LNAPL Transmissivity Data Mining Project

Excerpts: FINAL DRAFT Summary Report

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Conducted by:
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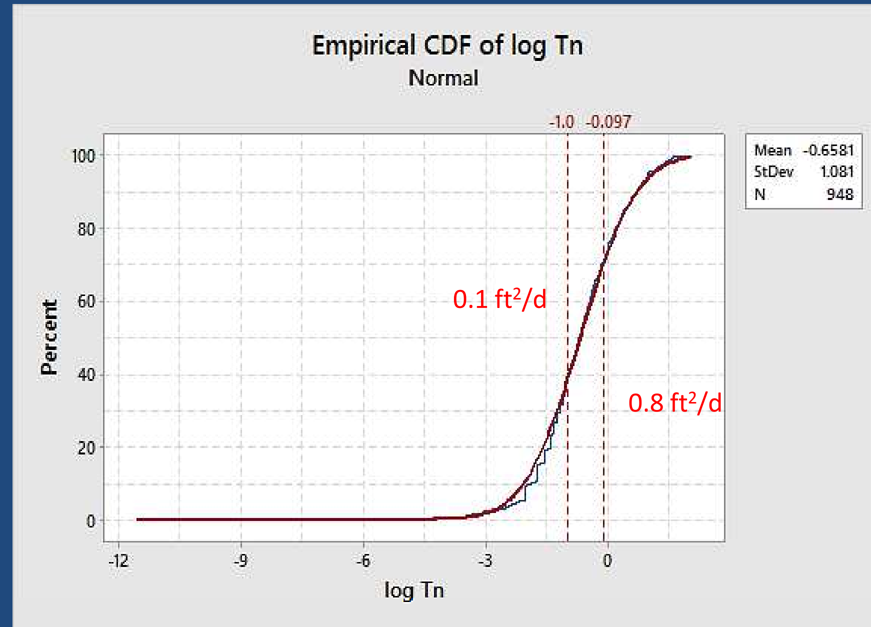
Top 10 Findings

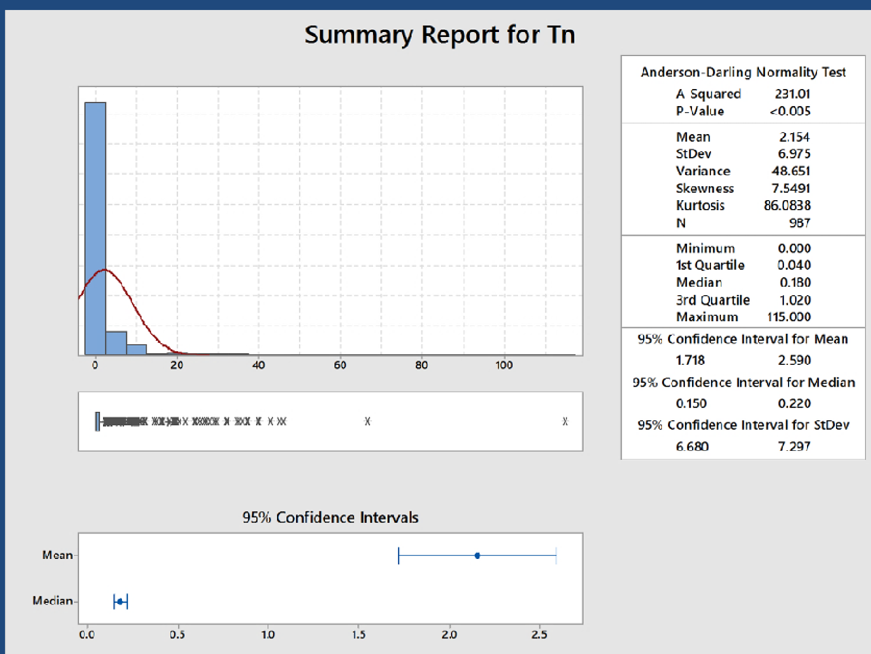
1. 90% of LNAPL transmissivity (T_n) values from 2002-2014 are below 5 ft^2/day
2. LNAPL transmissivity decreased substantially from 2003 to 2013 (latest full year)
3. Approximately 70% of LNAPL transmissivity values for 2013 are within or below the ITRC proposed hydraulic recoverability range of 0.1 – 0.8 ft^2/d
4. LNAPL transmissivity does not correlate to apparent NAPL thickness (ANT)
5. LNAPL transmissivity correlates negatively to increasing LNAPL density and viscosity
6. Unconfined LNAPL was reported in 41% of wells while 33% of wells reported confined, perched or complex hydrogeologic LNAPL conditions (26% were unknown)
7. The equilibrium apparent NAPL thickness (ANT) for unconfined LNAPL was substantially lower than the equilibrium ANT for confined or perched LNAPL
8. LNAPL transmissivity correlates positively with increasing soil grain size, controlled by the smallest grain size present
9. All test methods except for petrophysical calculation yielded similar ranges of LNAPL transmissivity values
10. LNAPL transmissivity values for Summer and multi-season measurements were lower than LNAPL transmissivity measurements during Fall, Winter or Spring

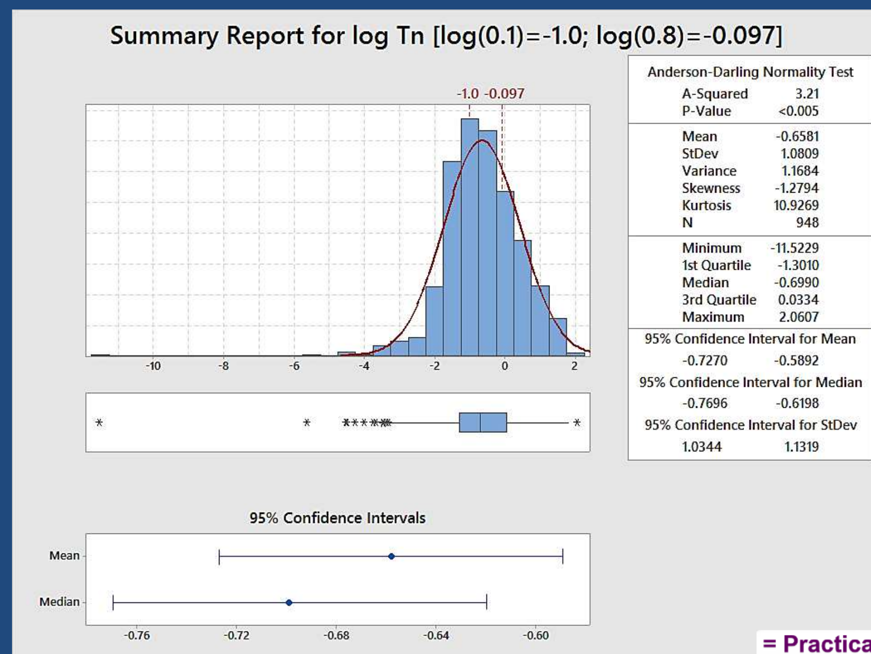
Summary of T_n Sample Population 2002-2014

```
         n = 987
       min = 0.00 ft²/day
       max = 115  ft²/day
      mean = 2.16 ft²/day
    median = 0.18 ft²/day

40% values <  0.1 ft²/day
70% values <  0.8 ft²/day
90% values <  5   ft²/day
95% values < 10   ft²/day
```







