

Oyster Creek Nuclear Generating Station

Unresolved Problems With Drywell Corrosion

January 18, 2007

Presented by:

Richard Webster, Rutgers Environmental Law Clinic
on behalf of the Coalition to Stop the Relicensing of
Oyster Creek

Outcome of Previous Meeting

- Must put the horse before the cart
- First establish margin for both sandbed and embedded region
 - Significant issues with paucity of data, non-rigorous statistics, large uncertainty, unrealistic modeling, and many cumulative unjustified assumptions
- Second determine whether margin can be maintained
 - Significant issues with equipment failure leading to ongoing leakage, operator failures, uncertainty in the measurements, lack of data to predict corrosion rate, scope & frequency of monitoring

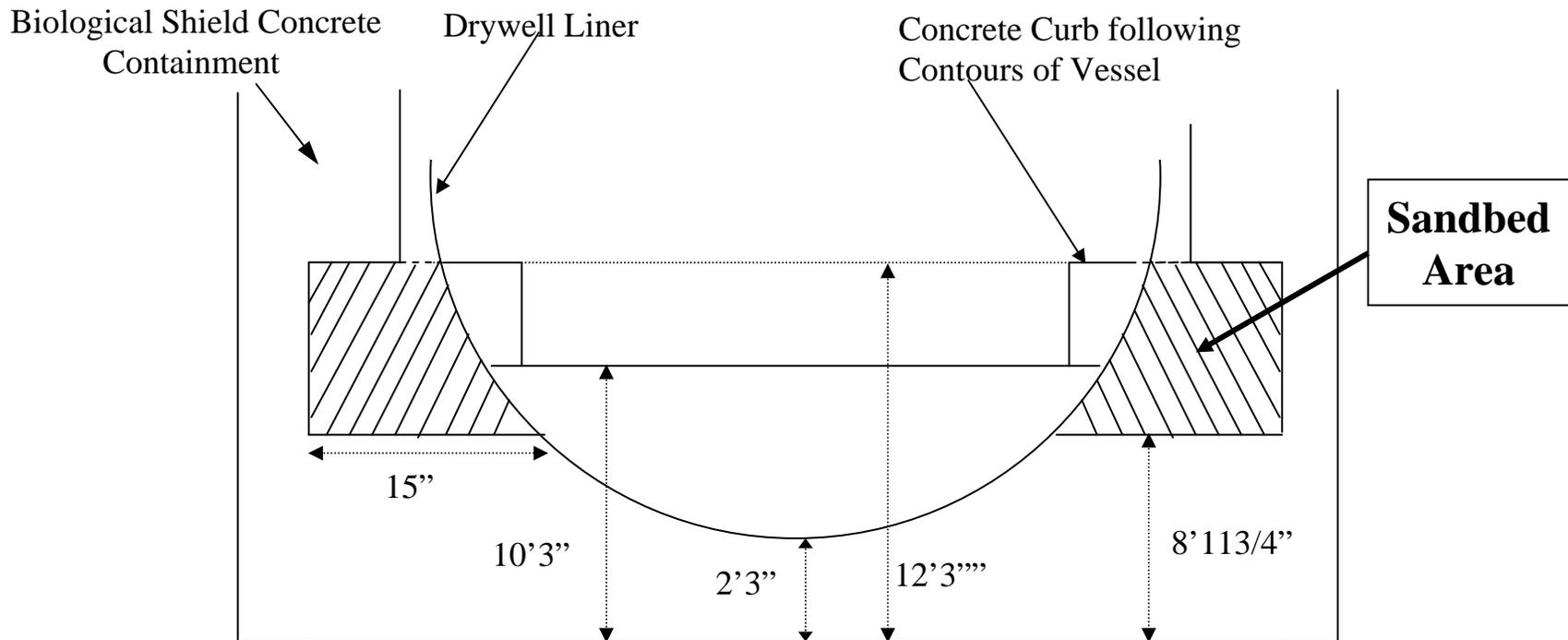
Key Issues from Previous Meeting

- Measured < 1% of Sandbed area, last good measurements in 1992 or 1994
- Fitted data to normal distribution by segmenting and editing out pits
- Acceptance criteria based on modeling of idealized geometries
- Margin not established, 0.064 inches claimed
- Visual assessment of coating alone inadequate
- Need better detection of corrosive conditions and faster response
- No measurements in the embedded region

What's New

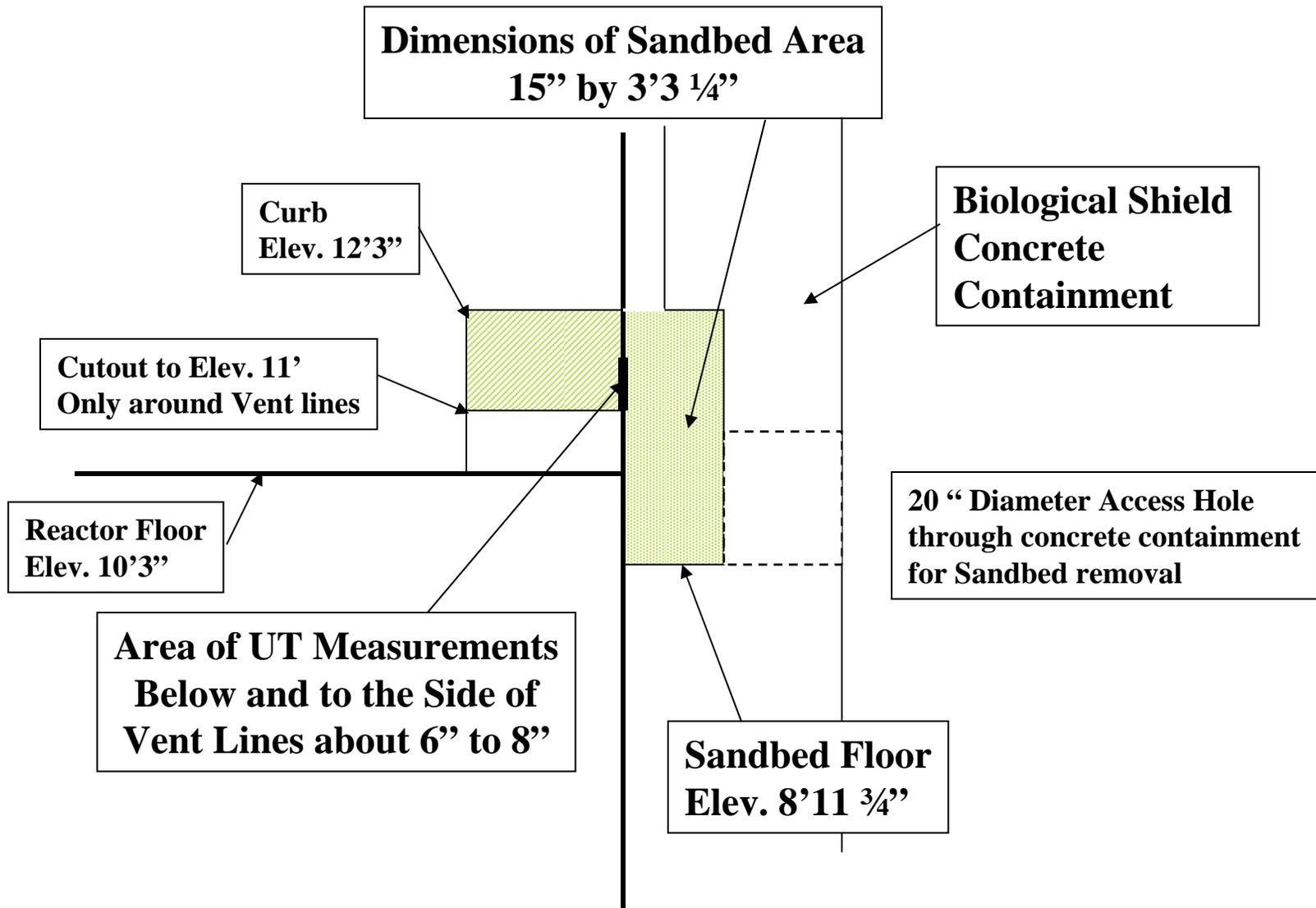
- For sandbed have historic results and new results taken in October 2006
- For embedded region now have a 42 point grid taken in a trench in bay 5 in October 2006
- In October 2006 found water on the inside of the shell below interior floor to be a normal operating condition
- Start with discussion with sandbed

Schematic Drawing of Lower Spherical Section of Drywell Liner (not to size)



Schematic Cross Section through Sandbed Area

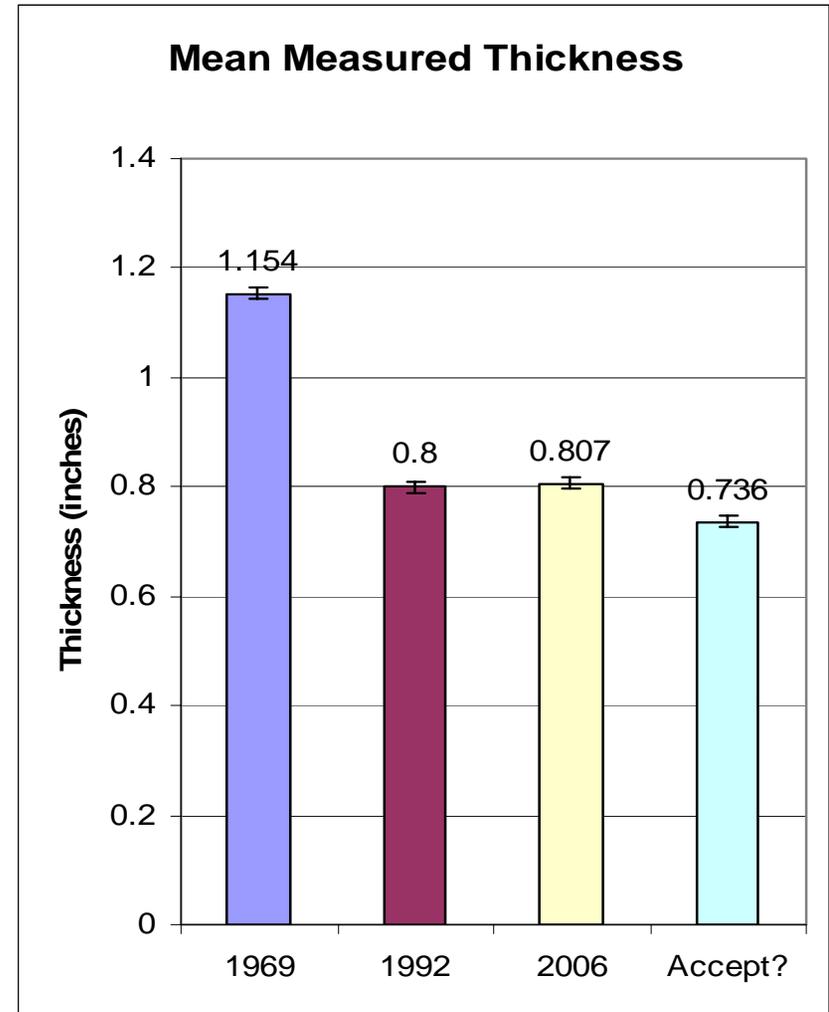
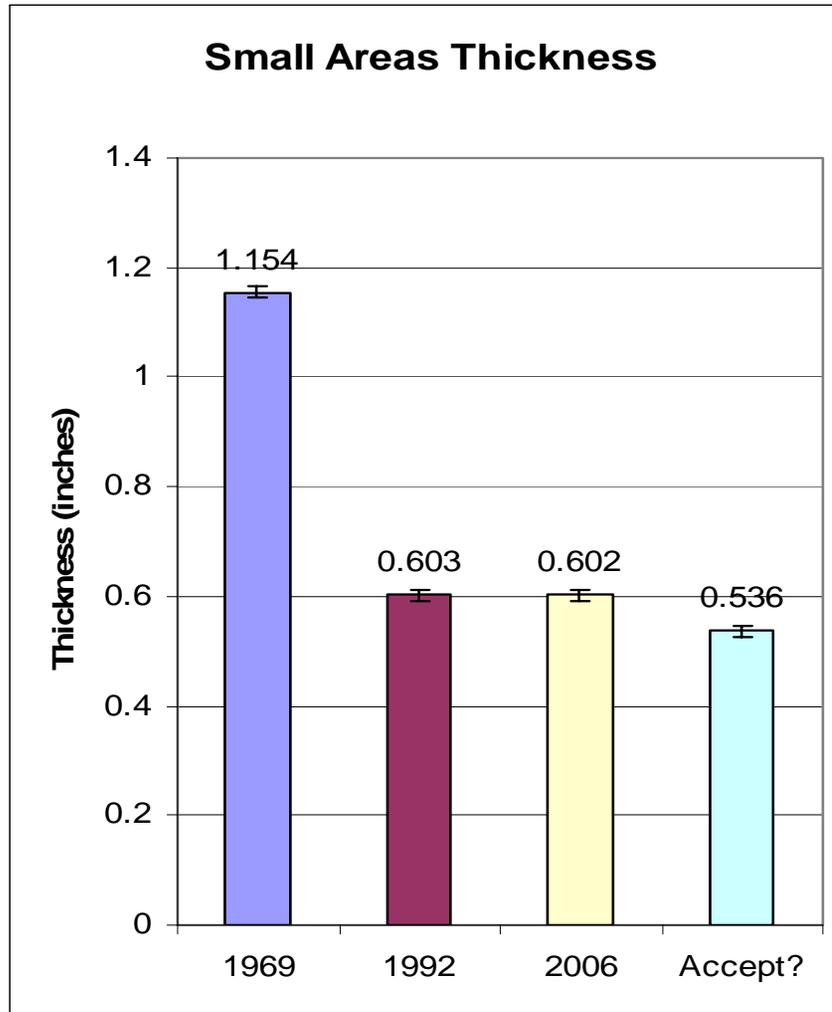
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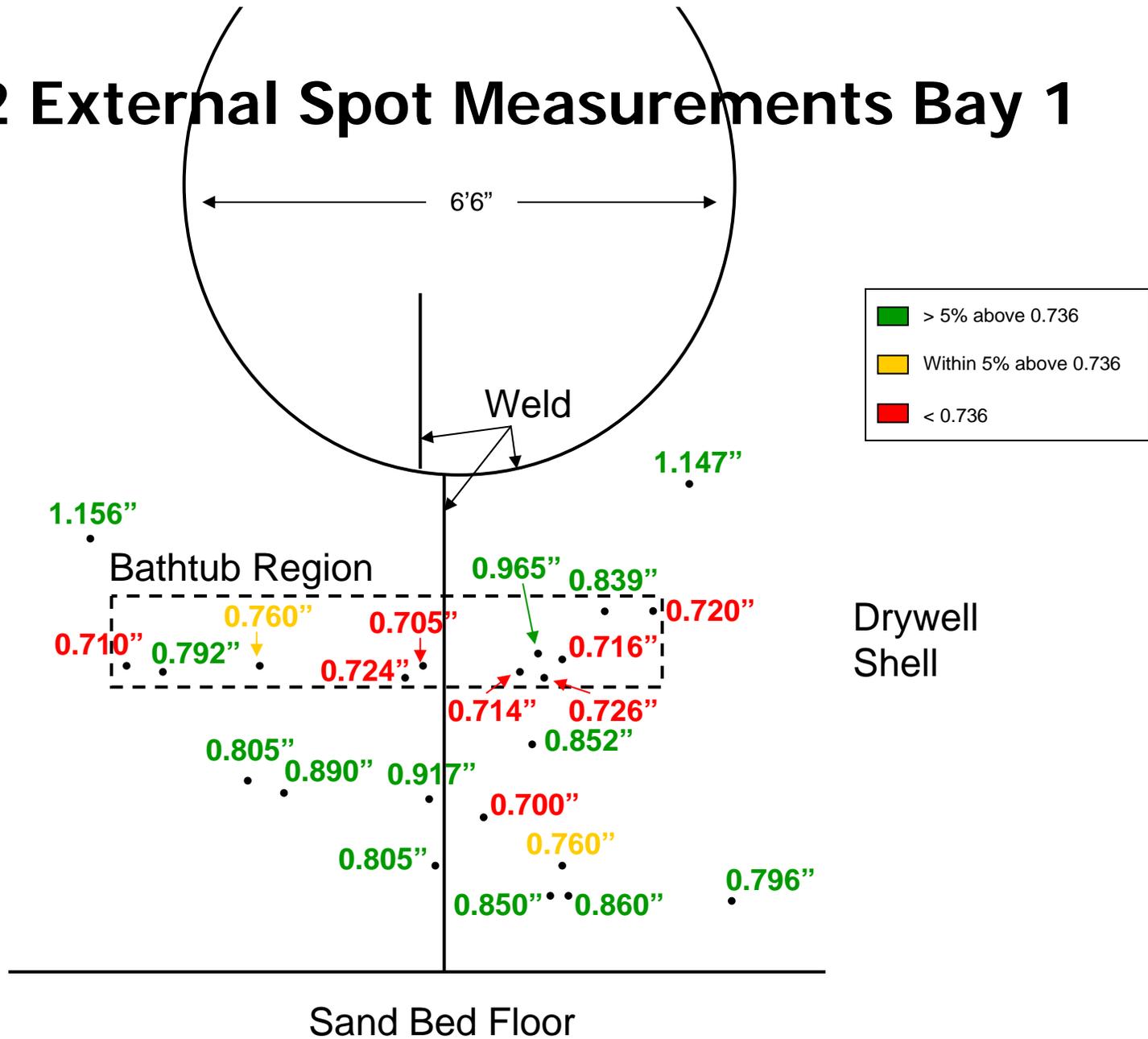
The Sandia Study

