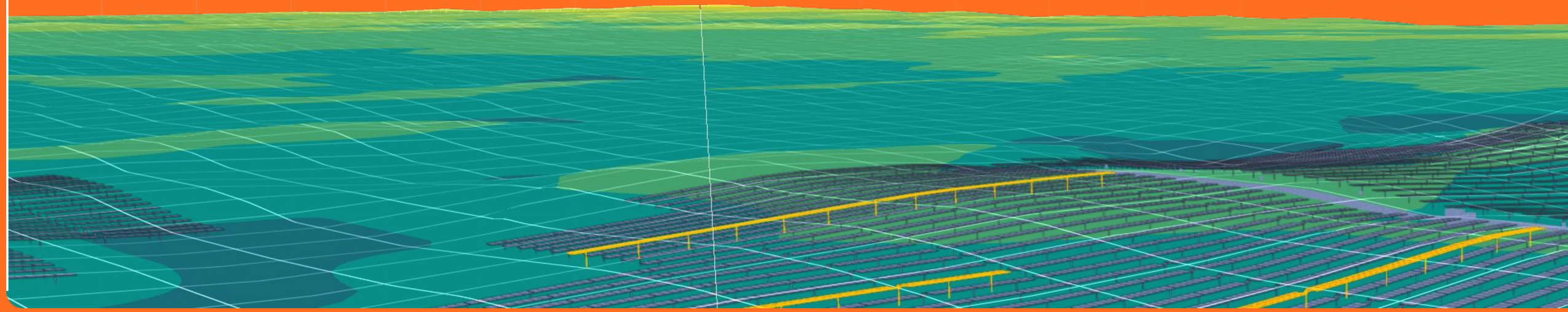
Dirt, Steel & Equipment

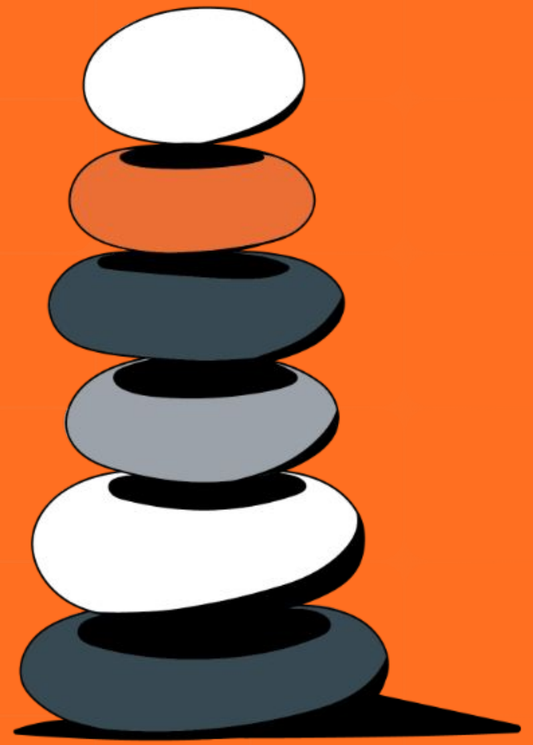
Capital Considerations When Designing Solar Layouts

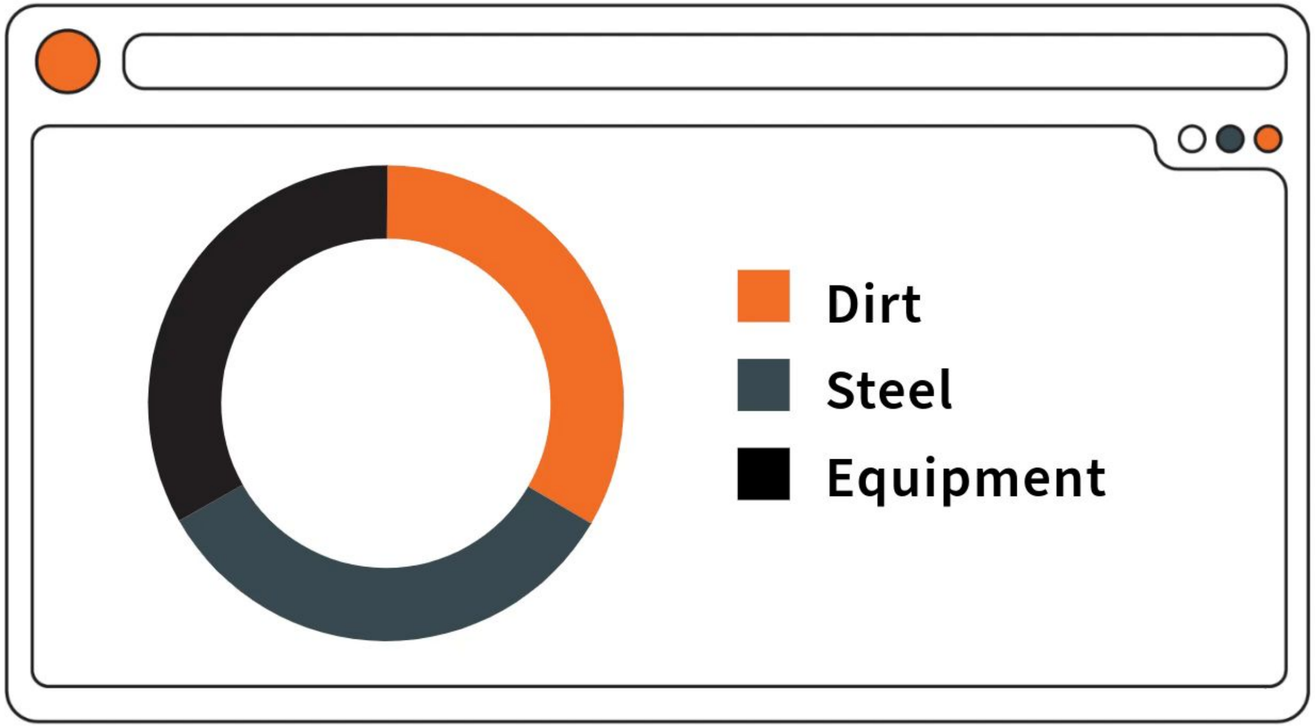


Balancing Act

Why balance is important?

Cutting costs in one area, like piles, can raise expenses elsewhere, such as moving dirt, making a good understanding of trade-offs essential



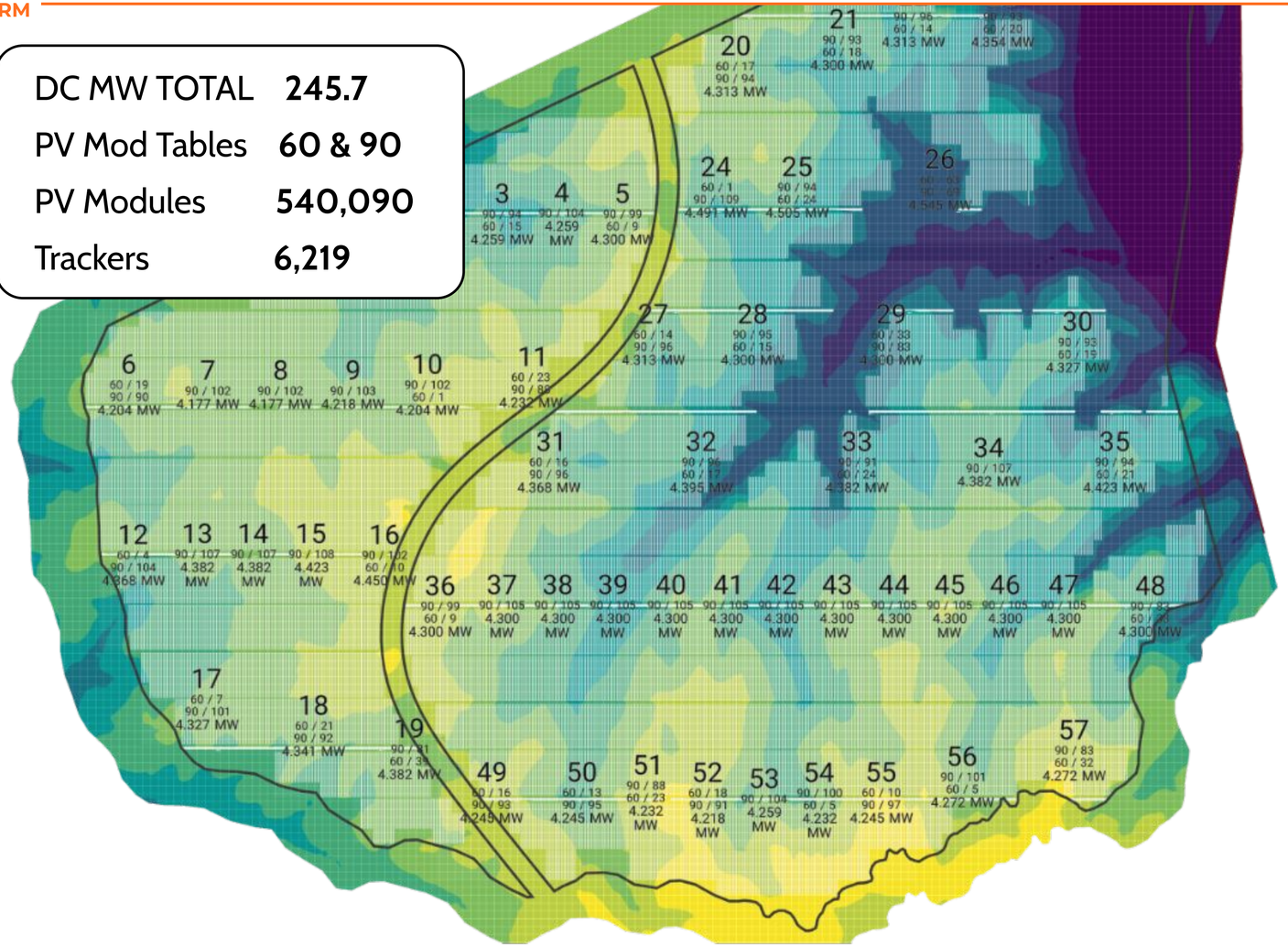


Total Cost

Capital Cost Optioneering

True costs are revealed only by exploring every possible path through careful analysis

DC MW TOTAL	245.7
PV Mod Tables	60 & 90
PV Modules	540,090
Trackers	6,219



Cost Fluctuations Explained

In this experiment, we aim to understand how costs vary based on different grading parameters for a specific solar PV layout, while keeping all other variables constant.

We maintain the same setup across all scenarios, ensuring that the solar PV system's capacity, number of solar modules, and number of trackers remain unchanged.

By standardizing these elements, we isolate the effect of different layout configuration on the project capital cost related to dirt, steel and trackers.

1

GW = 0ft
Rigid Trackers
No bin classes
Net balance: global
Total: $98.53 M
0.401 $/W

2

GW = 1ft
Rigid Trackers
No bin classes
Net balance: global
Total: $95.82 M
0.390 $/W

3

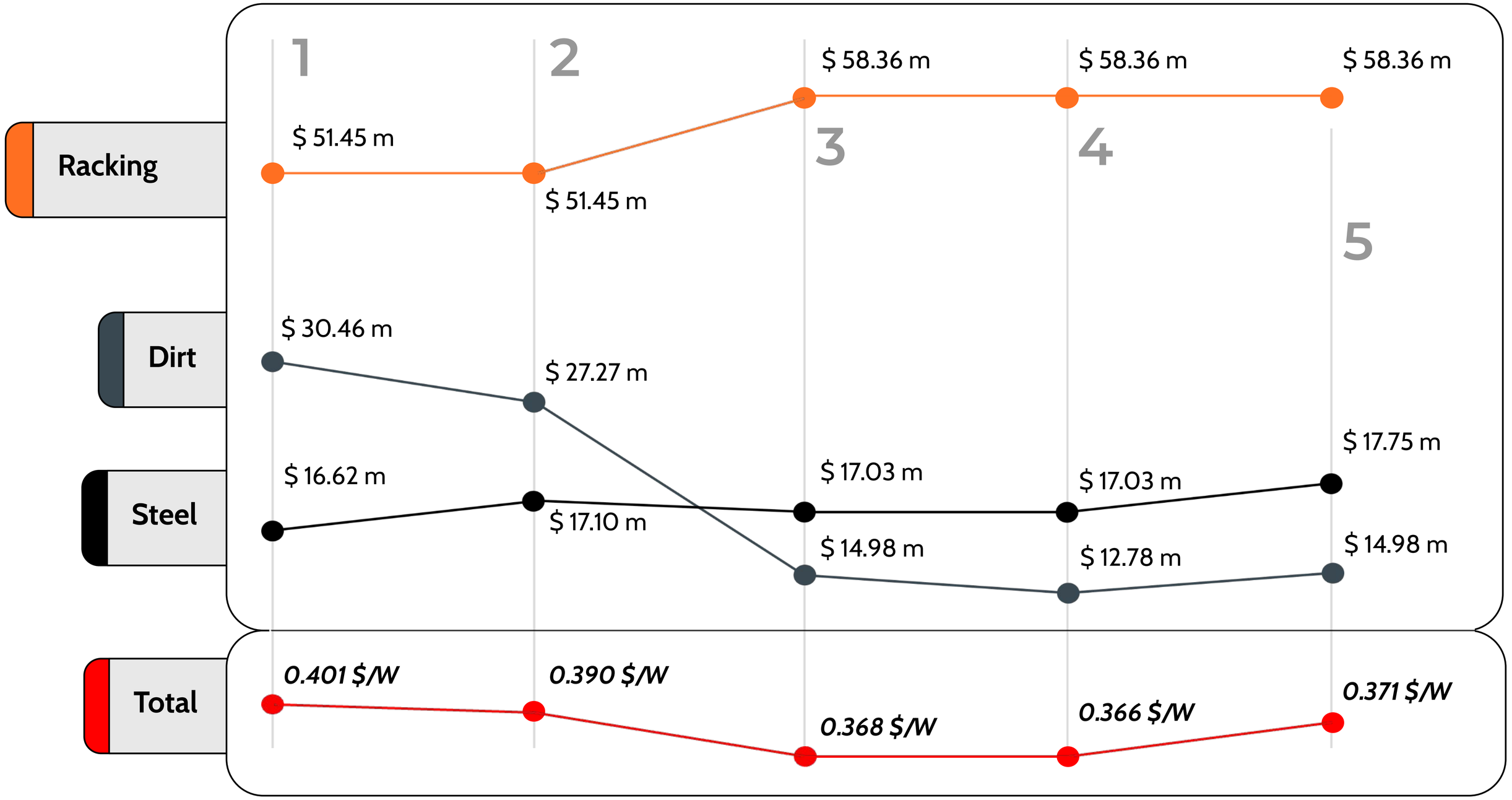
GW = 1ft
Undulated Trackers
No bin classes
Net balance: global
Total: $90.37 M
0.368 $/W

