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### Box Culverts

The Projected Future Expenditures include the structural maintenance and site maintenance costs for these box culverts annually under Category 3 State of Good Repair (in \$ millions).

There are 17 box culverts which are recommended for rehabilitation to address deterioration of the concrete (headwalls, wingwalls, or barrel), settlement issues, and/or channel deterioration. The costs for this work are also listed under Category 3 State of Good Repair.

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 4.67	\$ 4.57	\$ 4.10	\$ 4.15	\$ 4.15	\$ 21.65	\$ 42.37	\$ 83.79
<b>Box Culvert Total Cost</b>	<b>\$ 4.67</b>	<b>\$ 4.57</b>	<b>\$ 4.10</b>	<b>\$ 4.15</b>	<b>\$ 4.15</b>	<b>\$ 21.65</b>	<b>\$ 42.37</b>	<b>\$ 83.79</b>

### Roadway Pavement

The Projected Future Expenditures include the pavement maintenance and pavement replacement costs under Category 3 State of Good Repair (in \$ millions).

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 28.37	\$ 28.37	\$ 28.37	\$ 28.37	\$ 28.37	\$ 141.86	\$ 283.73	\$ 567.45
<b>Roadway Pavement Total Cost</b>	<b>\$ 28.37</b>	<b>\$ 28.37</b>	<b>\$ 28.37</b>	<b>\$ 28.37</b>	<b>\$ 28.37</b>	<b>\$ 141.86</b>	<b>\$ 283.73</b>	<b>\$ 567.45</b>

### Roadway Assets

The Projected Future Expenditures include the installation of the real time traffic monitoring system cost under Category 1 Modernization. Costs related to the roadway asset maintenance and roadway asset replacement costs under Category 3 State of Good Repair (in \$ millions).

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ 5.31	\$ -	\$ -	\$ -	\$ -	\$ 5.31	\$ 5.31	\$ 5.31
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 12.12	\$ 17.36	\$ 16.72	\$ 16.65	\$ 16.65	\$ 79.49	\$ 162.71	\$ 329.16
<b>Roadway Assets Total Cost</b>	<b>\$ 17.43</b>	<b>\$ 17.36</b>	<b>\$ 16.72</b>	<b>\$ 16.65</b>	<b>\$ 16.65</b>	<b>\$ 84.80</b>	<b>\$ 168.02</b>	<b>\$ 334.48</b>

### Interchange Pavement

The Projected Future Expenditures include pavement maintenance and replacement costs under Category 3 State of Good Repair (in \$ millions).

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 1.37	\$ 1.37	\$ 6.48	\$ 1.37	\$ 1.37	\$ 11.96	\$ 18.80	\$ 32.49
<b>Interchange Pavement Total Cost</b>	<b>\$ 1.37</b>	<b>\$ 1.37</b>	<b>\$ 6.48</b>	<b>\$ 1.37</b>	<b>\$ 1.37</b>	<b>\$ 11.96</b>	<b>\$ 18.80</b>	<b>\$ 32.49</b>

## Projected Future Expenditures

### Interchange Assets

The Projected Future Expenditures include the pavement maintenance and replacement costs under Category 3 State of Good Repair (in \$ millions).

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 204.51	\$ 204.51
3. State of Good Repair	\$ 2.84	\$ 2.84	\$ 2.84	\$ 2.84	\$ 2.84	\$ 14.21	\$ 24.91	\$ 53.33
<b>Interchange Assets Total Cost</b>	<b>\$ 2.84</b>	<b>\$ 2.84</b>	<b>\$ 2.84</b>	<b>\$ 2.84</b>	<b>\$ 2.84</b>	<b>\$ 14.21</b>	<b>\$ 229.42</b>	<b>\$ 257.84</b>

### Pipe Culverts

The Projected Future Expenditures include the structural maintenance and site maintenance costs for these pipe culverts annually under Category 3 State of Good Repair (in \$ millions).

The costs for these replacement and repair projects are listed under Category 3 State of Good Repair.