- Sandia model shows:
 - locally thin areas are significant and degradation has caused a 43% reduction in safety factor for the buckling in the sandbed under refueling conditions
 - GE model for buckling under refueling conditions was over optimistic, 0.844 inches uniform thickness needed, not 0.736 inches
 - Under accident conditions bending stress at the transition point at the bottom of the sand bed would be excessive
 - Safety factors for buckling under refueling conditions predicted at 1.95 in the upper drywell and 2.15 in sandbed
- Model fails to take account of measured thinning in the sandbed exterior measurements in October 2006
- Sandi failed to estimate the uncertainty of the prediction of the safety factor or its sensitivity and did not attempt to produce acceptance criteria for future corrosion

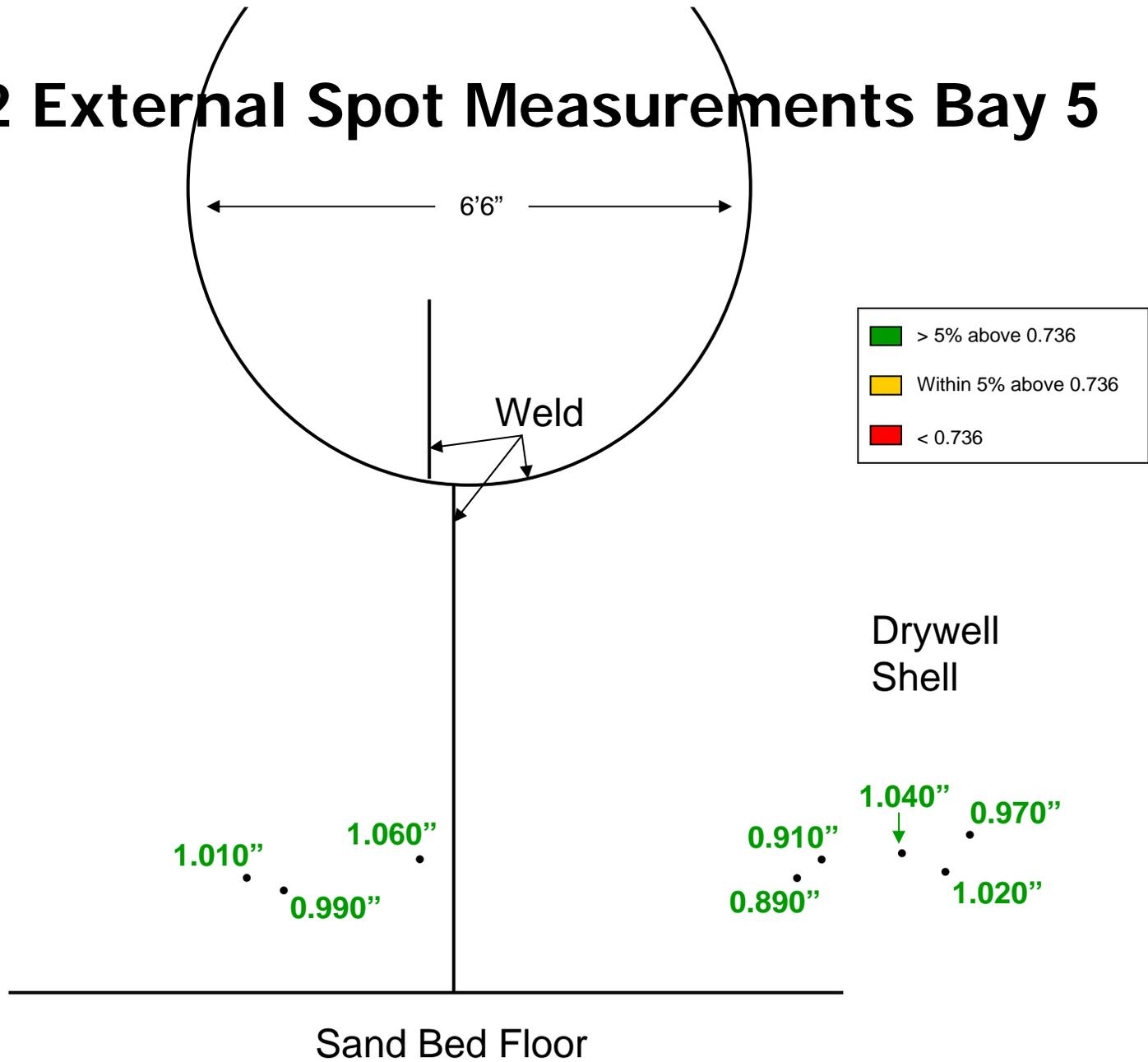
Claimed Safety Margins Based on 6 By 6 Grids



