

23 JANUARY 2026

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# Toward an Interactive Future for Explosives Safety Siting in Master Planning

Kyle Root, PE

Kevin A Mueller, PhD, PE, PSP

Fred Jorgensen, PE, PSP

**Thornton Tomasetti**



**Thornton Tomasetti**  
BLAST OPTIMIZATION & OPERATIONS MAPPER

# ACKNOWLEDGEMENTS

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The authors would like to thank Thornton Tomasetti's internal research and development team for their continued focus and backing of innovations across all industries.

# AGENDA

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1. **Master Planning and Current Methodologies**
2. Computational Design
3. BOOM

# MASTER PLANNING

- Collaborative, **in-person** session with various installation members
- Master planning sessions typically conducted over **one** week
- Initial set of interviews typically conducted virtually prior to charrette
- Explosives Safety incorporated into:
  - District Development Plan
  - Installation Development Plan
  - DD1391 Validation Program



# MASTER PLANNING

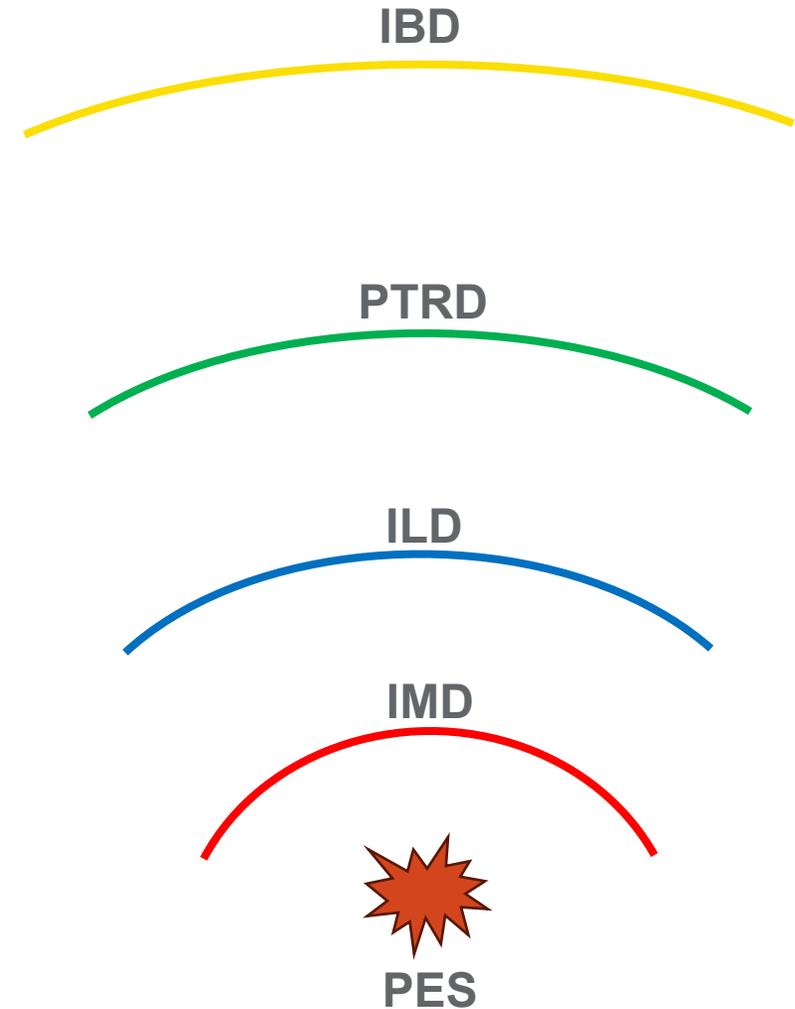
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- **Monday** inbrief and site visit
  - Receive existing site info
  - Stakeholder interviews
  - Obtain existing NEW
- **Wednesday** mid-week review
  - Deficiency mapping
  - Design options
- **Friday** out-brief with master plan



# QUANTITY DISTANCES

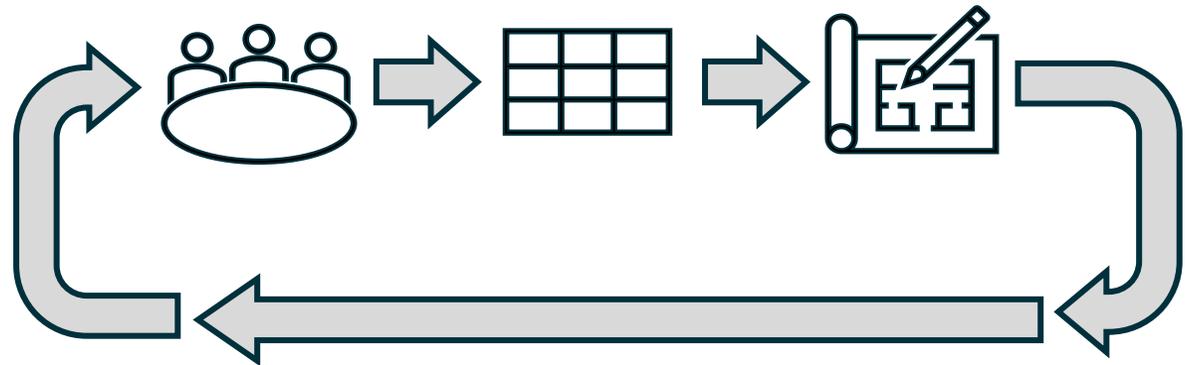
- Multiple quantity distances for each PES
- QD arcs calculated based on...
  - Net explosive weight
  - Magazine type
  - Orientation
  - Barricaded or unbarricaded



# MASTER PLANNING

- Iterative design process
- Discussion, calculation, drafting
- Complex spreadsheets **reduce potential for collaboration**
- Calculation and drafting of QD arcs performed **separately**
- Cyclical as design evolves
- Looking for better ways of addressing this workflow