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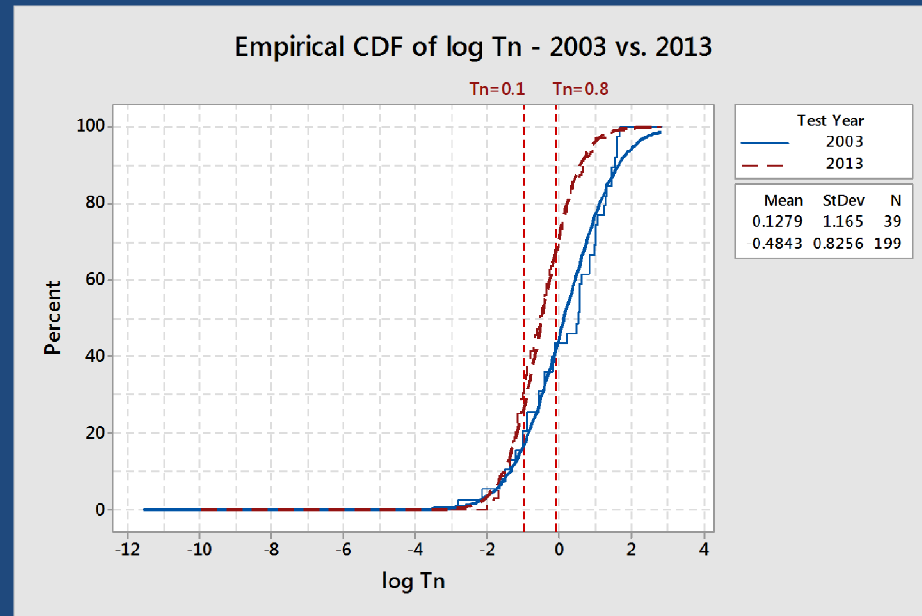
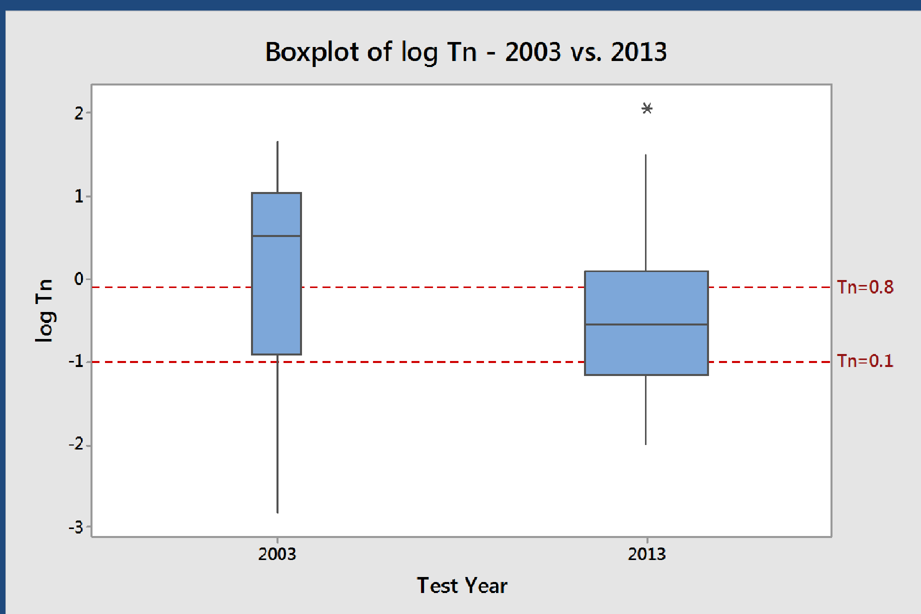
Comparison of $\log_{10} T_n$ Sample Population: 2003 vs. 2013

2003

n = 39
min = 0.0015 ft^2/day
max = 45 ft^2/day
mean = 1.90 ft^2/day
median = 3.31 ft^2/day

20% values < 0.1 ft^2/day
45% values < 0.8 ft^2/day
90% values < 33.4 ft^2/day
95% values < 39.2 ft^2/day





2013

n = 199
min = 0.01 ft^2/day
max = 115 ft^2/day
mean = 2.29 ft^2/day
median = 0.28 ft^2/day

30% values < 0.1 ft^2/day
68% values < 0.8 ft^2/day
90% values < 4.8 ft^2/day
95% values < 9.3 ft^2/day

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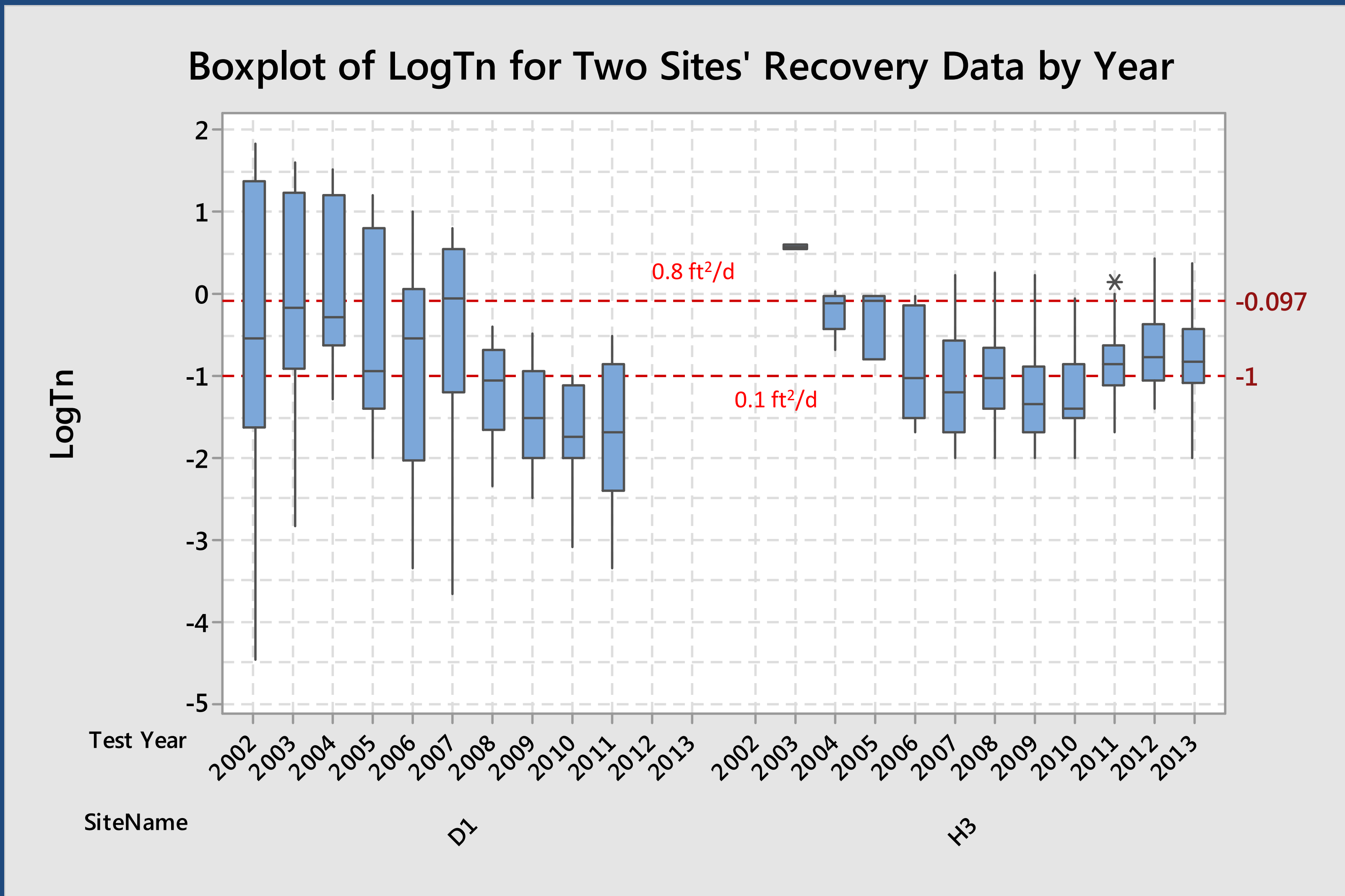
Sites with Long-Term Recovery Data: Log_{10} T_n Over Time

