volume analysis suggest that the effluent has percolated at least to the top of the Upper Basalt.

From there, it can move rapidly through the Upper Basalt to the Agua Azul gravels between the Upper and Middle Basalt layer.

In other wells these gravels are reported to have fair to good water production rates (up to 120 gpm).

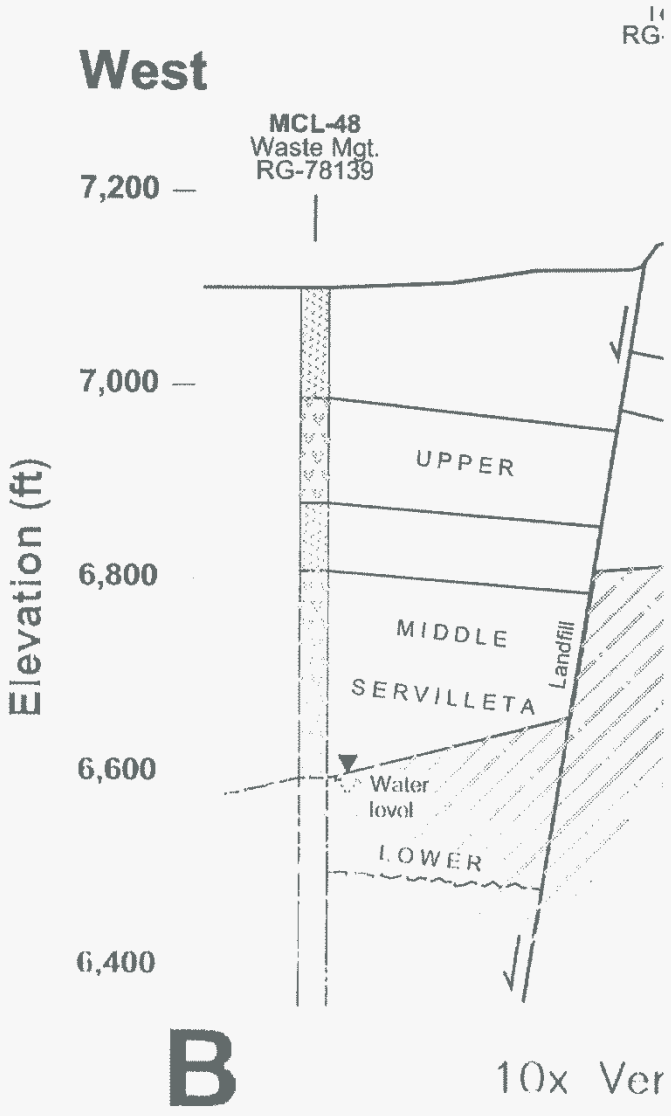

Figure 3. The Waste Mgmt well near the site. (From Benson, 2004)

00928

Exhibit 1

Based on tritium decay studies of the surface water and groundwater, Drakos and others [2004] determined that "recharge of the Shallow Aquifer occurs on a time scale of less than 5-10 years."

This indicates that the gross permeability of the Shallow Aquifer is relatively large, and like the groundwater, effluent from the cells can also move quickly through the same formations above the water table.

Other permeable pathways for connecting the effluent and the water table

- Faults and associated open fractures
  - There are faults in the area than have not been mapped or published (Benson, 2018, oral comm)
  - These north-trending faults can be seen on high resolution aeromagnetic data
  - One nearby fault is well exposed on Google Earth imagery