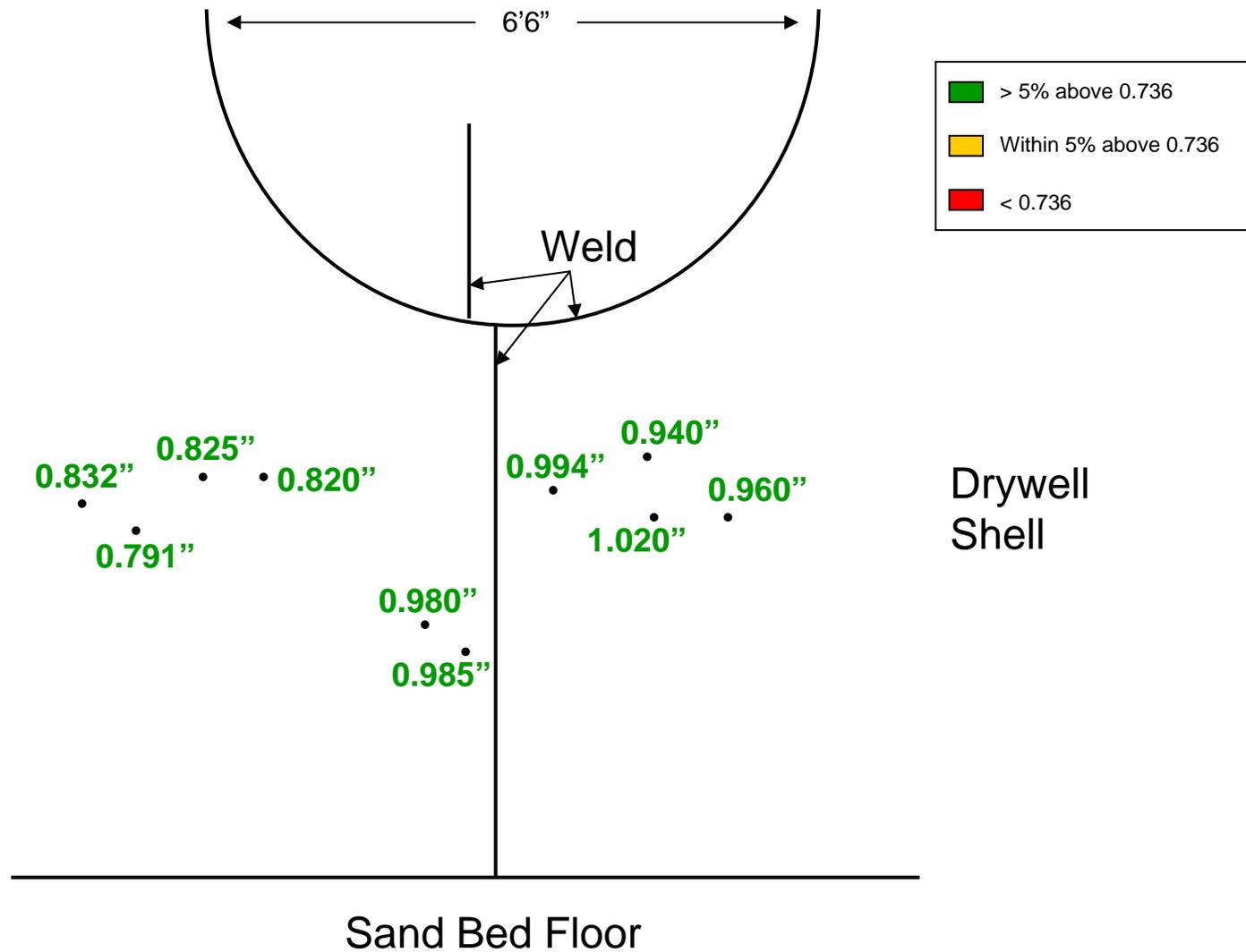
1992 External Spot Measurements Bay 1



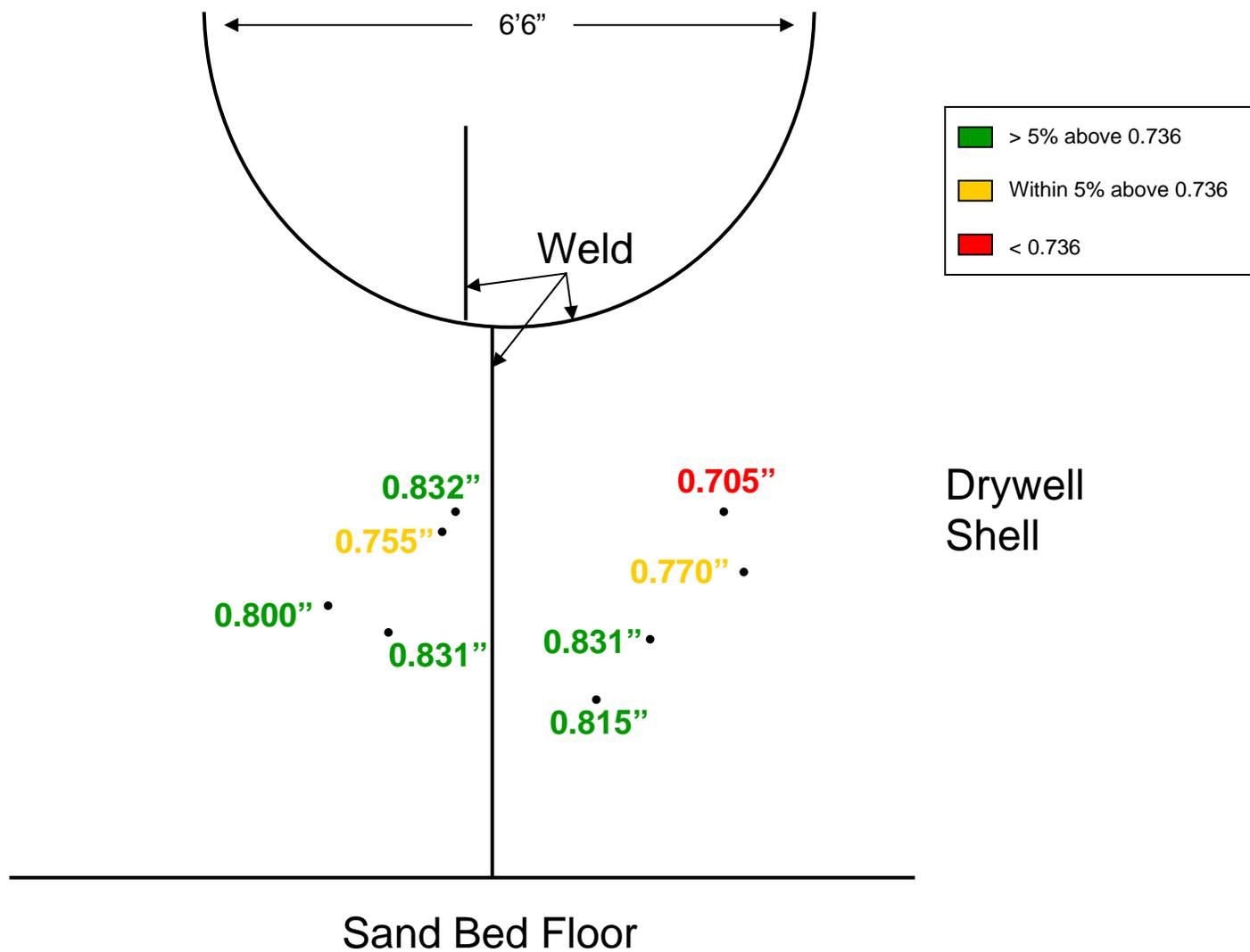
1992 External Spot Measurements Bay 5



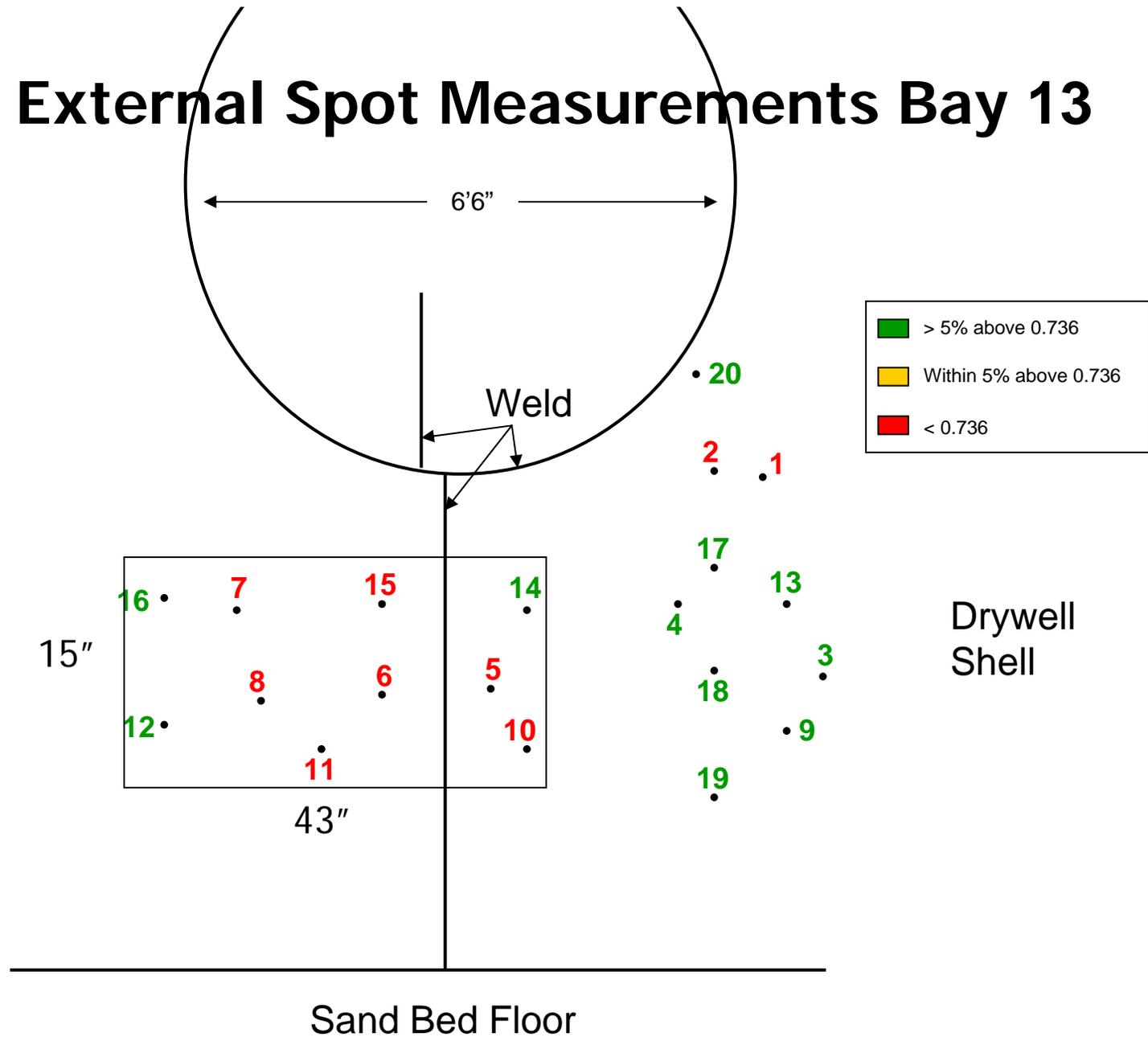
1992 External Spot Measurements Bay 9



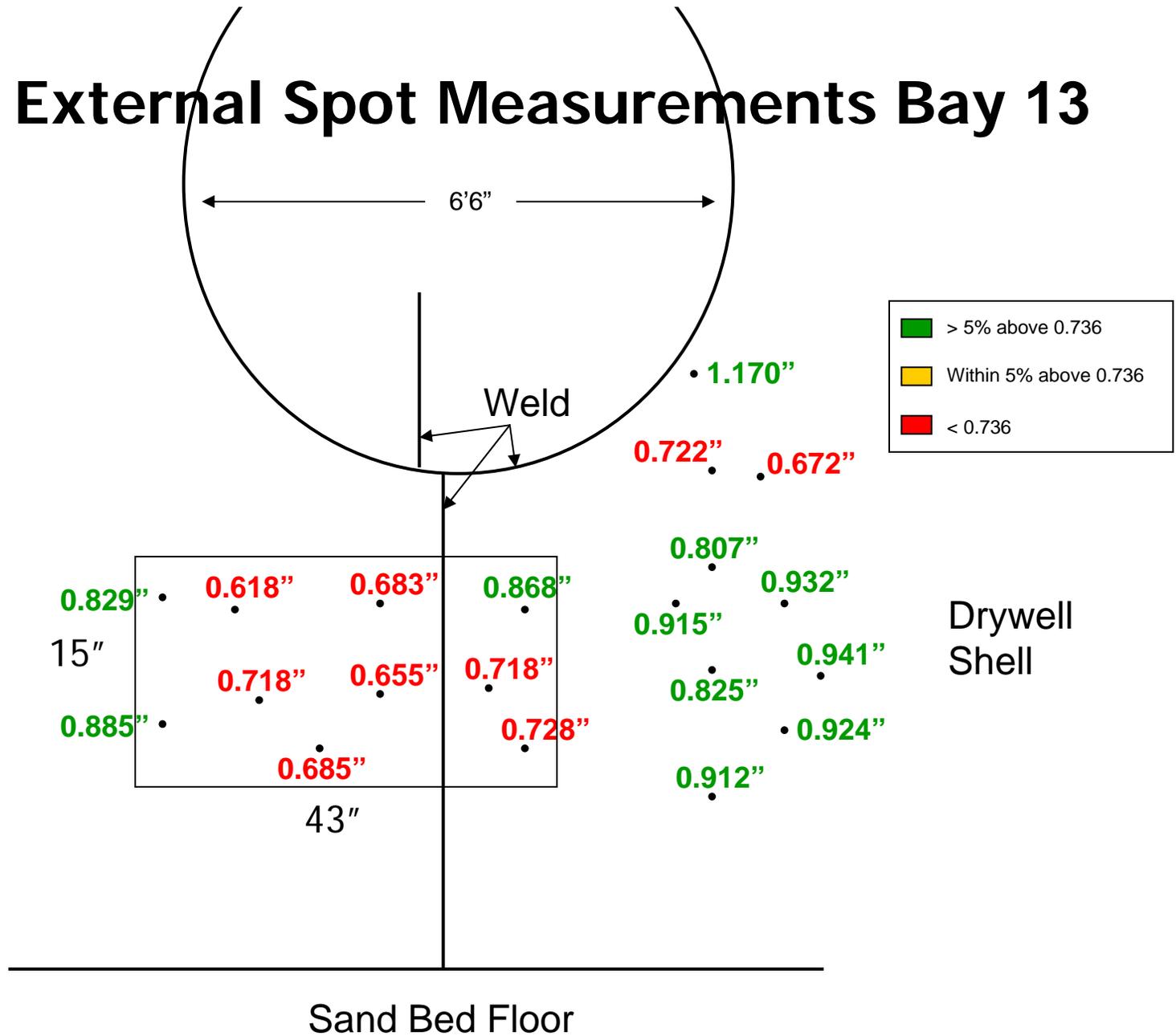
1992 External Spot Measurements Bay 11



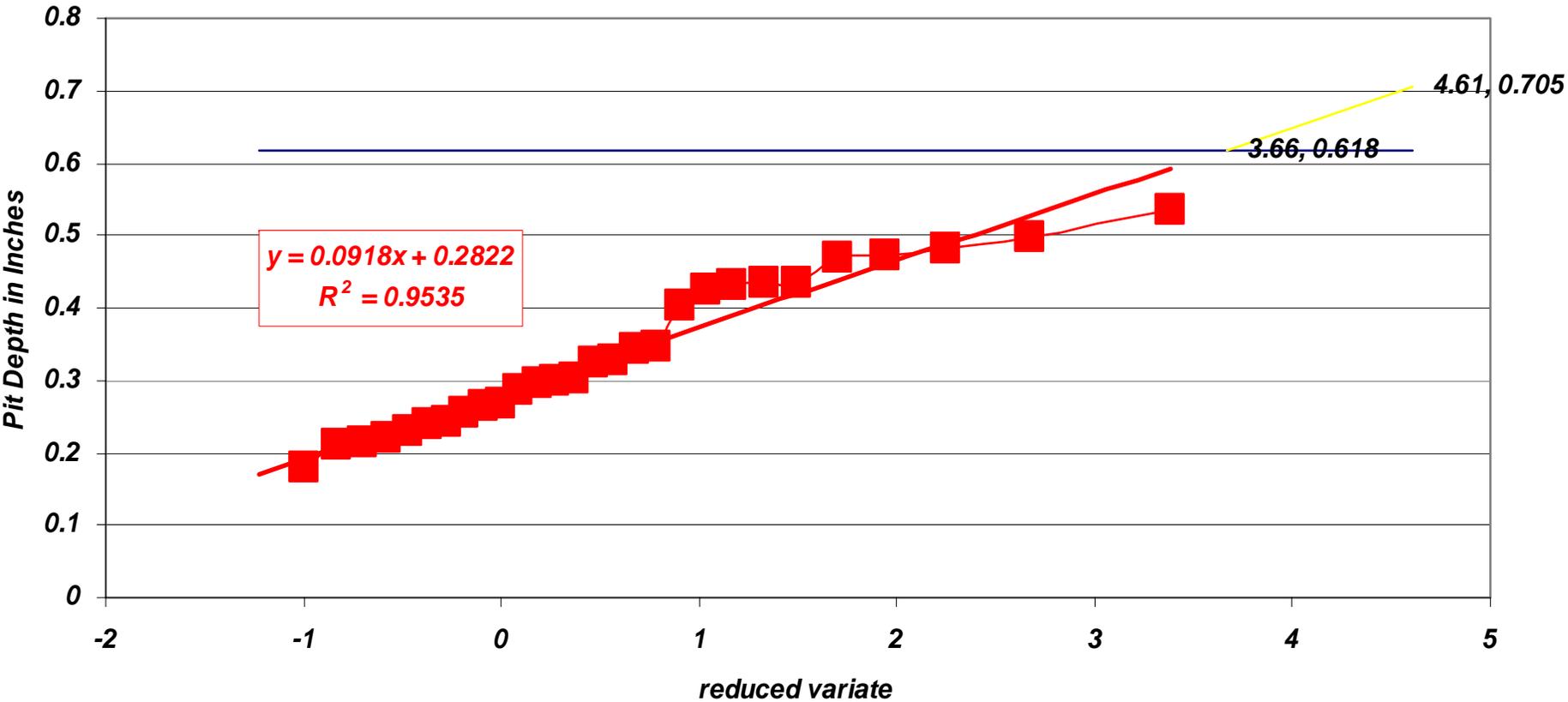
1992 External Spot Measurements Bay 13



1992 External Spot Measurements Bay 13

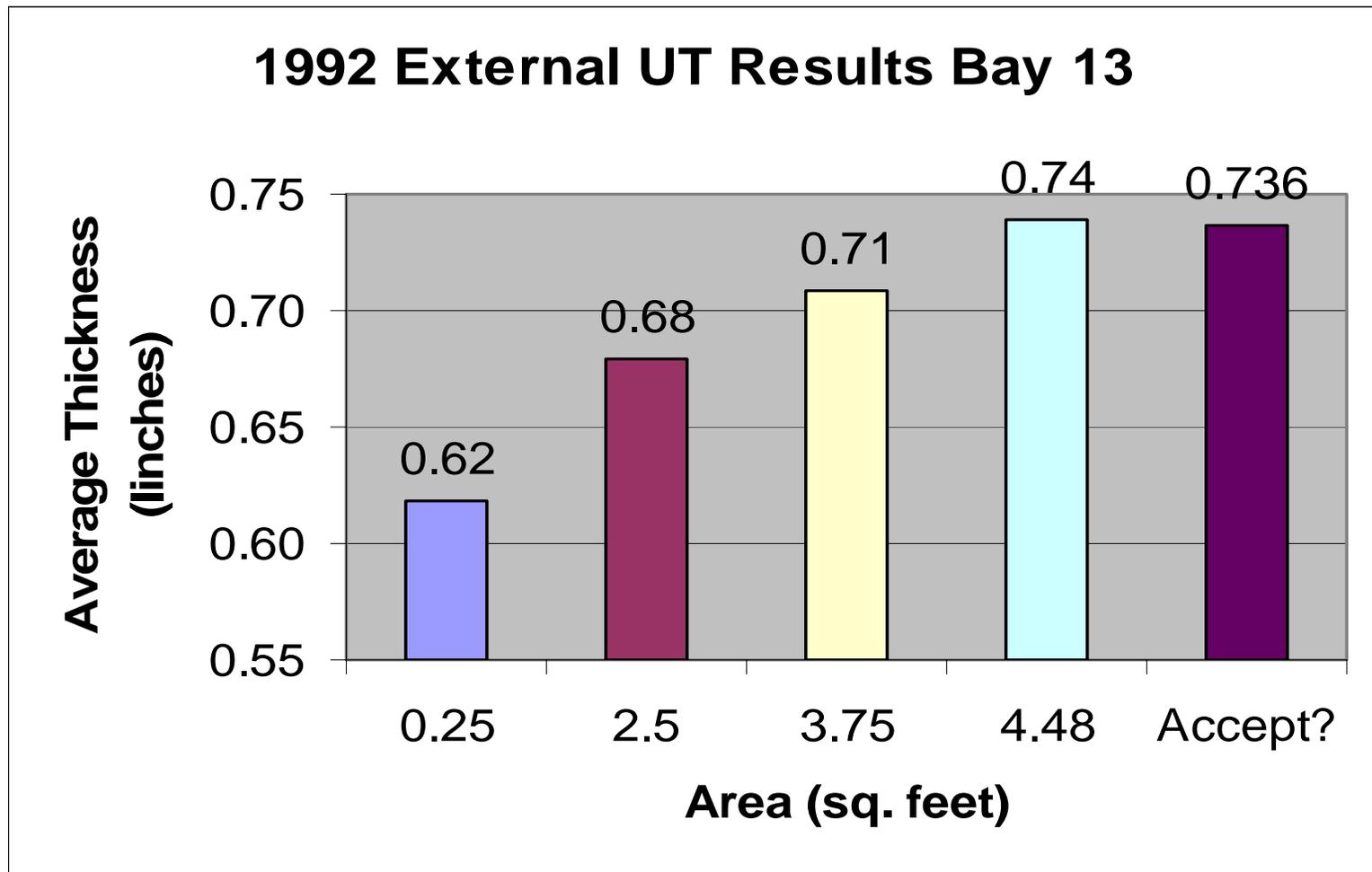


Extreme Value Statistics for 1992 Exterior UT Results in Bay 13

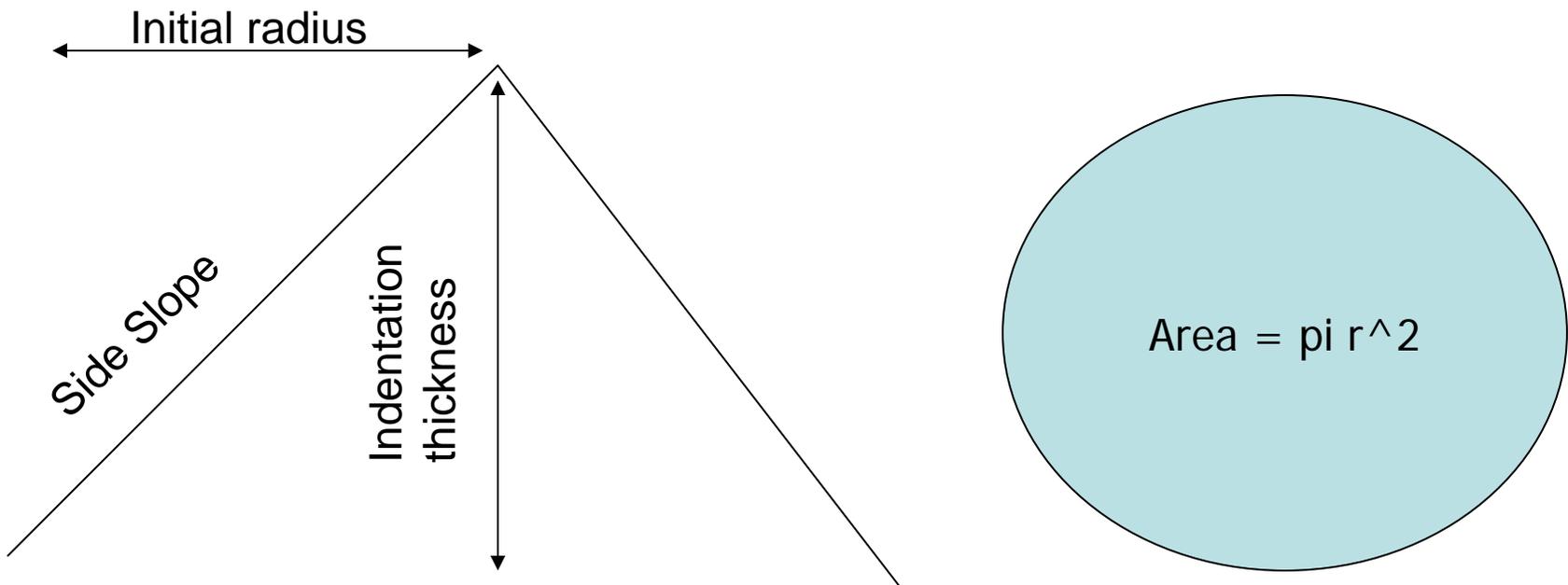


2.5% chance a single point measurement would give thickness less than 0.536"
 At 99% certainty shell thickness at each point is > 0.449 inches

Significant Thin Areas Existed in 1992

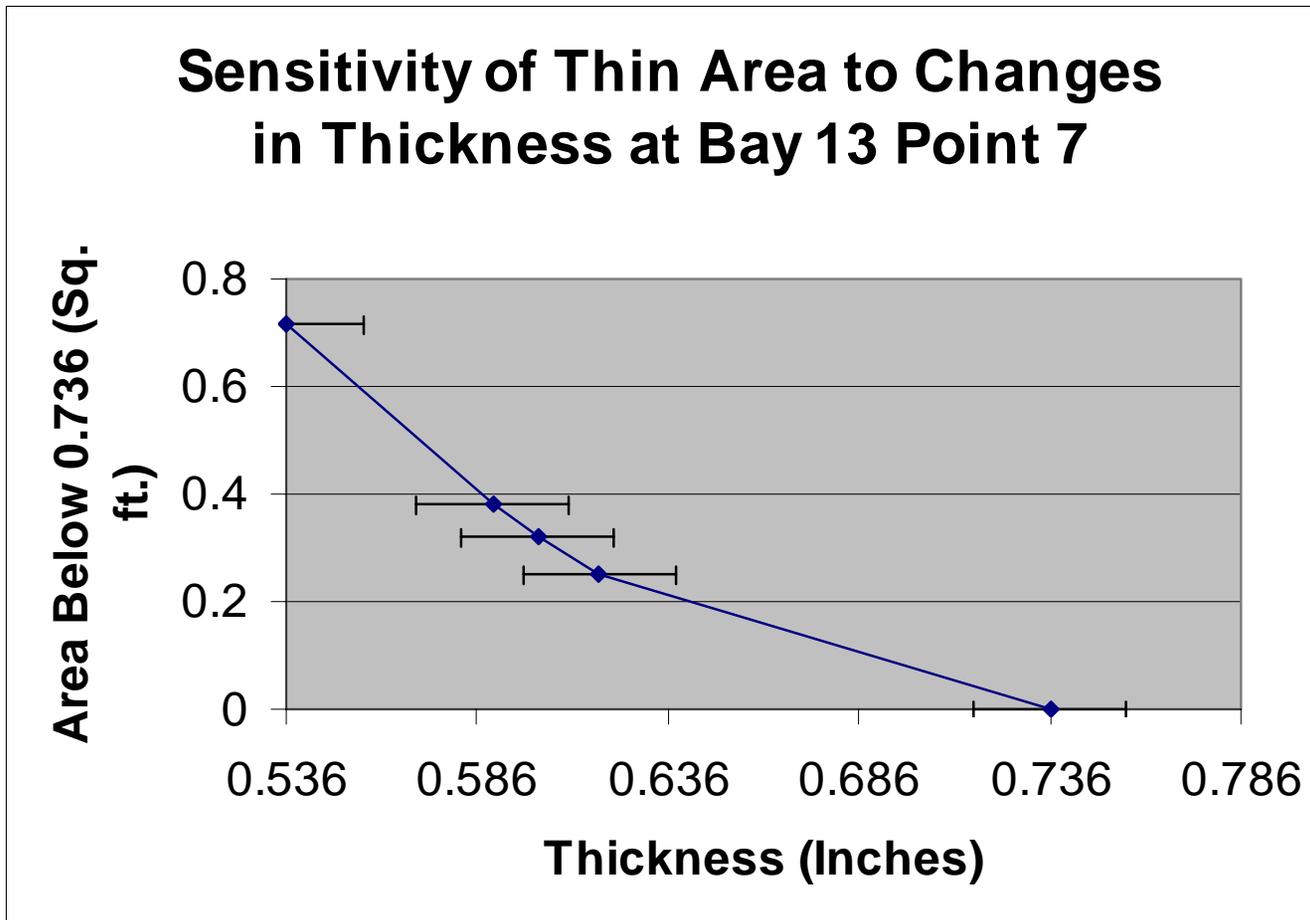


Sensitivity of Area Below 0.736 Inches to Thinning



For illustration assume constant side slope and conical shape
Use known result that Point 7 in Bay 13 has min thickness of 0.618 inches and area below 0.736 inches of 0.25 sq. ft