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 10.15	\$ 6.07	\$ 6.07	\$ 6.12	\$ 6.05	\$ 34.46	\$ 70.71	\$ 99.16
<b>Pipe Culverts Total Cost</b>	<b>\$ 10.15</b>	<b>\$ 6.07</b>	<b>\$ 6.07</b>	<b>\$ 6.12</b>	<b>\$ 6.05</b>	<b>\$ 34.46</b>	<b>\$ 70.71</b>	<b>\$ 99.16</b>

### Toll Plazas

The Projected Future Expenditures include the cost for the toll plaza demolition/removal under Category I Modernization (in \$ millions).

Additionally, a new All-Electronic Tolling System is programmed for installation under an upcoming MassDOT project. The Capital includes the cost for this new tolling system under Category I Modernization Projects.

Cost Category	2016	2017	2018	2019	2020	5 Year Total	10 Year Total	20 Year Total
1. Modernization	\$ 37.50	\$ 25.98	\$ 7.55	\$ 7.55	\$ 7.47	\$ 86.06	\$ 123.84	\$ 144.64
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 4.86	\$ 4.86	\$ 4.86	\$ 4.86	\$ 4.86	\$ 24.30	\$ 48.60	\$ 130.51
<b>Toll Plaza Total Cost</b>	<b>\$ 42.36</b>	<b>\$ 30.84</b>	<b>\$ 12.41</b>	<b>\$ 12.41</b>	<b>\$ 12.33</b>	<b>\$ 110.36</b>	<b>\$ 172.44</b>	<b>\$ 275.15</b>

## 7.4 Initial Five Year Action Plan

The initial five year time period of the SGR Action Plan prepared as part of this Triennial Inspection is focused on two main goals: 1. Improve the Turnpike condition to be considered in a State of Good Repair as defined previously in this report and 2. Implement a defined maintenance plan that is sufficient to keep assets in a State of Good Repair. To accomplish these goals, it is estimated that \$778M (in 2015 dollars) will be needed over the next five years (2016-2020) as shown in Tables 7-3 and 7-4 and Figure 7-1.

## Projected Future Expenditures

Cost Category	2016	2017	2018	2019	2020	5 Year Total
1. Modernization	\$ 42.82	\$ 25.98	\$ 7.55	\$ 7.55	\$ 7.47	\$ 91.38
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 134.12	\$ 135.80	\$ 142.12	\$ 135.87	\$ 138.62	\$686.54
<b>Western Turnpike Total Cost</b>	<b>\$176.94</b>	<b>\$161.78</b>	<b>\$149.68</b>	<b>\$143.42</b>	<b>\$146.10</b>	<b>\$777.92</b>

Table 7-3 - Projected expenditures over initial five years (in \$ millions) in 2015 dollars

Cost Category	2016	2017	2018	2019	2020	5 Year Total
1. Modernization	\$ 44.32	\$ 27.83	\$ 8.38	\$ 8.67	\$ 8.88	\$ 98.07
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
3. State of Good Repair	\$ 138.81	\$ 145.48	\$ 157.58	\$ 155.91	\$ 164.64	\$762.42
<b>Western Turnpike Total Cost</b>	<b>\$183.13</b>	<b>\$173.30</b>	<b>\$165.95</b>	<b>\$164.58</b>	<b>\$173.52</b>	<b>\$860.48</b>

Table 7-4 - Projected expenditures over initial five years (in \$ millions) escalated at 3.5%/yr

