Upper Charles River Pilot

Bellingham - Franklin - Milford

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Objective

Identify the optimum combination of BMP controls given the **real world** distribution of land use, and soil, and other constraints within three pilot communities to meet the Charles River TMDL.

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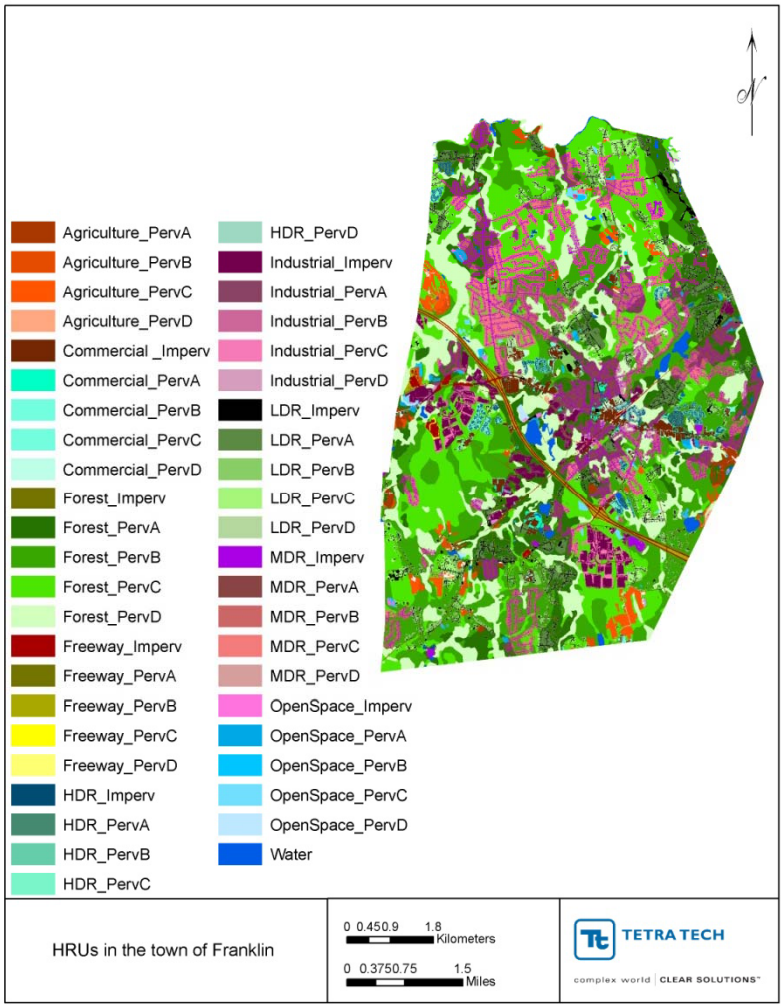
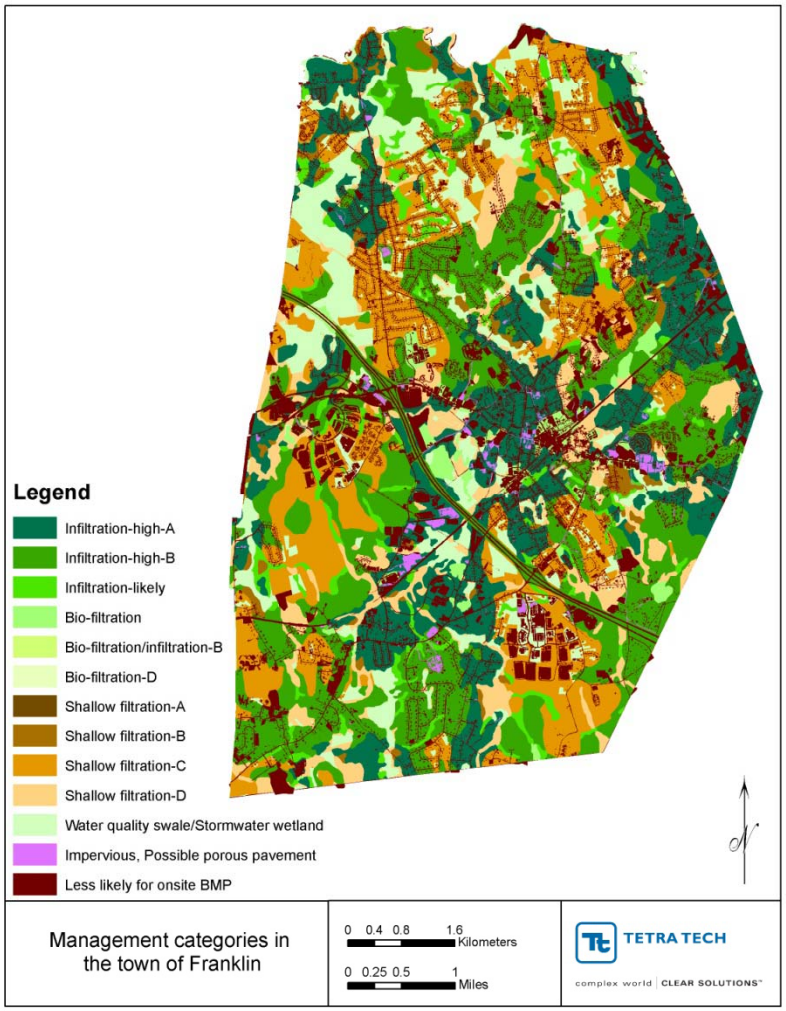
Identify the **optimum** combination of BMP control given the **real world** distribution of land use, and soil, and other constraints within three pilot communities to reach the Charles River TMDL.

Land Use & Soil < > Site Constraints

Pollution Load < > BMP Possibilities





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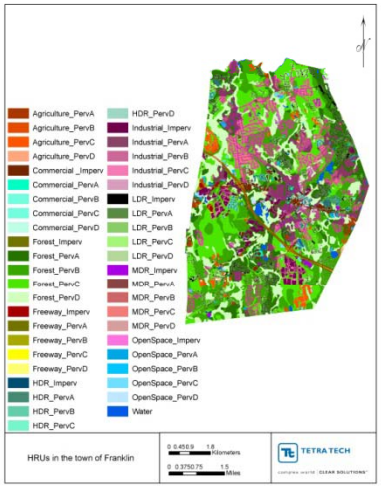
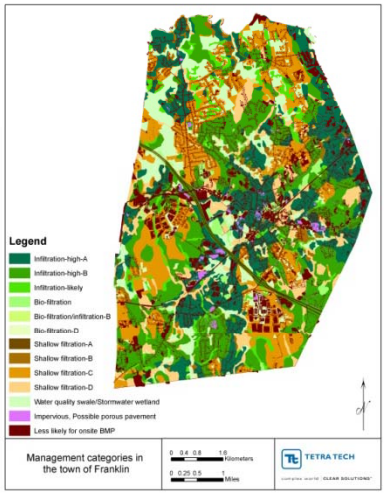
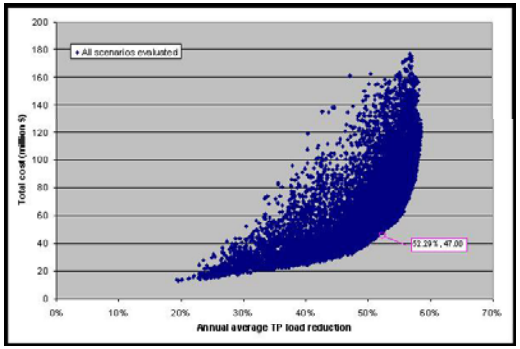
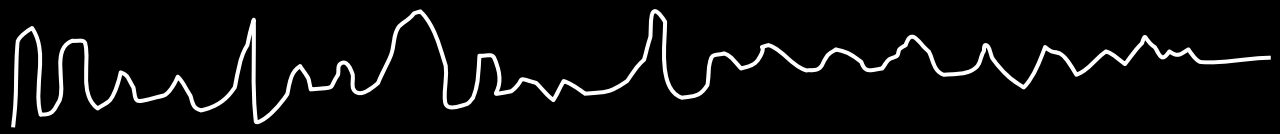




BMPDSS Optimizer





10 year hydrograph & pollutograph developed with SWMM
For each HRU

Characteristics of each BMP

BMP	Cost
Bioretention area	$3.20 (per ft^3 treated)
Constructed wetland	$1.77 (per ft^3 treated)
Grass swale	$0.45 (per ft^2)
Infiltration trench	$2.88 (per ft^3 treated)
Porous pavement	$1.52 (per ft^2)
Retention/Detention basins	$1.57 (per ft^3 treated)
Sand filter	$3.48 (per ft^3 treated)

Scenario One

Can we meet the TMDL with only on site treatment of just the runoff from impervious areas?

