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TRANSPORTATION RESEARCH BOARD

What is the True Cost of Infrastructure Assets Maintenance?

July 7, 2021

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hour (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact TRBWebinars@nas.edu

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RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Identify included maintenance costs within a total cost of ownership approach
2. Identify examples of improved decision-making processes on renewing or replacing assets
3. Discuss planning approaches that can help predict future increases or changes in maintenance and operations costs

#TRBwebinar

Assuring high level highway maintenance with budgeting and planning

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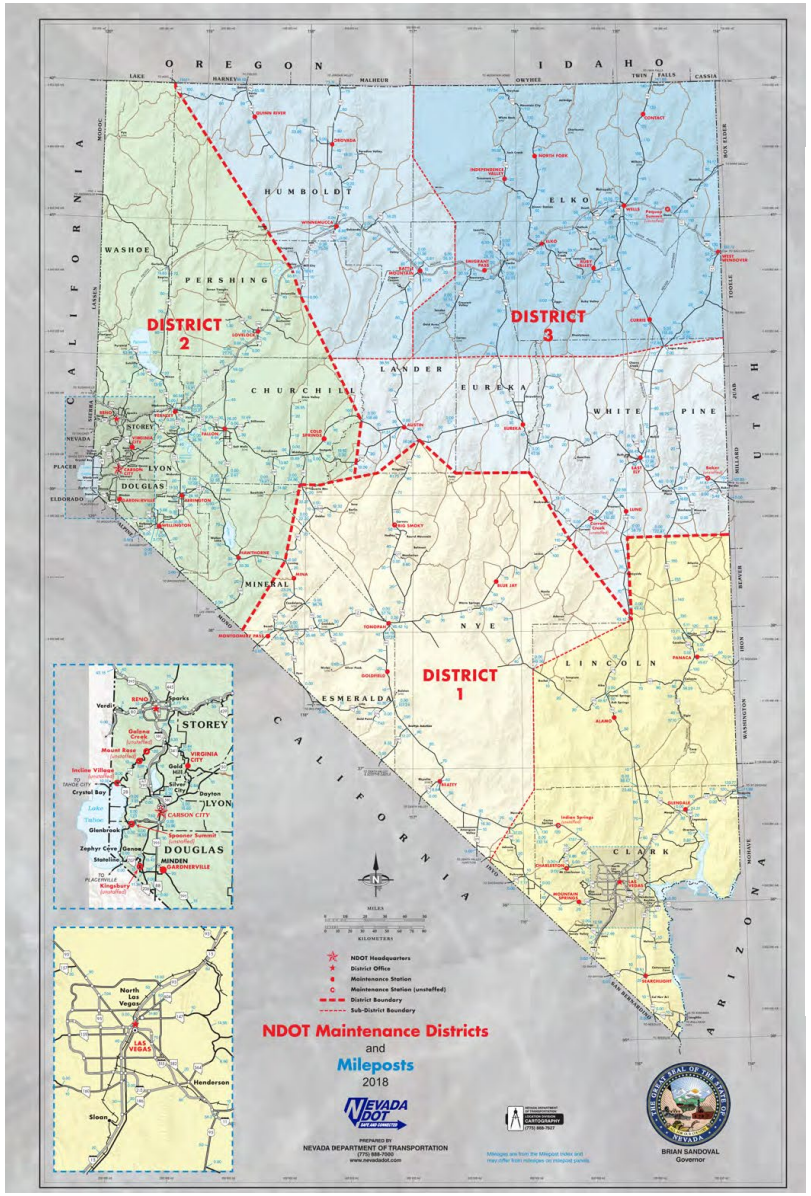
Chief Maintenance and Asset Management Engineer
Nevada Department of Transportation

TRB WEBINAR

UNDERSTANDING TOTAL COST OF OWNERSHIP OF TRANSPORTATION INFRASTRUCTURE ASSETS–APPROACHES FOR MAINTENANCE PLANNING
JULY 7, 2021

Nevada Dot Facts and Figures



STATISTICS

- Lane Miles NDOT & Local 13,463 NDOT / 88,768 Local
- Centerline Miles NDOT & Local 5,376 NDOT / 34,067 Local
- Miles of Rural Hwy 4,420 (2018 Data)
- Miles of Urban Hwy 708 (2018 Data
- Nevada Population 3,101,000 (2019 Estimate)
- Registered Passenger Vehicles 2,256,828
- **NV Licensed Drivers** 2,111,620 (7/7/19 Data)
- Vehicle Miles Traveled 27.5 Billion Miles (2019 Data)
- Truck Miles Traveled 1.8 Billion Miles (2019 Data)
- NDOT Employees 1,751
- NDOT Vehicles 671
- NDOT Heavy Equipment 1,979 Pieces
- NDOT Bridges 1,229
- 45 NDOT Staffed Maintenance Stations
- NDOT Owned Office Space Total 357,993 Sq. Ft.

NEVADA HIGHWAY FUND (2019)

FUEL TAX RATES AND FEES

Fuel Tax Rates and Revenue	Rate Per Gallon (Cents)	State Revenue (Millions)
Federal Gas Tax	18.4¢	-
State Gas Tax	18.455¢	$212.8
Federal Diesel Tax	24.4¢	-
State Diesel Tax	27.75¢	$100.1
Federal Propane Tax (LPG)	18.3¢	-
State Propane Tax (LPG)	22¢	$0.2
Federal Methane Tax (CNG)	18.3¢	-
State Methane Tax (CNG)	21¢	$1.1
	Total	**$312.90**

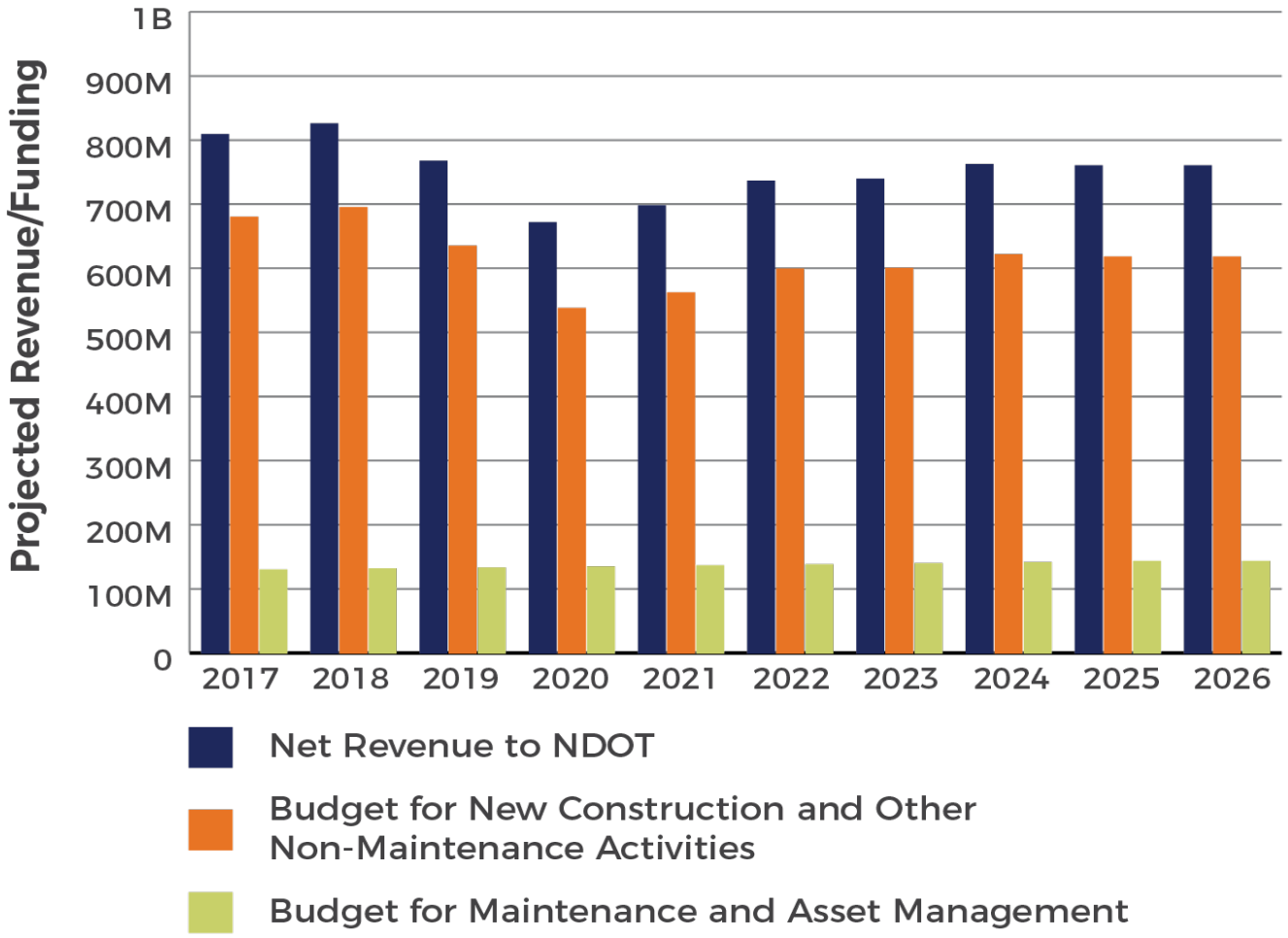
OTHER REVENUE

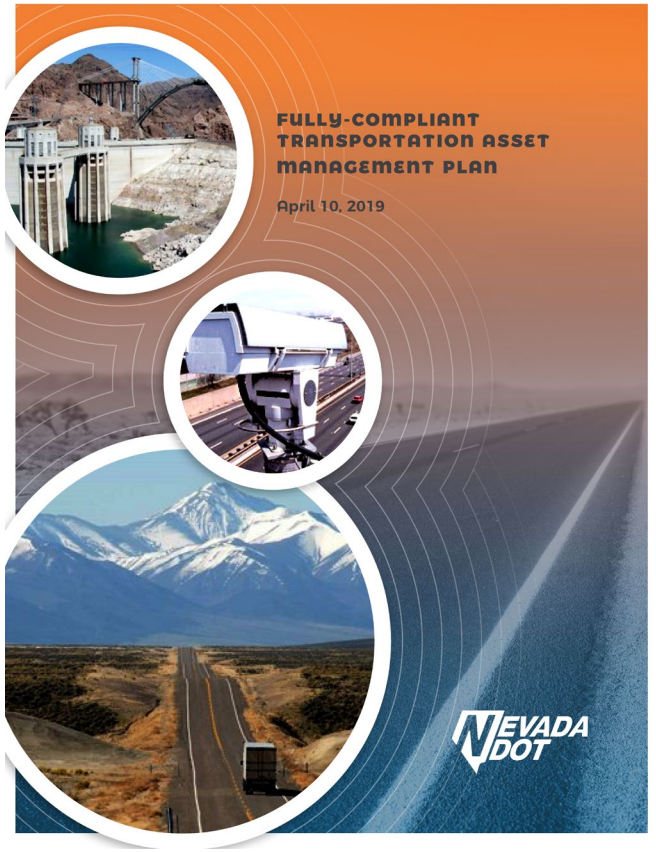
Vehicle Registration Fees $126.0 Million
Federal Aid Revenue $361.5 Million
Bonds & Other Revenue $204.4 Million
Motor Carrier Fees $46.8 Million
Drivers License Fees $22.5 Million

Total State Highway Fund Revenue $1.146

75% FOR THE DOT
25% FOR DPS, DMV AND OTHER STATE AGENCIES

Transportation Asset Management Plan (2019)



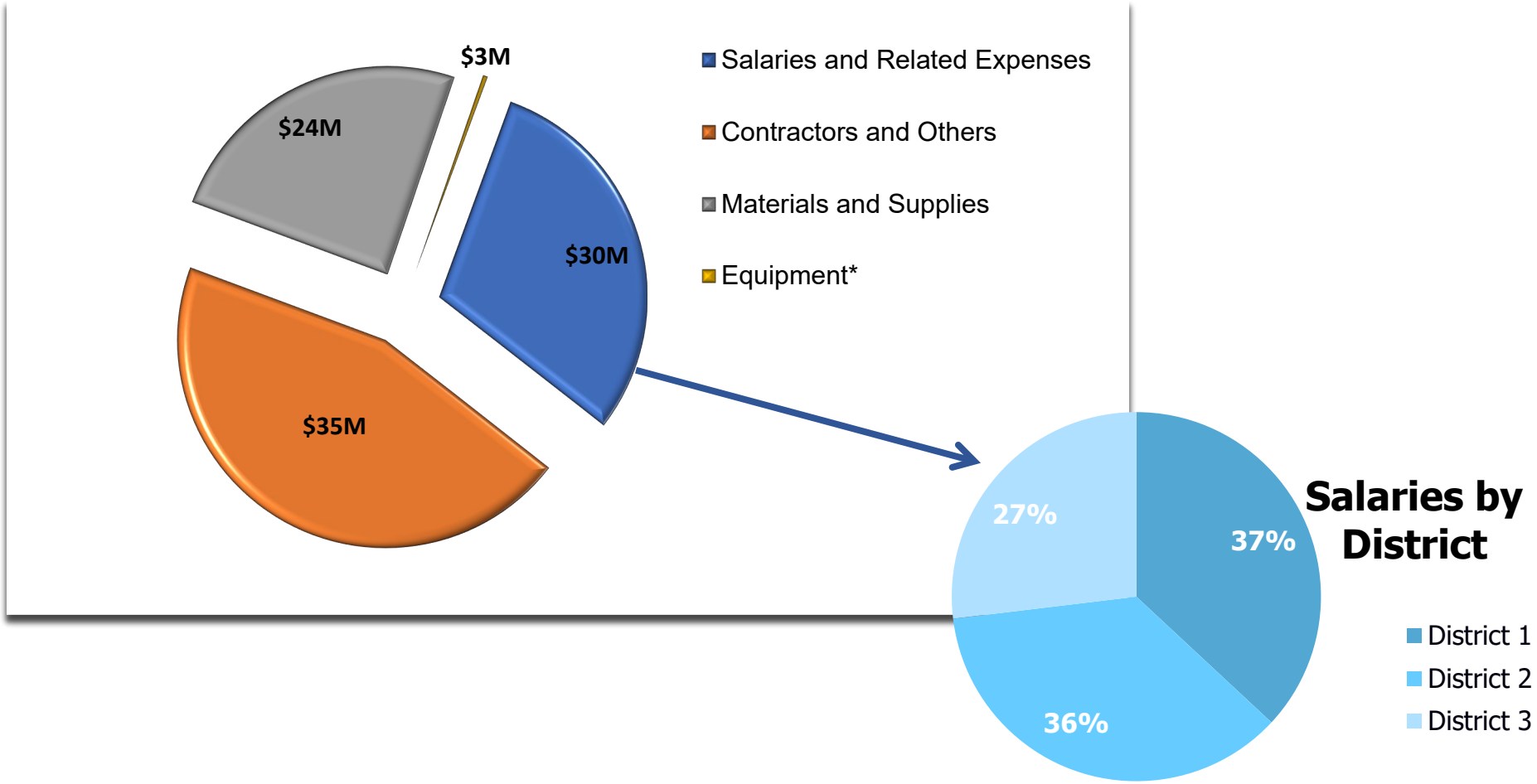


TAMP Chapter 6: Financial Plan and Investment Strategies

Table 6-1. Expected annual budget for new construction, maintenance, and asset management activities.

