

Using GIS to Support Multi-year Pavement MR&R Need Analysis

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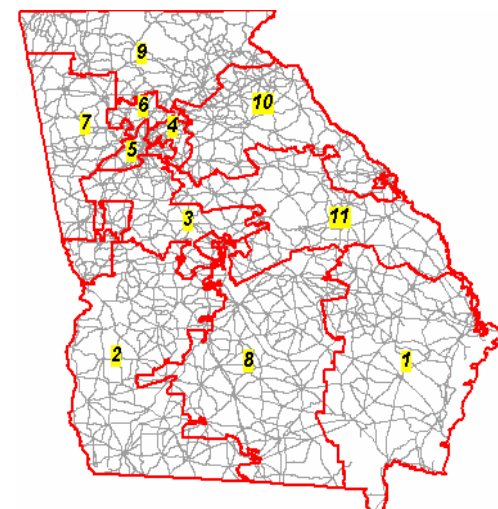
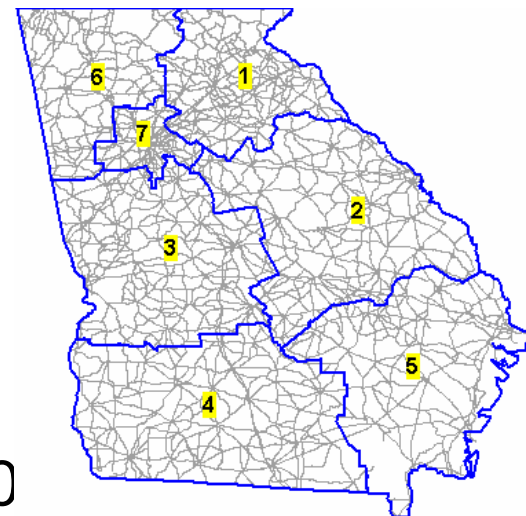
March 30, 2004

Outline

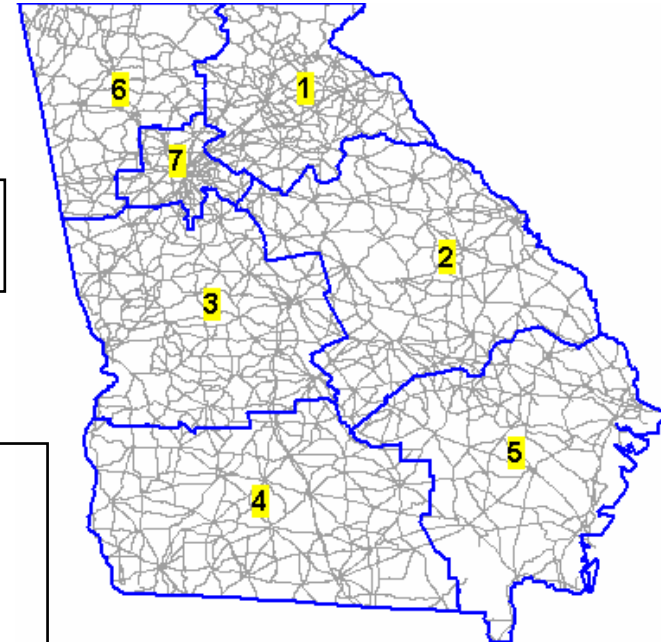
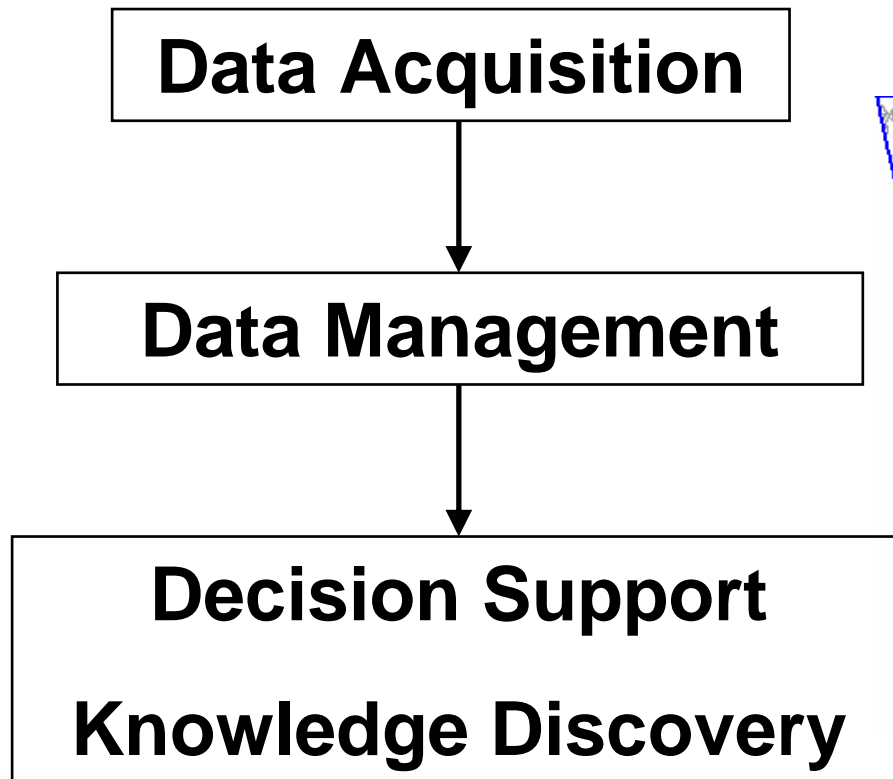
- Background
- Project objective
- Why GIS
- System component and information flow
- Analytical Functionality
- Conclusions & Future Research
- Demo

Background

- 18, 000 mile centerline highway.
- 7 working districts/13 cong. districts.
- Surveyed annually with about 60 engineers.
- 10 different types of distresses surveyed (i.g. load cracking)
- Project rating is between 0 and 100.
- Approximately 18,000 mile-segments in 2,000 projects surveyed annually.
- More than 18 years of survey data (1986 – 2003)
- Survey data used to determine suitable treatment strategies.
- Total miles of projects treated are subject to budget availability.