Table 5-5. Tabulation of impervious HRUs into management categories in Franklin for Scenario I setup (Unit: acres)

BMP	Commercial	High-density residential	Industrial	Medium-density residential	Freeway	Low-density residential	Open space	Forest
Infiltration high-A	103.87	28.41	82.75	416.91	22.52	164.83	9.34	71.42
Infiltration high-B	54.58	24.93	45.44	145.24	87.82	64.54	4.89	41.52
Infiltration likely	1.15	0.36	6.38	8.50	5.63	4.93	0.98	5.97
Biofiltration	39.10	4.55	11.68	2.88	1.26	3.57	0.17	2.03
Biofiltration/infiltration-A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biofiltration/infiltration-B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biofiltration/infiltration-C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Biofiltration-D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shallow filtration-A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Shallow filtration-B	3.98	0.00	1.86	8.04	0.00	4.72	0.63	0.27
Shallow filtration-C	11.85	29.00	156.13	152.32	16.22	84.32	4.09	80.21
Shallow filtration-D	10.94	12.20	16.46	22.07	0.00	13.98	3.41	5.31
Impervious, possible PP	39.65	0.00	49.26	0.43	4.65	0.81	0.86	4.11
WQ swale, wetland	10.82	1.35	65.25	13.46	0.02	9.31	0.29	5.92
Less likely for onsite BMP	3.34	1.21	2.57	13.40	15.11	9.34	0.16	6.08
Total	**279.28**	**102.00**	**437.77**	**783.27**	**153.24**	**360.36**	**24.81**	**222.84**

Table 5-9. The level of treatment needed in Franklin for Scenario I

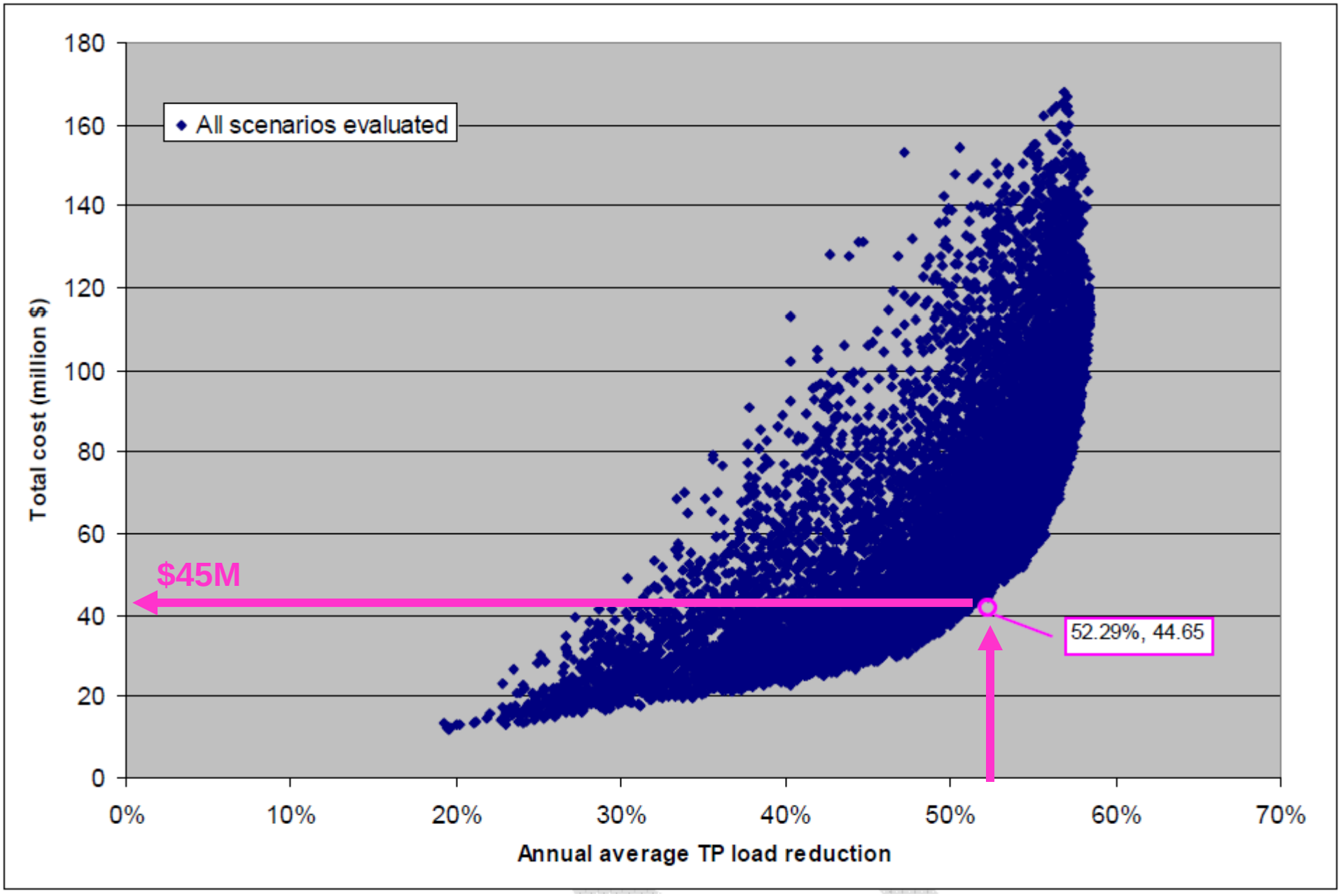
BMP	Commercial		High-density residential		Industrial		Medium-density residential		Low-density residential		Forest	
	BMP area (ac)	Depth of runoff treated (in)	BMP area (ac)	Depth of runoff treated (in)	BMP area (ac)	Depth of runoff treated (in)	BMP area (ac)	Depth of runoff treated (in)	BMP area (ac)	Depth of runoff treated (in)	BMP area (ac)	Depth of runoff treated (in)
Infiltration high-A	3.28	1.21 (99%)	0.45	0.60 (91%)	2.61	1.21 (99%)	6.58	0.60 (90%)	5.21	0.60 (90%)	2.26	1.21
Infiltration high-B	1.72	1.21 (97%)	1.18	1.20 (98%)	1.43	1.21 (97%)	4.59	1.00 (95%)	1.02	1.00 (94%)	0.66	0.60
Infiltration likely	0.09	1.00 (94%)	0.02	1.00 (94%)	0.10	0.60 (82%)	0.27	1.21 (95%)	0.31	1.00 (92%)	0.66	1.00
Biofiltration[$]	0.62	1.00 (76%-89%)	0.07	0.60 (64%-73%)	0.37	1.21 (79%-93%)	0.14	1.00 (75%-88%)	0.11	1.00 (73%-87%)	0.22	1.00
Shallow filtration-B	0.06	0.25 (38%)	0.00	0.00	0.15	1.23 (80%)	1.02	1.00 (75%)	0.74	1.00 (73%)	0.02	1.24
Shallow filtration-C	0.19	1.00 (76%)	1.83	0.99 (76%)	9.86	0.98 (76%)	4.81	0.49 (58%)	5.33	0.49 (58%)	5.07	0.98
Shallow filtration-D	0.69	0.98 (76%)	0.39	1.00 (76%)	1.56	1.00 (76%)	0.70	0.49 (58%)	0.22	0.25 (39%)	0.5	1.00
Impervious, possible PP	3.13	1.00 (74%)	0.00	0.00	1.56	0.40 (75%)	0.01	0.20 (73%)	0.10	1.00 (71%)	0.06	0.20
WQ swale, wetland[&]	1.37	5.76	0.19	5.76	6.18	4.32	1.70	5.76	1.18	5.76	0.75	5.76

[$] No direct curve data for biofiltration; range was an estimation based on bioretention (lower bound) and infiltration trench (higher bound).
[&] TP removal percentages for depths larger than 2.5" were not available because of a lack of corresponding curve data.

