Approaches to allocating climate change effects

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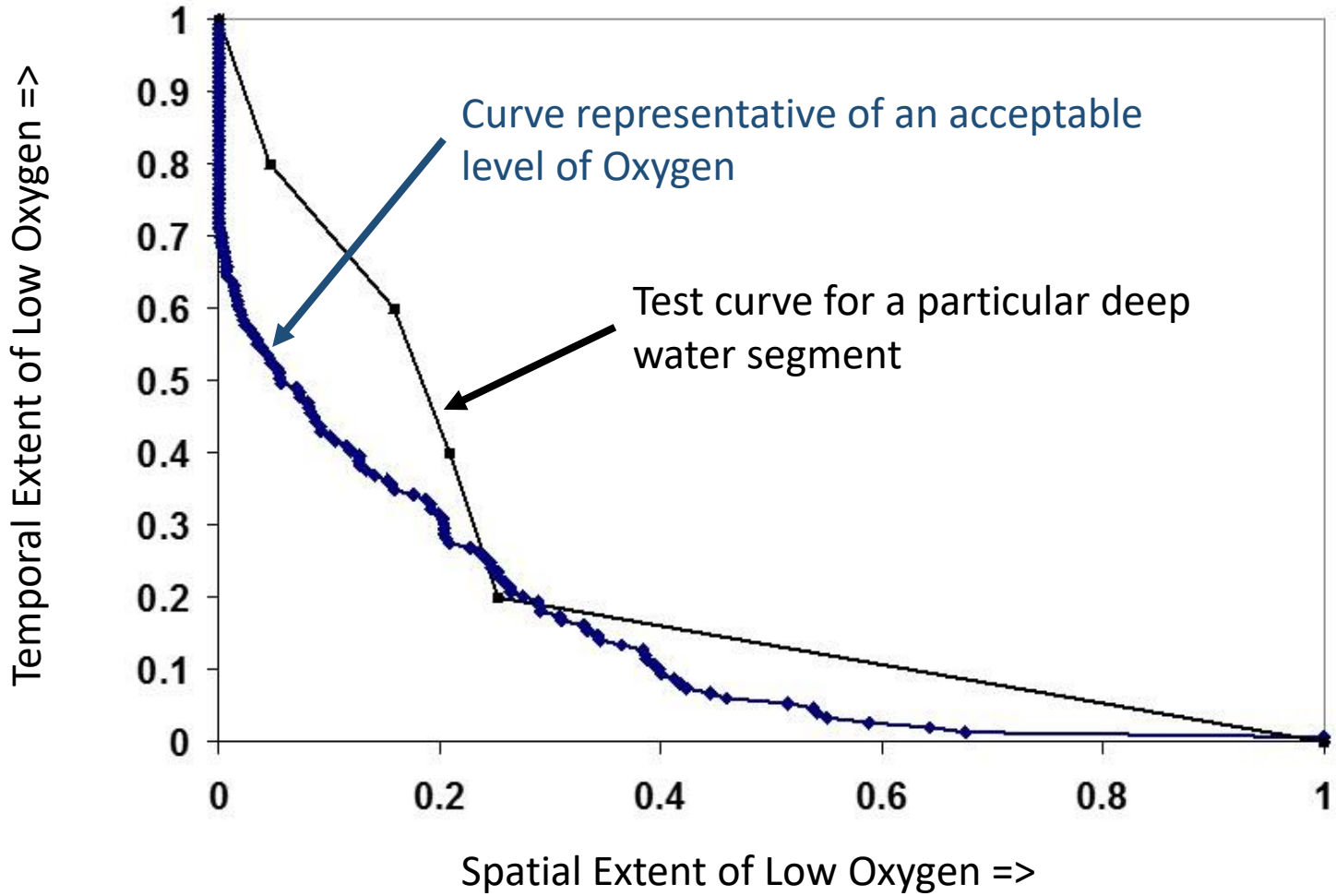
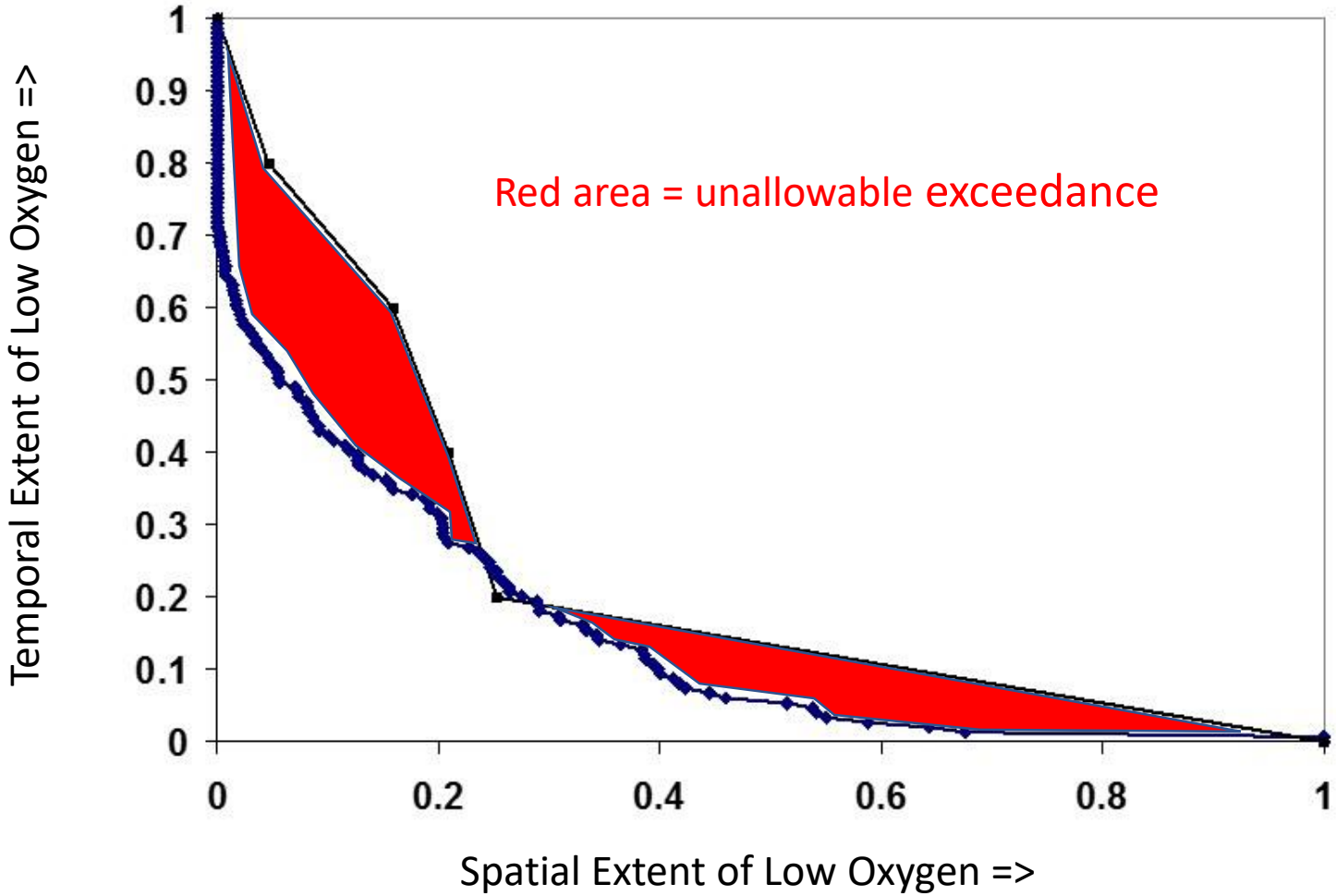
Lewis Linker – EPA, Isabella Bertani - UMCES

WQGIT 2/10/20

An Assessment of Dissolved Oxygen Criteria

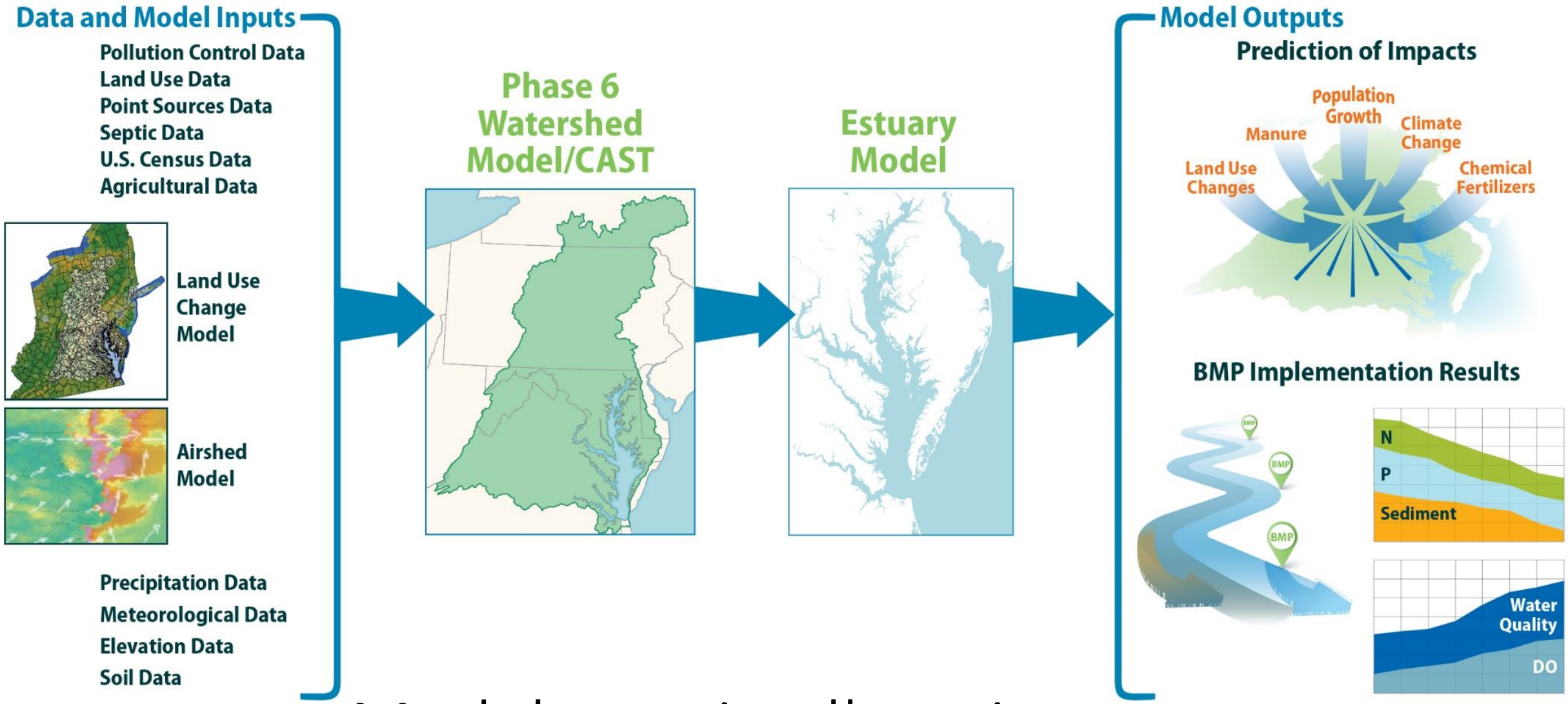


An Assessment of Dissolved Oxygen Criteria



‘Stoplight’ Table

Deep Water Attainment			
Cbseg	Base	Draft Allocation	E3
CB3MH	2.5%	0.1%	0.0%
CB4MH	23.3%	3.8%	1.5%
CB5MH	5.3%	0.0%	0.0%
CB6PH	0.6%	0.0%	0.0%
CB7PH	0.4%	0.0%	0.0%
CHSMH	5.5%	0.0%	0.0%
EASMH	3.3%	0.0%	0.0%
Calculated January 2009			

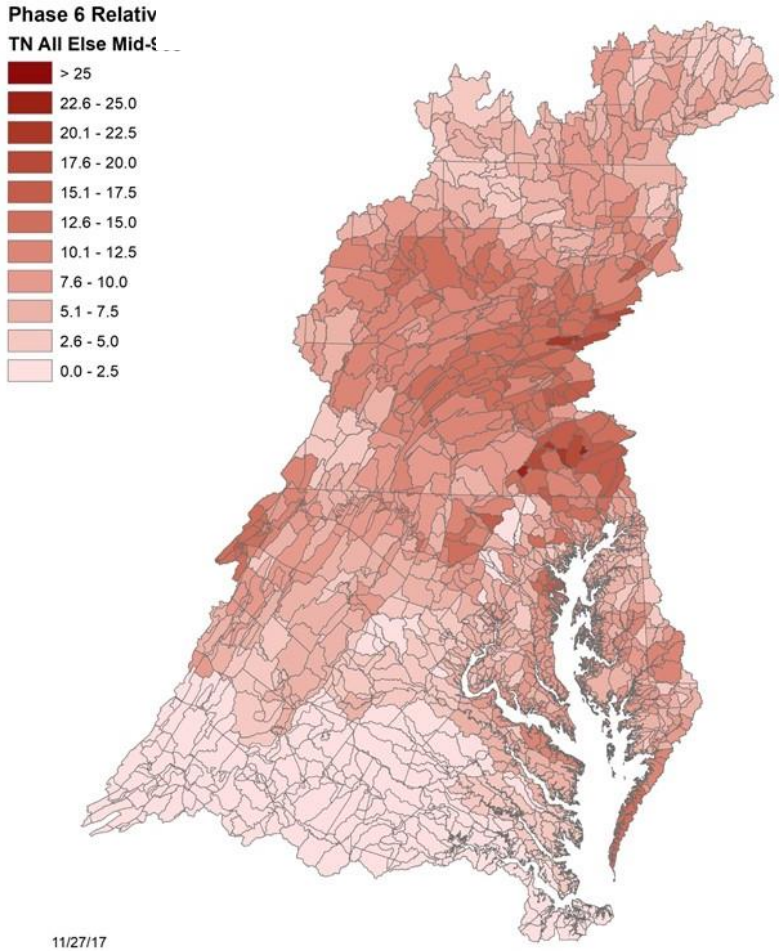


Models use in allocations

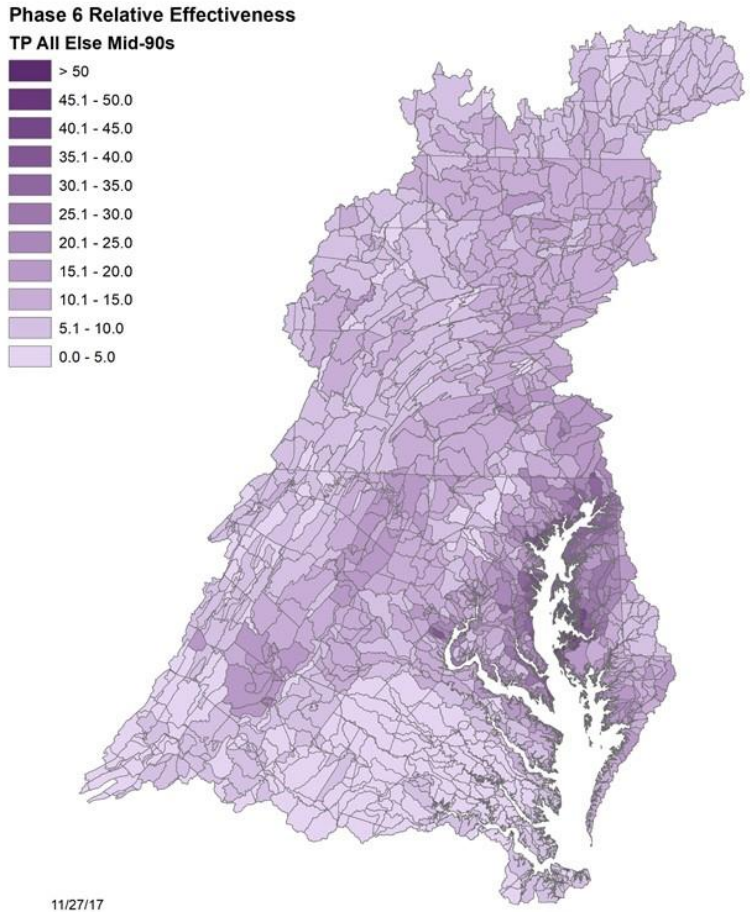
Dissolved Oxygen effect per pound of nutrient released in the watershed