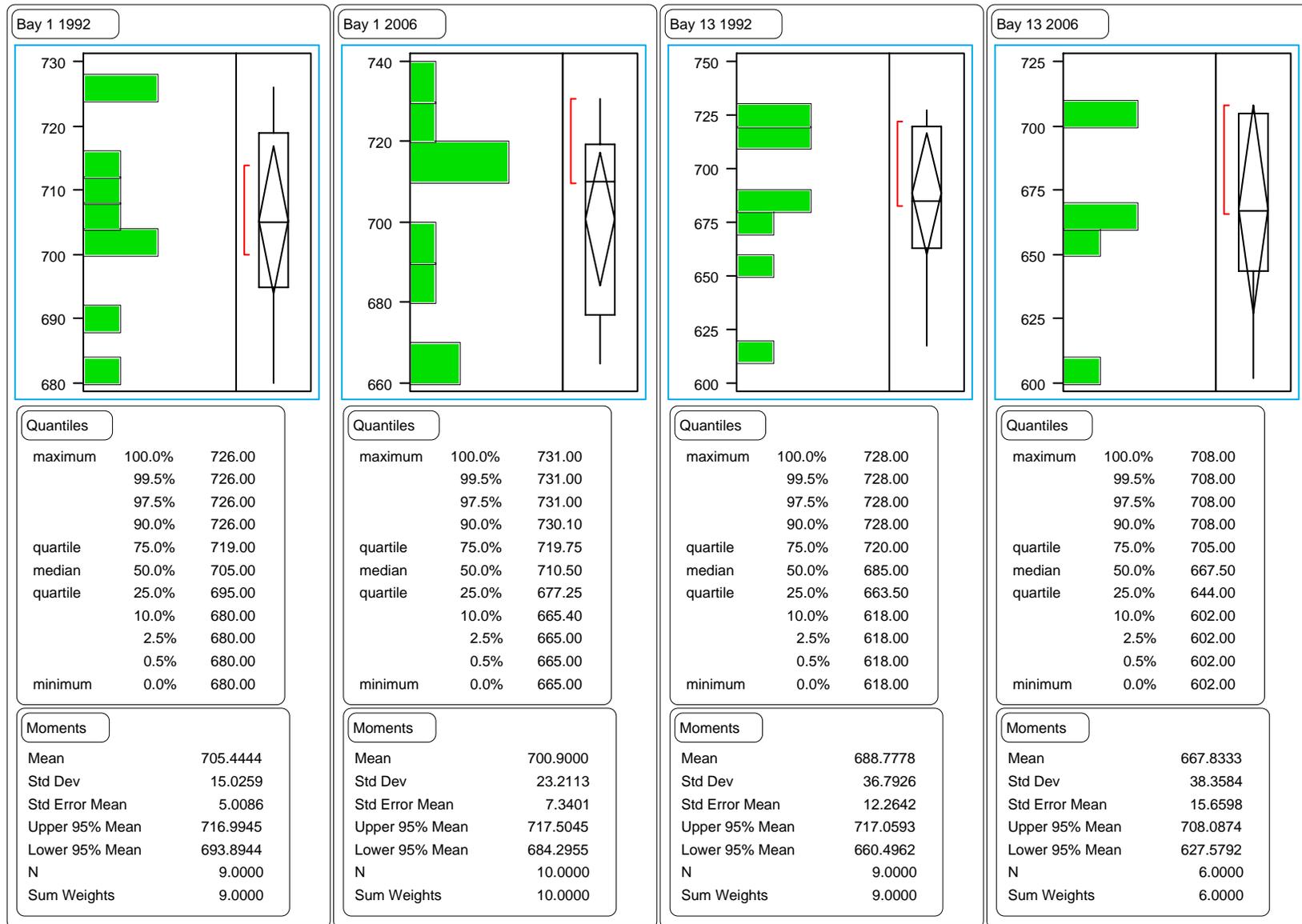
Areas of Thin Regions Are Sensitive to Corrosion



2006 External UT Results

- Incomplete results presented in an opaque way in ACRS information package
- Thinnest point measured decreased from 0.618 inches to 0.602 inches
- Results indicated general thinning of the drywell shell by up to 0.039 inches
- Likely that shell is thinner than it was in 1992
- Even 0.02 inches of corrosion would be significant because claimed margin was 0.064 inches and thin areas expand quickly with additional thinning

2006 External UT Results: Details



Possible Causes of Thinning

- Systematic measurement error in 1992 – unlikely, major concern if true
- External corrosion occurring despite the preventative measures taken – all coatings were visually inspected as satisfactory, would mean that corrosion could occur when coating is visually intact
- Internal corrosion – water inside the drywell identified as a normal operating condition in October 2006
- Cause of thinning is probably corrosion