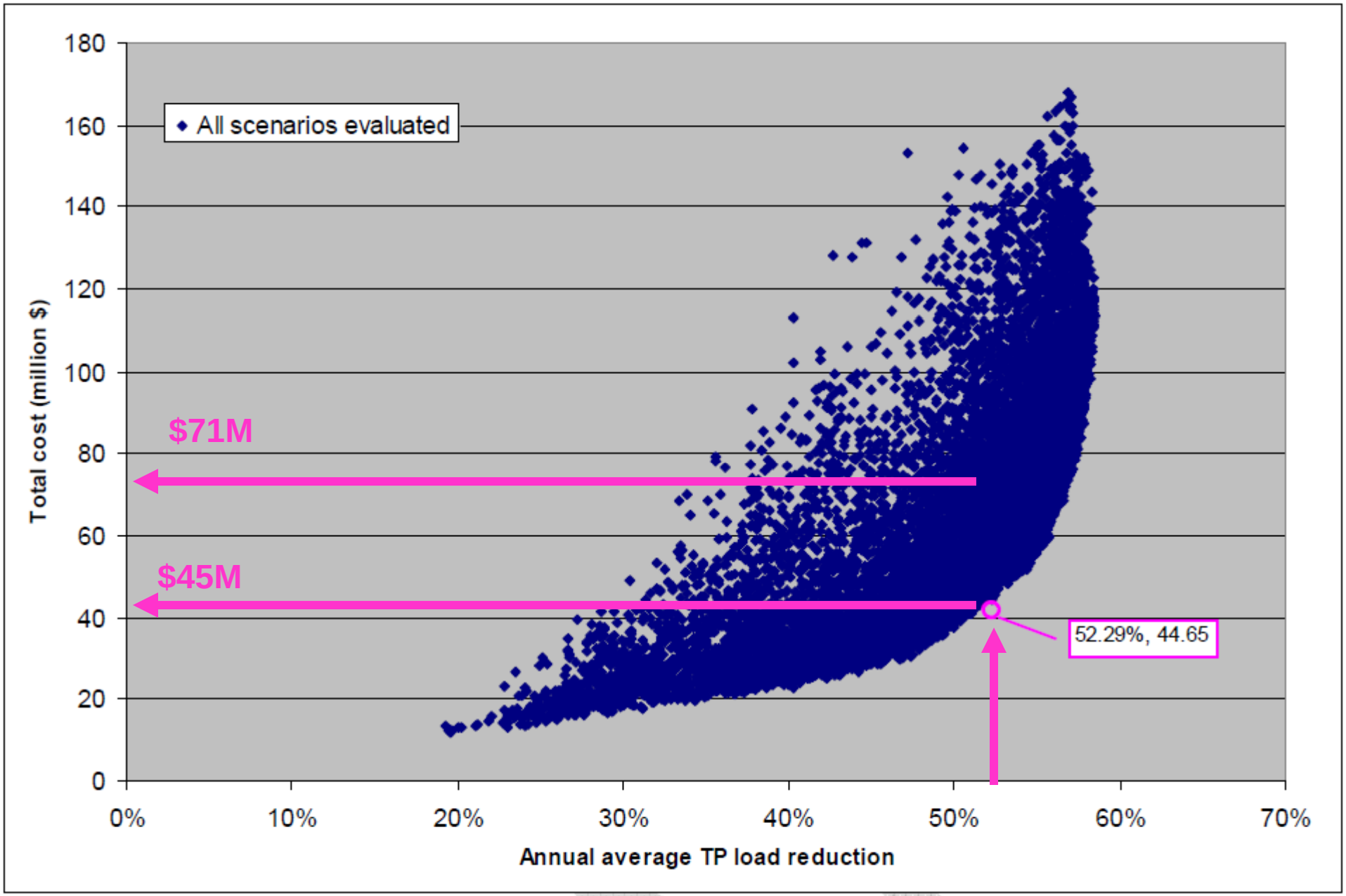
A GRAIN of Salt

- We dealt with cost as a means of choosing between treatment options. Relative costs!
- Use these numbers to understand the big picture.

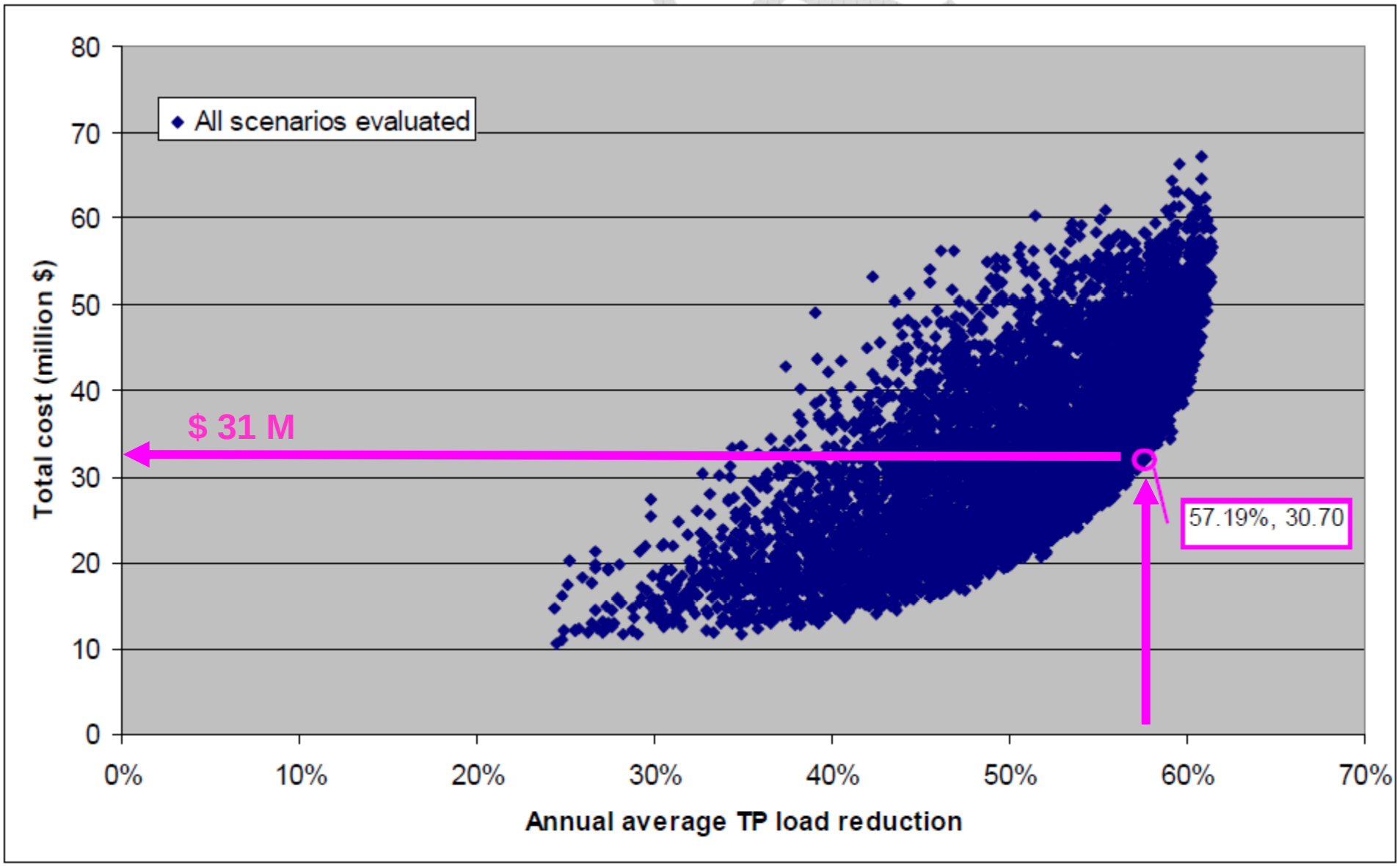
Franklin


All scenarios evaluated
Total cost (million $)
180
160
140
120
100
80
60
40
20
0
$45M
52.29%, 44.65
0%
10%
20%
30%
40%
50%
60%
70%
Annual average TP load reduction