	Work Type	Budget ($, Million)										
		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	Total 2017-26
Pavements	Initial Construction	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00	$170.00	**$1,700.00**
	Maintenance	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	$25.00	**$250.00**
	Preservation	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	**$350.00**
	Rehabilitation	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	$35.00	**$350.00**
	Reconstruction	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	$5.00	**$50.00**
	Subtotal	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$270.00**	**$2,700.00**
Bridges	Initial Construction	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	$17.00	**$170.00**
	Maintenance	$0.55	$0.55	$0.55	$0.55	$0.55	$0.55	$0.55	$0.55	$0.55	$0.55	**$5.50**
	Preservation	$3.24	$3.24	$3.24	$3.24	$3.24	$3.24	$3.24	$3.24	$3.24	$3.24	**$32.4**
	Rehabilitation	$3.13	$3.13	$3.13	$3.13	$3.13	$3.13	$3.13	$3.13	$3.13	$3.13	**$31.3**
	Reconstruction	$4.08	$4.08	$4.08	$4.08	$4.08	$4.08	$4.08	$4.08	$4.08	$4.08	**$40.8**
	Subtotal	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$28.00**	**$280.00**
ITS	Maintenance	$3.59	$3.59	$3.59	$3.59	$3.59	$3.59	$3.59	$3.59	$3.59	$3.59	**$35.90**
Grand Total		**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$301.59**	**$3015.90**

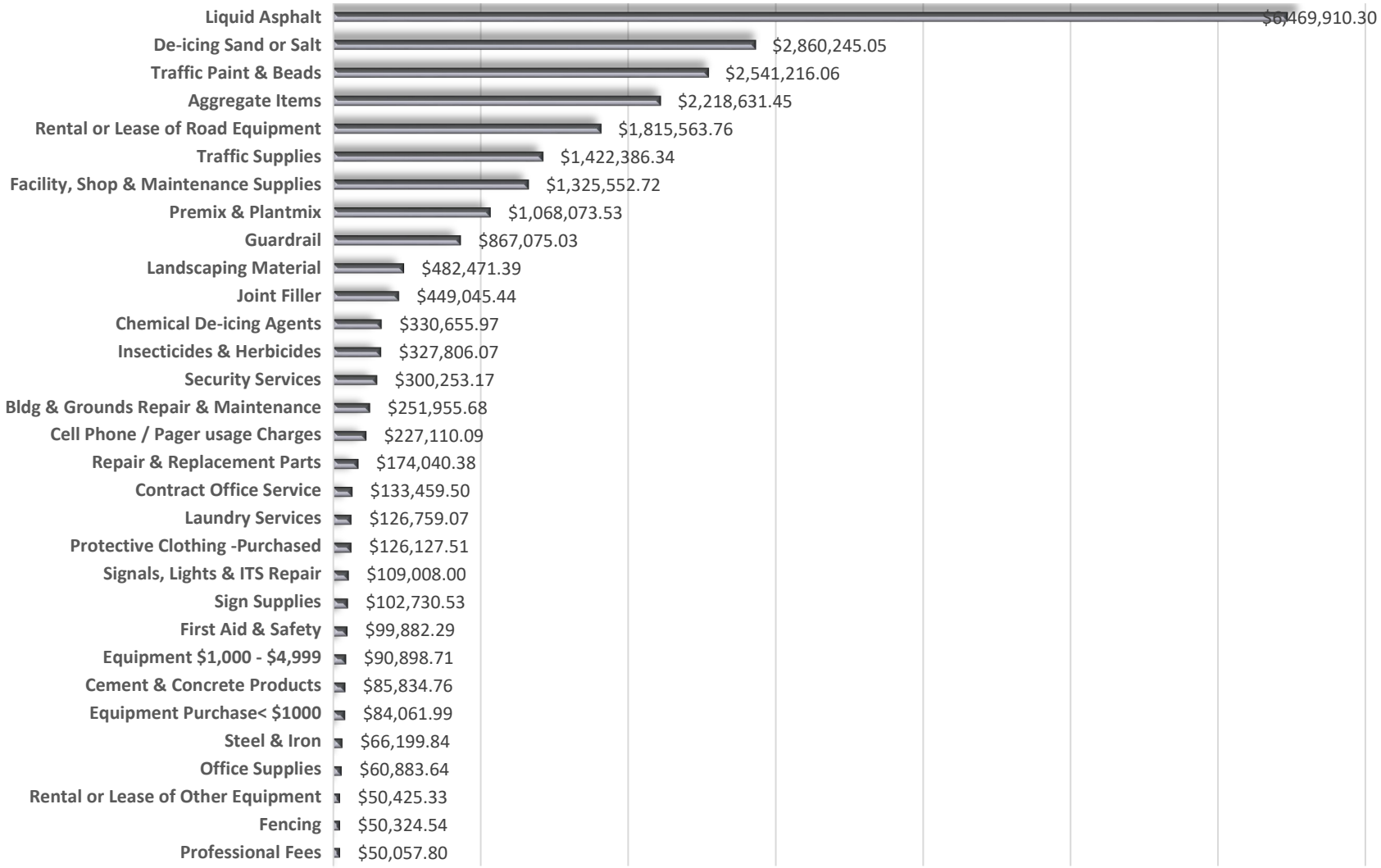
Maintenance Costs



Statewide Expenditures

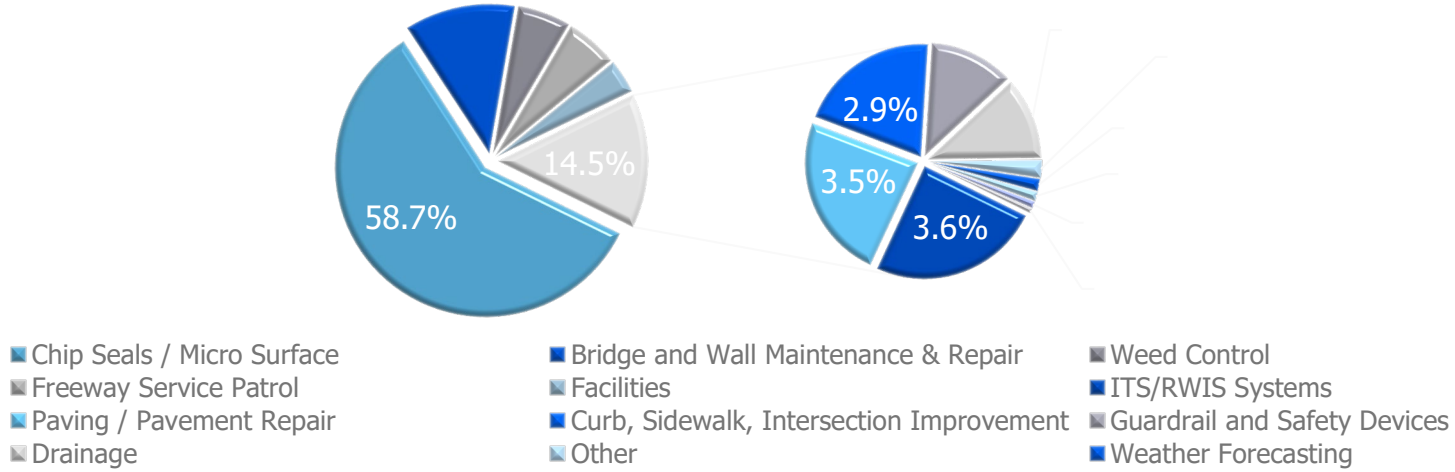
*Non-rental equipment

Fiscal Year 2020 Expenditures for Materials and Supplies

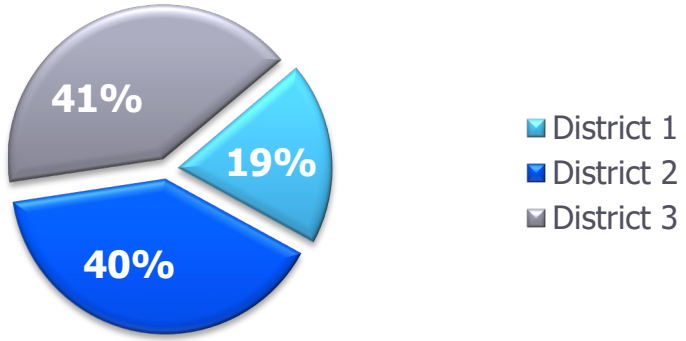


Contractor Payments

Contractor Payments by Type of Work



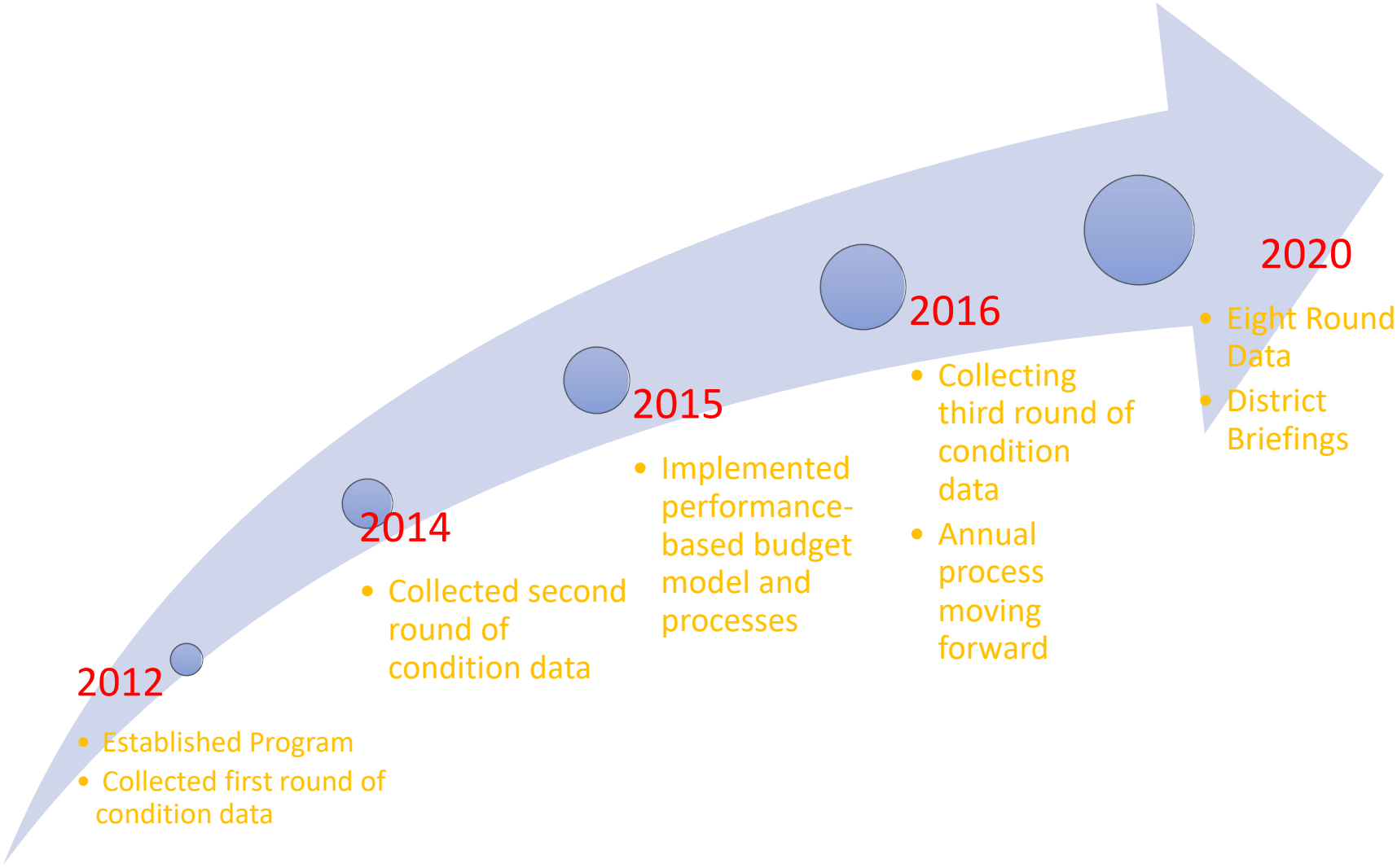
Contract Payments by District



Maintenance Program Overview

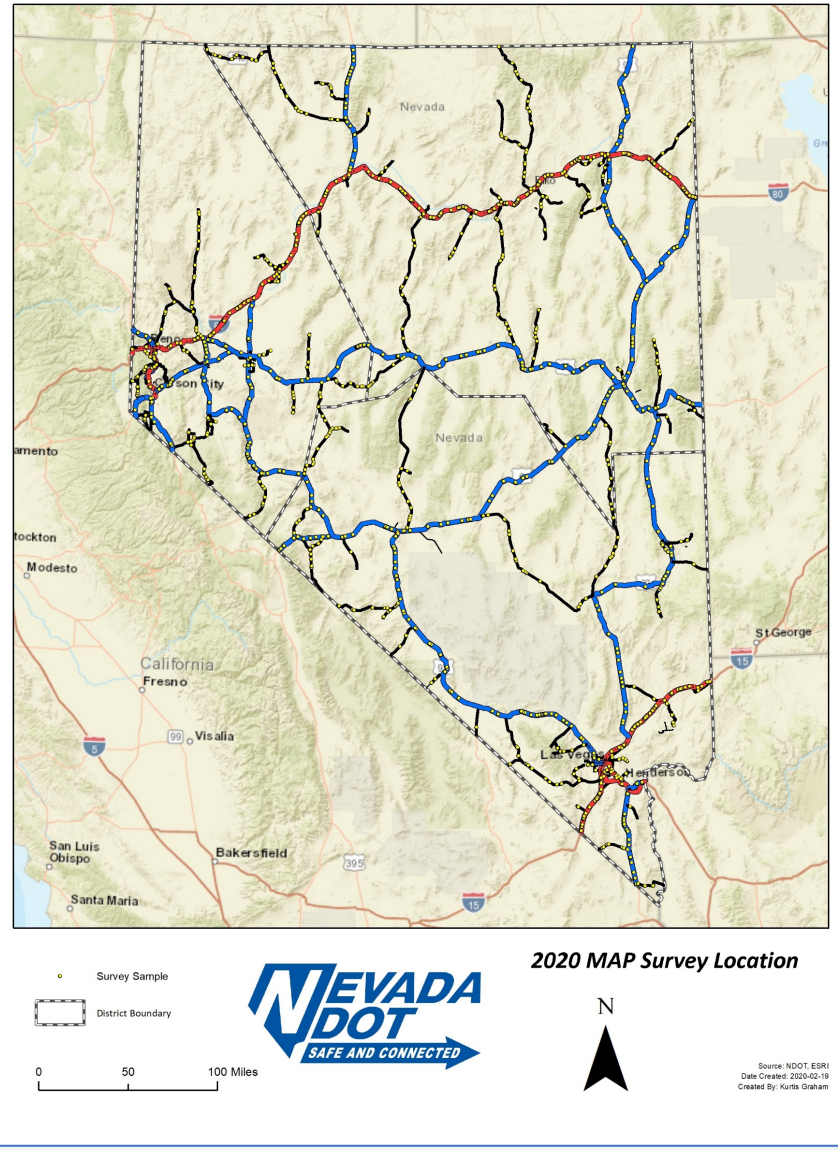
- Maintenance Achievement Program (MAP):
  - Assess the condition of roadway and roadside assets
  - Objectively measures the outcome of a maintenance task or Level of Service (LOS)
- Work & Planning Budget Model (MBM):
  - Close the gaps between LOS by setting LOS targets
  - Allows NDOT to more effectively plan, budget and manage maintenance work
  - Provides for the continual improvement of maintenance performance and improve program effectiveness and efficiency

NDOT Maintenance Achievement Program(MAP) Timeline



MAP Data Overview

- Survey 1000 locations
  - 100 miles of road to provide 95% confidence level
  - Evaluate condition of 37 tasks at each location
  - Surveyed by experienced Maintenance personnel



MAP - Data Collection

NDOT Maintenance and Asset Management Division

- Condition Assessments
  - 37 Specific MMS tasks evaluated out of 99 total MMS tasks
  - Signs
  - Guardrail
  - Pavement Markings
  - Shoulders
  - Culverts
  - ROW Fence
  - Etc.