Type	ID	NEW (lb)														HFD (ft)			IBD (ft)			PTRD (ft)			Barricaded ILD (ft)			Unbarricaded ILD (ft)			ECM IMD (ft)						AGM IMD (ft)	
		1.1	1.2.1	1.2.2	1.2.3	1.3	1.4	All Sides	Front	Side	Rear	Front	Side	Rear	Front	Side	Rear	Front	Side	Rear	Front	Side	Rear	Side-Side	Rear-Rear	Front-Back	Front-Front	Barricaded	Unbarricaded									
ECM	1043	50,000	35,000	10,000	10,000	10,000	CAP	1250	1289	1289	1250	774	774	750	368	258	221	663	589	442	46	46	74	101	221	...	...											
AGM	1048	2,050	700	188417	100000	142119	CAP	1250	1250	1250	1250	750	750	750	114	114	114	229	229	229	...	...	...	...	...	...	...	...										
ECM	1055	75,000	35,000	10,000	10,000	10,000	CAP	1250	1476	1476	1250	886	886	750	422	295	253	759	675	506	55	55	88	121	263	...	...											
AGM	1068	200	480	50000	100000	100000	CAP	927	927	927	927	556	556	556	51	51	51	106	106	106	...	...	...	...	...	...	...	...										
AGM	1061	1,520	496	20000	20000	100000	CAP	1250	1250	1250	1250	750	750	750	103	103	103	207	207	207	...	...	...	...	...	...	...	...										
AGM	1062	9,750	0	20000	20000	78000	CAP	1250	1250	1250	1250	750	750	750	192	192	192	385	385	385	...	...	...	...	...	...	...	...										
AGM	1064	1,098	0	88000	50000	78000	CAP	1250	1250	1250	1250	750	750	750	92	92	92	184	184	184	...	...	...	...	...	...	...	...										
AGM	1065	67	652	50000	50000	100000	CAP	628	628	628	628	375	375	375	37	37	37	73	73	73	...	...	...	...	...	...	...	...										
Pad	1069	5,804	3103	20000	50000	50000	10000	1250	1250	1250	1250	750	750	750	162	162	162	323	323	323	...	...	...	...	...	...	...	...										
ECM	1087 B3	2,097	1063	20000	20000	160000	CAP	1250	1250	1250	1250	750	750	750	128	90	77	230	205	154	17	17	27	38	82	...	...											
ECM	1087 B4	2,097	917	20000	20000	128000	CAP	1250	1250	1250	1250	750	750	750	128	90	77	230	205	154	17	17	27	38	82	...	...											
ECM	1087 B5	2,097	850	20000	20000	83000	CAP	1250	1250	1250	1250	750	750	750	128	90	77	230	205	154	17	17	27	38	82	...	...											
ECM	1087 B4	1,728	795	20000	20000	23000	CAP	1250	1250	1250	1250	750	750	750	120	84	72	216	192	144	15	15	24	33	73	...	...											
ECM	1087 B5	1,728	795	20000	20000	5700	CAP	1250	1250	1250	1250	750	750	750	120	84	72	216	192	144	15	15	24	33	73	...	...											
AGM	1102	1,400	450	68000	100000	76000	CAP	1250	1250	1250	1250	750	750	750	101	101	101	201	201	201	...	...	...	...	...	...	...	...										
ECM	1103	60,082	50,000	50,000	50,000	50,000	CAP	1250	1371	1371	1250	822	822	750	392	274	235	705	627	470	49	49	78	107	234	...	...											
ECM	1105	47,881	50,000	50,000	50,000	50,000	CAP	1250	1271	1271	1250	763	763	750	363	254	218	654	581	436	43	43	68	93	204	...	...											
Test Pit	1508	1						419	419	419	419	251	251	15	15	15	31	31	31	...	...	...	...	...	...	...	...											
Safe Haven	SF	65000						1250	1608	1608	1608	966	966	966	362	362	362	724	724	724	...	...	...	...	...	...	...											
AGM	1065 exs+exp	115						712	712	712	712	427	427	427	44	44	44	88	88	88	...	...	...	...	...	...	...											
AGM	1102 exs+exp	1400						1250	1250	1250	1250	750	750	750	101	101	101	201	201	201	...	...	...	...	...	...	...											
AGM	MI	2650						1250	1250	1250	1250	750	750	750	114	114	114	228	228	228	...	...	...	...	...	...	...											
AGM	RestPit	225						973	973	973	973	584	584	584	55	55	55	109	109	109	...	...	...	...	...	...	...											
AGM	AGM1	2500						1250	1250	1250	1250	750	750	750	122	122	122	244	244	244	...	...	...	...	...	...	...											
ECM	1	75000						1250	1476	1625	1250	886	886	975	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	2	75000						1250	1476	1715	1250	886	886	1029	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	3	75000						1250	1476	1855	1250	886	886	1083	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	4	75000						1250	1476	1895	1250	886	886	1137	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	5	75000						1250	1476	1970	1250	886	886	1182	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	6	75000						1250	1476	2080	1250	886	886	1238	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	7	75000						1250	1476	1790	1250	886	886	1074	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
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ECM	10	75000						1250	1476	1520	1250	886	886	912	750	422	295	253	759	675	506	55	55	88	121	263	...	...										
ECM	11	65000						1250	1407	1430	1250	844	858	750	402	281	241	724	643	482	49	49	78	107	234	...	...											
ECM	12	55000						1250	1331	1340	1250	799	804	750	380	266	228	685	608	456	49	49	78	107	234	...	...											
ECM	13	45000						1250	1250	1250	1250	750	750	750	356	249	213	640	569	427	43	43	68	93	204	...	...											

