Methodology for Evaluating Sites for Community Wastewater Systems

NOWRA 2024 Onsite Wastewater

Mega Conference

By

Gary S. MacConnell, P.E.

MacCONNELL
& Associates, P. C.

501 Cascade Pointe Lane, Suite 103
Cary, North Carolina 27513
Tel: (919) 467-1239

“The comments and opinions made in this presentation are those of the presenter and not of NOWRA or the Mega-Conference sponsors”

I've been doing a lot of thinking!

Presentation Overview

- Why On-Site Community System.
- Overview of Onsite Wastewater Collection System Options.
- Overview of Onsite Wastewater Treatment System Options.
- Overview of Onsite Disposal/Reuse System Options.
- Model/Methodology to Optimize Design (PPPPPP).
- Case Studies

Why On-Site Community System

- POTW is not available.
- Often preferred over individual on-site systems.
- Allows for concentrated development (cluster, conservation, etc.) .
- Maximizes open or natural areas.
- Environmentally friendly (groundwater recharge, irrigation of natural or landscaped areas, other).

On-Site Collection Systems

- Gravity lines with manholes/cleanouts.
- Pump stations with forcemains.
- Pressure (pump stations).
- Vacuum.
- Septic tank effluent pump (STEP).
- Septic tank effluent gravity (STEG).

On-Site Treatment Systems

- Soil based with disposal (septic).
- Aerobic treatment units (ATU).
- Activated sludge (MBR, BNR, SBR, MBBR, Etc.).
- Recirculating media filters (synthetic or natural).

On-Site Disposal/Reuse Systems

- Soil based with disposal.
- Septic systems.
- Aerobic treatment units (ATU).
- Activated sludge (MBR, BNR, SBR, MBBR, Etc.).
- Recirculating media filters (synthetic or natural).

On-Site Disposal/Reuse Systems

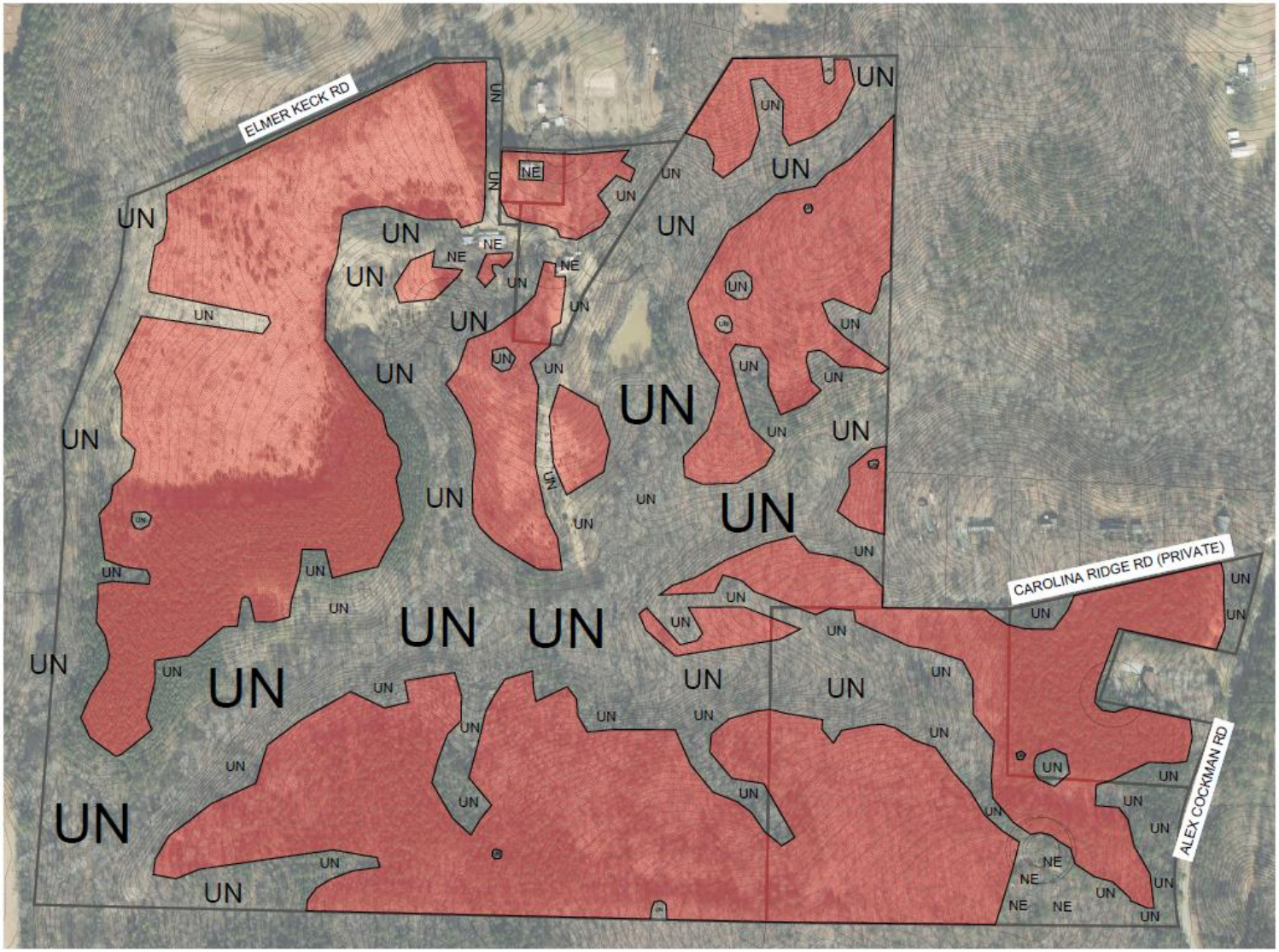
- Gravity (stone, chamber, synthetic, enhanced treatment).
- Low pressure pipe (LPP).
- Pressure manifold.
- Drip (surface and subsurface).
- Spray.
- Non-potable reuse (flushing toilets, construction, agriculture, etc.).