More Impact, Do More

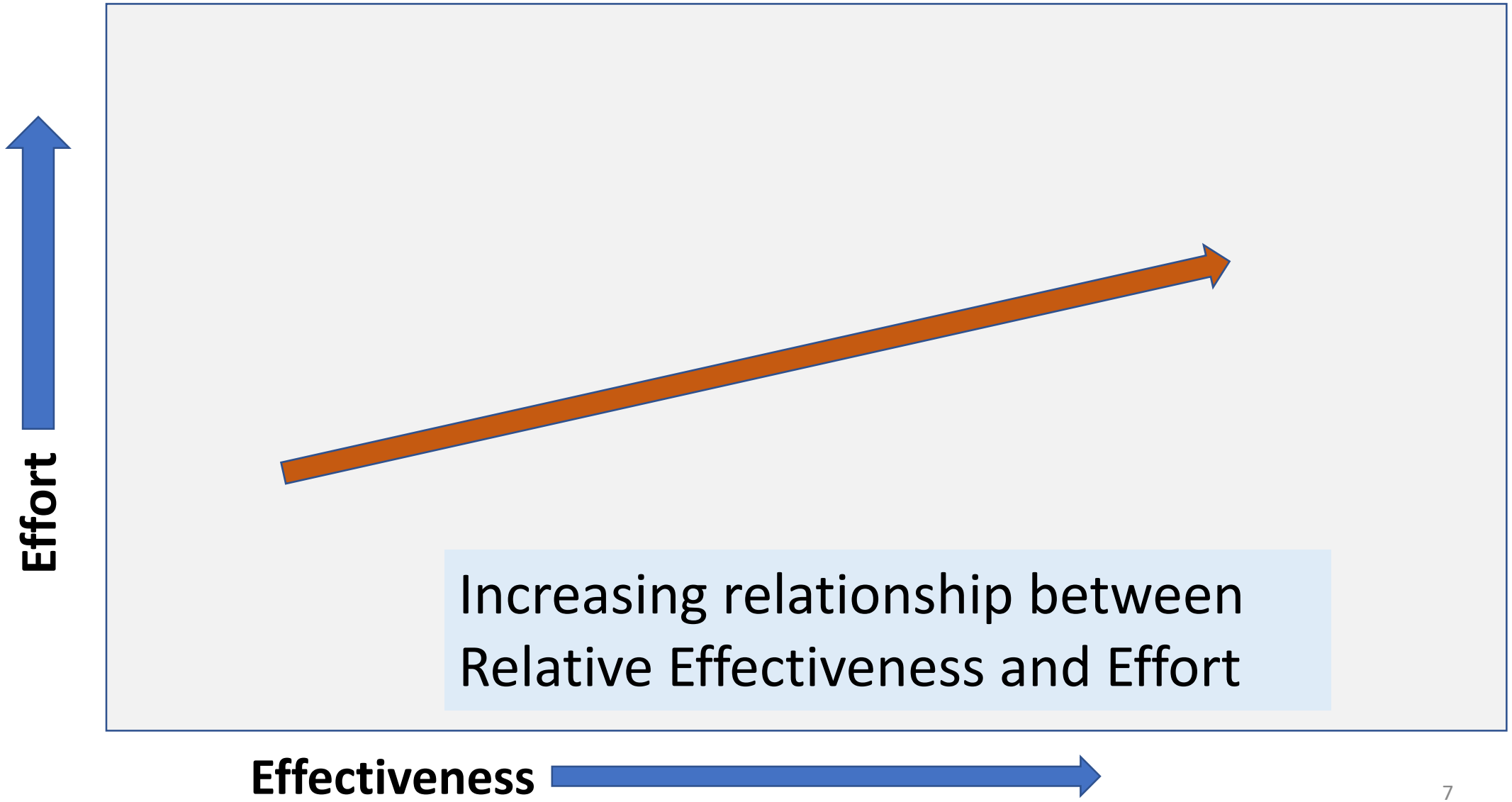
Nitrogen



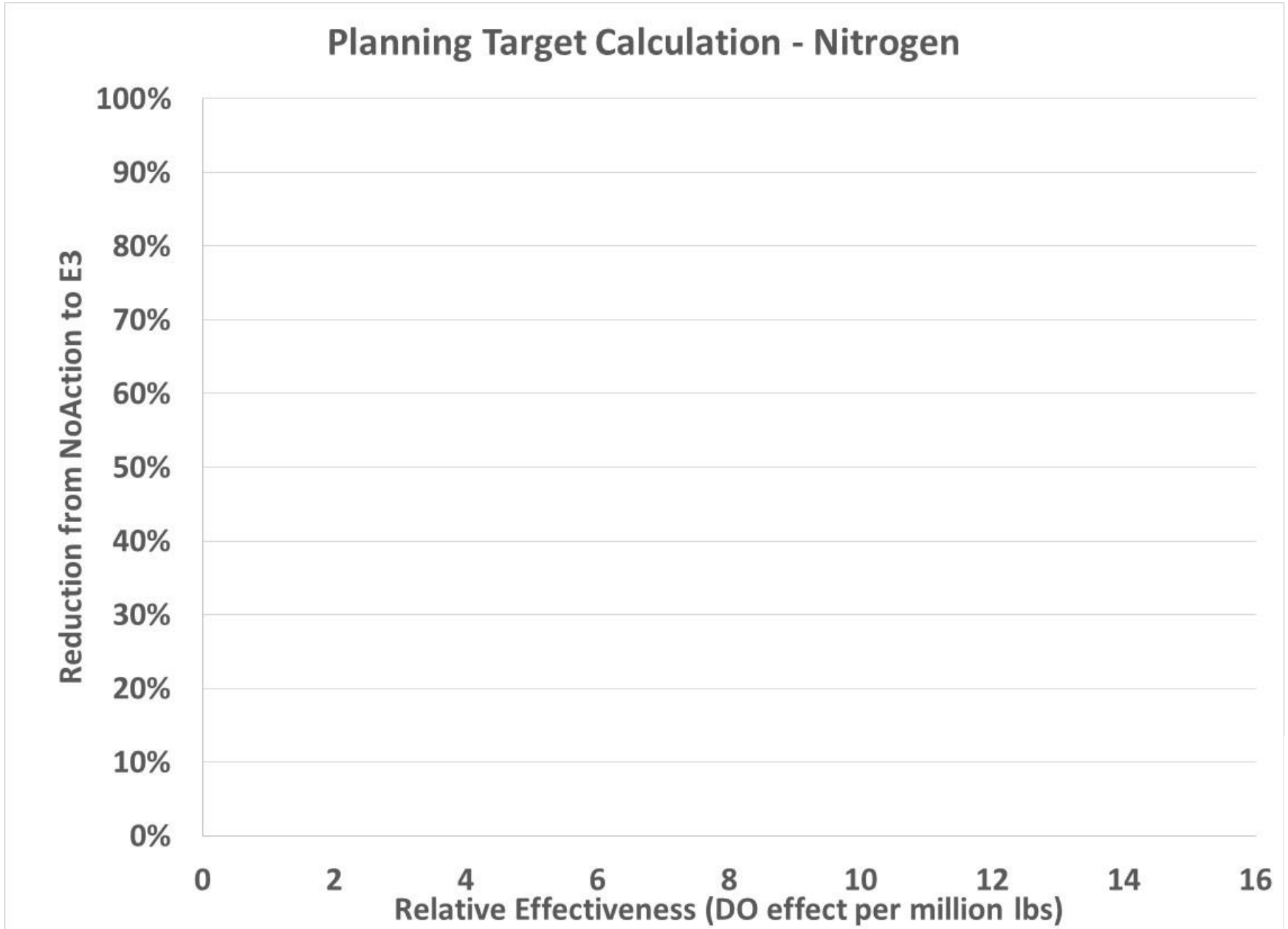
Phase 6 Phosphorus

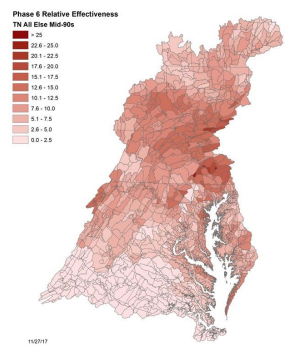


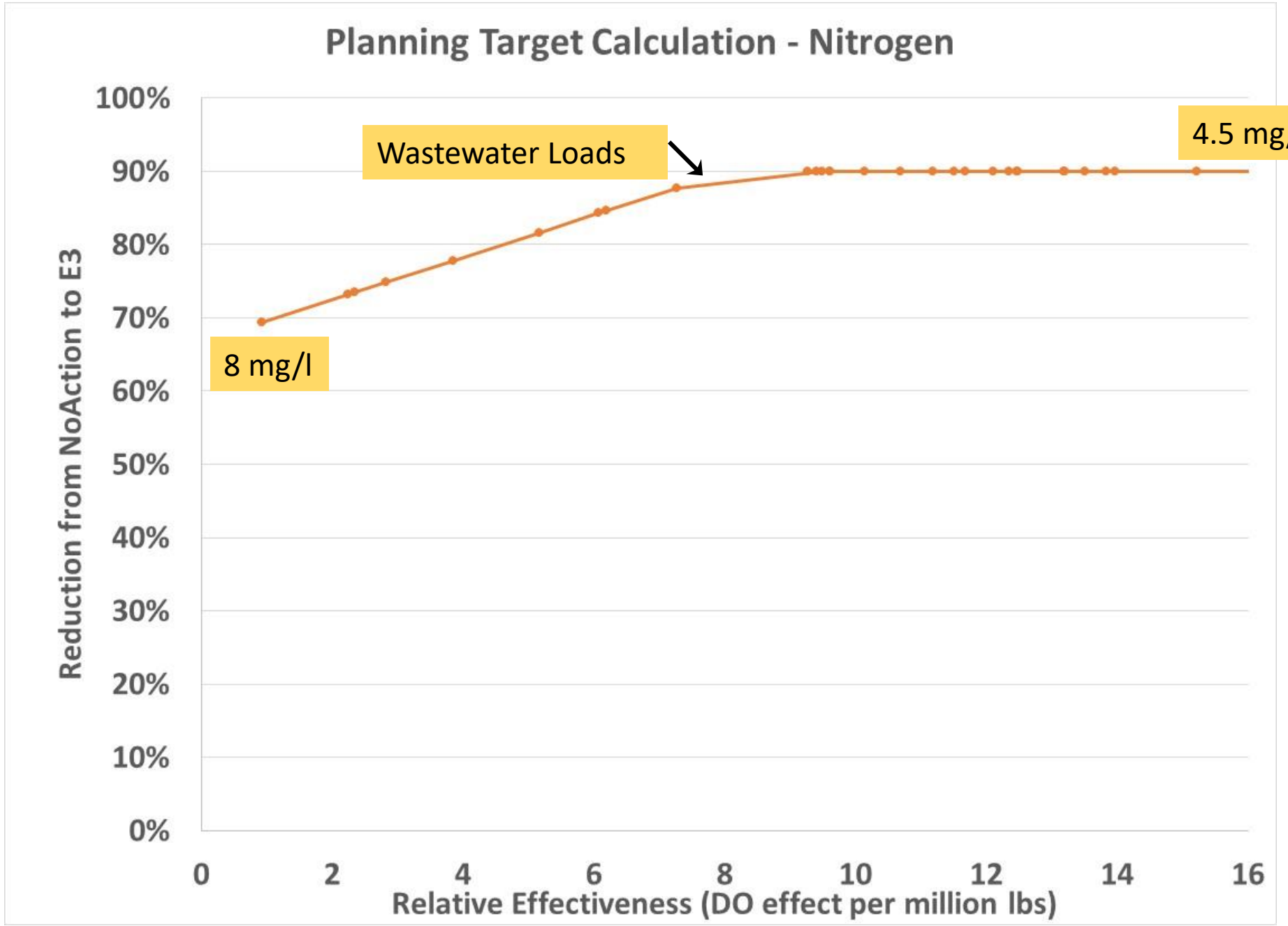
Guidelines for 2010 Allocation and 2017 Planning Targets