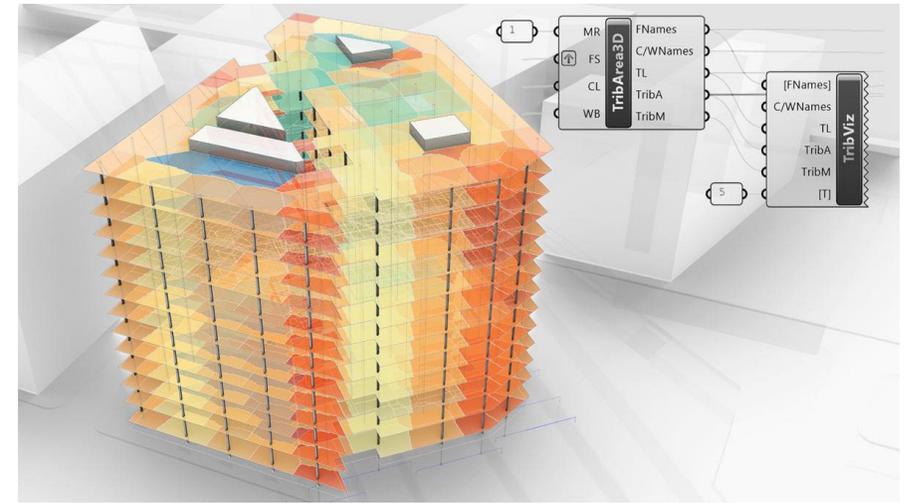
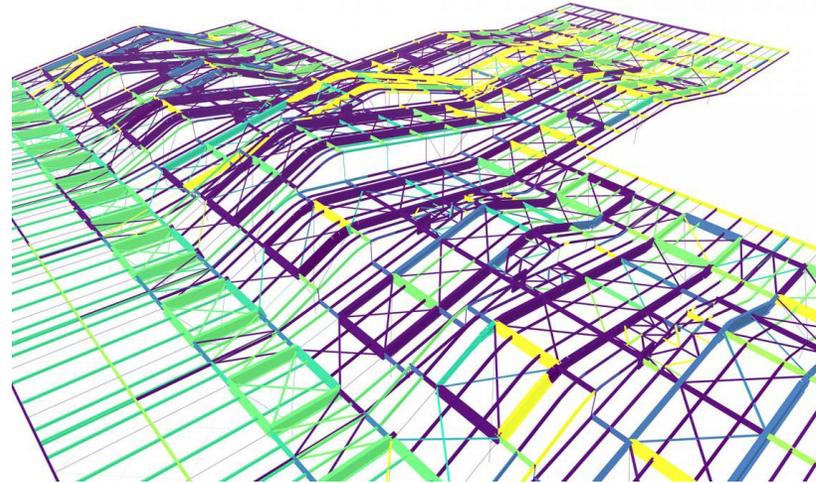
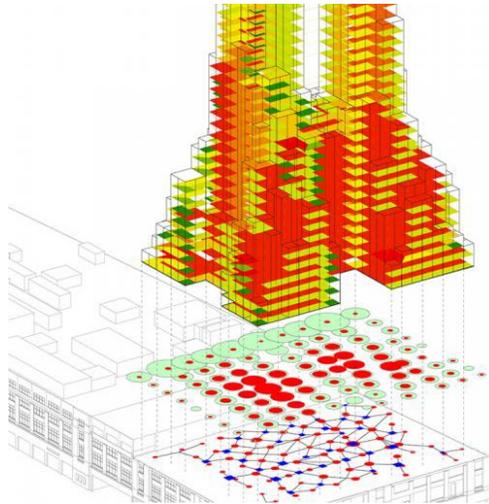


# AGENDA

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3. BOOM

# COMPUTATIONAL DESIGN



**Spotlight**

41. Choate Auditorium

6/16/2019

Explorer | Quantity Matrix | Usage Takeoffs | Rebar

Usage | Category | Family | Material Set | Units pressure (psi)

**Spotlight Report**

Net Steel Tonnage	587 tons	Q
Net Steel Weight	16.61 klf	Q
Net Concrete Volume	2001.18 yd <sup>3</sup>	Q
Assumed Concrete Density	150 pcf	
Net Floor Tonnage	17.60 klf	
Net Riser Weight	2.90 klf	
Net Surface Area	14902 sqft	Q
Unique Elements	107 members	Q
Unshored Elements	124	Q
Gravity System Tonnage	282 tons, 7.93 pcf	
Lateral System Tonnage	28 tons, 0.88 pcf	
Column System Tonnage	90 tons, 2.4 pcf	

Suggestion!