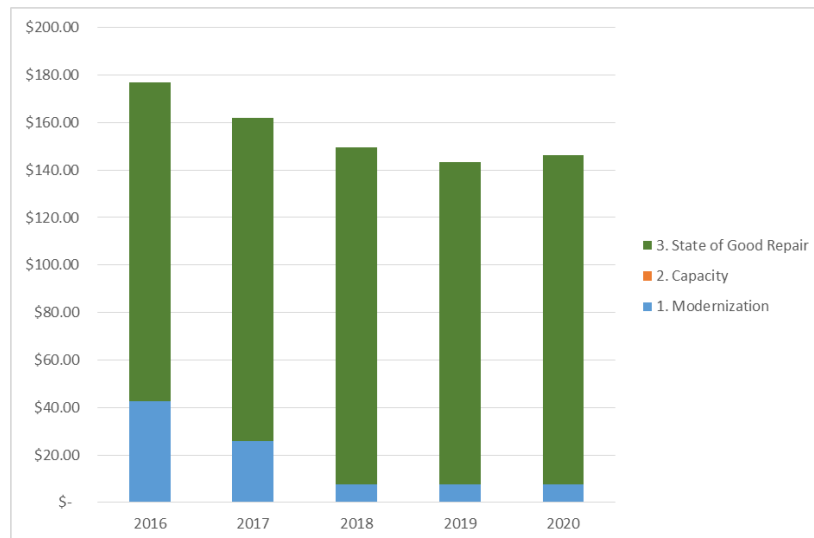


Figure 7-1 - Breakdown of projected expenditures (in \$ millions) in 2015 dollars

### Initial Five Year Expenditure by Asset Class

As depicted in Figure 7-2, 26% and 20% of overall expenditures are allocated to the Turnpike bridges and pavement, respectively, while 14% of expenditures are allocated to Toll Plazas. The relatively high percentage of allocation to the Toll Plaza asset class is primarily driven by the ongoing AETS conversion project.

## Projected Future Expenditures

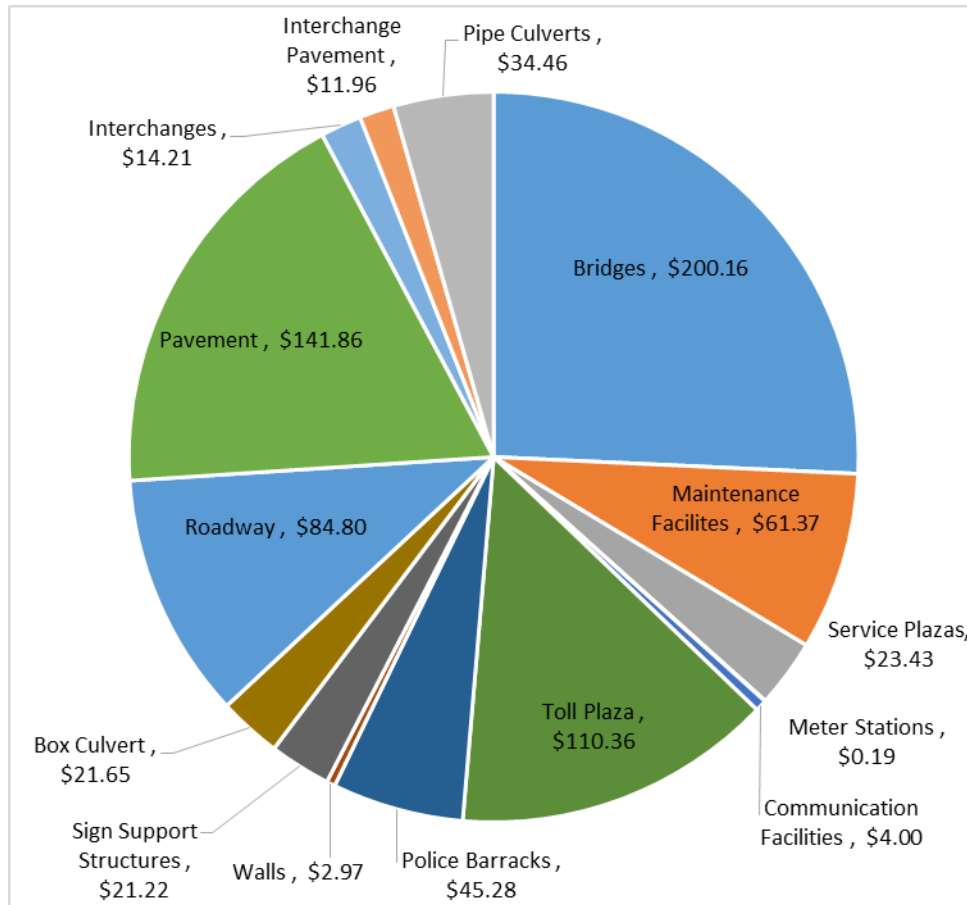


Figure 7-2 - Initial Five Year Expenditures (in \$ millions) by Asset Class

The following are actions recommended for specific asset classes. These action items are in conjunction with the conduction of a routine and comprehensive maintenance program as described previously.