Steps in Planning a Community System "PPPPPPP"

- Get "Preliminary Soils Report" of property (defines capacity of site).
- Delineate wetlands, existing wells, features, etc.
- Get preliminary well site approval and drill well.
- Layout concept plan with respect to soils, wells, buffers, setbacks, zoning, etc.
- Financial Analysis.
- Do design and permitting.
- Construction.

Proposed Site #1

Total Area:	161.80 Acres
Riparian Buffers:	30.45 Acres
Net Site Area:	131.35 Acres
Zoning:	R-1
Water:	Public
Wastewater:	On-Site


ELMER KECK RD
CAROLINA RIDGE RD (PRIVATE)
ALEX COCKMAN RD
UN
NE
GRAPHIC SCALE
1" = 100'
LEGEND
UN
NE

Individual On-Site Concept Plan

Minimum Lot Area:	40,000 SQ. FT.
Minimum Lot Width:	100 FT.
Minimum Front Setback:	40 FT.
Minimum Side Setback:	25 FT.
Minimum Rear Setback:	25 FT.
Minimum Height:	60 FT.
Total Units:	84 Units
Net Density:	0.52 Units/Acre

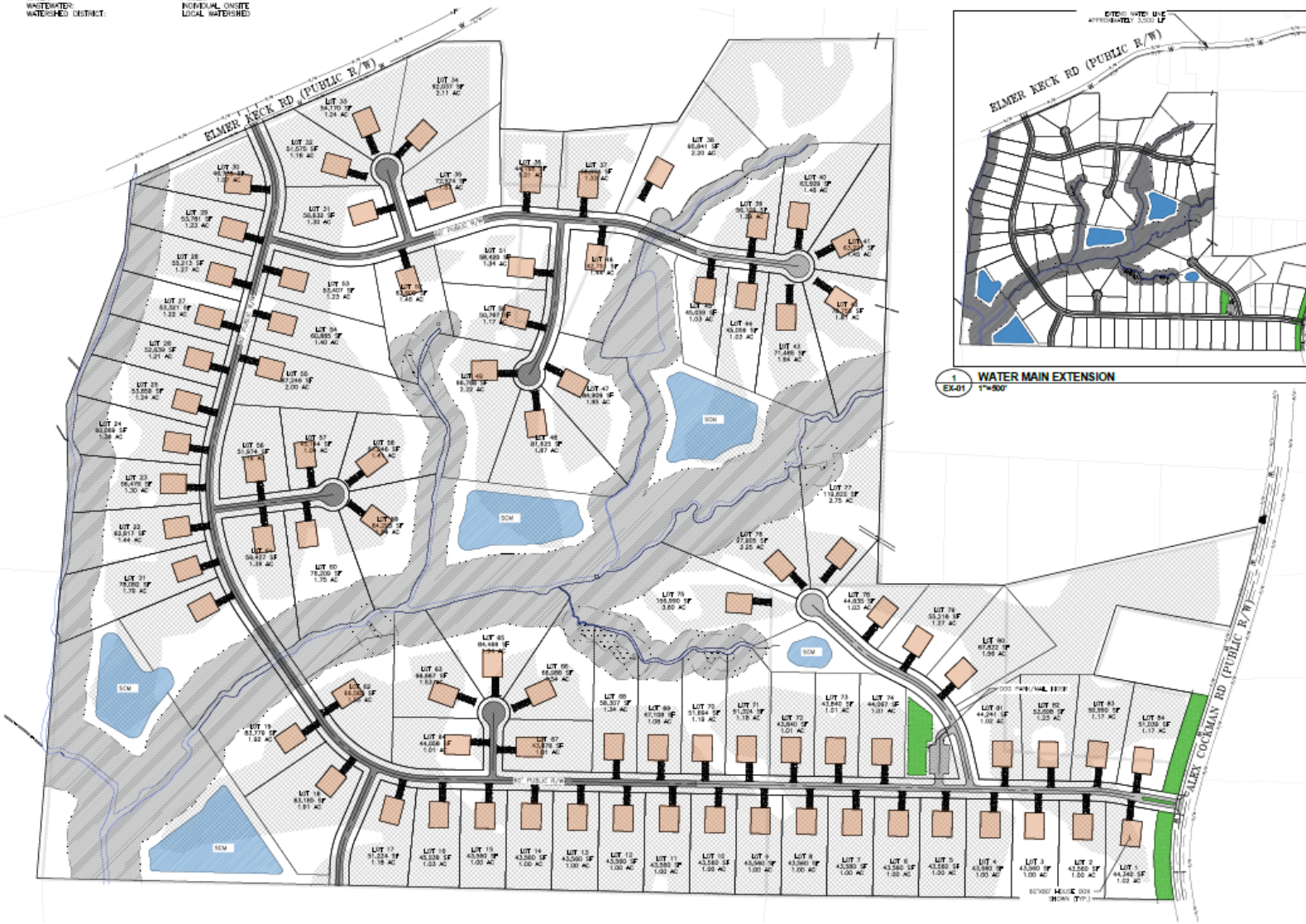
On-Site System on Each Lot with Some Off-Site/Flag Lots.

