

# Caltrans' LRS Data Model – A Modern Geodatabase Supporting Historical Linear Referencing Methods

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*Spatial Information Solutions*

*GIS-T 2005*

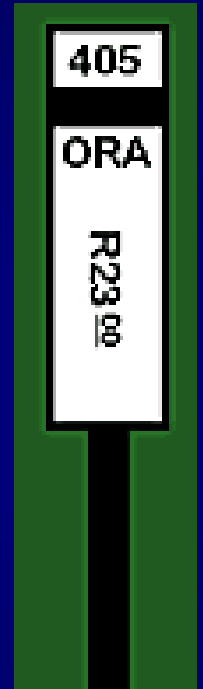
# LRS at Caltrans

- ◆ Over a decade of LRS mapping
- ◆ Multiple LRMs and data structures that have historical information  
(Postmiles, Kilopost, Field Elements, Odometer, HPMS)
- ◆ ~80% based on the Caltrans Postmile
- ◆ Utilized for visualization of
  - n physical conditions (i.e., pavement conditions),
  - n system usage and events (i.e., accident statistics),
  - n projects (i.e., highway extension)



# The Problems Were...

- ◆ Institutional “Postmile” LRM involving alphanumeric and discontinuous at County line
- ◆ Institutional “FUNC” route coverage with insufficient positional accuracy
- ◆ LRS operation programmatically coupled “Postmile” LRM to “FUNC” route coverage
- ◆ Decentralized LRS data and applications