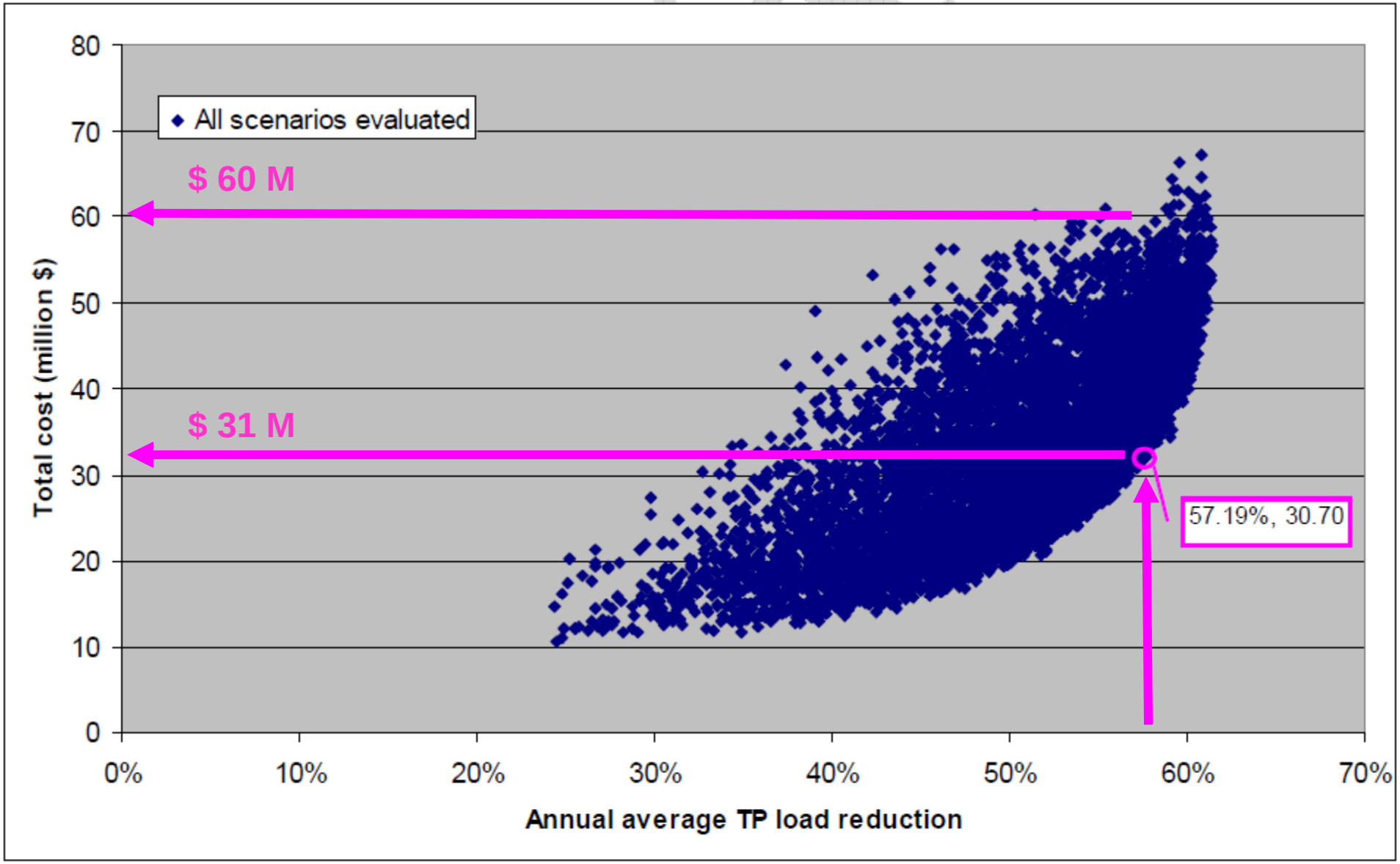
Franklin


All scenarios evaluated
$71M
$45M
52.29%, 44.65
Total cost (million $)
Annual average TP load reduction
180
160
140
120
100
80
60
40
20
0
0%
10%
20%
30%
40%
50%
60%
70%

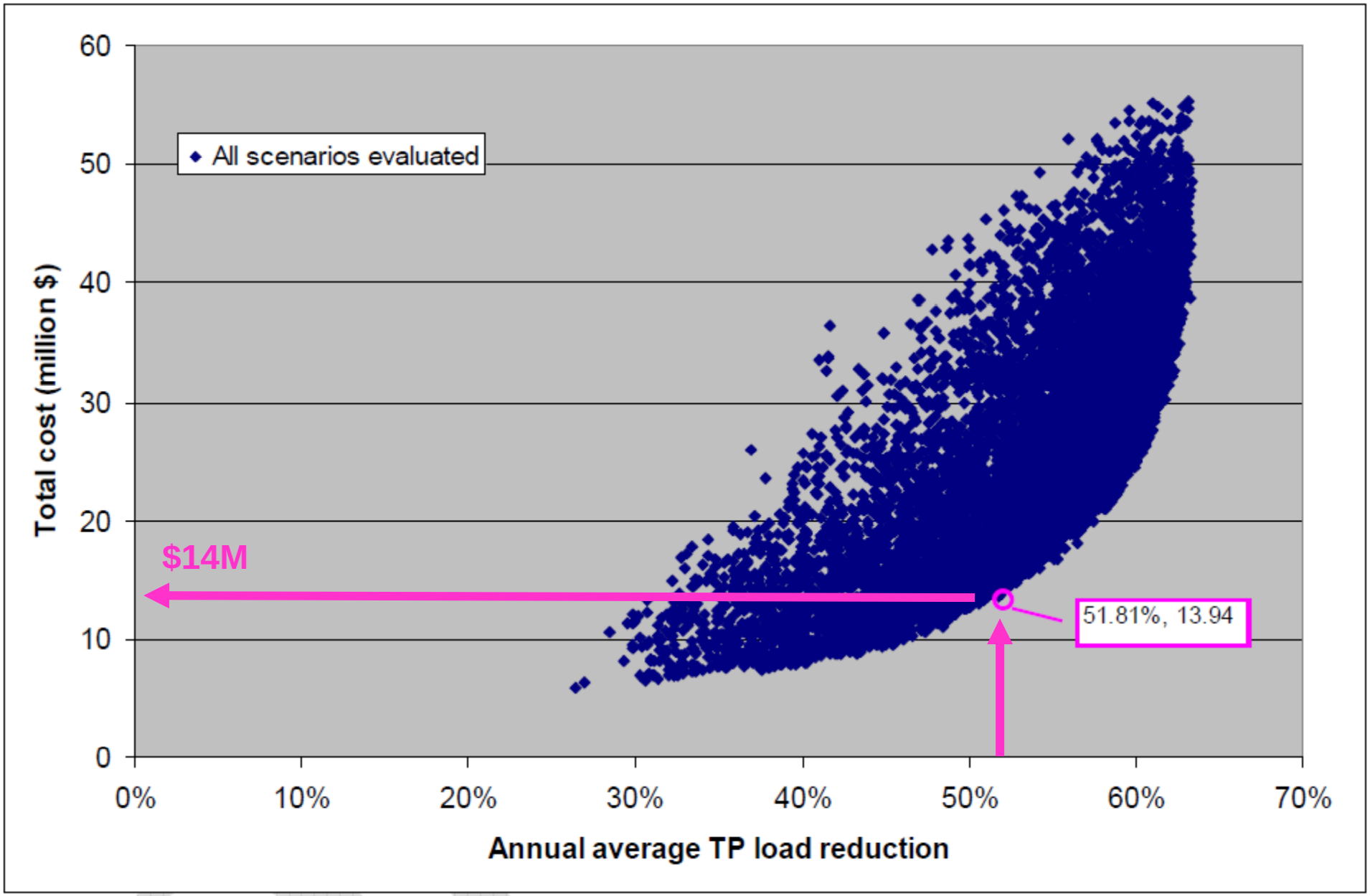
Milford


All scenarios evaluated
Total cost (million $)
80
70
60
50
40
30
20
10
0
0%
10%
20%
30%
40%
50%
60%
70%
Annual average TP load reduction
$ 31 M
57.19%, 30.70