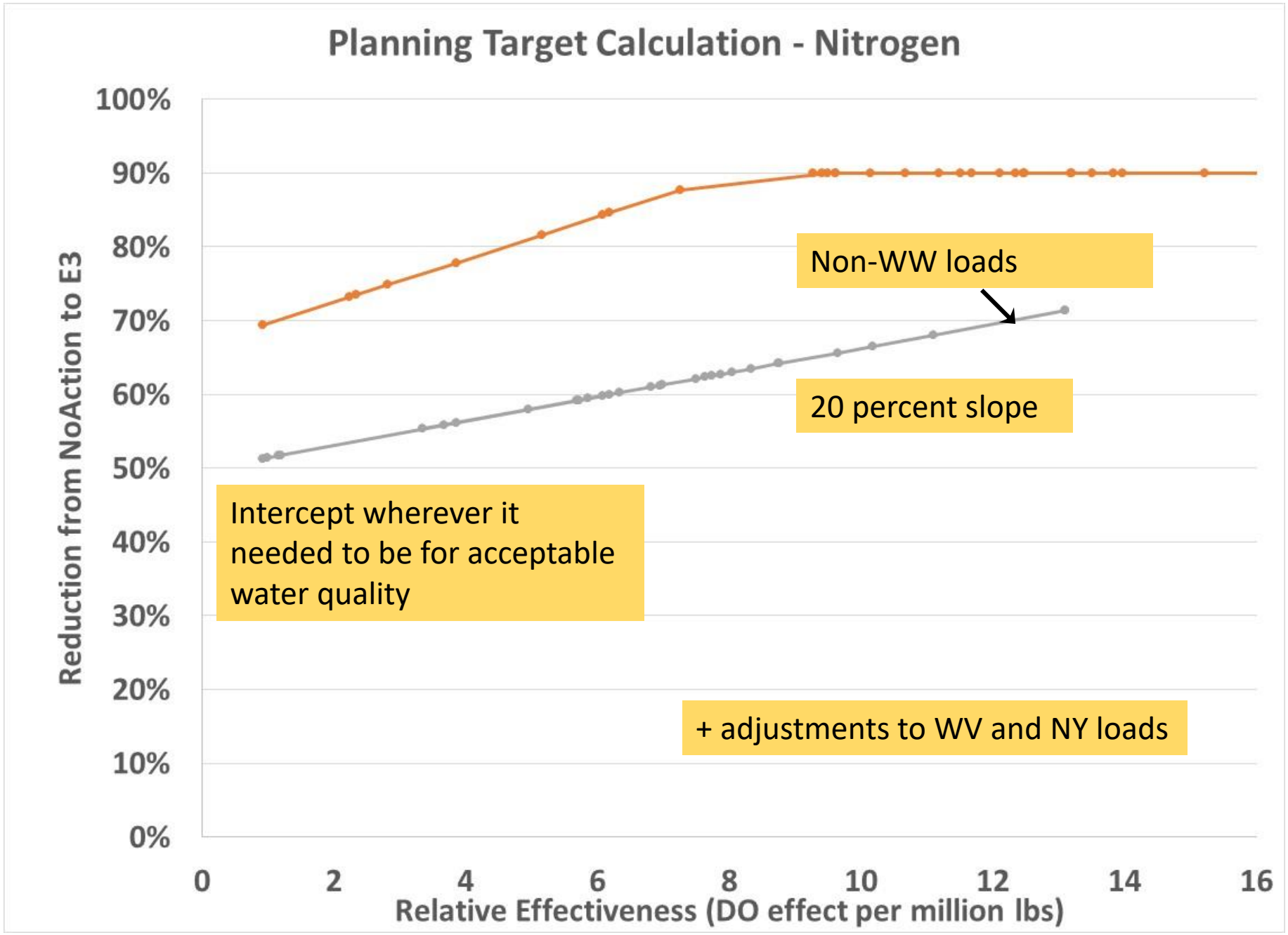


Planning Target Calculation - Nitrogen



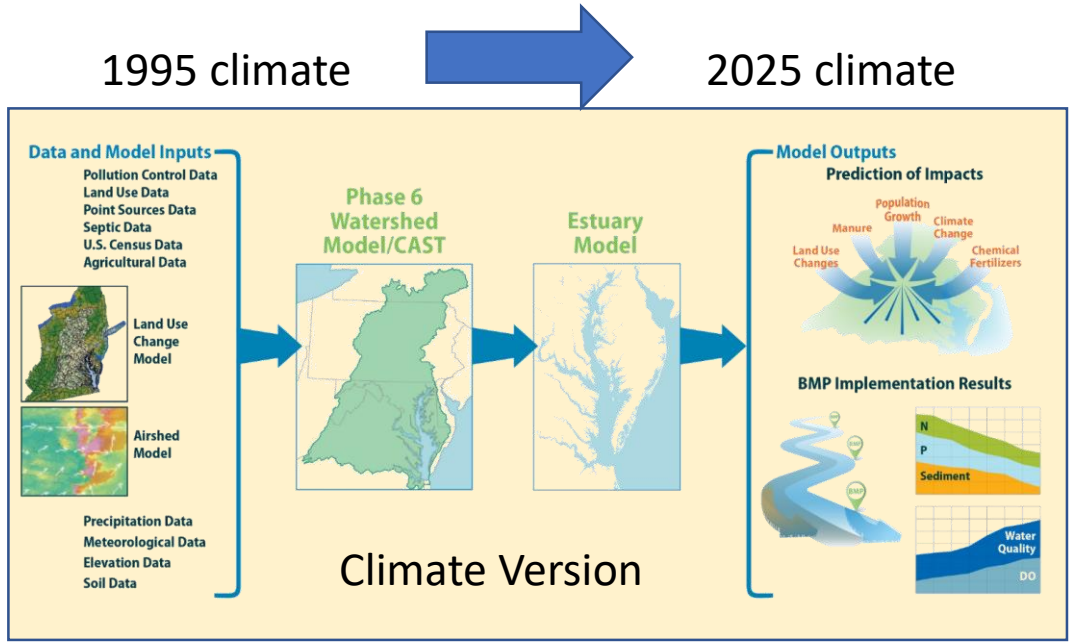


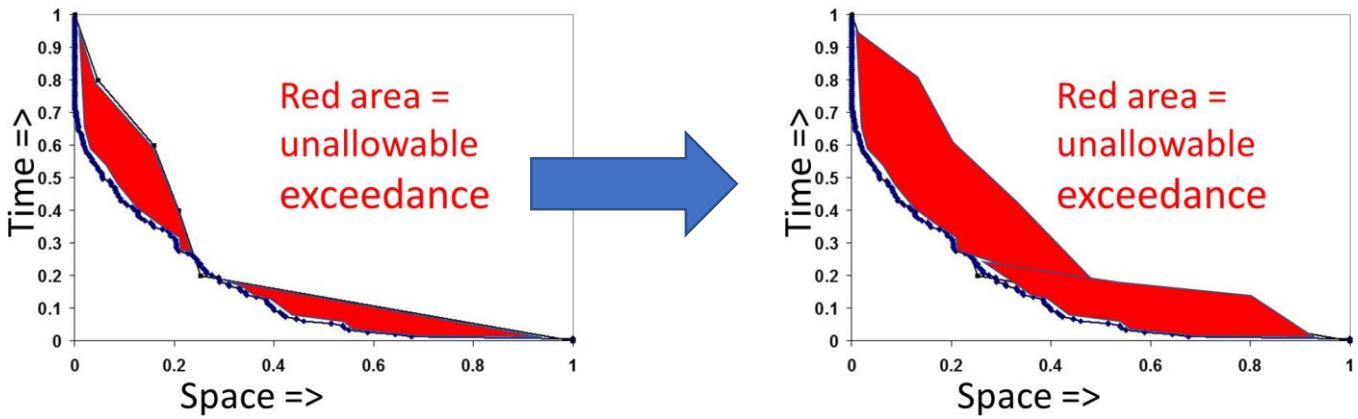

Planning Target Calculation - Nitrogen
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction from NoAction to E3
Wastewater Loads
4.5 mg/l
8 mg/l
0
2
4
6
8
10
12
14
16
Relative Effectiveness (DO effect per million lbs)


Planning Target Calculation - Nitrogen
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction from NoAction to E3
0
2
4
6
8
10
12
14
16
Relative Effectiveness (DO effect per million lbs)
Non-WW loads
20 percent slope
Intercept wherever it needed to be for acceptable water quality
+ adjustments to WV and NY loads

December 2017 Method – Step 1

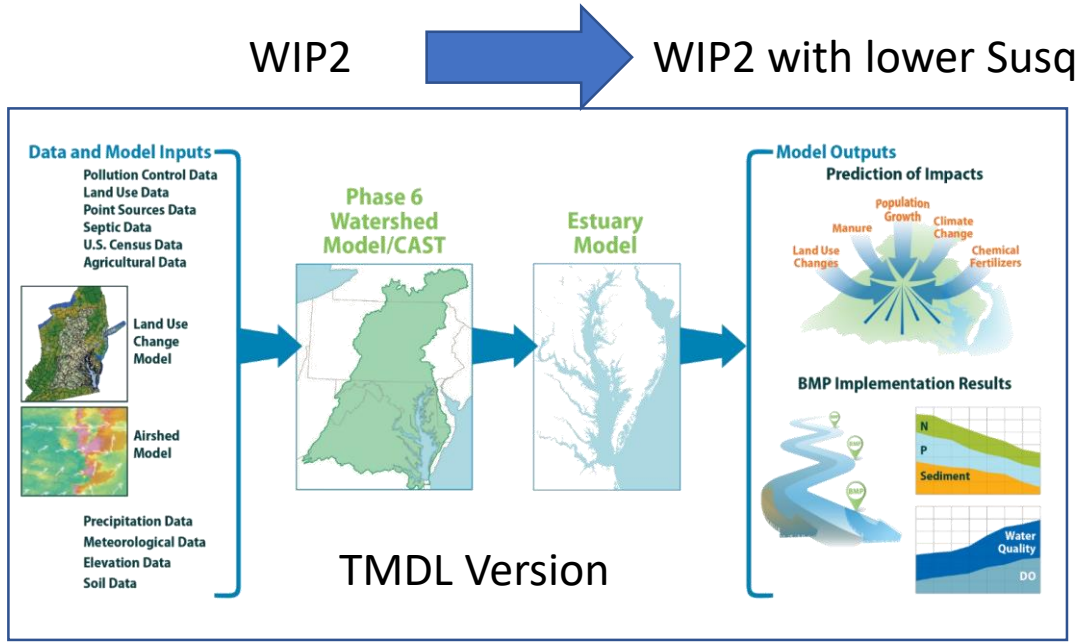
- Using the Climate Model System, estimate the change in DW and DC attainment due to all climate change effects

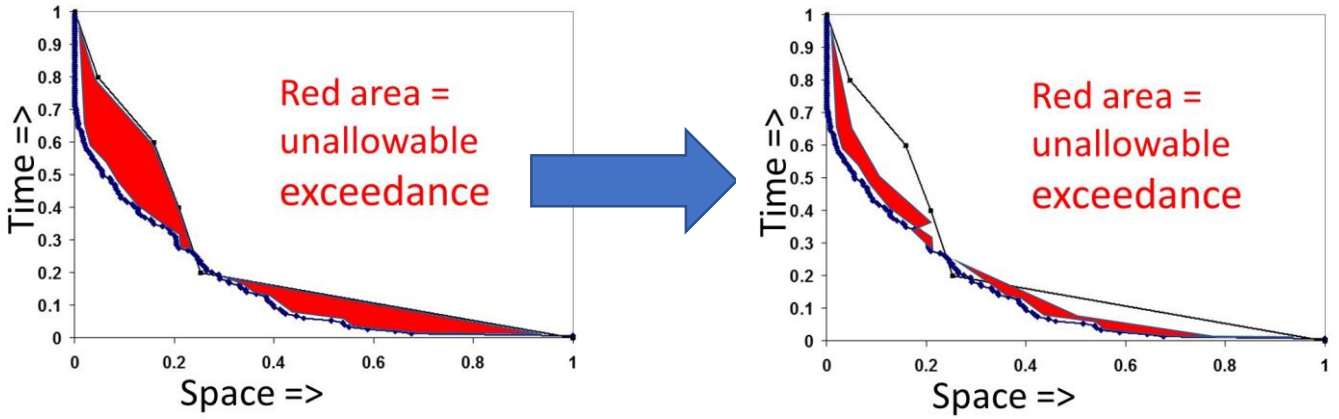




December 2017 Method – Step 2

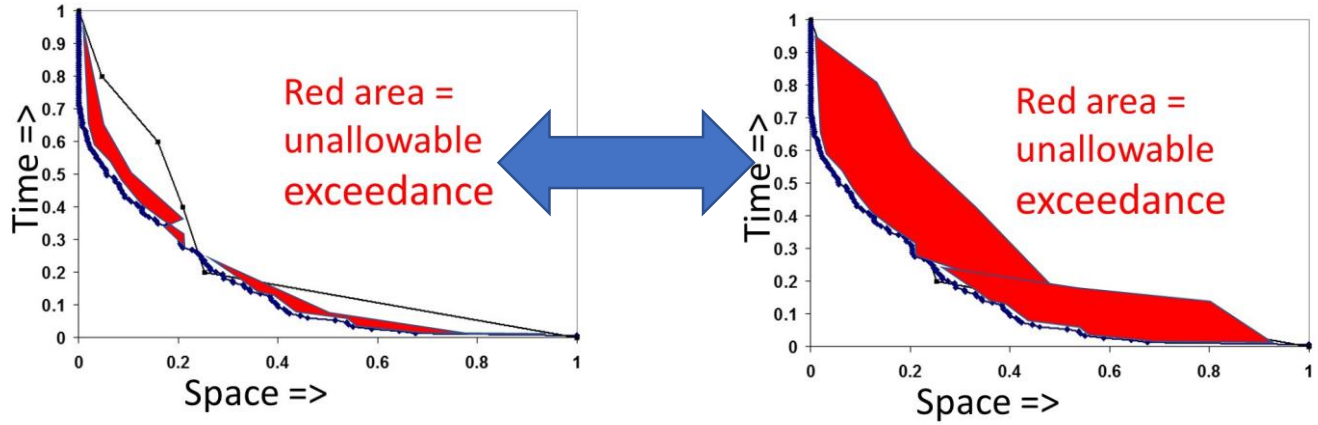
- Using the TMDL Model System, estimate the change in load from the Susquehanna necessary to counteract that change



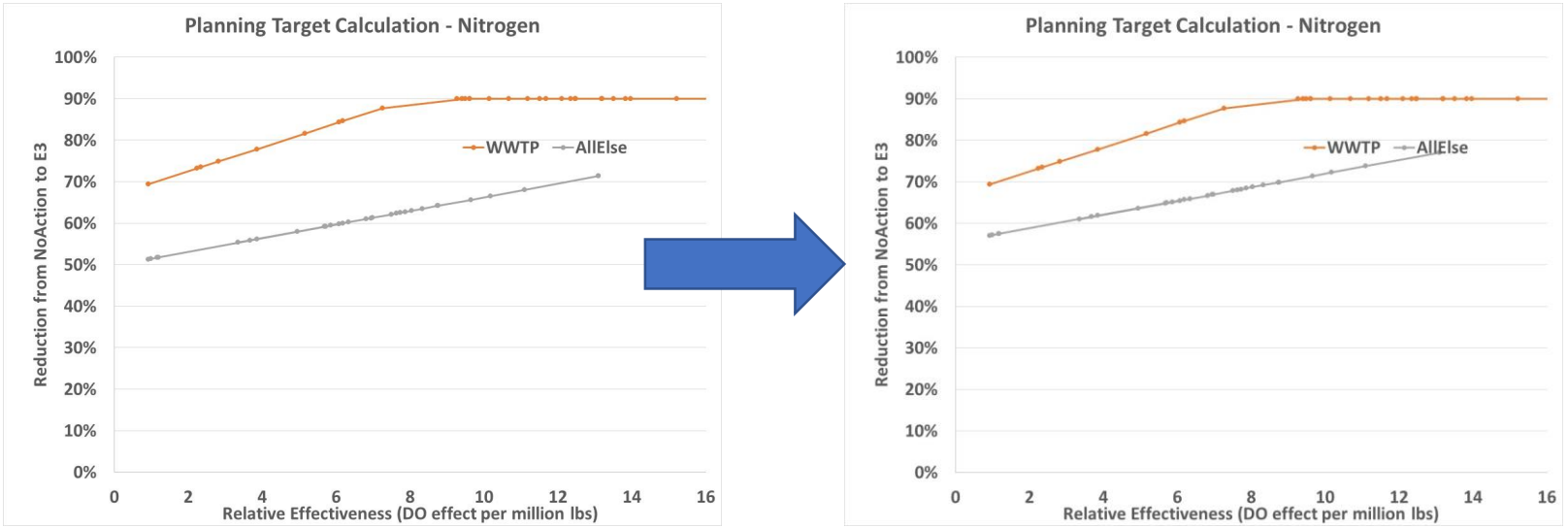


December 2017 Method – Step 3

- Find the Susquehanna reduction that balances the increase



- Using the planning target curves, distribute the effort to all areas.

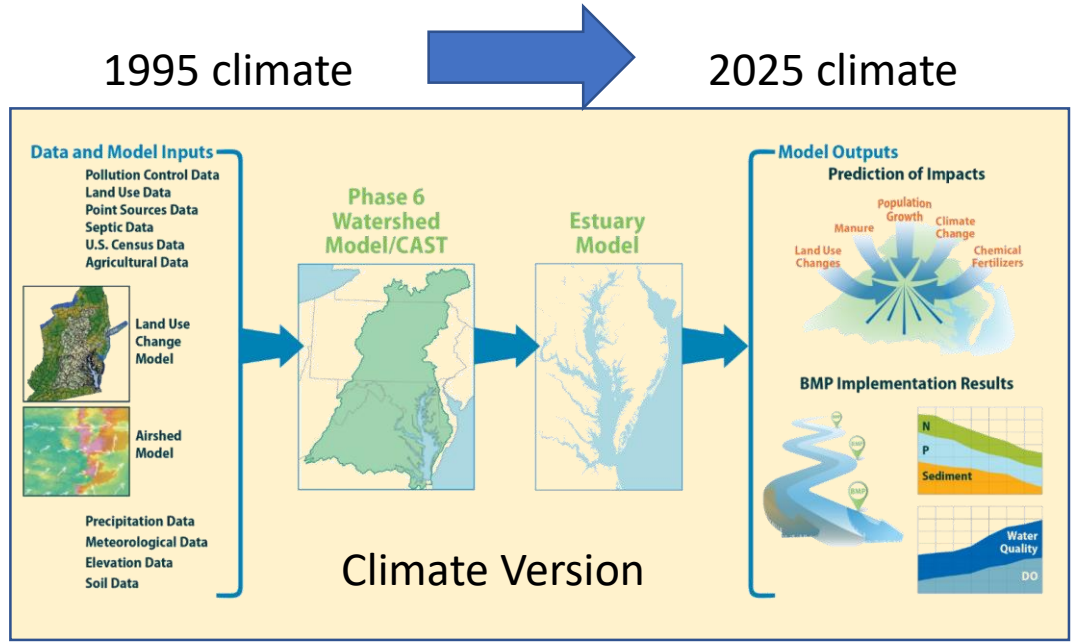


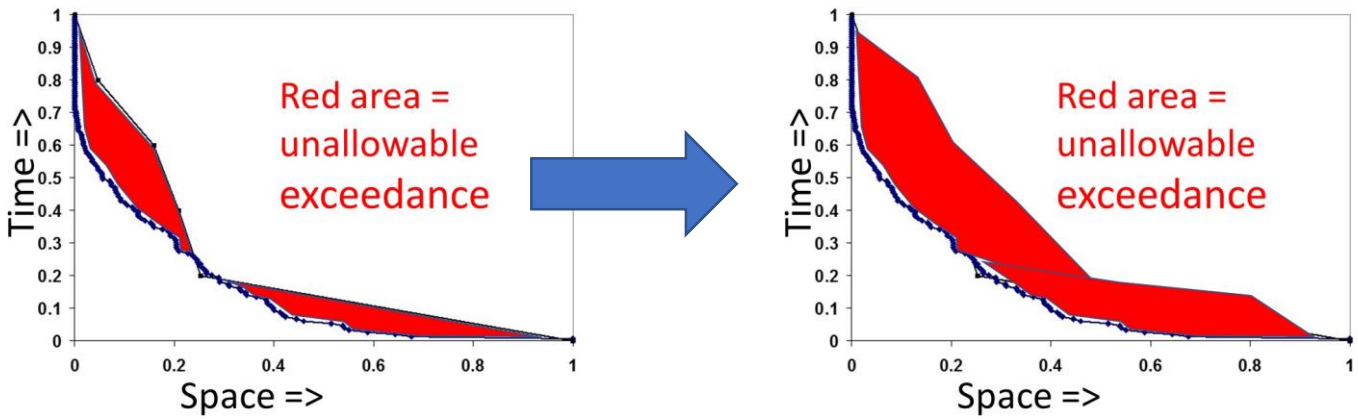
Issues with the December 2017 method

- Actual reductions will be taken in 2025 climate, not 1995 climate. Should model the change in attainment in the climate model.
- N:P ratio is from the Susquehanna meaning an over-emphasis on N
- Did not address Open Water
- Lack of partnership input
  - Just raise the all else curve or include WWTP curve?
  - Some other method of allocating responsibility?