SITE DATA SUMMARY

PARCEL NO.(S):	12278; 68108; 81567
ZONING:	R-1
TOTAL SITE AREA:	161.8 AC
DEVELOPMENT TYPE:	SINGLE-FAMILY
MINIMUM REQUIRED LOT AREA:	40,000 SQ.FT.
MINIMUM REQUIRED LOT WIDTH:	100 FT
MINIMUM REQUIRED FRONT SETBACK:	40 FT
MINIMUM REQUIRED SIDE SETBACK:	25 FT
MINIMUM REQUIRED REAR SETBACK:	25 FT
MAXIMUM BUILDING HEIGHT:	60 FT
TOTAL UNITS:	84 UNITS
NET DENSITY:	84 UNITS / 161.8 AC = 0.52 UNITS/AC
WATER:	PUBLIC
WASTEWATER:	INDIVIDUAL ONSITE
WATERSHED DISTRICT:	LOCAL WATERSHED

FOR REVIEW ONLY
NOT RELEASED FOR CONSTRUCTION

1 EX-01 WATER MAIN EXTENSION
1"=500'



Community On-Site Concept Plan Conservation

Minimum Lot Area:	N/A
Minimum Lot Width:	70 FT.
Minimum Lot Depth:	120 FT.
Minimum Lot Size Provided:	11,616 SQ. FT.
Total Units:	140 Units
Net Density:	0.86 Units/Acre
Average Bedrooms/Unit:	3.33 Bedrooms
Required Drainfield (I&R):	18.49 Acres

Community Wastewater System with 25% Reduction.

CONSERVATION SPACE CALCULATIONS

	SF	ACRES	% of Total
Total Site Area	7,047,881	161.80	100.00%
Riparian Buffers	1,326,191	30.45	18.82%
NET SITE AREA (minus buffers)	**5,721,690**	**131.35**	**81.18%**

		SF	ACRES	% of Net
Conservation Space REQUIRED		**2,288,676**	**52.54**	**40.00%**
	Open Space (MAX. REQUIRED)	**457,735**	**10.51**	**8.00%**
	Misc. Open Space	439,319	10.09	
	Total Provided:	439,319	10.09	7.68%
	Natural Areas (MIN. REQUIRED)	**1,830,941**	**42.03**	**32.00%**
	50' Perimeter Buffer	533,985	12.26	
	Other Natural Area	1,383,427	31.76	
	Total Provided:	1,917,412	44.02	33.51%

SEPTIC CALCULATIONS

Septic Soils Calculation Summary	
Bedrooms:	3.33
GPD/Br:	90
GPD/unit:	299.7
LTAR:	0.125
Error Factor:	20%

# of Units:	140
Total GPD:	41,958
SF Soils Needed:	335,664
Initial + Repair:	671,328
Total Area (SF)	**805,594**
Total Area (AC)	**18.49**