Pavement Management Components



Georgia Pavement Management (GPAM)

GPAM---Georgia Pavement Management System Prerelease



Georgia Pavement Management System

GPAM

Developed by
Georgia Department of Transportation

Network-level Pavement Condition Analysis is an application that queries, displays, and analyzes the COPACES data from the Oracle database. Double click this option to begin pavement condition analysis.

Field Data Collection

- COPACES
- Load Data to Central Office

Data Management and Analysis

- Network-level Pavement Condition Analysis
- Treatment Criteria and Determination
- GIS-Based Pavement Condition Analysis

Decision Support & Knowledge Discovery

- Multi-year Need Analysis

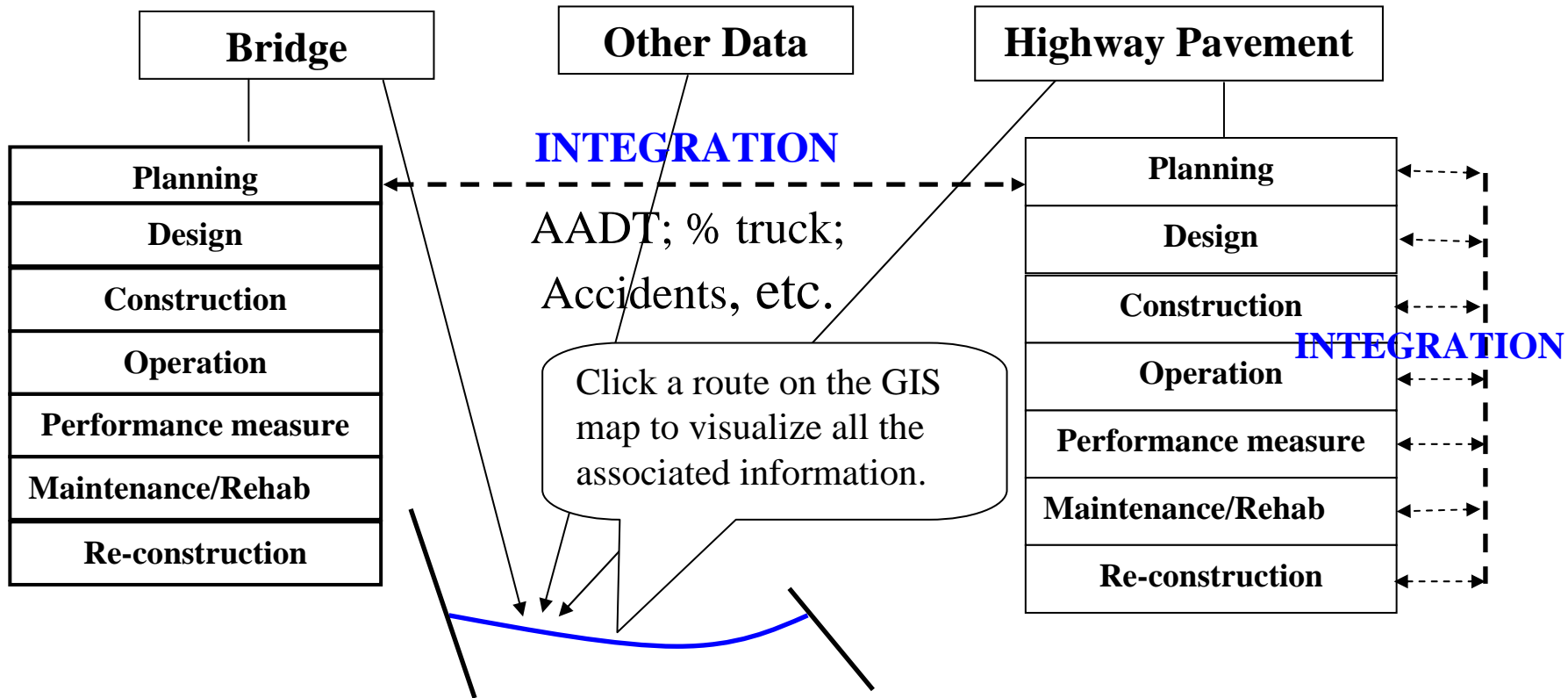
Help Exit

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Project Objective

- Conduct “**what-if**” analysis as to **when, where, what to treat**, and their impacts on future pavement performance and cost in project and network levels.
- Integration between **Need Analysis Modeling** with **GIS**.
- Data integration with other data sources such AADT, etc..
- Easy to use/communicate through GIS user interface.
- Validate and calibrate forecasted results such as project ratings, costs, etc.