Statewide LOS Score Cards

Statewide LOS

Nevada DOT Maintenance Assets Level of Service, 2020

Group	Task	Asset Feature	Sum of Deficient Asset	Sum of Total Asset	% Deficient	Level of Service			Level Of Service Grade Ranges				
						Units	Measure	Grade	A	B	C	D	F
Group 112 - Concrete Repair	112.03.01	Curb & Gutter (Lin Ft)	200	36375	0.55	% Deficient	0.55	A+	2	5	10	20	>20
	112.05.01	Reinforced Concrete Boxes (Ea)	2	108	1.85	% Deficient	1.85	B	1	3	5	10	>10
	112.06.01	Concrete Barrier Rail (Lin Ft)	0	36480	0.00	% Deficient	0.00	A+	1	3	5	10	>10
	112.08.01	Repair Drop Inlets (Ea)	1	109	0.92	% Deficient	0.92	A-	1	3	5	10	>10
Group 131 - Roadside Maintenance	131.01.01	Clean Drains & Culverts (Ea)	10	544	1.84	% Deficient	1.84	A-	2	5	10	20	>20
	131.01.02	Clean Drop Inlets (Ea)	2	101	1.98	% Deficient	1.98	A-	2	5	10	20	>20
	131.01.03	Clean Slotted Drains (Ea)	3	11	27.27	% Deficient	27.27	F	2	5	10	20	>20
	131.01.04	Clean Culvert Openings (Ea)	65	803	8.09	% Deficient	8.09	C	2	5	10	20	>20
	131.01.07	Clean Retention Basins (Ea)	0	0		% Deficient			3	7	15	30	>30
	131.05.01	Repair Culverts (Ea)	14	433	3.23	% Deficient	3.23	C+	1	3	5	10	>10
	131.05.03	Repair Channels/Ditches (Lin Ft)	3168	916218	0.35	% Deficient	0.35	A+	2	5	10	20	>20
	131.05.05	Clean Ditches (Lin Ft)	4474	44682	10.01	% Deficient	10.01	D+	1	5	10	15	>15
	131.06.01	Fill & Cut Slopes (Lin Ft)	2262	159876	1.41	% Deficient	1.41	B+	1	3	5	10	>10
	131.07.01	Blade Shoulders (Lin Ft)	69428	994155	6.98	% Deficient	6.98	D	1	3	5	10	>10
Group 133 - Roadside Cleanup	133.01.01	Debris/Litter (Ea)	328683	109.90	2990.82	No. / Mile	2990.82	D-	750	1500	2250	3000	>3000
	133.01.03	Litter Barrels (Ea)	0	100	0.00	% Deficient	0.00	A+	10	30	50	90	>90
	133.05.01	Sweepable Area (Sq Ft)	16896	546192	3.09	% Deficient	3.09	A	5	10	20	40	>40
Group 134/135 - Maint. of Roadside Appurtenances	134.02.02	Rock Mulch (Sq Ft)	0	251300	0.00	% Deficient	0.00	A+	1	3	5	10	>10
	135.01.01	Wire/Fabric Fences (Lin Ft)	0	522204	0.00	% Deficient	0.00	A+	5	10	20	40	>40
	135.01.02	Chain Link Fences (Lin Ft)	0	13450	0.00	% Deficient	0.00	A+	5	10	20	40	>40
	135.01.03	Glare Screens (Lin Ft)	0	1584	0.00	% Deficient	0.00	A+	2	5	10	20	>20
Group 141 - Traffic Services	141.01.01	Regulatory Traffic Signs (Ea)	5	1111	0.45	% Deficient	0.45	A	1	2	5	10	>10
	141.02.01	Guardrail (Lin Ft)	0	22360	0.00	% Deficient	0.00	A+	1	2	5	10	>10
	141.02.03	Guardrail End & Impact Attenuator(Ea)	0	55	0.00	% Deficient	0.00	A+	0	1	2	3	>3
	141.02.06	Cable Barrier (Lin Ft)	0	11032	0.00	% Deficient	0.00	A+	1	2	5	10	>10
	141.04.01	Paint Stripes (Lin Ft)	14784	1639881	0.90	% Deficient	0.90	A+	15	30	42.5	50	>50
	141.06.01	Raised Pavement Markers (Ea)	635	9721	6.53	% Deficient	6.53	B+	5	10	20	30	>30
	141.08.01	Pavement Markings (Ea)	12	506	2.37	% Deficient	2.37	A+	10	30	50	90	>90
	141.09.01	Street Lights (Ea)	0	110	0.00	% Deficient	0.00	A+	5	7.5	10	20	>20
	141.09.02	Structure & Tunnel Lights (Ea)	0	6	0.00	% Deficient	0.00	A+	5	7.5	10	20	>20
	141.09.03	High Mast Lights (Ea)	0	16	0.00	% Deficient	0.00	A+	5	7.5	10	20	>20
	141.09.05	Overhead Sign Lights (Ea)	0	10	0.00	% Deficient	0.00	A+	5	7.5	10	20	>20
	141.11.01	Roadway Markers (Ea)	409	4581	8.93	% Deficient	8.93	C-	1	5	10	20	>20
Group 161 - Structure Maintenance	161.01.05	Structure Drains (Ea)	0	0		% Deficient			2	5	10	20	>20
	161.01.07	Retaining, Sound & Bin Walls (Sq Ft)	0	3168	0.00	% Deficient	0.00	A+	1	2	5	10	>10
	161.02.02	Sweep Structures (Sq Ft)	0	0		% Deficient			5	10	20	40	>40
	161.03.01	Graffiti (Sq Ft)	0	109.90	0.00	Sq Ft / Mi	0.00	A+	10	20	50	100	>100

Statewide LOS Score Cards

2018 -2020 Comparison

Statewide LOS Score Cards

Statewide: LOS 2020 LOS 2019 LOS 2018

Tasks & Assets			A	B	C	D	F
Group 112 - Concrete Repair	112.03.01	Curb & Gutter (Lin Ft)	A+				
	112.05.01	Reinforced Concrete Boxes (Ea)		B			
	112.06.01	Concrete Barrier Rail (Lin Ft)	A+				
	112.08.01	Repair Drop Inlets (Ea)	A-				
Group 131 - Roadside Maintenance	131.01.01	Clean Drains & Culverts (Ea)	A-				
	131.01.02	Clean Drop Inlets (Ea)	A-				
	131.01.03	Clean Slotted Drains (Ea)					F
	131.01.04	Clean Culvert Openings (Ea)			C		
	131.01.07	Clean Retention Basins (Ea)					
	131.05.01	Repair Culverts (Ea)			C+		
	131.05.03	Repair Channels/Ditches (Lin Ft)	A+				
	131.05.05	Clean Ditches (Lin Ft)				D+	
	131.06.01	Fill & Cut Slopes (Lin Ft)		B+			
	131.07.01	Blade Shoulders (Lin Ft)				D	
Group 133 - Roadside Cleanup	133.01.01	Debris/Litter (Ea)				D-	
	133.01.03	Litter Barrels (Ea)	A+				
	133.05.01	Sweepable Area (Sq Ft)	A				
Group 134/135 - Maint. of Roadside Appurtenances	134.02.02	Rock Mulch (Sq Ft)	A+				
	135.01.01	Wire/Fabric Fences (Lin Ft)	A+				
	135.01.02	Chain Link Fences (Lin Ft)	A+				
	135.01.03	Glare Screens (Lin Ft)	A+				
Group 141 - Traffic Services	141.01.01	Regulatory Traffic Signs (Ea)	A				
	141.02.01	Guardrail (Lin Ft)	A+				
	141.02.03	Guardrail End & Impact Attenuator(Ea)	A+				
	141.02.06	Cable Barrier (Lin Ft)	A+				
	141.04.01	Paint Stripes (Lin Ft)	A+				
	141.06.01	Raised Pavement Markers (Ea)		B+			
	141.08.01	Pavement Markings (Ea)	A+				
	141.09.01	Street Lights (Ea)	A+				
	141.09.02	Structure & Tunnel Lights (Ea)	A+				
	141.09.03	High Mast Lights (Ea)	A+				
	141.09.05	Overhead Sign Lights (Ea)	A+				
	141.11.01	Roadway Markers (Ea)			C-		
Group 161 - Structure Maintenance	161.01.05	Structure Drains (Ea)					
	161.01.07	Retaining, Sound & Bin Walls (Sq Ft)	A+				
	161.02.02	Sweep Structures (Sq Ft)					
	161.03.01	Graffiti (Sq Ft)	A+				

A	B	C	D	F
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DISTRICTS' LOS SCORE CARDS

2018 -2020 Comparison

DISTRICT 1: LOS 2020 LOS 2019 LOS 2018

Tasks & Assets			A	B	C	D	F	A	B	C	D	F	A	B	C	D	F
Group 112 - Concrete Repair	112.03.01	Curb & Gutter (Lin Ft)	A+					A+					A+				
	112.05.01	Reinforced Concrete Boxes (Ea)				D		A+						B-			
	112.06.01	Concrete Barrier Rail (Lin Ft)	A+					A+					A-				
	112.08.01	Repair Drop Inlets (Ea)	A+					A+								D+	
Group 131 - Roadside Maintenance	131.01.01	Clean Drains & Culverts (Ea)		B+				A-							C+		
	131.01.02	Clean Drop Inlets (Ea)	A+					A+							C+		
	131.01.03	Clean Slotted Drains (Ea)	A+					A+									F
	131.01.04	Clean Culvert Openings (Ea)			C					C+						D-	
	131.01.07	Clean Retention Basins (Ea)											A+				
	131.05.01	Repair Culverts (Ea)	A-						B-					B-			
	131.05.03	Repair Channels/Ditches (Lin Ft)	A+					A					A+				
	131.05.05	Clean Ditches (Lin Ft)				D+		A+									F
	131.06.01	Fill & Cut Slopes (Lin Ft)			C+					C+				B+			
	131.07.01	Blade Shoulders (Lin Ft)				D-						F					F
Group 133 - Roadside Cleanup	133.01.01	Debris/Litter (Ea)					F		B+				A-				
	133.01.03	Litter Barrels (Ea)	A+					A+									
	133.05.01	Sweepable Area (Sq Ft)	A											B			
Group 134/135 - Maint. of Roadside Appurtenances	134.02.02	Rock Mulch (Sq Ft)	A+					A+					A+				
	135.01.01	Wire/Fabric Fences (Lin Ft)	A+					A+					A+				
	135.01.02	Chain Link Fences (Lin Ft)	A+					A+					A+				
	135.01.03	Glare Screens (Lin Ft)															
Group 141 - Traffic Services	141.01.01	Regulatory Traffic Signs (Ea)	A+						B+						C		
	141.02.01	Guardrail (Lin Ft)	A+					A+							C+		
	141.02.03	Guardrail End & Impact Attenuator(Ea)	A+					A+					A+				
	141.02.06	Cable Barrier (Lin Ft)	A+					A+					A+				
	141.04.01	Paint Stripes (Lin Ft)	A+					A+					A+				
	141.06.01	Raised Pavement Markers (Ea)		B+					B+					B+			
	141.08.01	Pavement Markings (Ea)	A					A+					A				
	141.09.01	Street Lights (Ea)	A+					A+					A+				
	141.09.02	Structure & Tunnel Lights (Ea)	A+														
	141.09.03	High Mast Lights (Ea)	A+					A+					A+				
	141.09.05	Overhead Sign Lights (Ea)	A+					A+								D+	
	141.11.01	Roadway Markers (Ea)				D				C				B			
Group 161 - Structure Maintenance	161.01.05	Structure Drains (Ea)															
	161.01.07	Retaining, Sound & Bin Walls (Sq Ft)	A+					A+					A+				
	161.02.02	Sweep Structures (Sq Ft)															
	161.03.01	Graffiti (Sq Ft)	A+					A+									

DISTRICT 2: LOS 2020 LOS 2019 LOS 2018

Tasks & Assets			A	B	C	D	F	A	B	C	D	F	A	B	C	D	F
Group 112 - Concrete Repair	112.03.01	Curb & Gutter (Lin Ft)	A					A+					A+				
	112.05.01	Reinforced Concrete Boxes (Ea)	A+								D+					D+	
	112.06.01	Concrete Barrier Rail (Lin Ft)	A+					A+					A+				
	112.08.01	Repair Drop Inlets (Ea)		B				A+					A+				
Group 131 - Roadside Maintenance	131.01.01	Clean Drains & Culverts (Ea)		B						C+					C+		
	131.01.02	Clean Drop Inlets (Ea)		B				A+						B+			
	131.01.03	Clean Slotted Drains (Ea)					F									D	
	131.01.04	Clean Culvert Openings (Ea)			C-					C-							F
	131.01.07	Clean Retention Basins (Ea)															
	131.05.01	Repair Culverts (Ea)			C+				B+						C		
	131.05.03	Repair Channels/Ditches (Lin Ft)	A+					A					A+				
	131.05.05	Clean Ditches (Lin Ft)					F		B-							D+	
	131.06.01	Fill & Cut Slopes (Lin Ft)	A+					A+					A-				
	131.07.01	Blade Shoulders (Lin Ft)				D+						F				D-	
Group 133 - Roadside Cleanup	133.01.01	Debris/Litter (Ea)		B				A-					A-				
	133.01.03	Litter Barrels (Ea)															
	133.05.01	Sweepable Area (Sq Ft)	A-											B			
Group 134/135 - Maint. of Roadside Appurtenances	134.02.02	Rock Mulch (Sq Ft)	A+					A+					A+				
	135.01.01	Wire/Fabric Fences (Lin Ft)	A+					A+					A+				
	135.01.02	Chain Link Fences (Lin Ft)	A+					A+					A+				
	135.01.03	Glare Screens (Lin Ft)	A+					A+					A+				
Group 141 - Traffic Services	141.01.01	Regulatory Traffic Signs (Ea)	A-					A-							C+		
	141.02.01	Guardrail (Lin Ft)	A+					A+						B+			
	141.02.03	Guardrail End & Impact Attenuator(Ea)	A+					A+					A+				
	141.02.06	Cable Barrier (Lin Ft)	A+							C			A+				
	141.04.01	Paint Stripes (Lin Ft)	A+					A+					A+				
	141.06.01	Raised Pavement Markers (Ea)															
	141.08.01	Pavement Markings (Ea)	A+					A+					A+				
	141.09.01	Street Lights (Ea)	A+					A+					A+				
	141.09.02	Structure & Tunnel Lights (Ea)											A+				
	141.09.03	High Mast Lights (Ea)	A+										A+				
	141.09.05	Overhead Sign Lights (Ea)	A+					A+					A+				
	141.11.01	Roadway Markers (Ea)			C-				B						C		
Group 161 - Structure Maintenance	161.01.05	Structure Drains (Ea)															
	161.01.07	Retaining, Sound & Bin Walls (Sq Ft)						A+					A+				
	161.02.02	Sweep Structures (Sq Ft)															F
	161.03.01	Graffiti (Sq Ft)	A+					A-									