**Strength + Deflection Design**

Vibration Design + Advanced Analysis **alpha**

Damping: 0.005, Occupancy: Electronic Office, SDL: 4 psf

**Vibration Criteria**

Walking

Boys in X: 2 total, Boys in Y: 2 total

Occupancy Type: Electronic Office

Component Damping: **Electronic** 0.005

Office Fitout

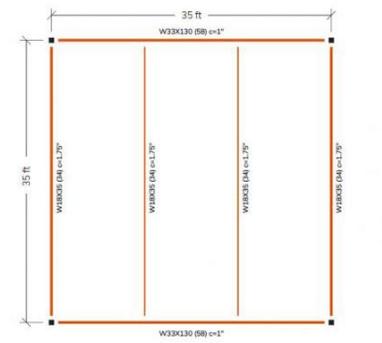
Live Load: 6 psf

Superimposed Dead Load: 4 psf

Damping Ratio: 0.005

**Sensitive Equipment Vibration Analysis**

Floor: Custom, Velocity: 5000 mips



**NOTES:**

1 DECK CONSISTS OF 4.5" NW CONCRETE ON 3" 18 GA. COMPOSITE DECK

2. \*\* DENOTES ADDITIONAL LOADING AND DEFLECTION CRITERIA HAS BEEN APPLIED



**All Design Results**

Tonnage: 5.4 psf strength + deflection, 6.7 psf vibration

Strength + Deflection	Clear Display
Vibration	

Girders	W24X84	W33X130
Beams	W18X35	W18X35
Tonnage	5.4 psf	6.7 psf

Member: [Dropdown] Hide Details

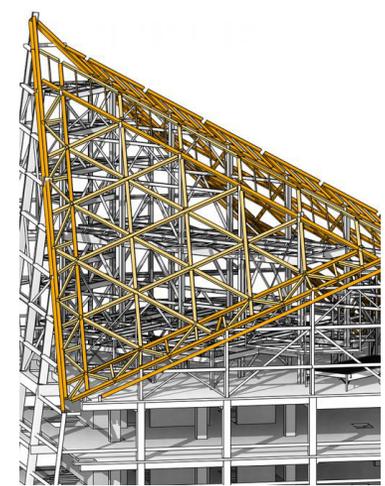
**Advanced Analysis**

**Sensitive Equipment Vibration Results**

Analysis Performed: [Dropdown]

Method: [Dropdown]

Expert Design



# COMPUTATIONAL DESIGN

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- Computational design brings together **design** and **computation**
- Merging **geometry** and **calculation**
- Development of workflows, tools often through visual programming
- Rhino and Grasshopper widely used across industries



# AGENDA

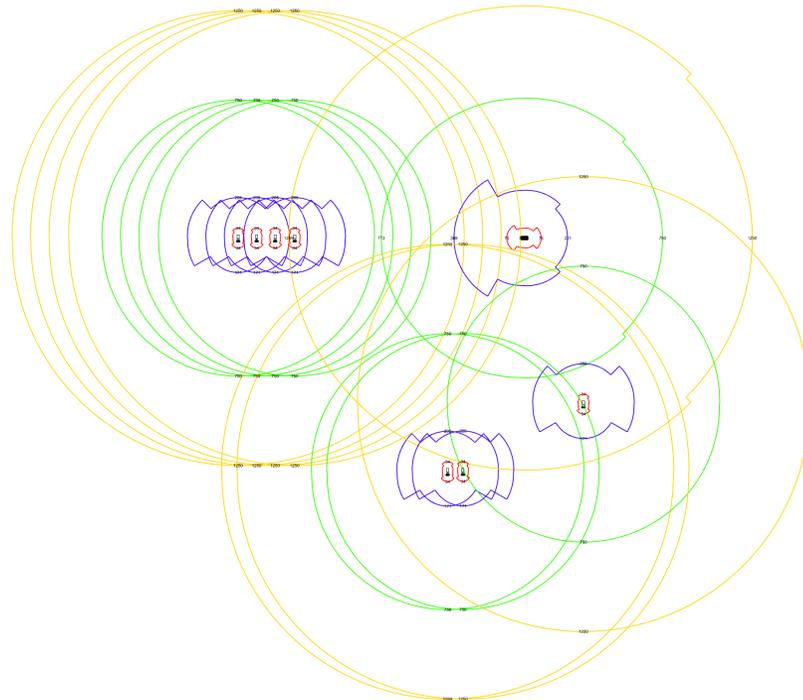
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1. Master Planning and Current Methodologies
2. Computational Design
3. **BOOM**

# BLAST OPTIMIZATION AND OPERATIONS MAPPER

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- TT internal development of Grasshopper tool
- Single source platform for instantaneous **calculation** and **plotting**
- Calculations and plotting performed **in context**