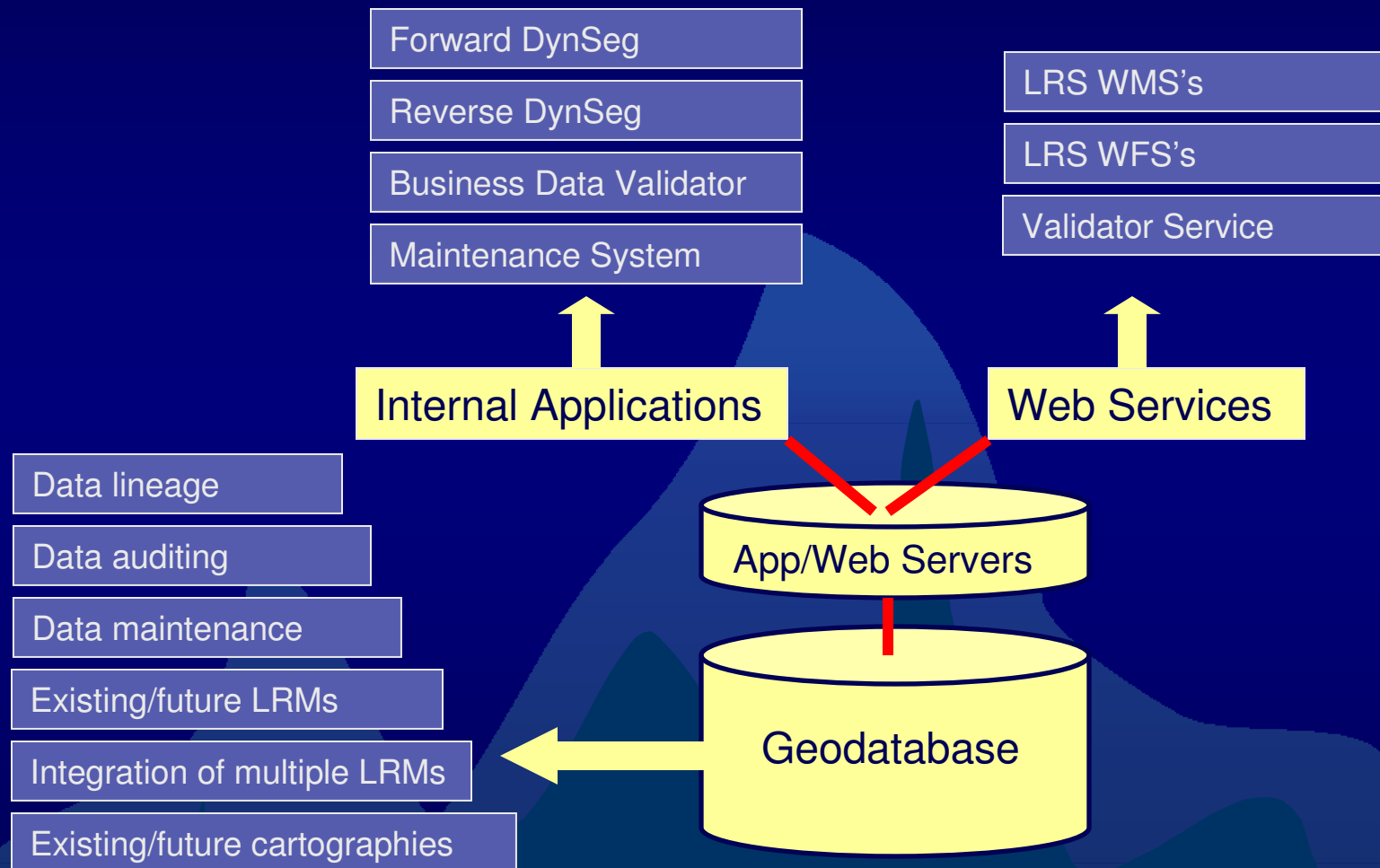


# The Solution Is...

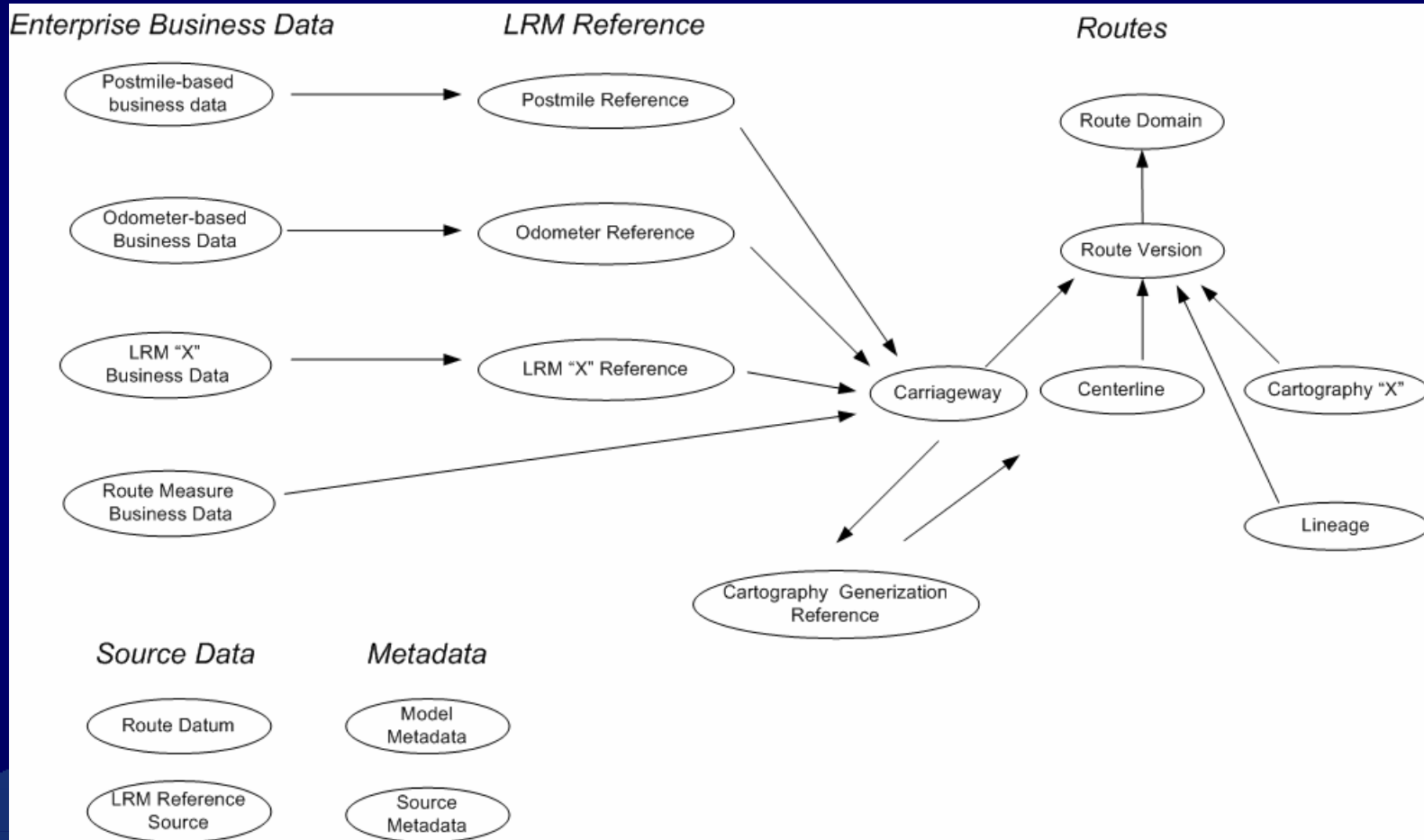
- ◆ “Loose coupling” of Postmile LRM to LRS routes
- ◆ Improved positional accuracy of continuous statewide routes
- ◆ Centralization of data and application to support enterprise-wide goals
- ◆ Implemented as data model, methodologies, and applications



