Asset Preservation: System-Wide and Structure Specific Bridge Asset Management Plans

Presenters:

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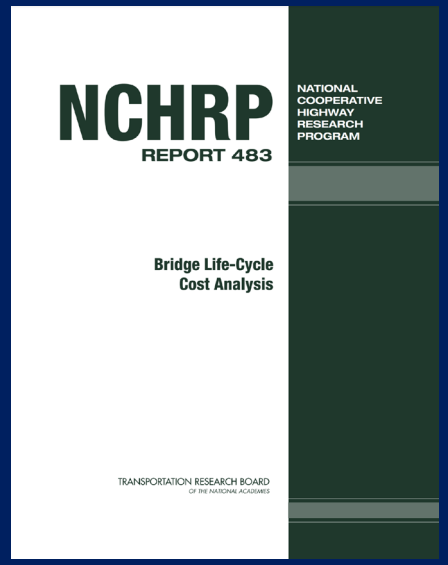
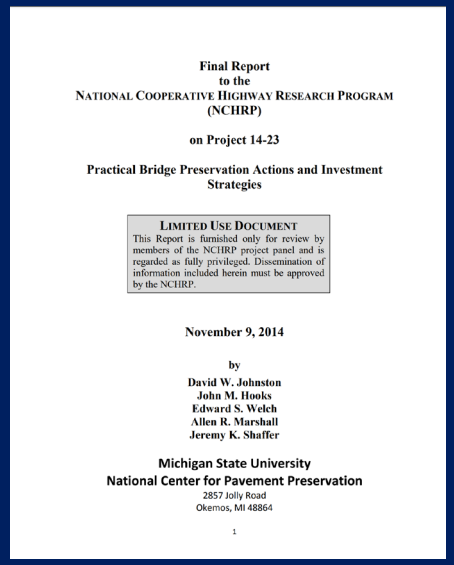
B&N
burgessniple.com

U.S. Department of Transportation
Federal Highway Administration

Bridge management is a core bridge discipline that focuses on making informed and effective decisions on the operation, maintenance, preservation, replacement, and improvement of bridges within a bridge inventory.




Final Report
to the
NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
(NCHRP)

on Project 14-23

Practical Bridge Preservation Actions and Investment Strategies

LIMITED USE DOCUMENT
This Report is furnished only for review by members of the NCHRP project panel and is regarded as fully privileged. Dissemination of information included herein must be approved by the NCHRP.

November 9, 2014

by
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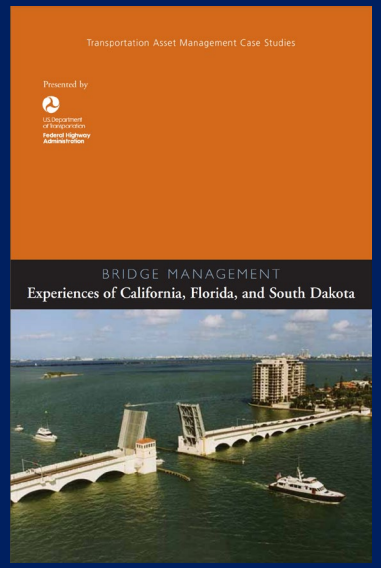
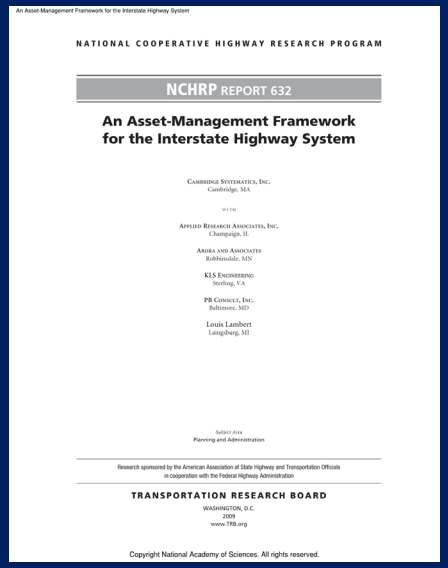




2 Types of AMPs

System-Wide:
- **Many Structures**
- **High-level Planning**

Single Structure:
- **In-depth study**
- **Detailed Assessment**

Common Characteristics:
- **Inventory of Assets**
- **Condition Assessment**
- **Life-cycle costs**

System Wide AMPs:

City of Delaware, Ohio

- Population 42,800
- 46 total structures
- 24 bridges, 22 culverts
- Data Collection & Field Review
- Projection of repairs and maintenance required for 75-year duration

City of Goodyear, Arizona

- Population 101,700
- 132 total structures
- 30 bridges, 102 culverts
- Data Collection & Field Review
- Current repairs only

Bridge Inventory:

CITY OF DELAWARE OHIO

Structure Type	Count
Steel beam / girder	14
Stone Arch Culvert	1
Con-Span	8
3-Sided Box	1
Concrete Slab	8
Concrete Box Culvert	10
Elliptical Concrete	1
Steel Truss	2
Corr. Metal Pipe	1

CITY OF Goodyear

- 30 bridges, 102 culverts
- All concrete structures
- Many multi-span slab bridges and multi-cell culvert structures

AMP Development:

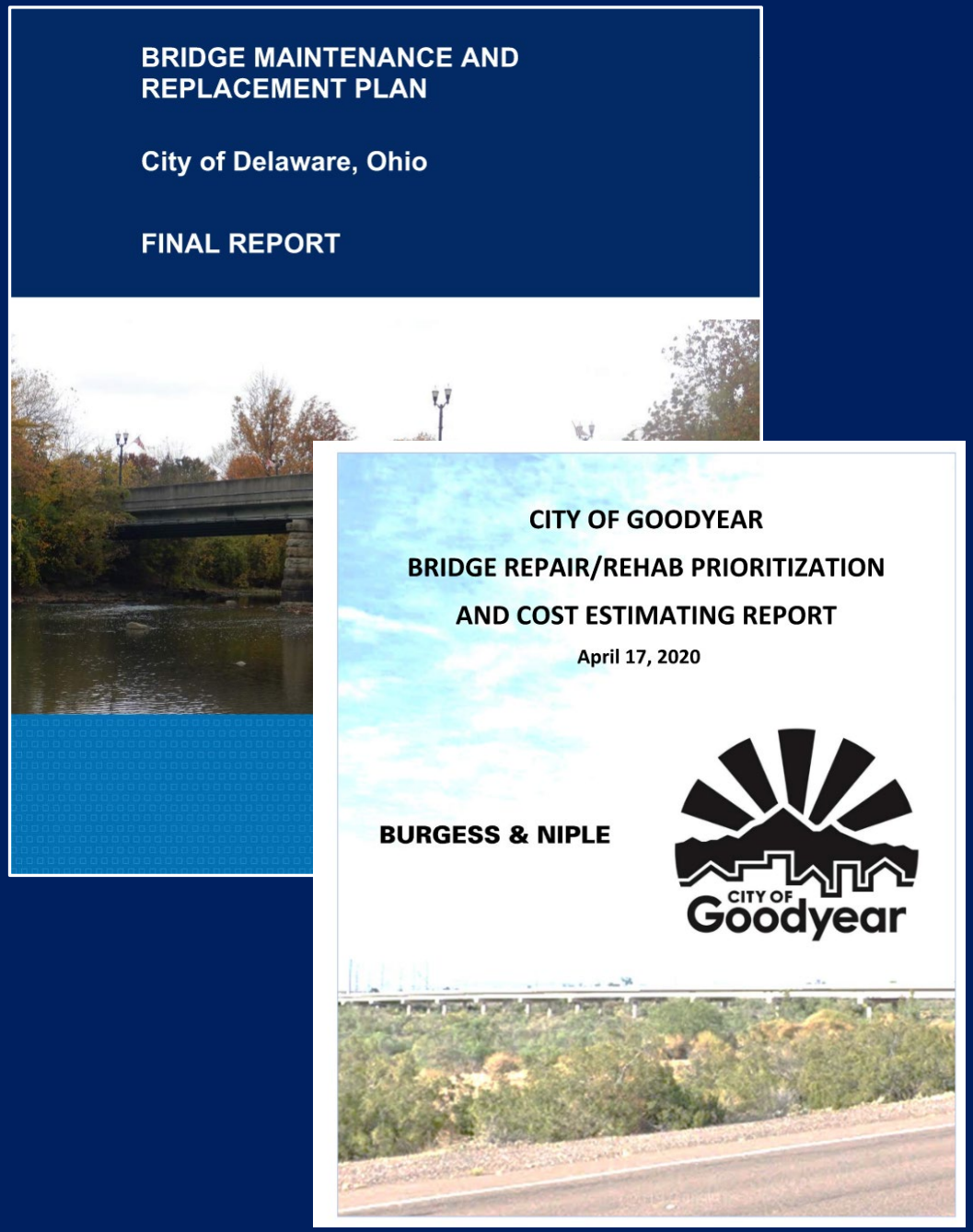
Phase 1 – Data collection and Review

Phase 2 – Field Review

Phase 3 – Maintenance / Repair Plan

Phase 4 – Life Cycle Costs

Phase 5 – Deliverables
(Plan Document / Data Updates / Website)