4

GW = 1ft
Undulated Trackers
No bin classes
Net balance: local
Total: $88.17 M
0.366 $/W

5

GW = 1ft
Undulated Trackers
Bin classes
Net balance: global
Total: $91.09 M
0.371 $/W


Racking
Dirt
Steel
Total
1
2
3
4
5
$ 51.45 m
$ 51.45 m
$ 58.36 m
$ 58.36 m
$ 58.36 m
$ 30.46 m
$ 27.27 m
$ 16.62 m
$ 17.10 m
$ 17.03 m
$ 17.03 m
$ 17.75 m
$ 14.98 m
$ 12.78 m
$ 14.98 m
0.401 $/W
0.390 $/W
0.368 $/W
0.366 $/W
0.371 $/W

Parameters Driving Capital Cost

Cost has good reasons to fluctuate

Grading Window & Pile Reveal

A. Maximum Flood Depth

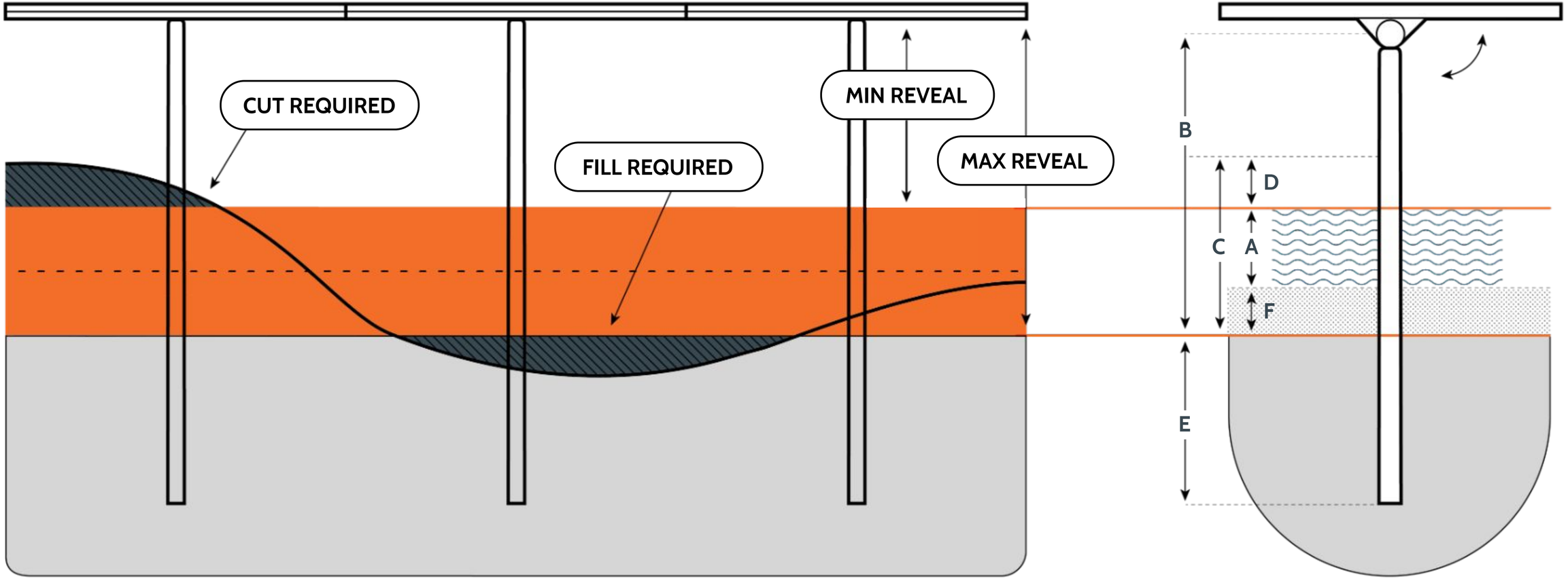
B. Pile Reveal

C. Minimum Ground Clearance

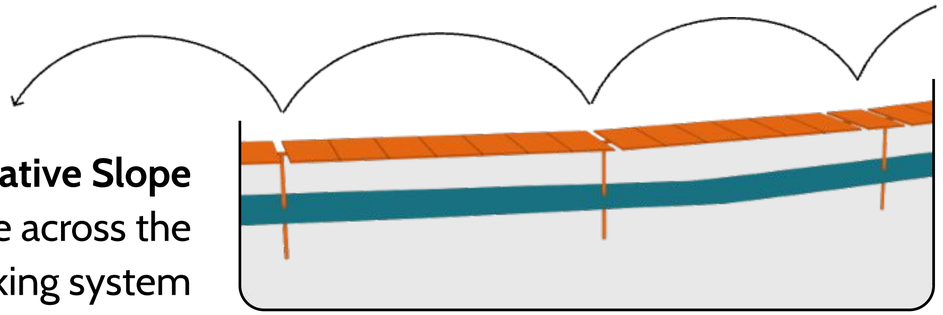
D. Minimum Free Board

E. Pile Embedment

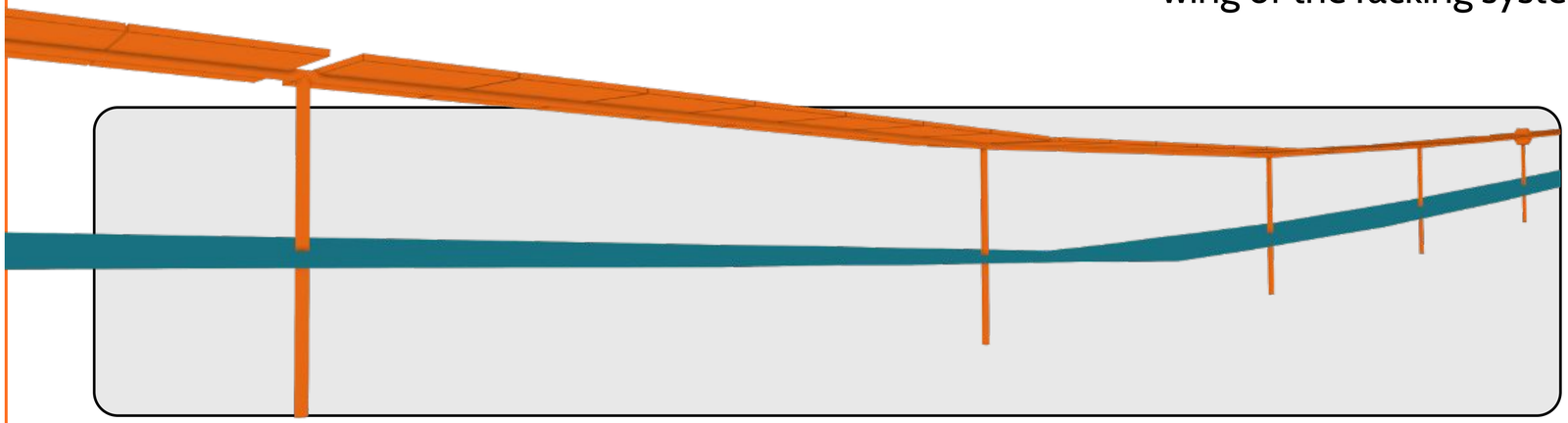
F. Subcontractor Tolerance



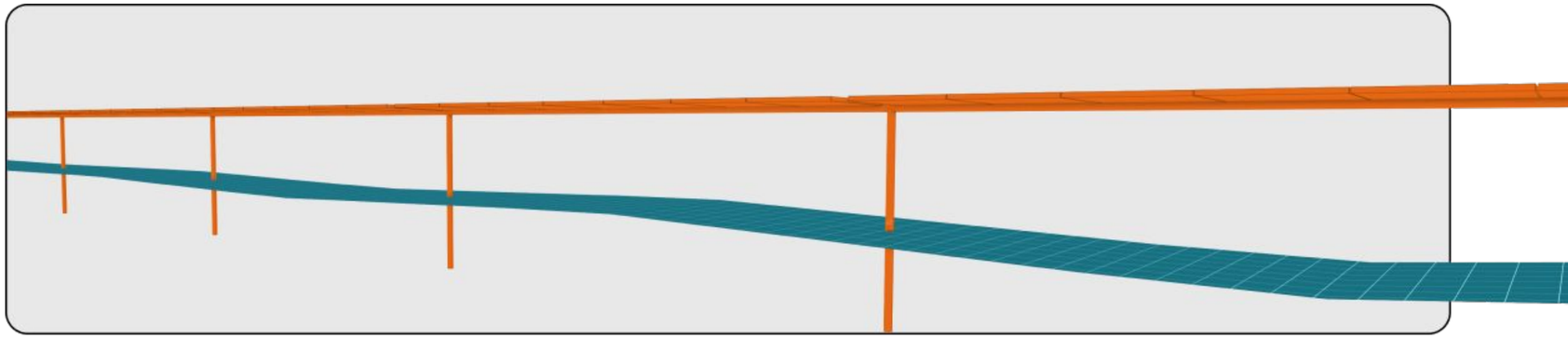
Manufacturer Constraints



Cumulative Slope
This is the total slope across the wing of the racking system



Bay-to-Bay Slope Change
Deals with variations in slope between adjacent bays of the racking system



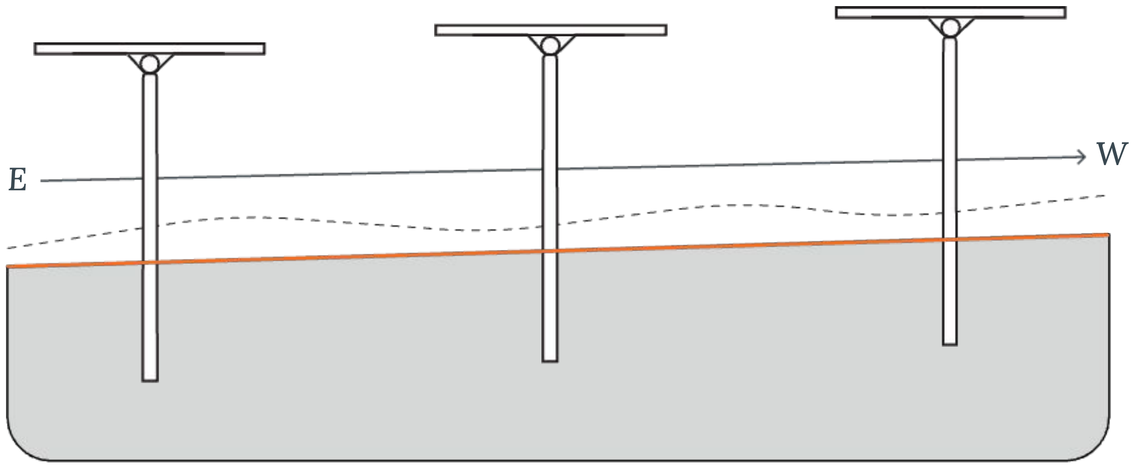
Slope Along the Axis
Allowable slope that racking system can handle along their bays

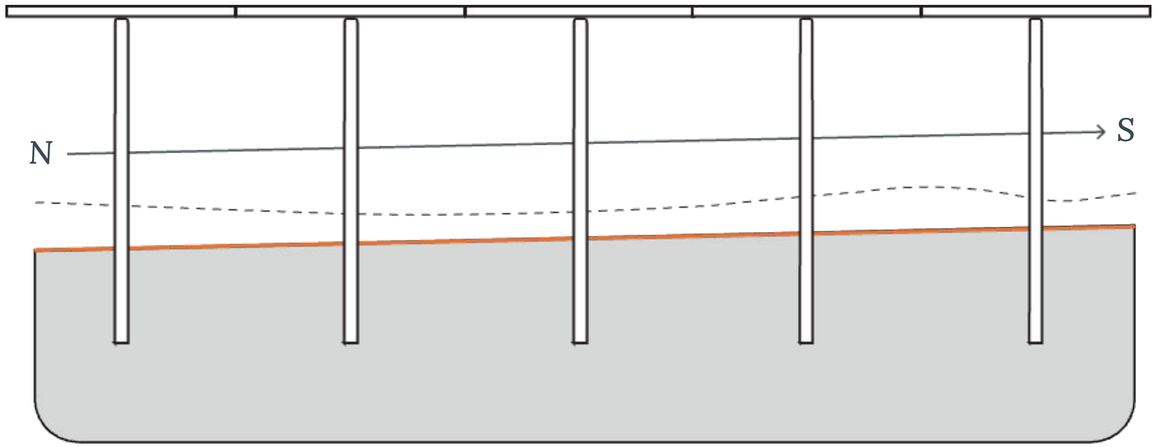
Grading Constraints

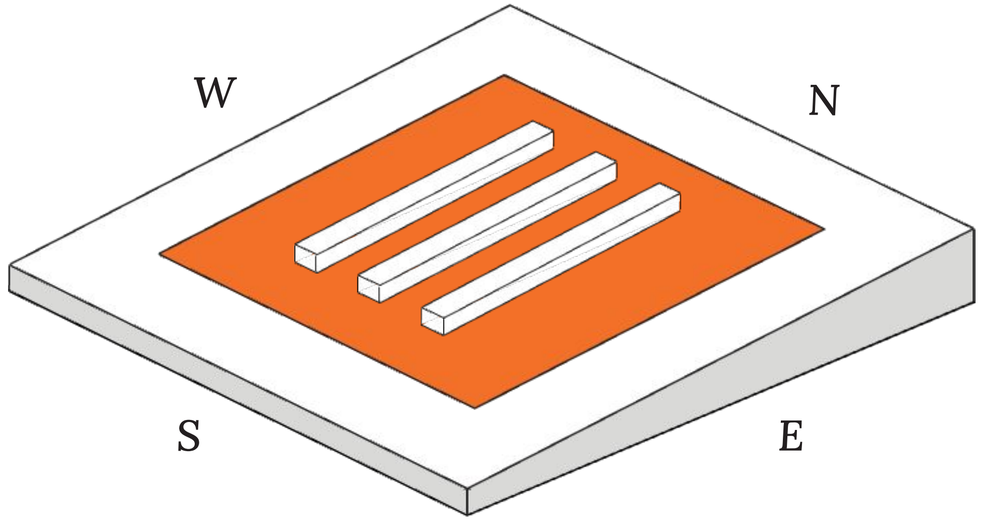
Within every obstacle lies a hidden opportunity

