

Coordinating Environmental Public Health
Practice with Epidemiology and
Laboratory Analysis: A Waterborne
Outbreak of “Norwalk-like Virus” in the
Big Horn Mountains of Wyoming

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“Norwalk-like Virus” (NLV)

- Nausea, vomiting, cramps, diarrhea
- Duration of 12-60 hours
- Incubation period of 12-48 hours
- Humans are only known reservoir
- Fecal-oral transmission primarily

Waterborne Transmission of NLV

- 3% of NLV outbreaks implicated as waterborne
- 0 of 17 drinking water outbreaks in 1997-98
- 2 drinking water outbreaks caused by viral agents since 1991

Initial Case Investigation

- February 6, 2001 – First report of illness consistent with NLV from MN resident
- February 13, 2001 – Second group of ND residents reporting illness
- 3 lodges popular for snowmobilers

Epidemiologic Investigation

- Retrospective cohort study
- Lodge guest list from January 1, 2001
- Personal phone interview using standardized questionnaire
- Data entered and analyzed using Epi Info

Laboratory Investigation

- Stool samples from 13 lodge guests
- Identified from cohort study and self-reported illness
- Reverse transcriptase-polymerase chain reaction (RT-PCR) performed to detect NLV

Environmental Health Investigation

- Conducted concurrently
- Risk factors and system failures
 - Water supply system
 - Sewage disposal system
- Collection of well water specimens
 - Coliform
 - RT-PCR to detect NLV