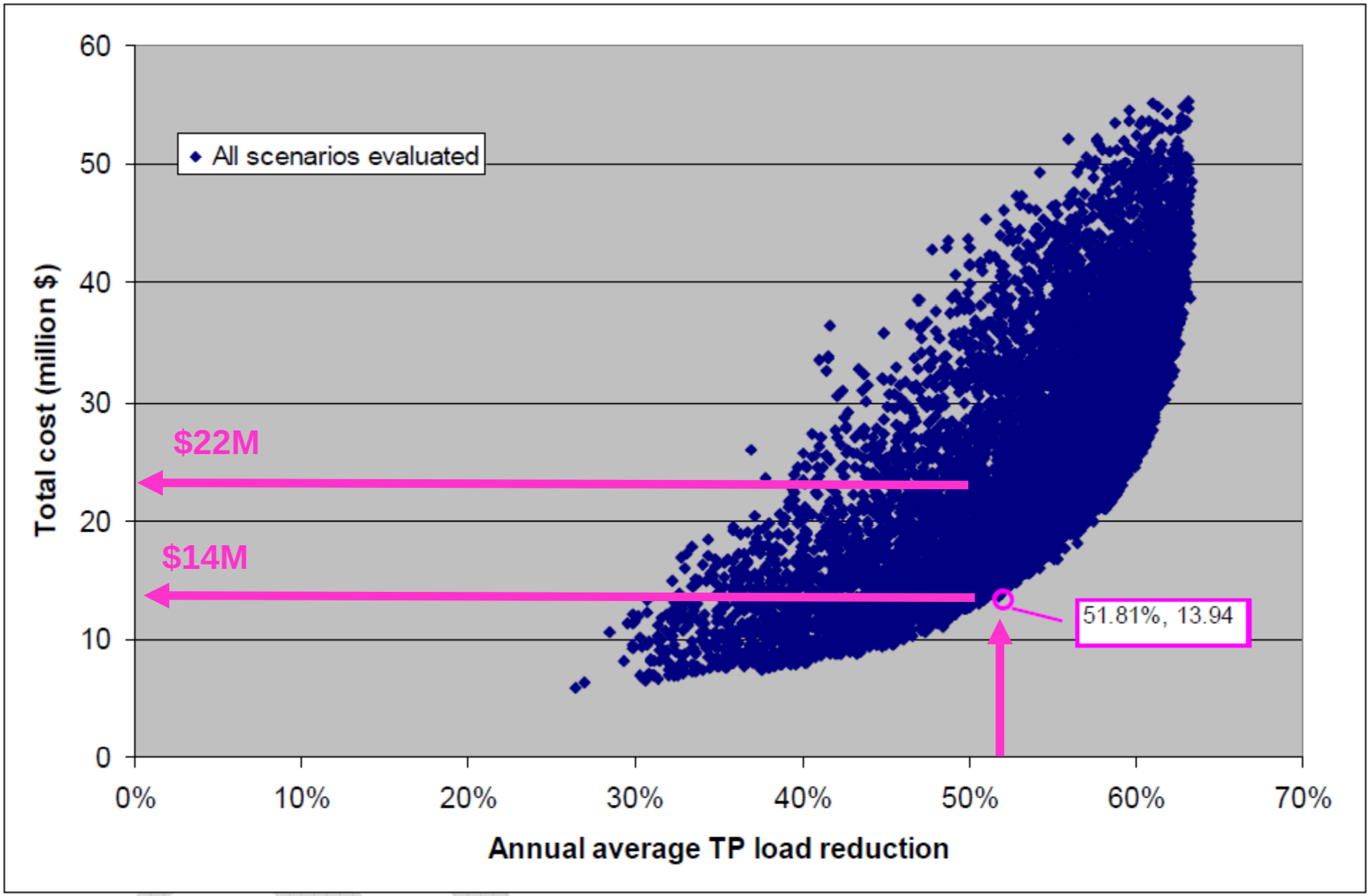
Milford


All scenarios evaluated
$ 60 M
$ 31 M
57.19%, 30.70
Total cost (million $)
Annual average TP load reduction
0
10
20
30
40
50
60
70
80
0%
10%
20%
30%
40%
50%
60%
70%

Bellingham

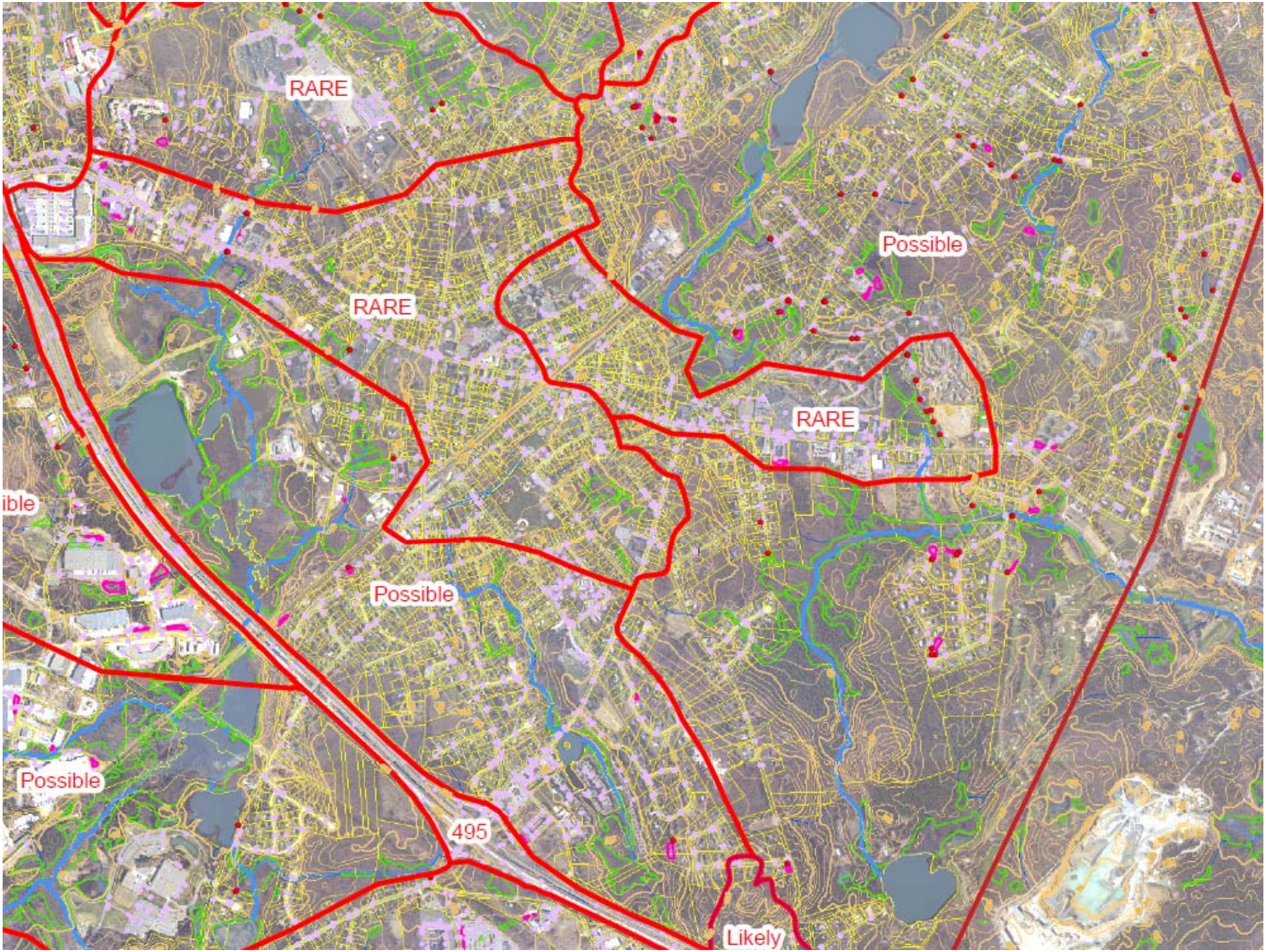

All scenarios evaluated
Total cost (million $)
60
50
40
30
20
10
0
$14M
51.81%, 13.94
0%
10%
20%
30%
40%
50%
60%
70%
Annual average TP load reduction