EW Terrain Slope

A setting used to adjust the terrain slope in both array areas and surrounding regions

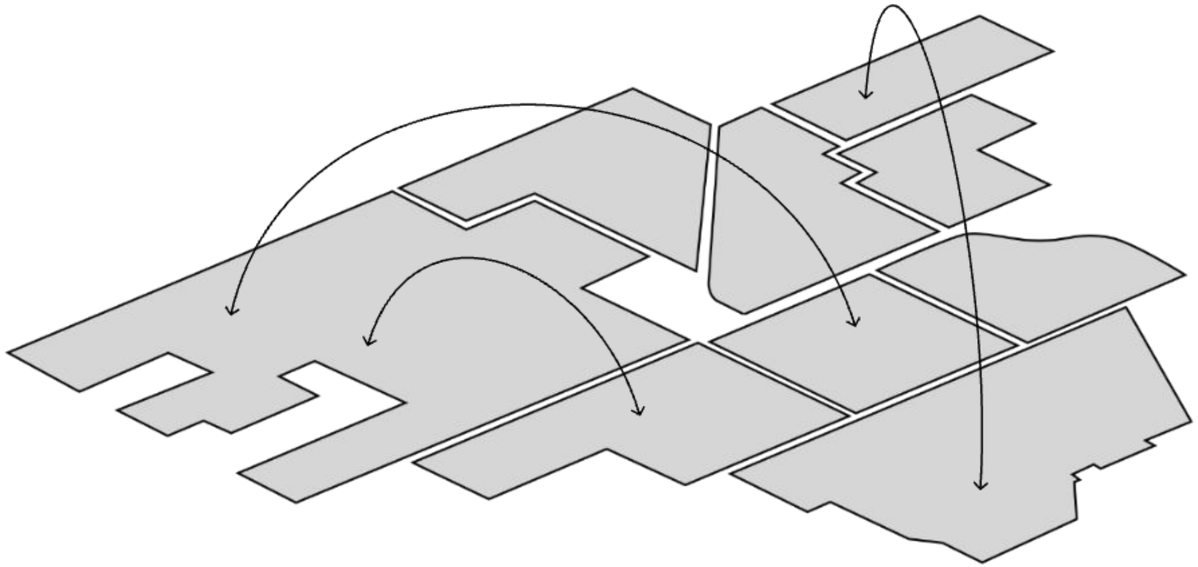


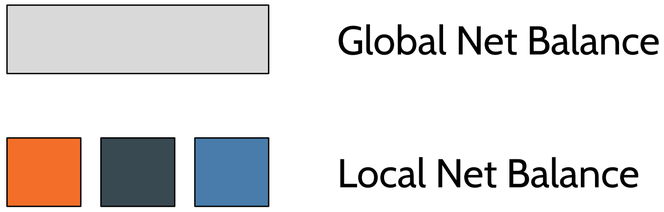




NS Terrain Slope

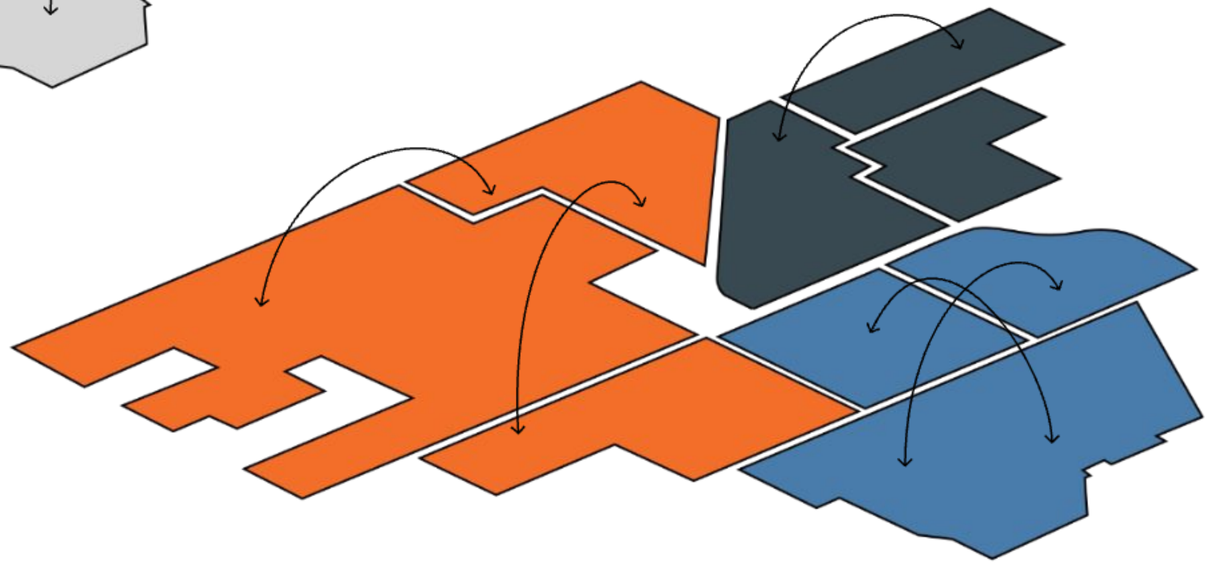
A setting used to adjust the terrain slope in both array areas and surrounding regions. It allows for different slopes to be set for the north and south directions





Net Balance

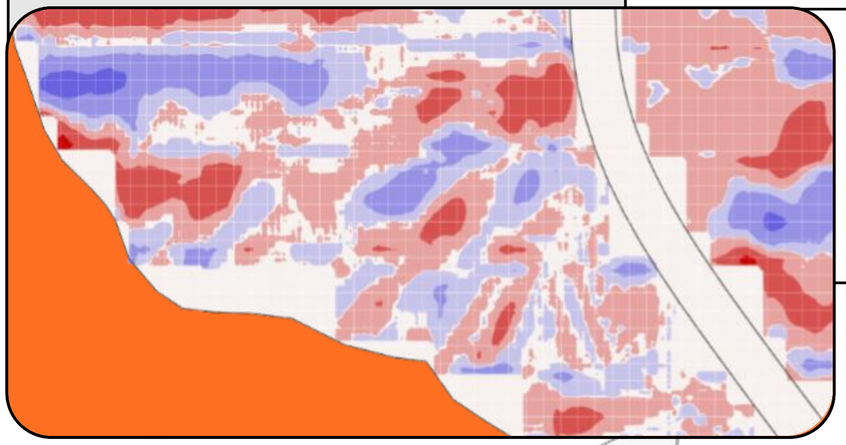
Net balance can be achieved locally by dividing the site into smaller sections and moving dirt only within those sections. This approach avoids moving soil over long distances, saving time and resources while staying within the allowed areas.



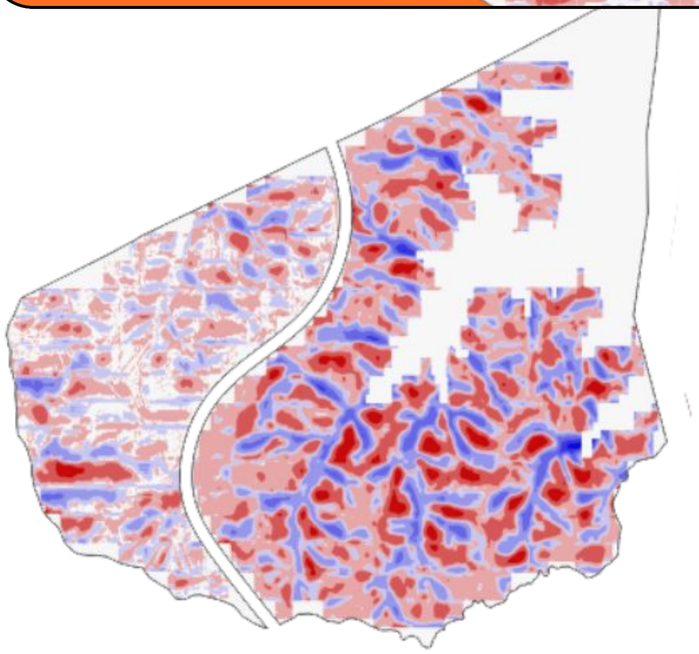
Workflows

Cut & Fill vs Piles

1.5 ft Grading Window

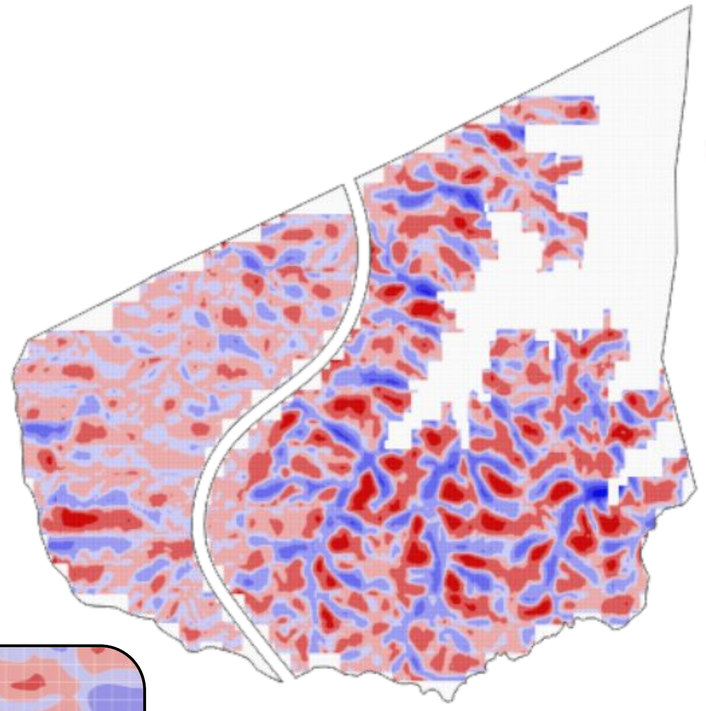


Trackers	$51.45M	0.2094 $/W
Piles	$17.44M	0.071 $/W
Dirt	$24.77M	0.1008 $/W
Total	***$93.7M***	***0.3812 $/W***

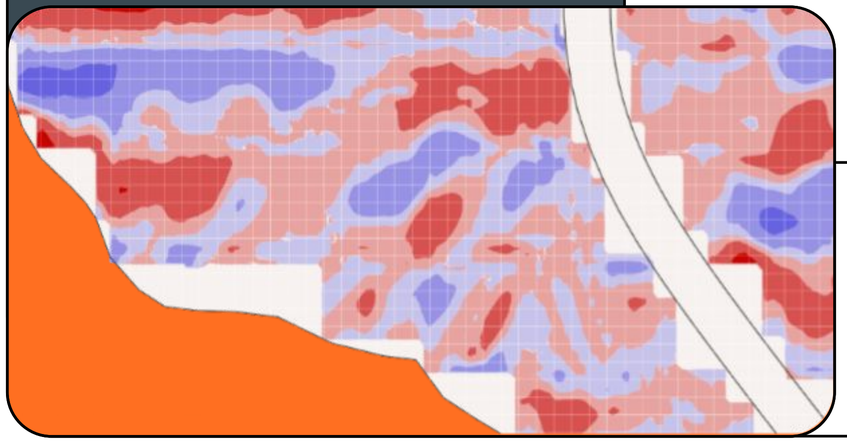


Piles ⬇️ 3.6%

Dirt ⬆️ 13.8%

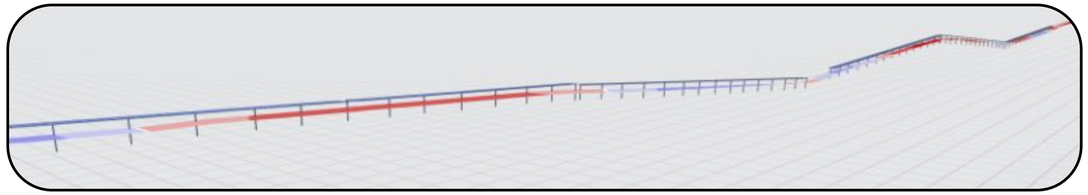


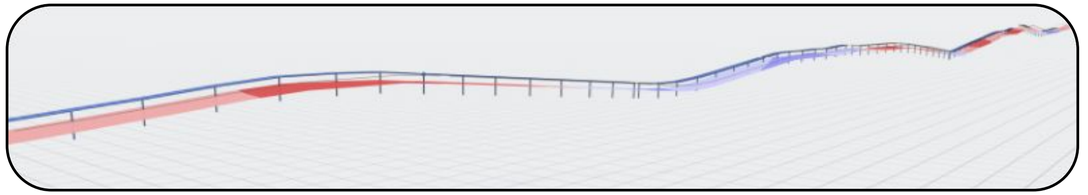
0.5 ft Grading Window

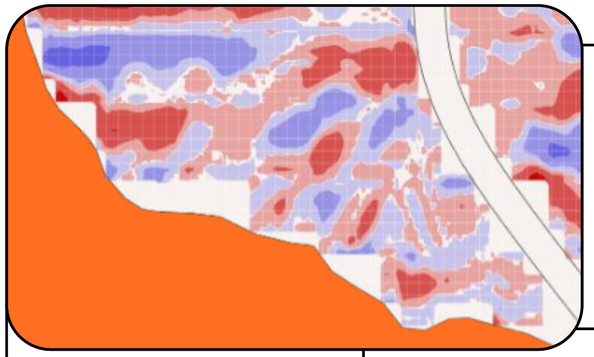


Trackers	$51.45M	0.2094 $/W
Piles	$16.81M	0.0648 $/W
Dirt	$28.72M	0.1169 $/W
Total	***$96.98M***	***0.3947 $/W***