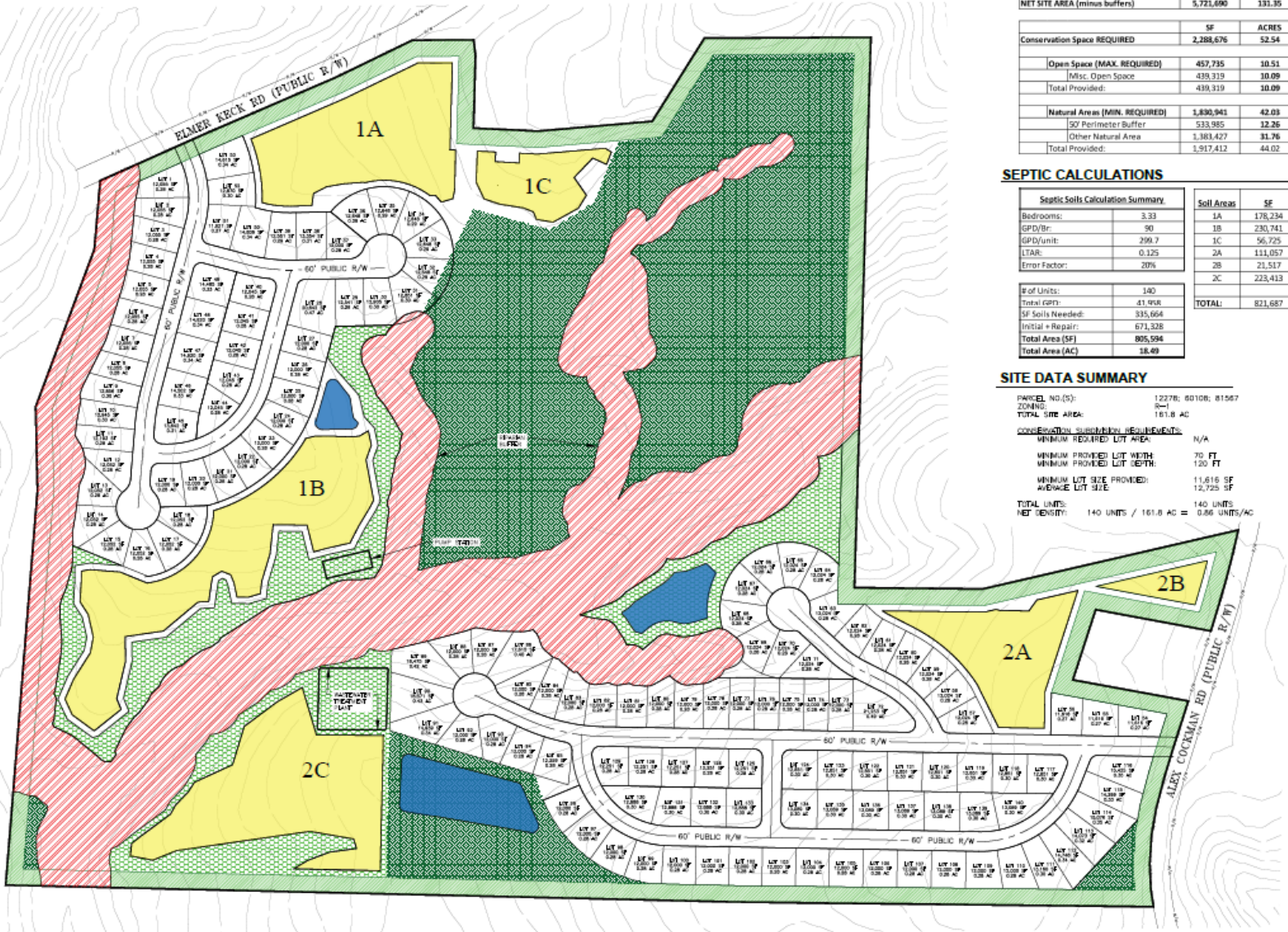
Soil Areas	SF	AC
1A	178,234	4.09
1B	230,741	5.30
1C	56,725	1.30
2A	111,057	2.55
2B	21,517	0.49
2C	223,413	5.13
TOTAL:	821,687	18.86

SITE DATA SUMMARY

PARCEL NO.(S): 12278; 60108; 81567
ZONING: R-1
TOTAL SITE AREA: 161.8 AC

CONSERVATION SUBDIVISION REQUIREMENTS:

MINIMUM REQUIRED LOT AREA:	N/A
MINIMUM PROVIDED LOT WIDTH:	70 FT
MINIMUM PROVIDED LOT DEPTH:	120 FT
MINIMUM LOT SIZE PROVIDED:	11,616 SF
AVERAGE LOT SIZE:	12,725 SF
TOTAL UNITS:	140 UNITS
NET DENSITY:	140 UNITS / 161.8 AC = 0.86 UNITS/AC