No Margin Left

- Instead of using area acceptance criterion, Exelon has applied point acceptance for exterior measurements without justification
- If area acceptance criterion were applied to external and internal results, the drywell failed in 1992 – worst 0.25 sq ft area measured externally had average thickness of around 0.62 inches, 0.12 inches under 0.736
- Margin failure has increased by around 0.02 inches since 1992, so worst 0.25 sq ft is now around 0.6 inches thick
- If adjust grid criterion to 0.844 inches, 4 of 12 grids fail significantly, and margin is insignificant for 2 others
- Now have no valid acceptance criteria except for 0.844 inches

Operator Approach To Margin

- 1992 average thickness of Bay 13 estimated at 0.800 inches – not clear how
- Margin was assessed as 0.064 inches by comparing to 0.736 inches uniform thickness prediction
- Bay 13 is now around 0.02 inches thinner
- NRC documents confirm operator also needs to track extent of corroded areas e.g. April 4, 1992 - “In order to consider the corroded area as a discontinuity in NE-3213.10 the extent of the reduction in thickness due to corrosion should be known”
- Sandi cautioned area measured is “limited” and “in many cases, the raw data was not available”²³

Operator Cannot Show Margin

- Sandia Model shows a uniform symmetric sandbed at thickness 0.844 inches exactly conforms to code requirements
- Corrosion in Bays 1, 9, 11 and 13 is widespread, are many points thinner than 0.844 inches
- 4 Grids in Bays 11, 17, and 19 show average thinner than 0.844 inches
- In Bay 13, best estimate is that area with average thickness thinner than 0.736 inches is around 4 sq. ft.
- Area thinner than 0.736 inches has probably expanded since 1992
- High degree of uncertainty about the nature of the corroded surface

Operator Cannot Maintain Margin

- Even if margin is 0.04 inches, can't rely on visual inspection – could have concealed exterior corrosion or interior corrosion
- Worst sand bed exterior corrosion rate was 0.04 inches/year
- Worst case interior corrosion rate unknown
- Individual measurements have at least 0.02 inches random error, additional location error, and possible additional systematic error

E-mail from Ryan to Polaski, dated October 10, 2006

- “The equipment used in the past to perform ‘randomly selected’ locations did not function worth a ‘sh_t’, or it didn’t perform to expectation
- “Because the locations were not ‘stamped or date match marked,’ it wouldn’t be possible to provide accurate follow up inspections”
- “If you wanted to perform baseline inspections now”

Embedded Region

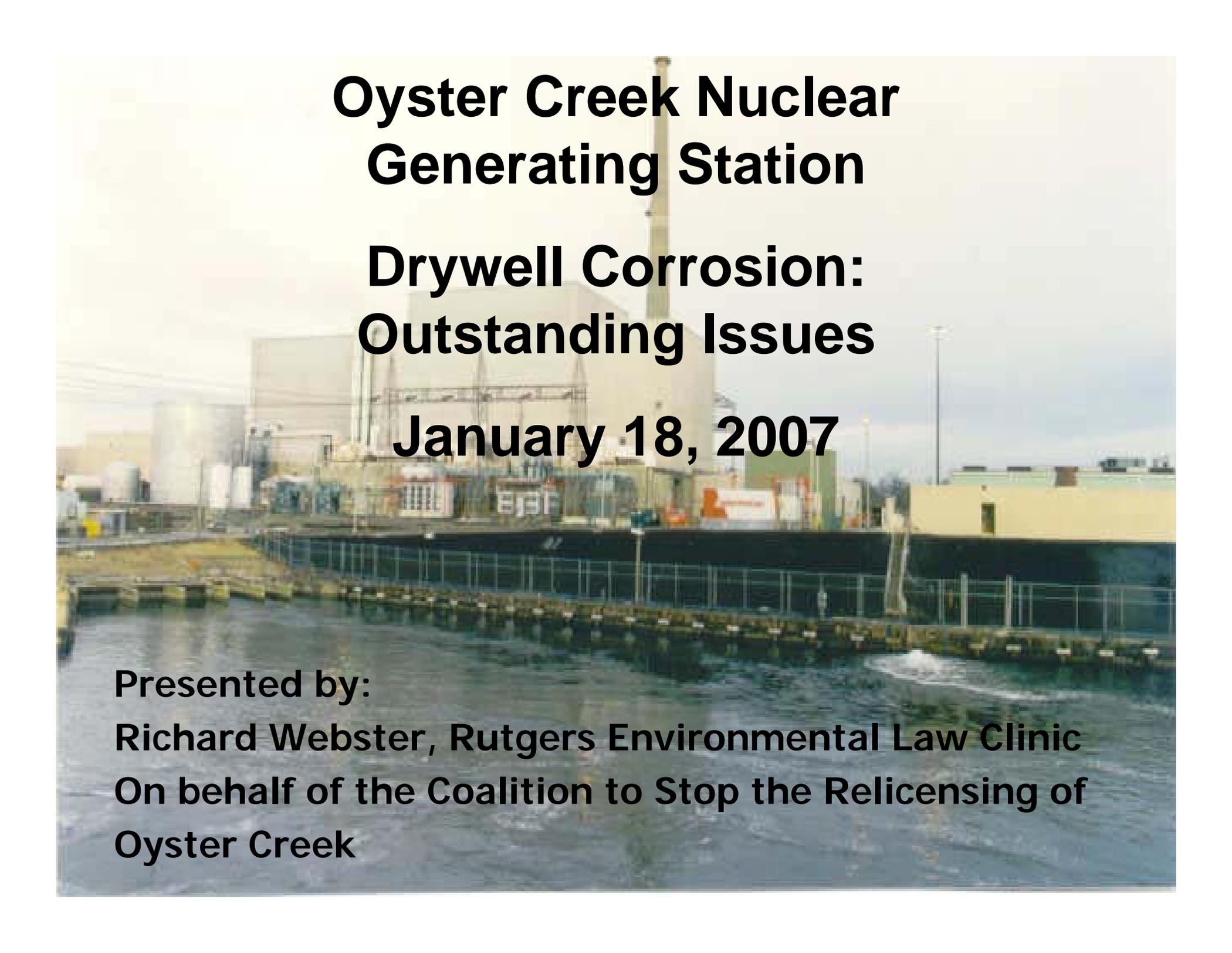
- Sandbed floor damaged when sand was removed
- Floor repaired with epoxy in 1992
- “Since 1996 inspections have found indications of epoxy separating from concrete” and “the separate seams could potentially allow some water to get under the epoxy coating repair” – AmerGen October 25, 2006
- Separation “could be caused by concrete swelling”
- Bottom of drywell is below the groundwater table
- Embedded region corrosion observed at Beaver Valley
- Drilled holes in interior concrete floor at Dresden to take UT measurements
- SER – could get a semi-quantitative assessment using guided wave technology

Embedded Region Measurements

- First measurements taken in Bay 5 in Oct. 2006
- Grid of 42 measurements showed loss in thickness of 0.041 inches
- Corrosion in the embedded region has occurred
- Corrosion in Bay 5 is not bounding - Bay 5 was one of the least corroded bays in the sandbed region
- Shows need for measurement in most corroded bays and for monitoring of conditions in the embedded region
- No assurance of margin at present

Conclusion

- Margin in the sandbed region ranges from 0.04 inches to less than zero
- There is a significant probability that there is no current margin in the sandbed region
- Err on the side of caution – safety at stake and Exelon has created uncertainty by failing to monitor adequately
- Even if margin is 0.04 inches, it is too small to maintain because of uncertainty in measurements and corrosion rates
- Margin in embedded region is unknown



Oyster Creek Nuclear Generating Station

Drywell Corrosion: Outstanding Issues

January 18, 2007

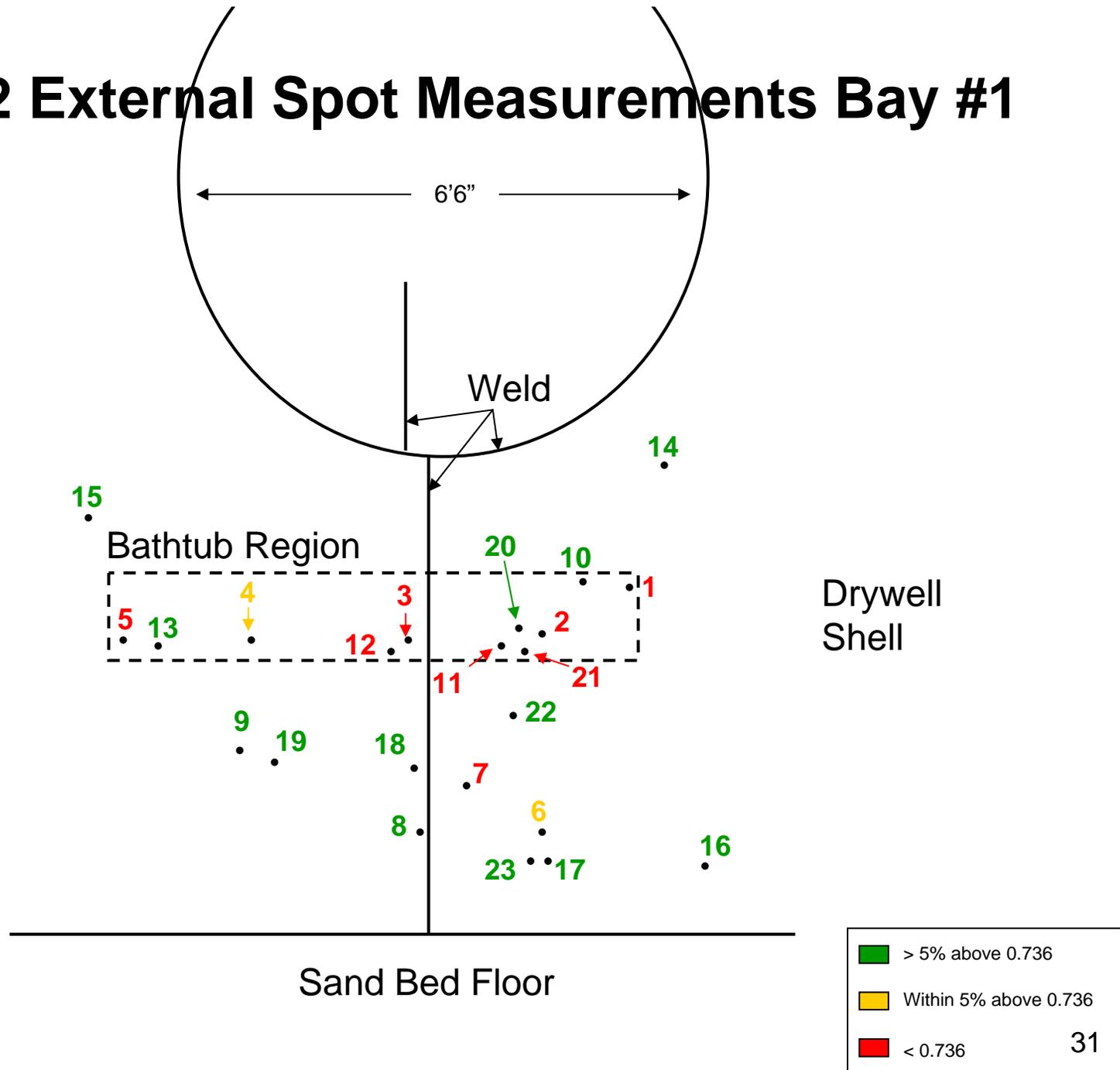
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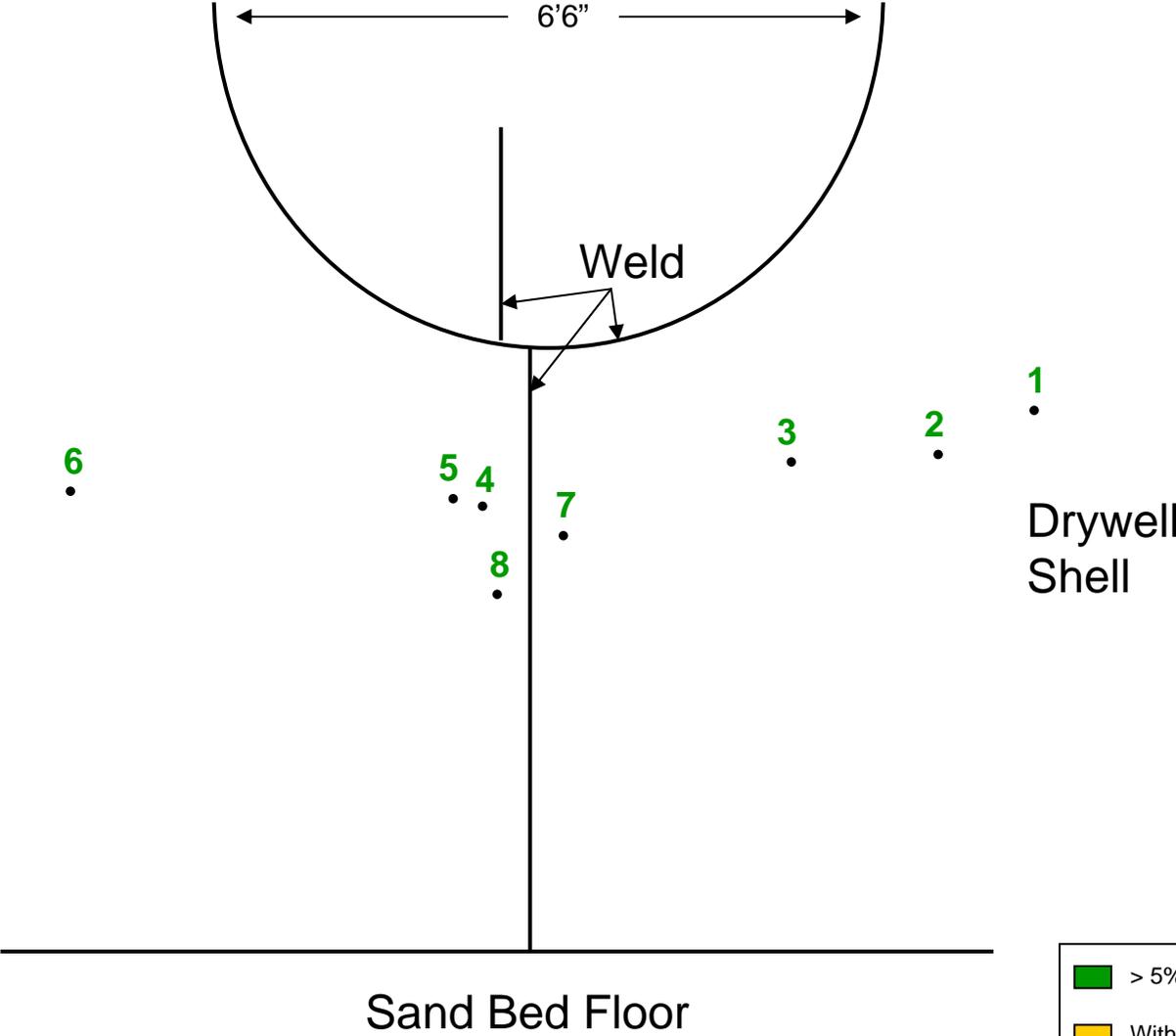
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1992 External Spot Measurements Bay #1