Interquartile ranges decrease then stabilize within or below 0.1-0.8 ft^2/d range



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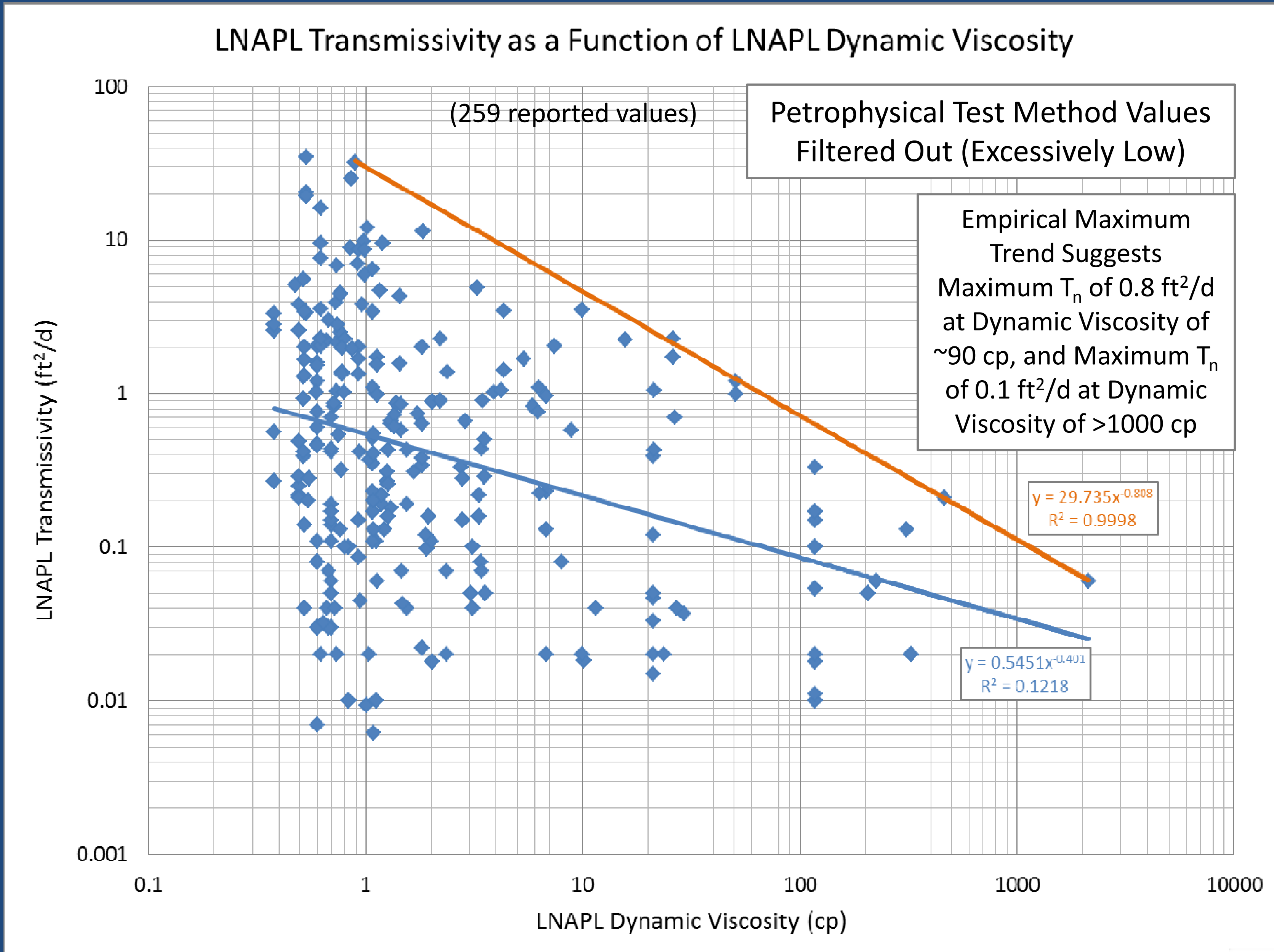
Decreasing Log_{10} T_n with Increasing Log_{10} LNAPL Viscosity