Nearby Wellbores

gravel packing completion techniques

Exhibit 1

Fault trace near the site

Figure 6 A POSSIBLE CONNECTION BETWEEN THE SEPTIC LAGOONS AND THE WATER TABLE

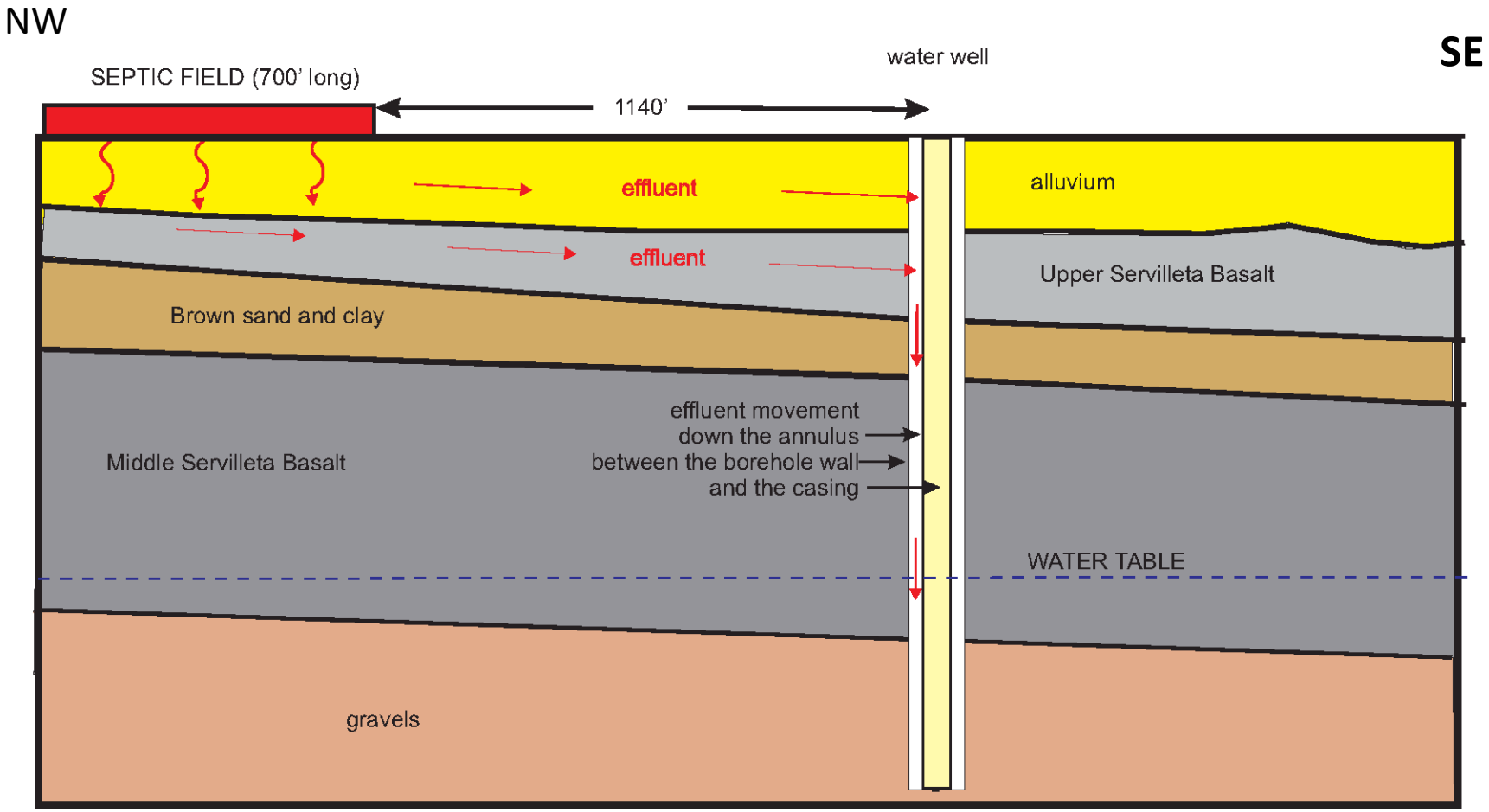

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Exhibit 1

Figure 7. The septic system 7/2018.