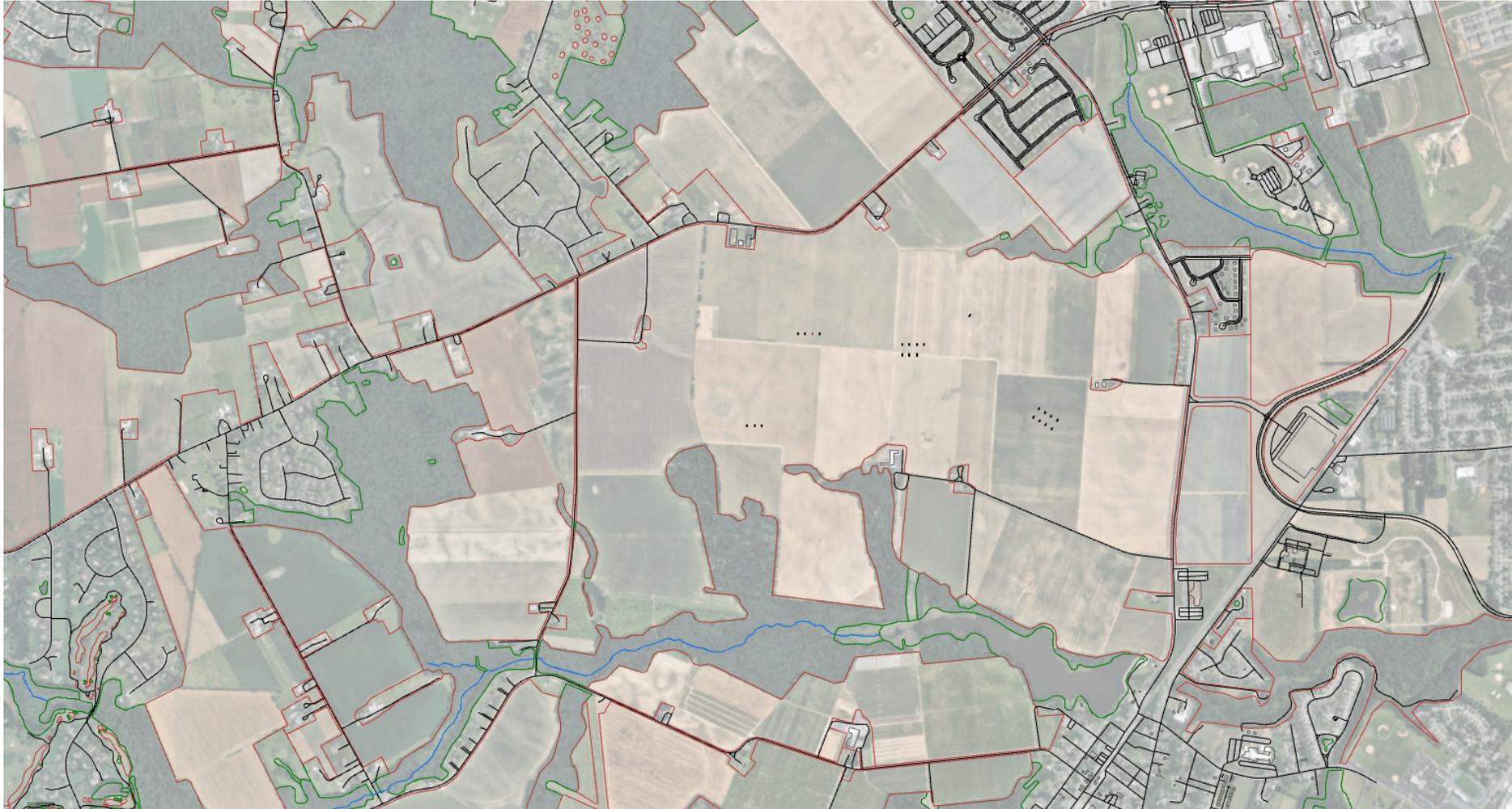


# PRE-CHARENTE

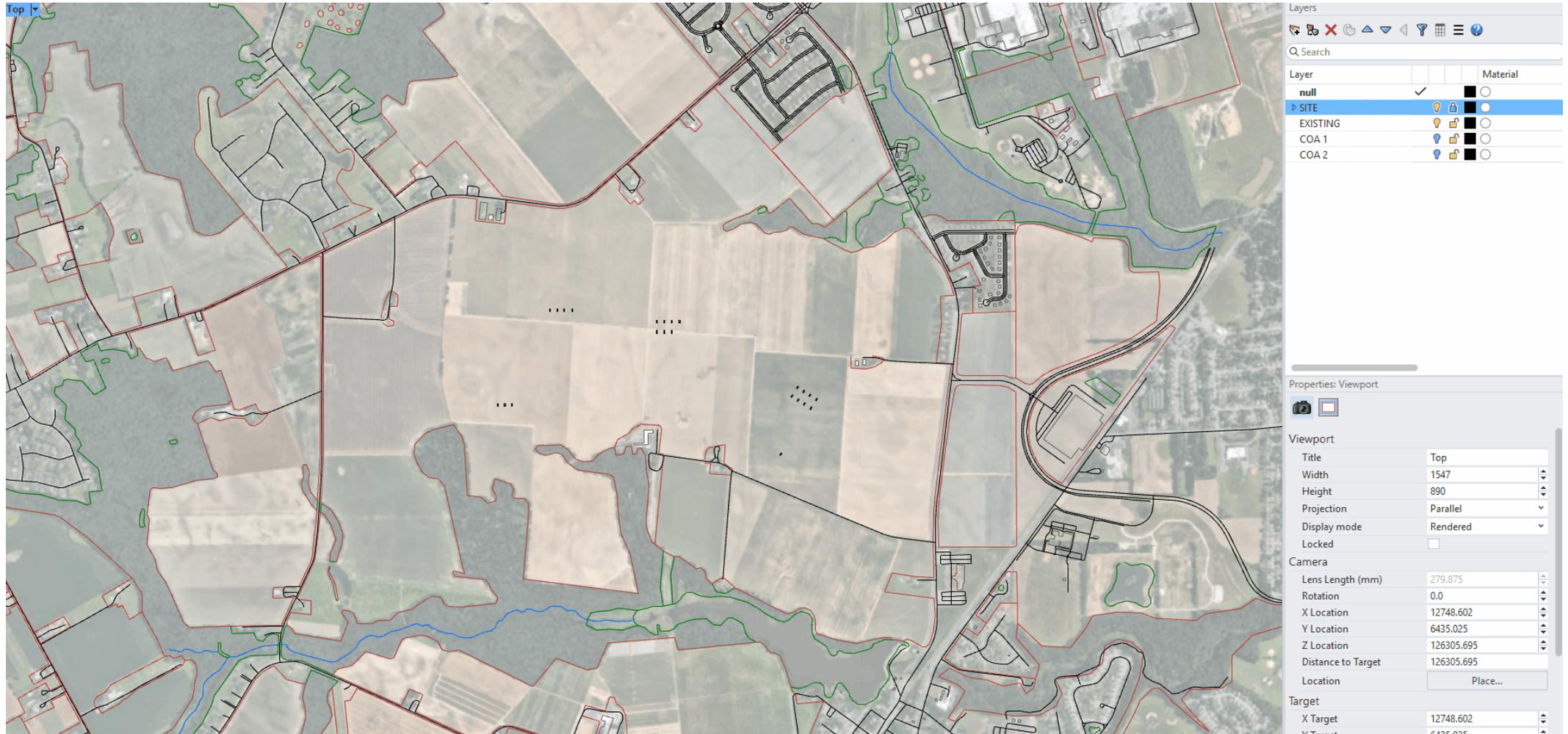
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# PRE-CHARENTE