### Bridges

A review of existing conditions reveals eight bridges that are recommended for replacement or significant rehabilitation in order to be considered in a State of Good Repair at the end of the Initial Five Year Period. These bridges are:

Municipality	BIN	Facility Carried	Facility Intersected	Estimated Replacement/Rehab Cost (\$M)
Framingham	4PJ	I-90 WB	MDC Res 3	\$3.6
Framingham	4PH	I-90 EB	MDC Res 3	\$3.6
Palmer	4MB	Flynt St	I-90	\$2.0
Millbury	4LP	Int. 11 Ramps	I-90	\$4.3
West Stockbridge	4HA	I-90 EB	Williams River	\$3.7
Auburn	4KP	Int. 10 Ramps	I-90	\$5.2
Auburn	4KJ	I-90 EB	Southbridge St.	\$6.6
Auburn	4KK	I-90 WB	Southbridge St.	\$6.8

## Projected Future Expenditures

The bridges carrying I-90 Eastbound and Westbound over the MDC Reservoir 2 (BIN 4PJ and 4PH) are currently being designed. All other bridges identified are not yet being designed. It is recommended that design of these bridges commence expeditiously to facilitate construction within the initial five year window.

### *Police Barracks*

The replacement of the Weston State Police Barracks is currently under construction. Costs associated with this replacement are included in the Initial Five Year Plan.

### *Walls*

A section of the metal bin retaining wall at MM 32.1 is failing. Major repairs to this section of the wall should be initiated as soon as possible. Additionally, a second metal bin retaining wall at MM 35.4 is also showing signs of distress and should be considered for rehabilitation.

### *Sign Support Structures*

All sign support structures are programmed to be replaced within the Initial Five Year Plan period. These costs are reflected in the Initial Five Year Plan.

### *Box Culvert*

Based on observed conditions, nine box culverts have been identified as in need of major concrete repairs. These repairs should be completed within the initial five year period for the Western Turnpike to be considered in a State of Good Repair at the end of that period. These culverts are:

<u>Municipality</u>	<u>MM</u>	<u>No. of Cells</u>	<u>Cell Depth (ft)</u>	<u>Cell Width (ft)</u>
West Stockbridge	0.90	3	7	16
Lee	13.7	1	9	27
Becket	16.0	1	6	10
Becket	19.0	1	8	16
Otis	21.4	1	5.5	8
Sturbridge	78.3	1	10	20
Charlton	79.9	1	10	18
Charlton	82.3	1	10	18
Auburn	90.7	2	8	8

### *Roadway*

MassDOT is in the process of initiating a Real Time Traffic Monitoring System (RTTMS). Costs for implementation of this system are included in the initial five year action plan.

### *Pipe Culverts*

Based upon observed conditions, it is anticipated that approximately 109 pipe culverts will be in need of replacement or significant rehab during the 20 year planning horizon of this Report. It is recommended that 40 culverts be addressed within the initial five year period to correspond with the defined State of Good Repair at the end of the initial five year period.

## Projected Future Expenditures

### Toll Plazas

MassDOT is currently in the process of converting the Turnpike (Western Turnpike and MHS) to an All Electronic Toll System (AETS). As part of this project, the existing toll plazas on the Turnpike will be removed. Much of the construction work associated with this project will be conducted within the initial five year period.

### 7.5 Expenditure Summary

The following tables present a summary of projected expenditures for a 20 year planning period in present day (2015) costs (Table 7-5) and future costs escalated at 3.5%/year (Table 7-6).