GIS for Data Integration and Analysis



Common Location Reference System (LRS)

System Components

- **PROJECT LEVEL ANALYSIS MODULE**

- **Treatment Method and Cost Determination.**
- **Pavement Performance Forecasting.**
- **Life Cycle Cost Effectiveness Analysis.**

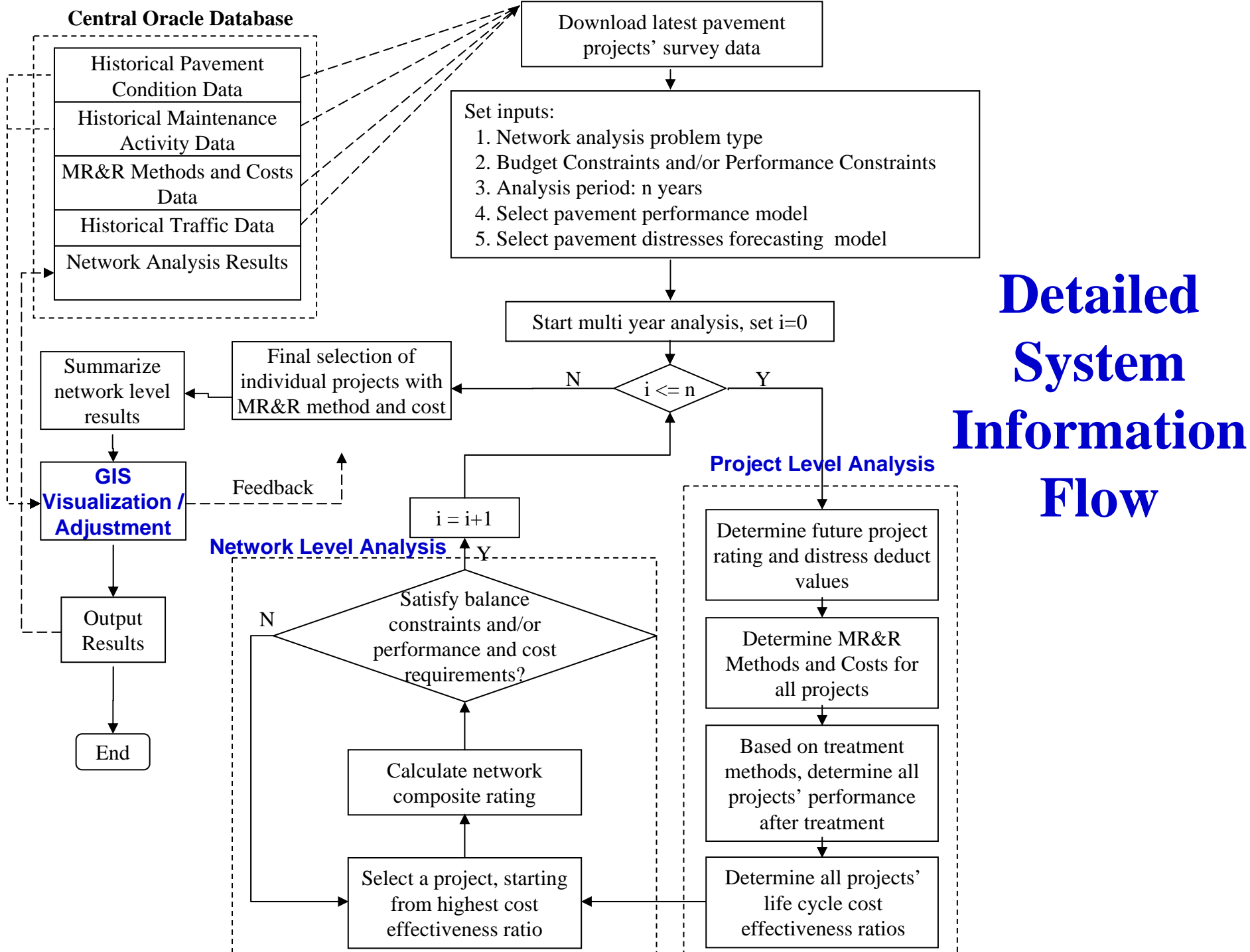
- **NETWORK LEVEL ANALYSIS MODULE**

- **Determine minimal funding needed to meet prescribed future pavement performance.**
- **Determine optimum pavement treatment plans under funding availability constraints.**
- **Determine optimum pavement treatment plans subject to both pavement performance and budget availability constraints.**

System Components (cont.)