FOR REVIEW ONLY
NOT RELEASED FOR CONSTRUCTION

Differences in Concept Plans

Individual Lots

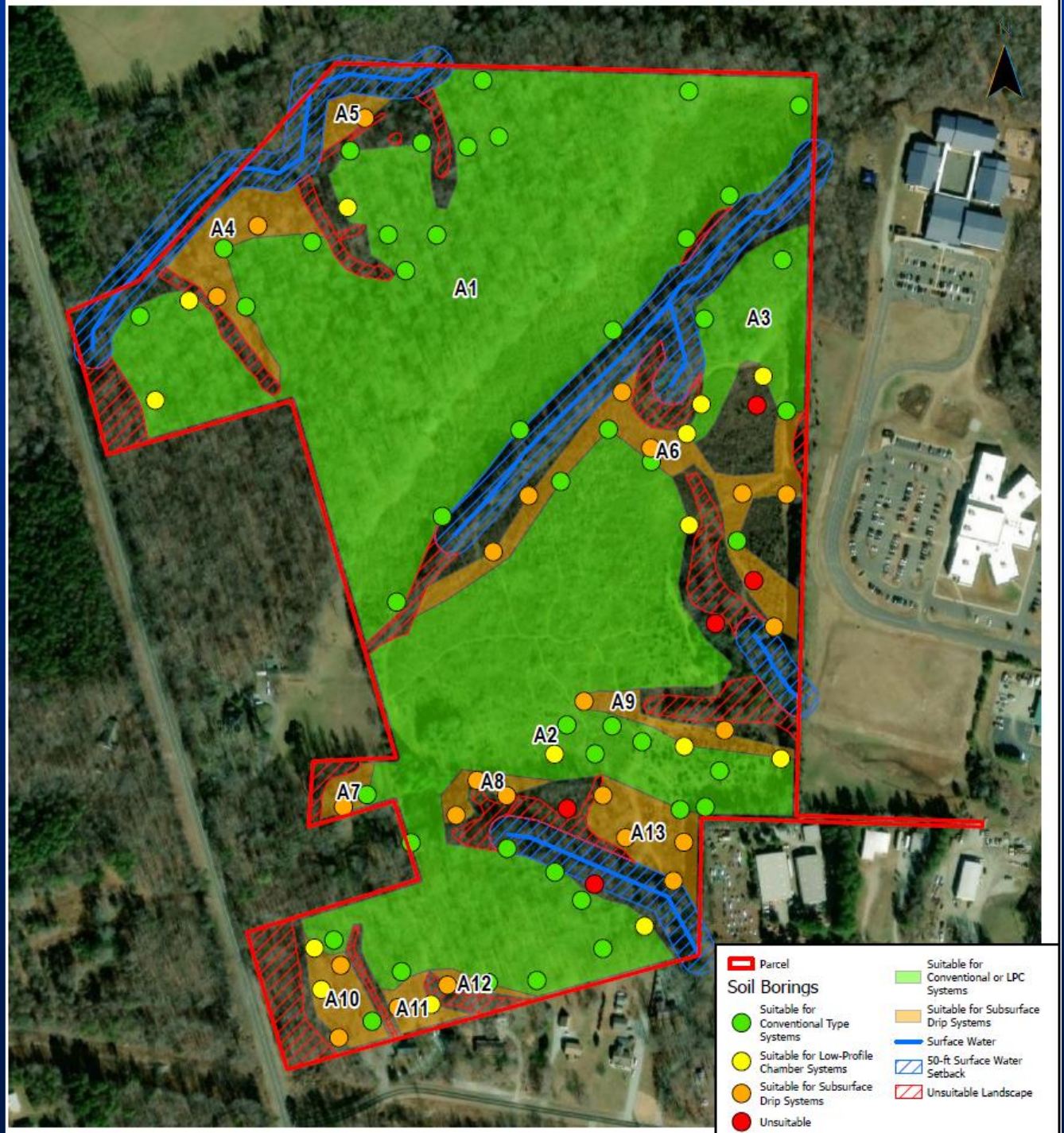
- Number of Lots – Less
- Mass Grading - No
- Natural Areas – Less
- Infrastructure – More
- Wastewater – Individual Responsibility

Community System

- Number of Lots – More
- Mass Grading – Yes
- Natural Areas - More
- Infrastructure – Less
- Wastewater – HOA or Private Utility Responsibility

Proposed Site #2

Total Area:	79.2 Acres
Riparian Buffers:	11.3 Acres
Net Site Area:	67.9 Acres
Zoning:	AR
Water:	Well
Wastewater:	On-Site


A5
A4
A1
A3
A6
A9
A2
A8
A7
A13
A10
A11
A12
N
Parcel
Soil Borings
Suitable for Conventional Type Systems
Suitable for Low-Profile Chamber Systems
Suitable for Subsurface Drip Systems
Unsuitable
Suitable for Conventional or LPC Systems
Suitable for Subsurface Drip Systems
Surface Water
50-ft Surface Water Setback
Unsuitable Landscape

Individual On-Site Concept Plan

Minimum Lot Area:	40,000 SQ. FT.
Minimum Lot Width:	150 FT.
Minimum Front Setback:	40 FT.
Minimum Side Setback:	20 FT.
Minimum Rear Setback:	20 FT.
Minimum Height:	25 FT.
Total Units:	41 Units
Net Density:	0.52 Units/Acre

On-Site System on Each Lot.

SITE DATA SUMMARY

PARCEL NO.:	9865878090
ZONING:	AR
TOTAL SITE AREA:	79.2 AC
TOWNSHIP:	HILLSBOROUGH
DEVELOPMENT TYPE:	CONSERVATION
WATER SUPPLY WATERSHED:	LOWER ENO (UNPROTECTED)
MINIMUM REQUIRED LOT AREA:	14,000 SQ.FT.
MINIMUM REQUIRED LOT WIDTH:	100 FT
MINIMUM REQUIRED FRONT SETBACK:	30 FT
MINIMUM REQUIRED SIDE SETBACK:	15 FT
MINIMUM REQUIRED REAR SETBACK:	15 FT
MAXIMUM BUILDING HEIGHT:	25 FT
TOTAL UNITS:	50 UNITS
NET DENSITY:	50 UNITS / 79.2 AC = 0.63 UNITS/AC
CONSERVATION SPACE REQUIRED:	33% (1,138,584 SF)

CONSERVATION SPACE CALCULATIONS

	SF	ACRES	% OF TOTAL
TOTAL SITE AREA:	3,450,255	79.2	100%
CONSERVATION SPACE REQUIRED:	1,138,584	26.1	33%
NATURAL AREAS PROVIDED			
LANDSCAPE BUFFERS:	430,314	9.9	12%
RIPARIAN/WETLAND BUFFERS:	492,946	11.3	14%
OTHER NATURAL AREA:	604,920	13.9	18%
TOTAL PROVIDED:	1,528,180	35.1	44%