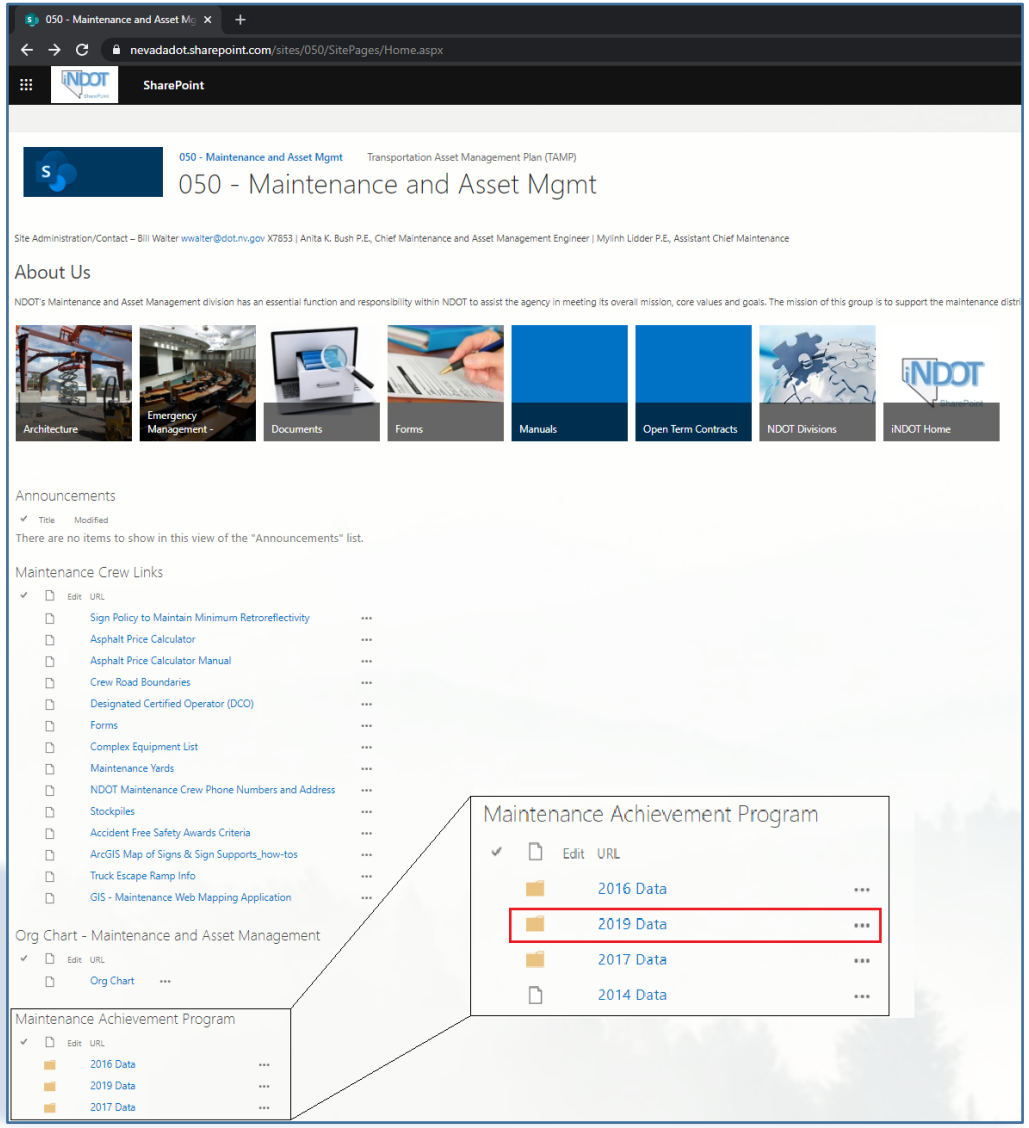
DISTRICT 3: LOS 2020 LOS 2019 LOS 2018

Tasks & Assets			A	B	C	D	F	A	B	C	D	F	A	B	C	D	F
Group 112 - Concrete Repair	112.03.01	Curb & Gutter (Lin Ft)	A+					A+					A+				
	112.05.01	Reinforced Concrete Boxes (Ea)	A+					A+						B-			
	112.06.01	Concrete Barrier Rail (Lin Ft)	A+					A+					A+				
	112.08.01	Repair Drop Inlets (Ea)	A+					A+					A+				
Group 131 - Roadside Maintenance	131.01.01	Clean Drains & Culverts (Ea)	A						B+						C		
	131.01.02	Clean Drop Inlets (Ea)	A+					A+								D-	
	131.01.03	Clean Slotted Drains (Ea)															
	131.01.04	Clean Culvert Openings (Ea)			C-				B-							D	
	131.01.07	Clean Retention Basins (Ea)															
	131.05.01	Repair Culverts (Ea)			C-			A-							C		
	131.05.03	Repair Channels/Ditches (Lin Ft)	A+					A+					A+				
	131.05.05	Clean Ditches (Lin Ft)		B-						C					C		
	131.06.01	Fill & Cut Slopes (Lin Ft)		B					B-					B			
	131.07.01	Blade Shoulders (Lin Ft)				D+					D-					D	
Group 133 - Roadside Cleanup	133.01.01	Debris/Litter (Ea)		B					B+				A-				
	133.01.03	Litter Barrels (Ea)															
	133.05.01	Sweepable Area (Sq Ft)	A+													D-	
Group 134/135 - Maint. of Roadside Appurtenances	134.02.02	Rock Mulch (Sq Ft)											A+				
	135.01.01	Wire/Fabric Fences (Lin Ft)	A+					A+					A+				
	135.01.02	Chain Link Fences (Lin Ft)	A+					A+					A+				
	135.01.03	Glare Screens (Lin Ft)	A+														
Group 141 - Traffic Services	141.01.01	Regulatory Traffic Signs (Ea)	A-						B					B+			
	141.02.01	Guardrail (Lin Ft)	A+							C+						D	
	141.02.03	Guardrail End & Impact Attenuator(Ea)	A+					A+					A+				
	141.02.06	Cable Barrier (Lin Ft)						A+									
	141.04.01	Paint Stripes (Lin Ft)	A+					A+					A+				
	141.06.01	Raised Pavement Markers (Ea)															
	141.08.01	Pavement Markings (Ea)	A+					A+					A+				
	141.09.01	Street Lights (Ea)	A+					A+					A+				
	141.09.02	Structure & Tunnel Lights (Ea)															
	141.09.03	High Mast Lights (Ea)															
	141.09.05	Overhead Sign Lights (Ea)						A+									
	141.11.01	Roadway Markers (Ea)		B-					B-					B			
Group 161 - Structure Maintenance	161.01.05	Structure Drains (Ea)											A+				
	161.01.07	Retaining, Sound & Bin Walls (Sq Ft)															
	161.02.02	Sweep Structures (Sq Ft)															
	161.03.01	Graffiti (Sq Ft)	A+					A+									

SharePoint Demonstration

FY2020 MAP Survey Results

SharePoint Demonstration



Maintenance Budget Model and Analysis Tool (MBM)

- Performance-Based Maintenance Model based on LOS concept.
- Links performance data to budgets
- Estimates costs required to obtain specific LOS for all assets.

Maintenance Budget Model and Analysis Tool for 2020

TARGET LOS

CURRENT LOS

YRS TO TARGET

Adjustment of parameters : target LOS and target period

2019	District 1 - Road Category 1	MAINTENANCE WORK PROGRAM AND BUDGET												Annual Budget (For LOS-Rated Assets Only)				
Asset Group	Asset Feature	Current LOS	Target LOS	Target FY	Yrs to Target	Activity	Description	LOE Qty	Units	% Distrib.	Factor	Annual Work Quantity	Units	Labor	Equipment	Materials	Other	Total
Group 112 - Concrete Repair	Concrete Barrier Rail	A+	B	2020	1	112.06.01	Repair / Install Barrier Rail	-	Lin Ft	100.00	1	-	Lin Ft	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Concrete Boxes	A+	B	2020	1	112.05.01	Repair / Replace / Extend Reinforced Concrete Boxes	-	Lin Ft	100.00	1	-	Lin Ft	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Curb & Gutter	A+	B	2020	1	112.03.01	Repair / Install Curb, Gutter, Sidewalk or Wheelchair F	-	Cu Yds	100.00	1	-	Cu Yds	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Drop Inlets	A+	B	2020	1	112.08.01	Repair / Install Drop Inlets	-	Each	100.00	1	-	Each	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
Group 131 - Roadside Maintenance	Clean Drains & Culverts	B	B	2020	1	131.01.01	Clean Culverts	52,765	Lin Ft	100.00	1	52,765	Lin Ft	$ 73,034	$ 134,203	$ 5,360	$ -	$ 212,597
										100.00				$ 73,034	$ 134,203	$ 5,360	$ -	$ 212,597
	Clean Drop Inlets	A+	B	2020	1	131.01.02	Clean Drop Inlets	216	Each	100.00	1	216	Each	$ 4,129	$ 3,284	$ 6	$ -	$ 7,419
										100.00				$ 4,129	$ 3,284	$ 6	$ -	$ 7,419
	Clean Slotted Drains	A+	B	2020	1	131.01.03	Clean Slotted Drains	-	Lin Ft	100.00	1	-	Lin Ft	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Clean Culvert Openings	D+	C+	2021	2	131.01.04	Clean Culvert Openings	118	Each	100.00	1	118	Each	$ 10,989	$ 16,321	$ 18	$ -	$ 27,328
										100.00				$ 10,989	$ 16,321	$ 18	$ -	$ 27,328
	Clean Retention Basins		B	2020	1	131.01.07	Clean Sediment Or Retention Basins	30	Cu Yds	100.00	1	30	Cu Yds	$ 604	$ 885	$ 80	$ -	$ 1,570
										100.00				$ 604	$ 885	$ 80	$ -	$ 1,570
	Repair Culverts	A+	B	2020	1	131.05.01	Repair / Replace / Extend or Install Culverts	-	Lin Ft	100.00	1	-	Lin Ft	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Repair Channels / Ditches	A+	B	2020	1	131.05.03	Repair / Reshape / Construct Ditches or Channels	-	Lin Ft	100.00	1	-	Lin Ft	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Clean Ditches	A+	B	2020	1	131.05.05	Clean Cuts / Ditches Up To Culvert Wings	-	Cu Yds	100.00	1	-	Cu Yds	$ -	$ -	$ -	$ -	$ -
										100.00				$ -	$ -	$ -	$ -	$ -
	Fill & Cut Slopes	D-	C+	2021	2	131.06.01	Repair Fill and Cut Slopes	21,602	Cu Yds	100.00	1	21,602	Cu Yds	$ 73,657	$ 123,499	$ 627	$ -	$ 197,783
										100.00				$ 73,657	$ 123,499	$ 627	$ -	$ 197,783
	Blade Shoulders	F	C	2022	3	131.07.01	Blade Shoulders	67	Shldr Mi	100.00	1	67	Shldr Mi	$ 22,265	$ 34,881	$ 2,393	$ 39	$ 59,578
										100.00				$ 22,265	$ 34,881	$ 2,393	$ 39	$ 59,578
Group 133 - Roadside Cleanup	Debris/Litter	C+	B	2020	1	133.01.01	Remove Debris	22,243	Cu Yds	100.00	1	22,243	Cu Yds	$ 1,131,387	$ 646,560	$ 10,297	$ -	$ 1,788,244
										100.00				$ 1,131,387	$ 646,560	$ 10,297	$ -	$ 1,788,244
	Litter Barrels	A+	B	2020	1	133.01.03	Empty Litter Barrels	574	Each	100.00	1	574	Each	$ 6,267	$ 2,901	$ 214	$ -	$ 9,382
										100.00				$ 6,267	$ 2,901	$ 214	$ -	$ 9,382
	Sweepable Areas	A+	B	2020	1	133.03.01	Sweeping-Pull Broom / Self Propelled Broom	4,978	Sweep Mi	0.68	1	34	Sweep Mi	$ 318	$ 377	$ -	$ -	$ 695
						133.05.01	Pickup Broom Sweeping	4,978	Sweep Mi	99.32	2	9,888	Cu Yds	$ 441,973	$ 839,150	$ 1,202	$ -	$ 1,282,326
										0.68				$ 442,291	$ 839,527	$ 1,202	$ -	$ 1,283,020

Maintenance Budget Model and Analysis Tool for 2020

Collection of accomplishment and cost collected from MMS

District 1 - Road Category 1 **Annual Accomplishments & Expenditures - FY2019**

			District 1 - Road Category 1 - Totals						
			Annual	Annual	Annual Expenditures				
Code	Description / Definition	Units	Accomp	Labor Hrs	Labor$	Equip.$	Mat.$	Expend.$	TOTAL$
100.02.01	Supervisory Duties	Lhrs	184	184	4,858	760	0	0	5,617
101.01.01	Base & Surface Repair	Cu Yds	70	50	1,156	1,862	400	0	3,418
101.02.01	Hand Patching	Cu Ft	358	476	10,915	6,318	2,216	0	19,449
101.02.02	Maintenance Patching (less than 500 ft)	Cu Yds	19	191	4,962	7,111	1,720	686	14,479
101.02.03	Overlay / Inlay (over 500 ft)	Cu Yds	0	0	0	0	0	0	0
101.02.04	Roadway Capacity Improvements	Sq Yds	0	0	0	0	0	0	0
101.05.01	Sand	Sq Yds	0	0	0	0	0	0	0
101.05.02	Fog / Flush	Sq Yds	76,876	65	1,375	1,238	19,912	0	22,524
101.05.03	Chip	Sq Yds	0	0	0	0	0	0	0
101.05.04	Scrub Seal	Sq Yds	0	0	0	0	0	0	0
101.05.05	Micro Surfacing / Slurry Seal	Lhrs	0	0	0	0	0	0	0
101.07.01	Crackfilling	Lbs Filler	0	0	0	0	0	0	0
101.10.01	Surface Profiling	Sq Yds	0	0	0	0	0	0	0
111.01.01	Temporary Patching / Spall Repair PCCP	Sq Ft	8	26	741	395	61	0	1,197
111.01.02	Permanent Patching / Spall Repair PCCP	Sq Ft	0	0	0	0	0	0	0
111.04.01	Concrete Joint Filling Weakened Sawed Joints	Lin Ft	0	0	0	0	0	0	0
111.04.02	Concrete Crack Filling Random Cracks	Lbs Filler	0	0	0	0	0	0	0
112.03.01	Repair / Install Curb, Gutter, Sidewalk or Wheelchair Ramp	Cu Yds	24	491	10,660	3,186	275	0	14,121
112.05.01	Repair / Replace / Extend Reinforced Concrete Boxes	Lin Ft	0	0	0	0	0	0	0
112.06.01	Repair / Install Barrier Rail	Lin Ft	13,165	372	9,016	12,076	11,311	0	32,404
112.08.01	Repair / Install Drop Inlets	Each	0	0	0	0	0	0	0
131.01.01	Clean Culverts	Lin Ft	52,959	1,641	35,293	78,663	8,915	0	122,871
131.01.02	Clean Drop Inlets	Each	252	412	8,653	9,834	0	0	18,487
131.01.03	Clean Slotted Drains	Lin Ft	0	0	0	0	0	0	0
131.01.04	Clean Culvert Openings	Each	130	274	5,902	9,331	0	0	15,233
131.01.05	Clean Sand Oil Separators	Cu Yds	0	0	0	0	0	0	0
131.01.07	Clean Sediment Or Retention Basins	Cu Yds	30	35	692	1,400	0	0	2,092
131.05.01	Repair / Replace / Extend or Install Culverts	Lin Ft	195	245	5,328	8,636	156	0	14,120
131.05.03	Repair / Reshape / Construct Ditches or Channels	Lin Ft	11,780	767	15,406	27,277	0	0	42,684
131.05.05	Clean Cuts / Ditches Up To Culvert Wings	Cu Yds	1,373	344	7,598	9,140	0	0	16,739
131.06.01	Repair Fill and Cut Slopes	Cu Yds	14,031	2,163	49,490	89,653	30	0	139,173
131.07.01	Blade Shoulders	Shldr Mi	155	1,829	40,040	71,124	7,660	0	118,824
131.08.01	Flailing / Mowing / Dragging	Shldr Mi	31	231	5,391	7,176	0	0	12,567
131.08.05	Chemical Weed Spray	Shldr Mi	545	2,373	44,234	22,177	56,114	0	122,524
131.08.06	Hand Weeding / Burning	Lhrs	4,063	4,027	76,281	103,999	904	0	181,185
131.08.07	Reseeding	Lhrs	0	0	0	0	0	0	0
131.09.01	Install / Repair / Replace Pollution Prevention Devices	Lhrs	46	46	950	1,106	353	0	2,408