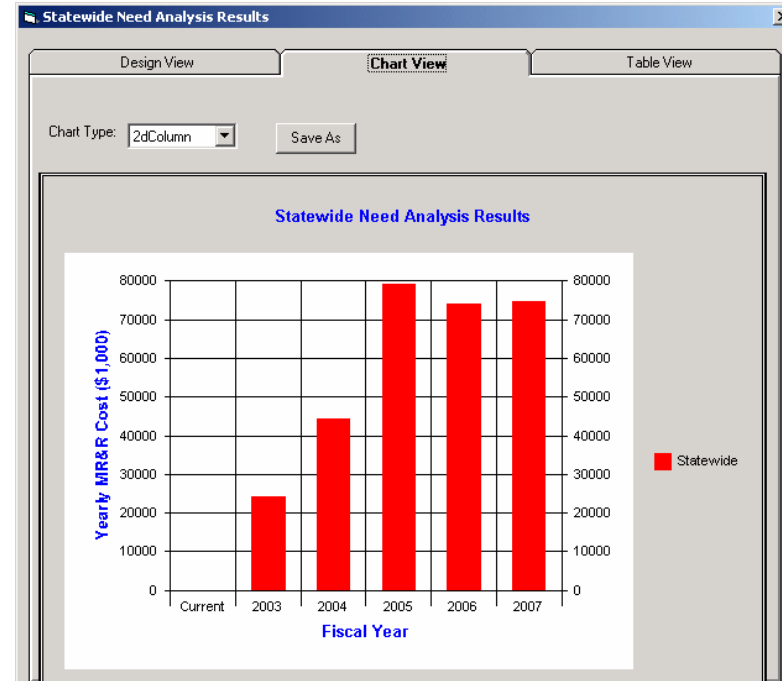
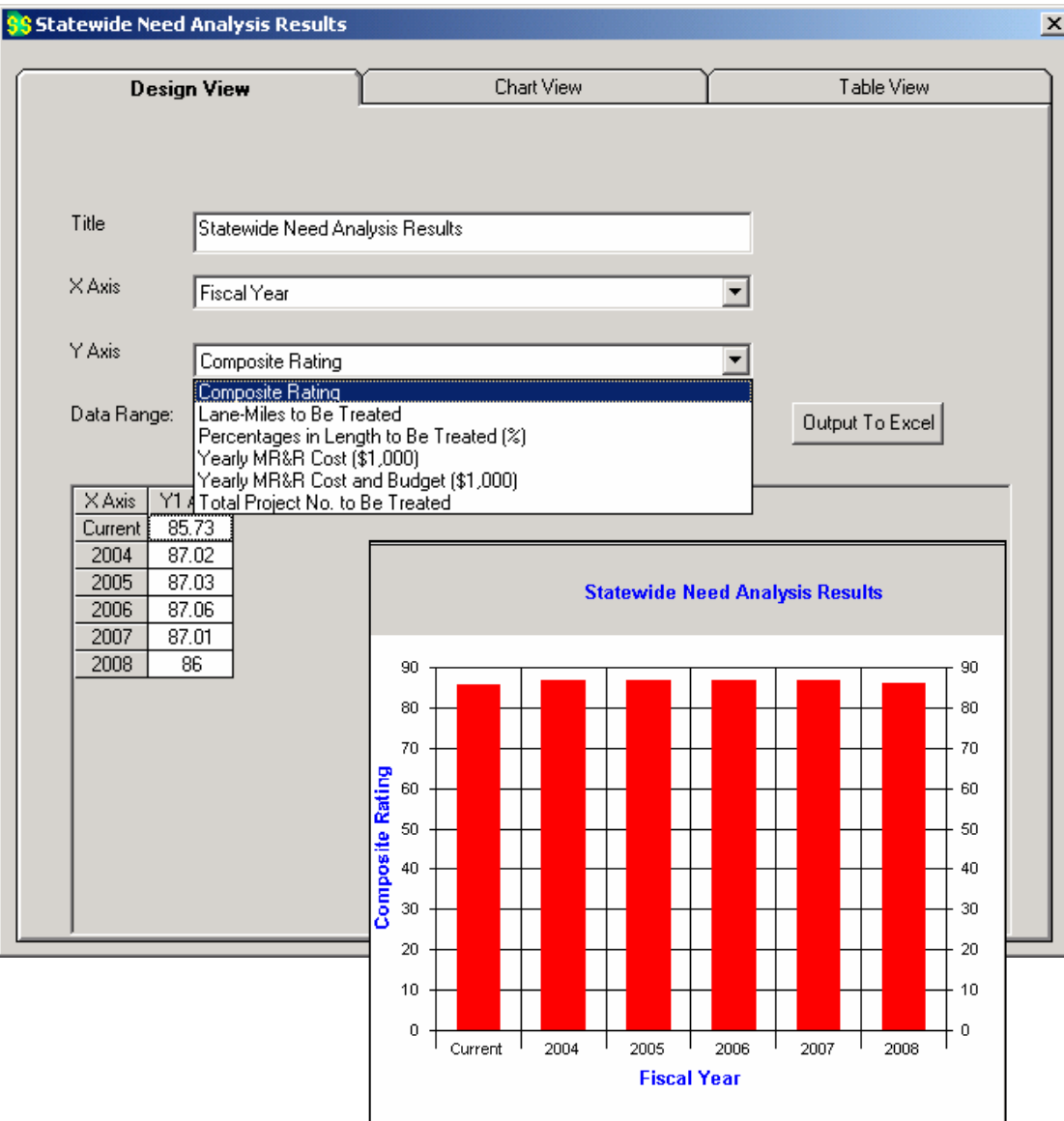
- **GIS MODULE**

- Link GIS with various data sources such as traffic, bridges etc.
- Display analytical results on the map including the projects to be treated at different years with treatment methods and costs.
- Interactively change project treatment method on the map to see its impact on performance and cost in the project and network levels.
- Display the performance on the GIS map based on different jurisdictions such as GDOT District, Congressional District, county, etc.