SEPTIC CALCULATIONS

Dwellings		
Number of Dwellings:	50 Dwellings	
Number of Bedrooms/Dwelling	4 Bedrooms	Gloves
Average Daily Flow per Bedroom:	120 GPD/Bedroom	15A NCAC 18E .0401
Unadjusted Design Flow:	24,000 GPD	
Flow Reduction	25%	per 15A NCAC 18E
Adjusted Design Flow:	18,000 GPD	
Adjusted Design Flow:	18,000 GPD	
LTAR (Conventional):	0.250 GPD/SF	
Total Drain Field Required (Initial):	216,000 SF	
Total Drain Field Required (I&R)	432,000 SF	
Contingency	20%	
	86,400 SF	
Total Drain Field Required (I&R)	518,400 SF	
Total Drain Field Proposed (I&R)	521,043 SF	

FOR REVIEW ONLY
NOT RELEASED FOR CONSTRUCTION

Community On-Site Concept Plan Conservation

Minimum Lot Area:	N/A
Minimum Lot Width:	100 FT.
Minimum Front Setback:	30 FT.
Minimum Side Setback:	15 FT.
Minimum Rear Setback:	15 FT.
Minimum Height:	15 FT.
Minimum Lot Size Provided:	14,000 SQ. FT.
Total Units:	50 Units
Net Density:	0.63 Units/Acre
Average Bedrooms/Unit:	4 Bedrooms
Required Drainfield (I&R):	11.9 Acres

SITE DATA SUMMARY

PARCEL NO.:	9865878090
ZONING:	AR
TOTAL SITE AREA:	79.2 AC
TOWNSHIP:	HILLSBOROUGH
WATER SUPPLY WATERSHED:	LOWER ENO (UNPROTECTED)
MINIMUM REQUIRED LOT AREA:	40,000 SQ FT
MINIMUM REQUIRED LOT WIDTH:	150 FT
MINIMUM REQUIRED FRONT SETBACK:	40 FT
MINIMUM REQUIRED SIDE SETBACK:	20 FT
MINIMUM REQUIRED REAR SETBACK:	20 FT
MAXIMUM BUILDING HEIGHT:	25 FT
TOTAL UNITS:	41 UNITS
NET DENSITY:	41 UNITS / 79.2 AC = 0.52 UNITS/AC
RECREATION SPACE RATIO REQUIRED:	.028 (96,598 SF)
RECREATION SPACE PROPOSED:	.052 (180,151 SF)
IMPERVIOUS SURFACE LIMIT:	24% (827,988 SF)

IMPERVIOUS CALCULATIONS

MAXIMUM IMPERVIOUS SURFACE AREA (MSA):

BLDG/DRIVEWAY PER LOT (ASSUMED):	4,200 SF
IMPERVIOUS ONSITE (41 UNITS):	172,200 SF
RIGHT-OF-WAY IMPERVIOUS:	289,863 SF
MISC IMPERVIOUS:	7,781 SF
TOTAL IMPERVIOUS:	469,844 SF
TOTAL SITE AREA:	3,449,952 SF (79.2 AC)
TOTAL PROPOSED IMPERVIOUS:	469,844 SF (10.7 AC) = 13.6%

Well	Latitude	Longitude
Site 1	36.106521	-79.108875
Site 2	36.1026729	-79.1059203
Site 3	36.1015628	-79.1071124