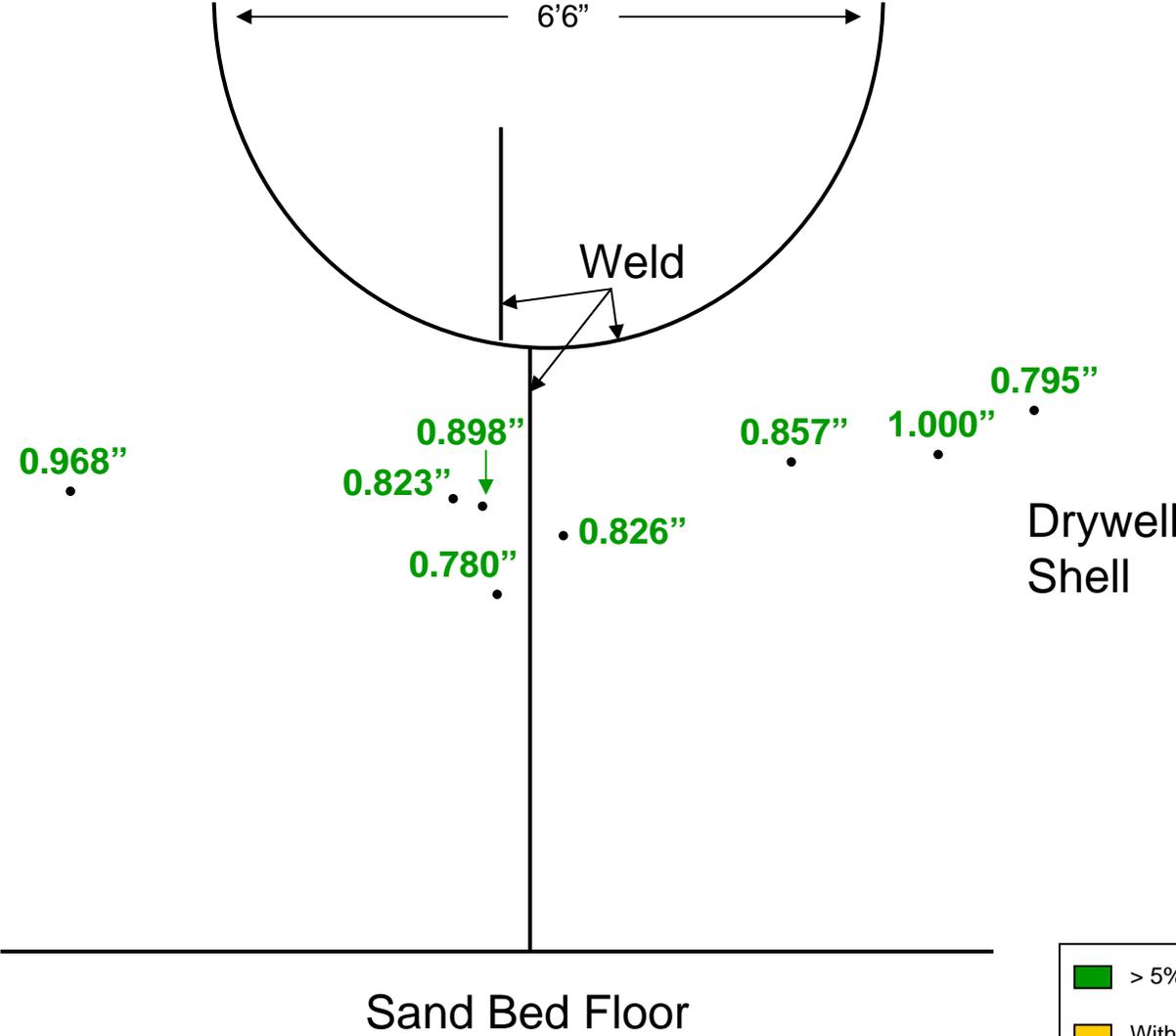


BAY #3 DATA



■	> 5% above 0.736	
■	Within 5% above 0.736	
■	< 0.736	32

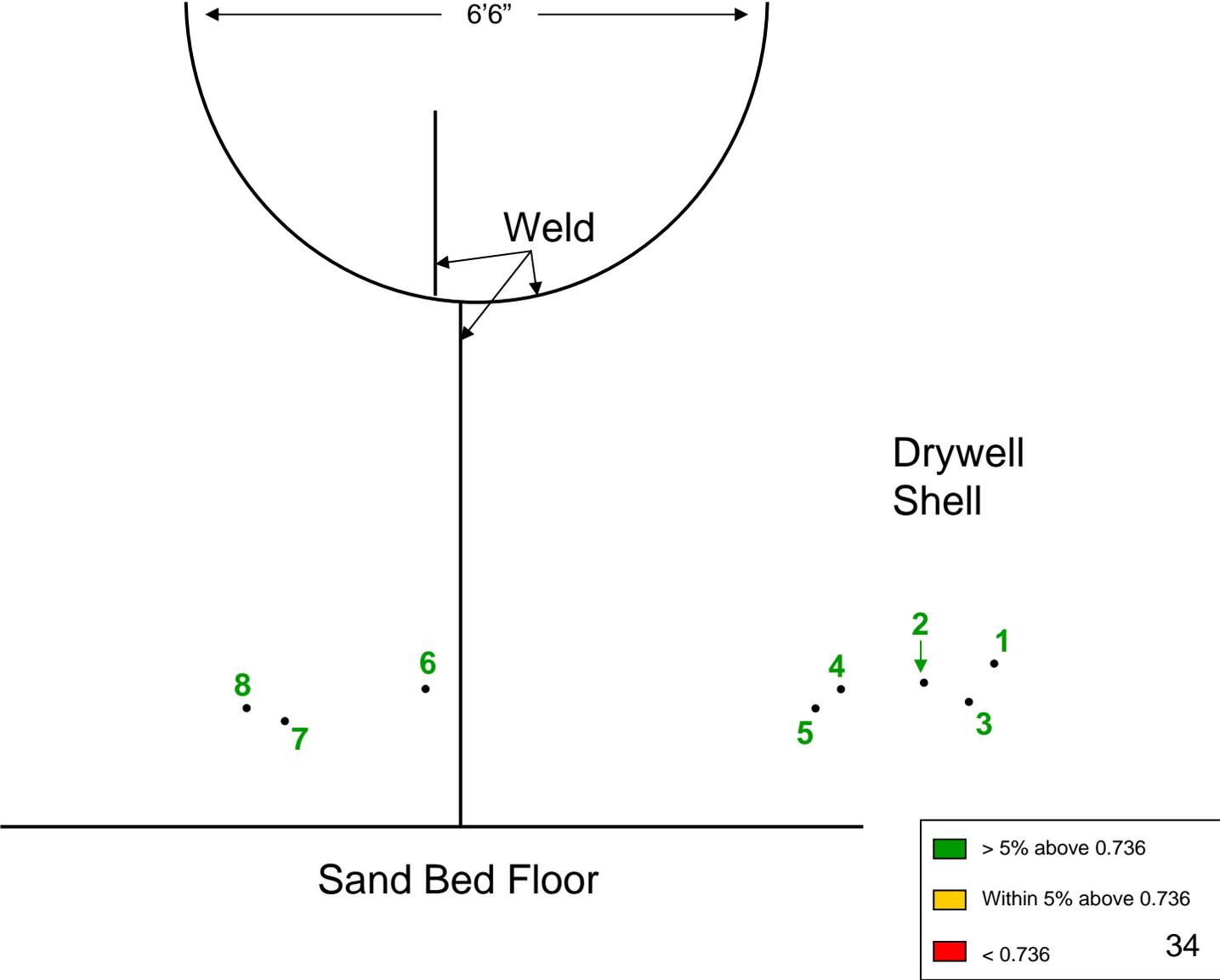
BAY #3 DATA



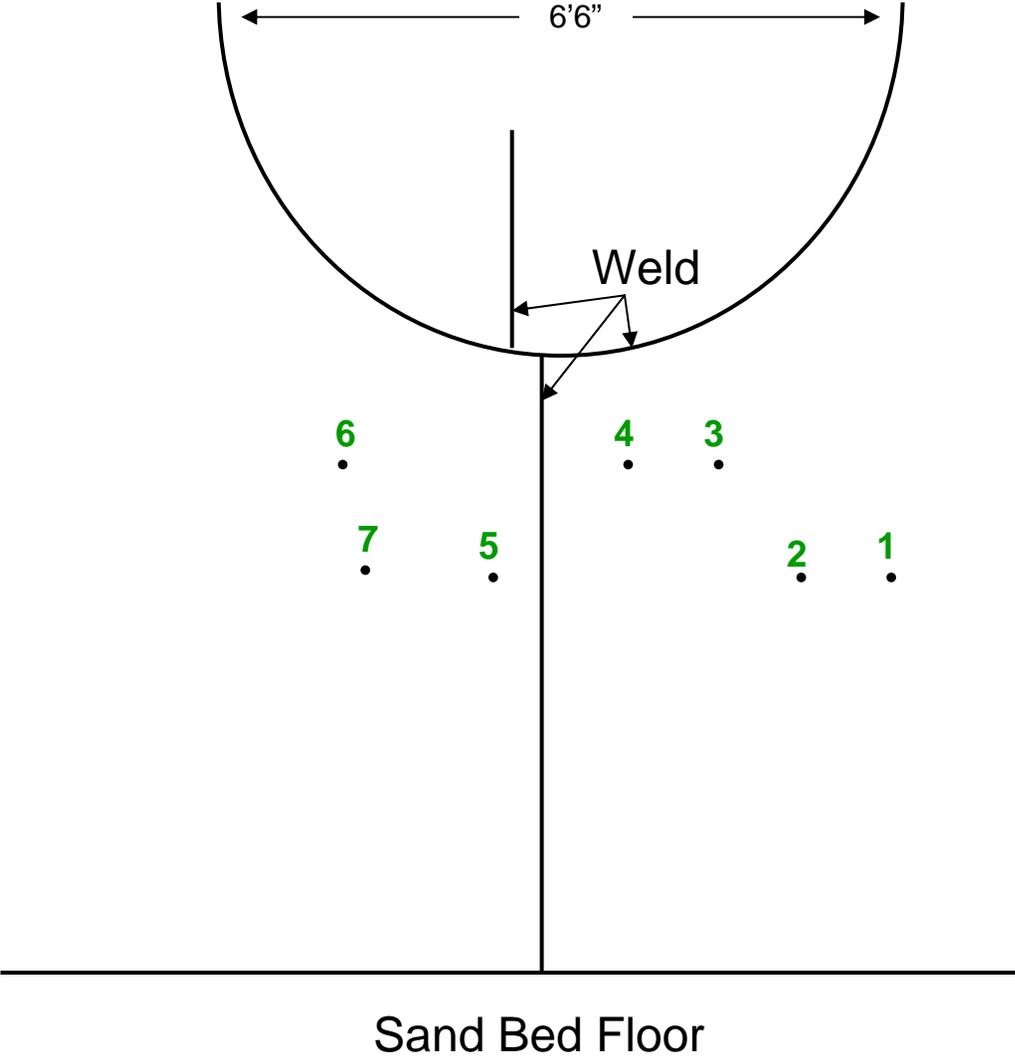
■	> 5% above 0.736
■	Within 5% above 0.736
■	< 0.736