Revised Method – Step 1

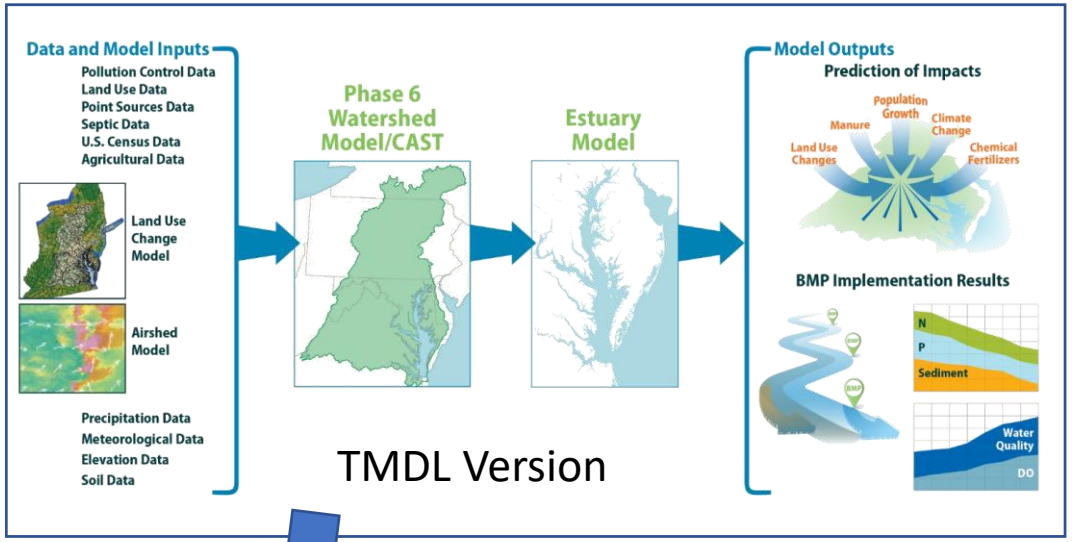
- Using the Climate Model System, estimate the change in OW, DW, and DC attainment due to all climate change effects

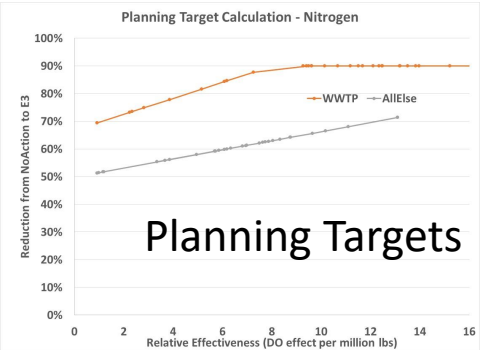


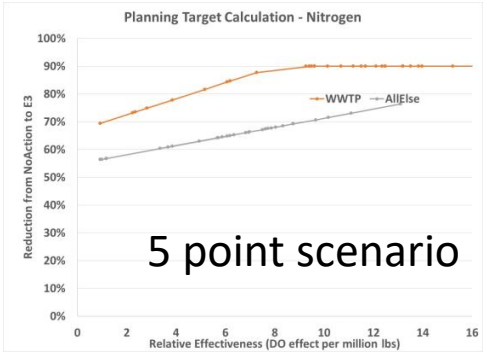


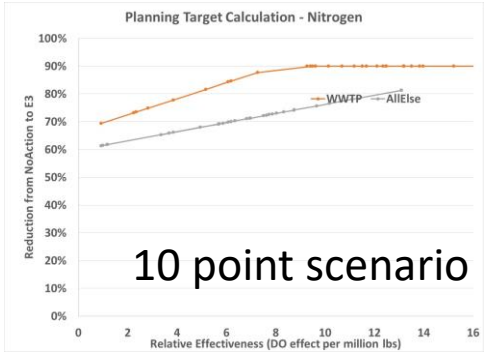
Revised Method – Step 2

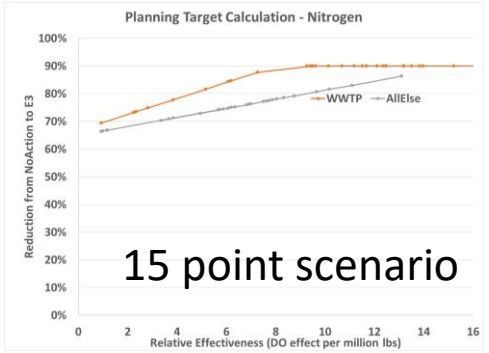
- Using the TMDL modeling system, develop reduction scenarios
- Use TMDL modeling system because this is the accounting system until 2025

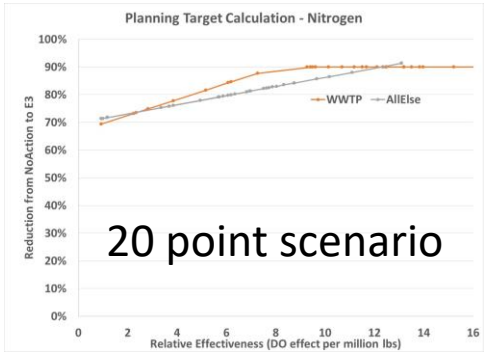






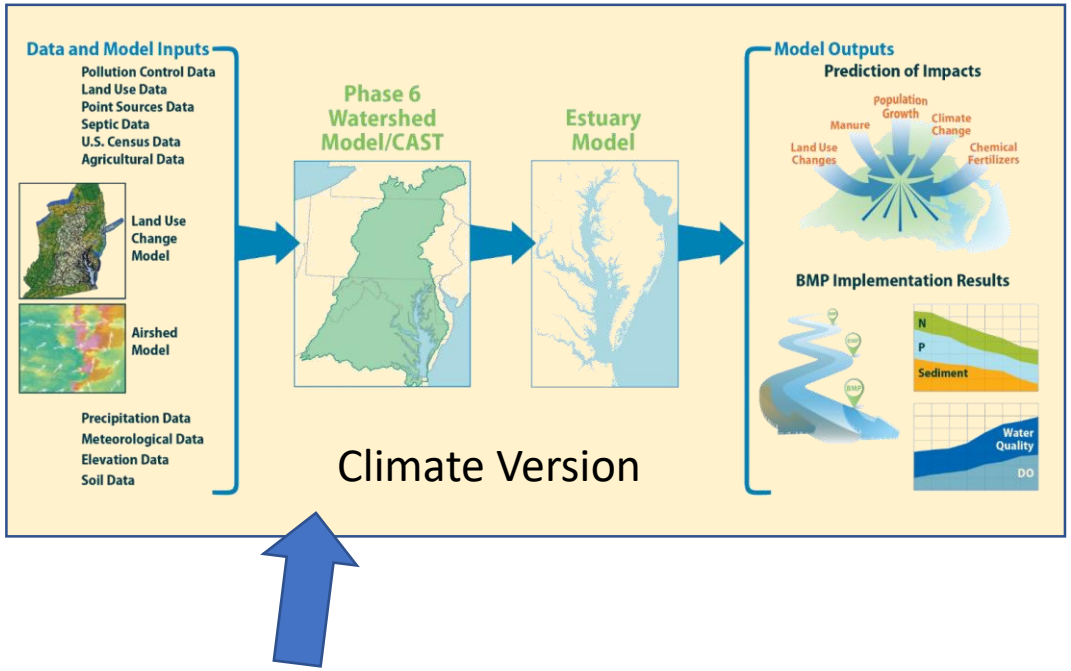


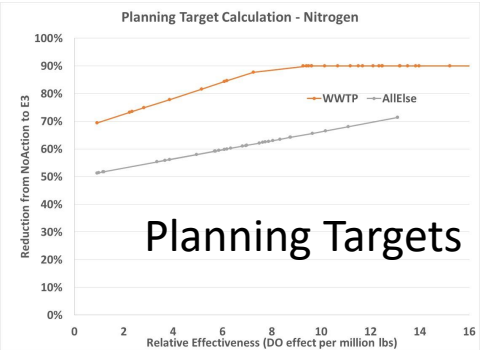


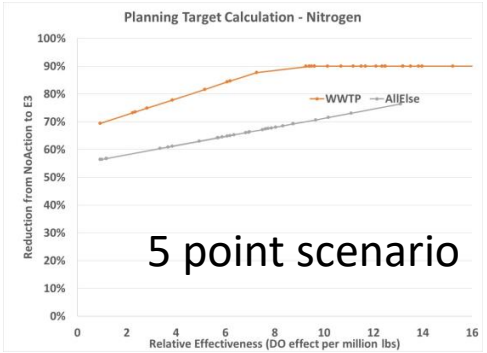


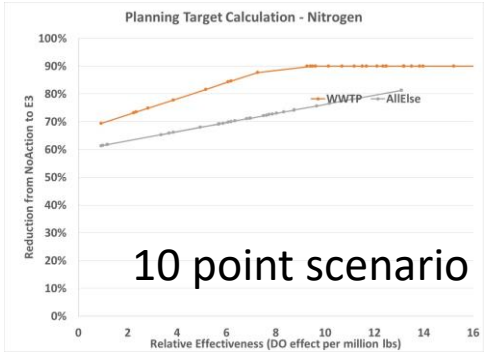
Revised Method – Step 3

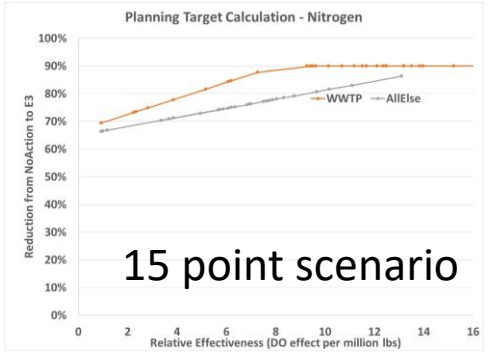
- Use same reduction percentages in climate model

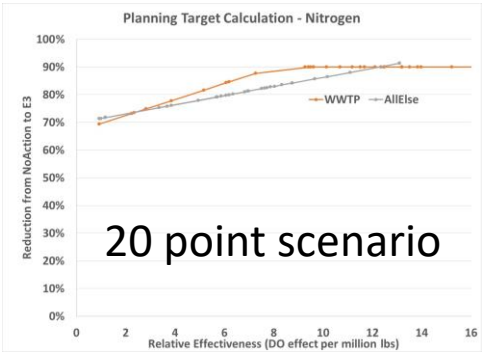




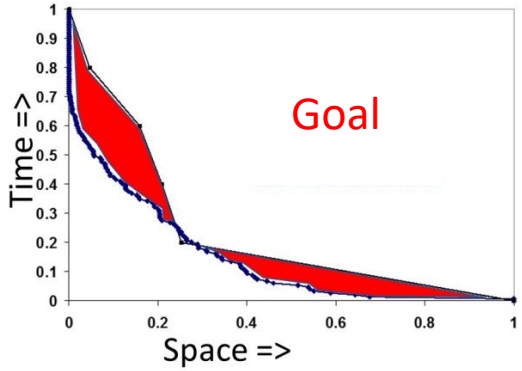




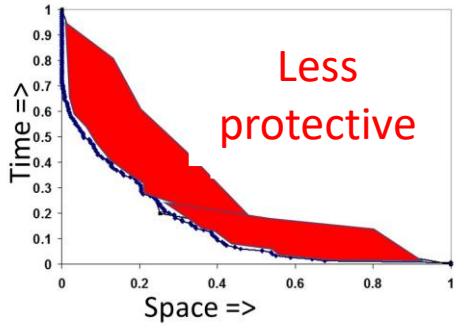


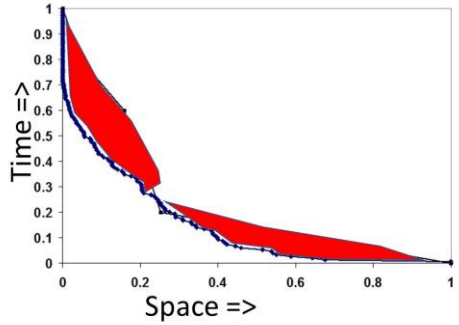


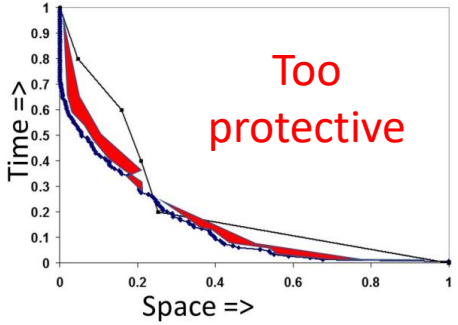
Revised Method – Step 4

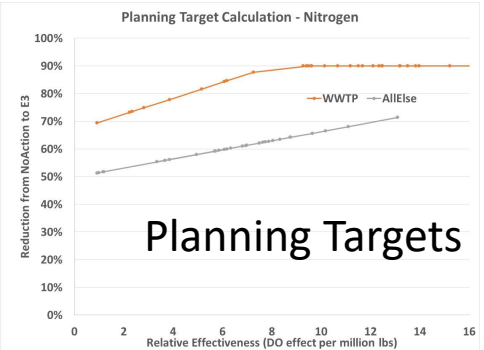


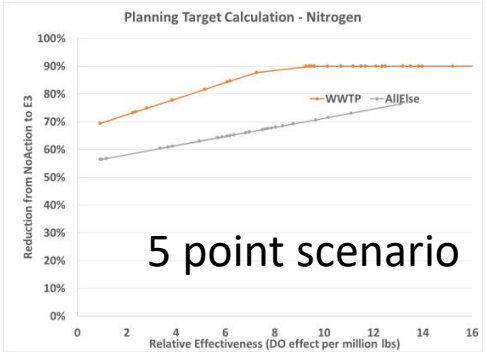
- Find point where climate change effects are counteracted

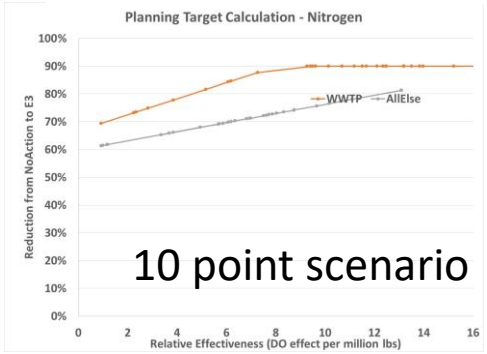


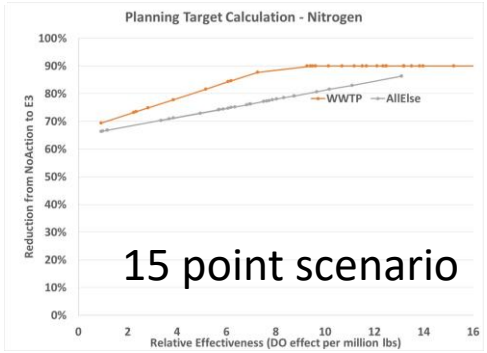


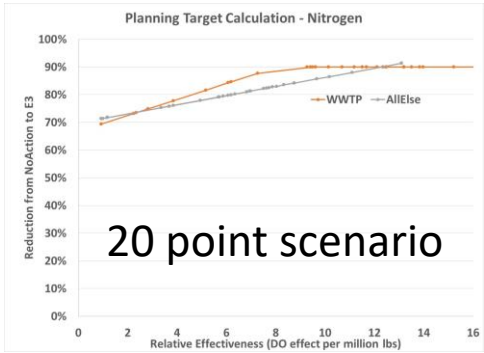












Revised Method – Step 5

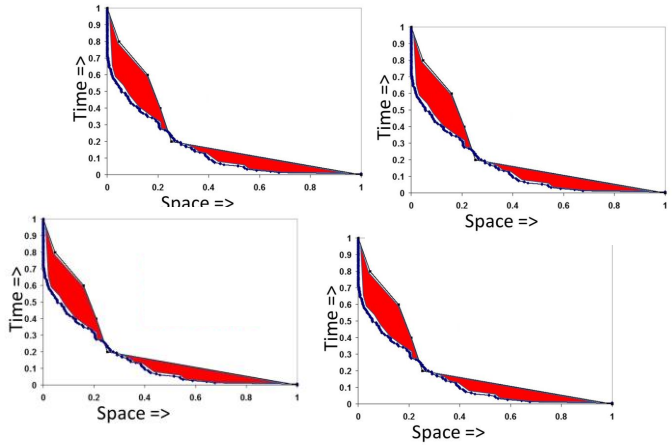
- Convert to load reductions in TMDL model (CAST-2017)

Just an example, this is not for 2025!