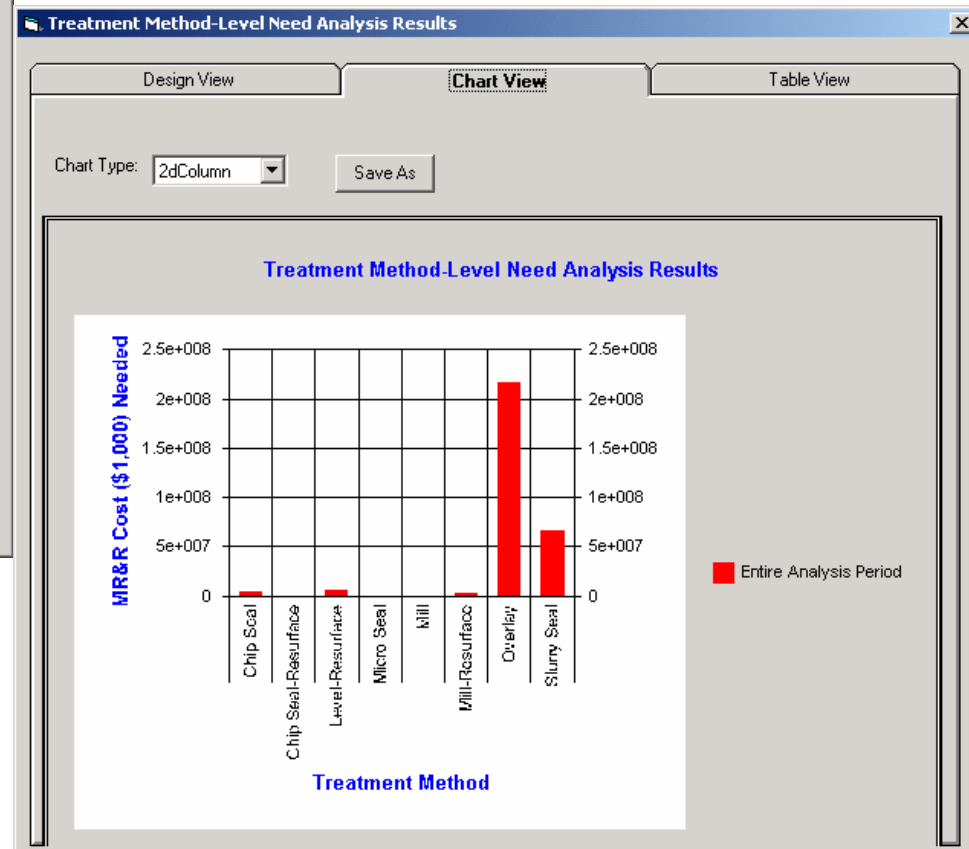
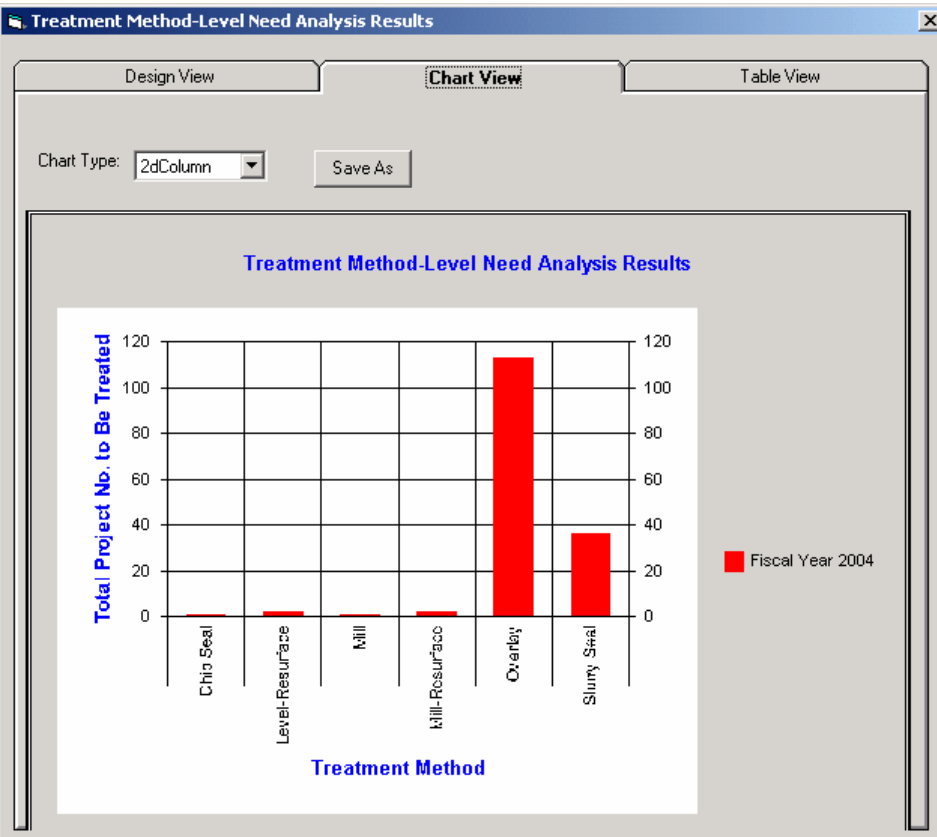
Example of Multi-year Pavement Need Analysis - Performances and Costs