FOR REVIEW ONLY
NOT RELEASED FOR CONSTRUCTION

Differences in Concept Plans

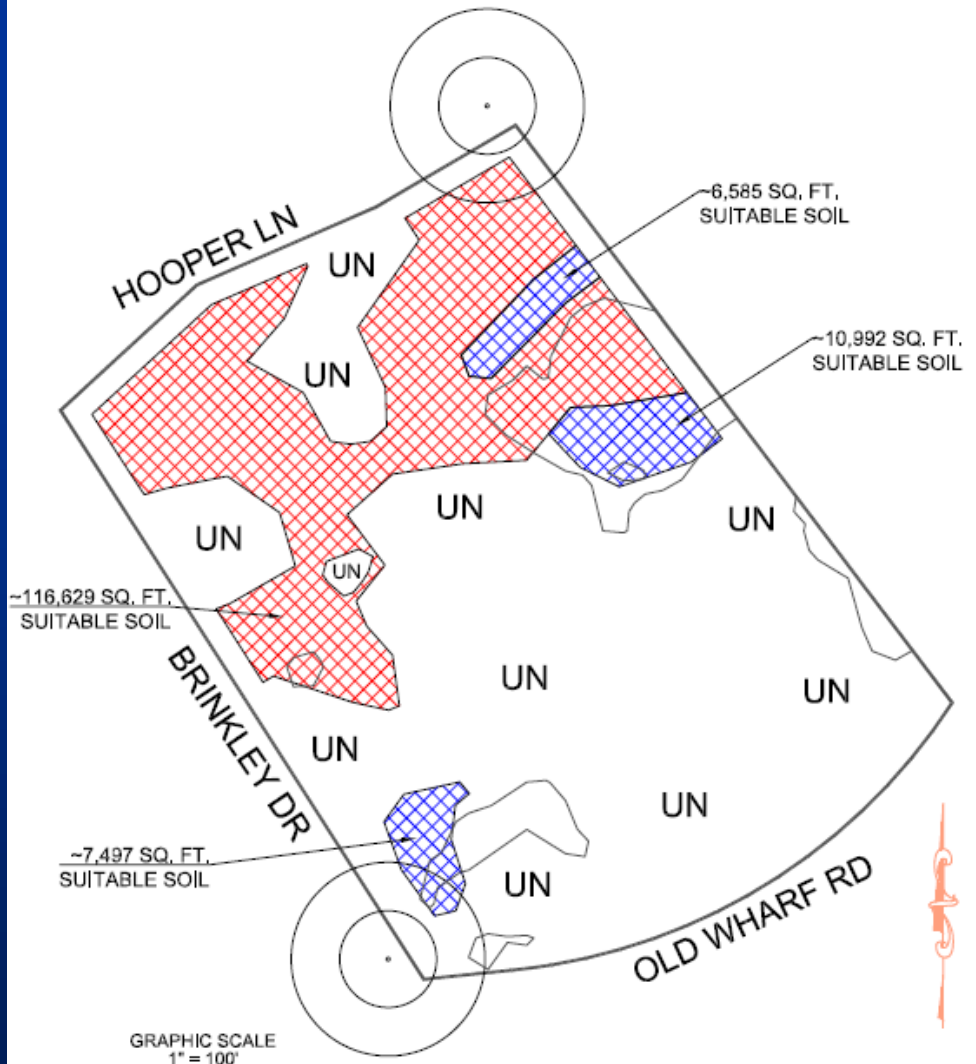
Individual Lots

- Number of Lots – Less
- Mass Grading - No
- Natural Areas – Less
- Infrastructure – More
- Wastewater – Individual Responsibility

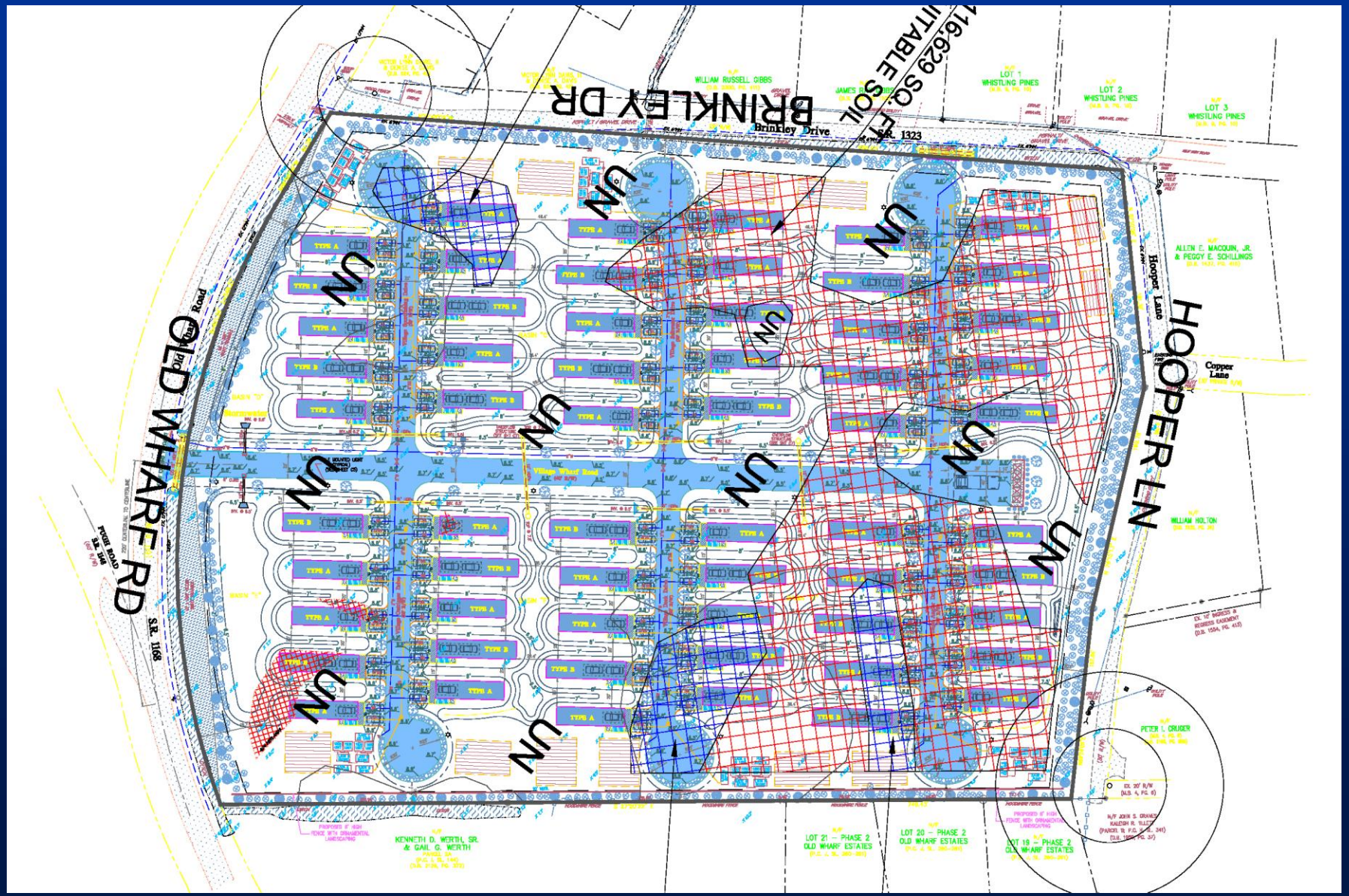
Community System

- Number of Lots – More
- Mass Grading – Yes
- Natural Areas - More
- Infrastructure – Less
- Wastewater – HOA or Private Utility Responsibility