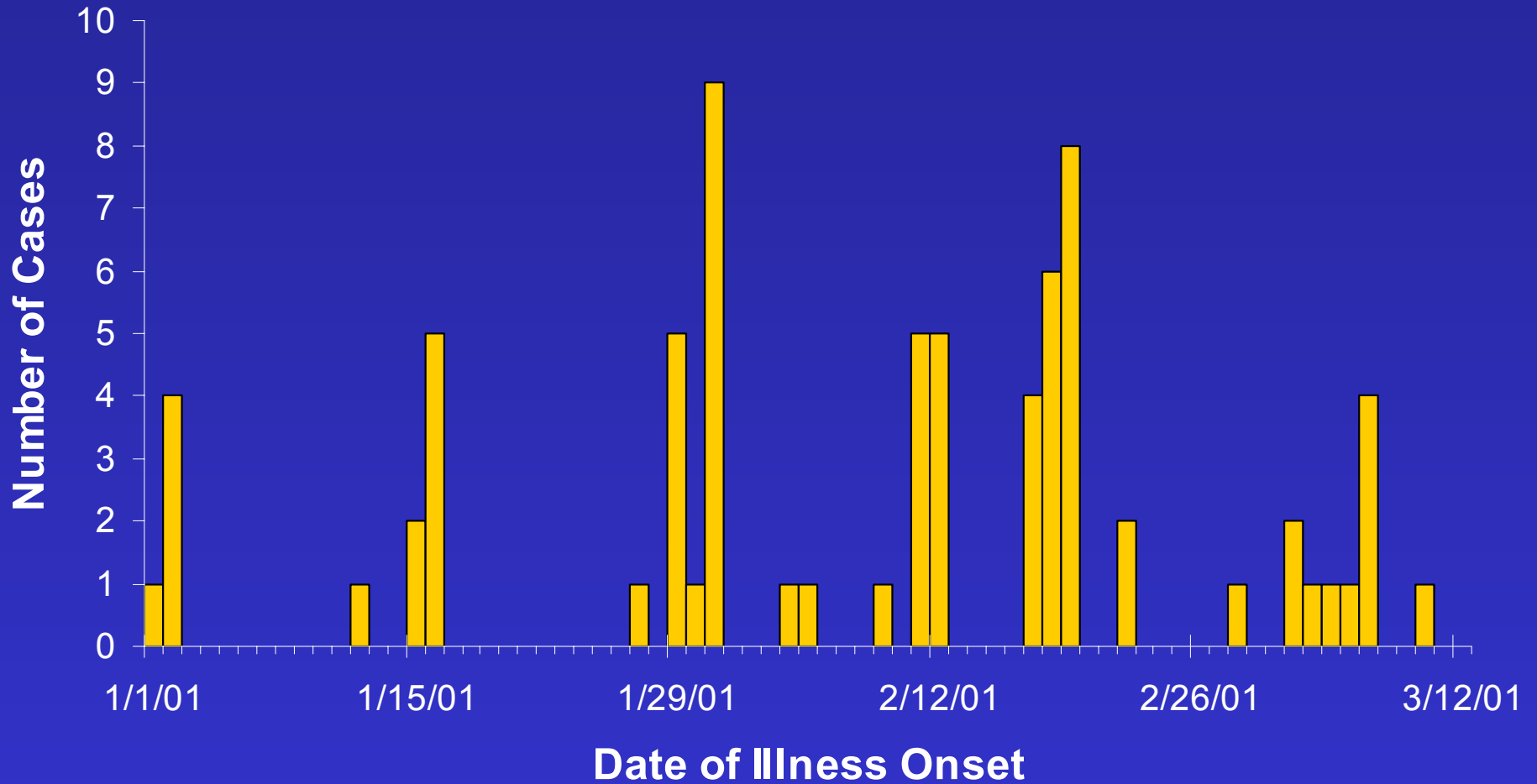
Lodge Cohort Study Results

- 54 questionnaires completed
- 22 (41%) met case definition
 - 91% diarrhea
 - 77% nausea
 - 73% vomiting
 - 32% fever
- Median duration of 2 days

Attack Rates – Tap Water

- Attack rate was 61% in exposed, versus 19% in unexposed
- RR = 3.3; 95% CI = 1.4, 7.7; $p = 0.002$
- Risk of illness increased with amount of water consumed
- Chi-square for linear trend = 13.3, $p = 0.0003$

Cases of Gastroenteritis



Laboratory Results

- 8 (61%) stool samples positive
- NLV genogroup II
- Sequencing of RT-PCR products
 - 6 with identical sequence
 - 2 unique sequences

Environmental Assessment Results

Suspect Source of Etiologic Agent

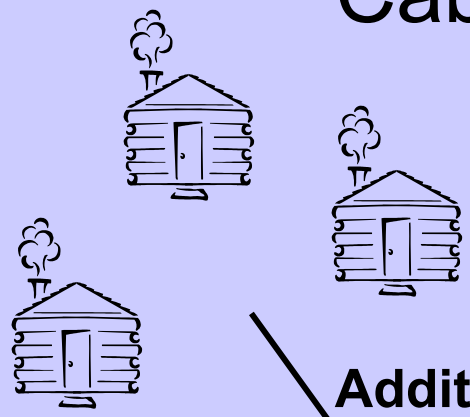
- Sewage from on-site treatment and disposal system
- Outhouse

Environmental Assessment Results

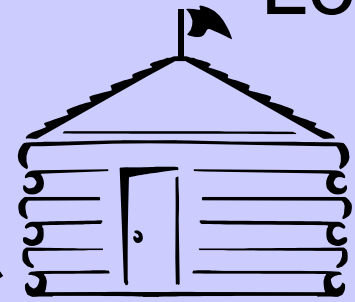
Suspect Mode of Contamination

- Flow of sewage increased
- Unused wells placed into service
 - Increased “reach” for water
- Sewage system installed in fractured granite