Network-level

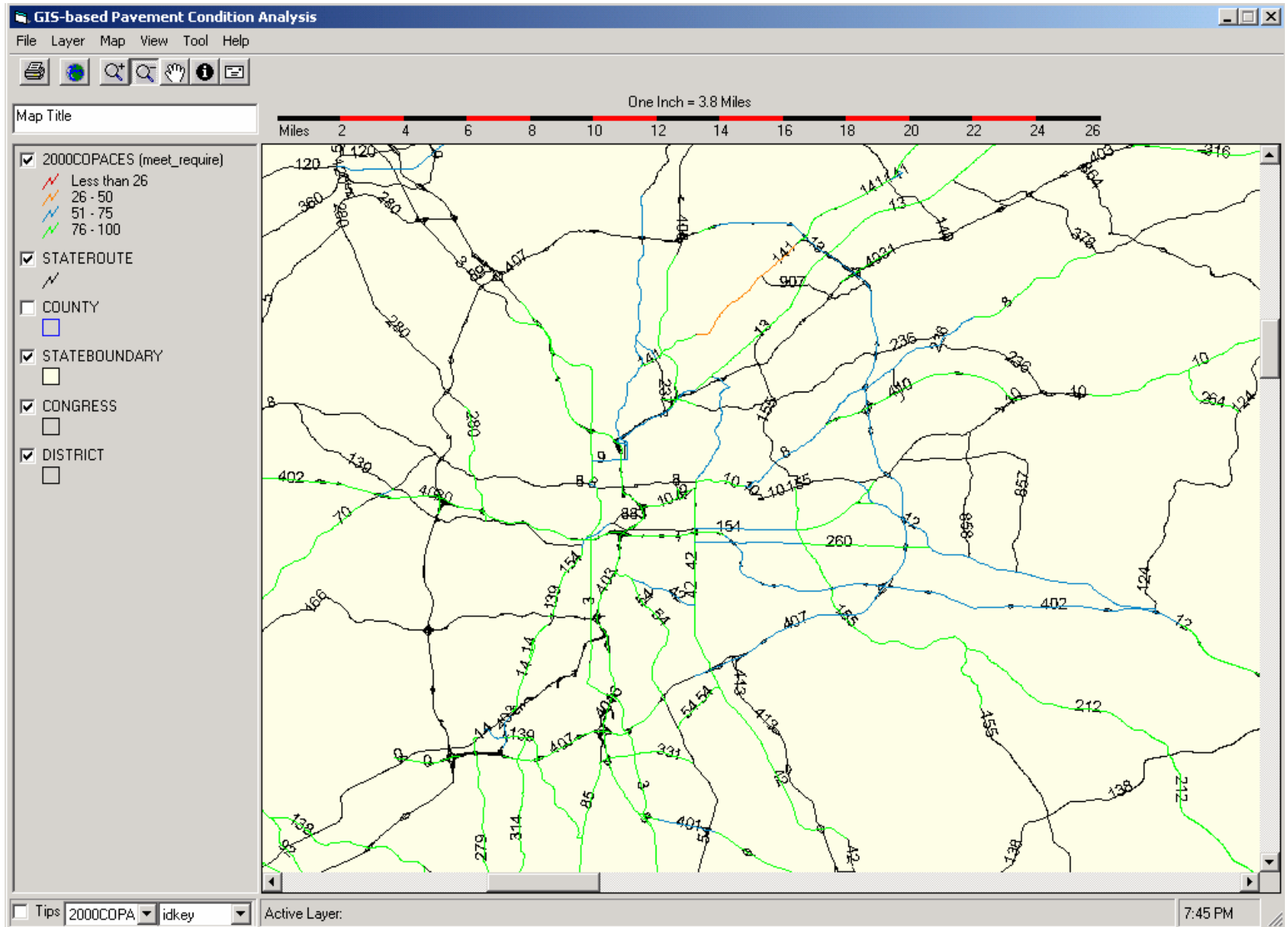


Example of Forecasted No. of Projects to be Treated and Cost

Network-level



Network-level Pavement Condition



Selected Project, Treatment, and Cost

Pavement Rehabilitation Funding Allocation System REFAS v1.0 - [All Projects Detail Information]

File View Setting Treatment Run Output Tool Help

Select All Add Other Project(s) Determine Treatment Combine/Separate Change Priority View Detail Info. Determine Fund Source Exit

Select working District(s): All

1.a

2 **3** **4**

The Results of Query --- Let Projects

	Dist	Dist Pri	State Pri	G Pri	Cong Pri	FinalTreatme	Criteria	Cost	StateSel	Fiscal	FundTyp	StateRemar	RouteN	CountyNa	MileP	MilePos	Office	Dist F
	1	1	1	1	9	Overlay	Default	85707	YES	2002			0284	HALL	0	1.7	GO	1
	1	3	2	1	9	Overlay	Regular	722700	YES	2002			0105	HABERSH	0	13.14	A2	3
	1	5	3	16	9	Overlay	Regular	429000	YES	2002			0017	STEPHENS	7.8	0	GO	5
▶	1	36	4	24	11	Slurry Seal	Regular	326083	YES	2002			0053	OCONEE	0	13.34	A6	36
	1	4	5	30	11	Overlay	Regular	511500	YES	2002			0015	JACKSON	12.3	21.6	A6	4
	1	6	6	37	11	Overlay	Regular	563648	YES	2002			0186	WALTON	0	6.82	A6	6
	1	17	7	46	11	Overlay	Regular	354423	YES	2002			0077	HART	0	7.03	GO	17
	1	7	8	50	11	Overlay	Regular	272800	YES	2002			0017	FRANKLIN	16.36	11.4	GO	7
	1	9	9	57	11	Overlay	Regular	67650	YES	2002			0022	MADISON	0	1.23	GO	9
	1	11	10	63	11	Overlay	Regular	176000	YES	2002			0017	FRANKLIN	0.3	3.5	GO	11
	1	20	11	70	11	Overlay	Regular	314594	YES	2002			0098	BANKS	0	6.24	GO	20