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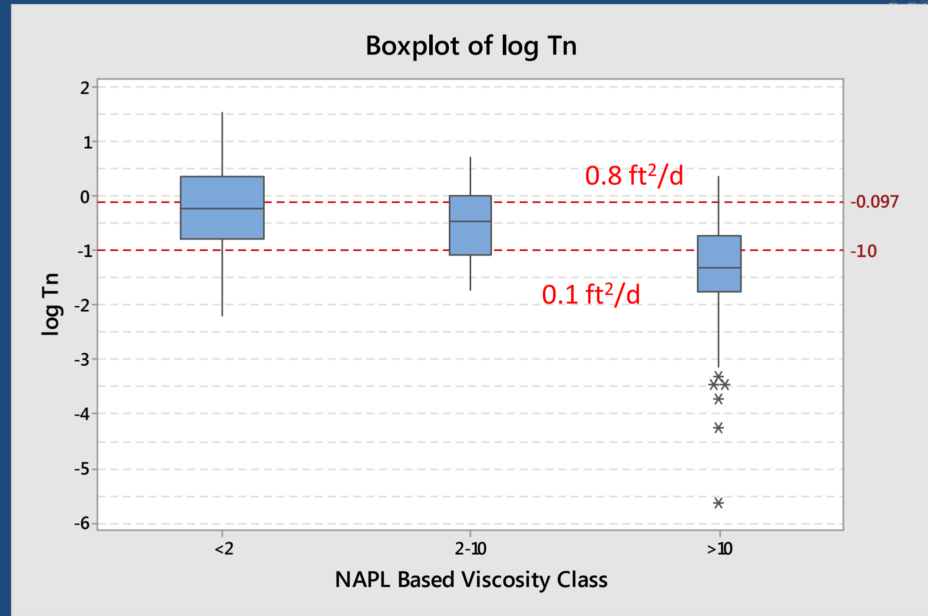
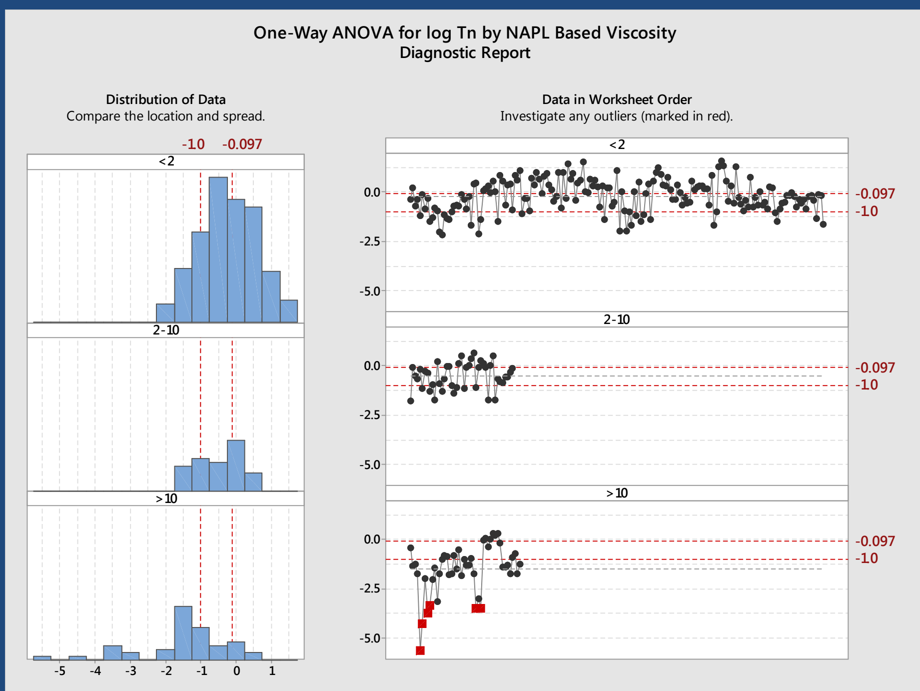
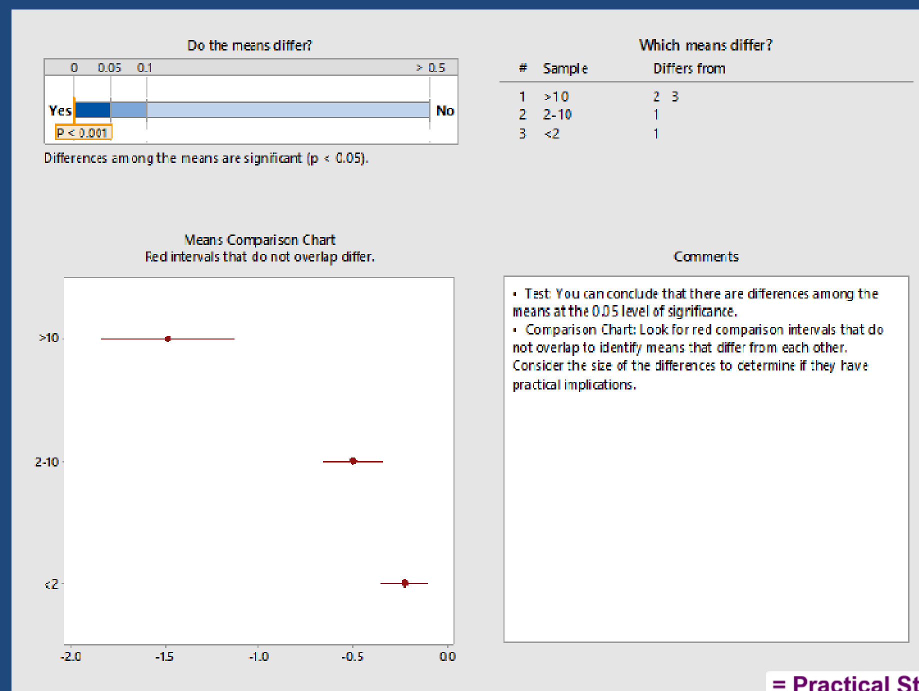
One-Way ANOVA: $\text{Log}_{10}\ T_n$ by LNAPL Based Viscosity Class

- Mean T_n values for LNAPL viscosities >10 cp are significantly lower than mean T_n values for viscosities <10cp at $p < 0.05$
- Median T_n for viscosity <10 cp within range 0.1–0.8 ft_2/day; median T_n for viscosities >10 cp are below range 0.1–0.8 ft_2/day







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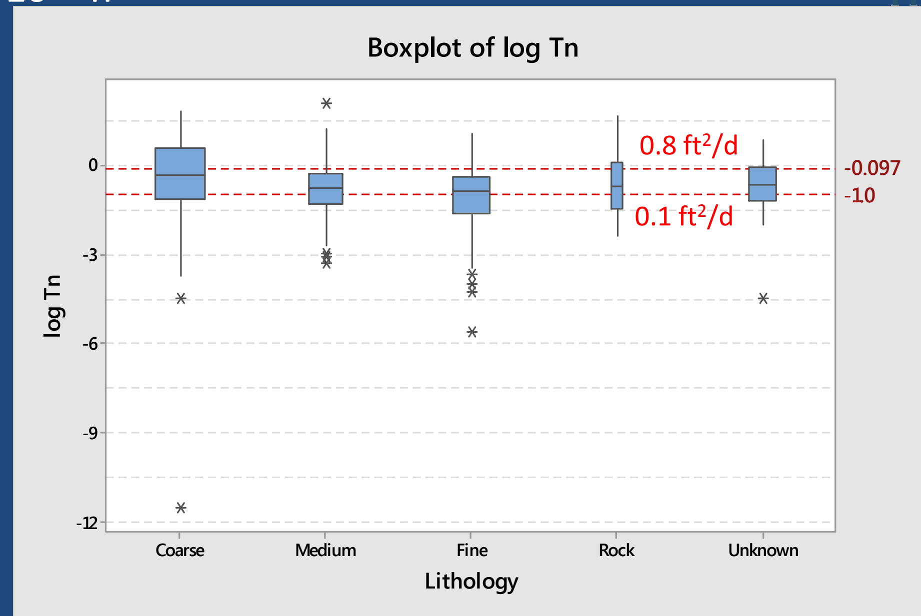
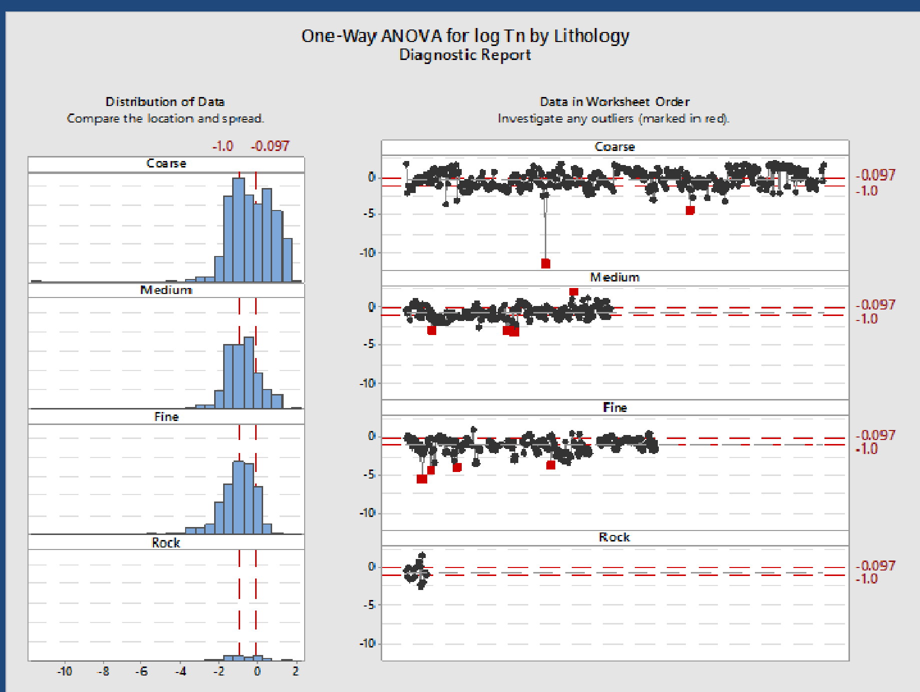
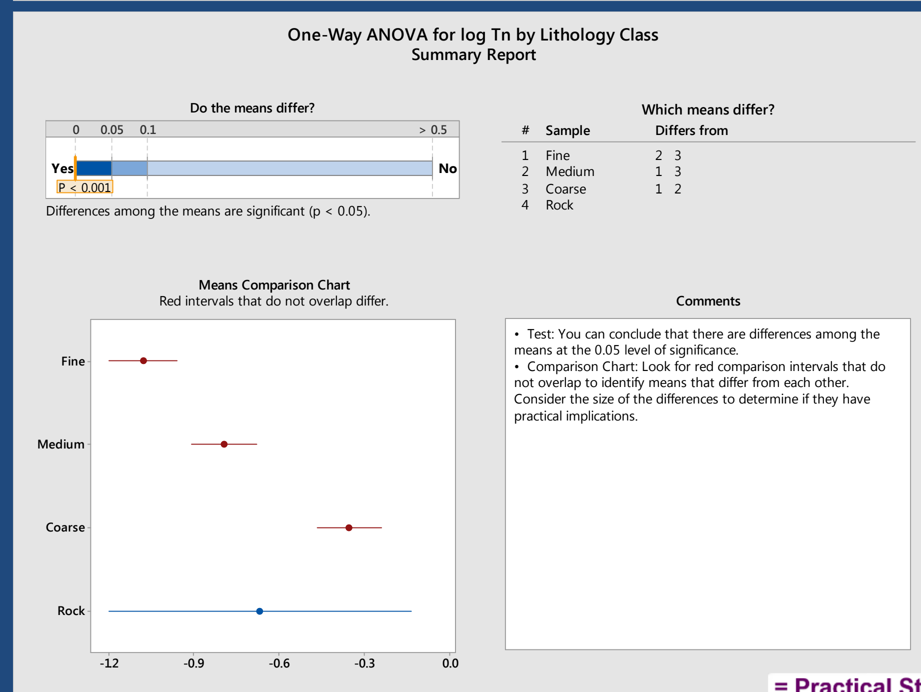
One-Way ANOVA: Log_{10} T_n vs Lithology Class