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# MONDAY

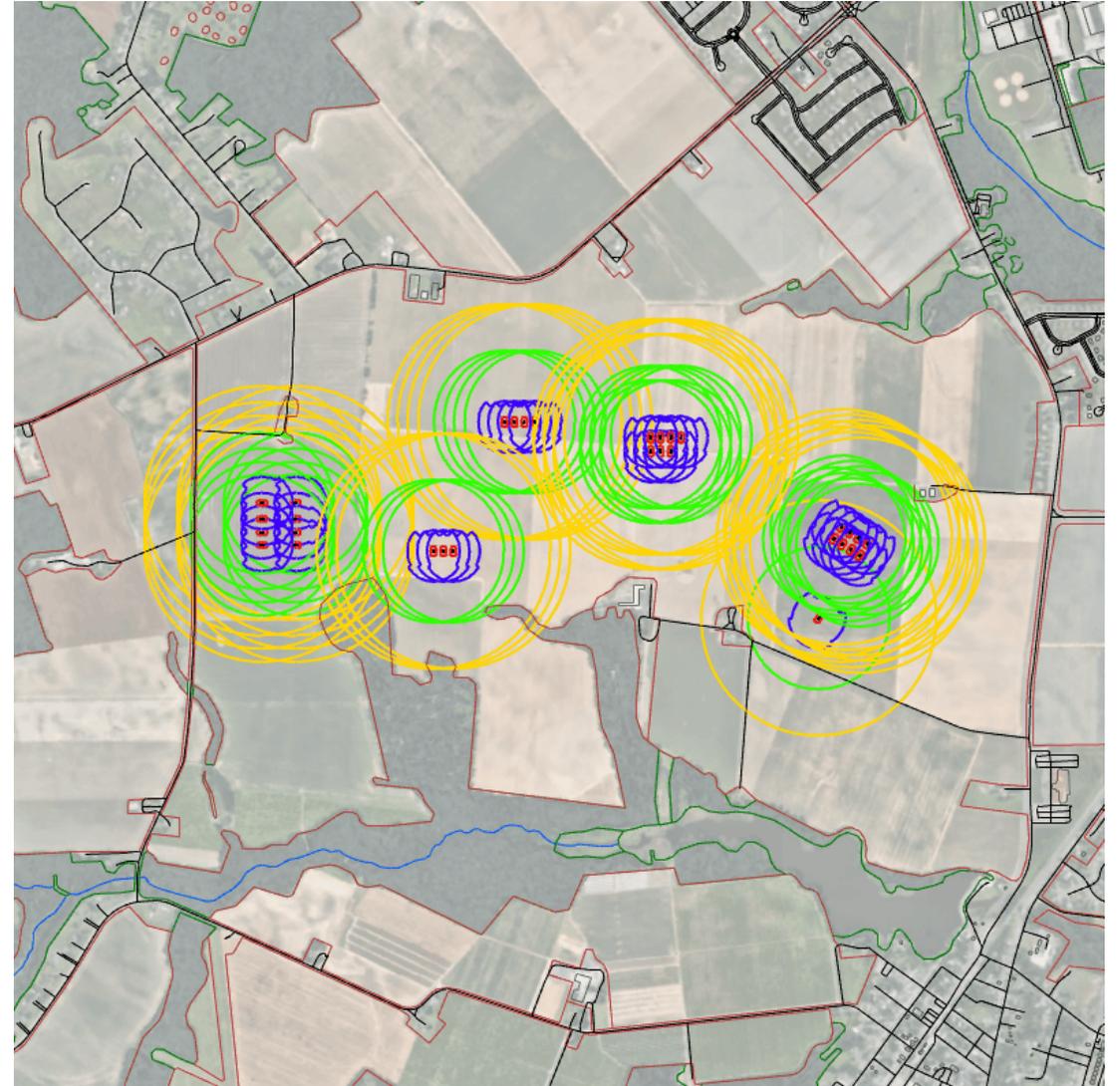
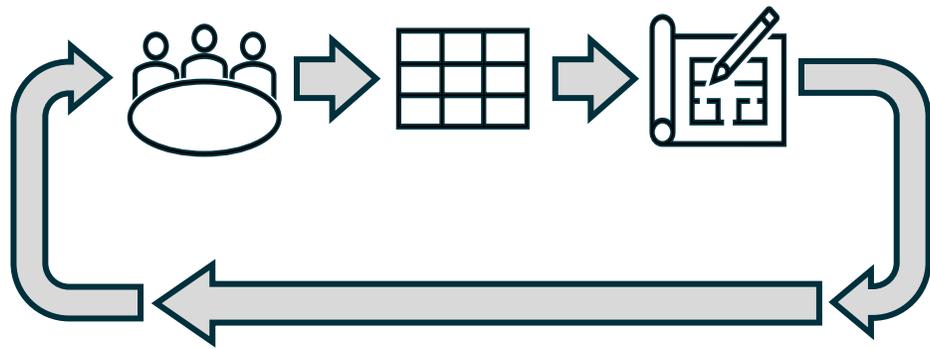