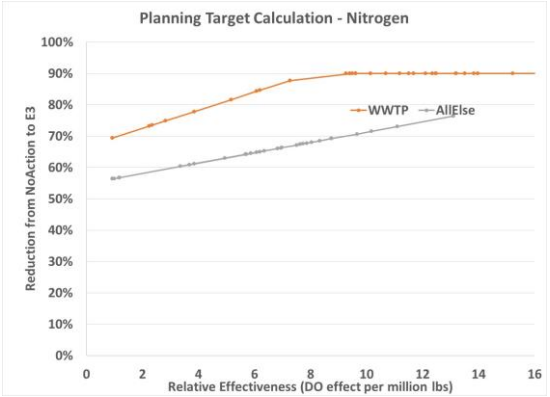
	5 point scenario	10 point scenario	8.5 point reductions
DC	0.00	0.01	0.01
DE	0.30	0.59	0.51
MD	1.62	3.25	2.78
NY	0.34	0.67	0.58
PA	3.20	6.41	5.48
VA	1.33	2.67	2.28
WV	0.19	0.39	0.33
Total	6.99	13.99	11.96

Questions for the WQGIT

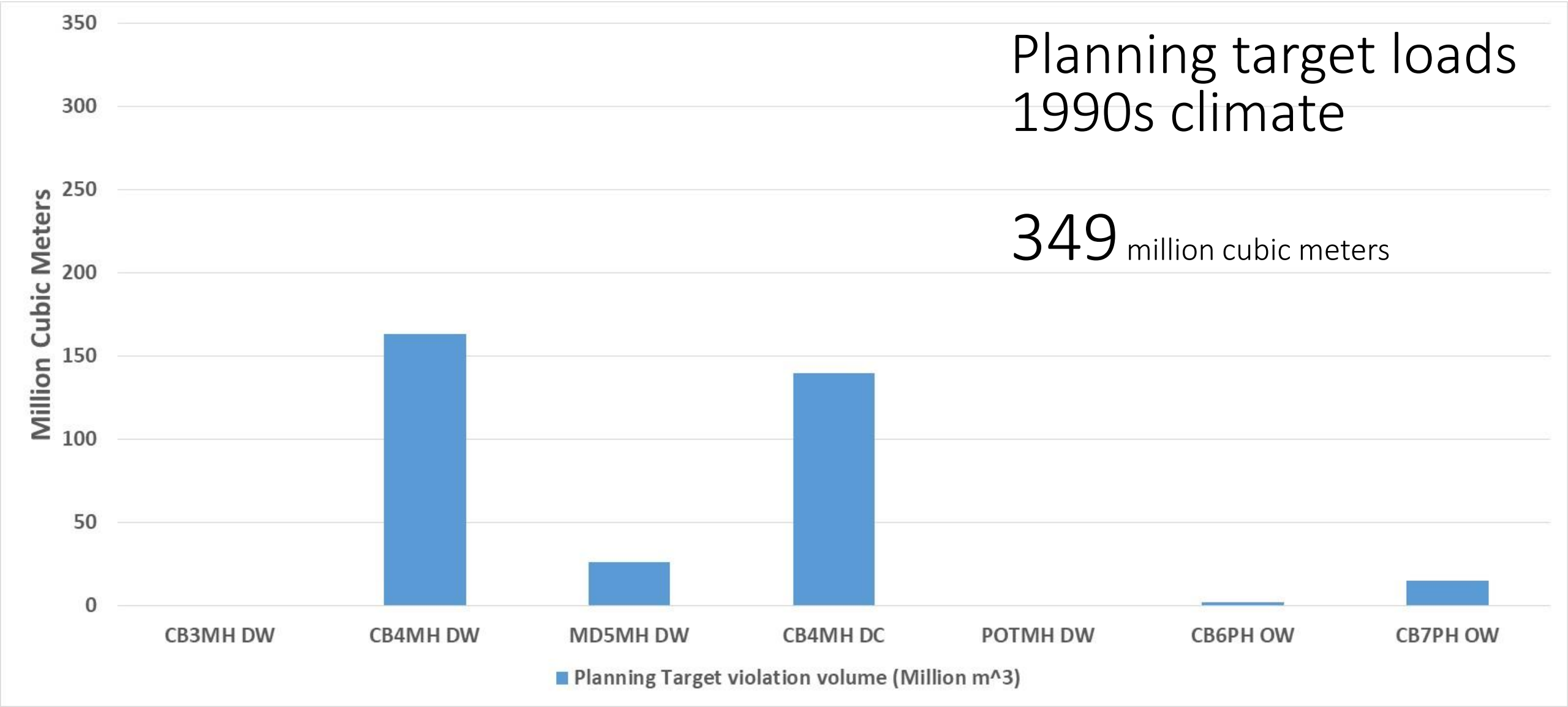
- How do we estimate climate effect?
  - Just ‘allocation segments’ or include Open Water?
  - Volume-weighted average?



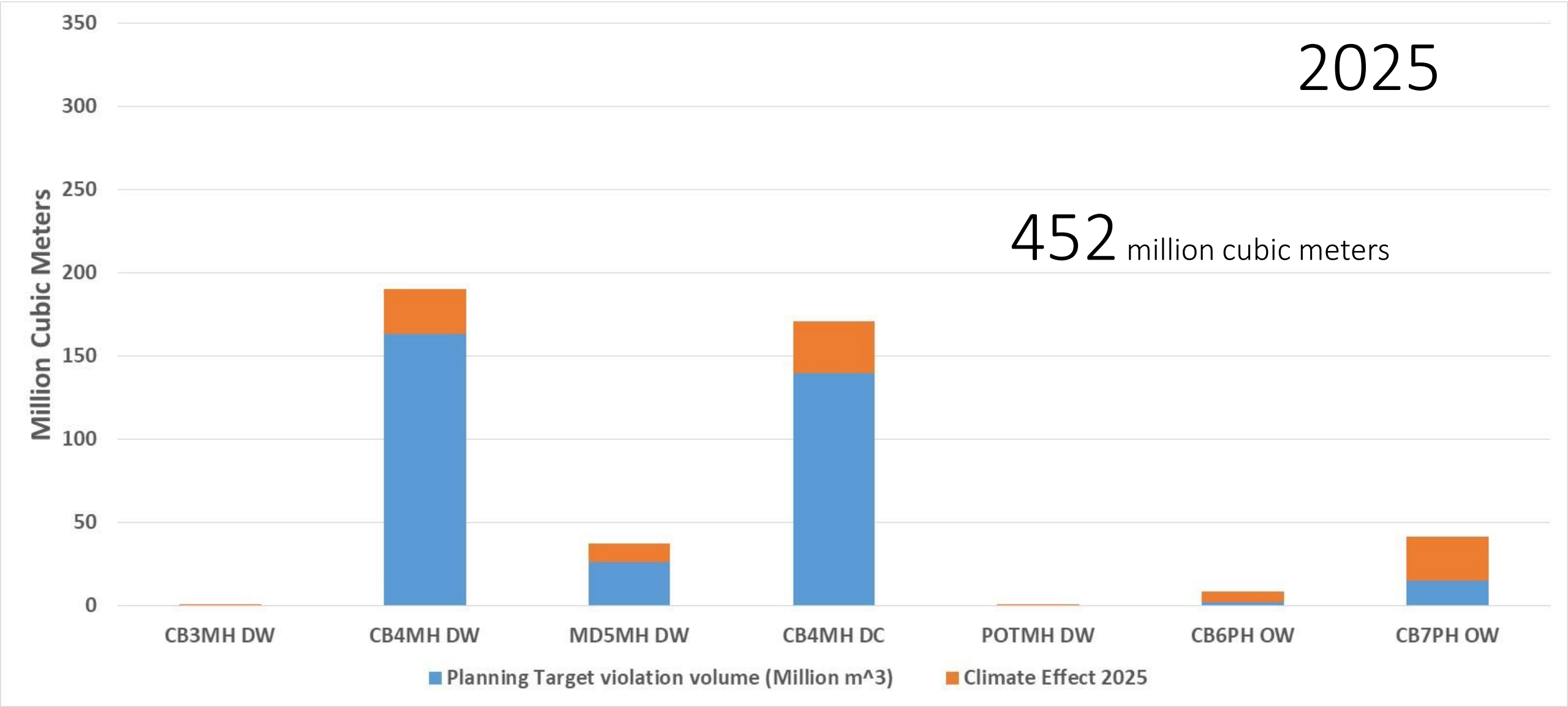
- How do we allocate reductions?
  - WWTP or Just All other sources?
  - Use something other than planning target curves?