Cabins

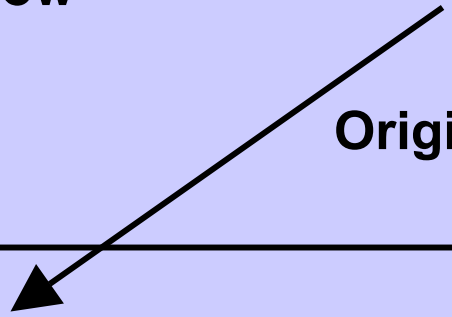
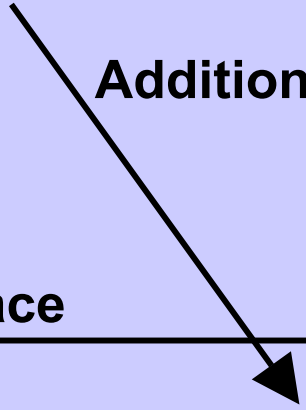


Lodge



Additional Inflow

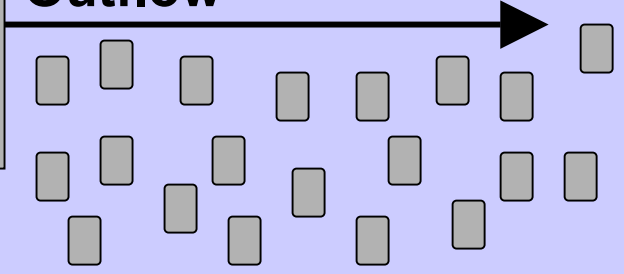
Original Inflow



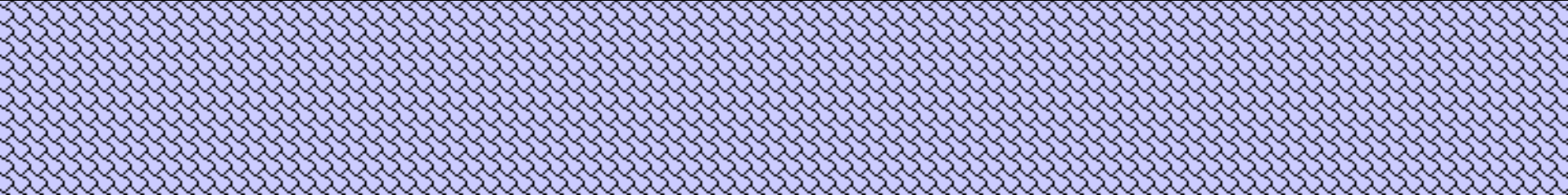
Ground Surface



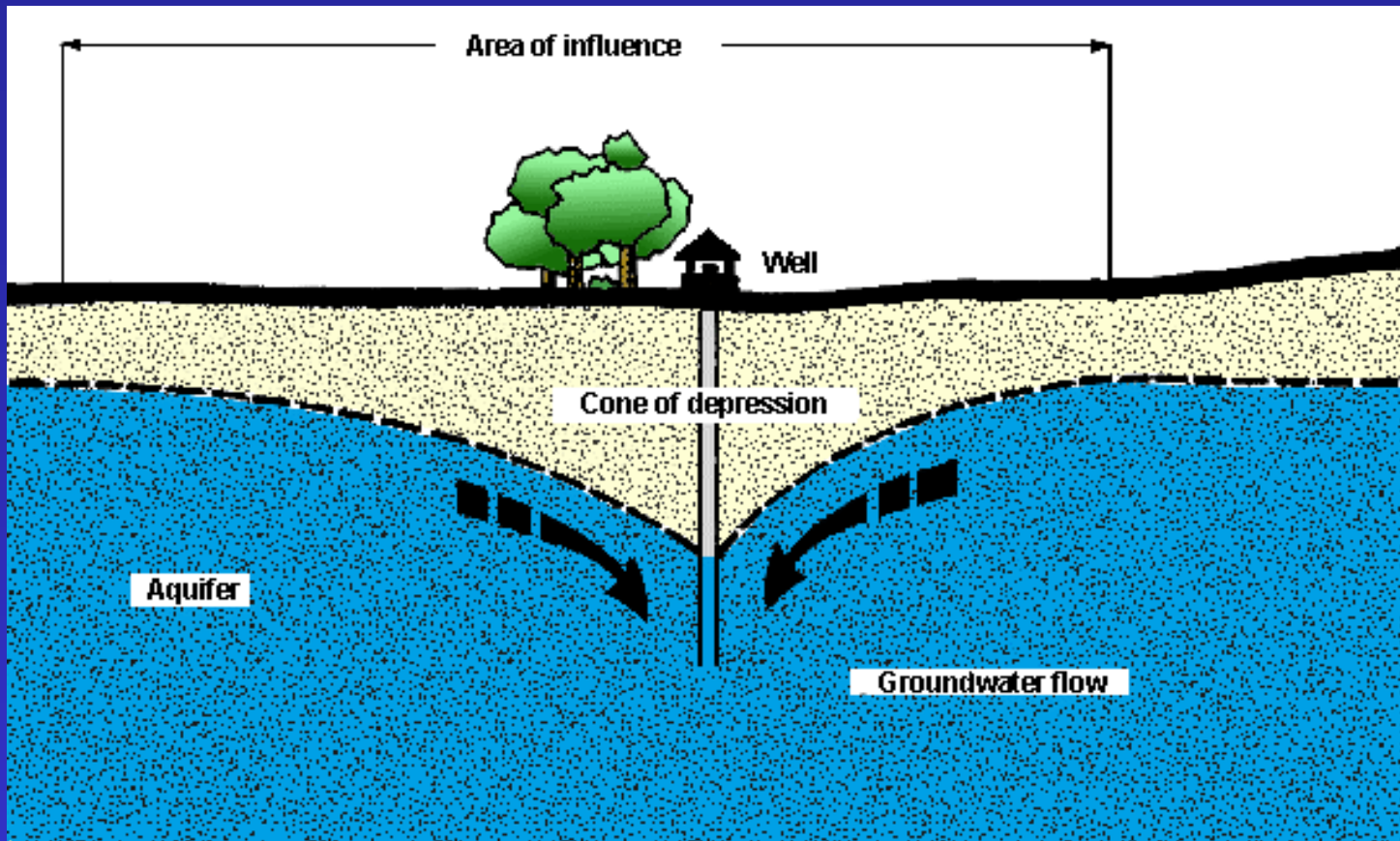
Outflow



Fractured Bedrock Surface

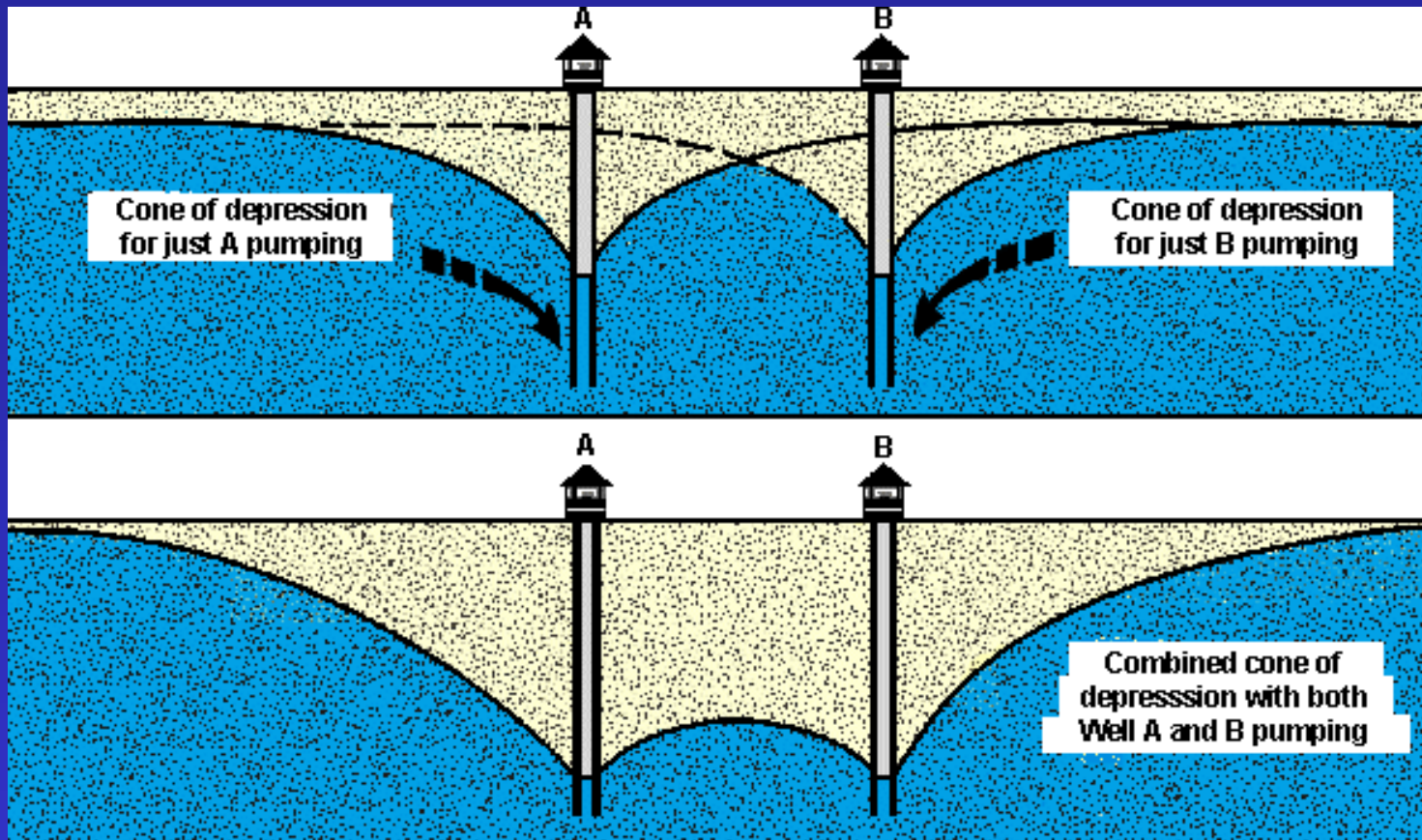


Cone of Depression



Source: Oregon State University (adapted from Cornell University)

Well Interference



Source: Oregon State University (adapted from Cornell University)

Environmental Assessment Results

Survival of Agent

- Shallow, coarse-textured soils
- Heavy application of sewage
- Water not filtered
- Water not appropriately chlorinated

Environmental Assessment Results

Isolation of Agent

- 7 of 8 source water samples fecal coliform positive
- NLV positive sample
 - Sequence identical to 6 human specimens

Summary

Drinking water from a contaminated water supply system was associated with illness that affected at least 230 people

Discussion

- Waterborne transmission of NLV
- Going beyond epidemiology and laboratory investigation
- Target high risk facilities/areas

Discussion

- Questions to focus on prevention
- Outbreak response plan
- Identifying resources