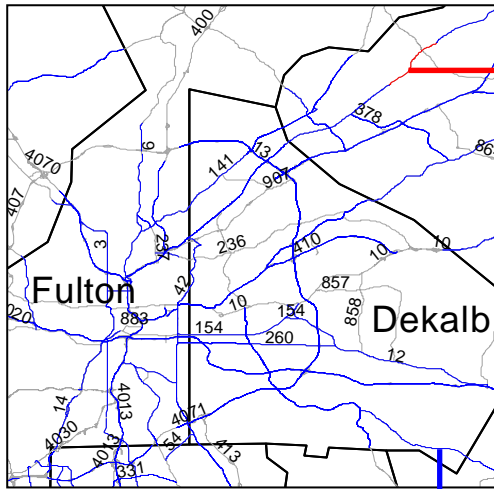
Total #: 108 Total Mileage (lane miles): 687.57 Total Cost (\$): 28,069,933

1.b

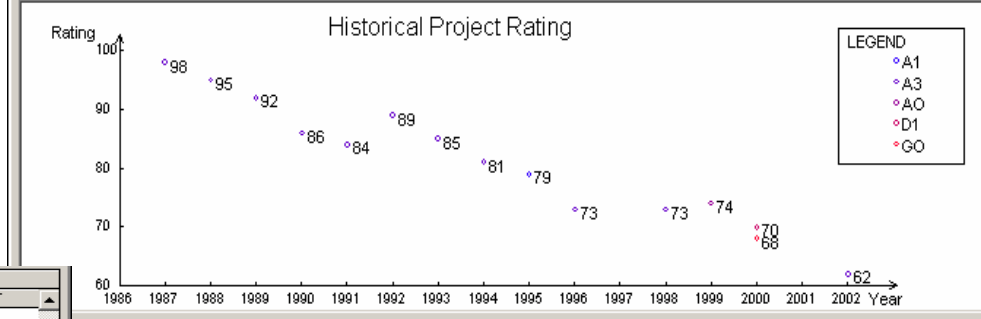
The Results of Query --- Not Let Projects

	Dist	Dist Pri	State Pri	G Pri	Cong Pri	FinalTreatme	Criteria	Cost	StateSel	Fiscal	FundTyp	StateRemar	RouteN	CountyNa	MileP	MilePos	Office	Dist F
▶	1	38	14	113	11	Slurry Seal	Regular	273769	NO	2002			0024	OCONEE	0	9.6	A6	38
	1	40	15	118	11	Slurry Seal	Regular	182513	NO	2002			0017	ELBERT	23.6	26	A3	40
	1	10	16	123	11	Overlay	Regular	203500	NO	2002			0051	HART	10.7	14.4	A3	10
	1	19	17	127	10	Overlay	Regular	506000	NO	2002			0017	ELBERT	0	9.2	GO	19
	1	12	18	131	9	Overlay	Regular	544600	NO	2002			0105	HABERSH	4	13.14	GO	12
	1	22	19	135	9	Overlay	Regular	465850	NO	2002			0011	WHITE	6.5	14.97	GO	22
	1	23	20	142	11	Overlay	Regular	114400	NO	2002			0015	JACKSON	21.6	23.68	A6	23
	1	8	21	146	11	Overlay	Regular	311846	NO	2002			0011	JACKSON	14.3	19.16	GO	8
	1	27	22	150	9	Overlay	Regular	600050	NO	2002			0136	DAWSON	23.8	27.12	A1	27
	1	28	23	159	11	Overlay	Regular	494450	NO	2002			0083	WALTON	0	8.99	A6	28

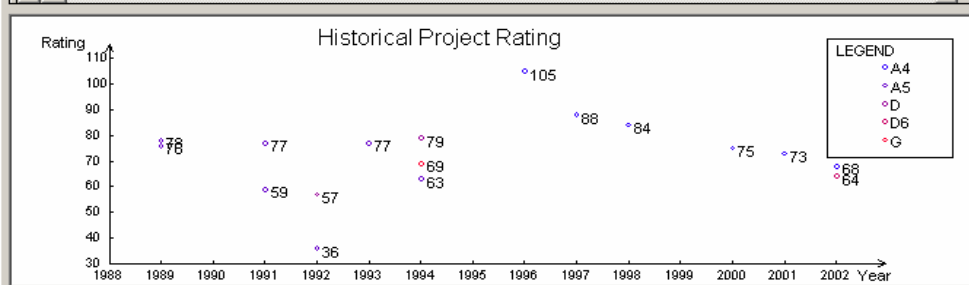
Historical Pavement Performance Analysis