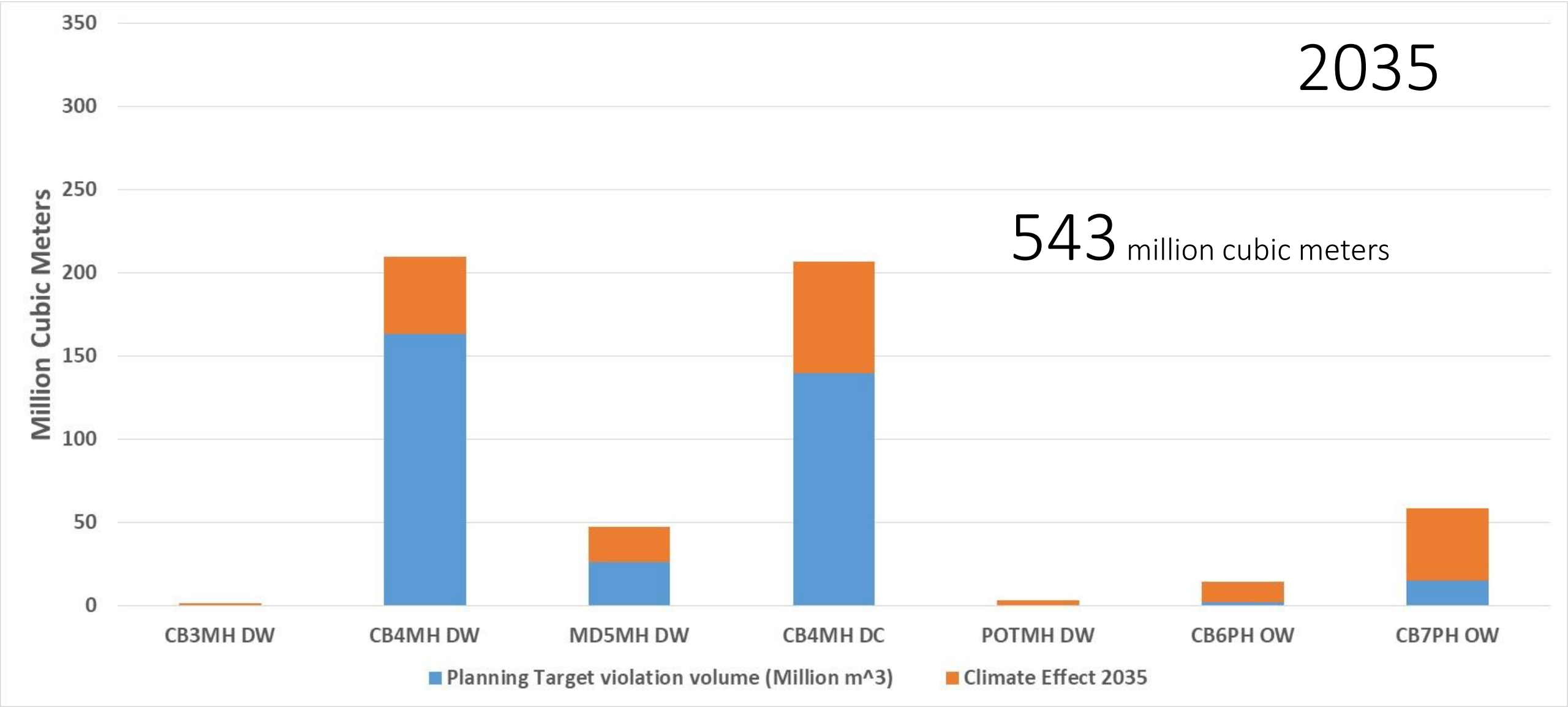
Climate Change Effect on Main Bay



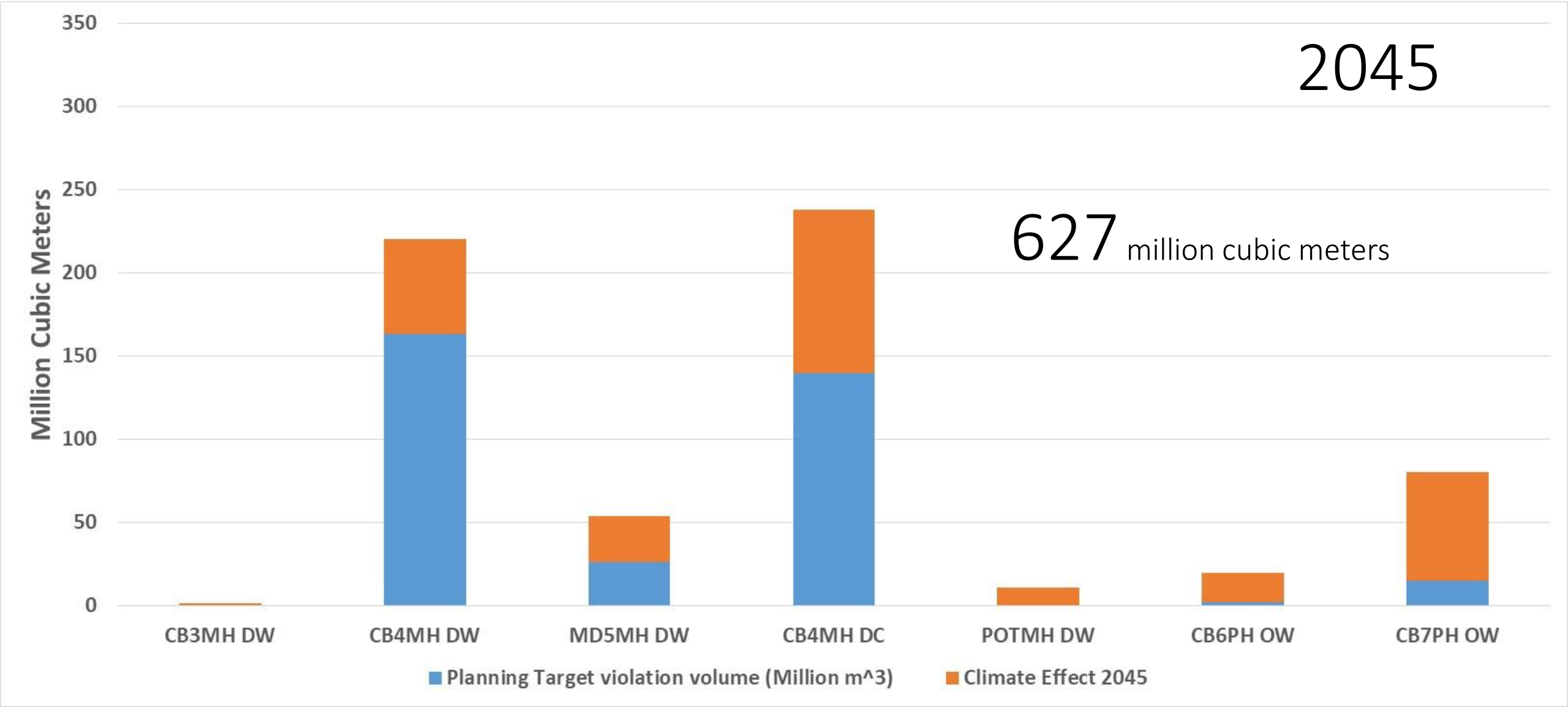
Climate Change Effect on Main Bay



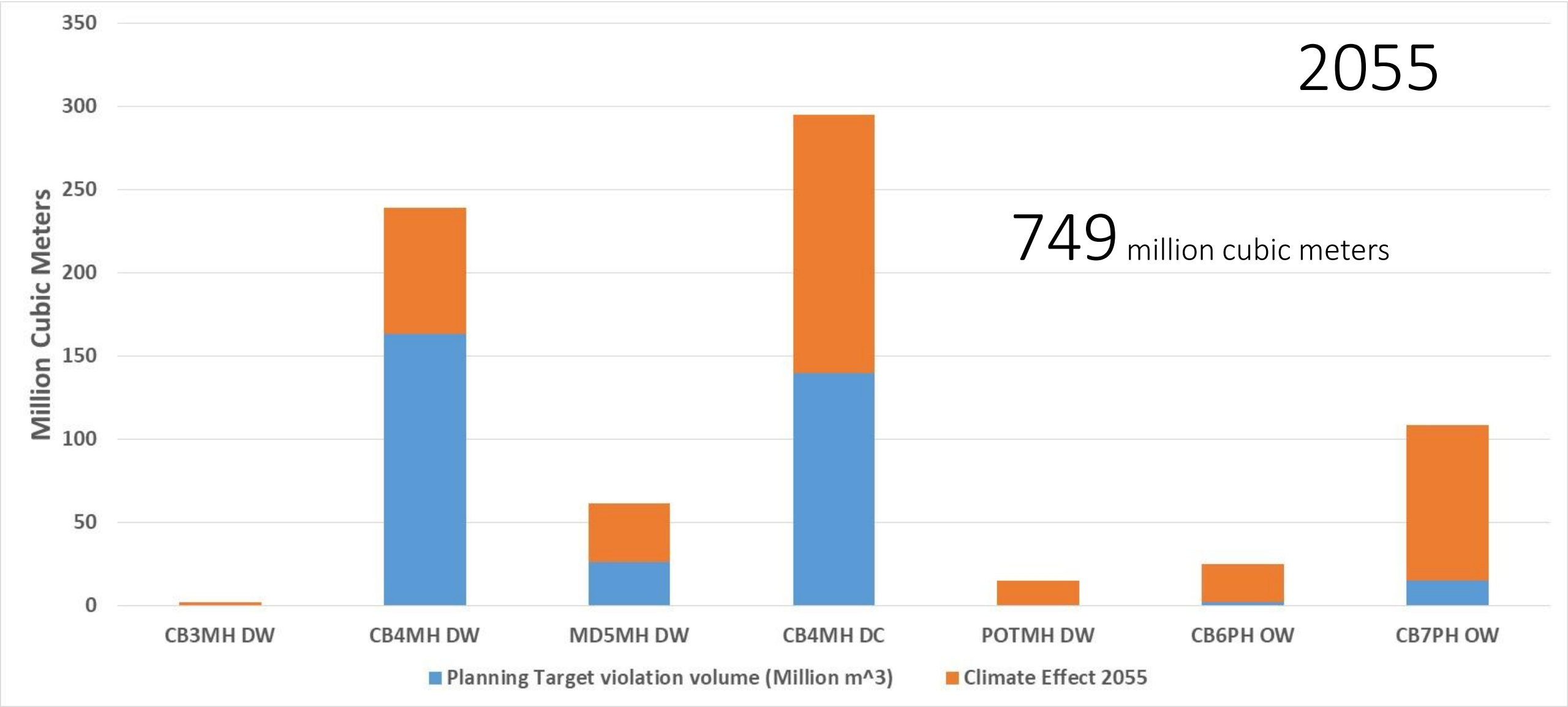
Climate Change Effect on Main Bay



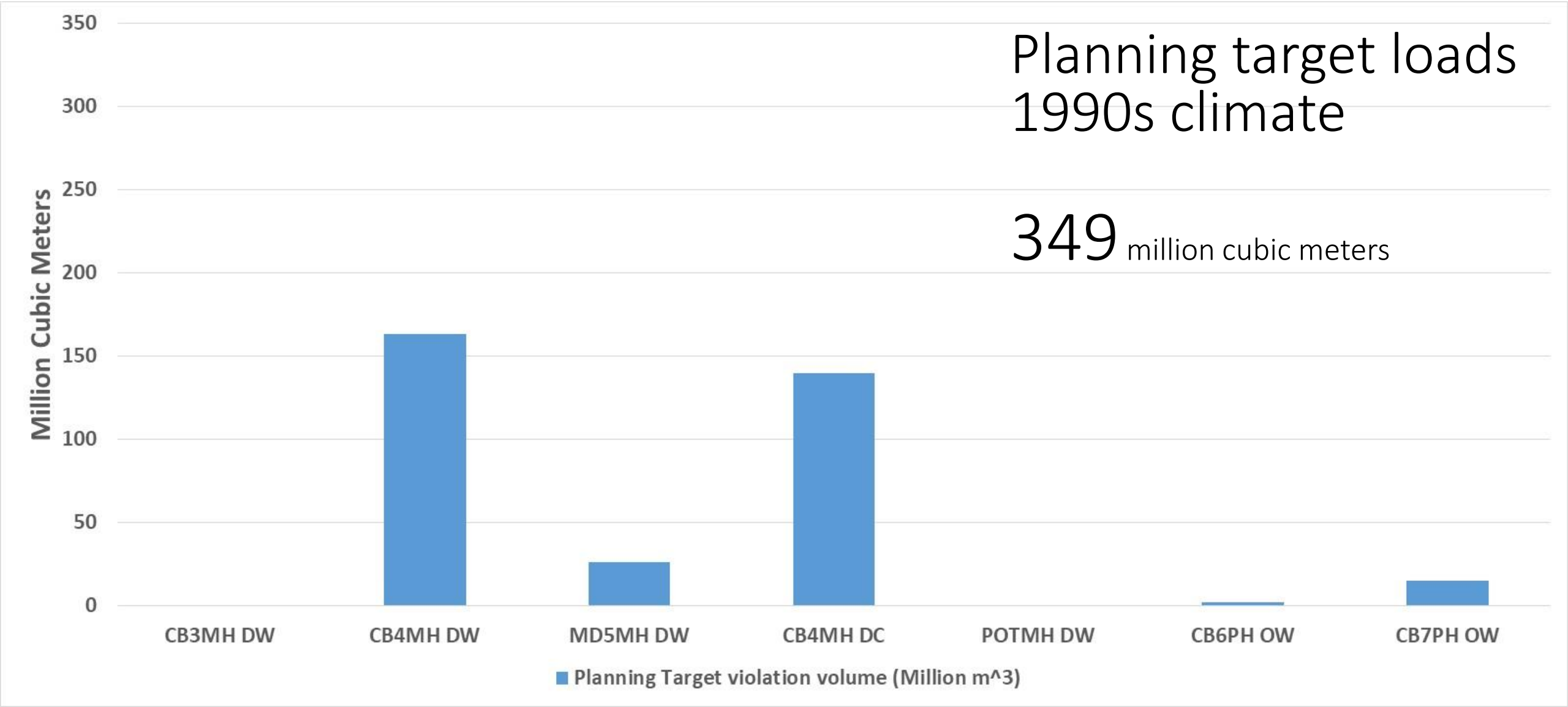
Climate Change Effect on Main Bay



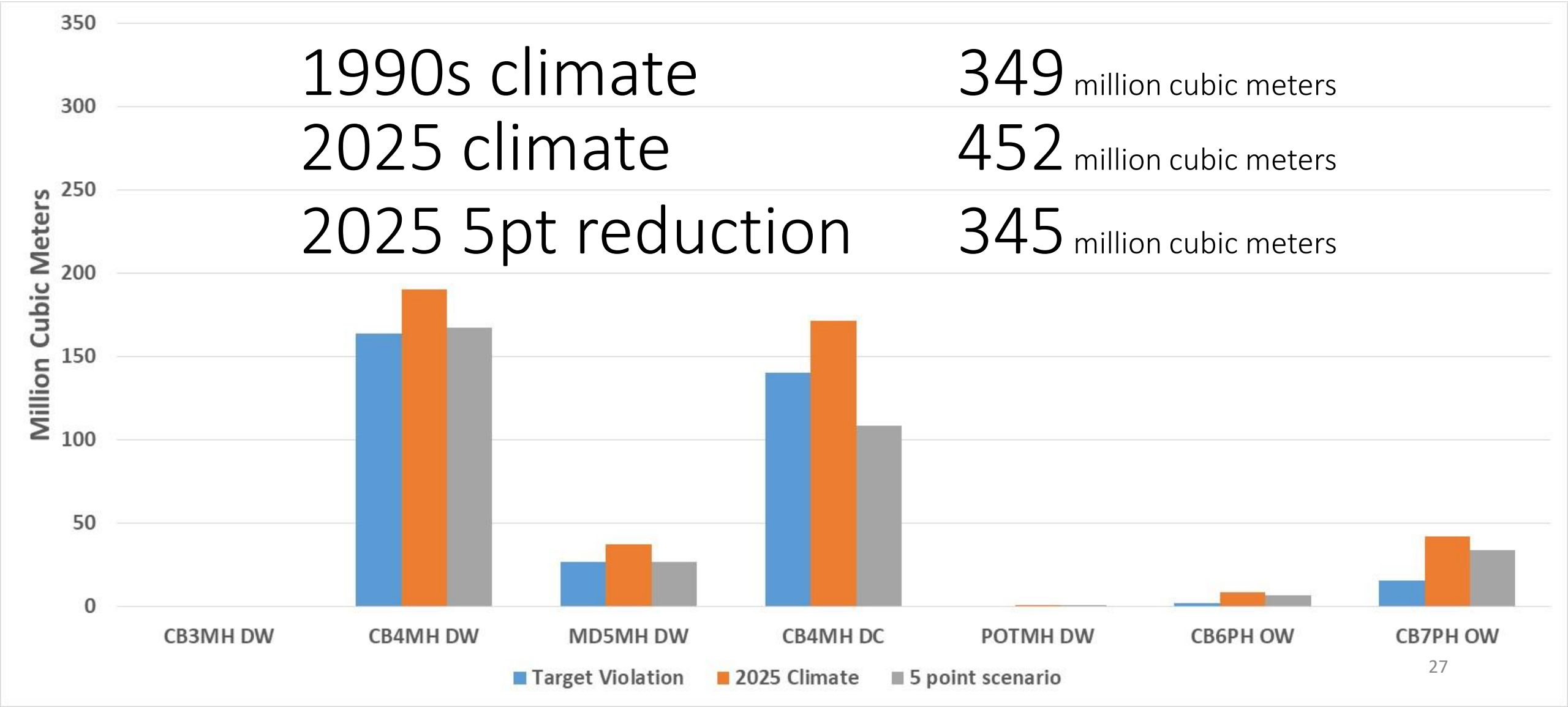
Climate Change Effect on Main Bay



Climate Change Effect on Main Bay



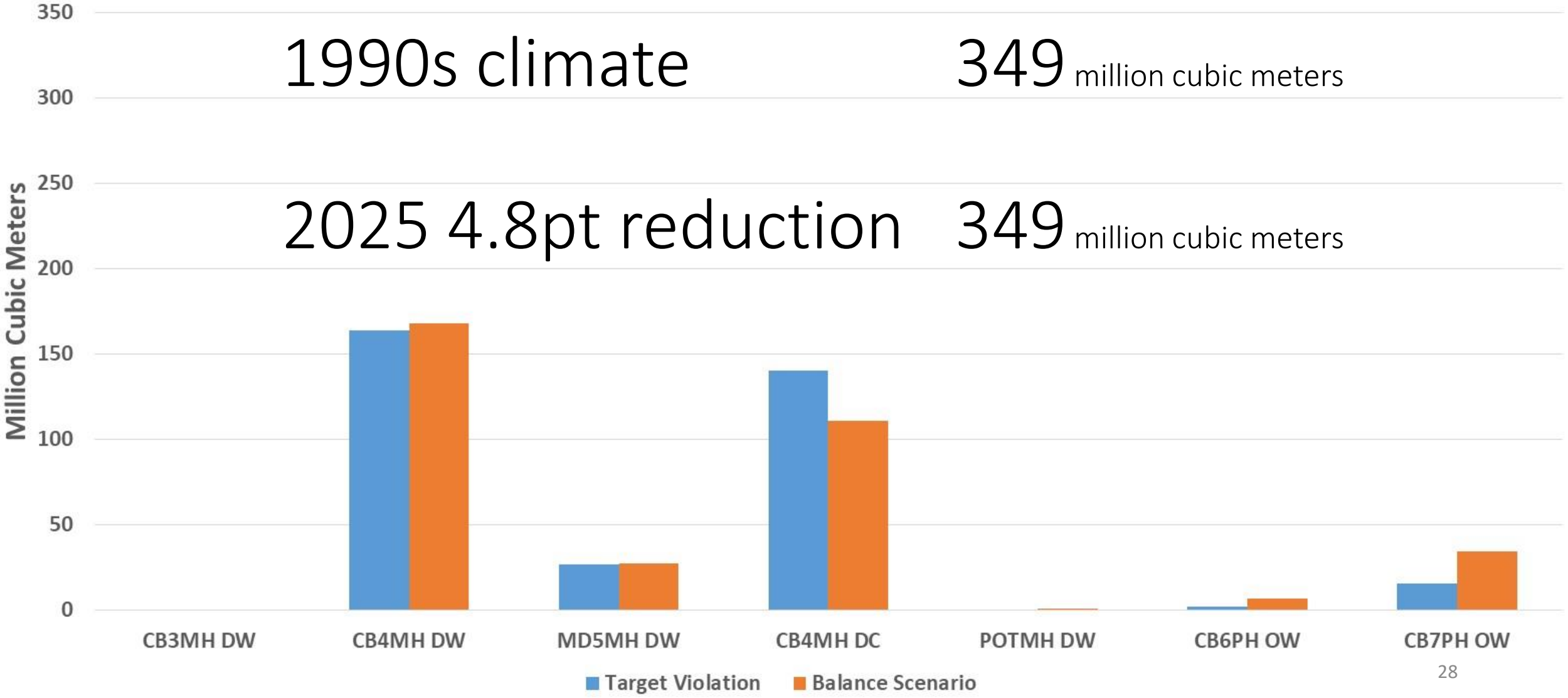
Climate Change Effect on Main Bay



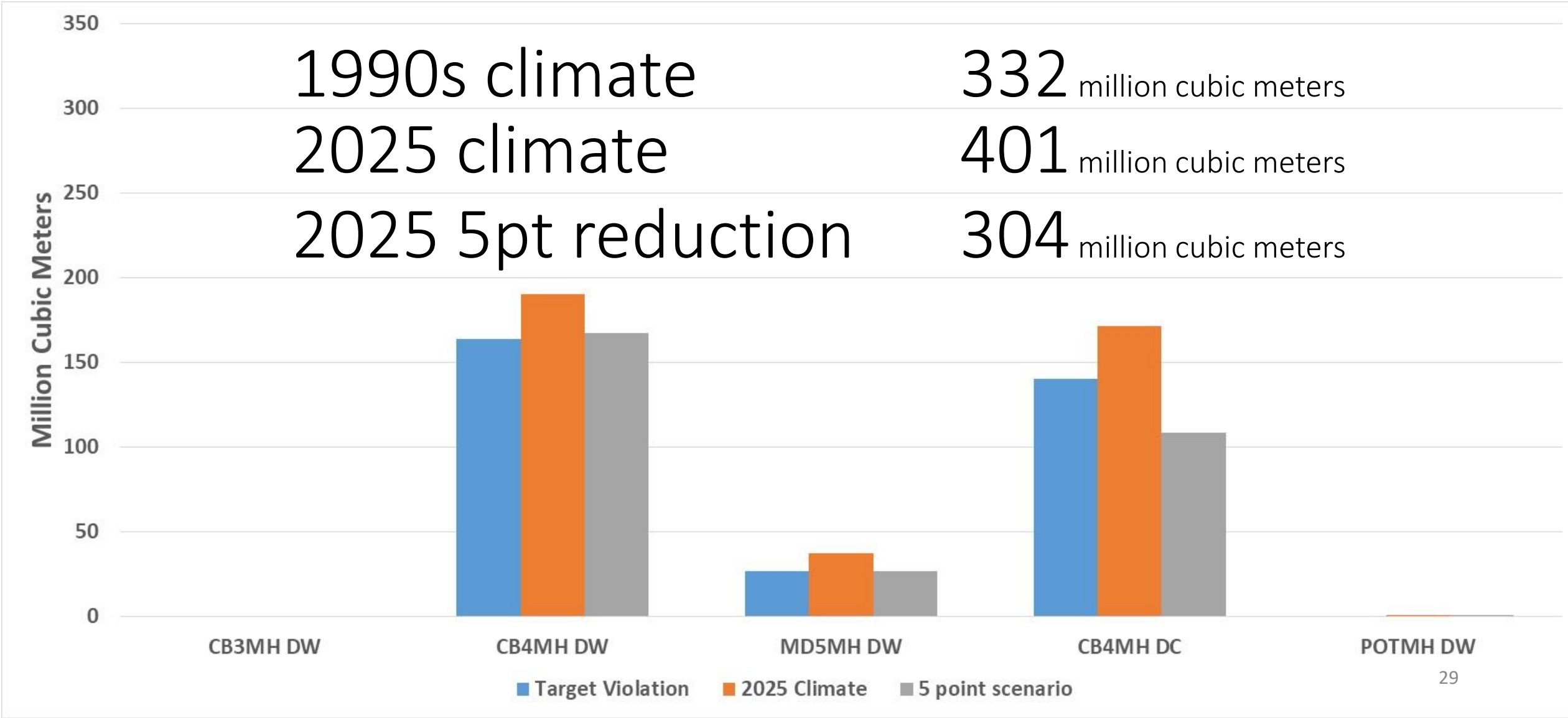
Climate Change Effect on Main Bay

1990s climate 349 million cubic meters

2025 4.8pt reduction 349 million cubic meters