Maintenance Budget Model and Analysis Tool for 2020

Comparison cost ratios between districts and state

2020 District Cost Ratios

District 1 Avg. Expenditures & Labor Hours / Accomplishment Unit (Costs updated to FY2020)					
$Labor / Unit	$Equip / Unit	$Mtrl / Unit	$Expend / Unit	Total$	LHr / Unit
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.56	6.65	0.00	0.00	12.21	0.23
3.41	5.72	0.03	0.00	9.16	0.15
332.38	520.71	35.72	0.58	889.38	14.40
137.36	229.85	0.00	0.00	367.20	5.87
70.17	37.23	86.15	0.00	193.56	3.52
19.74	21.73	0.28	0.00	41.74	0.99
0.00	0.00	0.00	0.00	0.00	0.00
22.25	21.34	3.80	0.00	47.39	1.00

2020 Statewide Cost Ratios

Statewide Avg. Expenditures & Labor Hours / Accomplishment Unit (Costs updated to FY2020)					
$Labor / Unit	$Equip / Unit	$Mtrl / Unit	$Expend / Unit	Total$	LHr / Unit
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6.21	7.31	0.20	0.00	13.72	0.27
3.64	6.27	0.05	0.56	10.52	0.16
357.72	547.20	51.74	34.24	990.90	15.91
67.69	124.11	1.16	0.00	192.96	3.08
35.82	26.18	107.85	0.00	169.86	1.71
20.00	20.22	2.32	0.00	42.54	0.99
0.00	0.00	0.00	0.00	0.00	0.00
22.43	24.91	1.74	0.00	49.08	0.98

Closing Remarks

- MAP combined with Work Planning & Budgeting model (MBM) is a tool for NDOT Maintenance Districts. It provides the capability to plan, budget and manage the limited maintenance resources more effectively.

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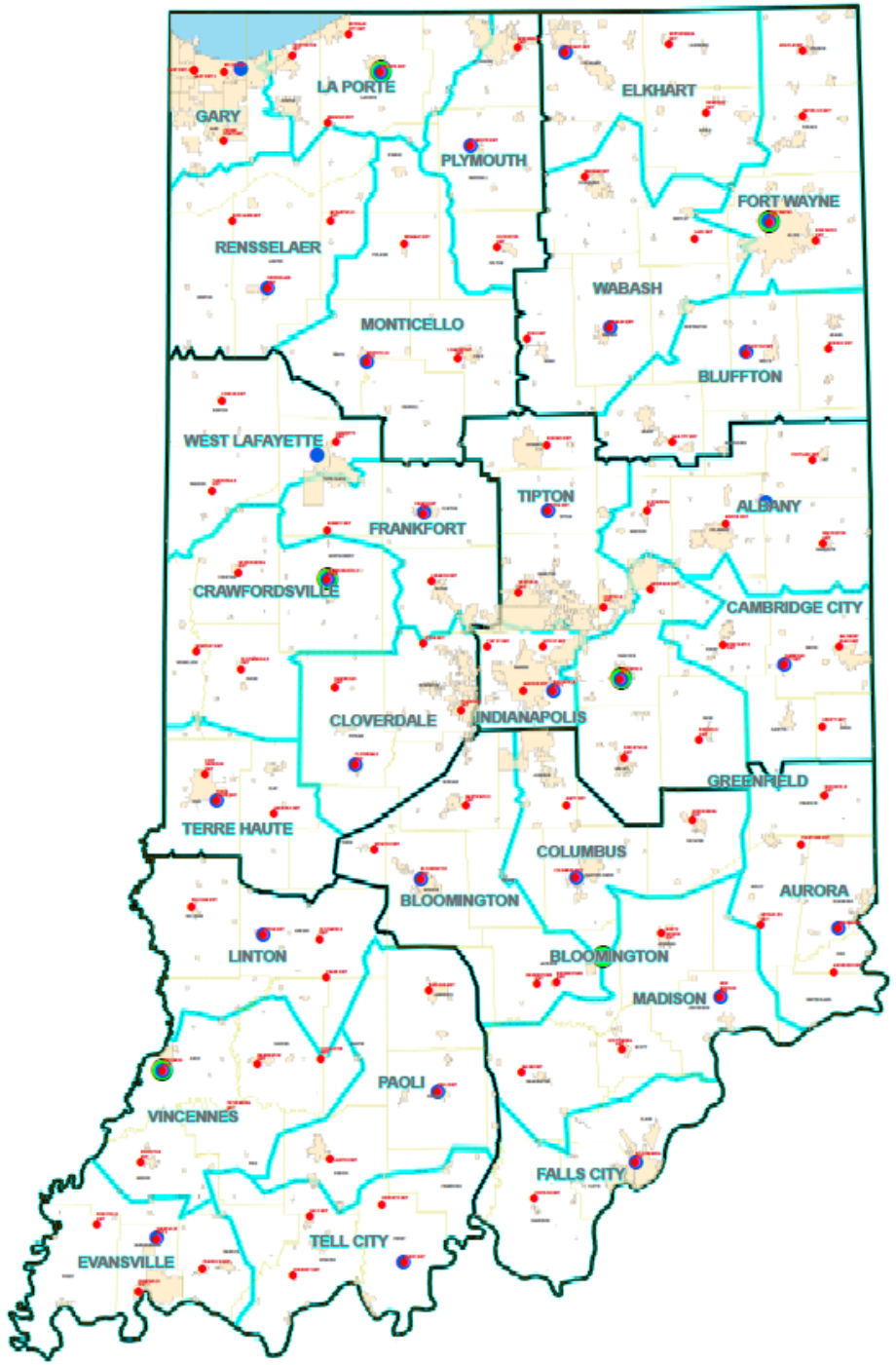
Indiana DOT Maintenance Planning

TODD SHIELDS

JULY 7, 2021

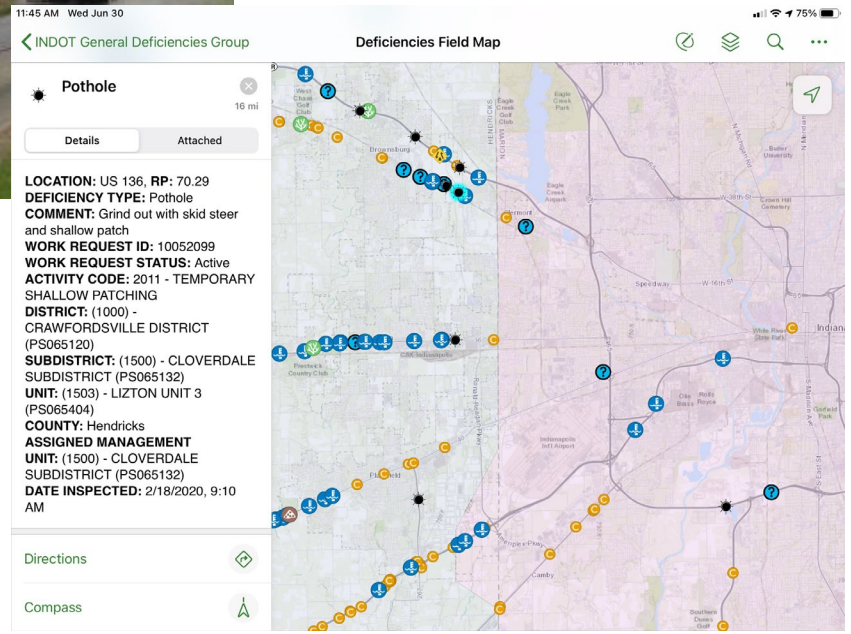
Indiana DOT Organization

- ~3,700 total employees
  - ~1,500 field maintenance
- ~12,000 center/29,000 lane miles of road
- 6 Districts
  - ~5 Subdistricts
    - ~4 Units
- In a typical year, our crews perform:
  - 15,000 tons of patching
  - 1,600 lane miles of chip sealing
  - 20,000 SFT bridge deck patching
  - 18,000 sign replacements
  - 25,000 miles of pavement striping



How do Maintenance Needs get Identified?

- District Technical Services
  - Engineering/Asset management
- Local Maintenance Level
  - Drainage
  - Vegetation
- Work Requests
  - Bridge/Culvert Deficiencies
  - Customer Service
  - General Deficiency Application



INDOT's maintenance crews perform ~2.5 million person-hours of work per year

INDOT Planning Process

- Annual Maintenance Work Plan (July 1 – June 30)
  - Planning Unit = Month
  - Planning Element = Person Days
  - Planning Level = Subdistrict
  - Each maintenance activity includes
    - Performance standard
      - "How" to do the work
    - Quantity Guideline
      - "Typical" crew size, materials, equipment, accomplishment
- District Technical Services identifies asset needs
  - Generally preservation type activities
  - Other "heavy" activities

INDOT Planning Process

- INDOT does NOT plan 100% of available resources (any more)

Totals Actions ▾

Description	Jul	Aug	Sep	Oct	Nov	D...	Jan	Feb	Mar	Apr	May	Jun	T
Planned	598	577.58	555	606.33	444.9	277...	237.66	254.33	456.1	556.4	523.12	582.78	
Available	736	704	672	736	672	704	672	640	726	672	640	640	
Difference	-138	-126.42	-117	-129.67	-227.1	-42...	-434...	-385...	-269.9	-115.6	-116....	-57.22	

- Plan the “Knowns”, be prepared for the “Unknowns”

INDOT Planning Process

- Plan to assets to the maximum extent possible
  - Much of this is "prepopulated" from Central Office
    - Asset
    - Activity
    - Quantity

Activity	Inventory Asset	J..	A..	S..	O..	N..	D..
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60001				81.36		
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60022			46.8			
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60080			41....	42.3		
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60175				21.6		
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60178			75....			
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60248			66....			
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60280				34.2		
2070 - CRACK SEALING (LNM - LANE MILE)	PK-60312			40....			

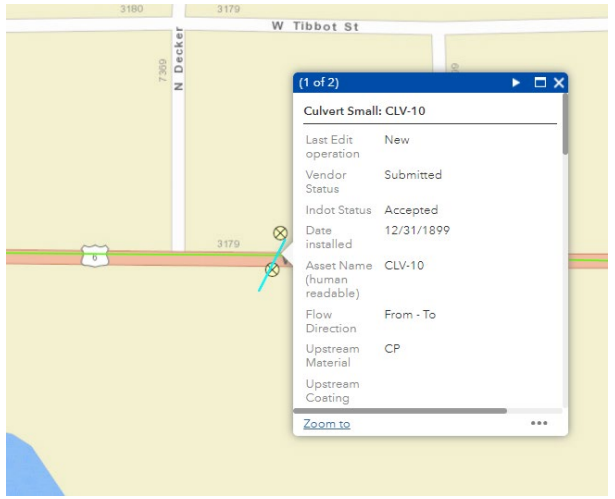
Integration with Enterprise GIS

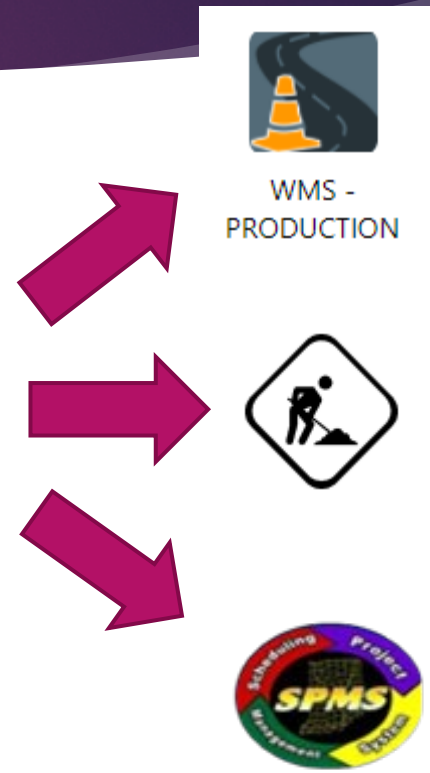
- INDOT uses ESRI Roads and Highways
  - Authoritative linear network
  - Authoritative location for inventory assets
  - Standardized naming convention between INDOT systems
    - Enterprise GIS
    - Maintenance Management System
    - Capital Project Management System
    - For Example
      - Old MMS – Human Readable