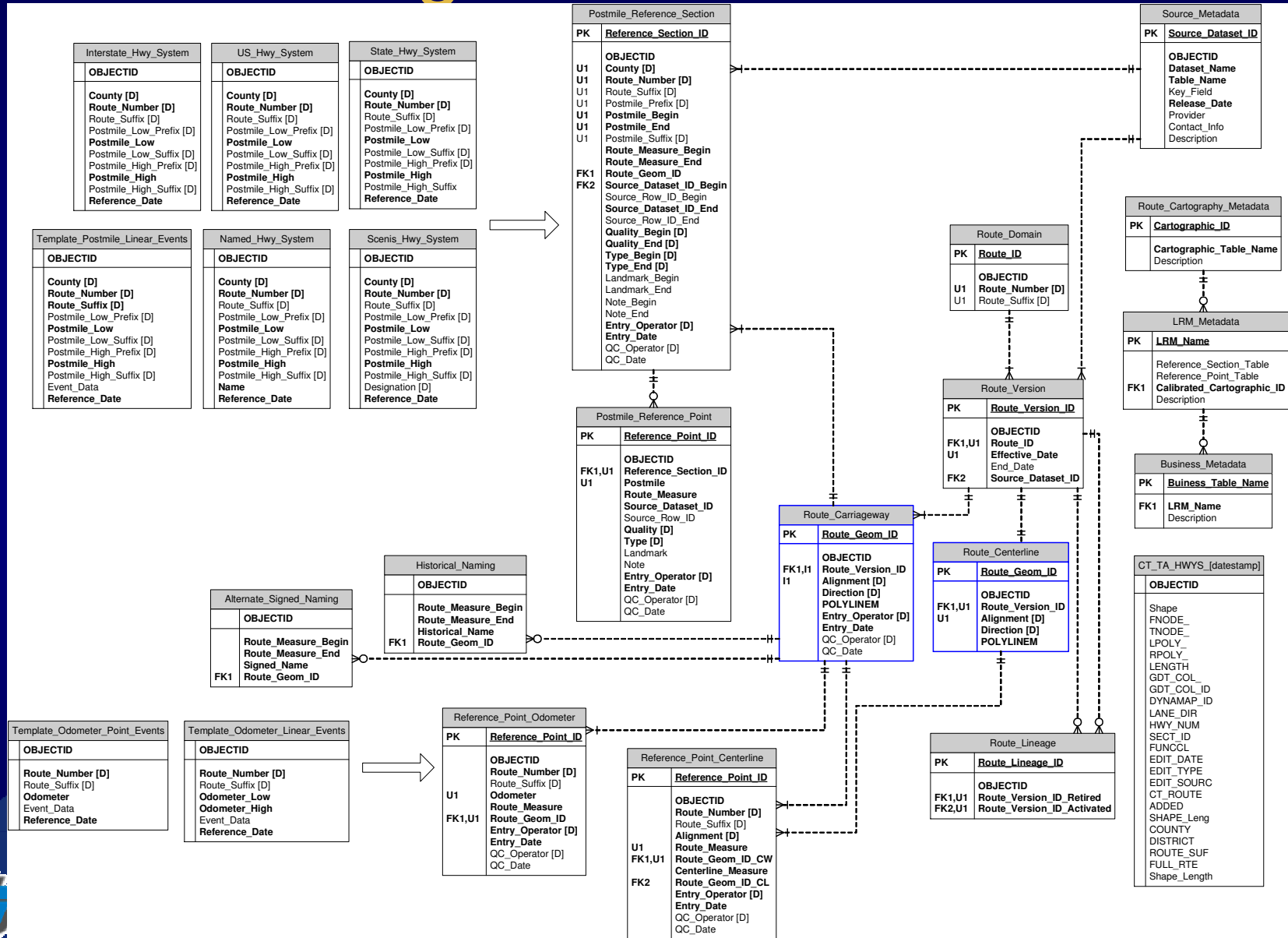
# Enterprise LRS Vision



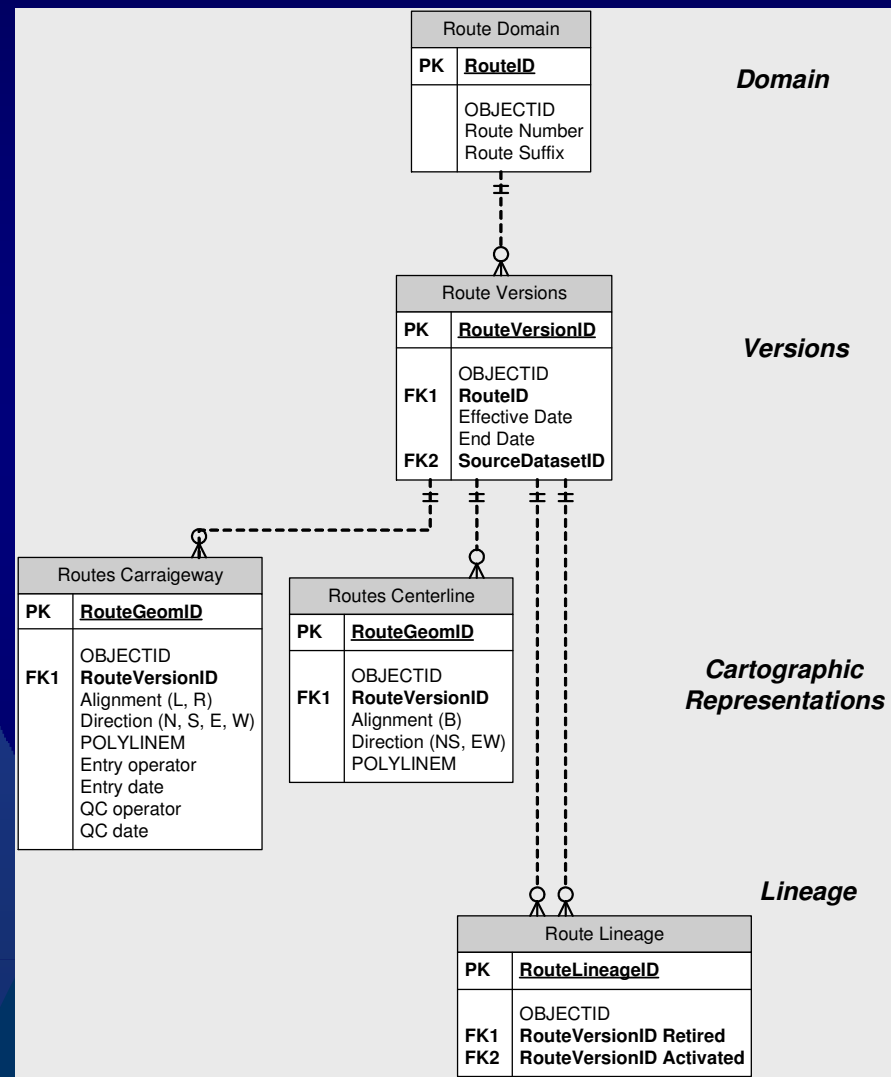