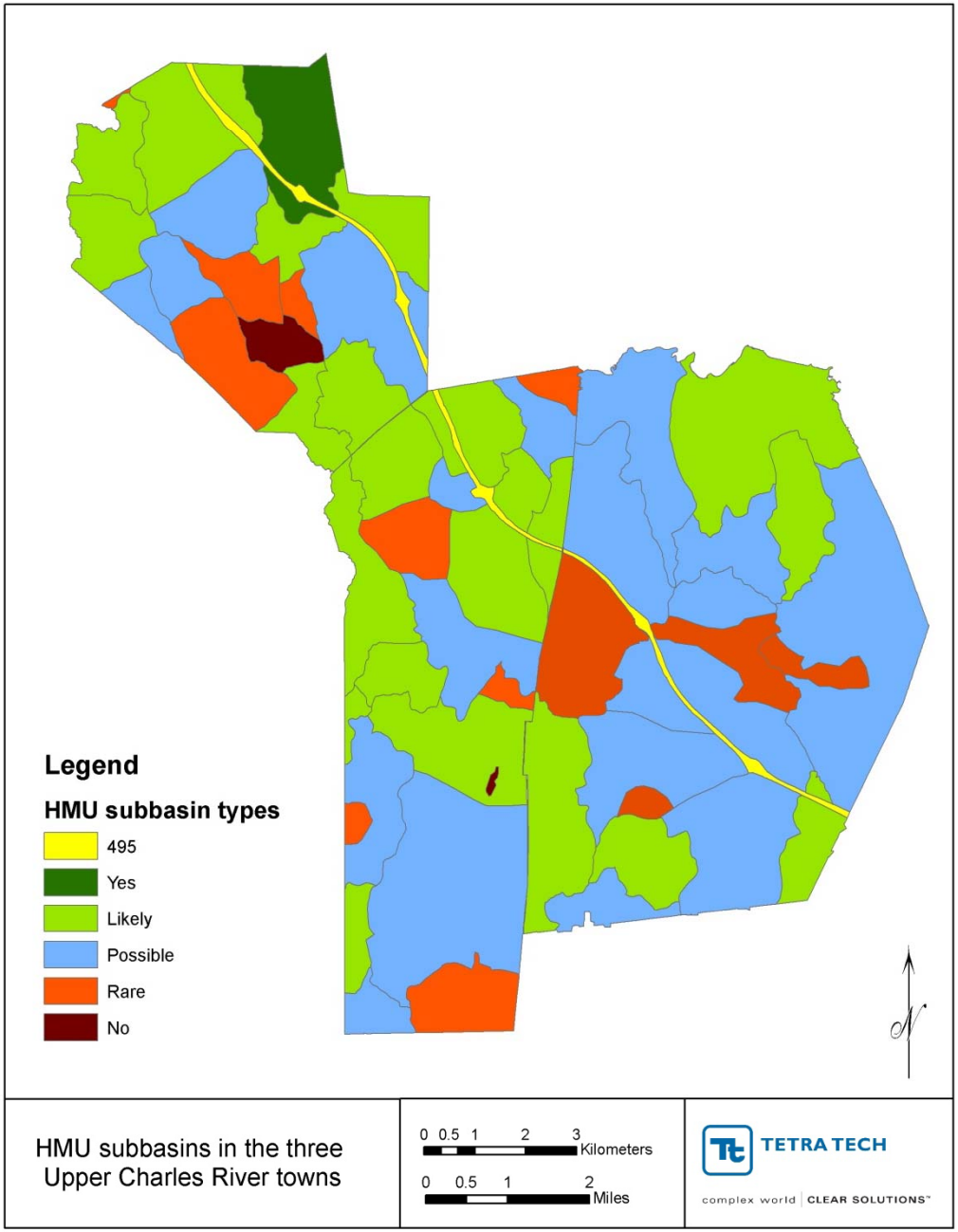
Bellingham


All scenarios evaluated
$22M
$14M
51.81%, 13.94
Total cost (million $)
Annual average TP load reduction
0
10
20
30
40
50
60
0%
10%
20%
30%
40%
50%
60%
70%

Scenario Two

- Similar to Scenario 1
- Public Rights of Way and places where “On site BMP was less likely” are treated with neighborhood BMPs to the extent that was considered probable.


RARE
RARE
Possible
RARE
ible
Possible
Possible
495
Likely

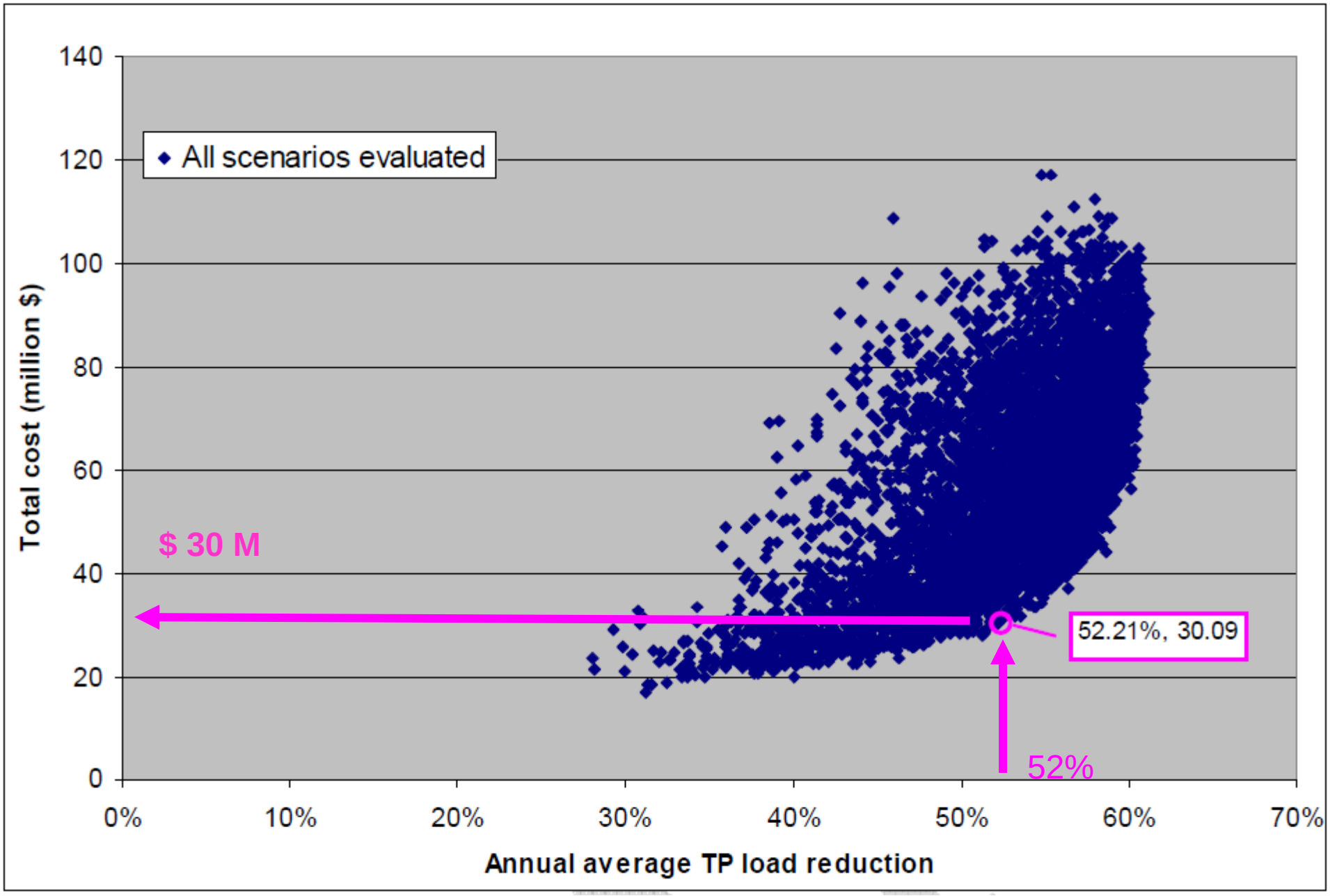


Neighborhood BMPs

- Assumed to be a constructed wetland

- Yes 100% treated
- Likely 75% treated
- Possible 50% treated
- Rare 25% treated
- No 0% treated