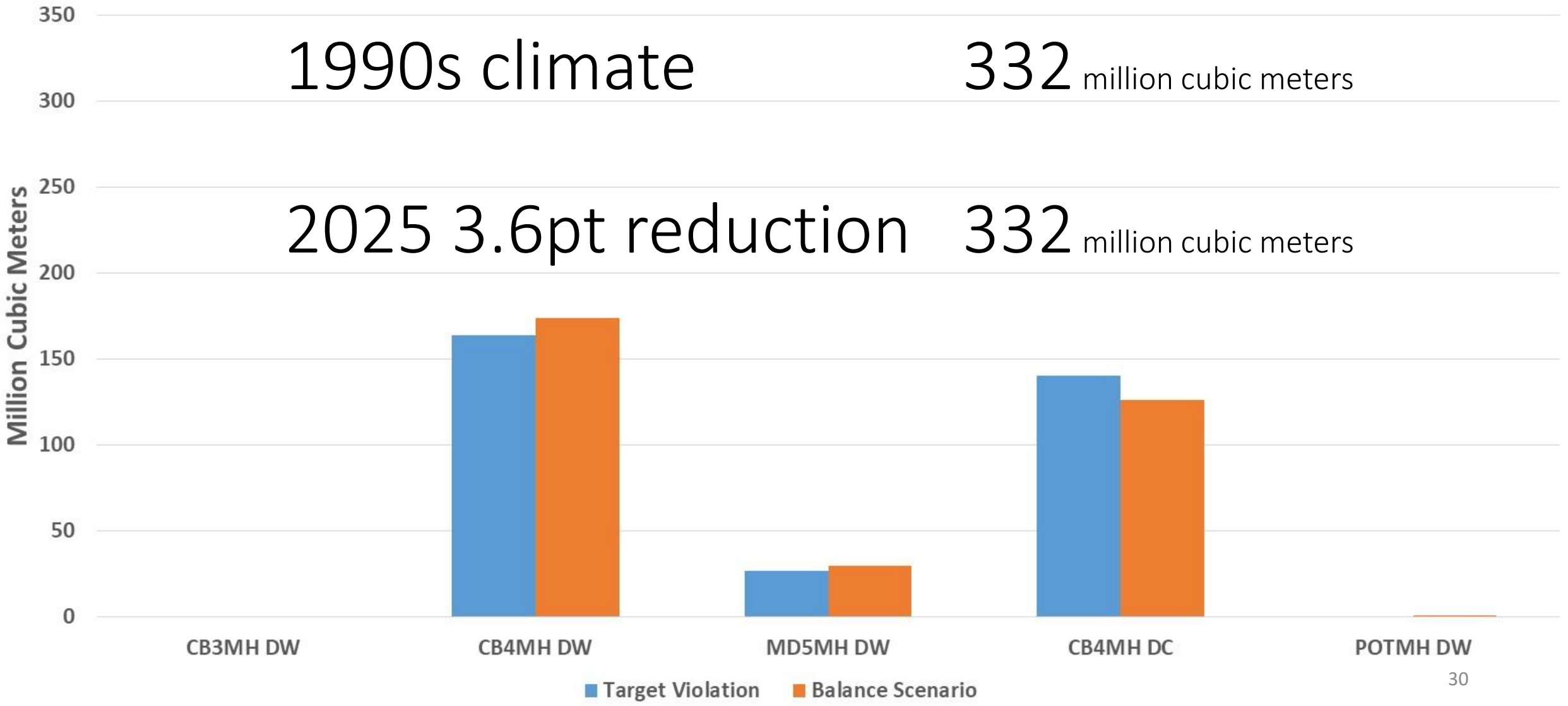
Climate Change Effect on Main Bay no OW



Climate Change Effect on Main Bay

1990s climate 332 million cubic meters

2025 3.6pt reduction 332 million cubic meters



DW and DC

Tradeoffs

CB Seg	Designated Use	Planning Target 1995 climate	Planning Target 2025 climate	PT + reductions 2025 climate	Change between Planning Target and Draft CC reductions
CB3MH	DW	0.05%	0.06%	0.06%	-0.01%
CB4MH	DW	5.74%	6.67%	6.09%	-0.35%
CB5MH_MD	DW	1.27%	1.79%	1.43%	-0.16%
CB5MH_VA	DW	0.00%	0.00%	0.00%	0.00%
POTMH_MD	DW	0.03%	0.06%	0.04%	-0.01%
CB3MH	DC	0.00%	0.00%	0.00%	0.00%
CB4MH	DC	6.59%	8.06%	5.95%	0.64%
CB5MH_MD	DC	0.00%	0.00%	0.00%	0.00%
CB5MH_VA	DC	0.00%	0.00%	0.00%	0.00%