Rigid vs Terrain Following Trackers



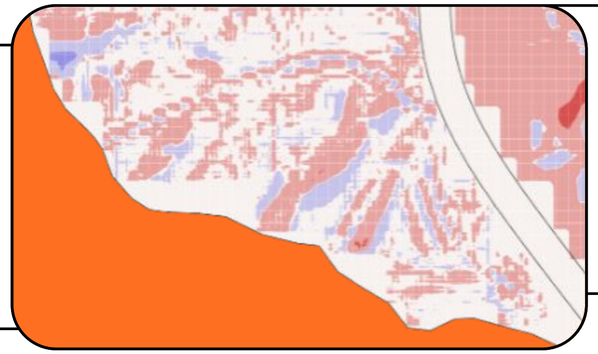




Total $96.98M

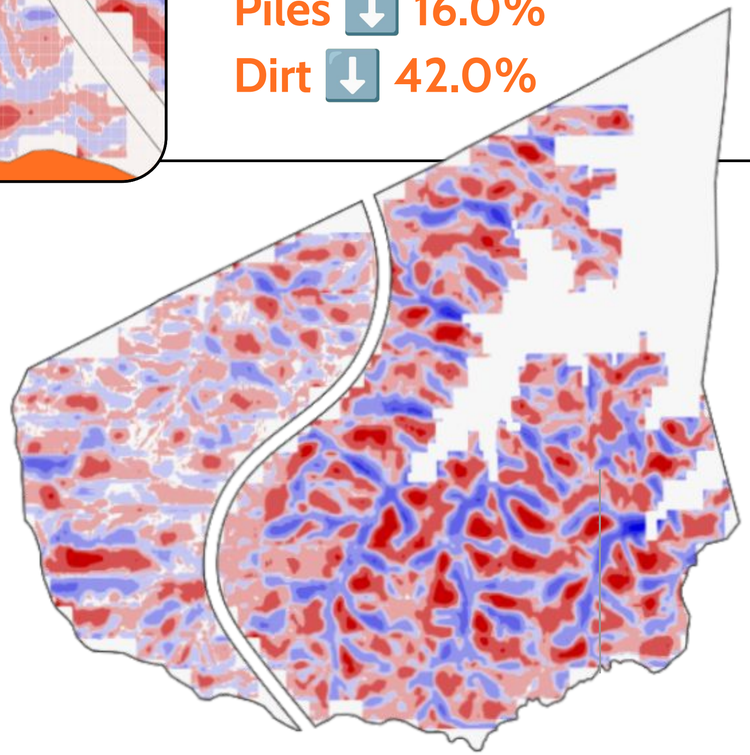
Trackers	$51.5M
Piles	$16.81M
Dirt	$28.72M

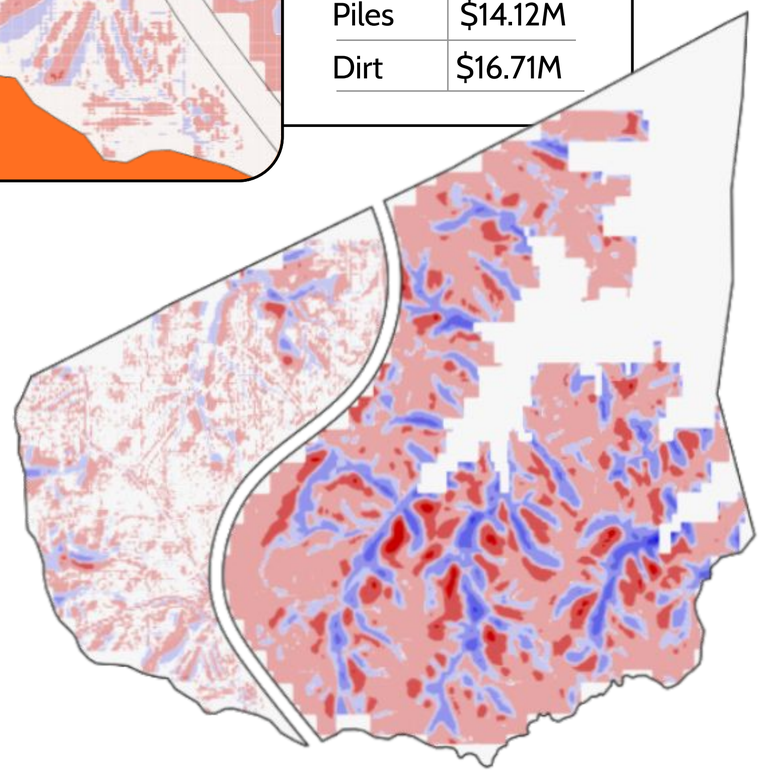
Trackers ⬆️ 9.8%
Piles ⬇️ 16.0%
Dirt ⬇️ 42.0%



Total $87.94M

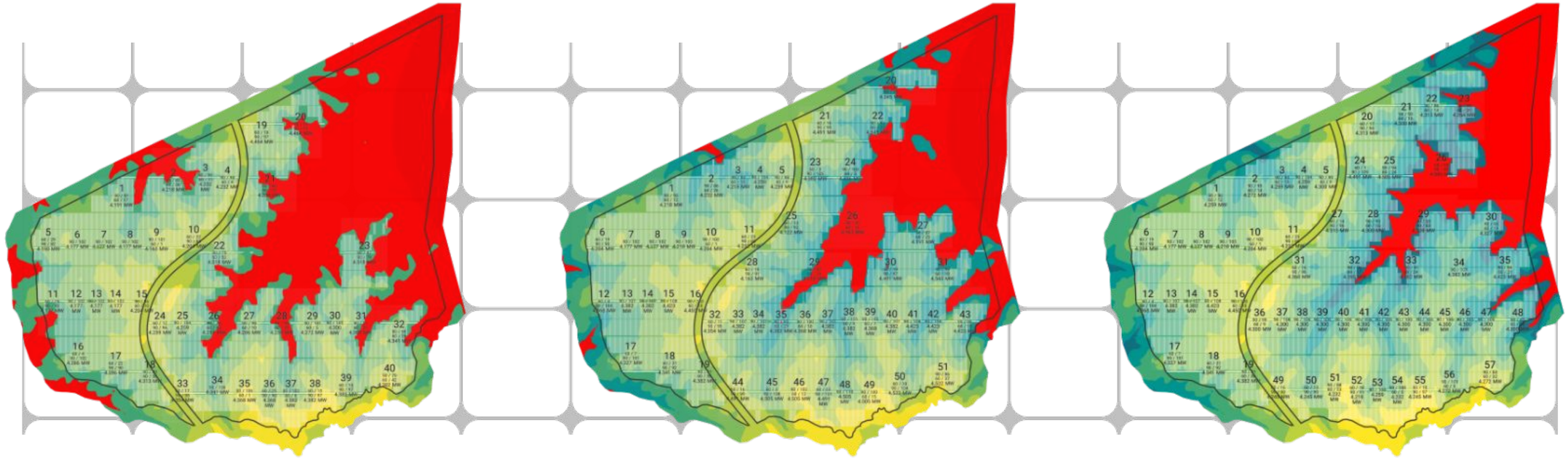
Trackers	$57.11M
Piles	$14.12M
Dirt	$16.71M





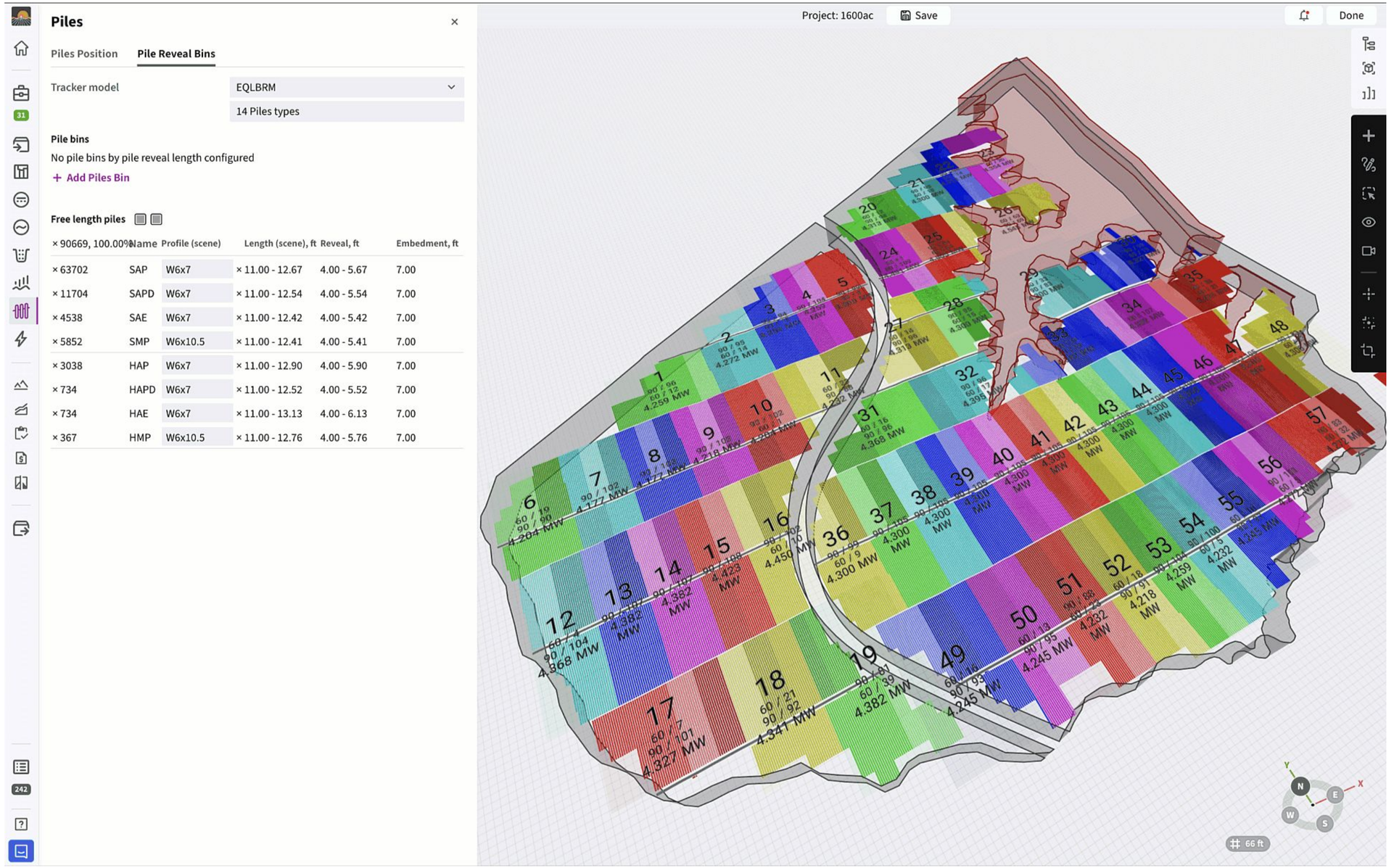
Grading Capital Cost Analysis

Every step forward comes with a higher price



0.366$/W	0.399 $/W	0.469$/W
171.4MWdc	222.2MWdc	245.7MWdc
$62.69M	$88.69M	$115.21M

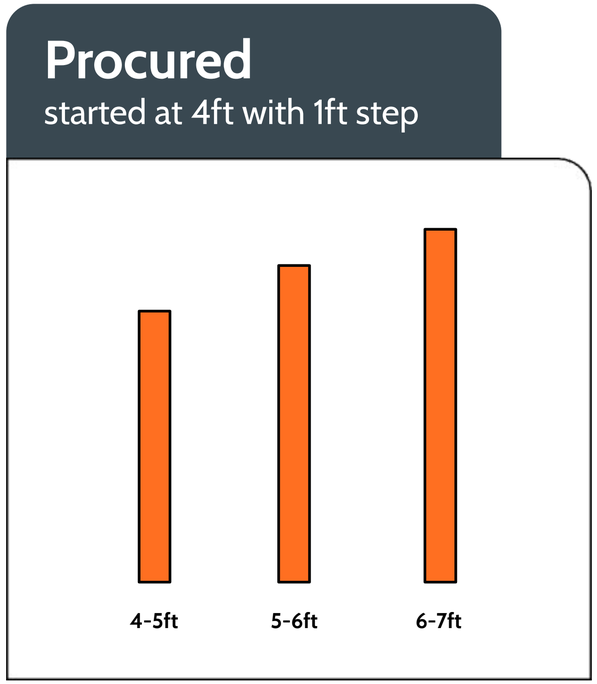
Piles Bin Classes Analysis



Piles Bin Classes Analysis

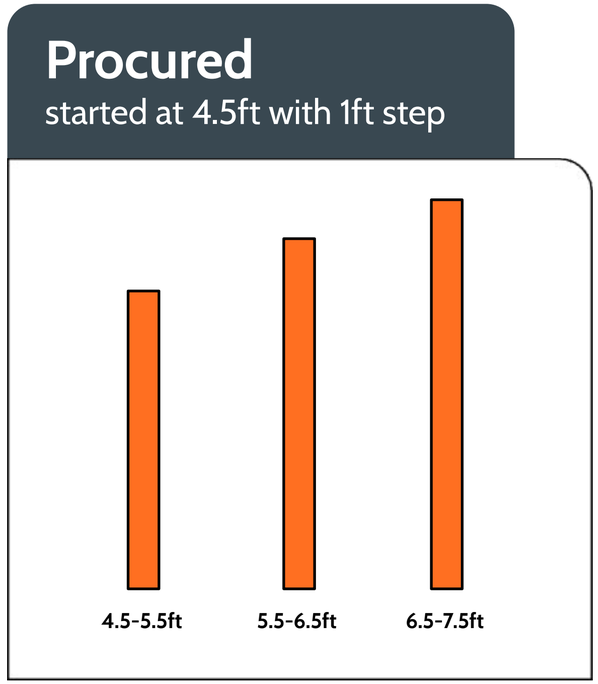
After design, pile lengths determined taking into account the grading strategy

3783 tons of steel



For procurement, pile lengths begin at the 4 ft reveal bin and increase in 1 ft increments

4118 tons of steel



For procurement, pile lengths start at the 4.5 ft reveal bin and increase in 1 ft increments