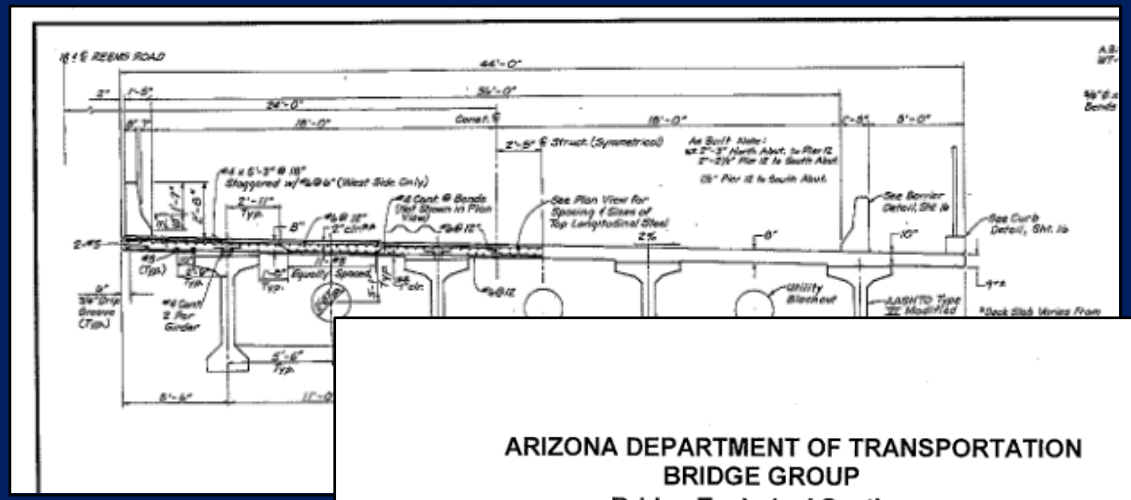


Phase 1 – Data Collection and Review

Data Sources:

- *Existing plans*
- *As-built drawings*
- *City GIS info*
- *Existing Photos*
- *Inspection reports*
- *Load ratings*
- *Scour assessments*

Others…



ARIZONA DEPARTMENT OF TRANSPORTATION
BRIDGE GROUP
Bridge Technical Section

Bridge Load Rating Summary Report

Registered Professional Engineer (Civil) CERTIFICATE NO. 44802 ABUL M. HYE Date Signed 09/28/2013 ARIZONA, U.S.A.

Expires on 09/30/2015

I. General Information

Structure No.	7565	Structure Name:	Gila River Bridge
Route:	0	Location:	0.80
Mile Post:	0	Owner:	Gooc
District:	Phoenix	Year Built:	1987
County:	Maricopa	Year of Reconst.:	NA

Rated By: Mokarrom Hye, P.E.

Date Printed : 08/21/2019

ARIZONA DEPARTMENT OF TRANSPORTATION

BRIDGE GROUP

Structure Inventory and Appraisal

Structure Number : 07565 Structure Name : Gila River Bridge Feature Under : Gila River

Route : 0 MP : 0 Road Name : Estrella Parkway Agency: Goodyear Location : 0.8 mi S of Broadway

LOCATION INFORMATION	
N1-State Code :	049
N2-State Hwy District :	Central
N3-County Code :	013
N4-Place Code :	28380
N16-Latitude:	33 Deg 23 Min 18.24 Sec
N17-Longitude :	112 Deg 23 Min 32.64 Sec
N98-Border St Code - % Resp:	
N99-Border Bridge Number:	

DIMENSIONS	
N32:Appr Rdwy Width (feet):	36
N48-Max Span Length (feet):	121
N49-Structure Length (feet):	2175
N50a-Lt Curb/Swlk Width (feet):	0.0
N50b-Rt Curb/Swlk Width (feet):	4.0
N51-Br Width Curb-Curb (feet):	36.0
N52-Deck Width Out-Out (feet):	44.0
N112-NBIS Br Length?	Y

PROPOSED IMPROVEMENTS	
N75-Type of Work:	
N76-Length of Str Imp (feet):	0
N94-Br Improv Cost (x1000):	$0
N95-Rdwy Improv Cost (x1000):	$0
N96-Total Project Cost (x1000):	$0
N97-Year of Cost Estimate:	

INVENTORY ROUTE DATA		
N19-Detour Length (miles):	4	
N20-Toll:	3	
ROADWAY RECORD	ON	UNDER
N5-Inv Rte:	1 5 0 00000 0	-
N28-Lanes:	2	0

VERTICAL & HORIZONTAL CLEARANCE		
N53-Min Vert Over Clr (feet):		99.99
N54-Min Vert Under Clr (feet):	N	0.00
N55-Min Lat Under Clr Rt (feet):	N	0.0
N56-Min Lat Under Clr Lt (feet):		0.0

CONSTRUCTION PROJECT DATA	
N27-Year Built:	1988
N106-Year of Reconstruction:	
A204-Orig Project Number:	4721-06
A205-Orig Project Station:	9+97.25
A223-TRACS Number:	
A225-Deck Area (sq. feet):	95700

SERVICE, TYPE and SPAN INFORMATION

INSPECTION

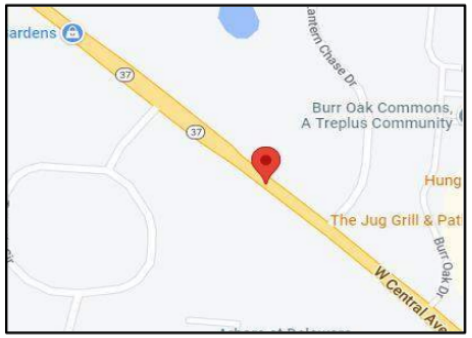
Phase 2 – Field Review

- 2-person team
- Verify information obtained in data collection phase (condition ratings / repair recommendations)
- Fill gaps in collected data
- Collect repair quantity data to support cost estimating

Phase 3 – Maintenance / Repair Plan

- Record created for each structure
- Includes collected data for each bridge (structure type, age, dimensions, condition factors, etc.)
- Recommendations for maintenance and repairs includes dates, frequency, and associated costs

CITY OF DELAWARE, OHIO BRIDGE MAINTENANCE AND REPLACEMENT PLAN
SFN: 2101505 Sr 37 over Delaware Run



Structure Number: 210150
Facility Carried: Sr 37
Feature Intersected: Delaw
Location: 0.08M

Date Built: 7/1/19
Major Reconstruction Date: N/A
Total Spans: 1
Overall Length: 30 Ft
Superstructure: Concre
Rear Abutment: Concre
Forward Abutment: Concre
Piers: N/A

Wearing Surface: Bitumi
Thickness: 5.4 in
Date of Wearing Surface: 9/17/2

STRUCTURE ASSESSMENT

Current Age: **68 years (Built in 1955)**
Estimated Remaining Life: **5 years**
End of Structure Life (Estimated Year*): **2028**
**Current Age + Estimated Remaining Life from 2022 Field Visit Assessment*

Immediate Action Required?: **NO**
Total City Responsible Repair/Maintenance Costs: **$0**
Recommended Inspection Frequency: **24 months**

The structure is in good condition. The City should power wash the bridge once a year (preferably in the spring after the last deicing), and continue to monitor the structure for spalls in the structural concrete and the condition of the railing.