# TUESDAY



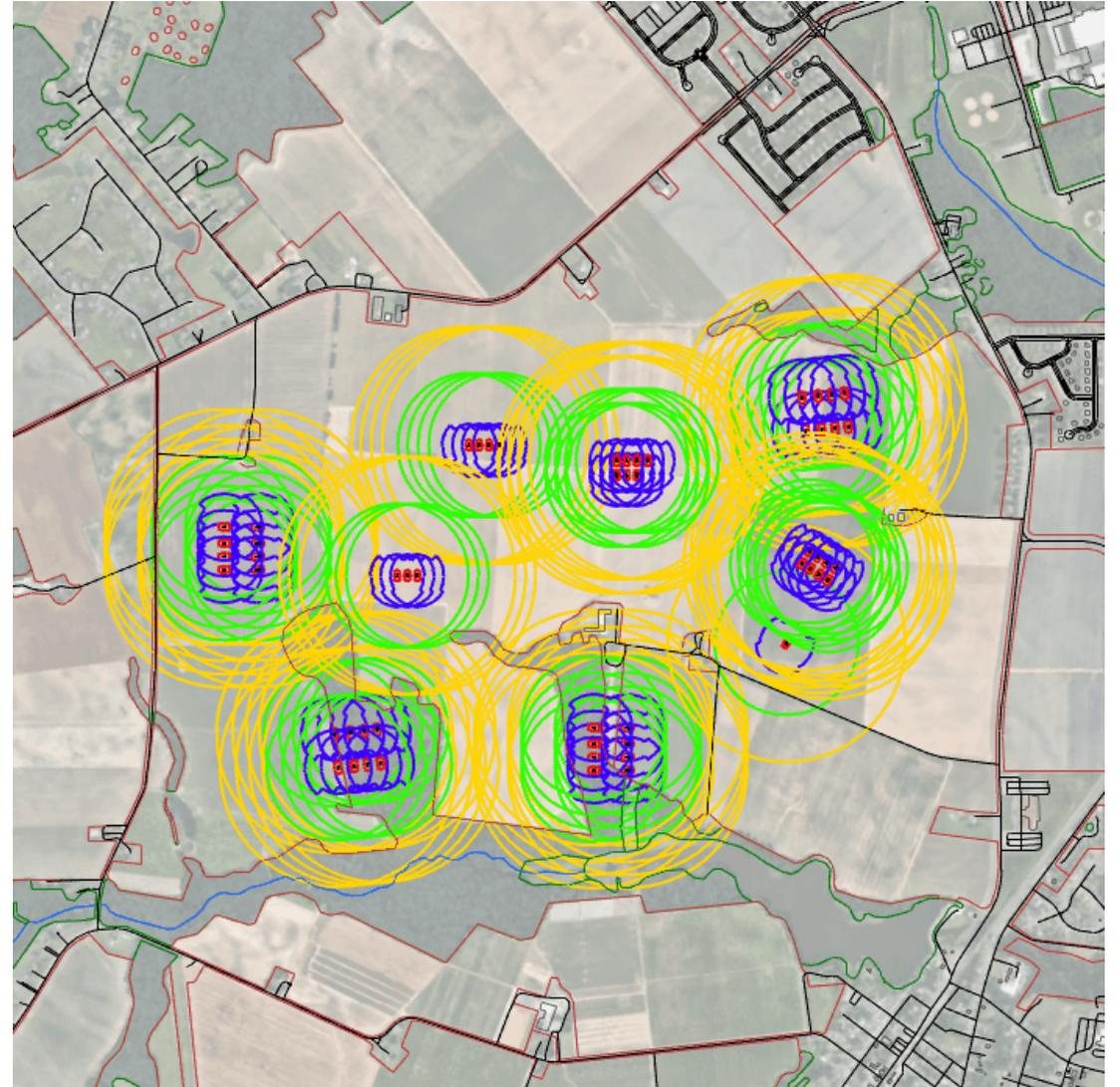
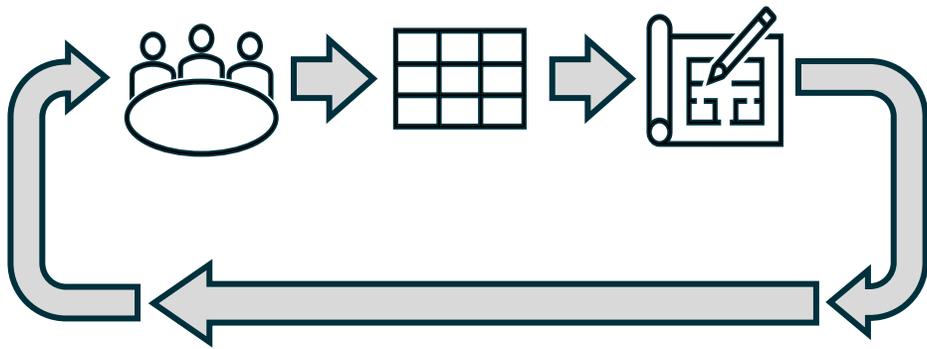
# WEDNESDAY

- Mid-week review of master plan
- Receive updates and changes from stakeholders
- Update master plan