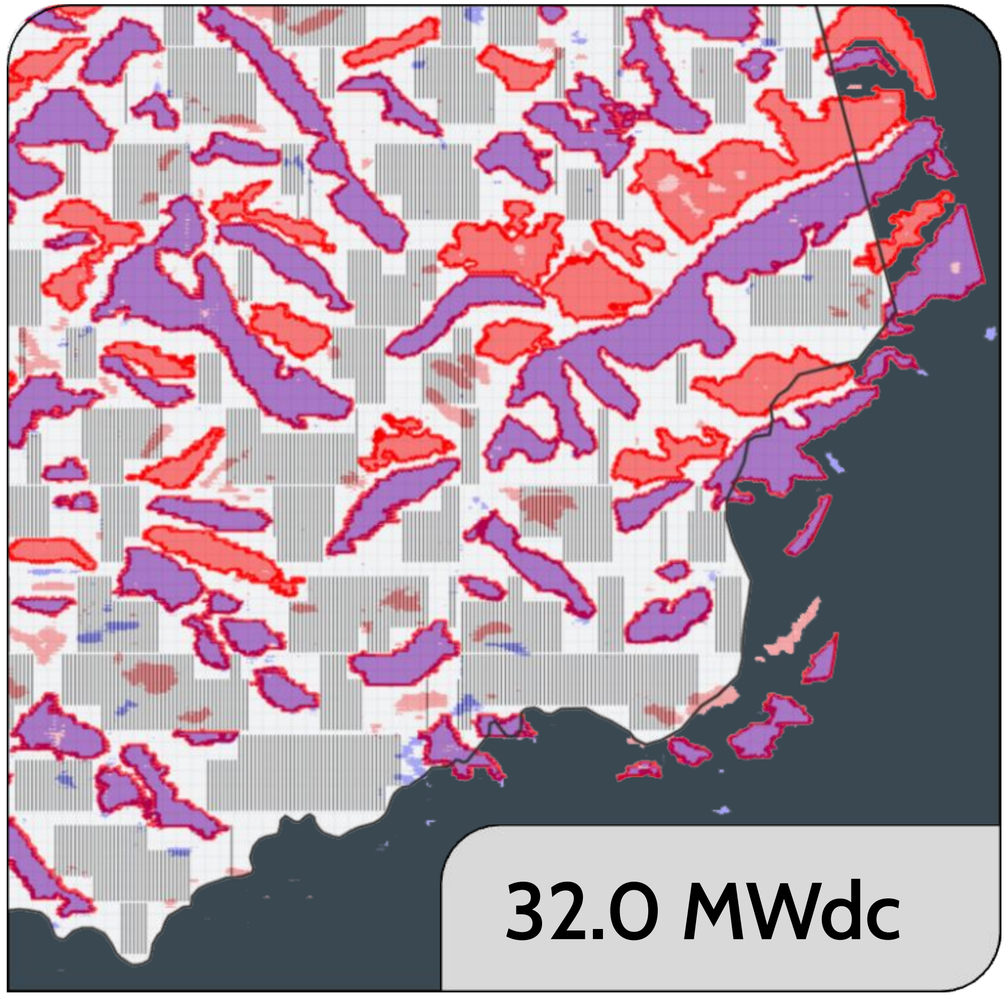
4041 tons of steel

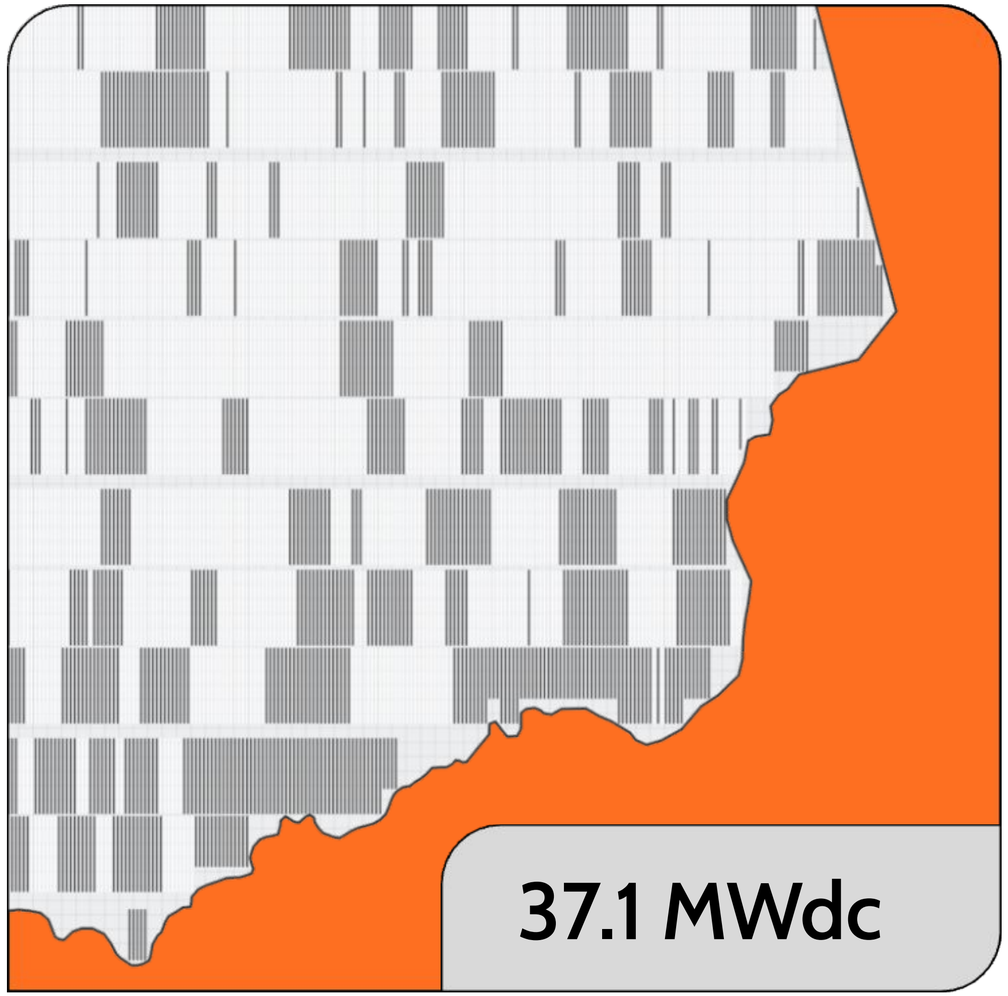
Insights

With PVFARM

Exclusion Areas

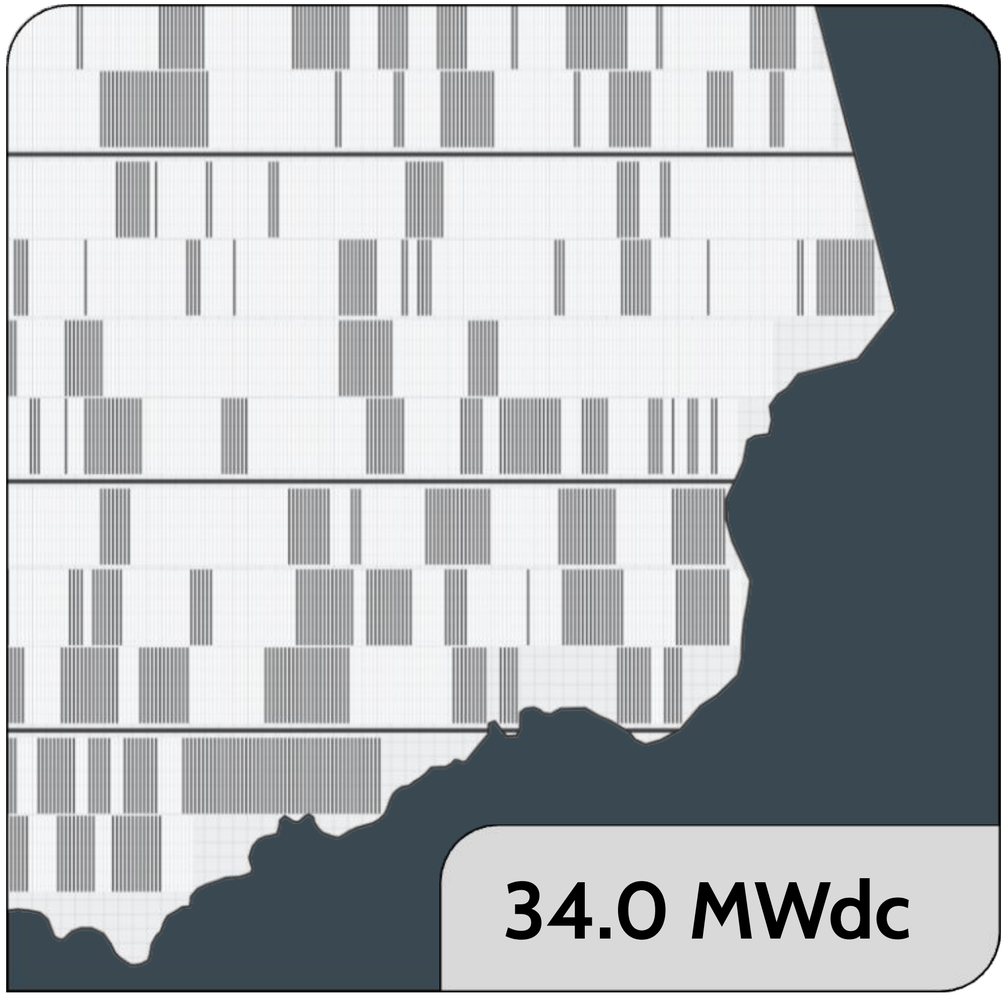
Slopes-first vs Trackers-first

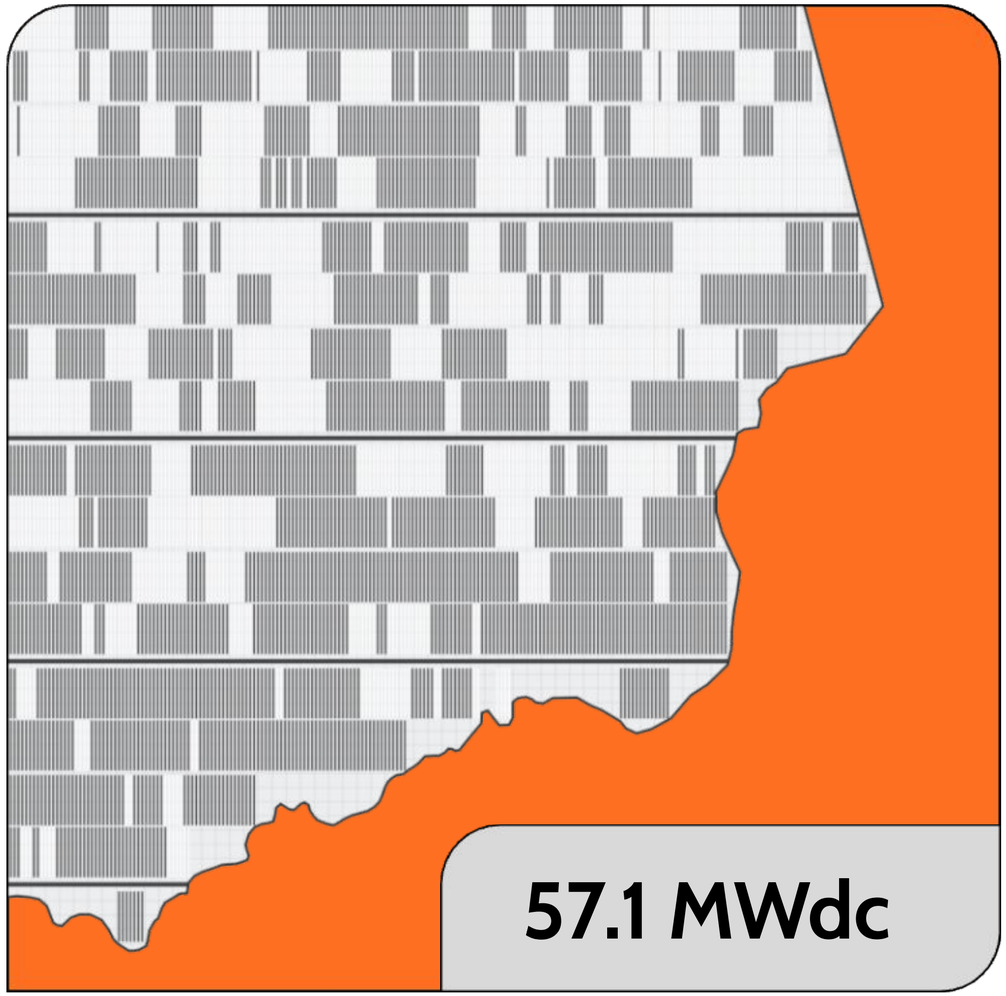




Exclusion Areas

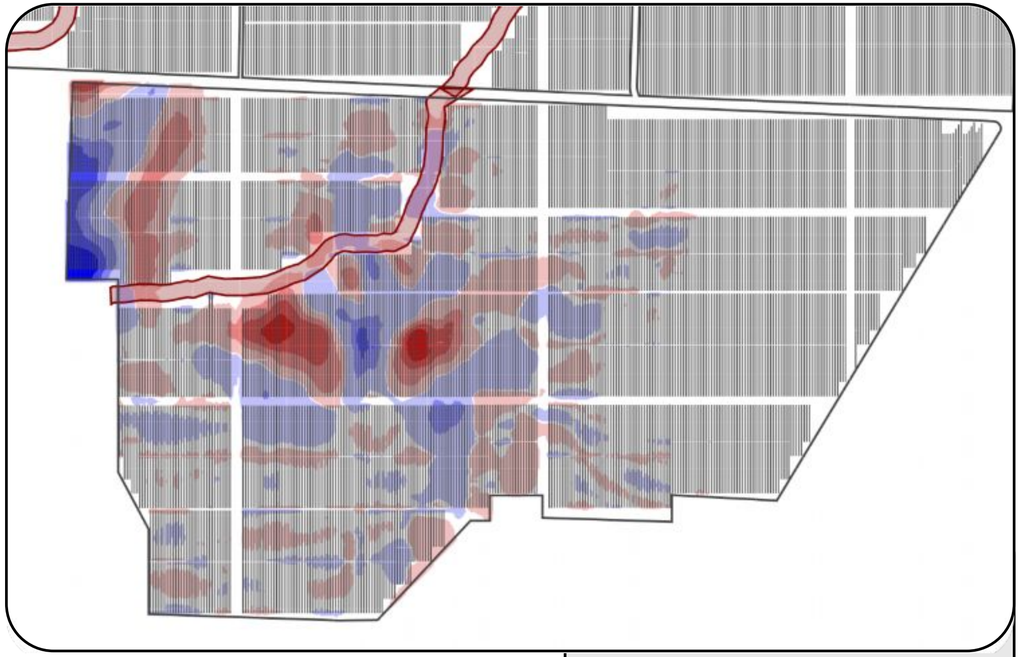
Long Trackers vs Short Trackers





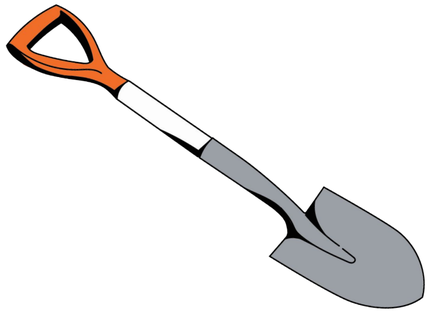
Grid Size Matters

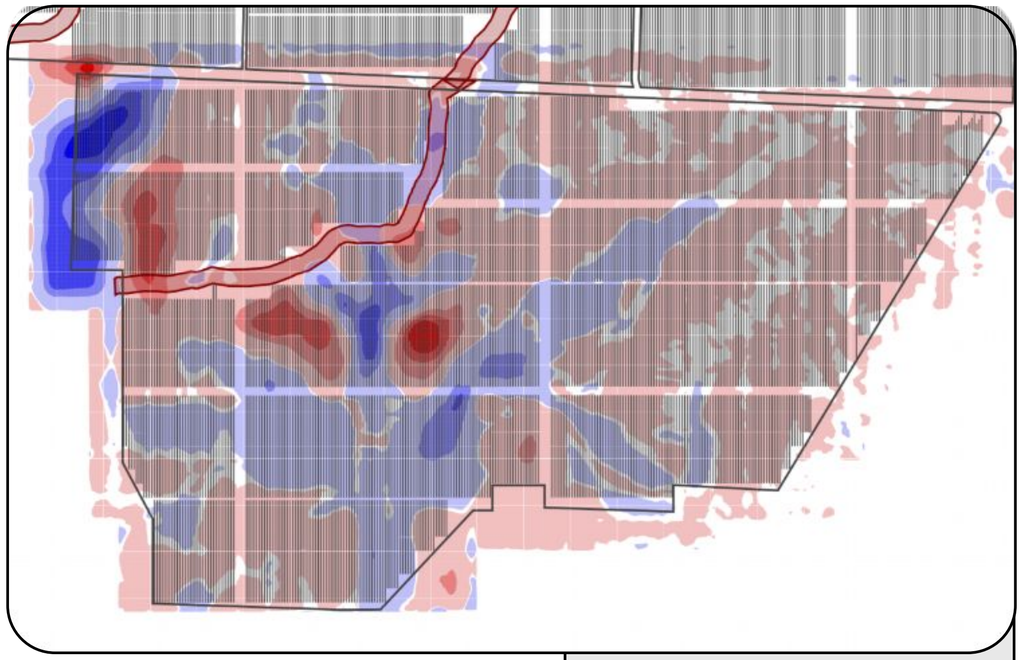
When you balance Dirt, Steel and Equipment