33

BAY #5 DATA



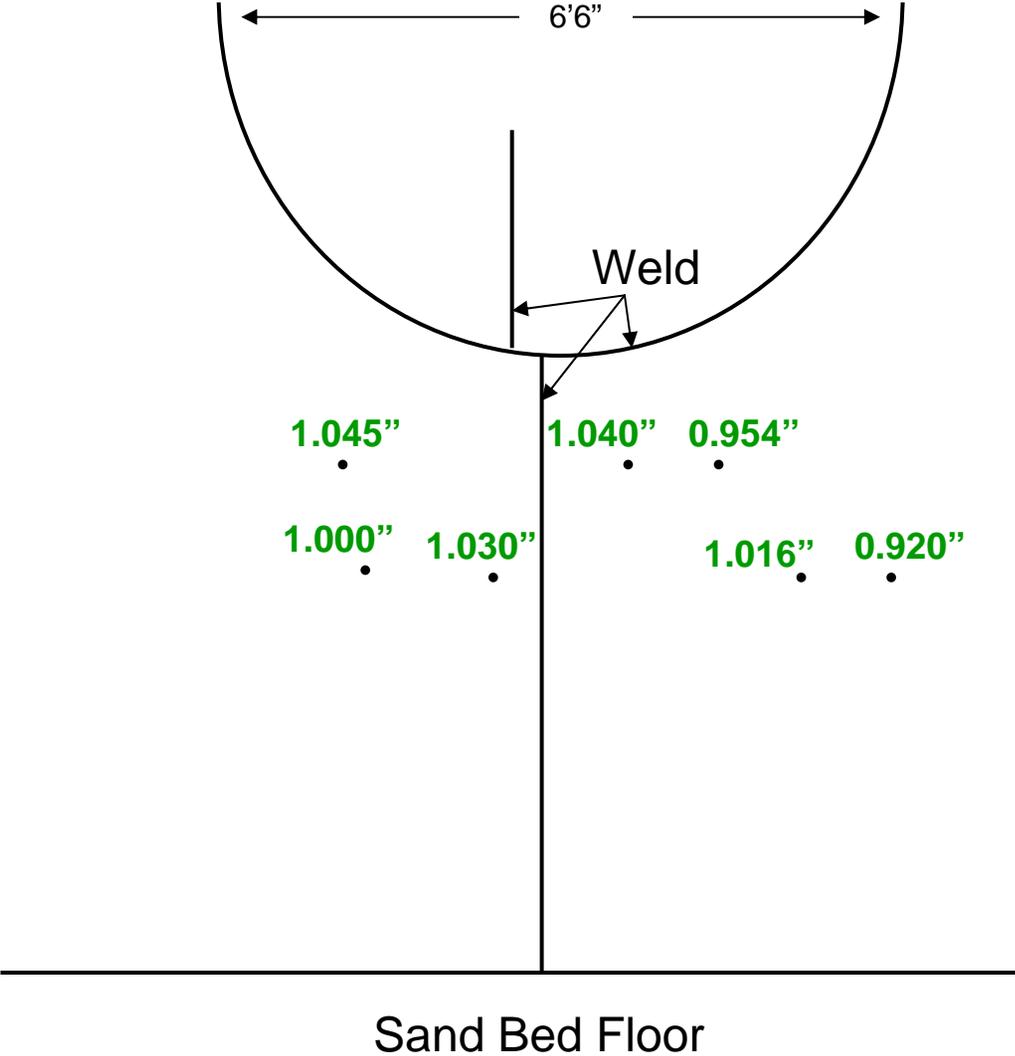
BAY #7 DATA



Drywell
Shell

■	> 5% above 0.736	
■	Within 5% above 0.736	
■	< 0.736	35

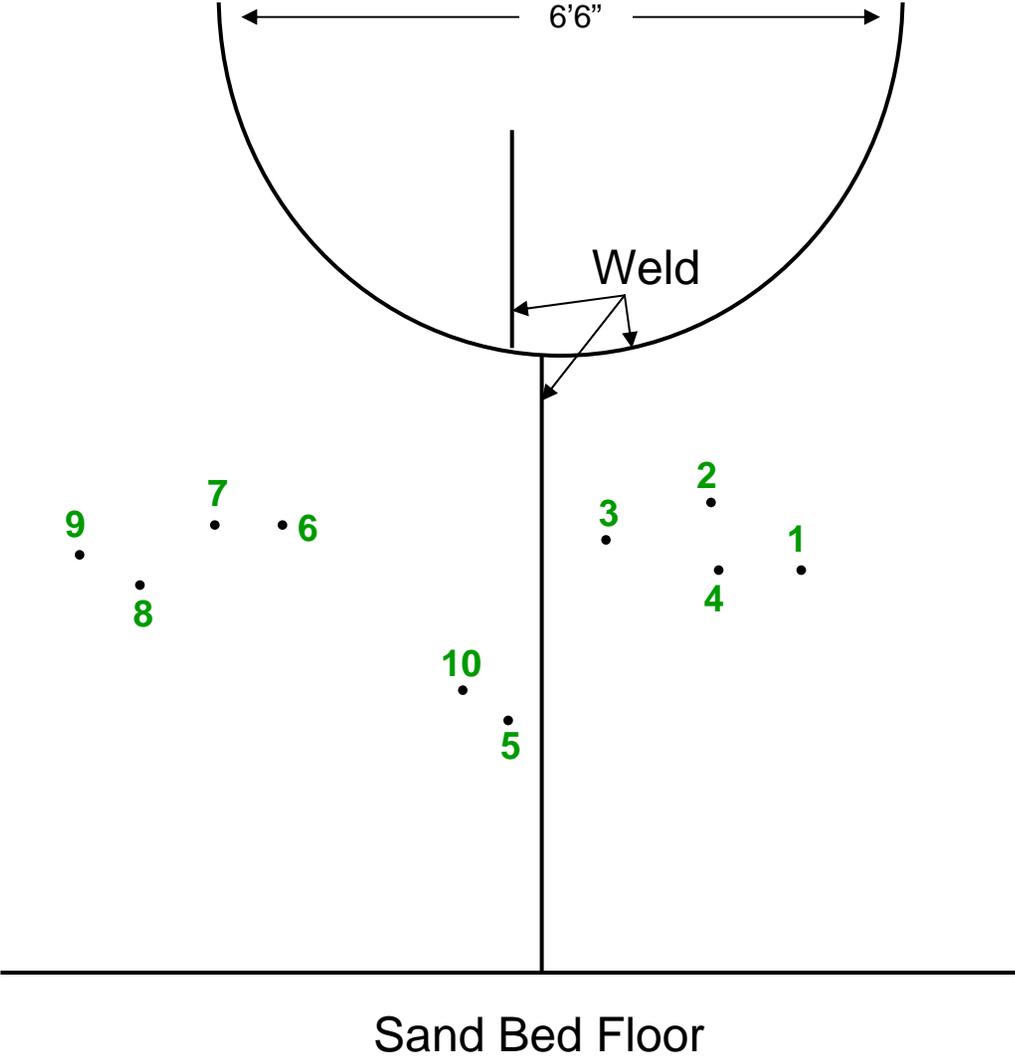
BAY #7 DATA



Drywell
Shell

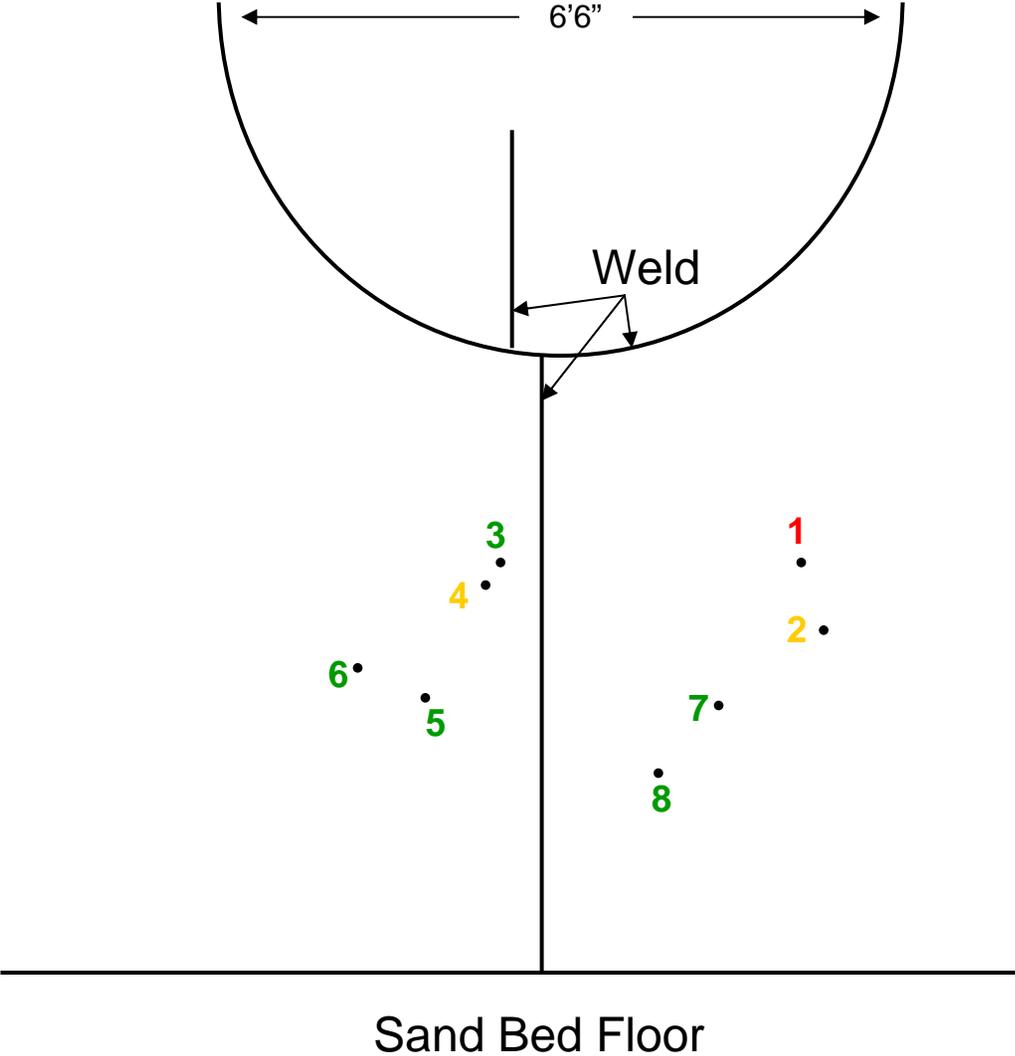
■	> 5% above 0.736	
■	Within 5% above 0.736	
■	< 0.736	36

BAY #9 DATA



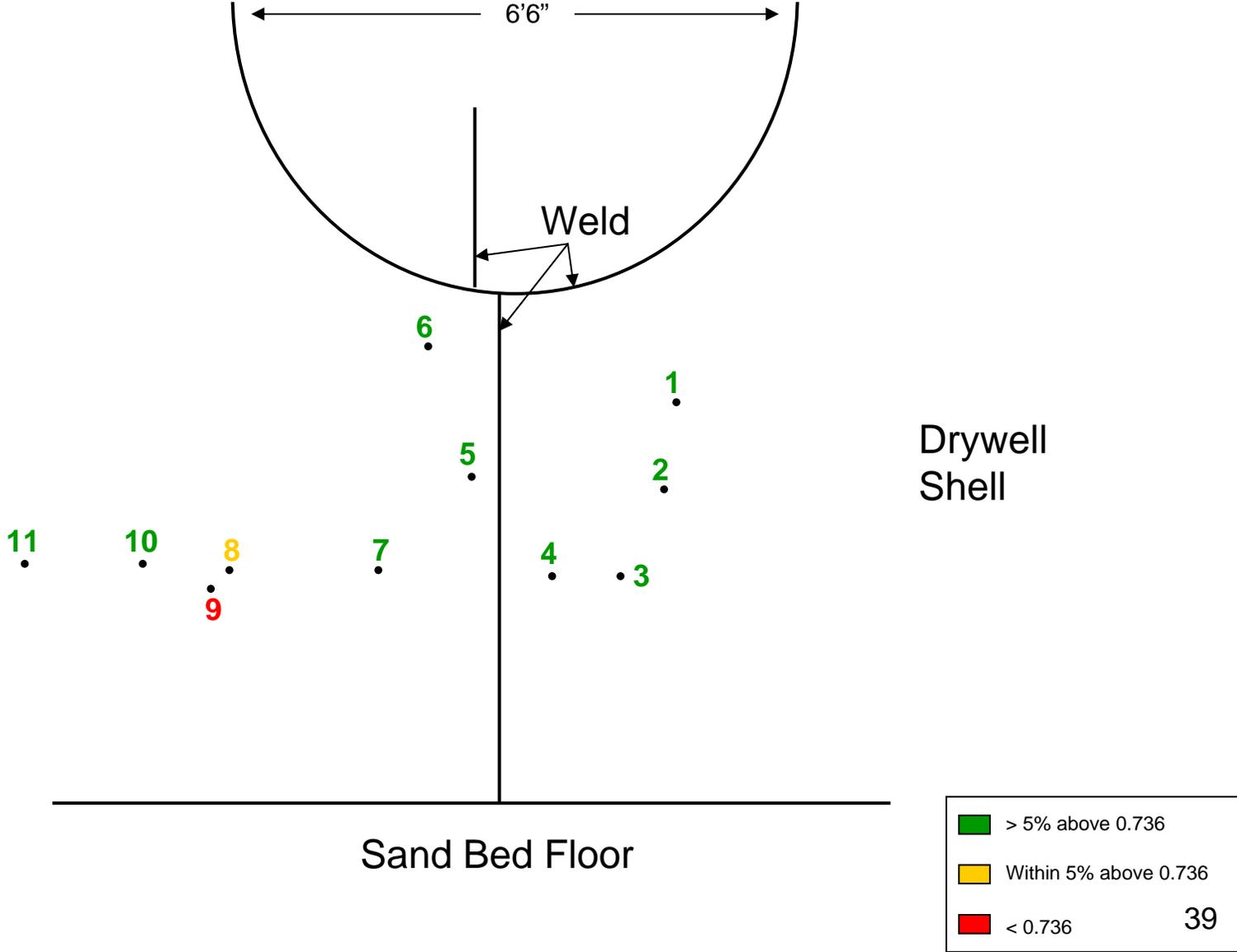
■	> 5% above 0.736	
■	Within 5% above 0.736	
■	< 0.736	37