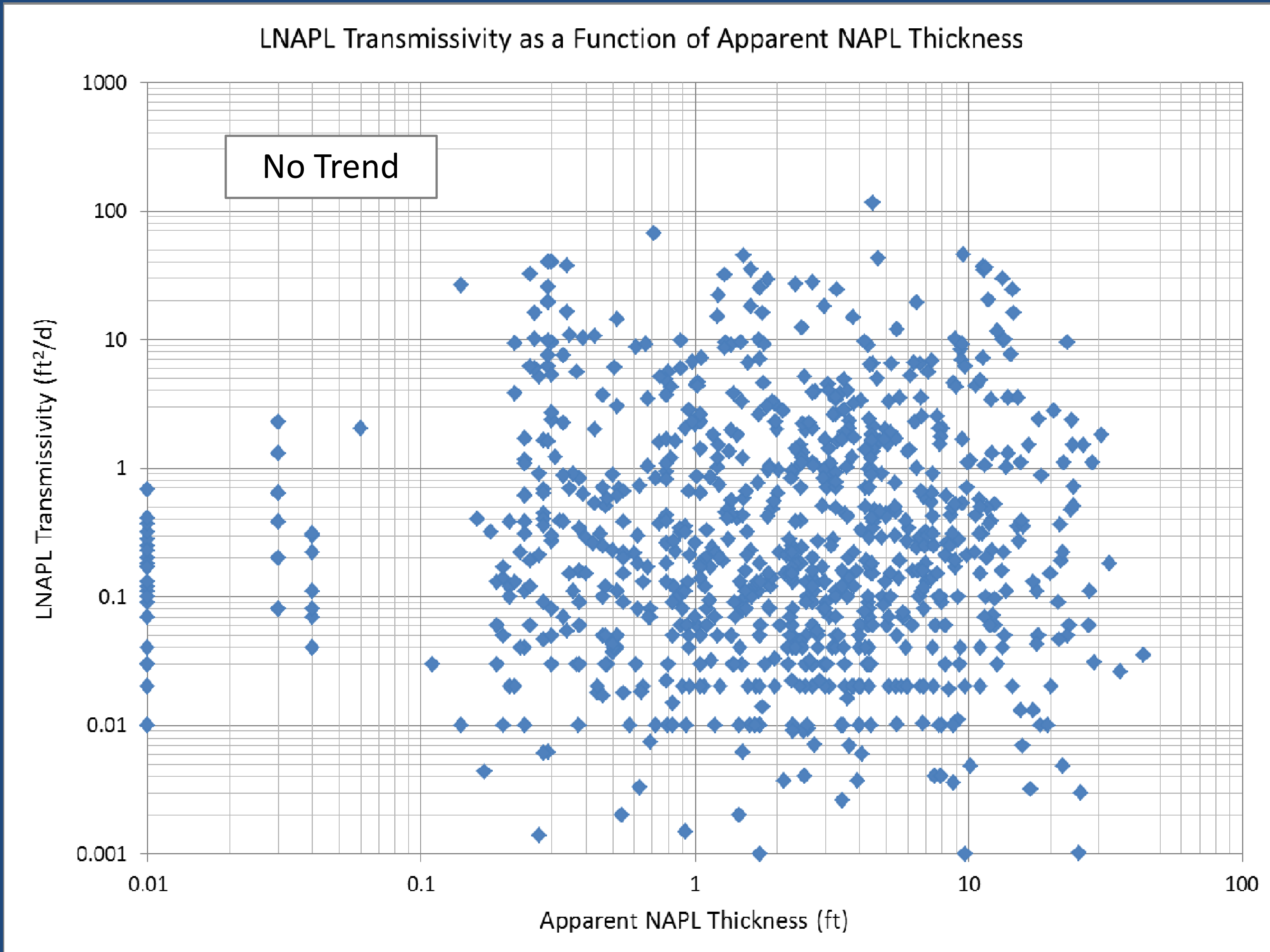
- Median T_n values for lithology classes are within range 0.1–0.8 ft_2/day
- Median T_n values decrease in order from coarse – medium – fine grain-size fractions
- Mean T_n values for fine, medium, and coarse grain-size fractions are significantly different from each other