Cut: 64,000 Y3

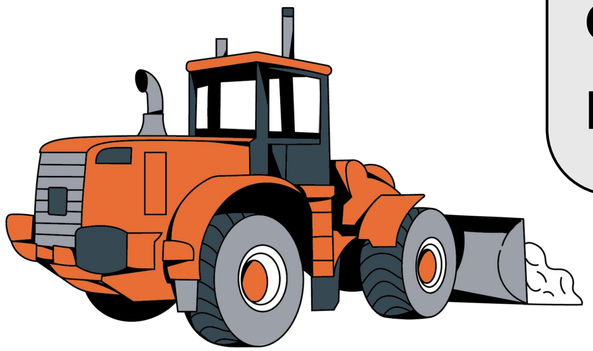
Fill: 65,000 Y3





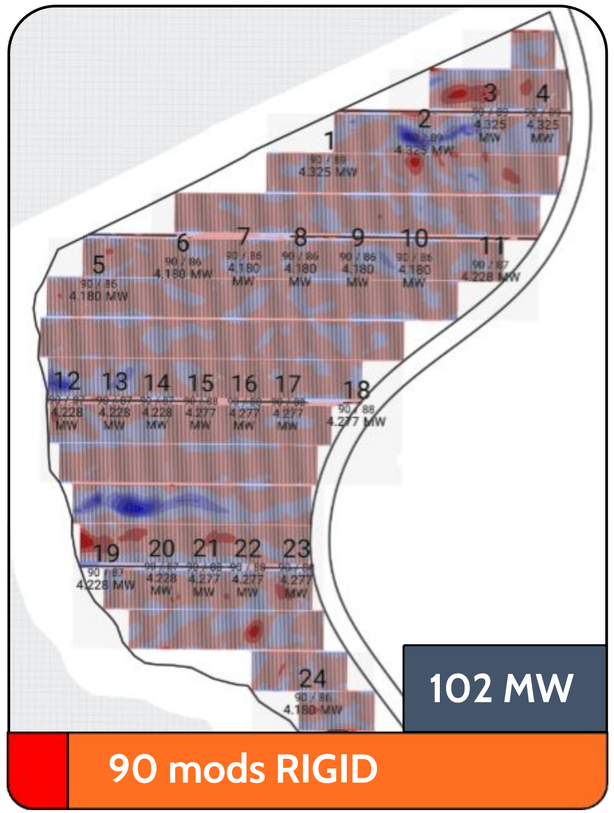
Cut: 143,000 Y3

Fill: 138,000 Y3



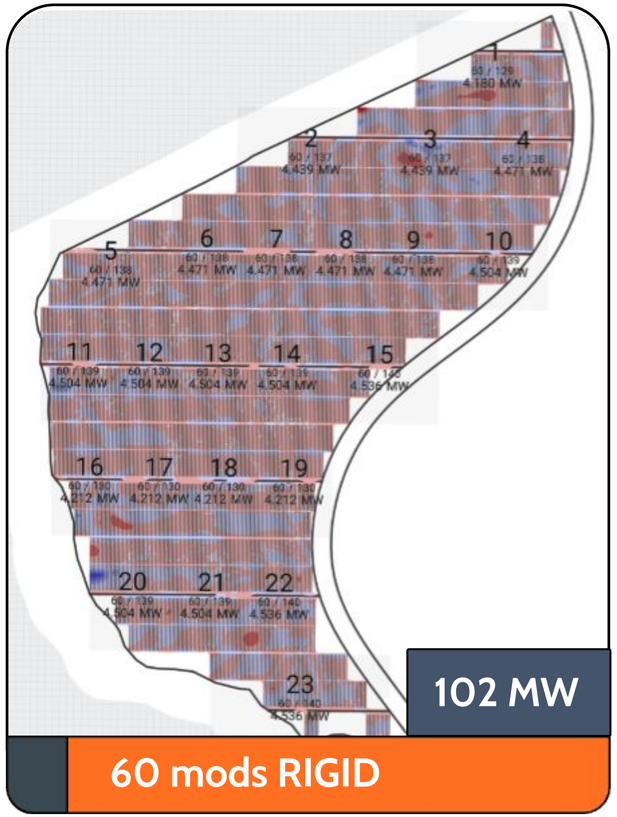
Tracker Size Matters

When you balance Dirt, Steel and Equipment



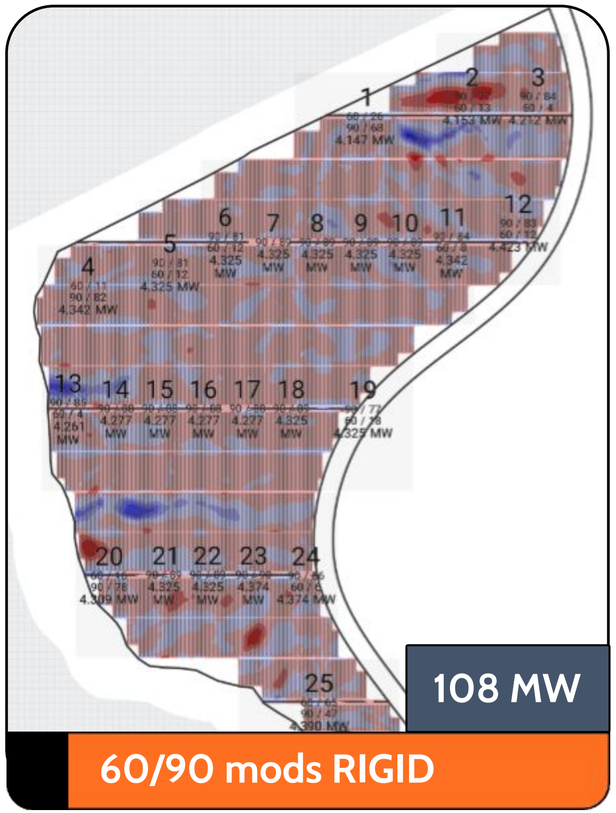
90 mods RIGID

Trackers	$17.9M	0.1753 $/W
Piles	$5.9M	0.0584 $/W
Dirt	$3.6M	0.0354 $/W
Total	***$27.4M***	***0.2691 $/W***



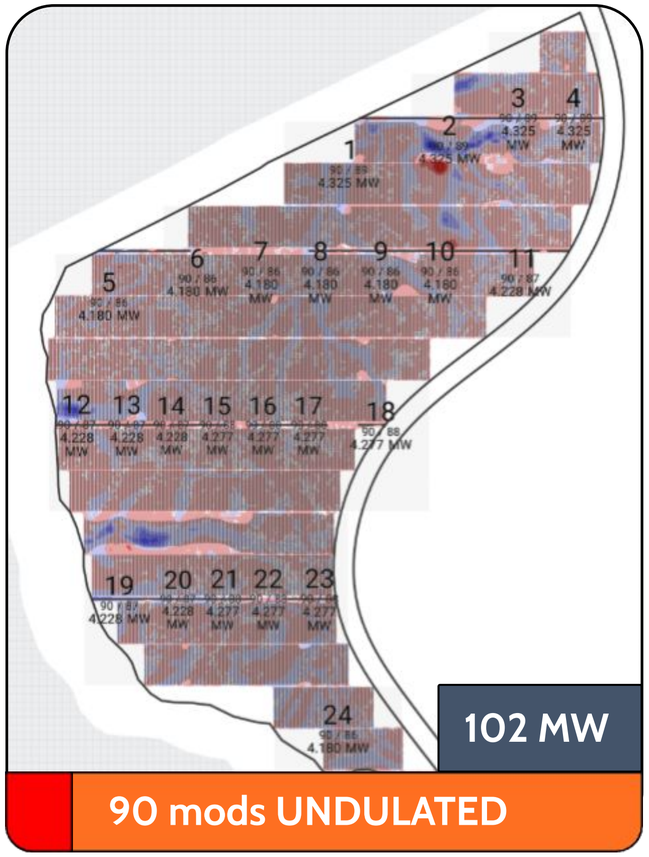
60 mods RIGID

Trackers	$18.7M	0.1838 $/W
Piles	$6.6M	0.0646 $/W
Dirt	$1.8M	0.0176 $/W
Total	***$27.1M***	***0.2660 $/W***



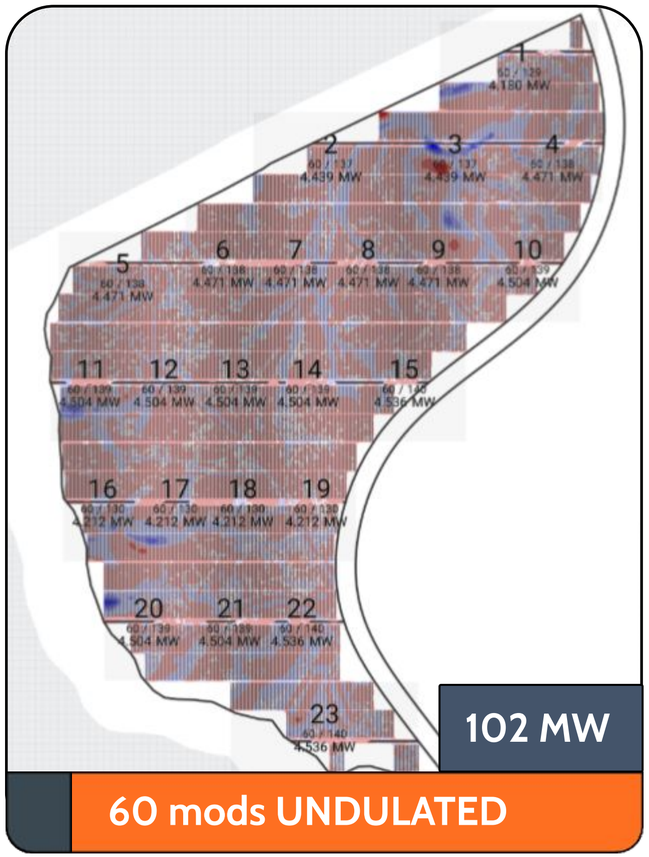
60/90 mods RIGID

Trackers	$19.0M	0.1762 $/W
Piles	$6.3M	0.0586 $/W
Dirt	$3.8M	0.0349 $/W
Total	***$29.1M***	***0.2697 $/W***



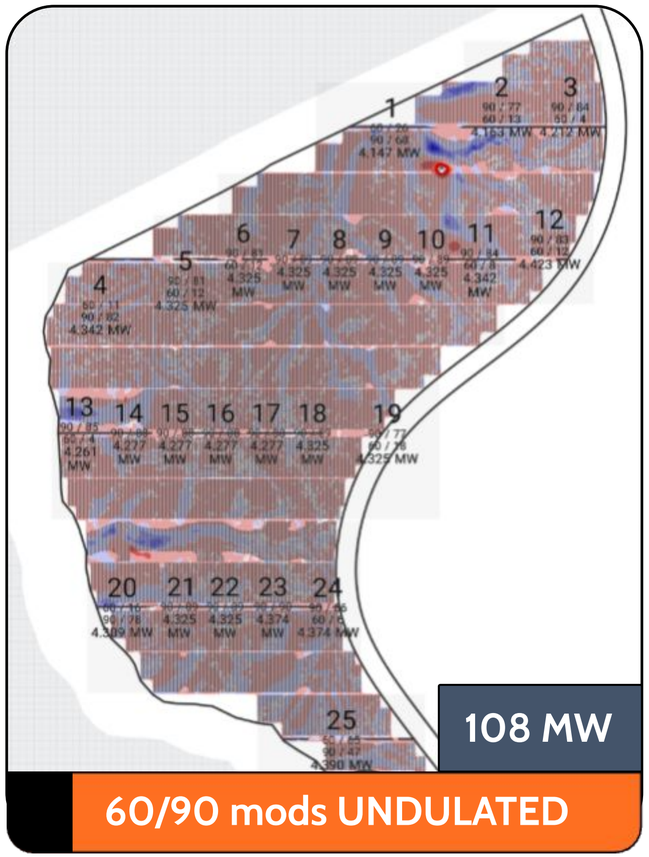
90 mods UNDULATED

Trackers	$20.6M	0.2016 $/W
Piles	$5.9M	0.0576 $/W
Dirt	$0.8M	0.0076 $/W
Total	***$27.3M***	***0.2668 $/W***