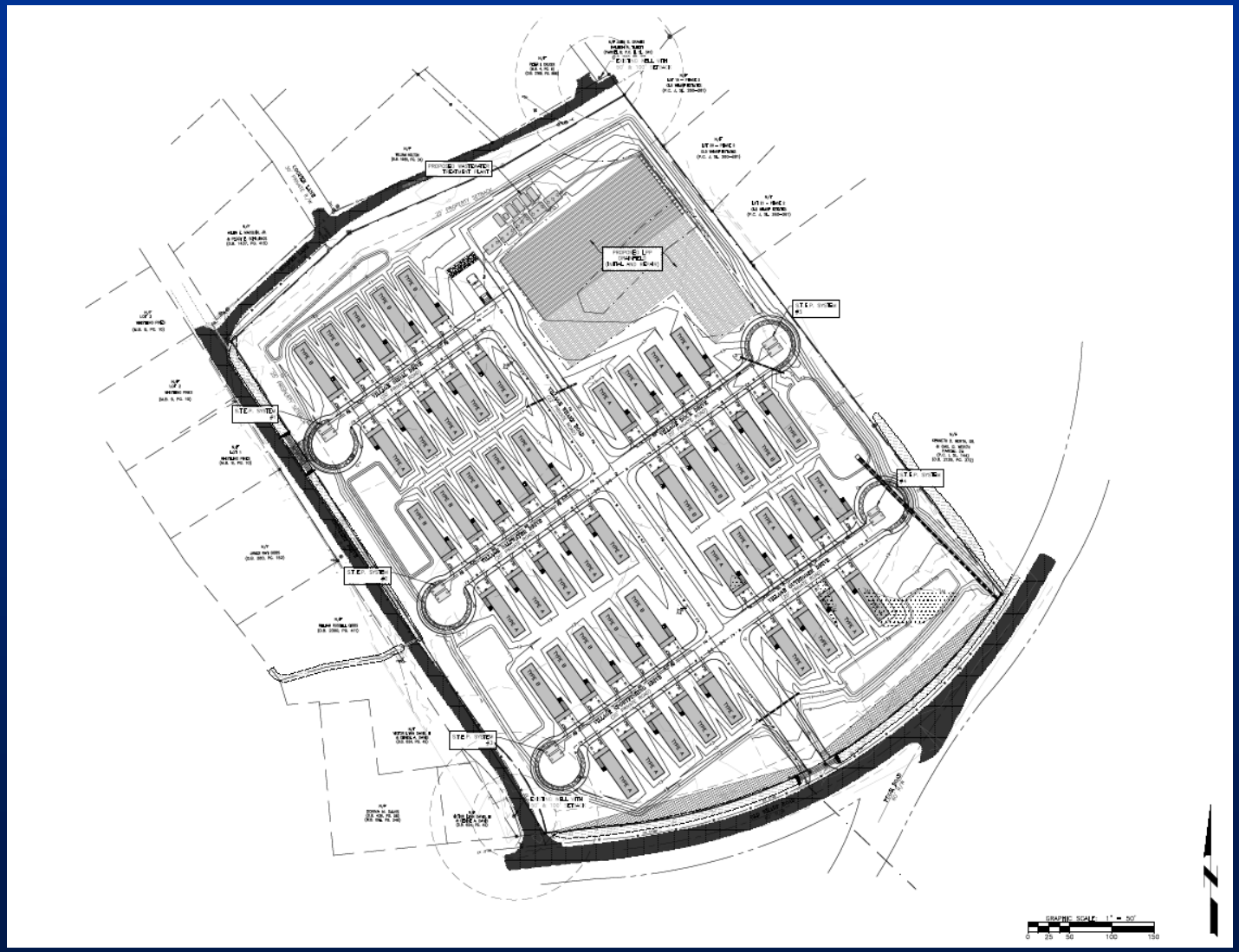
Proposed Site Plan


HOOPER LN
BRINKLEY DR
OLD WHARF RD
~6,585 SQ. FT.
SUITABLE SOIL
~10,992 SQ. FT.
SUITABLE SOIL
~116,629 SQ. FT.
SUITABLE SOIL
~7,497 SQ. FT.
SUITABLE SOIL
UN
GRAPHIC SCALE
1" = 100'
100 0 100 200
LEGEND
Areas contain soils with 24 to 30 inches or more of useable material and have the potential for subsurface drip, LPP/RIL modified conventional, or panel block type subsurface septic systems (without any mounding).
Areas contain soils with 12 to 18 inches or more of useable material and have the potential for TS-A subsurface drip, LPP/RIL septic systems (without any mounding).
Unsuitable areas due to soil conditions and landscape position.
Existing private well, 50'-100' septic system setback. Setback depends on system type.

Site Plan with Soils



Revised Site Plan



Summary

- Community water & wastewater often preferred.
- Environmentally friendly.
- May increase natural area.
- May increase density
- Use methodology to reduce risks.

Questions?