Co-Investigators

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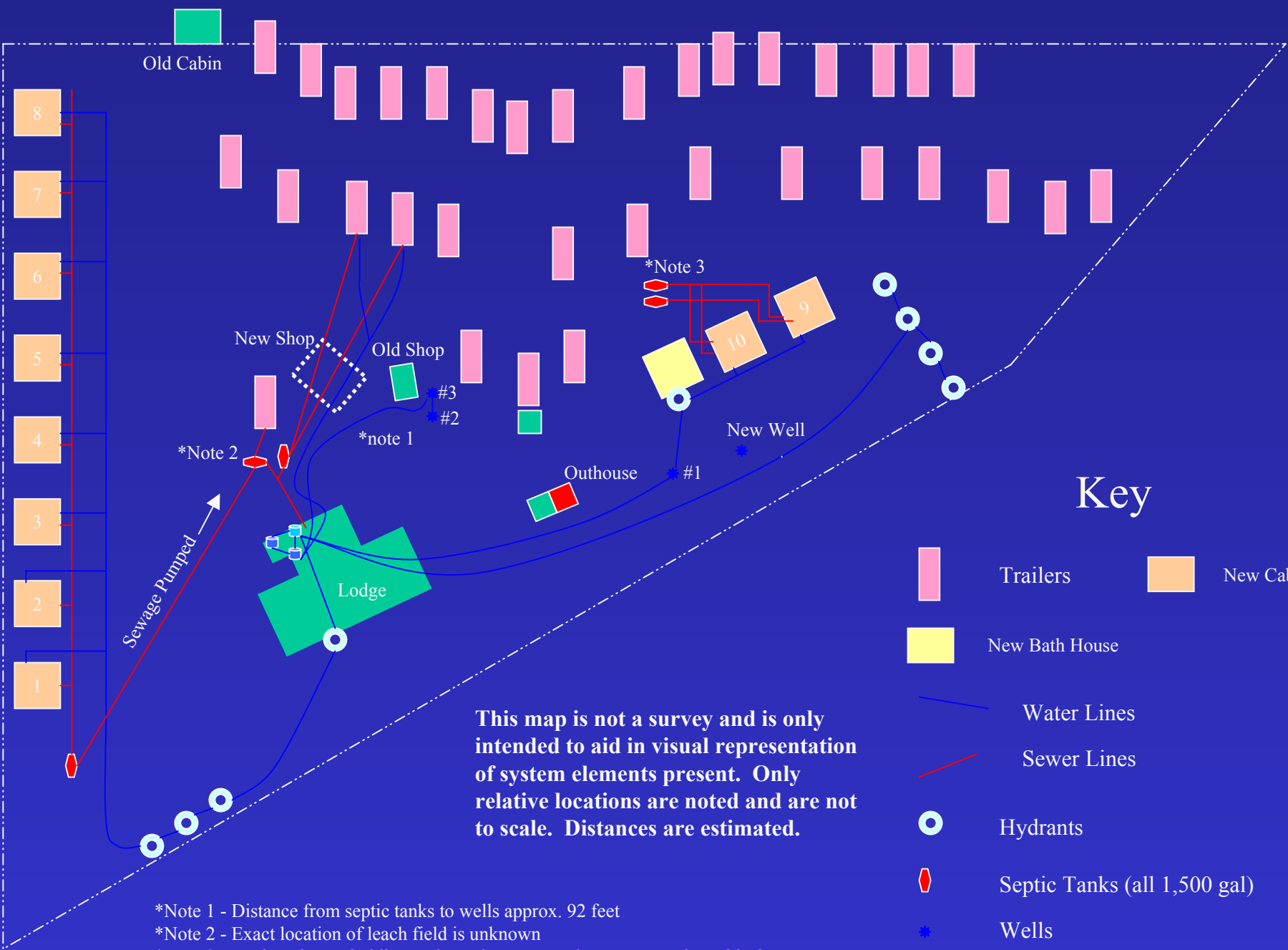
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Consequences

- Nine month closure of lodge
- \$200,000 in water and sewage treatment equipment
 - Drinking water filtered and chlorinated
 - Sewage aerated and treated



Key

- Trailers
- New Cabins
- New Bath House
- Water Lines
- Sewer Lines
- Hydrants
- Septic Tanks (all 1,500 gal)
- Wells
- Water Storage (3-225 gal and 2-1,600 gal)

This map is not a survey and is only intended to aid in visual representation of system elements present. Only relative locations are noted and are not to scale. Distances are estimated.

*Note 1 - Distance from septic tanks to wells approx. 92 feet
 *Note 2 - Exact location of leach field is unknown
 *Note 3 - Both tanks are holding tanks and are pumped, one grey and one black water