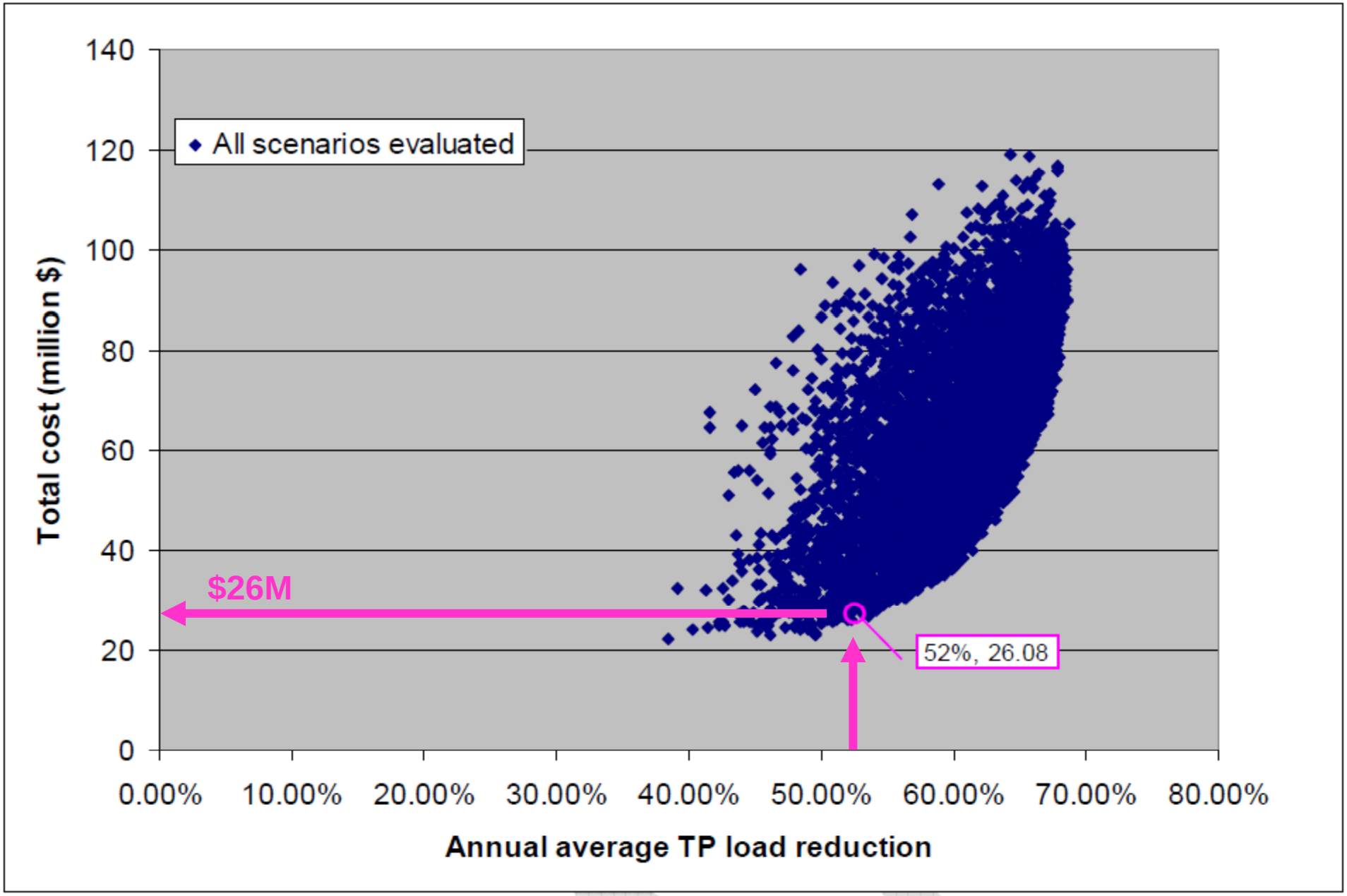
Franklin Scenario 2



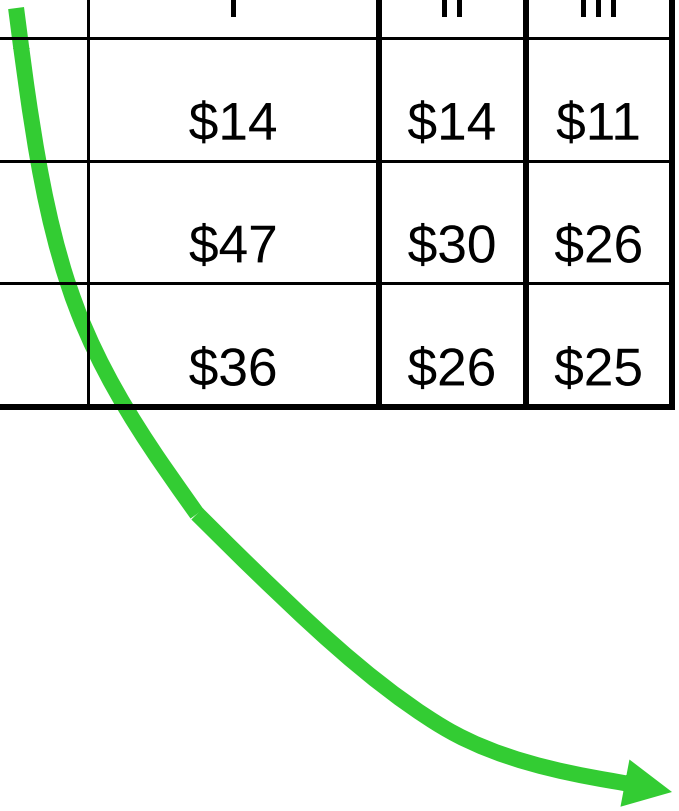
Scenario 3

- In addition to dealing with loads generated on impervious surfaces, loads from pervious surfaces other than forests were routed to the most appropriate BMP given the site constraints.