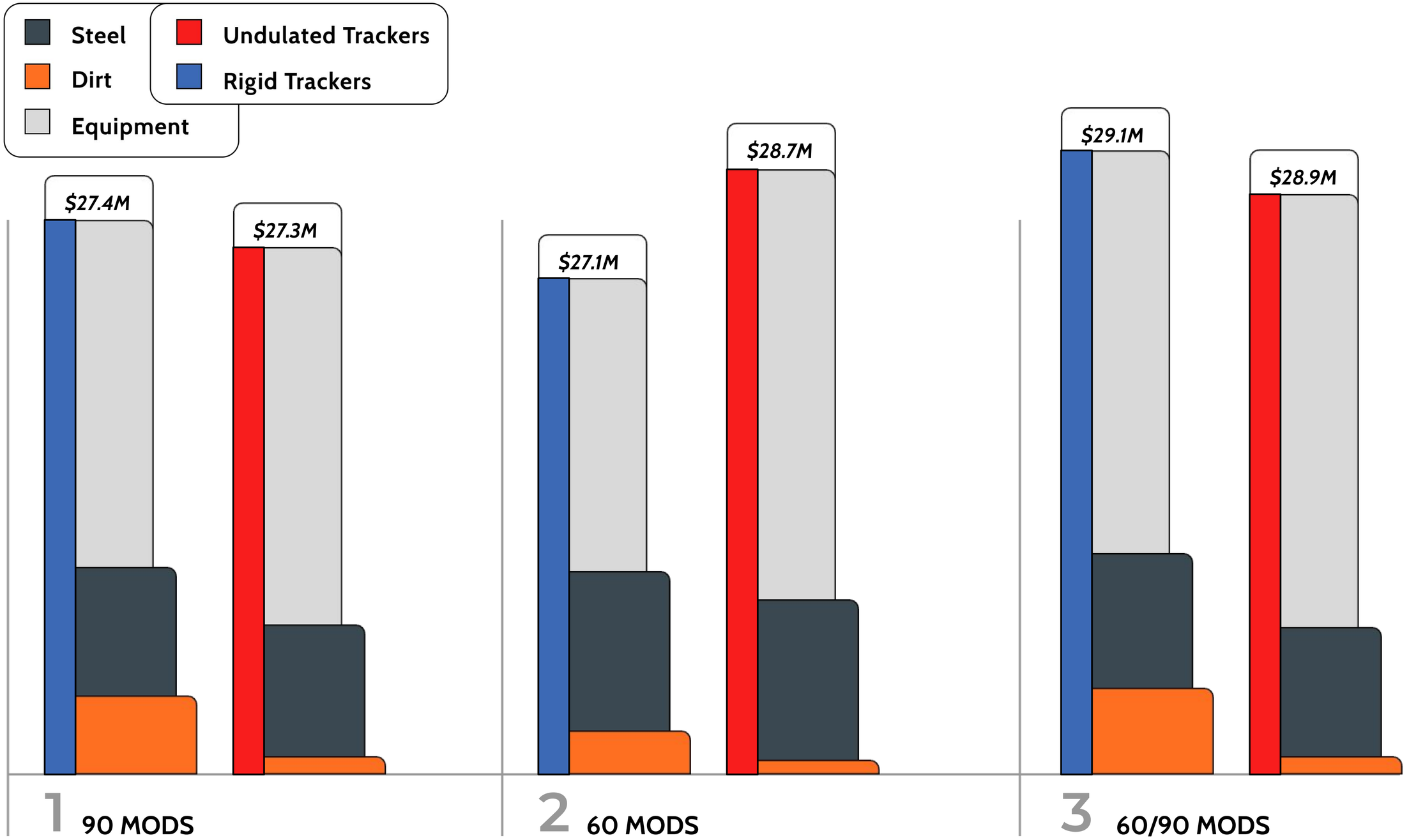
60 mods UNDULATED

Trackers	$21.5M	0.2114 $/W
Piles	$6.5M	0.0639$/W
Dirt	$0.7M	0.0071 $/W
Total	***$28.7M***	***0.2824 $/W***



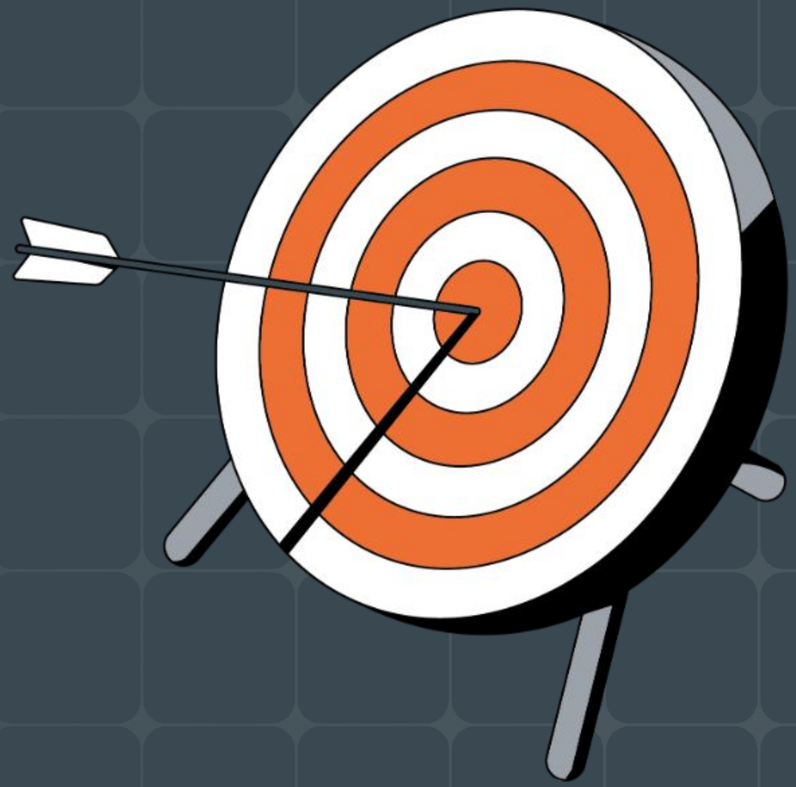
60/90 mods UNDULATED

Trackers	$21.9M	0.2026 $/W
Piles	$6.2M	0.0580 $/W
Dirt	$0.8M	0.0072 $/W
Total	***$28.9M***	***0.2678 $/W***

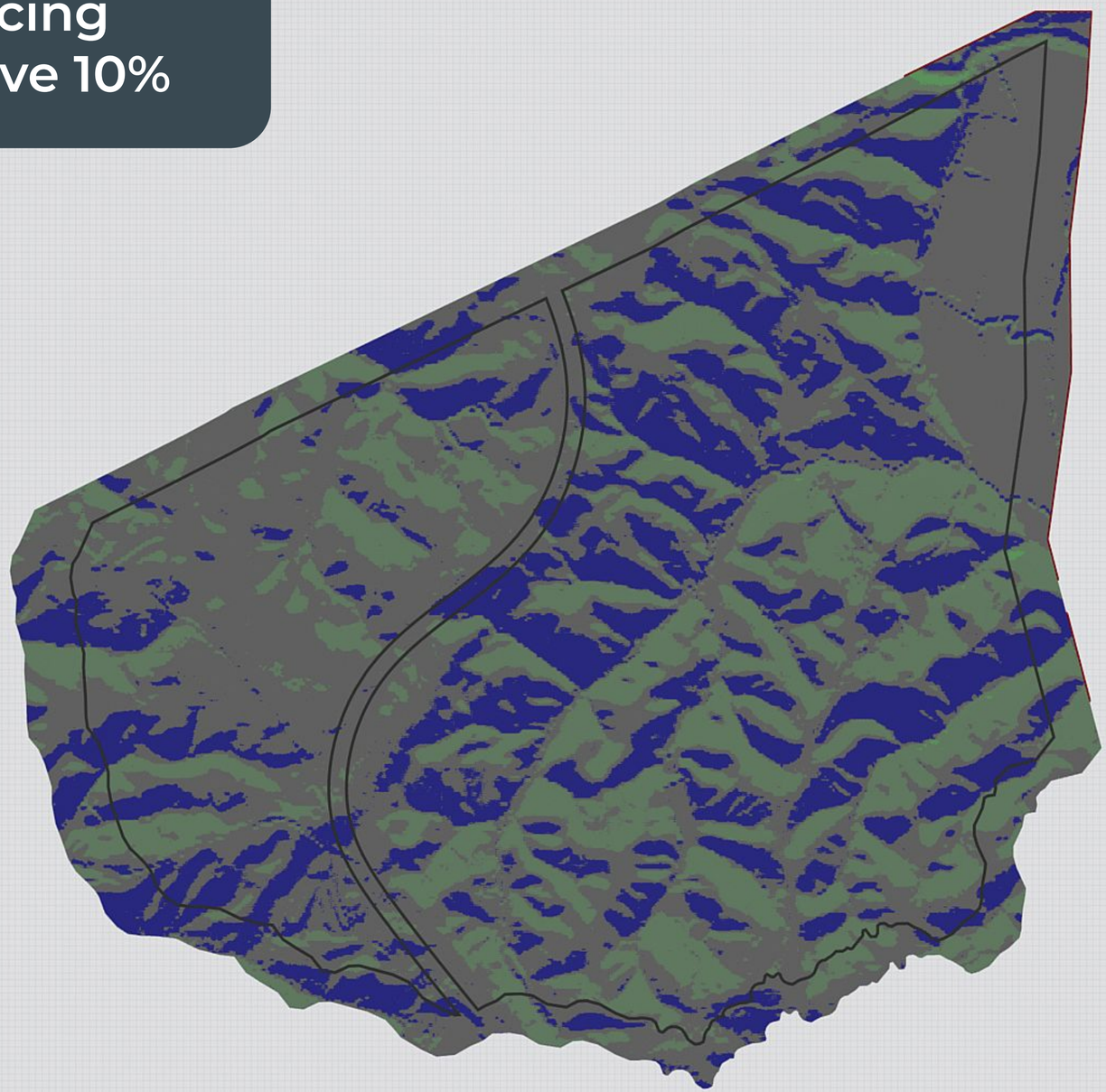

Steel
Dirt
Equipment
Undulated Trackers
Rigid Trackers
$27.4M
$27.3M
$27.1M
$28.7M
$29.1M
$28.9M
1 90 MODS
2 60 MODS
3 60/90 MODS

“How to … ?”