Log_{10} T_n Values vs Log_{10} Apparent NAPL Thickness



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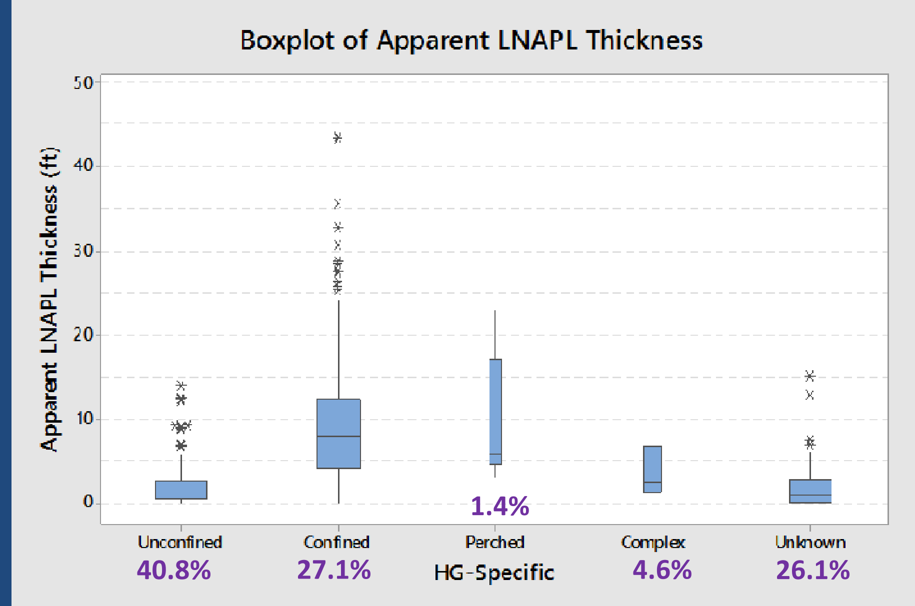
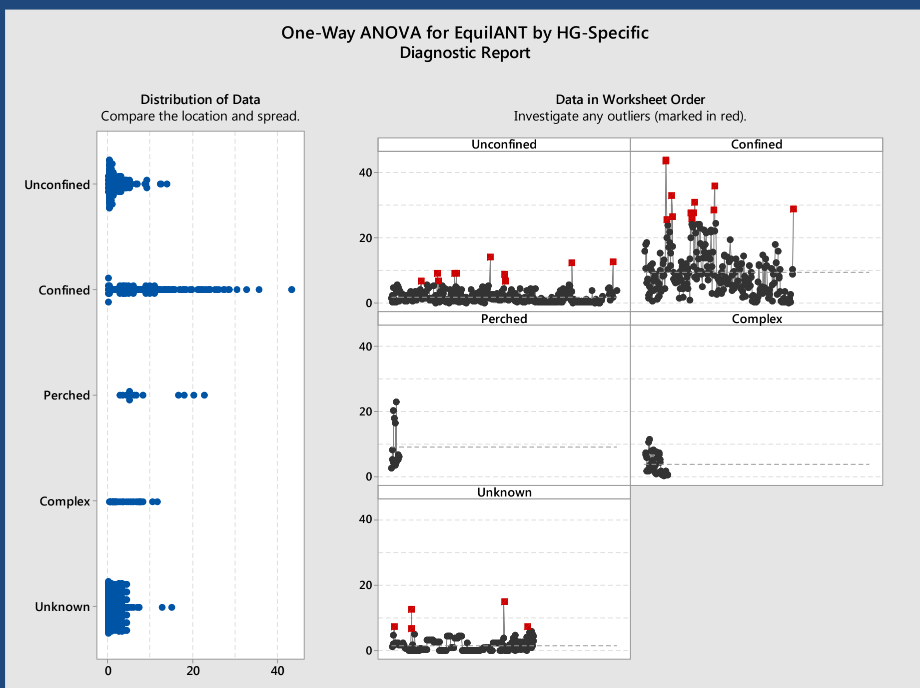
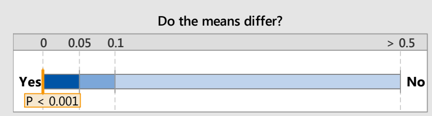
One-Way ANOVA: ANT Values vs Hydrogeologic Condition

- Median ANT values are higher in confined and perched conditions than in unconfined conditions
- Mean ANT values decrease from perched/confined conditions to unconfined conditions
- Mean ANT values for perched/confined conditions are significantly different than mean ANT in unconfined condition





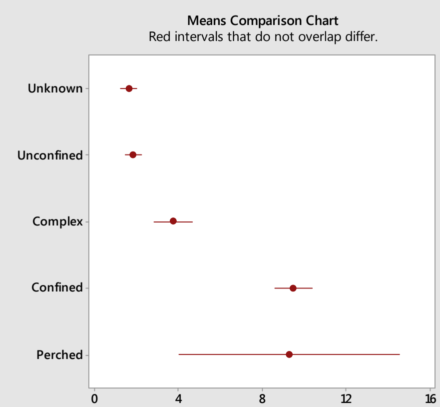
One-Way ANOVA for EquilANT by HG-Specific
Summary Report



Differences among the means are significant ($p < 0.05$).

Which means differ?

#	Sample	Differs from
1	Unknown	3 4 5
2	Unconfined	3 4 5
3	Complex	1 2 4
4	Confined	1 2 3
5	Perched	1 2



Comments

- Test: You can conclude that there are differences among the means at the 0.05 level of significance.
- Comparison Chart: Look for red comparison intervals that do not overlap to identify means that differ from each other. Consider the size of the differences to determine if they have practical implications.