Annual (Minor) Maintenance Costs

Work Performed	Estimated Cost	
Bridge Washing/Deck Sweeping	$500	*includes cleaning debris from deck*

Supporting Calculations

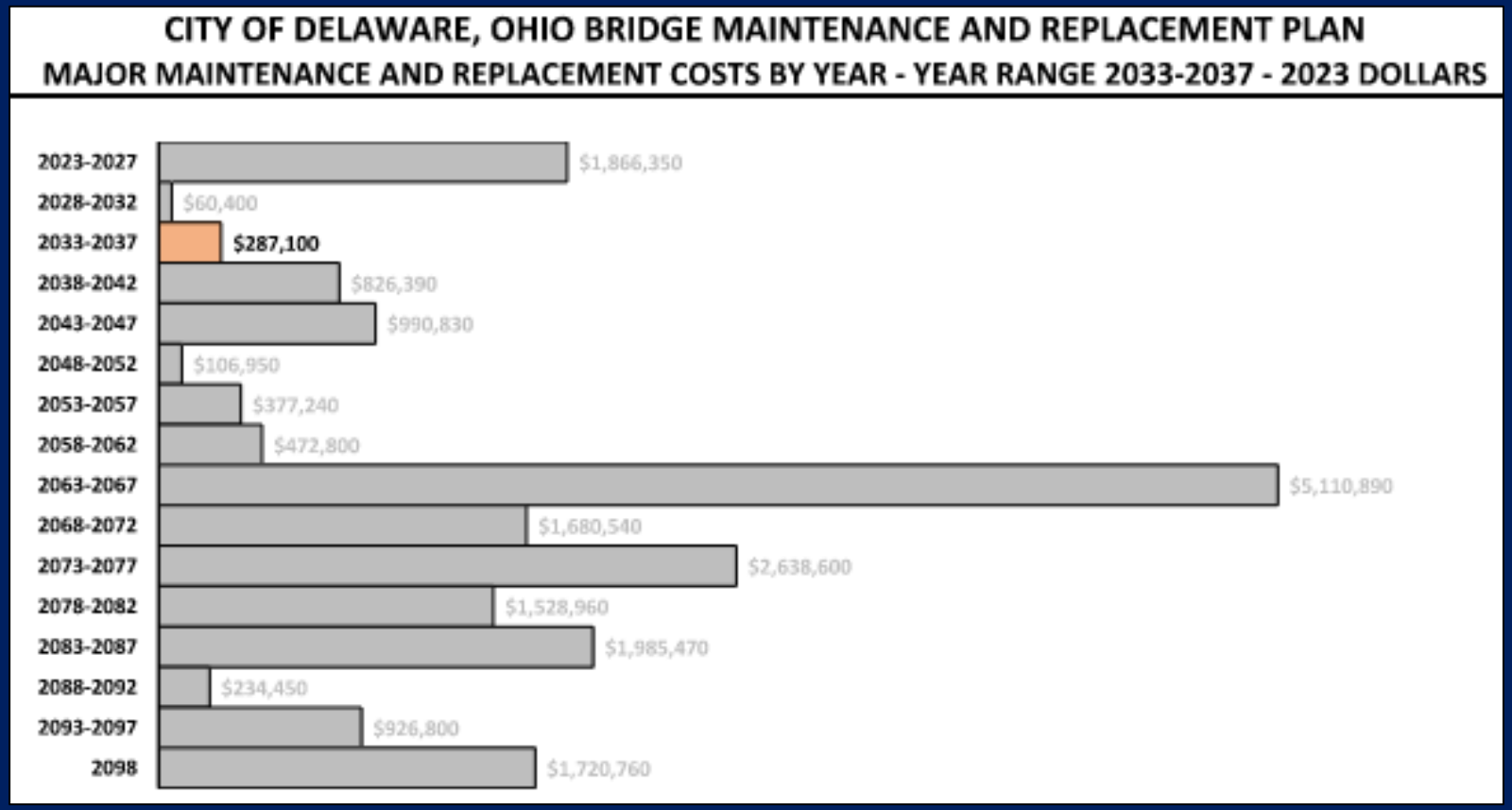
Site Visit Note: *Seal cracks in wearing surface and approach. Cracks have previously been sealed and newer cracks need sealing.*
Assume this is done with general roadway work.

Site Visit Note: *Pipe conduit on north edge has breaks/corrosion and needs replaced. Wire conduit on north edge is not encased. Rubber shedding is starting to fray exposing wires inside.*
Assume $500

Site Visit Note: *Fascia curb is cracked along N face 15' at bottom line of railing bolts. Interface between slab and fascia curb is spalling on the slab side with exposed rebar. Similar but less severe on south edge. 5' crack along south fascia.*
Major Maintenance - Responsibility of ODOT

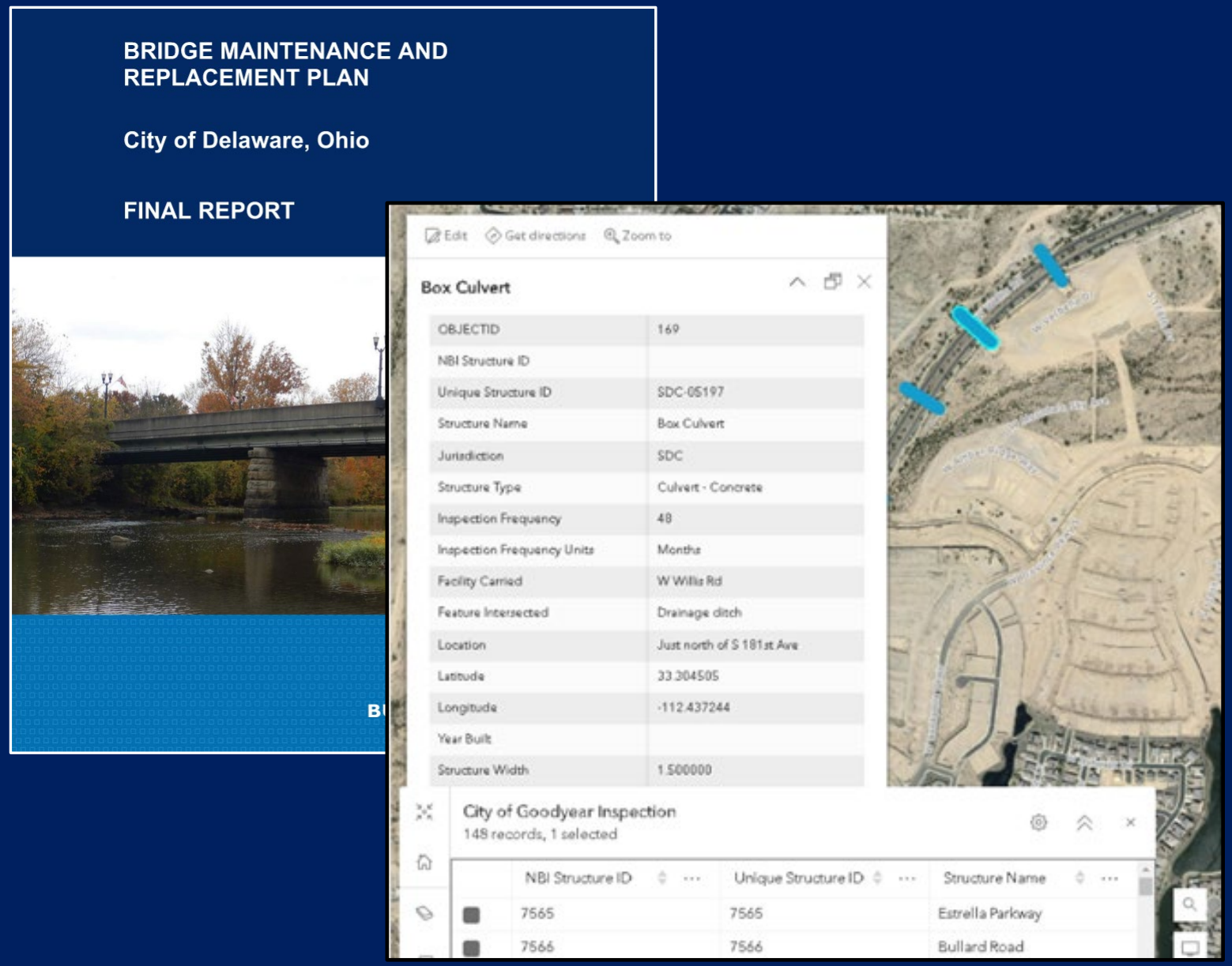
Phase 4 – Life Cycle Costs

- 75-year projection
- Includes maintenance, rehabilitation, and replacement costs
- Projects anticipated yearly expenditures