Franklin Scenario 3

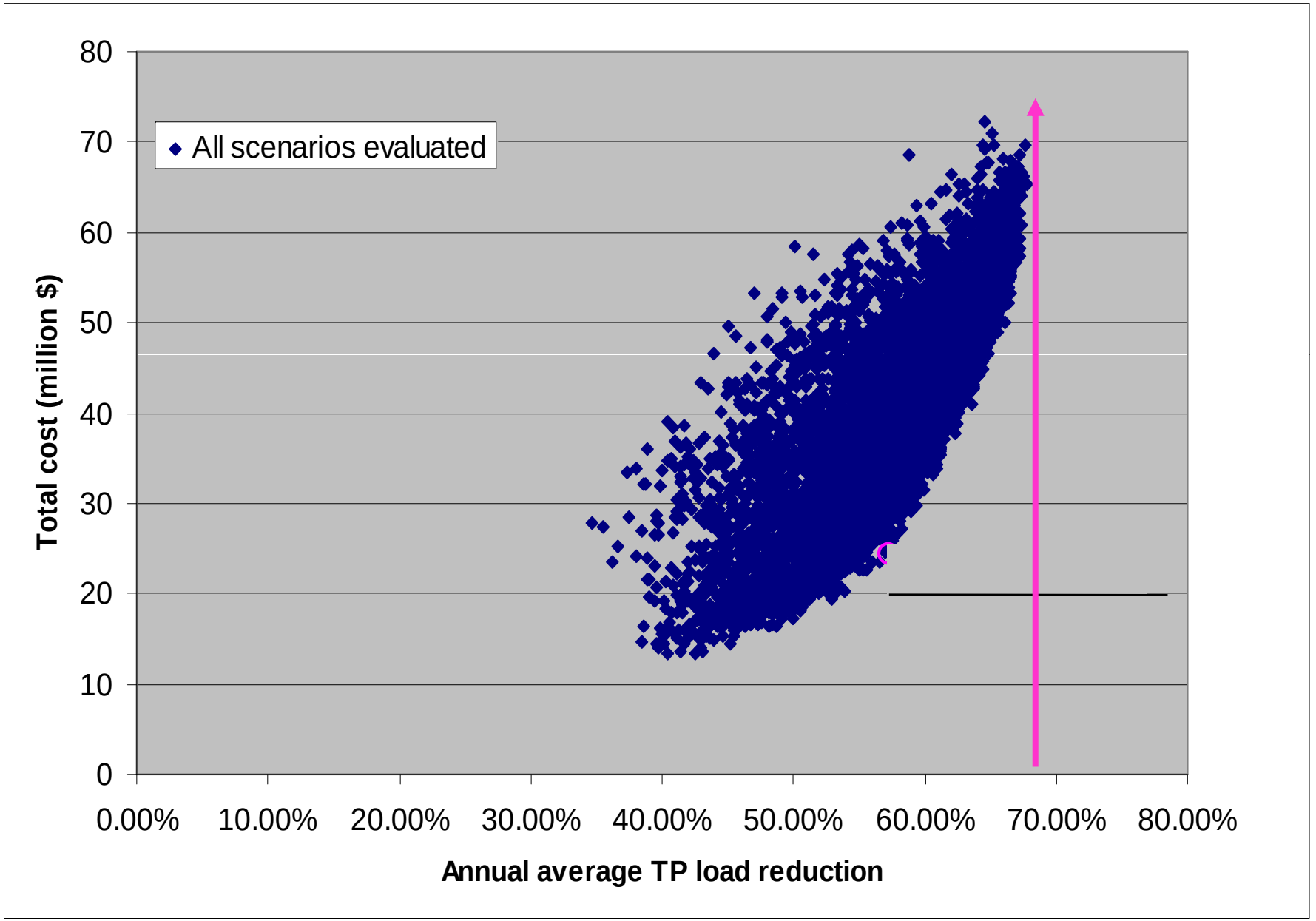


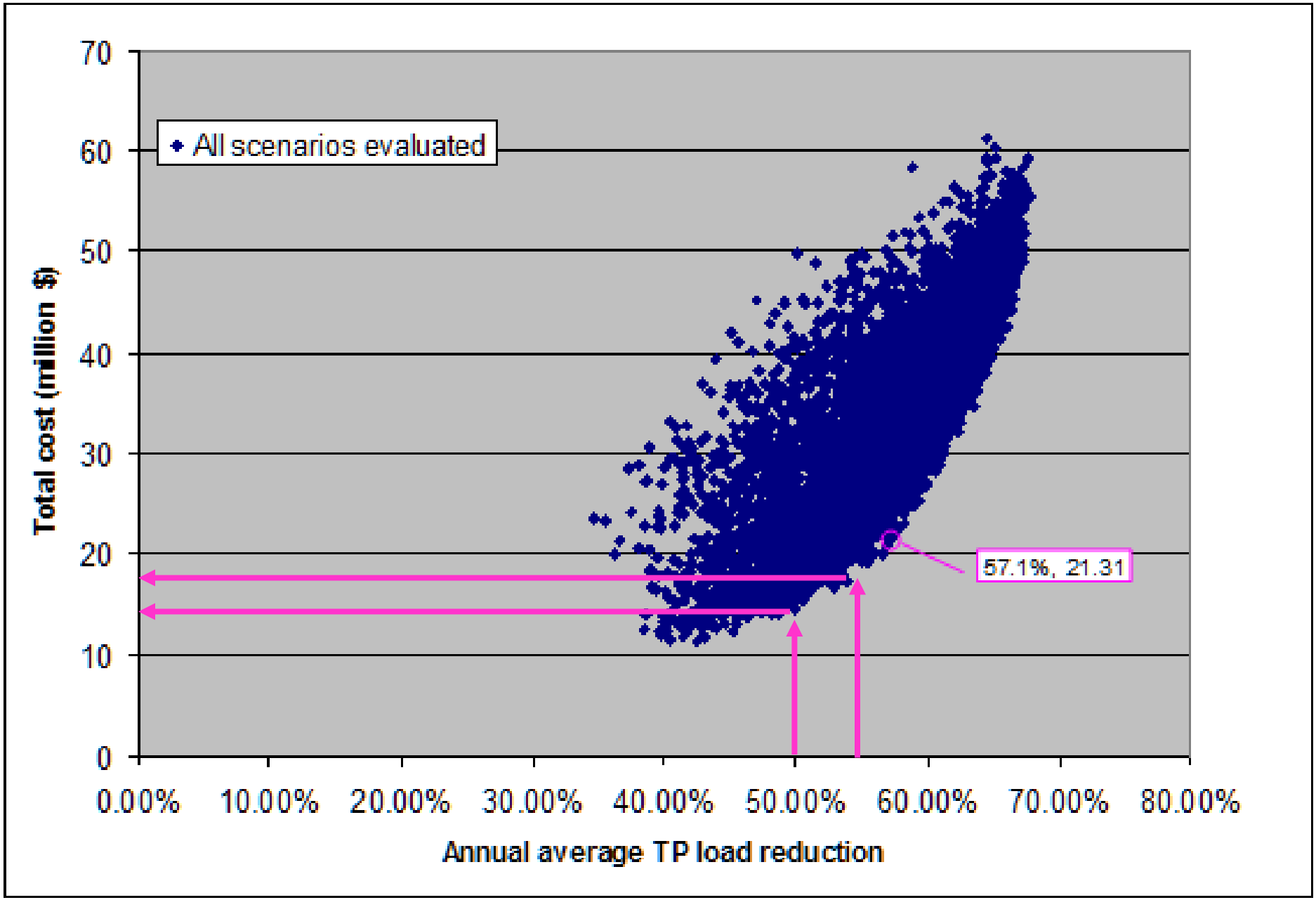
Town	Impervious Area (acres)	Reduction Goal	"Treat everyone the same"	Optimized Cost		
			zero	I	II	III
Bellingham	918	52%	$22	$14	$14	$11
Franklin	2,488	52%	$71	$47	$30	$26
Milford	1,955	57%	$60	$36	$26	$25



	Bellingham	Franklin	Milford
Scenario I	**30.1**	**87.4**	**125.5**
Scenario II	**22.3**	**79.6**	**94.0**
Scenario III	**18.8**	**66.0**	**74.8**

Total number of acres of BMP required for each scenario


All scenarios evaluated
Total cost (million $)
80
70
60
50
40
30
20
10
0
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
Annual average TP load reduction


All scenarios evaluated
Total cost (million $)
70
60
50
40
30
20
10
0
0.00%
10.00%
20.00%
30.00%
40.00%
50.00%
60.00%
70.00%
80.00%
Annual average TP load reduction
57.1%, 21.31

Key Issues

- **Over All Financial Impact is large**
- **The difference between “optimal” and “everybody reduce by 65%” is too big to ignore.**
- **Flexibility/trading is needed between MS4 and RIA/RDA permit programs to achieve most cost effective approach**
- **So regulation of public and private impervious surfaces needs to be carefully coordinated.**
- **Non-structural alternatives may offer significant savings if they reduce the need for structural BMPs.**

The End

- Questions?

The final report can be found at:

http://www.mass.gov/dep/water/wastewater/stormwat.htm

http://www.mass.gov/dep/water/resources/tmdls.htm#charlesdp

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