# THURSDAY

- Continue to refine master plan
- Updates to QD arcs **live and in context**

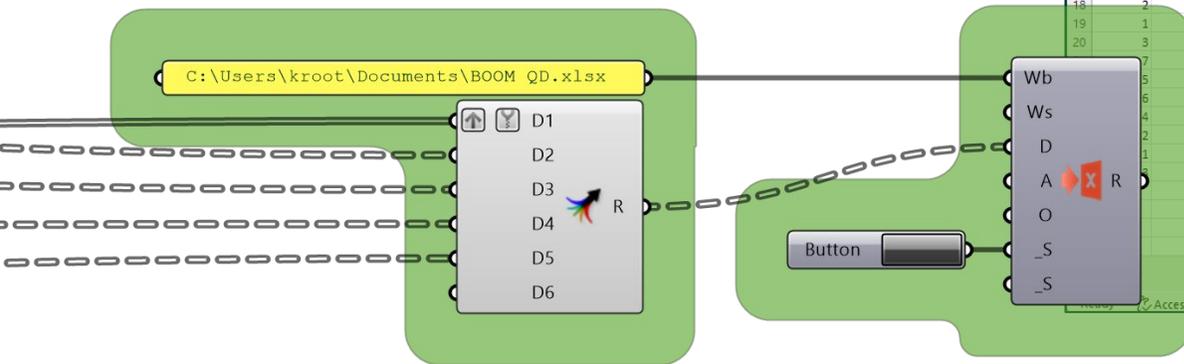


# FRIDAY

- Final site plan for MUNS area
- Info fed back into ArcGIS model

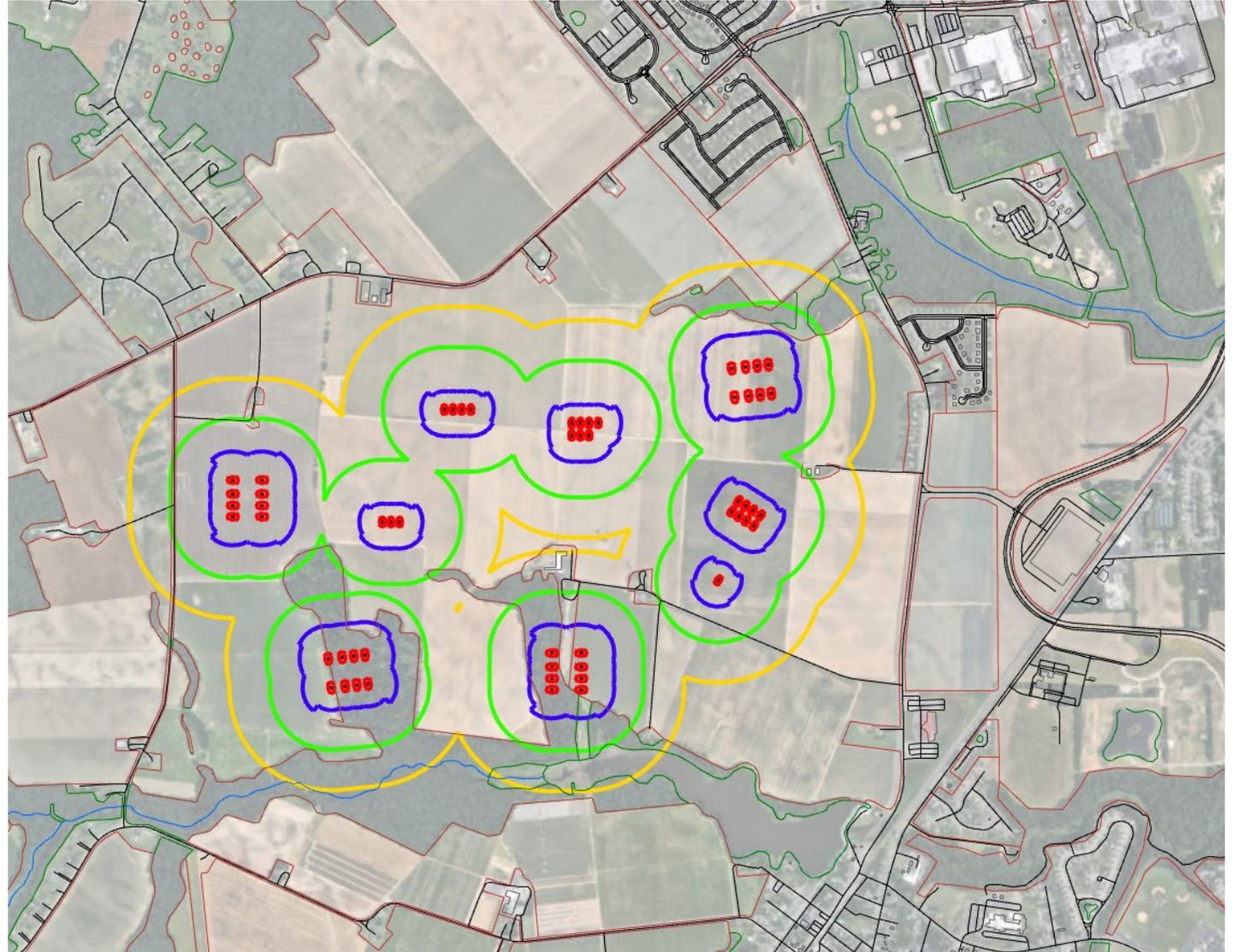
The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	ID	IMD	IMD	IMD	IMD	ILD	ILD	ILD	ILD	PTRD	PTRD	PTRD	PTRD	IBD	IBD	IBD	IBD					
2	4	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
3	2	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
4	1	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
5	3	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
6	6	126	1134	1889	3149	79	1008	1889	3149	79	1008	1889	3149	126	840	1889	3149					
7	5	126	1134	1889	3149	79	1008	1889	3149	79	1008	1889	3149	126	840	1889	3149					
8	7	126	1134	1889	3149	79	1008	1889	3149	79	1008	1889	3149	126	840	1889	3149					
9	7	74	663	773	1289	46	589	773	1289	46	589	773	1289	74	442	750	1250					
10	5	74	663	773	1289	46	589	773	1289	46	589	773	1289	74	442	750	1250					
11	6	74	663	773	1289	46	589	773	1289	46	589	773	1289	74	442	750	1250					
12	8	93	835	975	1625	58	743	975	1625	58	743	975	1625	93	557	750	1250					
13	8	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
14	7	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
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17	4	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
18	2	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
19	1	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
20	3	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
21	7	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
22	5	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
23	6	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
24	4	49	444	750	1250	31	395	750	1250	31	395	750	1250	49	296	750	1250					
25	2	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
26	1	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					
27	3	34	308	750	1250	21	274	750	1250	21	274	750	1250	34	205	750	1250					



# POST-CHARENTE

- Base weapons safety officer can update ESS software for record keeping as projects are completed from master plan



# CONCLUSION

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- BOOM under continued internal development
- The collaborative working nature of the explosives safety engineer in master planning is shifting
- Cross industry collaboration could inform new ways of working
- Computational design tools excel in geometry and data processing



# THANK YOU

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**Kyle Root, PE**

[KRoot@ThorntonTomasetti.com](mailto:KRoot@ThorntonTomasetti.com)