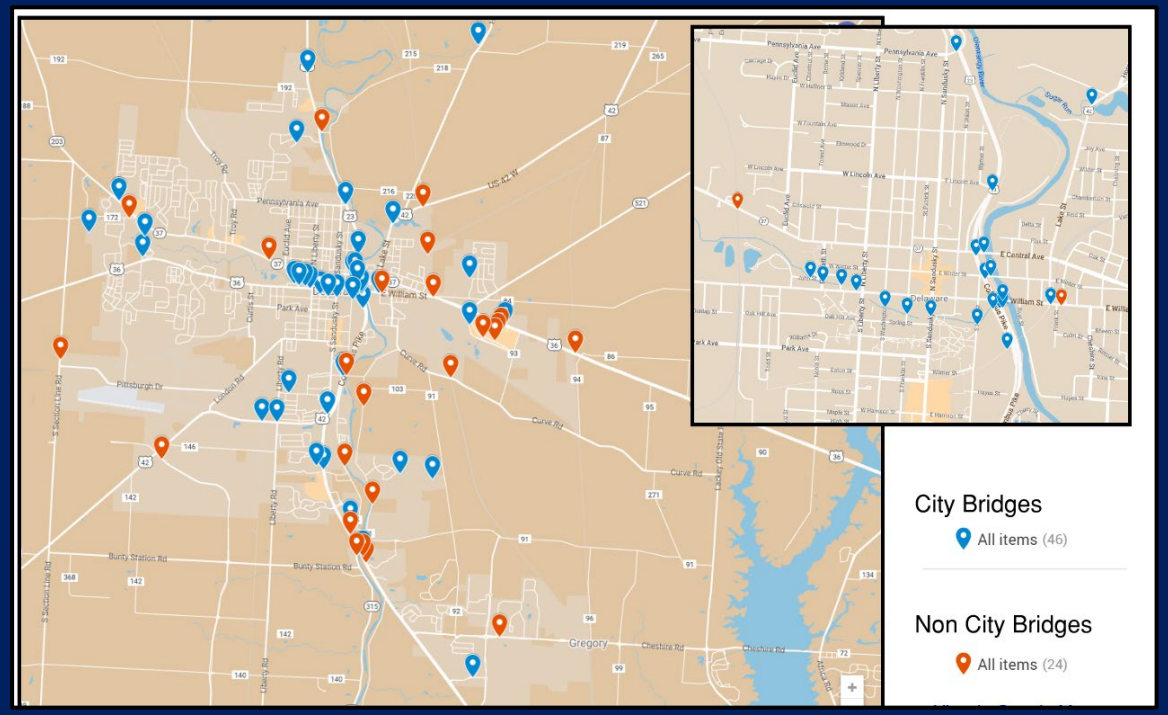
Phase 5 – Deliverables

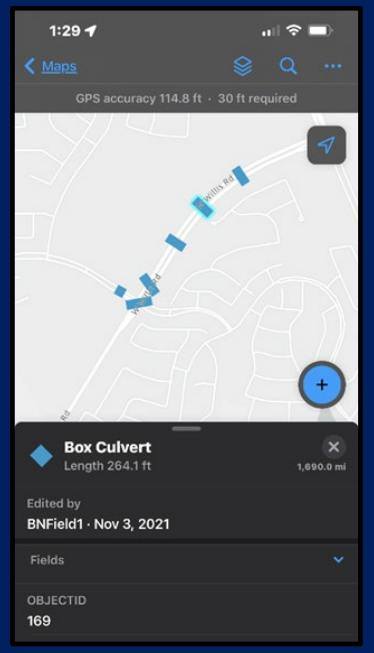
- Provided Delaware with a written report along with electronic data
- Delaware will add data to online management system
- Integrated data into Goodyear's Lucity Asset Management System
- Incorporated into ArcGIS Online and Field Maps Application

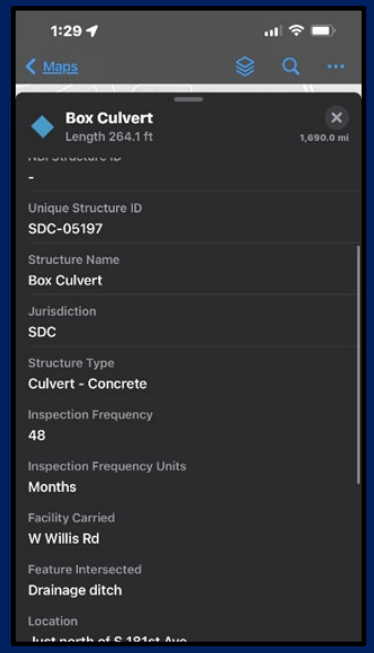


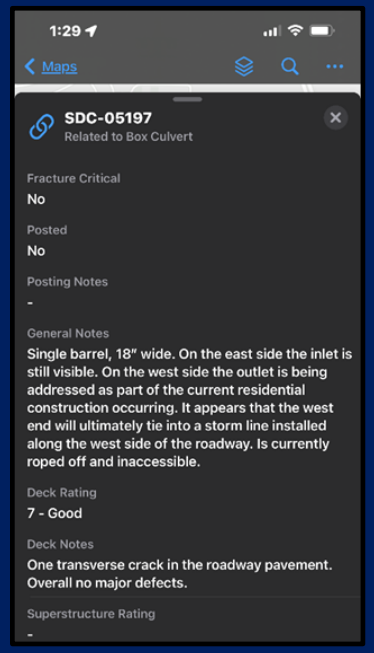
Data Application

- Assembled data provides the cities with a tool to help schedule maintenance, prioritize repairs, and plan for future capital expenditures
- Electronic systems allow for condition updates and the addition of new structures