      CLV-006-057-113.31

      (Asset Type)-(County)-(Route)-(Reference Post)
      - New Enterprise

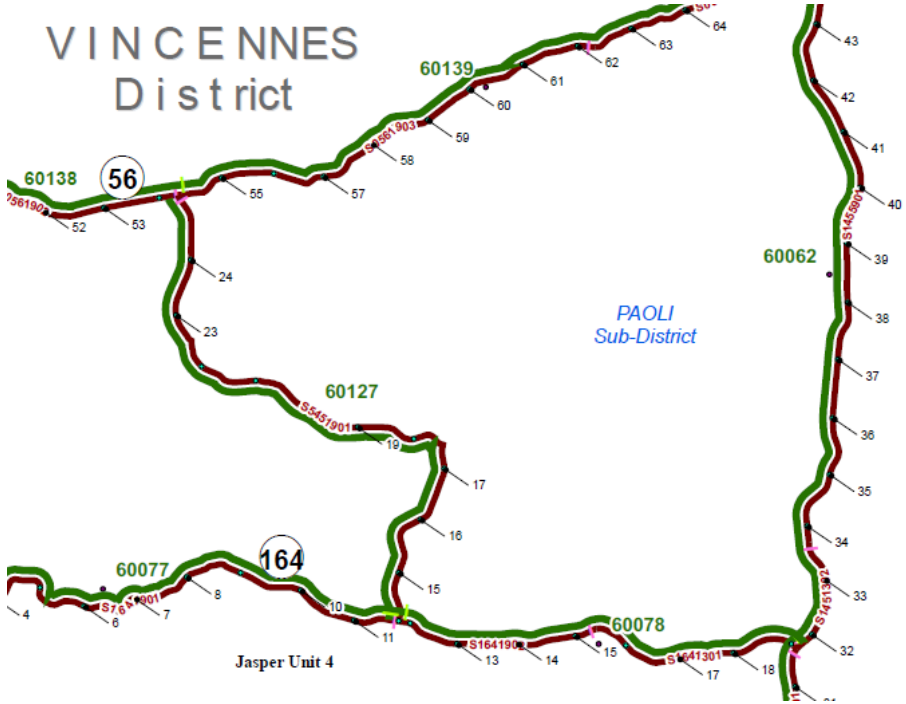
      CLV-10





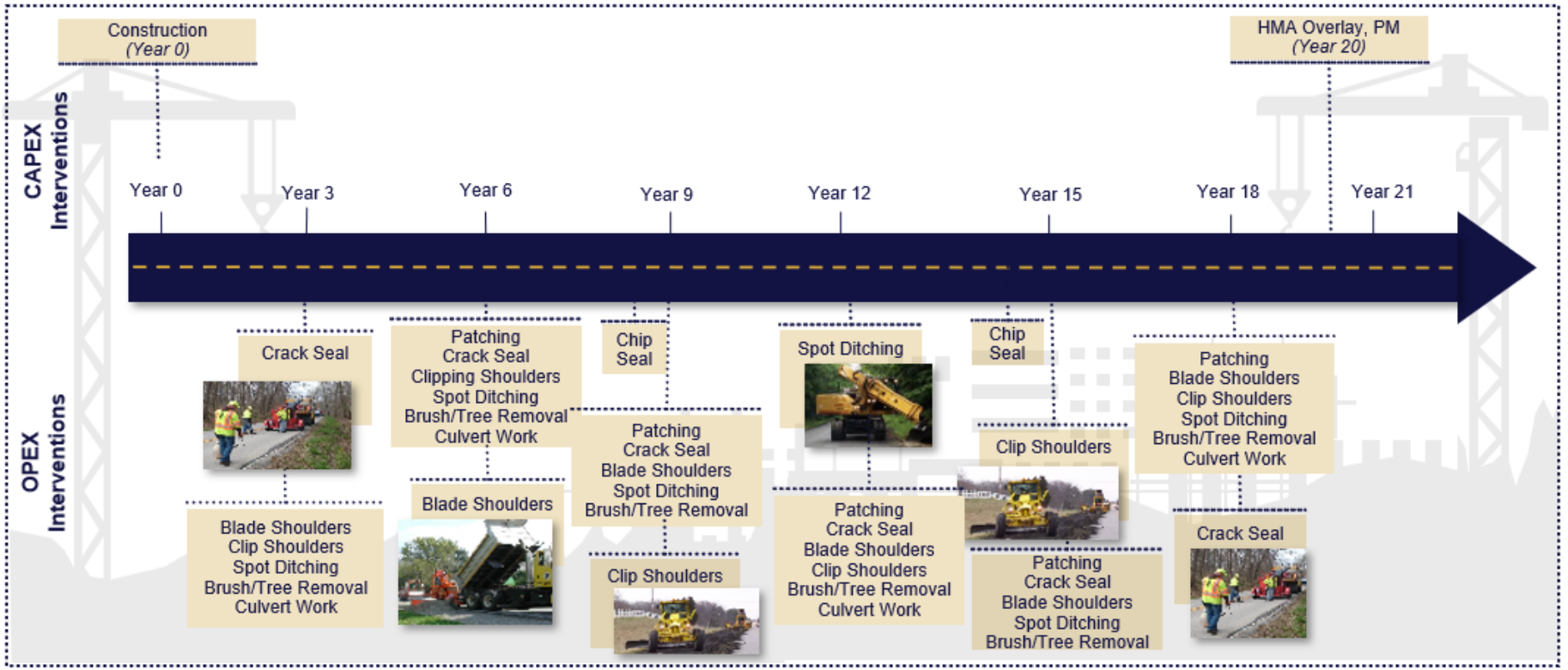
Integration with Enterprise GIS

- Align pavement asset sections (Pavement Keys) with MMS maintenance sections
  - Asset engineers and maintenance now speak same language
  - As PK's are updated, maintenance sections automatically align



Long Term Asset Management

- Align work plans with 20 year road/bridge plans
  - "Maintenance Owner's Manual"

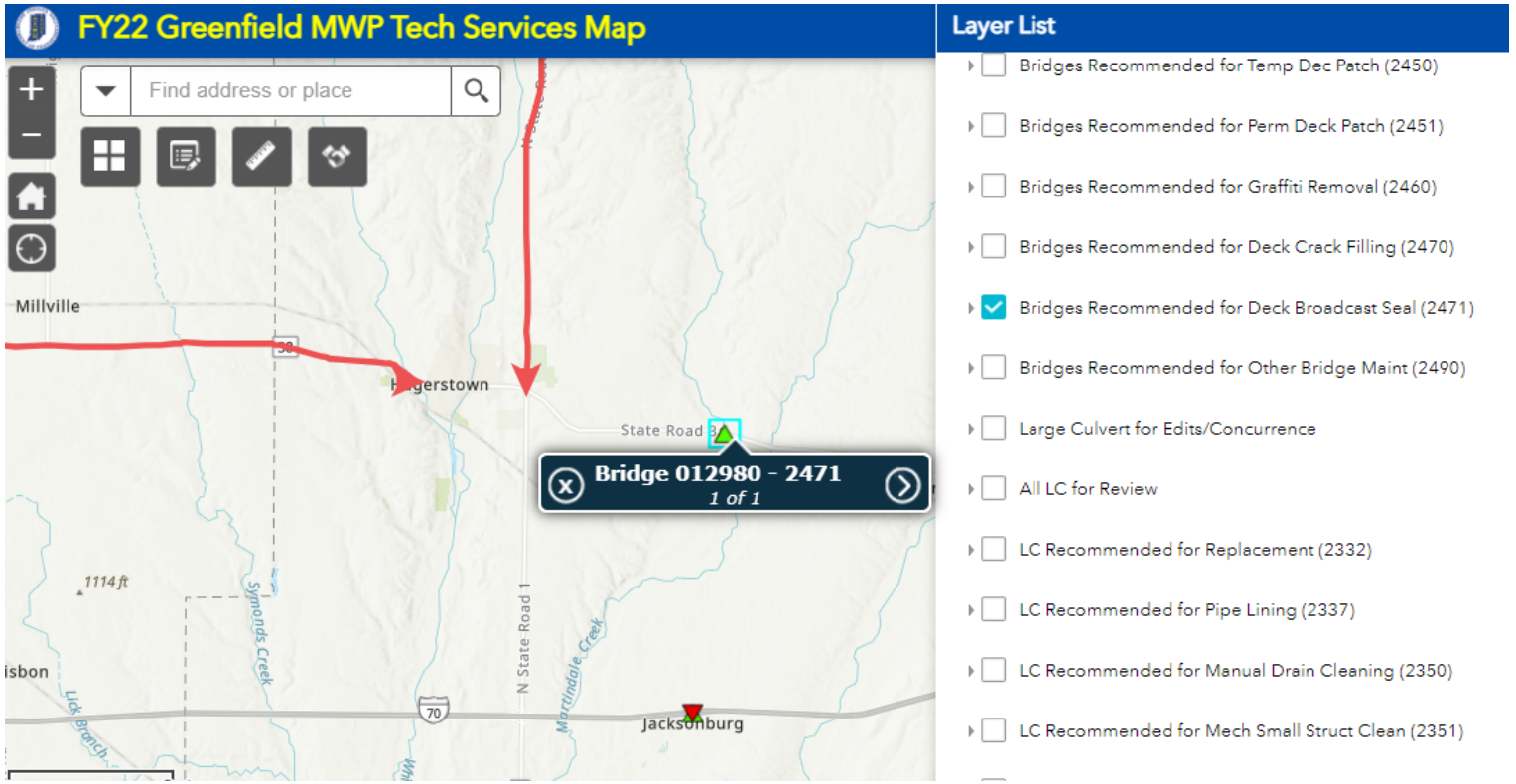


Long Term Asset Management

- With the "owner's manual", we can use our MMS performance standards to "project" needed manpower and budget
  - Total of 63,000 person days
    - Total available in "warm months" = 122,000
  - Total $12M in materials
    - This is almost entirely chip seal
- Corridor Approach
  - Capital – do all road and bridge work, stay out for years
  - Maintenance – road/drainage/vegetation activities

Work Plan Application

- Work Plan Tool
- Allows collaboration between Maintenance and Tech Services
- Allows complete visibility
  - What work is being proposed
  - What has been field verified
  - Comments/Notes/Photos



Advantages of having a Good Plan

- By using the quantity guidelines, can "back calculate" required staffing levels
- Can calculate "optimal" overtime levels
- Sharing/balancing equipment/resources
- Minimize "surprises"
- Maintain assets to the best possible condition
- Preclude the need for future more extensive repairs

Questions???

Todd Shields

Indiana Department of Transportation

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Total Cost of Ownership

Maintenance Management Planning

Adam Bevins

Director – Asset Management & Technical

Downer Ltd

01 Introduction

Agency Background

- Arnold Downer, 1895 – 1994
- Immigrated to NZ in 1899
- Join Public Works Dept as a cadet, 1913
- World War 1, 1915 to 1919
- Asked to leave Public Works and complete Mt Victoria Tunnel, 1930
- Downer & Company formed, 1933
- Dissolution of Ministry of Works (formerly Public Works), 1993
- Construction arm of Ministry of Works sold to Downer, 1996

01 Introduction

Agency Background

- 53,000 Employees
- Operating across all public infrastructure supporting our communities:
  - Transport – roads, rail, (light and heavy), ports, airports
  - Telecommunications - terrestrial, cellar, data centres
  - Utilities - power, water, gas
  - Facilities Management - health, defence, justice, public housing, education, etc
  - Mining – global supply chain partner
- Local/State/Central Government, World Bank, Global mining companies
- Long-term stewardship and performance contracts from 7 yrs to +30 yrs

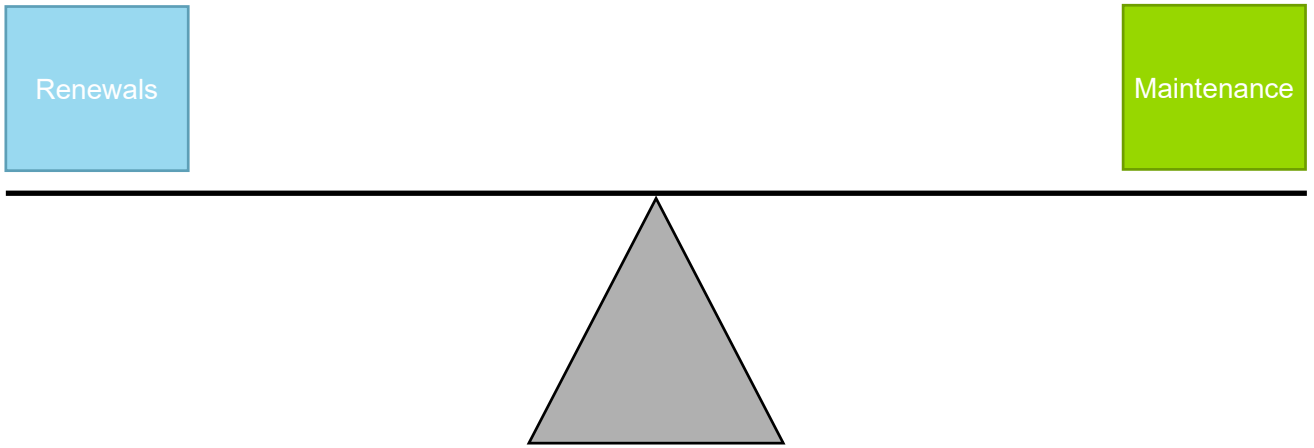
02 Performance Based Contracts

New Zealand Context

- 100,000 km national road network
- 10,000 km state highway network
- 100% outsourced physical works since early 1990's
- Mid 1990's - State Highway Agency commenced the development of performance-based contracts
- 2013 – Network Outcome Contracts were rolled out across state highway system, further integrating asset management, physical works and service delivery

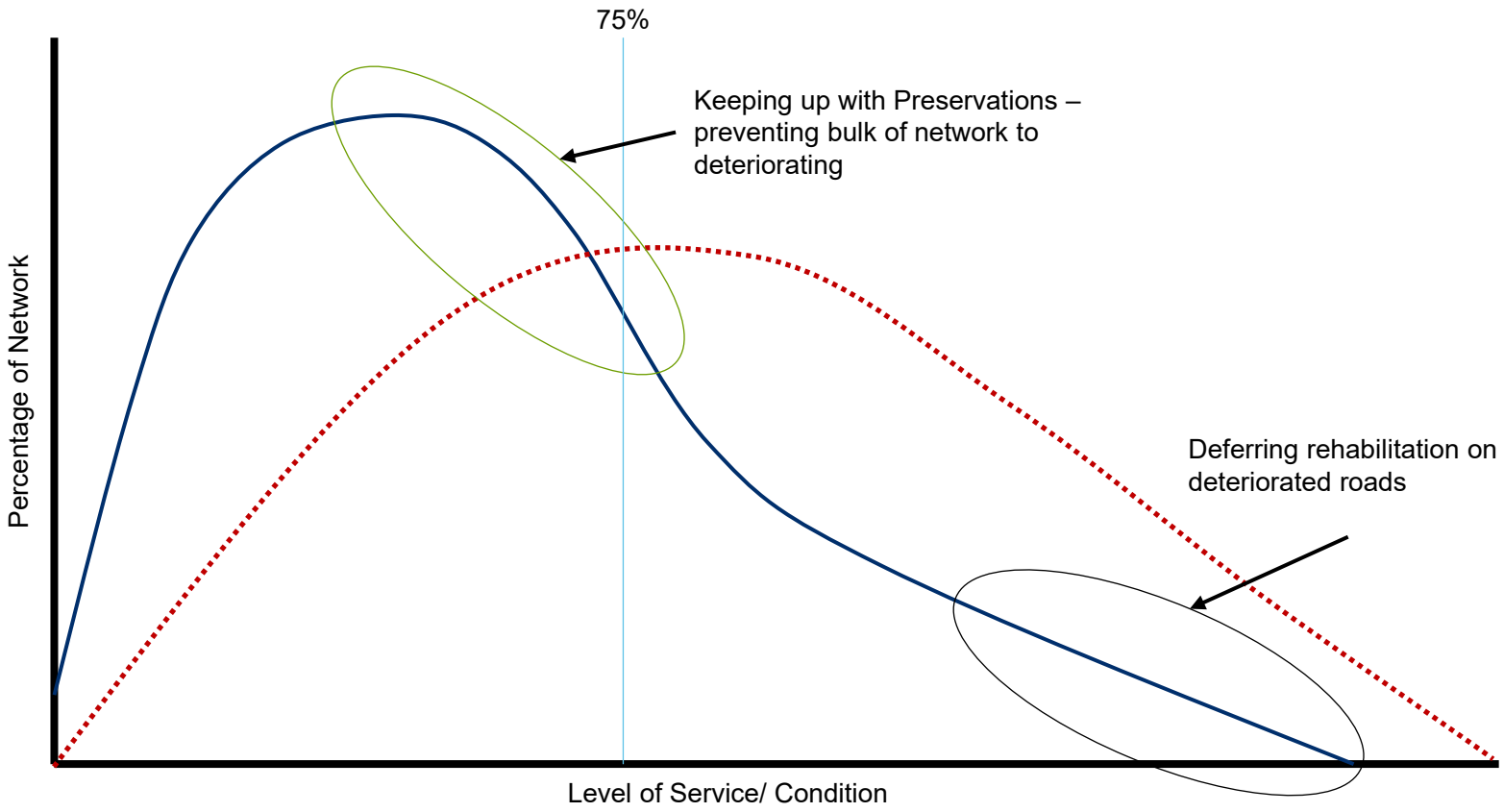
03 Maintenance Strategies

Finding the right balance



03 Maintenance Strategy

Keeping Good Roads Good

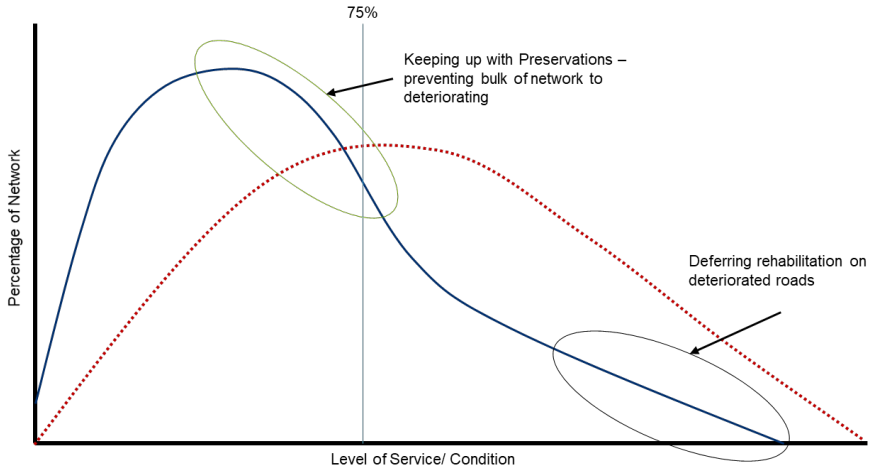


A Sustainable Method of Sweating the Asset (Henning et al., 2016)