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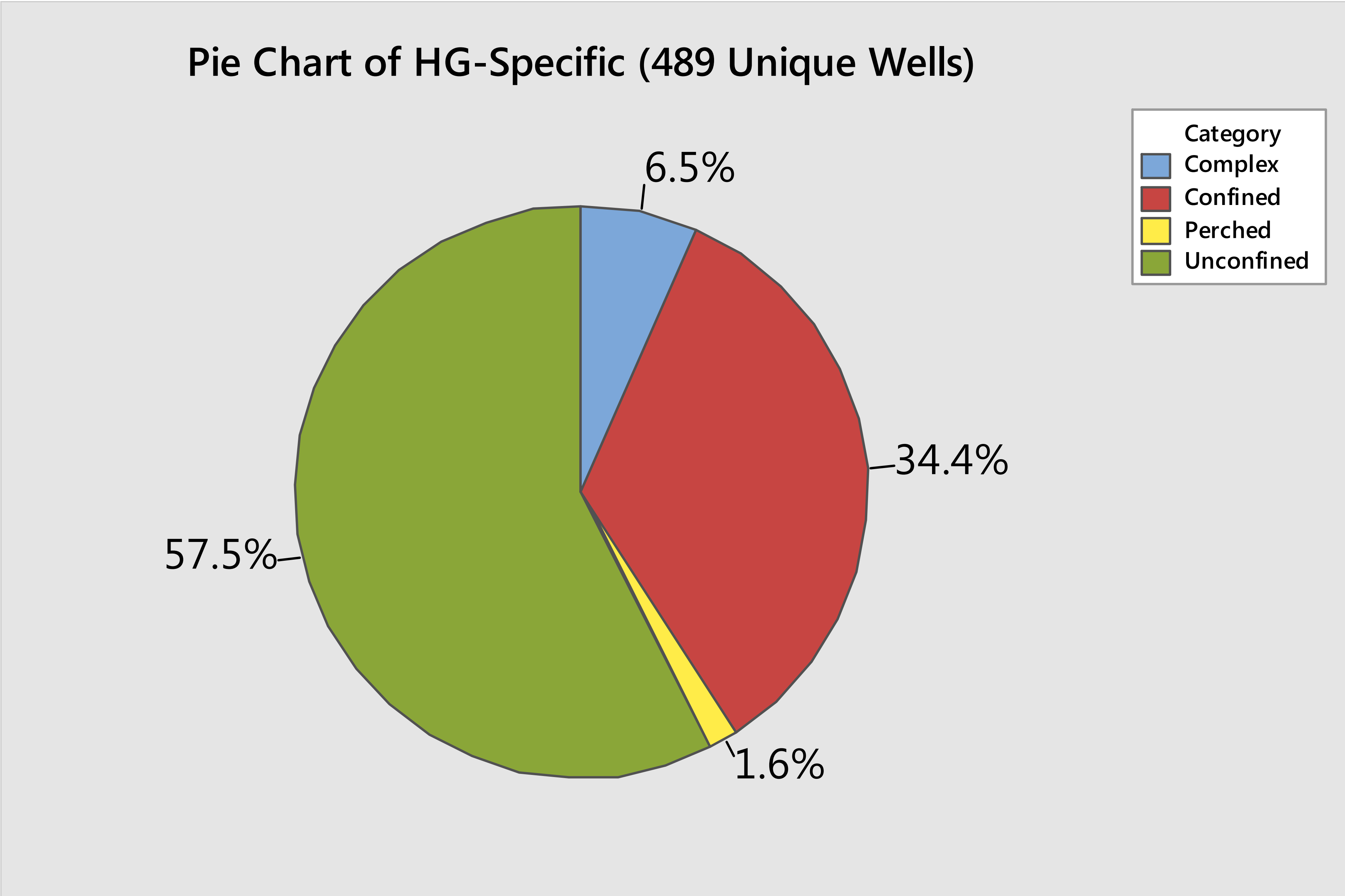
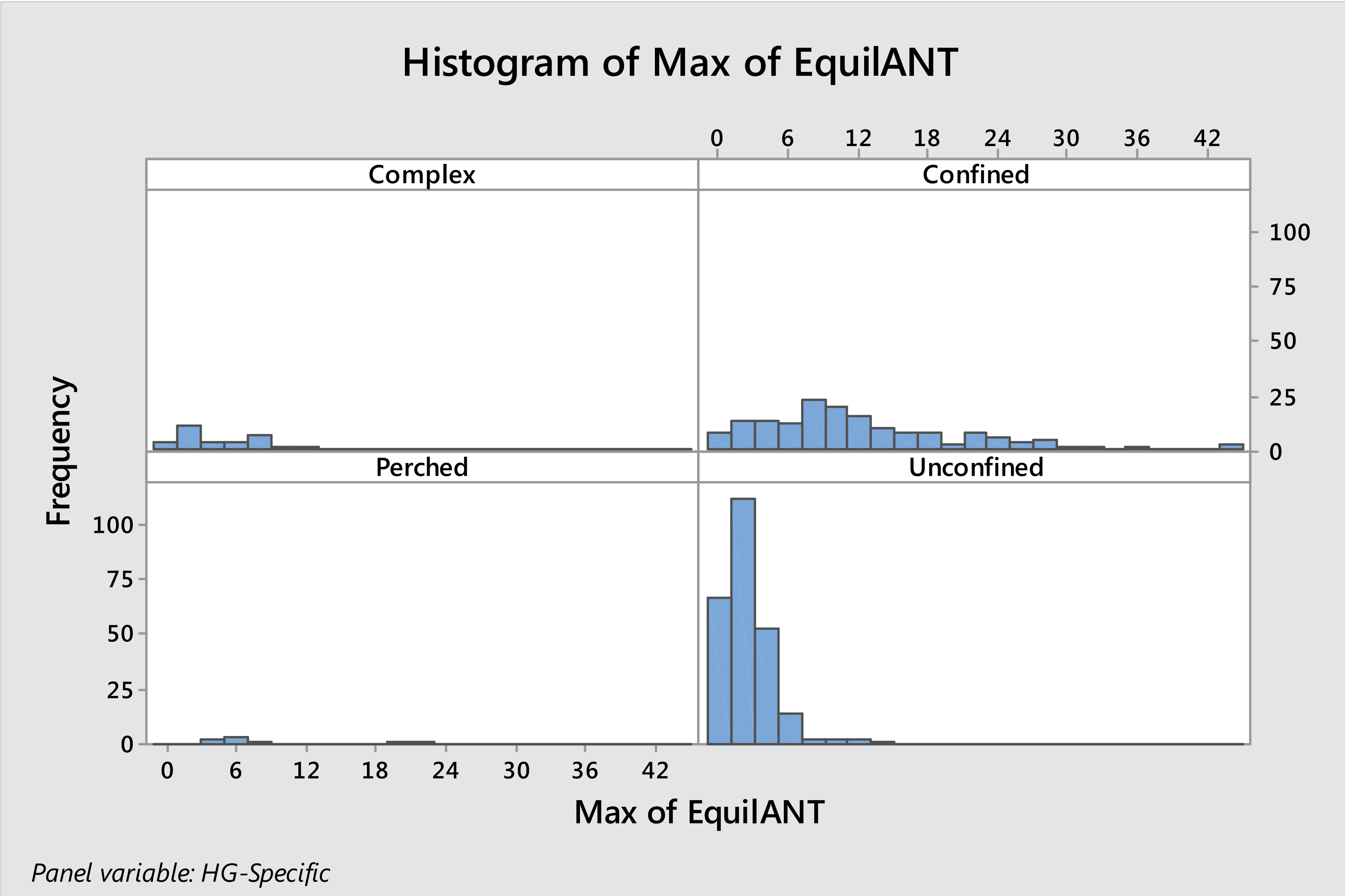
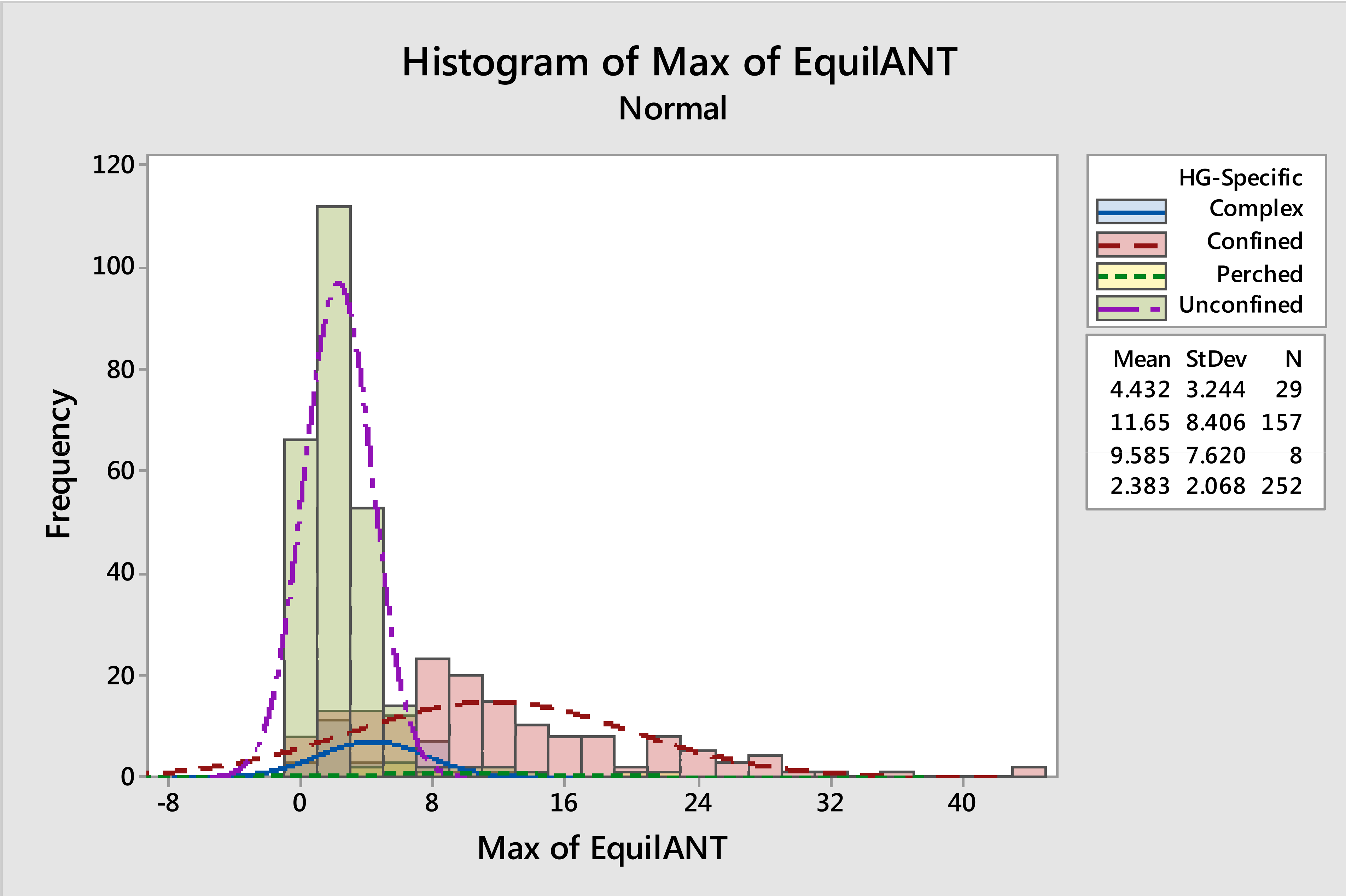
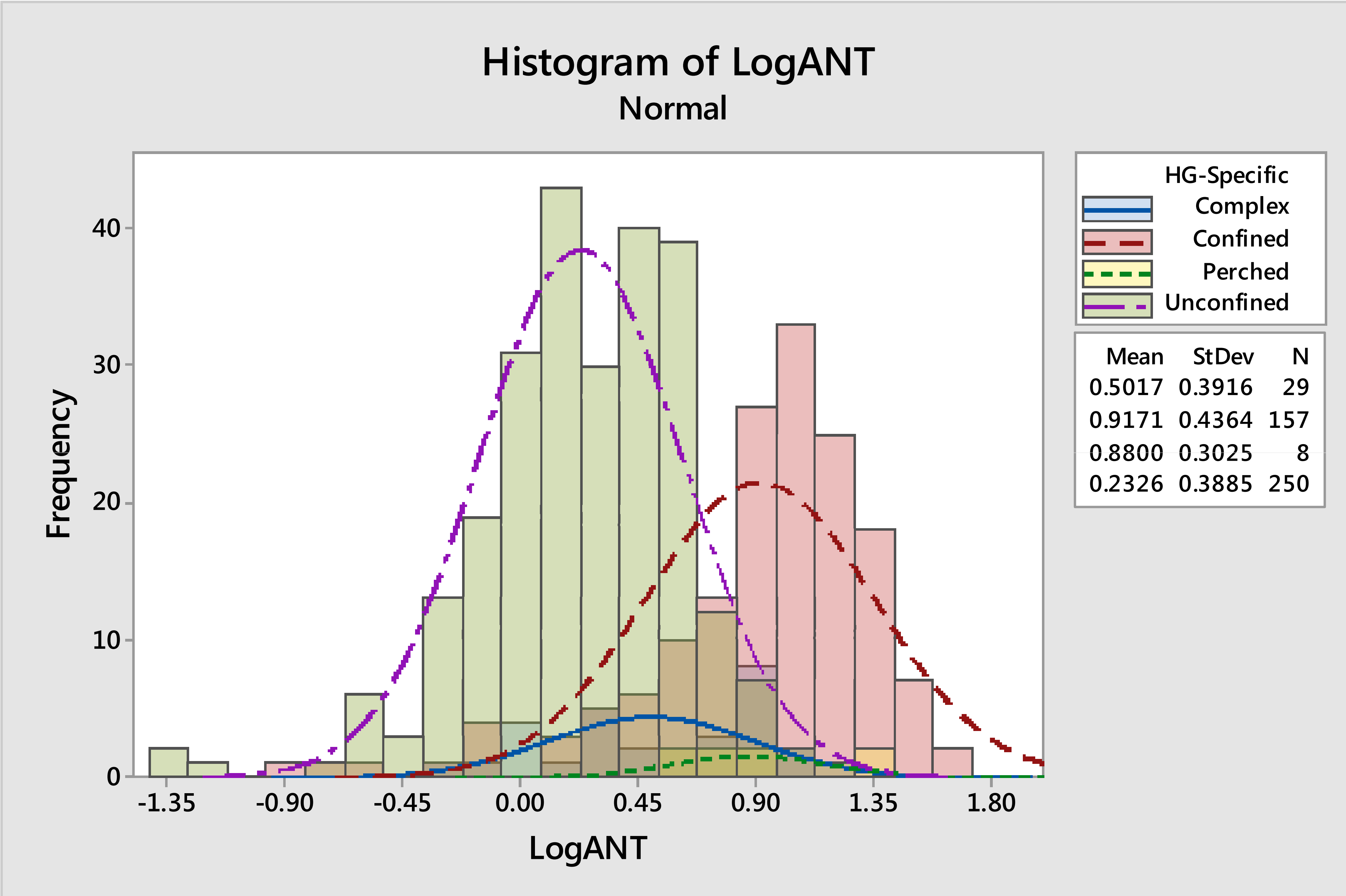

Pie Chart of HG-Specific (489 Unique Wells)
Category
Complex
Confined
Perched
Unconfined
6.5%
34.4%
1.6%
57.5%


Histogram of Max of EquilANT
Complex
Confined
Perched
Unconfined
Frequency
Max of EquilANT
0
6
12
18
24
30
36
42
0
25
50
75
100
Panel variable: HG-Specific



Histogram of Max of EquilANT
Normal
Frequency
120
100
80
60
40
20
0
-8
0
8
16
24
32
40
Max of EquilANT
HG-Specific
Complex
Confined
Perched
Unconfined
Mean StDev N
4.432 3.244 29
11.65 8.406 157
9.585 7.620 8
2.383 2.068 252


Histogram of LogANT
Normal
Frequency
LogANT
0
10
20
30
40
-1.35
-0.90
-0.45
0.00
0.45
0.90
1.35
1.80
HG-Specific
Complex
Confined
Perched
Unconfined
Mean StDev N
0.5017 0.3916 29
0.9171 0.4364 157
0.8800 0.3025 8
0.2326 0.3885 250

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