Google Earth Images of the Sewage Discharge Cells from 1991 to 2016

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I have not field checked the following observations. NMED personnel should be responsible for checking these observations during their site inspections


S&R Septic
9/1991
Figure 8
Legend
Functional lagoons
arroyo
sloping base
00935
N
Google Earth
300 ft


Legend
S&R SEPTIC
10-1997
Figure 9
Functional lagoons
arroyo
sloping base
Google Earth
Image U.S. Geological Survey
00936
N
300 ft


Legend
S&R SEPTIC
7-2005
Figure 10
Sub-divided cells
Vegetation choked
Nearby construction
Google Earth
Image NMRGIS
00937
N
4000 ft


Legend
S&R SEPTIC
11-2006
Figure 11
Sub-divided cells
Vegetation choked
Google Earth
Image © 2018 DigitalGlobe
00938
N
300 ft


Legend
S&R SEPTIC
8-2009
Figure 12
Dark spot persists
Note how cars are parked to avoid this spot
Google Earth
Image USDA Farm Service Agency
00939
N
4000 ft


S&R SEPTIC
9-2010
Figure 13
Legend
Dark spot persists
Car avoid this spot
Green vegetation
Google Earth
Image © 2018 DigitalGlobe
00940
N
4000 ft


Legend
S&R SEPTIC
8-2011
Figure 14
Dark spot persists
Note how cars
are parked to
avoid this spot
Google Earth
Image USDA Farm Service Agency
00941
N
4000 ft


S&R Septic
9/2013
Figure 15
Legend
Dark spot
Hummocky ground
Google Earth
00842
N
300 ft


S&R SEPTIC
2016
Figure 16
Legend
Dark spot persists
Similar vegetation
As in cells
Subsidence
Google Earth
00943
N
300 ft

- During site inspections, NMED personnel should determine whether or not near-surface seepage and ground subsidence out of the permit area has occurred.

- If they conclude that this is the case, it may be that the structural integrity of the cells is gone or they have been used beyond their original design capacity.

- And it raises a series of issues…..

Other issues

- Because ground subsidence has created a local low spot, is most of the effluent now draining on to adjacent property?
- It appears that S&R is disposing of effluent on adjacent property, which is not in compliance with the permit.
- The adjacent affected land needs to be covered by the site reclamation plan.
- If the sewage is being disposed in a small area, has the effluent penetrated deeper, i.e. closer to the water table?
- How deep is effluent, where is the plume located and at what speed and direction? Some of these important technical questions may be answered better and cheaper by geophysical techniques than by drilling test boreholes.

Recap

- Depth to water could be less than 500’.
- Permeability is greater than assumed
- Transit time from surface to the water table is less than assumed
- Many possible vertical conduits (faults, wellbores)
- Location, depth ,speed and direction of plume is unknown
- The cells appear to have lost structural integrity--effluent appears to be leaking off site
- Continuing discharge increases the risk of contamination of the Shallow Aquifer

Conclusions

- The groundwater is much more valuable to the public than the few dollars saved by not transporting the sewage to the municipal facility, as do all of the other septic haulers in Taos.
- The quality of the water from the Shallow Aquifer is still good. Therefore, there is a window of opportunity to avoid contamination.
- If any nearby wells show evidence of contamination, it's too late.
- *It's time to act: Deny the permit extension and commence the cleanup and reclamation*.
- *Time is of the essence.*

JEROME B. HANSEN

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SUMMARY

Geologist with more than thirty-three years of broad experience in all phases of oil and gas exploration and development from prospect inception to field development and reserve evaluation. Diverse technical experience aimed at prospect generation including surface and subsurface geological-geophysical mapping and interpretation, well site work, and well log analysis. Computer expertise in spreadsheets, word processing (MS Office) and geologic mapping (PETRA) and seismic interpretation (SMT) software. Experienced in project management, budgeting, and preparation of confidential reports and presentations to partners and clients. Discovered five oilfields in Nevada and two in Alabama Smackover trend.