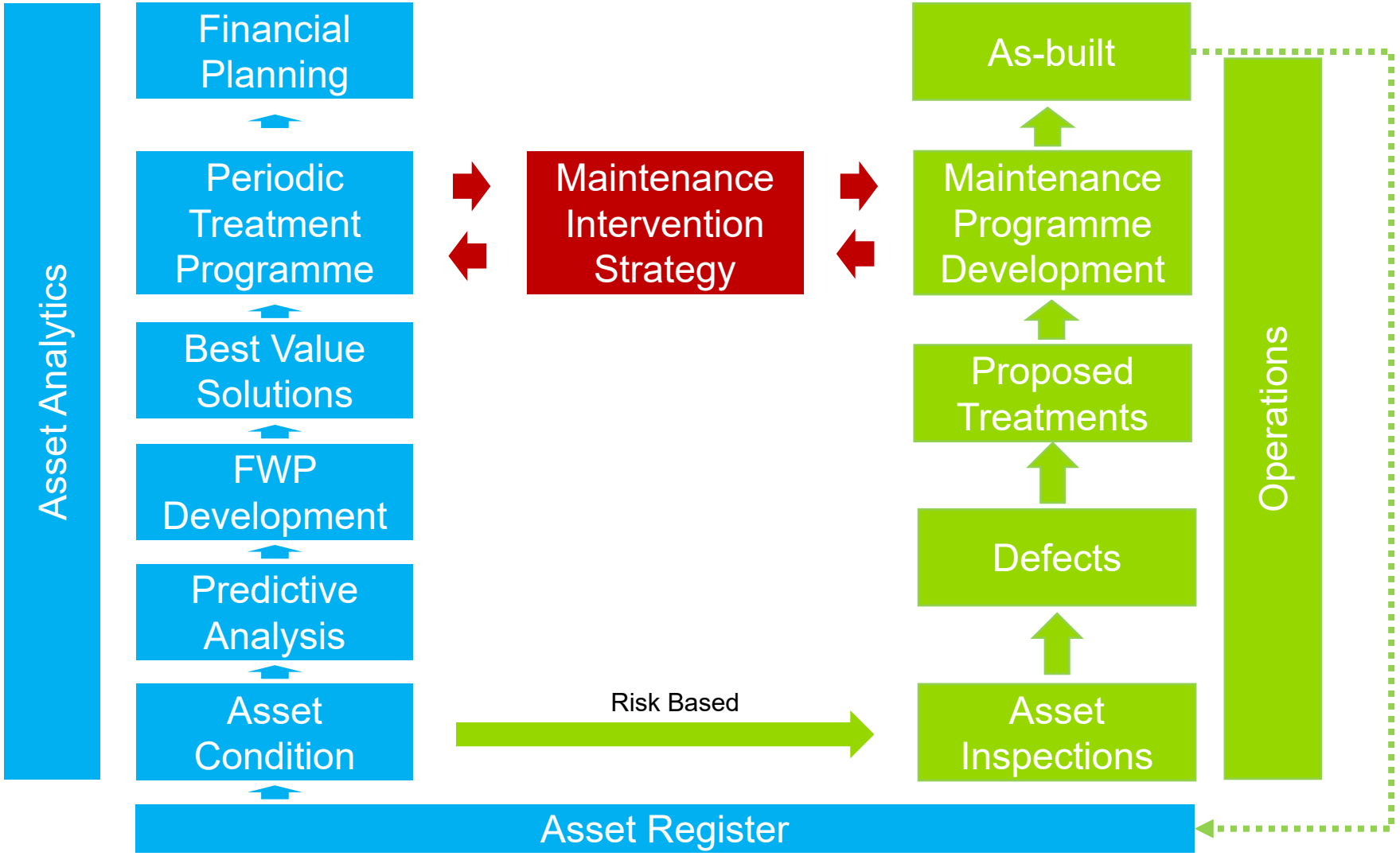
03 Maintenance Strategies

Key strategies we utilise

- Preservation Treatments
- Preventative Maintenance Treatments
- Reactive Maintenance Treatments
- Renewal Treatments

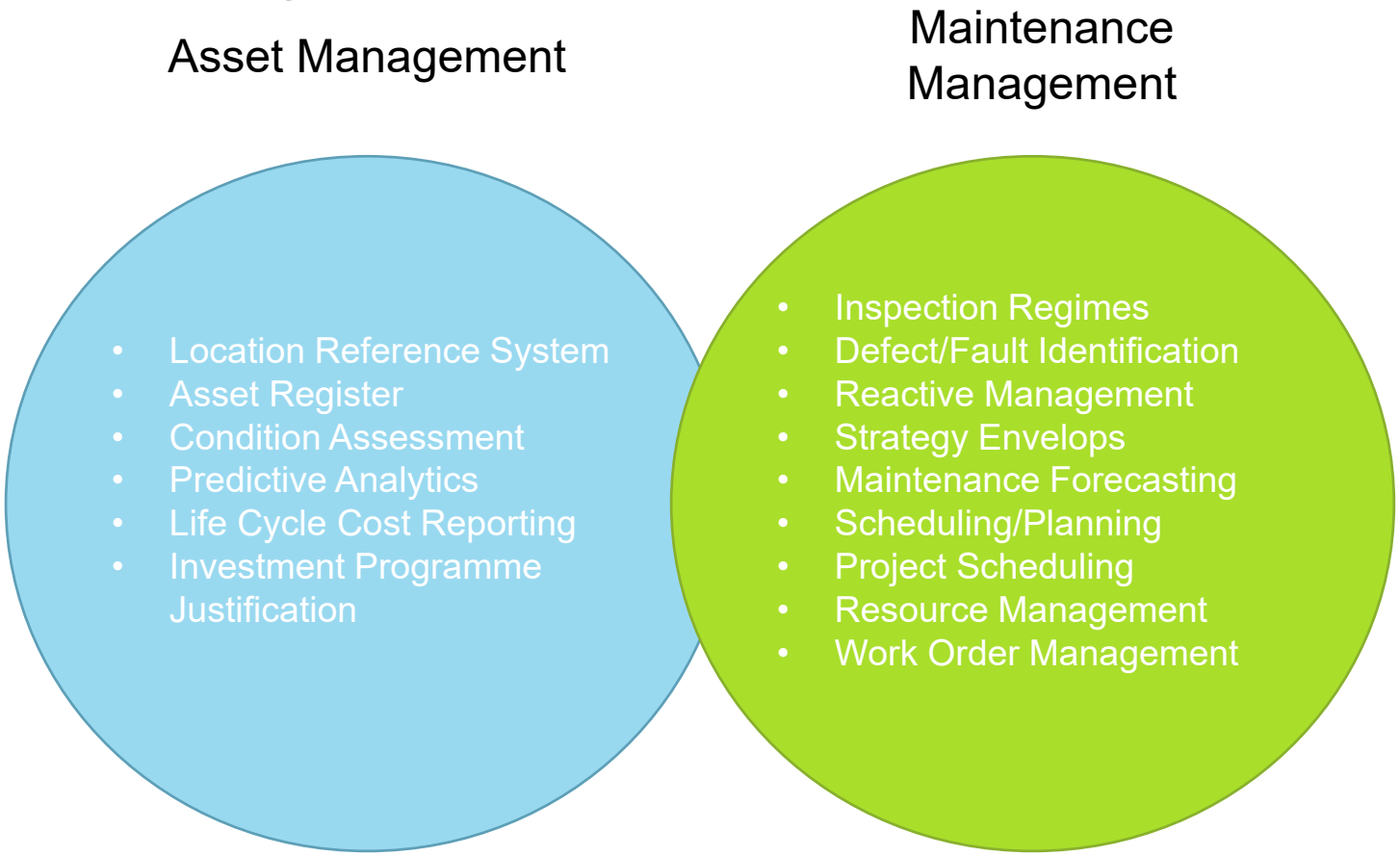


04 Integrated Maintenance Management



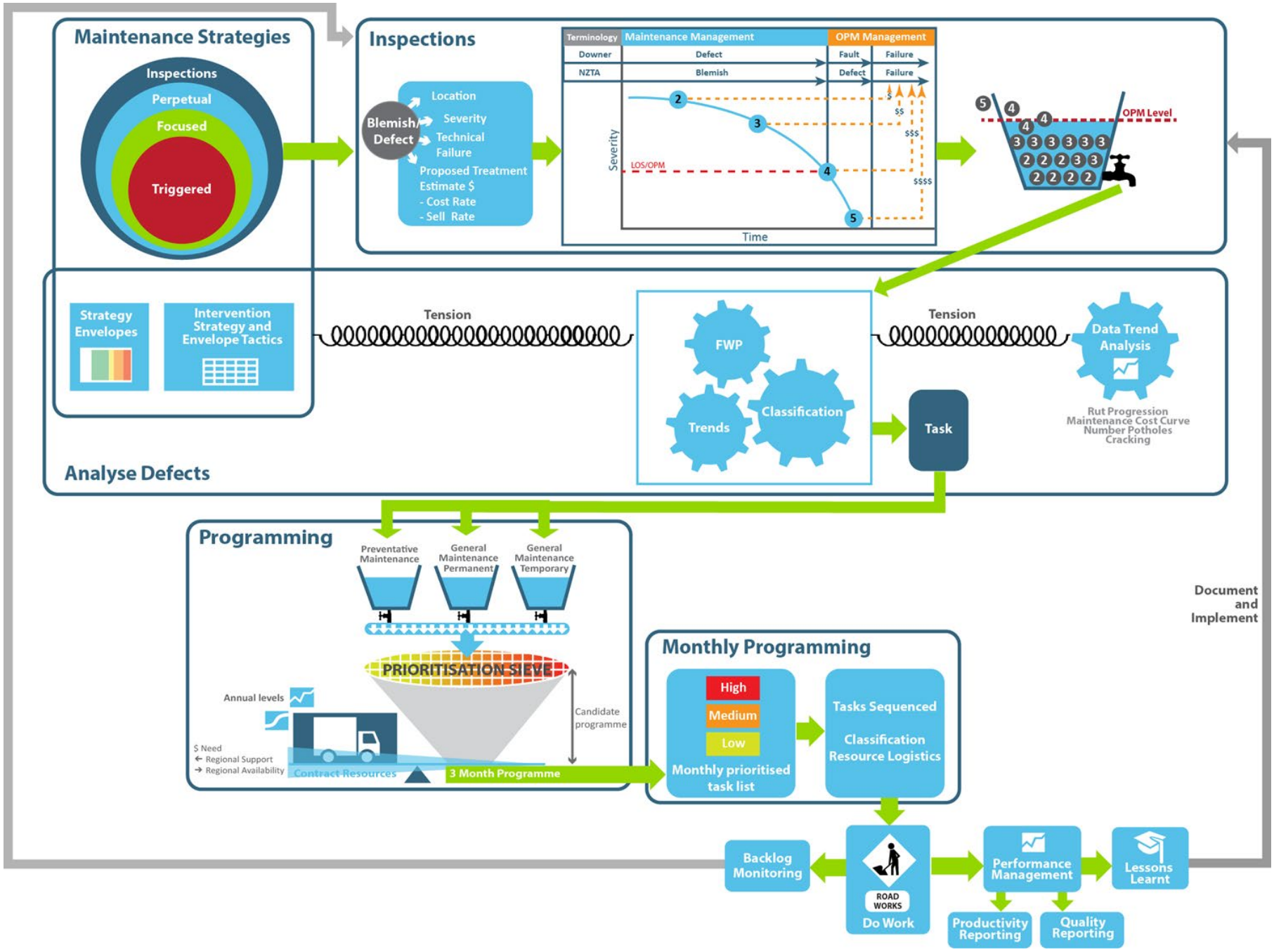
04 Integrated Maintenance Management

Connected System



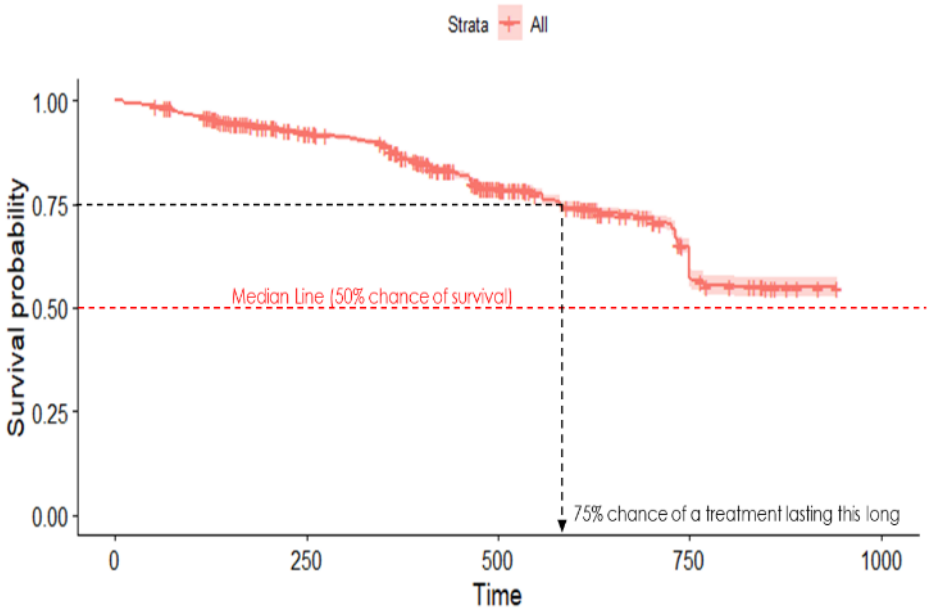
Informs Inspection Regime – risk based

Provides Maintenance Activity at Asset Level – incl. condition updates


Maintenance Strategies
Inspections
Perpetual
Focused
Triggered
Inspections
Blemish/ Defect
Location
Severity
Technical Failure
Proposed Treatment Estimate $
- Cost Rate
- Sell Rate
Terminology
Maintenance Management
OPM Management
Downer
Defect
Fault
Failure
NZTA
Blemish
Defect
Failure
Severity
LOS/OPM
Time
$
$$
$$$
$$$$
OPM Level
Strategy Envelopes
Intervention Strategy and Envelope Tactics
Tension
FWP
Trends
Classification
Task
Tension
Data Trend Analysis
Rut Progression
Maintenance Cost Curve
Number Potholes
Cracking
Analyse Defects
Programming
Preventative Maintenance
General Maintenance Permanent
General Maintenance Temporary
PRIORITISATION SIEVE
Annual levels
$ Need
← Regional Support
→ Regional Availability
Contract Resources
Candidate programme
3 Month Programme
Monthly Programming
High
Medium
Low
Monthly prioritised task list
Tasks Sequenced
Classification
Resource Logistics
Document and Implement
Backlog Monitoring
ROAD WORKS
Do Work
Performance Management
Lessons Learnt
Productivity Reporting
Quality Reporting