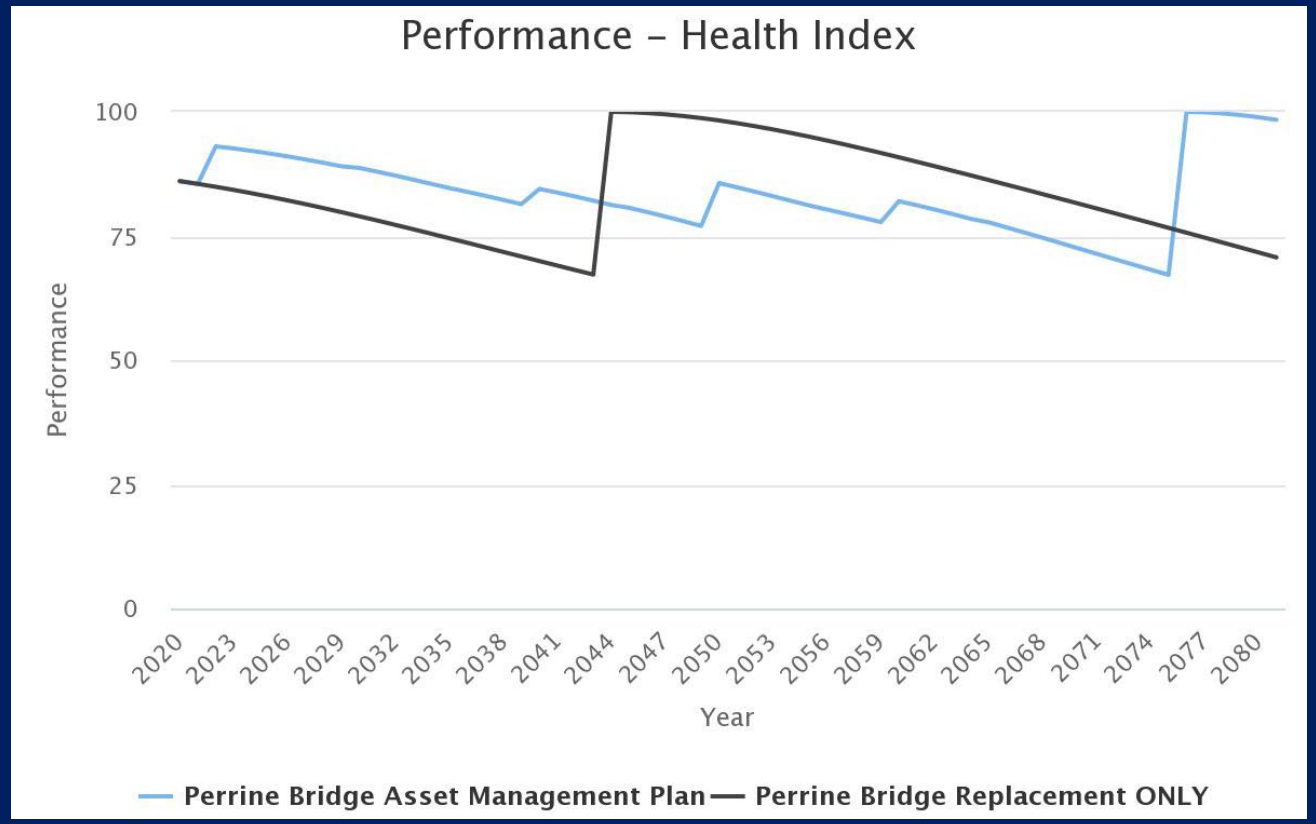


I. B. Perrine Bridge

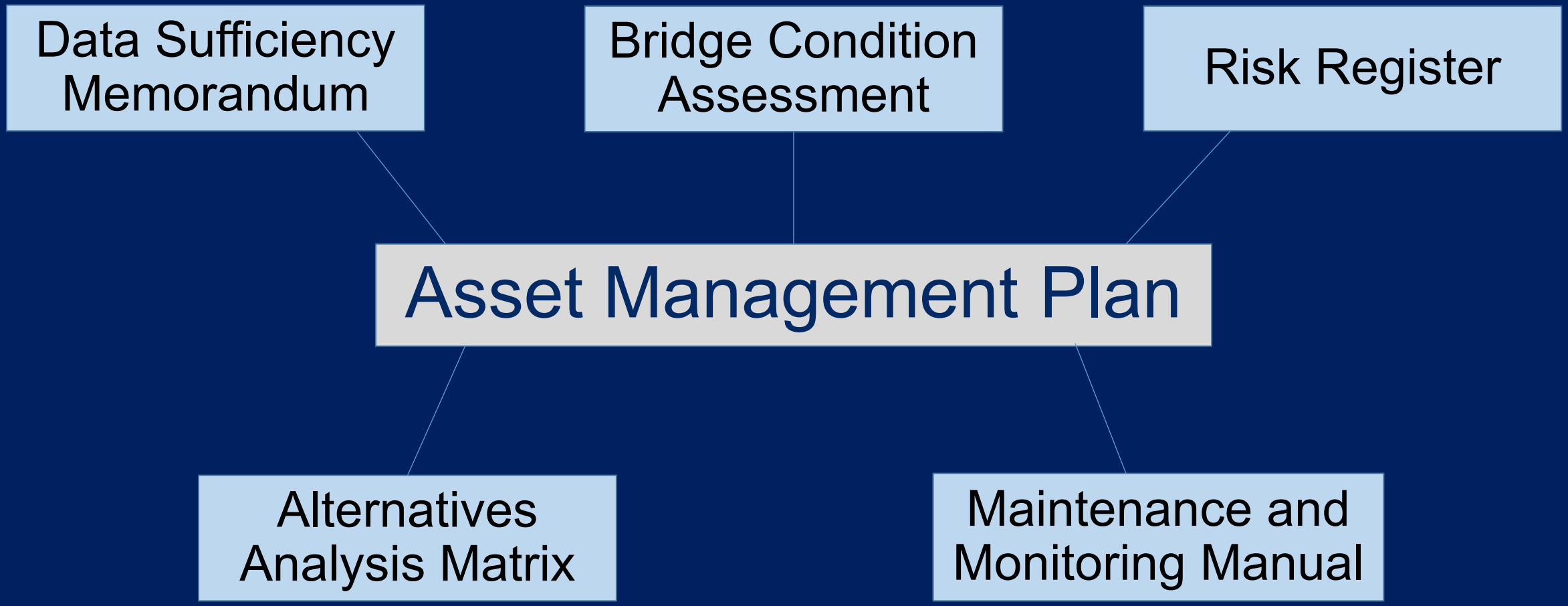
- Twin Falls, ID
- Snake River Canyon
- Opened 1976
- 1500 ft long
- 993 ft main span
- 486 ft high

ITD Bridge Asset Management Plans

- ITD developed eight individual Bridge Asset Management Plans for high-cost replacement bridges
- AMPs are used to analyze future funding scenarios and tradeoffs to ultimately pay for replacing these structures
- Data from AMP is used to perform life cycle cost analysis in BrM
- BrM accounts for the effect of rehabilitation project on condition of bridge components



Element	Str. Unit	Env.	Quantity	Units	Starting Conditions	Effect
(12) Re Concrete Deck	0	Sev.(4)	117750	sq.ft		
(107) Steel Opn Girder/Beam	0	Low(2)	2014	ft		
(113) Steel Stringer	0	Low(2)	8397	ft		


Data Sufficiency Memorandum
Bridge Condition Assessment
Risk Register
Asset Management Plan
Alternatives Analysis Matrix
Maintenance and Monitoring Manual

Data Sufficiency Memorandum

- Compile & review existing documents:

  Plans, shop drawings, load ratings, inspection reports

- Tabulate key information

Date	Event
1972	**Original Design Plans Submitted**
1976	**I.B. Perrine Bridge opened to traffic**
1994	**Rehabilitation** -Abutment Expansion Joint Repair -Deck Modifications -Parapet Modifications -Replace Finger Joints with Modular Expansion Joints -Fill Top Quadrants of Skewback Castings with Elastomeric Concrete -Install Pest Screens and Access Hatches -Drill Out Cracks in Girders -Median Light Supports
2008	**Rehabilitation** -Replace Modular Joint Control Springs -Replace Modular Joint Nylon Dowels -Replacing Missing or Loose Bolts. -Install Utility Conduits

ASTM A514 STEEL ELEMENTS				
File	Page	Welded	Description	Note
001 (JPG)_1973ShopDwgs1-112	14/112	Yes	L10-L12	L10'-L12' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	14/112		L11 Splice Plates	L11' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	14/112	Yes	L12 Gusset Plate	L12' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	14/112	Yes	L12 Gusset Plate Edge Stiffeners (welded to gusset plate)	L12' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	16/112	Yes	L12-L14	L12'-L14' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	16/112		L13 Splice Plates	L13' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	16/112		L13 Lower Lateral Gusset Plate	L13' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	16/112	Yes	L14 Gusset Plate	L14' assumed to be similar
001 (JPG)_1973ShopDwgs1-112	16/112	Yes	L14 Gusset Plate Edge Stiffeners (welded to gusset plate)	L14' assumed to be similar

Bridge Condition Assessment

- Selective visual inspection
- Chloride concentration sampling (deck and abutments)

Location	Depth	Low Contamination	Moderate Contamination	Advanced Contamination	Avg. Concentration (lb/cy)
Deck	1"	88%	13%	0%	0.60
	2.5"	100%	0%	0%	0.14
North Abutment	1"	67%	0%	33%	1.27
	2.5"	67%	33%	0%	0.58
South Abutment	1"	67%	0%	33%	0.93
	2.5"	100%	0%	0%	0.04

Risk Register

- Workshop with Key Stakeholders
- Identify risks and opportunities
- Quantify likelihood of occurrence
- Identify mitigation options, estimate cost

Risk ID	Risk Name	Risk Descriptions
Risk 1	**Gusset Plate Edge Stiffener Welds (A514)** Probability: 200 years (0.5%); Consequence Score: 16; Risk Ranking: 29/30; Risk Type: Asset	Several elements on the bridge are comprised of A514 Steel. Included in this are many of the gus Steel elements can be prone to cracking when welded and in tension. Bridge inspections identified attached the gusset plate edge stiffeners – photographs were shown during the risk workshop. Cra repairs. The workshop survey of potential financial impacts achieved consensus on low financial i 11% estimated very low impacts) – roughly $1M expected to arrest cracks and retrofit welded edg
Risk 2	**Significant Isolated Fatigue Cracks in Steel** Probability: Every 20 years; Consequence Score: 7.5; Risk Ranking: 20/30; Risk Type: Asset	Increases in loading cycles (volume and number of trucks) and environmental corrosion leads to l be very low, partial closures would be necessary for repair, and financial consequences are estima