PROFESSIONAL EXPERIENCE

Great Basin Exploration Consultants, Inc., Lakewood, CO

Owner/Geologist 2000-Present

Design and interpretation of 3D seismic surveys; Development of petroleum prospects (Great Basin, Gulf Coast, Oman); Partner negotiations and land work; Prospect presentations; Evaluation of submittals; Well site geology; Well permitting and scheduling logistics; Regional geologic studies (Williston, Gulf Coast); 2D and 3D seismic interpretation (Nevada, Texas, Gulf Coast, Rockies, Oman); Development of well database for structure, net sand, reserves, well log analysis for frac placement and well planning; (Piceance Basin, CO).

Foreland Corporation

Manager of Geology/Senior Structural Geologist, Lakewood, CO 1986-2000

Generation of petroleum prospects, sales, presentations and reports, negotiation of leases, development of federal units, coordination with land, engineering and finance divisions as part of Foreland's oil and gas exploration and development program in Nevada.

- 2-D and 3-D seismic interpretation on a Windows based workstation, development of maps and cross sections, evaluation of reserves, well-site work (examination of cuttings, scheduling, AFE's), evaluation, analysis and correlation of well logs, geologic mapping, source and reservoir rock sampling and evaluation, measured sections, photogeology, gravity map interpretation and modeling, dipmeter interpretation and integration, drill stem test evaluation, and preparation of reports, brochures, and presentations.
- Discovered four Nevada fields: Tomera Ranch, North Willow Creek, Ghost Ranch and Sand Dune, plus a number of successful development and step out locations within Eagle Springs, Nevada's oldest field.

US Geological Survey

Field Assistant, Central Mineral Resources Branch, Lakewood, CO 1985-1986

Map compilation, laboratory work (heavy mineral separations, major oxide analysis), outcrop mapping in Arizona and Nevada.

Colorado School of Mines Research Institute

Exploration Geologist, Golden, CO 1982-1985

Managed oil and gas prospect development programs and stratigraphic studies in the Powder River Basin and Gulf Coast for an independent oil company.

- Well log analysis, development of regional and detailed log correlation networks, source rock evaluation, structural and stratigraphic (facies) mapping, detailed oil and gas field studies, examination of cores for facies analysis, prospect generation, budget management, and preparation of confidential reports and presentations to clients.

Hecla Mining Company

Exploration Geologist (Nevada) 1980

Regional reconnaissance mapping, detailed mapping and sampling for precious metal deposits, Nevada.

Amuedo and Ivey, Consulting Geologists

Geological Team Supervisor, Denver, CO 1974-1979

Supervision of project operations and budget for exploration and engineering geology projects

- Exploration and resource evaluations of oil shale, coal (northwest Colorado, southwest Washington), sand and gravel and numerous geological engineering studies. Duties included well-site supervision, electric log interpretation and correlation, surface and subsurface mapping, field and photogeologic mapping and preparation of final reports.

University of Colorado

Geological Field Assistant, Boulder, CO 1973

Mapped glacial deposits in the Colorado Front Range, lab work on soil and rock samples.

EDUCATION AND TRAINING

Master of Science, Geology, University of Arizona, Tucson 1982

Bachelor of Arts, Geology, University of Colorado, Boulder 1973

Industry courses and seminars: 1982-Present

- Advanced Petroleum Geology (CSM Course)
- Well Log Analysis (Hiltchie, Inc.)
- Shelf Sandstone Reservoirs (SEPM)
- Deltaic Sandstone Bodies (RMAG)
- Wave-Dominated Deltas (AAPG Field Seminar)
- Carbonate Petrology (CSM Course)
- Seismic Interpretation (OGCI)
- Seismic Processing (RMAG)
- Drill Stem Test Analysis (RMAG)
- Minnelusa Trap Types (SEPM)
- Balanced Cross Sections (AAPG)
- 3-D Seismic Interpretation (RMAG)
- Geographix Basics
- Nevada Petroleum Society Field Trips

PROFESSIONAL AFFILIATIONS

- American Association of Petroleum Geologists
- Rocky Mountain Association of Geologists
- Colorado Scientific Society
- Nevada Petroleum Society

Certificate of Service

I hereby certify that on October 1, 2019 a copy of the foregoing was emailed to the persons listed below. A copy can be mailed via U.S. first-class mail upon request.

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