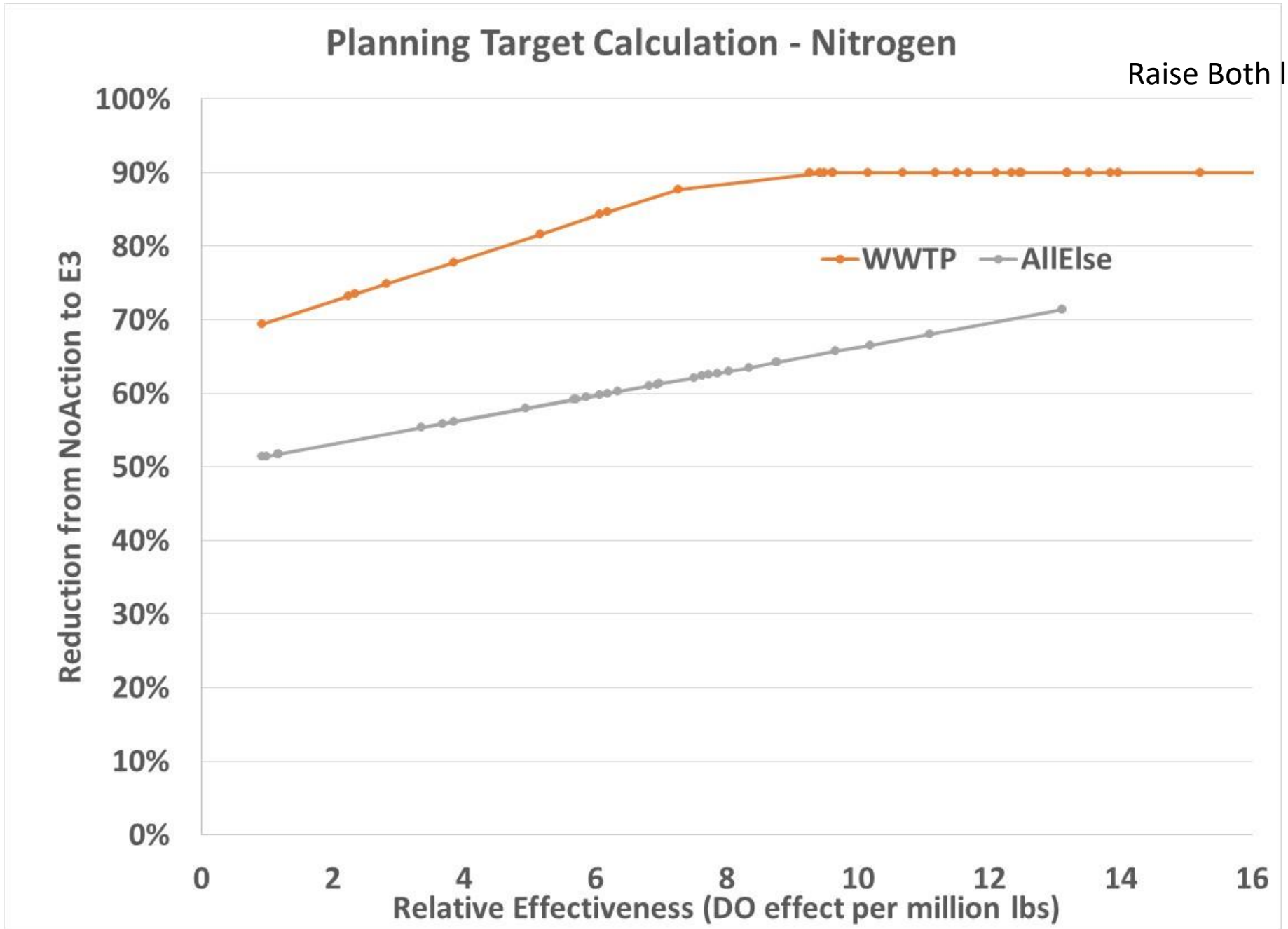
Tradeoffs

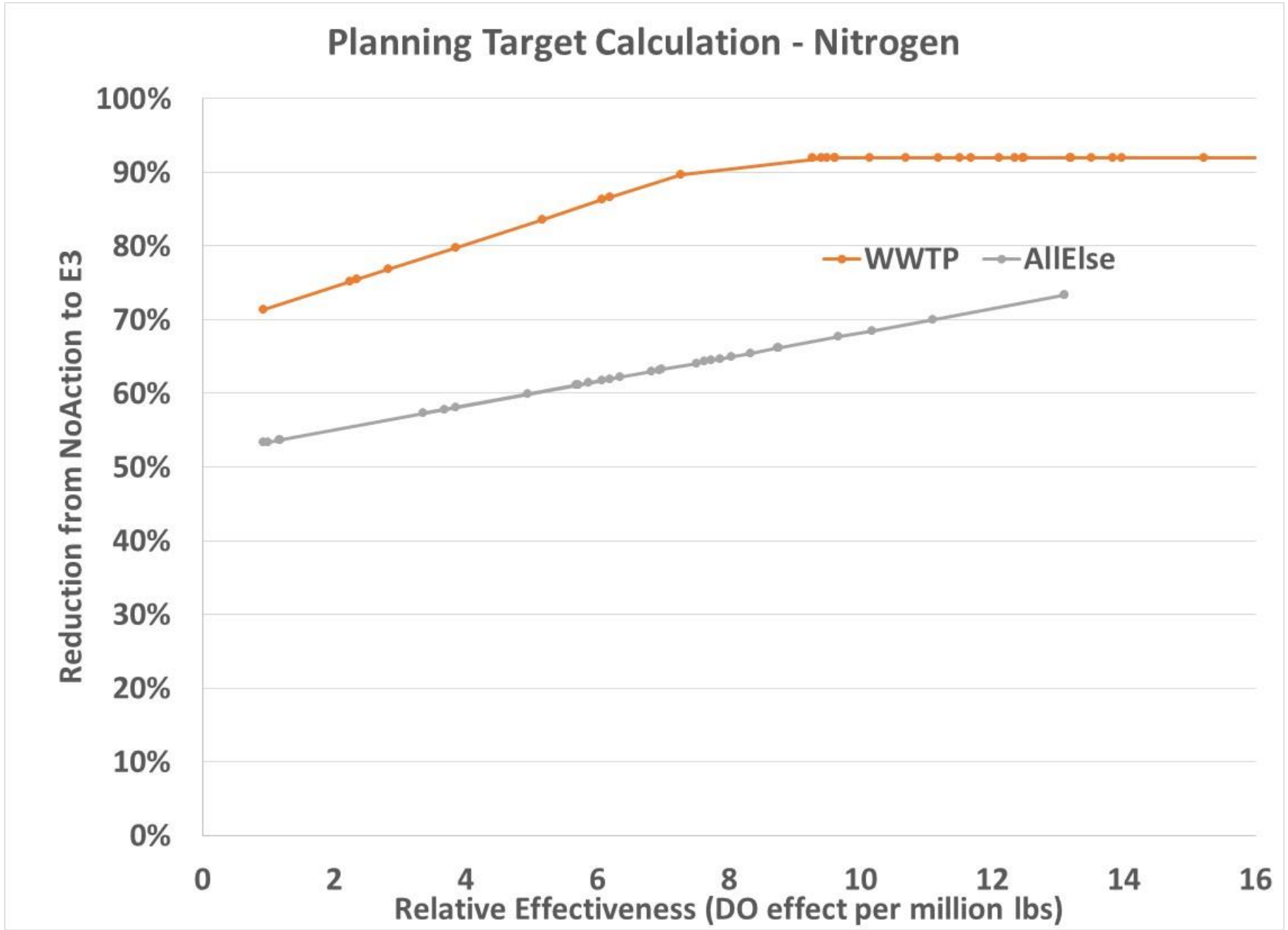
OW DW and DC

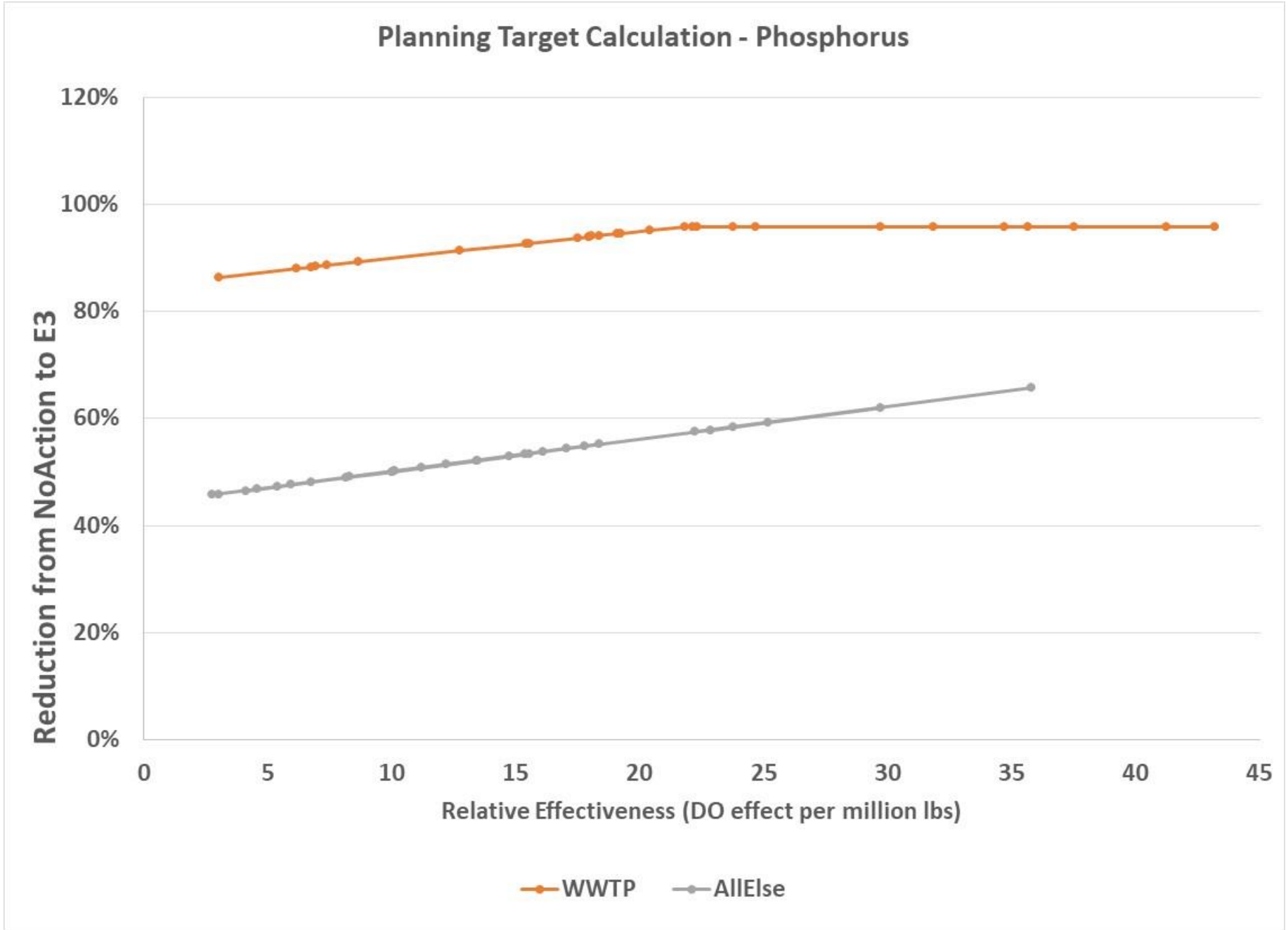
CB Seg	Designated Use	Planning Target 1995 climate	Planning Target 2025 climate	PT + reductions 2025 climate	Change between Planning Target and Draft CC reductions
CB6PH	OW	0.13%	0.49%	0.38%	-0.25%
CB7PH	OW	0.64%	1.74%	1.43%	-0.79%
CB3MH	DW	0.05%	0.06%	0.06%	-0.01%
CB4MH	DW	5.74%	6.67%	5.89%	-0.16%
CB5MH_MD	DW	1.27%	1.79%	1.31%	-0.03%
CB5MH_VA	DW	0.00%	0.00%	0.00%	0.00%
POTMH_MD	DW	0.03%	0.06%	0.04%	-0.01%
CB3MH	DC	0.00%	0.00%	0.00%	0.00%
CB4MH	DC	6.59%	8.06%	5.23%	1.36%
CB5MH_MD	DC	0.00%	0.00%	0.00%	0.00%
CB5MH_VA	DC	0.00%	0.00%	0.00%	0.00%

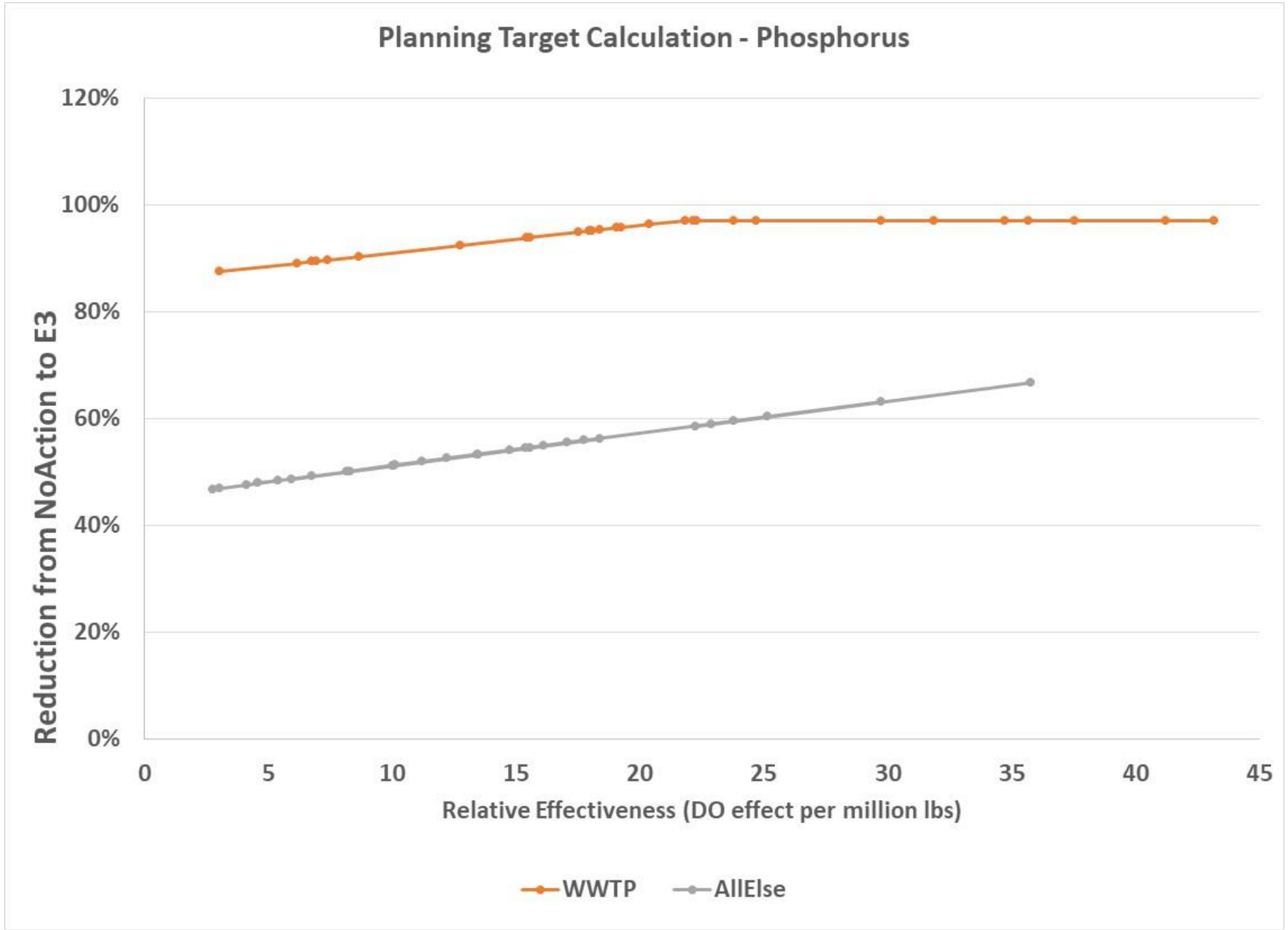
Climate change load increase and Options for increased effort

		Load Decrease Needed									
	Climate	Nitrogen - Non-WWTP					Climate	Phosphorus - Non-WWTP			
	Load	2025		2035			Load	2025		2035	
	Increase	DW DC	+OW	DW DC	+OW		Increase	DW DC	+OW	DW DC	+OW
DC	0.01	0.00	0.00	0.01	0.01	DC	0.00	0.001	0.001	0.001	0.002
DE	0.04	0.21	0.28	0.40	0.51	DE	0.00	0.005	0.006	0.009	0.012
MD	1.06	1.16	1.56	2.22	2.77	MD	0.11	0.079	0.105	0.150	0.187
NY	0.70	0.24	0.32	0.46	0.58	NY	0.04	0.013	0.017	0.024	0.030
PA	1.68	2.30	3.08	4.38	5.48	PA	0.09	0.103	0.138	0.196	0.245
VA	1.48	0.96	1.28	1.83	2.28	VA	0.34	0.137	0.183	0.261	0.326
WV	-0.05	0.14	0.19	0.26	0.33	WV	0.01	0.012	0.016	0.023	0.029
Total	4.91	5.01	6.72	9.56	11.95	Total	0.60	0.348	0.467	0.664	0.830


Planning Target Calculation - Nitrogen
Raise Both lines
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction from NoAction to E3
WWTP
AllElse
0
2
4
6
8
10
12
14
16
Relative Effectiveness (DO effect per million lbs)


Planning Target Calculation - Nitrogen
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction from NoAction to E3
WWTP
AllElse
0
2
4
6
8
10
12
14
16
Relative Effectiveness (DO effect per million lbs)


Planning Target Calculation - Phosphorus
120%
100%
80%
60%
40%
20%
0%
Reduction from NoAction to E3
0
5
10
15
20
25
30
35
40
45
Relative Effectiveness (DO effect per million lbs)
WWTP
AllElse


Planning Target Calculation - Phosphorus
120%
100%
80%
60%
40%
20%
0%
Reduction from NoAction to E3
0
5
10
15
20
25
30
35
40
45
Relative Effectiveness (DO effect per million lbs)
WWTP
AllElse

Load Decrease Needed

	Climate	Nitrogen - Non-WWTP			
	Load	2025		2035	
	Increase	DW DC	+OW	DW DC	+OW
DC	0.01	0.00	0.00	0.01	0.01
DE	0.04	0.21	0.28	0.40	0.51
MD	1.06	1.16	1.56	2.22	2.77
NY	0.70	0.24	0.32	0.46	0.58
PA	1.68	2.30	3.08	4.38	5.48
VA	1.48	0.96	1.28	1.83	2.28
WV	-0.05	0.14	0.19	0.26	0.33
Total	4.91	5.01	6.72	9.56	11.95

	Climate	Phosphorus - Non-WWTP			
	Load	2025		2035	
	Increase	DW DC	+OW	DW DC	+OW
DC	0.00	0.001	0.001	0.001	0.002
DE	0.00	0.005	0.006	0.009	0.012
MD	0.11	0.079	0.105	0.150	0.187
NY	0.04	0.013	0.017	0.024	0.030
PA	0.09	0.103	0.138	0.196	0.245
VA	0.34	0.137	0.183	0.261	0.326
WV	0.01	0.012	0.016	0.023	0.029
Total	0.60	0.348	0.467	0.664	0.830

	Climate	Nitrogen - all sources			
	Load	2025		2035	
	Increase	DW DC	+OW	DW DC	+OW
DC	0.01	0.15	0.20	0.29	0.36
DE	0.04	0.12	0.16	0.22	0.28
MD	1.06	1.59	2.13	3.03	3.79
NY	0.70	0.20	0.27	0.38	0.48
PA	1.68	1.74	2.33	3.32	4.15
VA	1.48	1.50	2.01	2.86	3.57
WV	-0.05	0.10	0.14	0.20	0.25
Total	4.91	5.40	7.24	10.30	12.87

	Climate	Phosphorus - all sources			
	Load	2025		2035	
	Increase	DW DC	+OW	DW DC	+OW
DC	0.00	0.018	0.024	0.033	0.042
DE	0.00	0.002	0.003	0.004	0.004
MD	0.11	0.107	0.143	0.203	0.254
NY	0.04	0.011	0.014	0.021	0.026
PA	0.09	0.069	0.092	0.131	0.164
VA	0.34	0.179	0.240	0.342	0.427
WV	0.01	0.008	0.010	0.014	0.018
Total	0.60	0.393	0.526	0.749	0.936

Increasing effort in future years

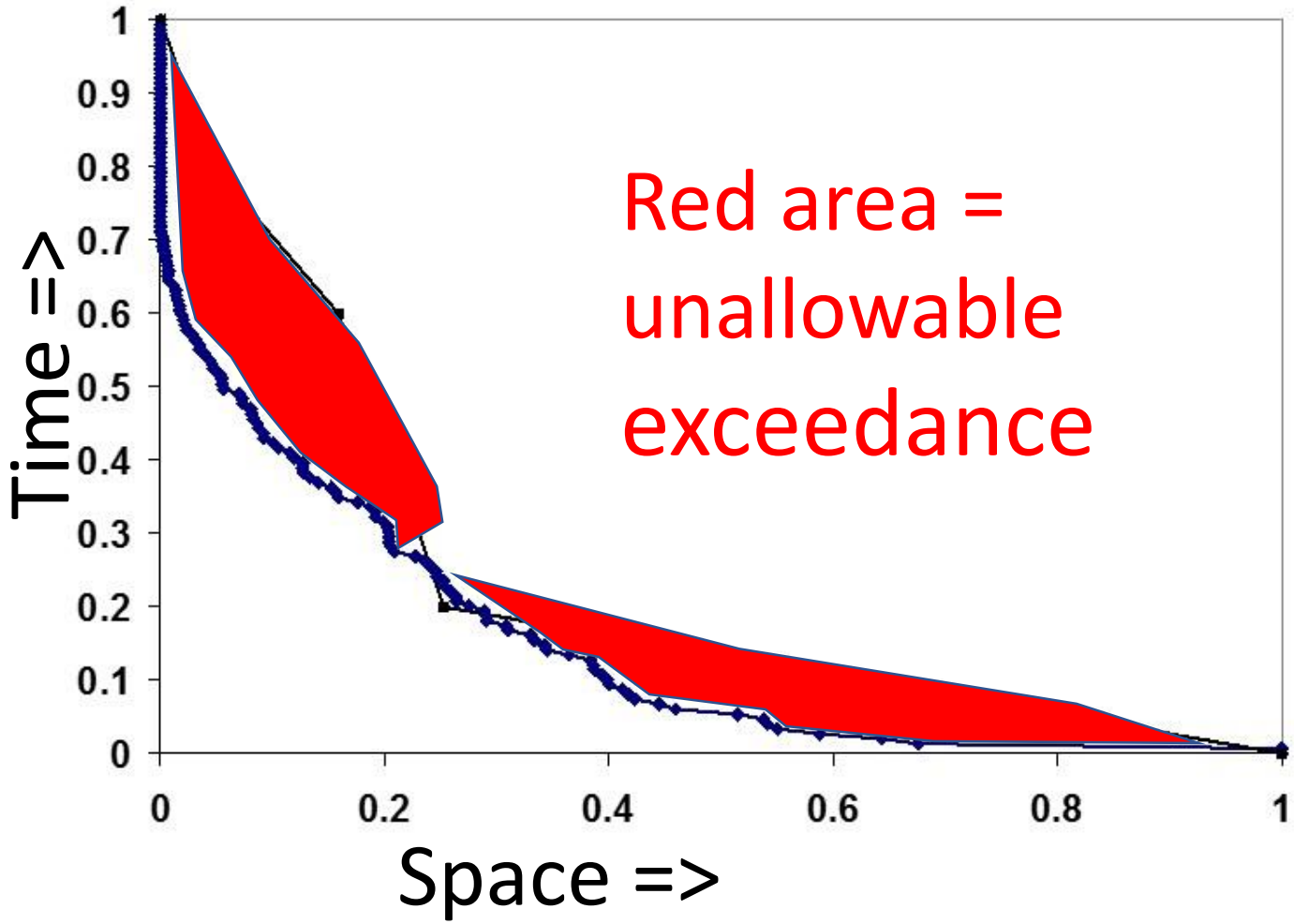
	Nitrogen					Phosphorus	
Year	**DW DC**	**+OW**			Year	**DW DC**	**+OW**
2025	5.01	6.72			2025	0.348	0.467
2035	9.56	11.95			2035	0.664	0.830
2045	14.60	18.95			2045	1.015	1.316
2055	20.10	25.45			2055	1.396	1.768

Questions *for the WQGIT*

- How do we estimate climate effect?
  - Just ‘allocation segments’ or include Open Water?
  - Volume-weighted average?
- How do we allocate reductions?
  - WWTP or Just All other sources?
  - Use something other than planning target curves?


Change Model
Airshed Model
Precipitation Data
Meteorological Data
Elevation Data
Soil Data
BMP Implementation Results
N
P
Sediment

Graphics


Time =>
Space =>
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0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0
0.2
0.4
0.6
0.8
1
Red area = unallowable exceedance