Alternatives Analysis Matrix

- Identify alternatives for maintenance and rehabilitation actions
- Determine future cost outlays for each alternative
- Present alternatives in a Decision Matrix
- Develop bridge replacement alternative

Bridge Element Known deficiency	**Recommended Rehabilitation**	**Cost Estimate (2020 Dollars)**
Deck: Joints Sliding plates at sidewalk joints require repair/replacement.	Repair Sidewalk Joints, Future Repair and Replacement of Modular Joints at ends of Arch Span, Future Replacement of Compression Seal Joints at Abutments.	$804,000
Deck: Wearing Surface	Future Polyester Overlays and Friction Treatments	$4,876,000
Deck: Sidewalks, Parapets and Barrier	Seal Sidewalks, Parapets and Barriers, Future Replacement of Pedestrian Railing	$1,432,000

Alternatives Analysis Matrix

Partial Decision Matrix:

Rehabilitation Actions													Service Life 2020 – 2075
	ITEM	YEAR											TOTAL COST ESTIMATE
		2022	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070	2075	
DECK ALTERNATIVE 1 (MAINTAIN EXISTING DECK)	Repair Sidewalk Joints	$18,000					$18,000							$36,000
	Repair Modular Joints			$160,000						$160,000				$320,000
	Replace Modular Joints						$400,000							$400,000
	Replace Abutments Joints			$16,000			$16,000			$16,000				$48,000
	Apply Polyester Overlay				$2,156,000					$2,156,000				$4,312,000
	Friction Treatment		$188,000				$188,000					$188,000		$564,000
	Seal Sidewalks, Parapets and Barrier (Silane)				$81,000				$81,000					$162,000
	Seal Sidewalk Cracks (HMWM)		$37,000	$37,000	$37,000	$37,000	$37,000	$37,000	$37,000	$37,000	$37,000	$37,000		$370,000
	Remove and Replace Pedestrian Railings			$900,000										$900,000
	Repair Soffit Spalls	$15,000				$15,000				$15,000				$45,000
	Deck Alternative 1 Total:	**$33,000**	**$225,000**	**$1,113,000**	**$2,274,000**	**$52,000**	**$659,000**	**$37,000**	**$118,000**	**$2,384,000**	**$37,000**	**$225,000**	**$0**	**$7,157,000**
DECK ALTERNATIVE 2 (DECK REPLACEMENT)	Repair Sidewalk Joints	$18,000												$18,000
	Repair Modular Joints			$160,000						$160,000				$320,000
	Replace Abutment Joints									$16,000				$16,000
	Apply Epoxy Overlay									$281,000				$281,000
	Friction Treatment		$188,000					$188,000				$188,000		$564,000
	Seal Sidewalks, Parapets and Barrier (Silane)									$81,000				$81,000
	Remove and Replace Deck, Sidewalks, Joints, Parapets, Barrier, and Pedestrian Railings					$11,863,000								$11,863,000
	Deck Alternative 2 Total:	**$18,000**	**$188,000**	**$160,000**	**$0**	**$11,863,000**	**$0**	**$188,000**	**$0**	**$538,000**	**$0**	**$188,000**	**$0**	**$13,143,000**

Maintenance and Monitoring Manual

- Identify critical areas for inspection and monitoring
- Recommended schedules for inspection and maintenance
- Report includes a Maintenance Log to note changing conditions and repairs

Access: From an Underbridge Inspection Vehicle

Monitor

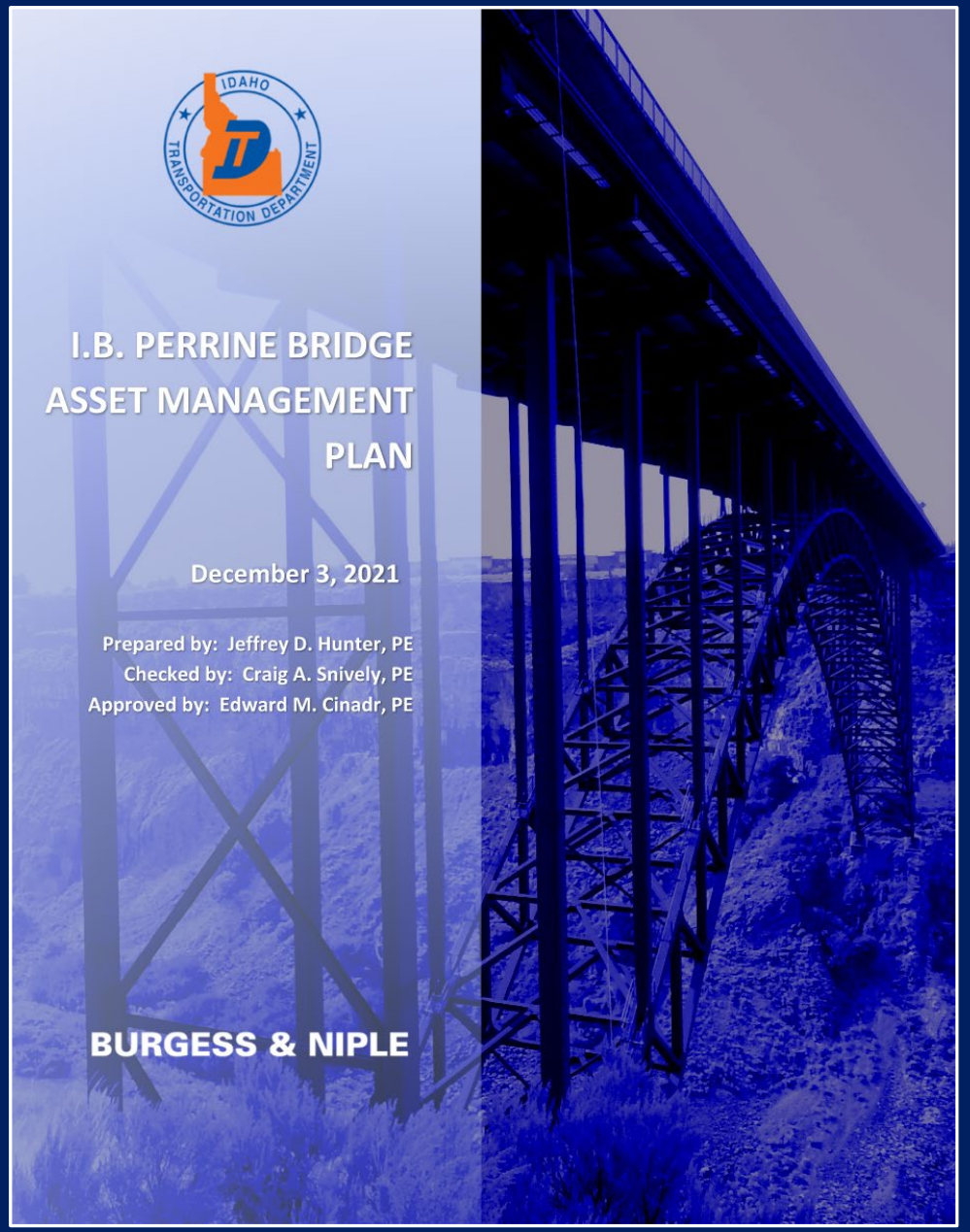
Stay-In-Place Forms: Inspect and monitor the metal stay-in-place forms for corrosion and other signs of leaking. This is indicative of water infiltration through the deck slab and/or access hole penetrations which accelerates deterioration of the deck, forms and superstructure components below.