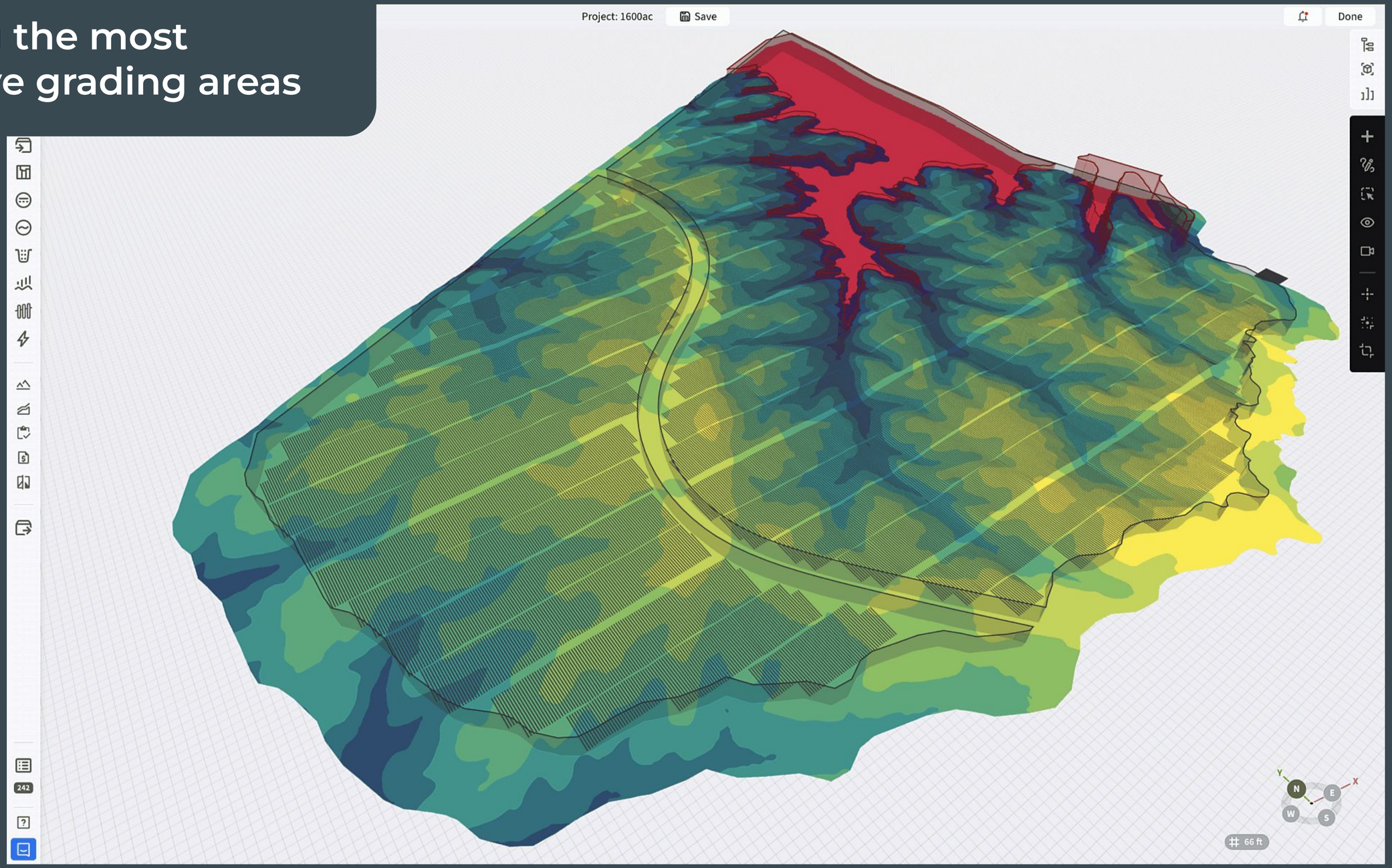
With PVFARM



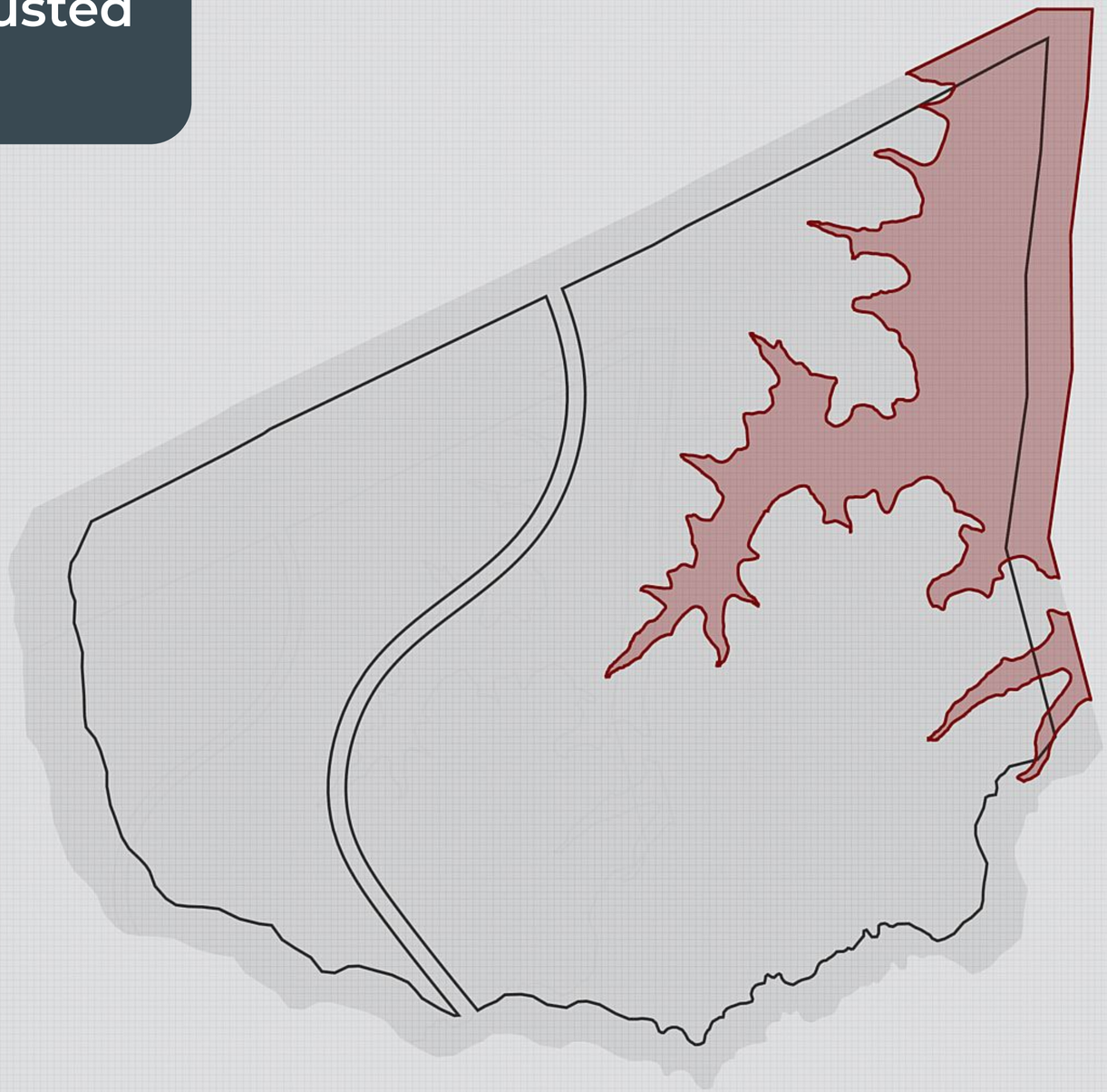
Avoiding north-facing terrain slopes above 10%



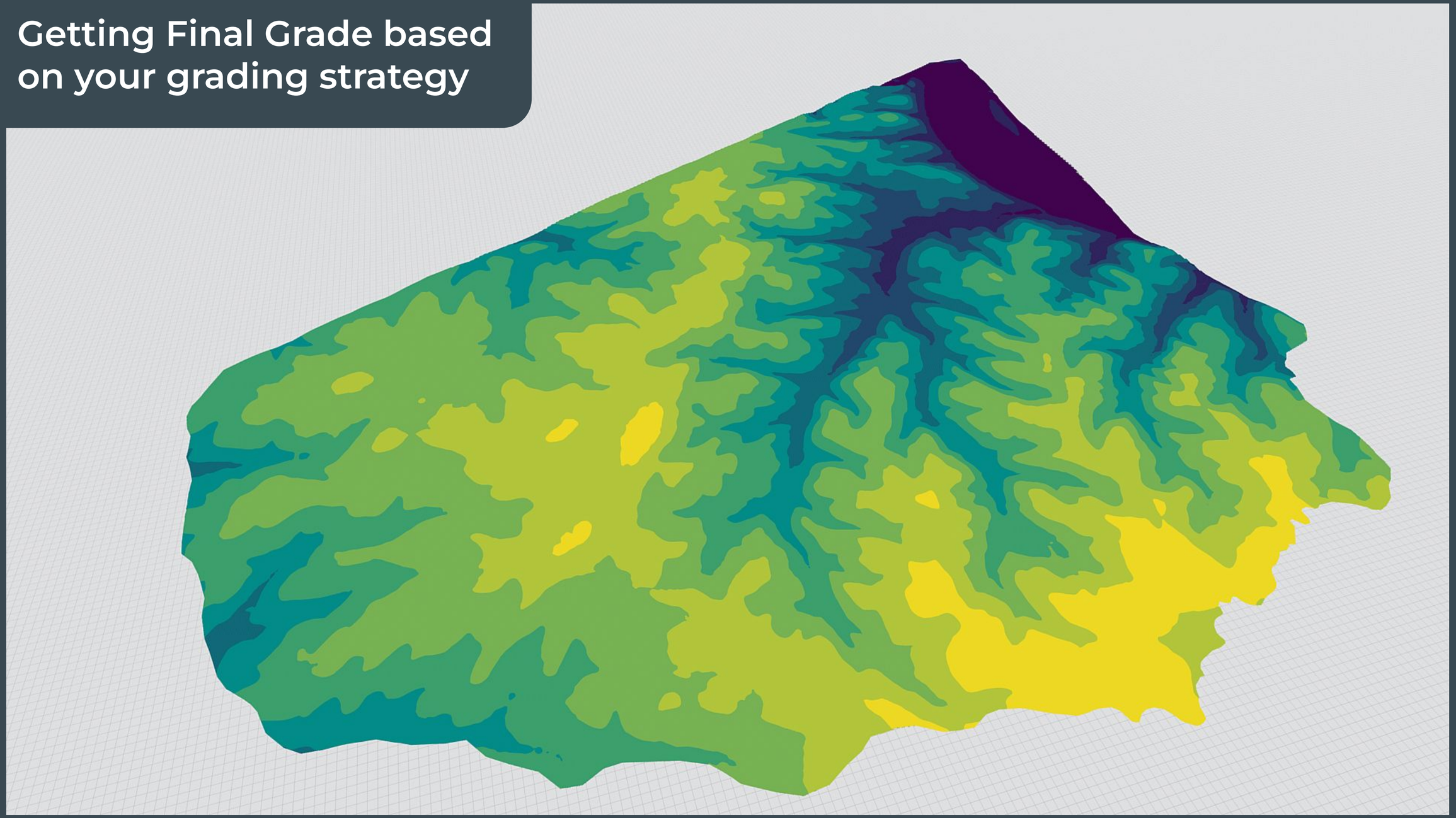
Avoiding the most expensive grading areas



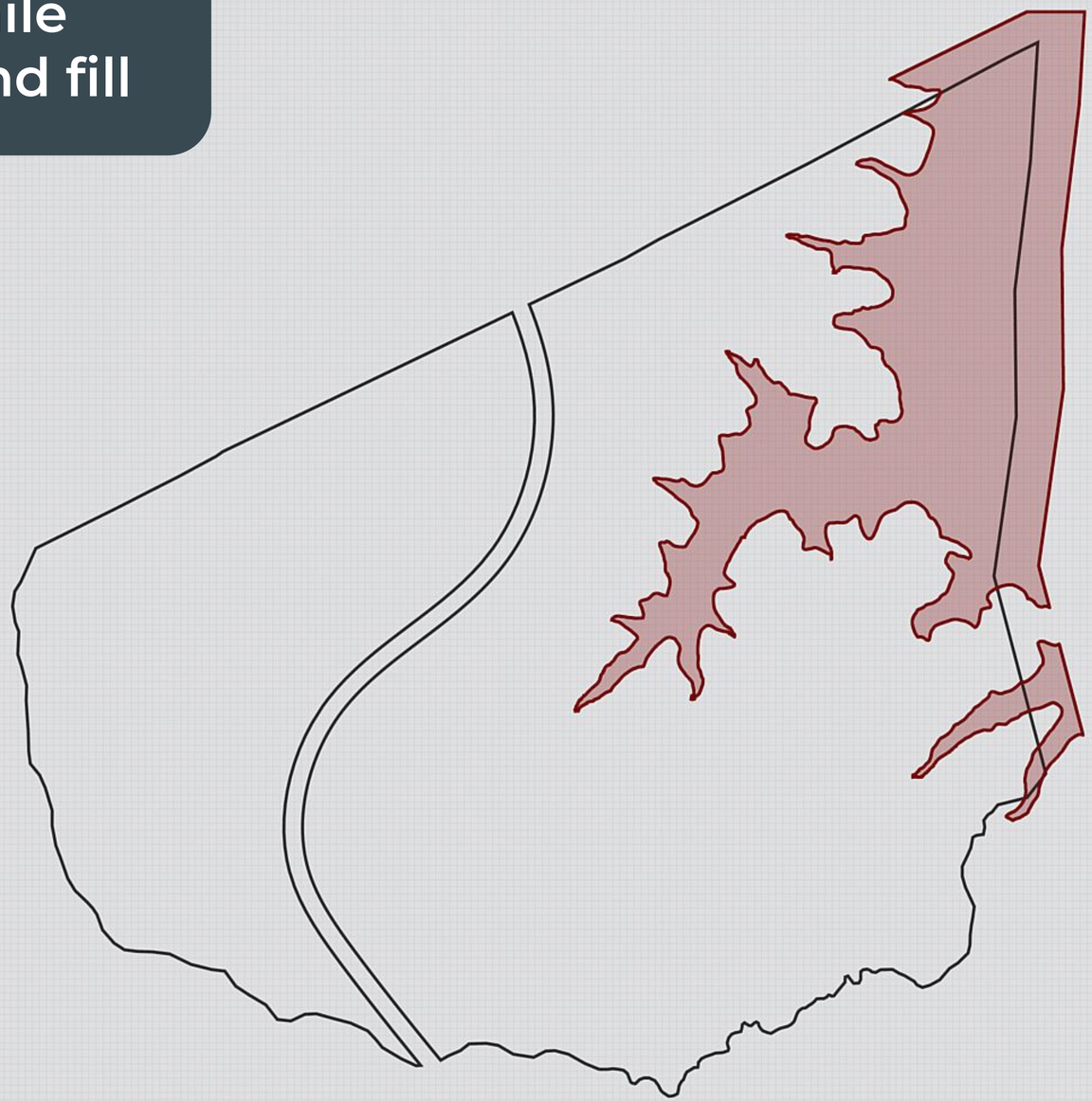
Getting slope adjusted Pile Point Plan



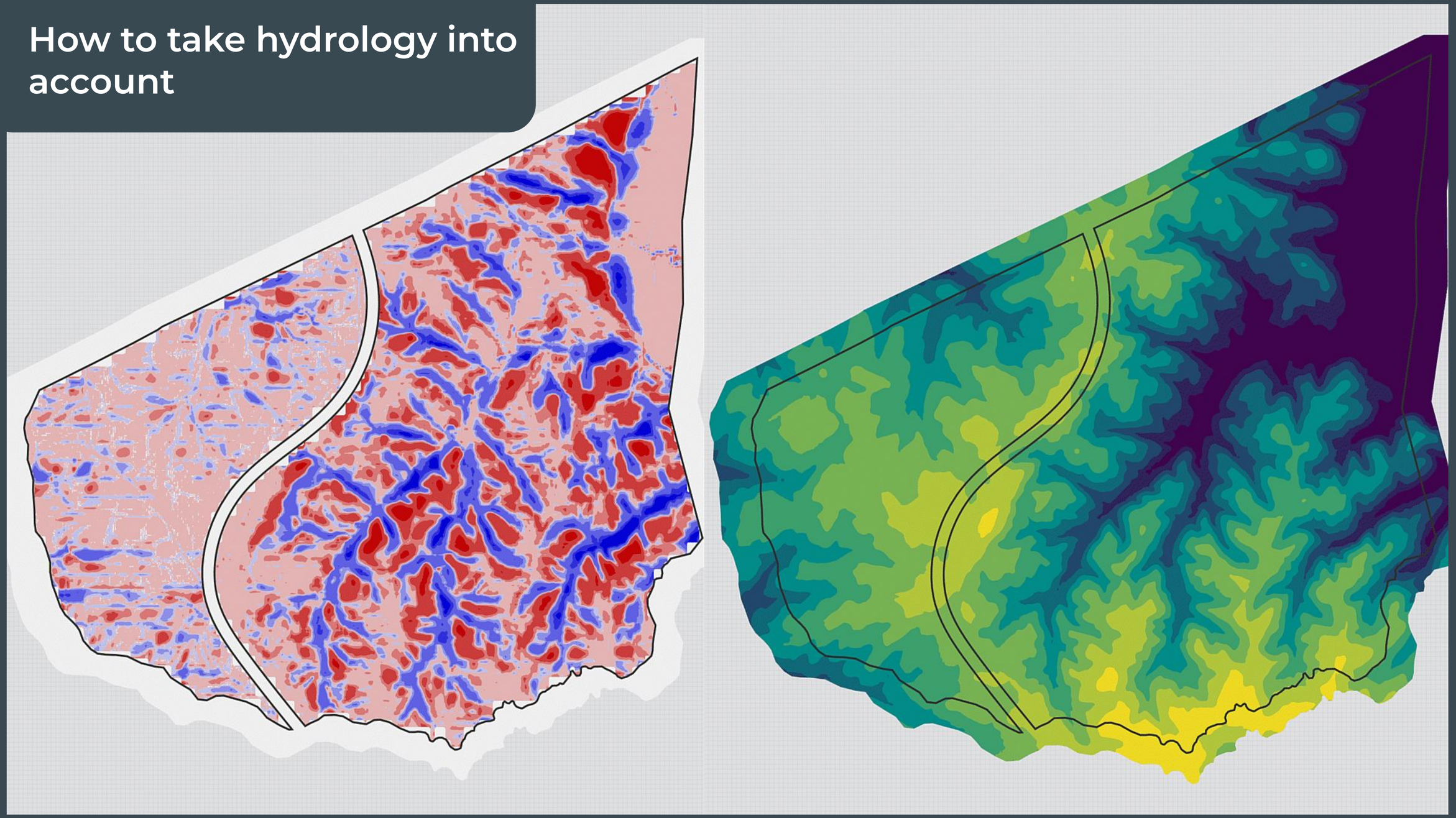
Getting Final Grade based on your grading strategy



Modelling basins while optimising for cut and fill



How to take hydrology into account



Thank you!

Any questions?

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