BAY #11 DATA

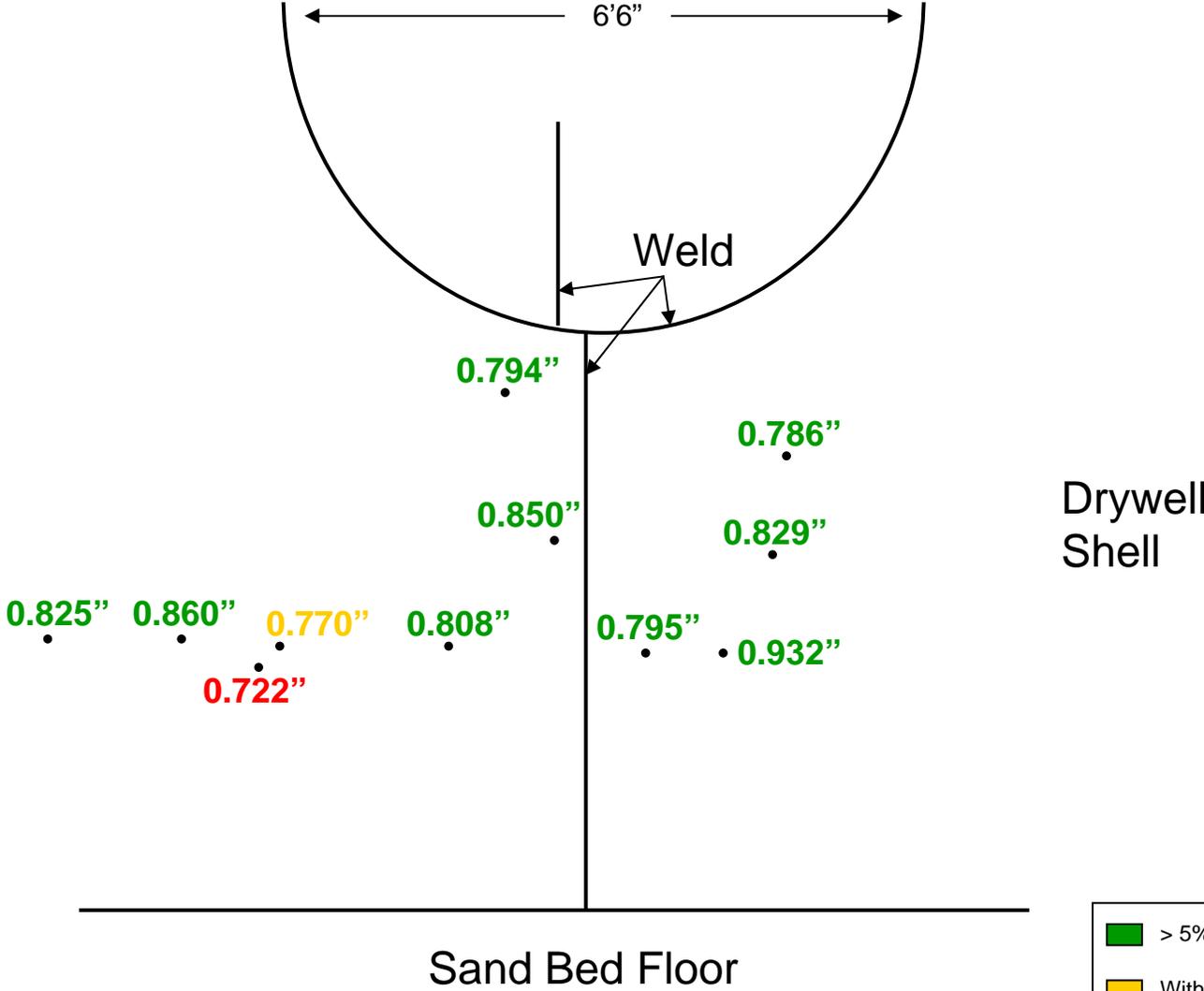


■	> 5% above 0.736	
■	Within 5% above 0.736	
■	< 0.736	38

BAY #15 DATA

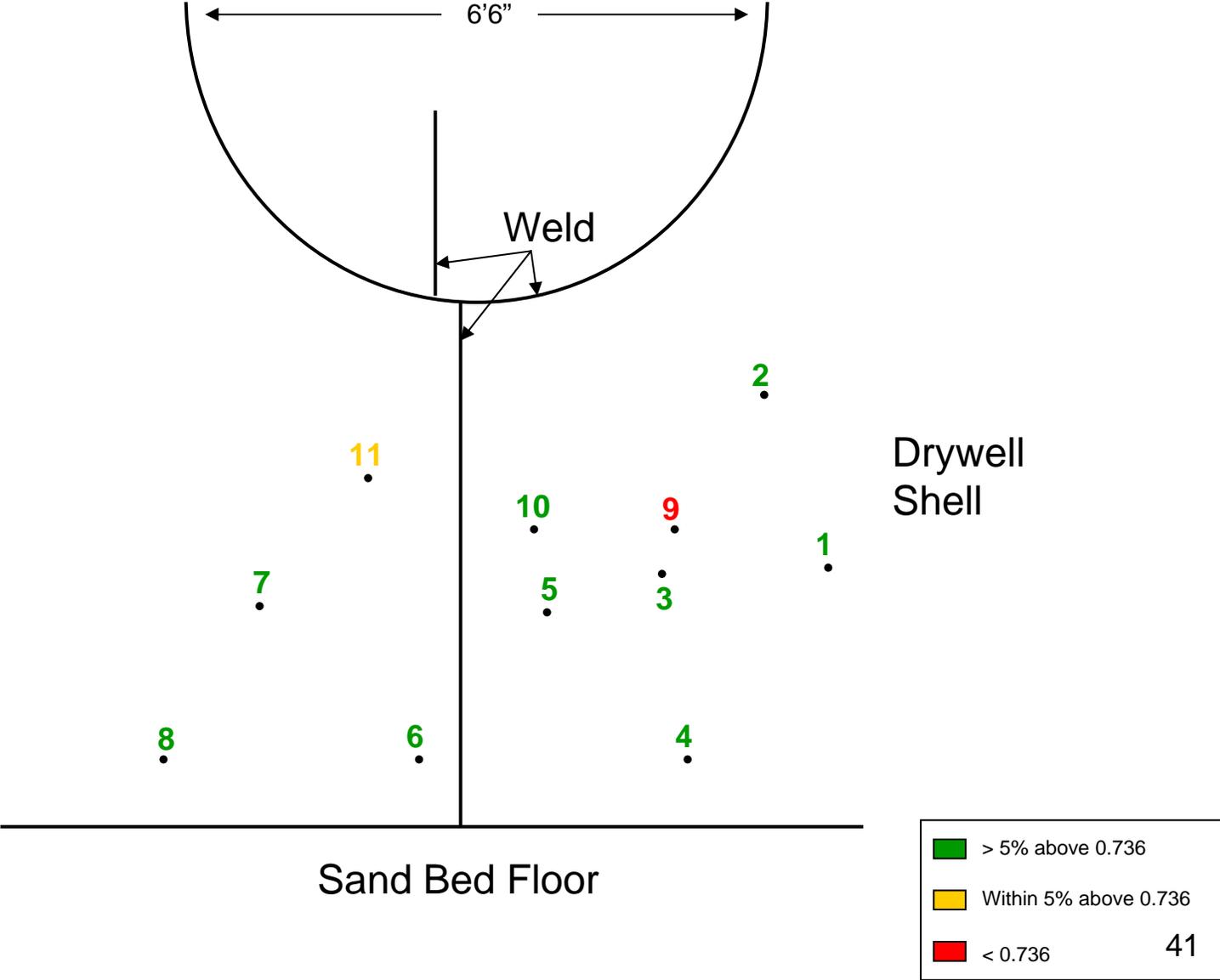


BAY #15 DATA

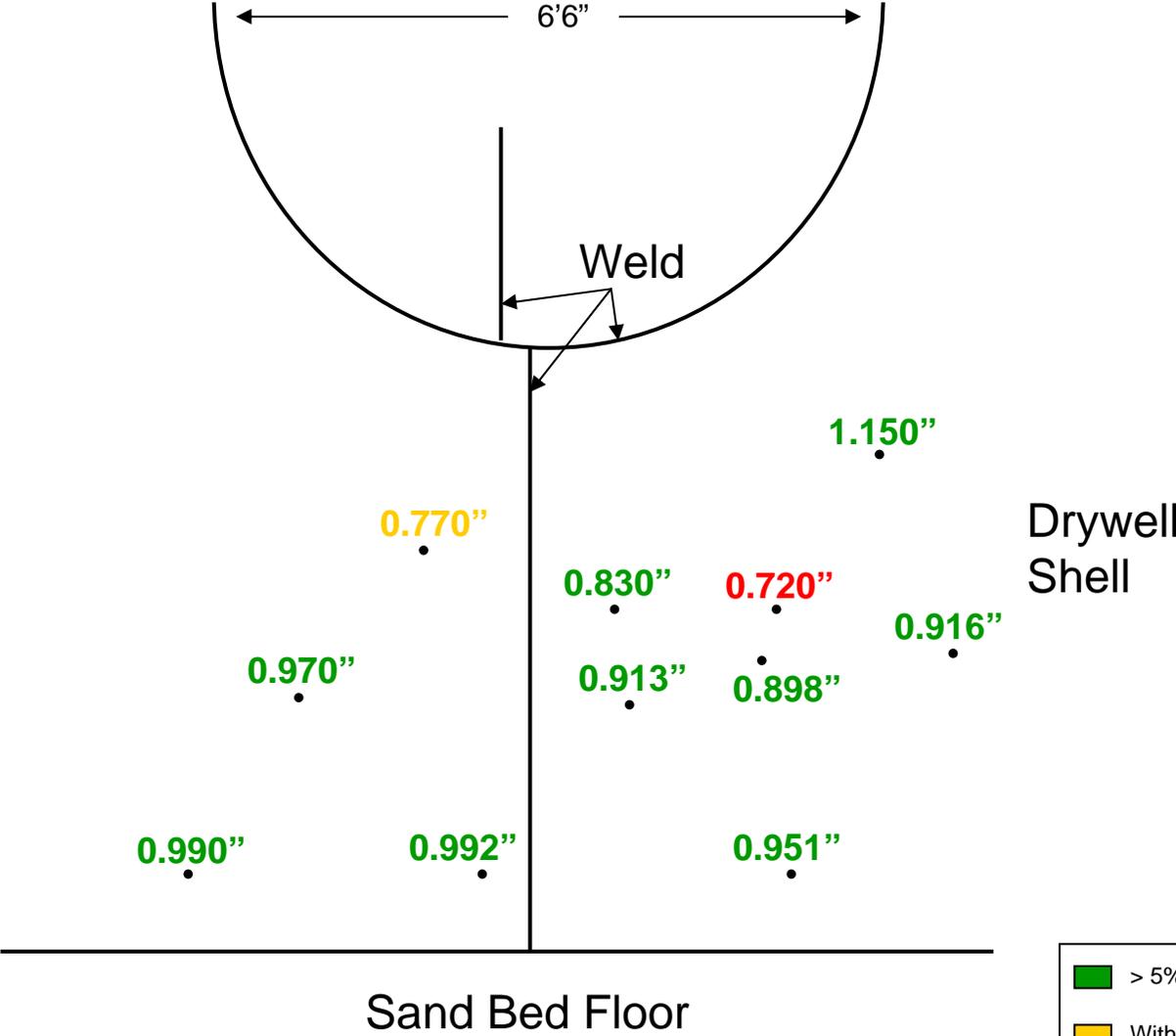


	> 5% above 0.736	
	Within 5% above 0.736	
	< 0.736	40

BAY #17 DATA

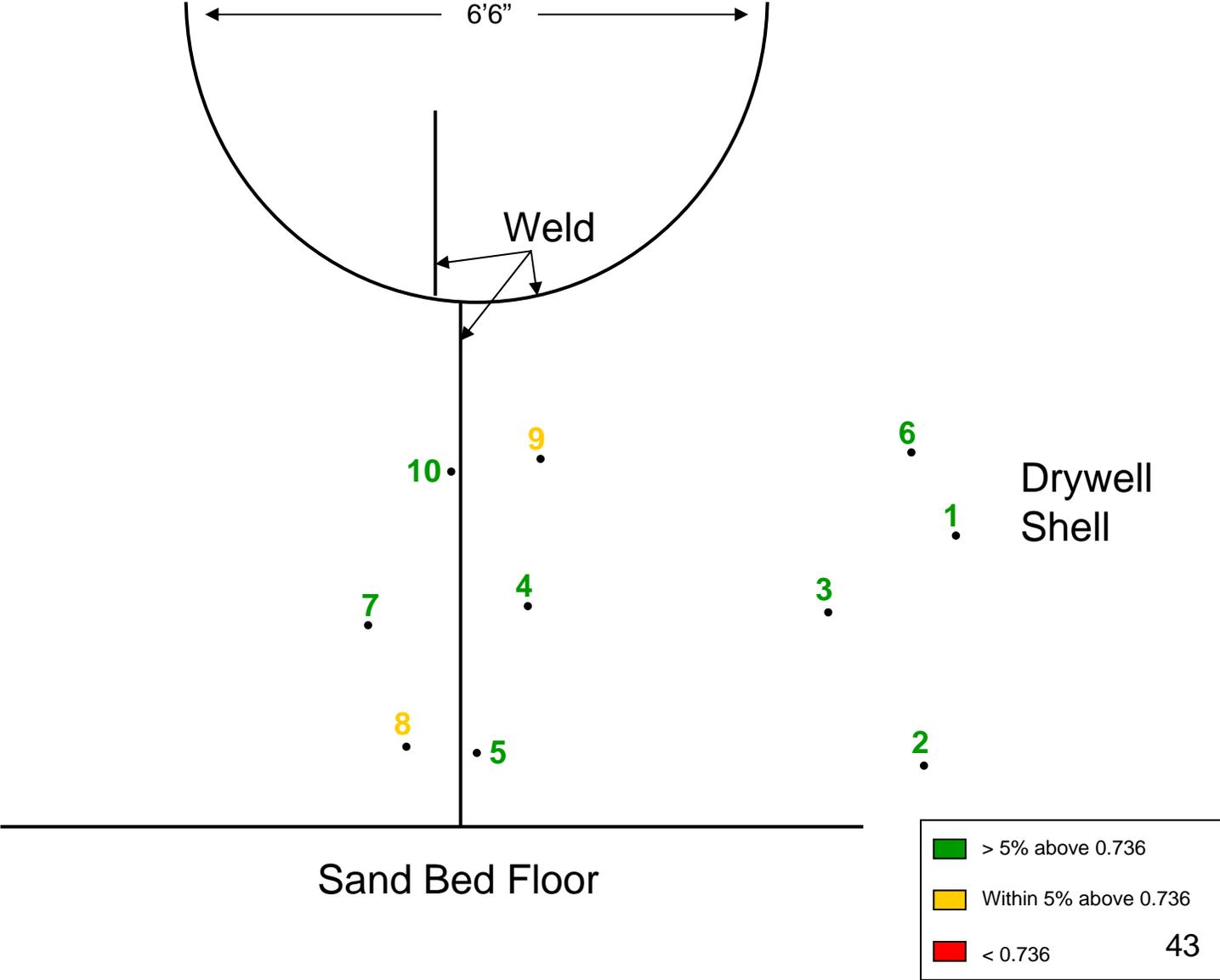


BAY #17 DATA



Green	> 5% above 0.736
Yellow	Within 5% above 0.736
Red	< 0.736
42	

BAY #19 DATA



BAY #19 DATA