Corrosion on SIP Forms

	Deck slab	12	Bi-annual, as part of NBI inspection	From underbridge inspection vehicle	Inspect metal stay-in-place deck forms for corrosion and leaking
	General Notes				
	Required Additional Repairs				

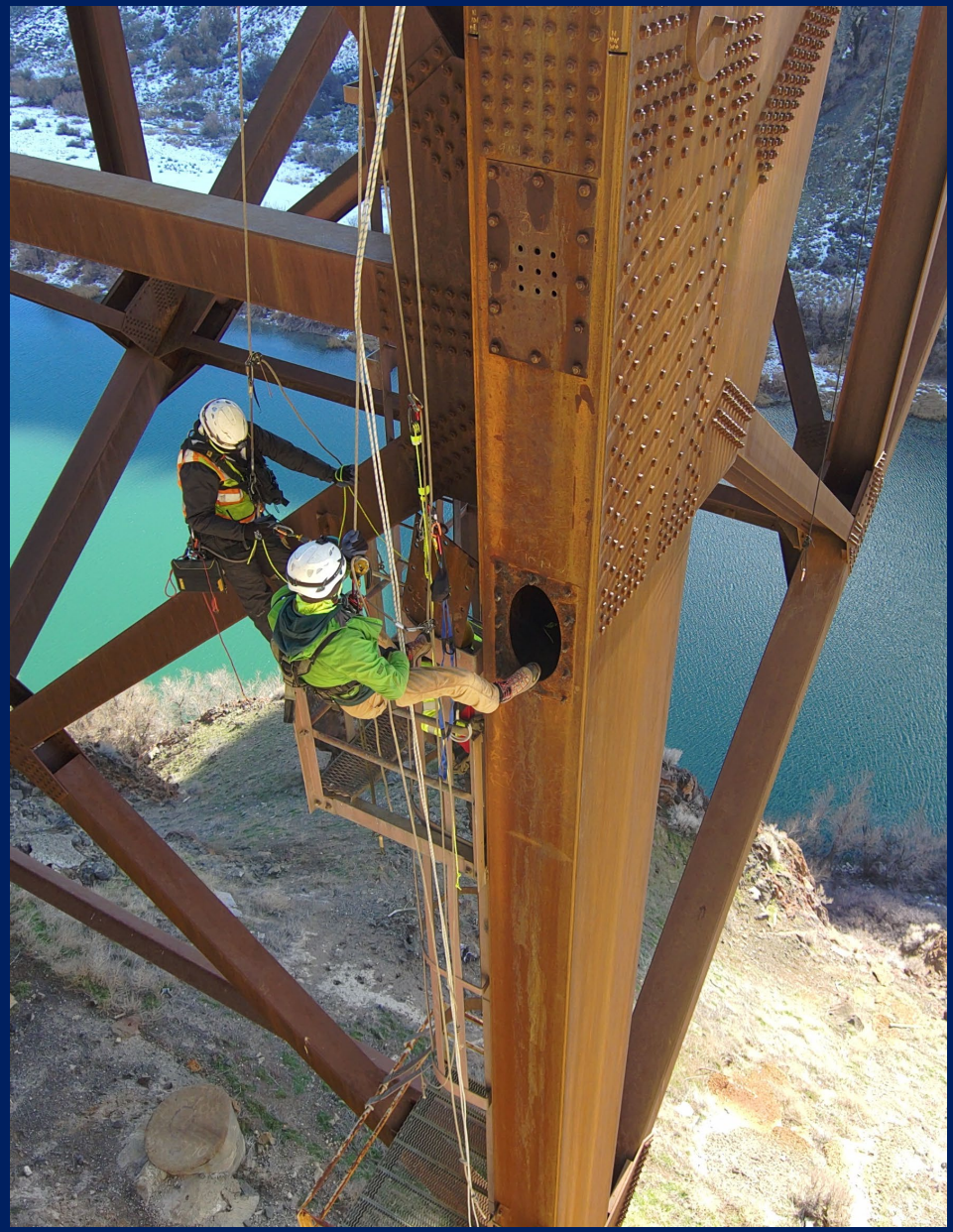
Asset Management Plan

- Provides an executive summary of the content of the component reports
- Rehabilitation, maintenance, and replacement recommendations
- The five component reports are included as appendices

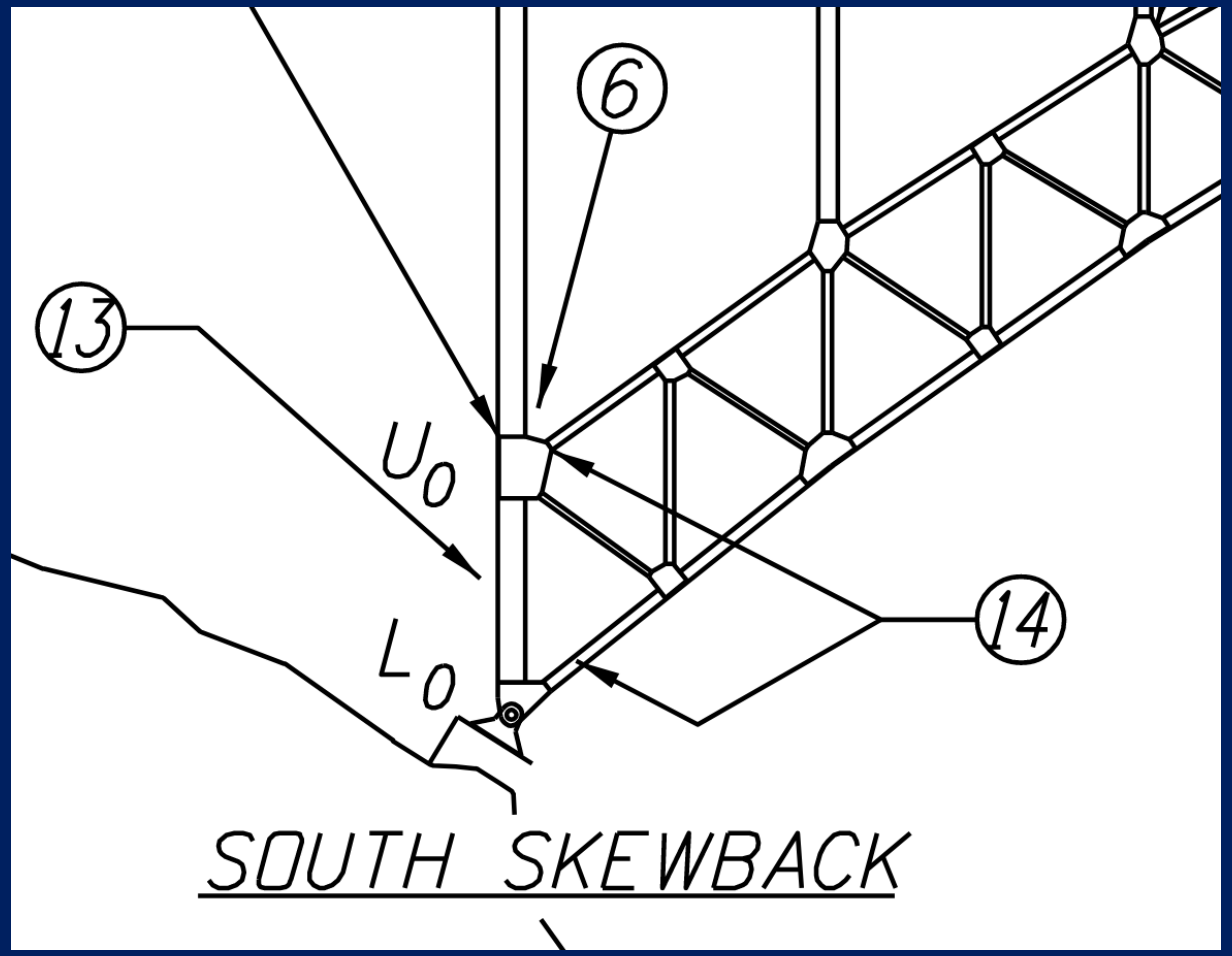


Repair Project

- Repairs to arch end posts
- Painting of corrosion-prone areas
- Inspection access system repairs
- Patching of concrete substructures
- Utility conduit repairs
- Sidewalk joint repairs
- Railing repairs