Cost Category	2016	2017	2018	2019	2020	5 Year Total	2021	2022	2023	2024	2025	10 Year Total
1. Modernization	\$ 42.82	\$ 25.98	\$ 7.55	\$ 7.55	\$ 7.47	\$ 91.38	\$ 7.55	\$ 7.55	\$ 7.55	\$ 7.55	\$ 7.55	\$ 129.15
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 68.17	\$ 68.17	\$ 68.17	\$ -	\$ 204.51
3. State of Good Repair	\$ 134.12	\$ 135.80	\$ 142.12	\$ 135.87	\$ 138.62	\$686.54	\$ 137.77	\$ 136.33	\$ 130.37	\$ 132.46	\$ 140.20	\$ 1,363.68
<b>Western Turnpike Total Cost</b>	<b>\$176.94</b>	<b>\$161.78</b>	<b>\$149.68</b>	<b>\$143.42</b>	<b>\$146.10</b>	<b>\$777.92</b>	<b>\$ 145.33</b>	<b>\$ 212.05</b>	<b>\$206.10</b>	<b>\$208.18</b>	<b>\$ 147.76</b>	<b>\$ 1,697.33</b>

Cost Category	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	20 Year Total
1. Modernization	\$ 7.55	\$ 7.55	\$ 5.69	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 149.95
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 204.51
3. State of Good Repair	\$ 131.90	\$ 133.56	\$ 127.55	\$ 125.22	\$ 133.75	\$ 135.65	\$ 136.24	\$ 132.34	\$ 138.08	\$ 133.67	\$2,691.63
<b>Western Turnpike Total Cost</b>	<b>\$139.46</b>	<b>\$141.12</b>	<b>\$133.24</b>	<b>\$125.22</b>	<b>\$133.75</b>	<b>\$135.65</b>	<b>\$ 136.24</b>	<b>\$ 132.34</b>	<b>\$138.08</b>	<b>\$133.67</b>	<b>\$3,046.09</b>

Table 7-5 Projected 20 Year Expenditures (in \$ millions) – Present Day (2015) Costs

Cost Category	2016	2017	2018	2019	2020	5 Year Total	2021	2022	2023	2024	2025	10 Year Total
1. Modernization	\$ 44.32	\$ 27.83	\$ 8.38	\$ 8.67	\$ 8.88	\$ 98.07	\$ 9.29	\$ 9.61	\$ 9.95	\$ 10.30	\$ 10.66	\$ 147.87
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 86.73	\$ 89.77	\$ 92.91	\$ -	\$ 269.40
3. State of Good Repair	\$ 138.81	\$ 145.48	\$ 157.58	\$ 155.91	\$ 164.64	\$762.42	\$ 169.36	\$ 173.45	\$ 171.68	\$ 180.53	\$ 197.77	\$ 1,655.20
<b>Western Turnpike Total Cost</b>	<b>\$183.13</b>	<b>\$173.30</b>	<b>\$165.95</b>	<b>\$164.58</b>	<b>\$173.52</b>	<b>\$860.48</b>	<b>\$ 178.64</b>	<b>\$ 269.79</b>	<b>\$271.39</b>	<b>\$283.73</b>	<b>\$ 208.43</b>	<b>\$ 2,072.47</b>

Cost Category	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	20 Year Total
1. Modernization	\$ 11.03	\$ 11.42	\$ 8.90	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 179.21
2. Capacity	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 269.40
3. State of Good Repair	\$ 192.58	\$ 201.82	\$ 199.48	\$ 202.69	\$ 224.07	\$ 235.22	\$ 244.51	\$ 245.82	\$ 265.45	\$ 265.97	\$3,932.81
<b>Western Turnpike Total Cost</b>	<b>\$203.61</b>	<b>\$213.24</b>	<b>\$208.38</b>	<b>\$202.69</b>	<b>\$224.07</b>	<b>\$235.22</b>	<b>\$ 244.51</b>	<b>\$ 245.82</b>	<b>\$265.45</b>	<b>\$265.97</b>	<b>\$4,381.42</b>

Table 7-6 Projected 20 Year Expenditures (in \$ millions) – Escalated Costs