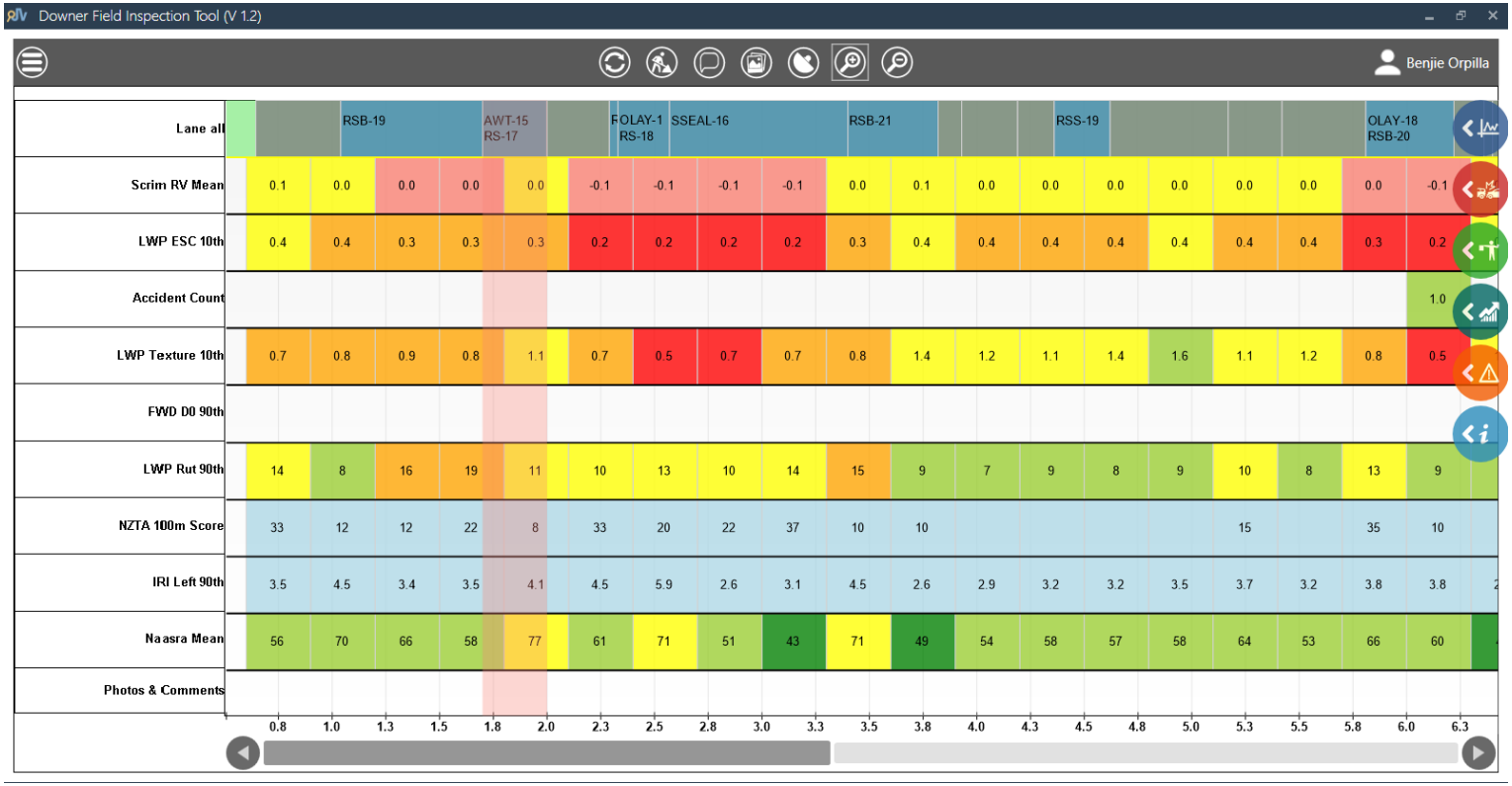
05 Where are we heading

- Development of Maintenance Treatment Survivability Analysis
- Utilisation of AI in network inspections to improve completeness, accuracy and reduce bias
- Development of maintenance forecasting models to provide 3 to 5 year activity level quantities



06 Making decisions at the coal face

Reducing the friction between users and our data



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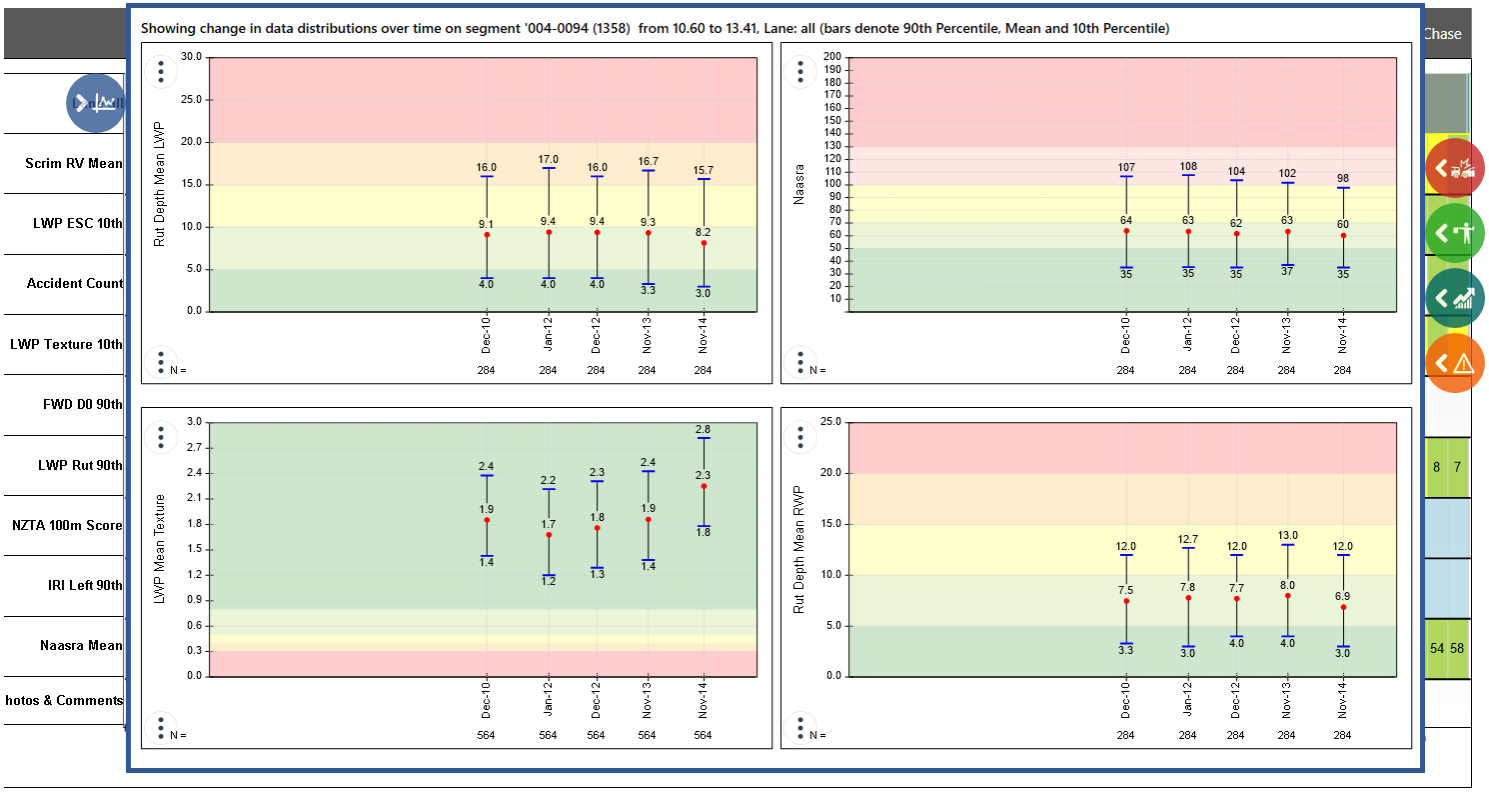
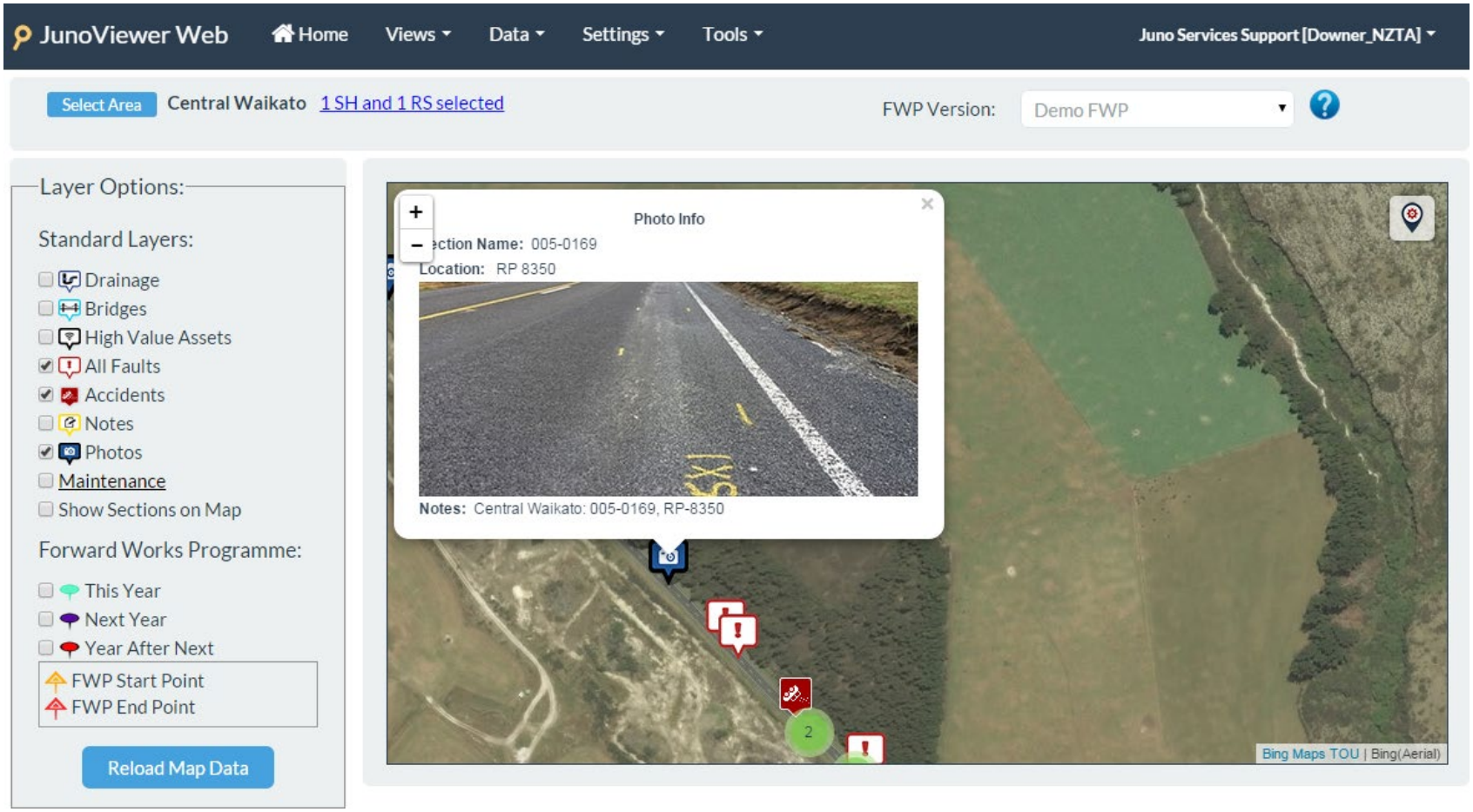


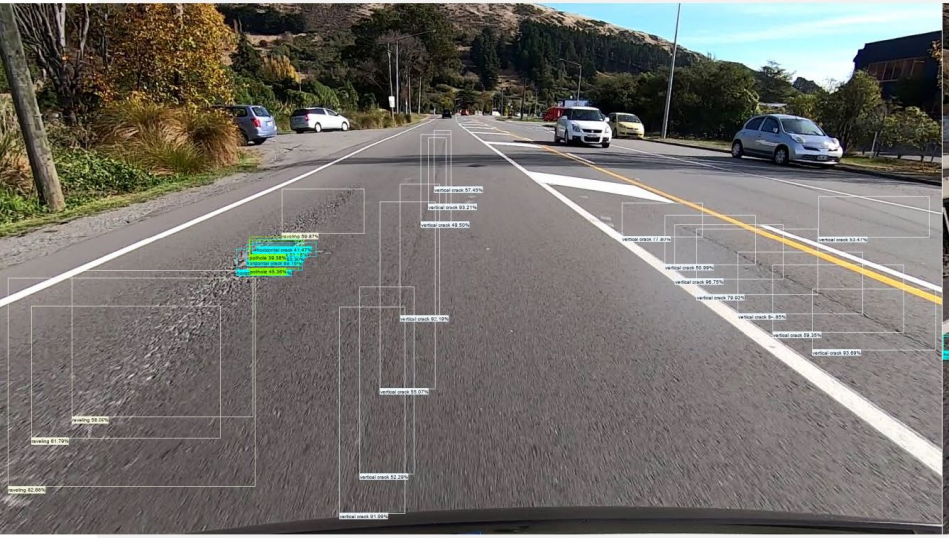
06 Making decisions at the coal face

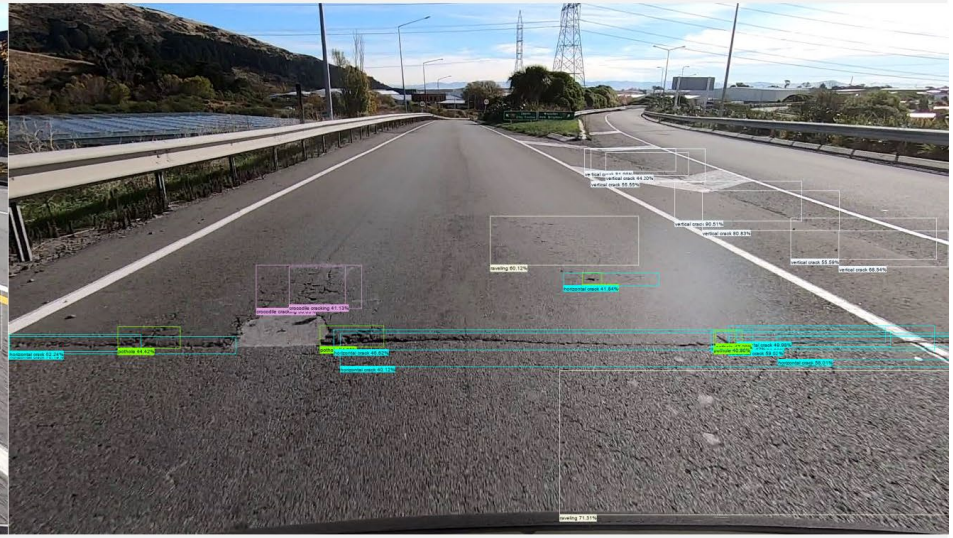
Reducing the friction between users and our data



07 Taking our inspectors off the road

Reducing the friction between users and our data





Today's Panelists

Moderated by:
Trisha Stefanski,
Minnesota DOT

Todd Shields,
Indiana DOT

Anita Bush,
Nevada DOT

Adam Bevans,
Downer

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