Repair Project - End Posts



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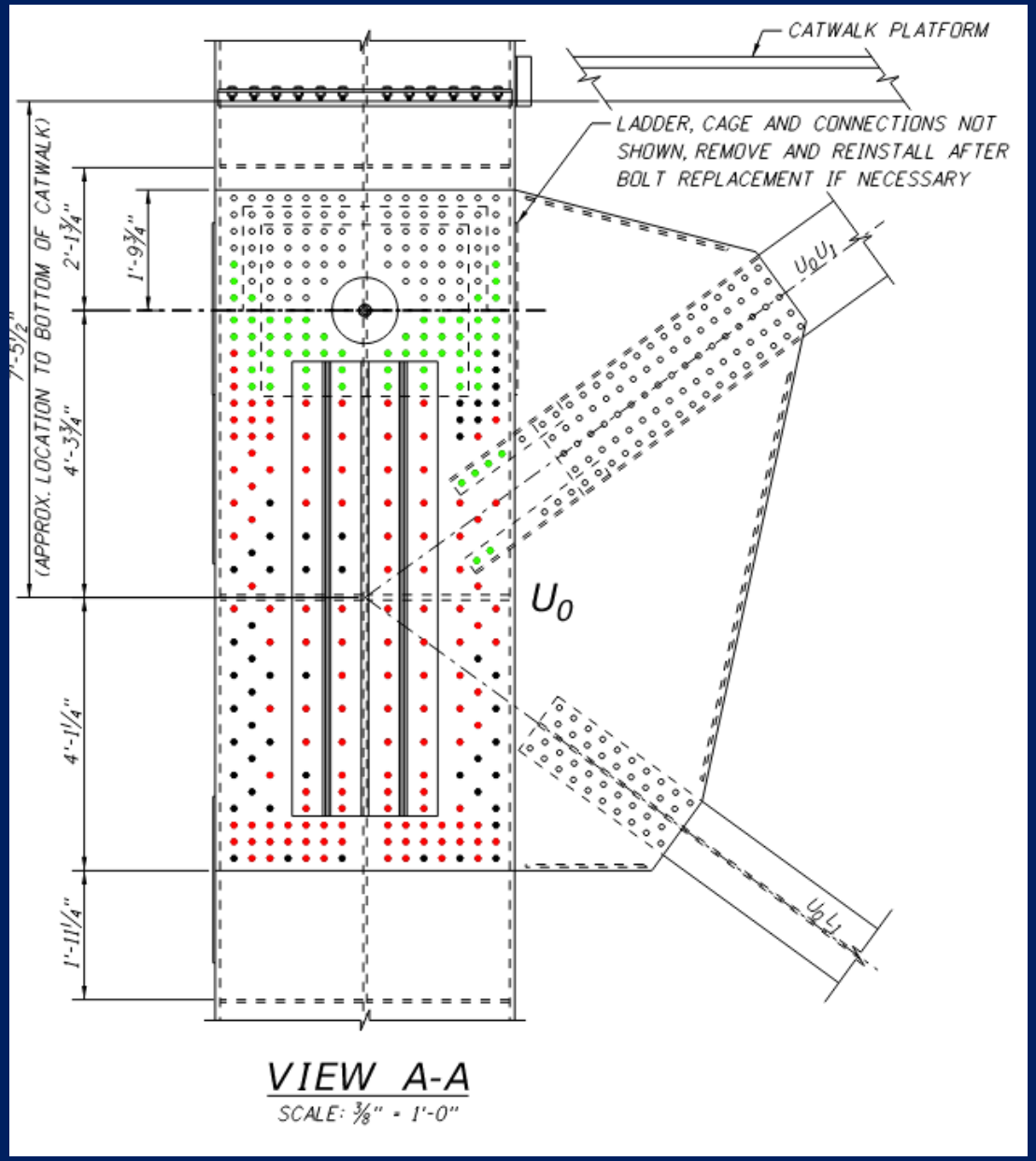
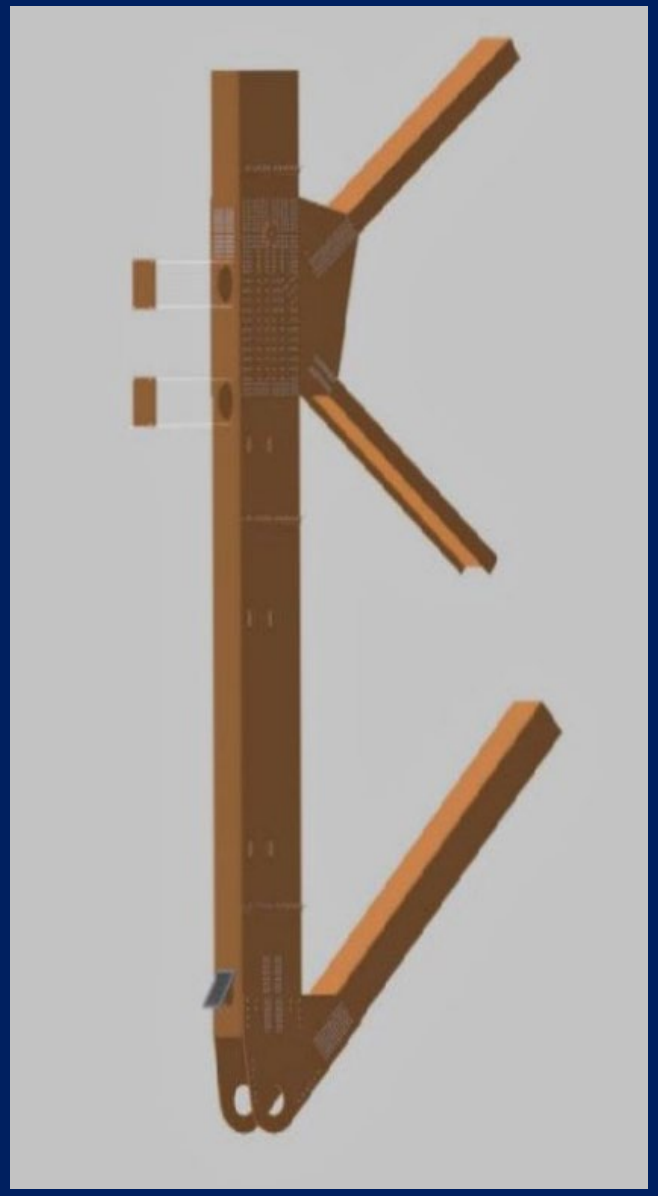


Repair Project - End Posts



CLEMCO®

Pipe Tools

INTERNAL PIPE BLASTING

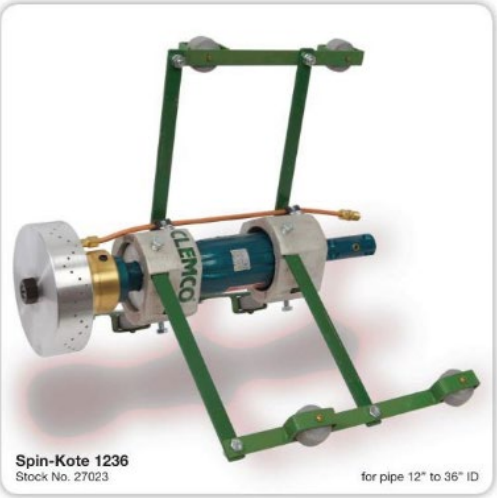
Precise, Efficient, Economical

CLEMCO® | ★★★★ MADE IN THE USA

SPIN-KOTE

INTERNAL PIPE COATING EQUIPMENT

IMPORTANT: *For safe, efficient blasting, read and follow the owner's manual and seek training for everyone who will use this equipment.*



Spin-Kote 1236
Stock No. 27023

for pipe 12" to 36" ID

For high-productions jobs, some customers use a gear motor or variable-speed drive to pull the tool through the pipe. This customer-provided mechanized alternative to manually drawing the tool from the pipe ensures a consistent paint application.

OPERATION:
Paint is applied in a 360-degree pattern by the centrifugal force of the spinning spray head. The coating material is fed to the spray head through a fluid manifold for maximum, even, distribution. The volume of coating material is adjusted by changing the pressure on the paint pump or by changing the media orifice used in the back-pressure assembly. Coating thickness is controlled by the speed at which the Spin-Kote is moved through the pipe.

APPLICATIONS:
The Spin-Kote can be used with any coating that can be applied with an airless spray system. Typically, pipes are coated internally for potable water

Thanks!

B&N
burgessniple.com

IDAHO TRANSPORTATION DEPARTMENT

CITY OF DELAWARE OHIO

CITY OF Goodyear