Historical survey data of selected project													
Status	Tripdate	RouteN	RouteS	RouteT	Project	Rater	Distri	Office	Count	MilePo	MilePos	AADT	
NORMAL	5/13/1992 6:47:06 AM	0051	00	1	89	JAMES MOORE	1	A3	147	10.7	14.7		
NORMAL	6/2/1993 8:14:44 AM	0051	00	1	85	JAMES MOORE	1	A3	147	10.6	14.7		
NORMAL	4/11/1994 12:59:09 PM	0051	00	1	81	JAMES MOORE	1	A3	147	10.7	14.4		
NORMAL	4/20/1995 1:58:57 PM	0051	00	1	79	JAMES S. MOORE	1	A1	147	10.7	14.4		
NORMAL	3/26/1996 5:03:31 PM	0051	00	1	73	FRED T. APPLING	1	A3	147	10.7	14.4		
NORMAL	4/3/1998 1:43:39 PM	0051	00	1	73	JEFF JACQUES	1	A3	147	10.7	14.4		
Normal	2/25/1999 7:45:15 AM	0051	00	1	74	JEFF JACQUES	1	A0	147	10.7	14.4	11800	
NORMAL	1/20/2000 2:35:18 PM	0051	00	1	68	JEFF JACQUES	1	A3	147	10.7	14.4	11800	
NORMAL	1/21/2000 4:49:56 PM	0051	00	1	70	GREGORY	1	D1	147	10.7	14.4	11800	
NORMAL	2/17/2000 9:07:55 AM	0051	00	1	68	SWINFORD	1	G0	147	10.7	14.4	11800	
NORMAL	10/17/2001 8:29:50 AM	0051	00	1	62	TMCDUFFIE	1	A3	147	10.7	14.4	11800	



Historical survey data of selected project													
Status	Tripdate	RouteN	RouteS	RouteT	Project	Rater	Distri	Office	Count	MilePo	MilePost	AADT	
NORMAL	4/21/1993 7:00:53	00	1	77	TERRY WRIGHT	6	A5	115	21.9	23.7			
NORMAL	2/7/1994 12:00:53	00	1	63	TERRY D. WRIGHT	6	A5	115	21.8	23.4			
NORMAL	3/10/1994 12:00:53	00	1	79	CLIFF HARDEN	6	D	115	21.8	23.4			
NORMAL	5/24/1994 12:00:53	00	1	69	TERRY JONES	6	G	115	21.8	23.4			
UNDER CON	8/2/1995 2:50:53	00	1	105	TERRY WRIGHT	6	A4	115	21.8	23.4			
NORMAL	6/13/1997 3:00:53	00	1	88	TERRY D. WRIGHT	6	A4	115	21.8	23.4			
NORMAL	6/5/1998 1:30:53	00	1	84	GARRY PRATHER	6	A4	115	21.8	23.4			
NORMAL	2/9/2000 8:50:53	00	1	75	GARRY PRATHER	6	A4	115	21.8	23.4	20000		
NORMAL	10/13/2000 1:00:53	00	1	73	GARRY PRATHER	6	A4	115	21.8	23.4	20000		
NORMAL	10/24/2001 9:00:53	00	1	68	GARRY PRATHER	6	A4	115	21.8	23.4	20000		
NORMAL	4/30/2002 9:00:53	00	1	64	T. RUTLEDGE	6	D6	115	21.8	23.4	39800		



Project-level

Impact on Network-Level – Cost

GDOT District-Level Need Analysis Results

Design View | Chart View | Table

Title: GDOT District-Level Need Analysis Results

X Axis: Fiscal Year

Y Axis: Yearly MR&R Cost (\$1,000)

Data Range: GDOT District 1

Refresh Output

X Axis	Y1 Axis
Current	0
2004	19020.5
2005	8595.8
2006	10458.7
2007	11652.2
2008	12378

GDOT District-Level Need Analysis Results

Design View | Chart View | Table

Title: GDOT District-Level Need Analysis Results

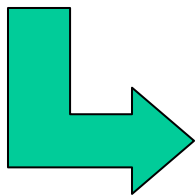
X Axis: Fiscal Year

Y Axis: Yearly MR&R Cost (\$1,000)

Data Range: GDOT District 1

Refresh Output To

X Axis	Y1 Axis
Current	0
2004	19360.1
2005	8595.8
2006	10119.1
2007	11652.2
2008	12378



Adjust Select Project's Treatment(s)

Project ID: 125

Current Treatment(s)

ProjectID	FutureYear	ForecastRatio	Treat	TreatmentMethod
125	2003	83	NO	Do Nothing
125	2004	80	NO	Do Nothing
125	2005	77	NO	Micro Seal
125	2006	100	YES	Micro Seal
125	2007	96	NO	Do Nothing
125	2008	92	NO	Do Nothing

Update Treatment(s)

Select a fiscal Year: 2006

Select a treatment: Micro Seal

Update Reset

Back

Adjust Select Project's Treatment(s)

Project ID: 125

Current Treatment(s)

ProjectID	FutureYear	ForecastRatio	Treat	TreatmentMethod
125	2003	83	NO	Do Nothing
125	2004	100	YES	Micro Seal
125	2005	96	NO	Micro Seal
125	2006	92	NO	Do Nothing
125	2007	88	NO	Do Nothing
125	2008	84	NO	Do Nothing

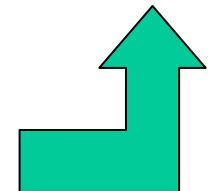
Update Treatment(s)

Select a fiscal Year: 2004

Select a treatment: Micro Seal

Update Reset

Back



Conclusions

- Link network-level performance/cost with project level plans.
- Perform “what-if” analysis in the network-level based on different treatment scenarios and balancing constraints.
- Dynamically change the project-level treatment method on the map to see its impact on project and network levels.
- Display project-level and network-level results on a GIS map.

Future Research

- Validate and calibrate models using historical data including rating, treatment method, and cost.
- Incorporate and test other performance models.
- Incorporate optimization solution.

Contact Info

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Thanks !