# Conceptual Data Model



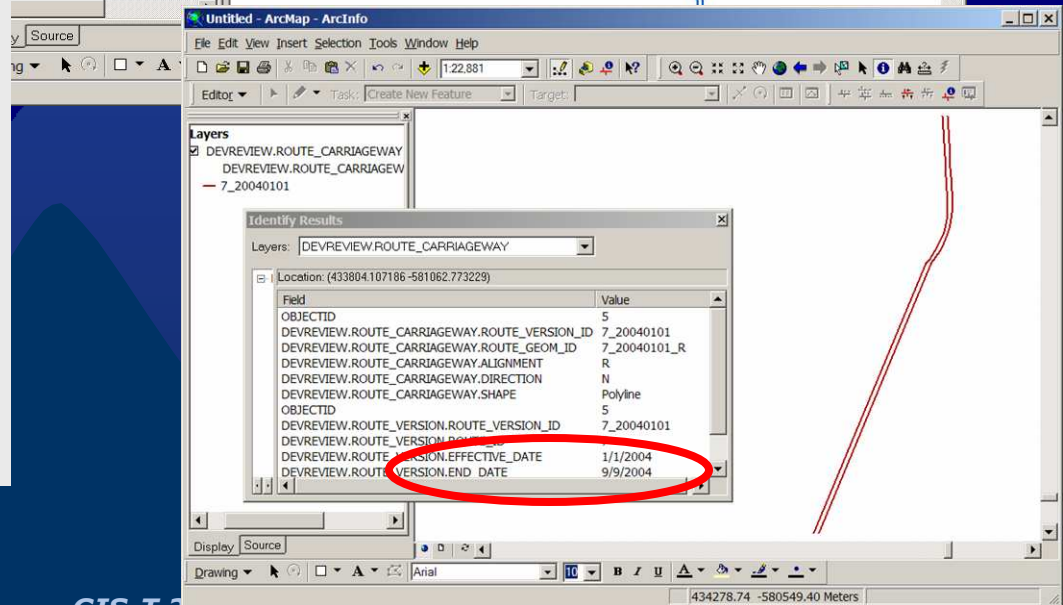
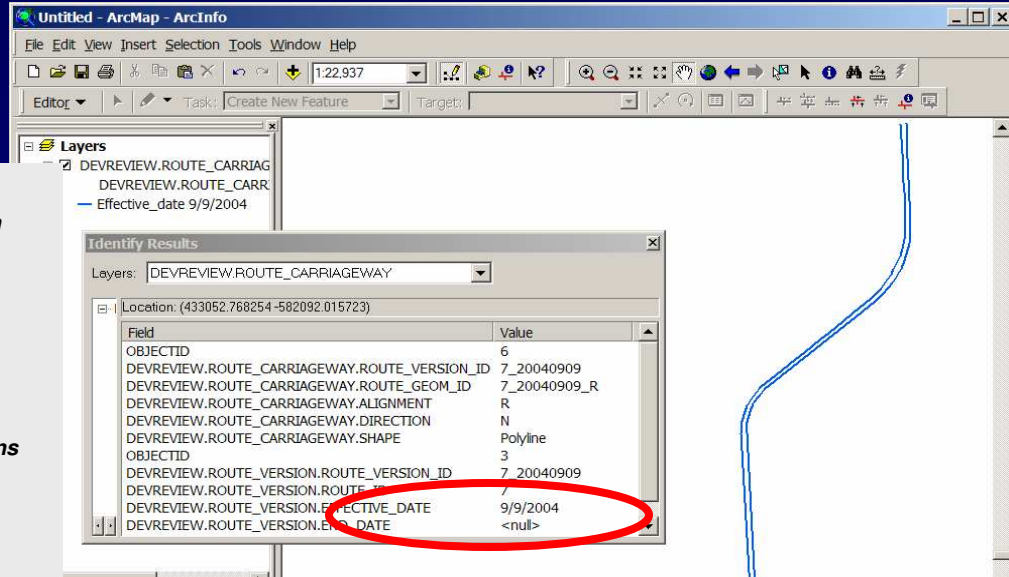
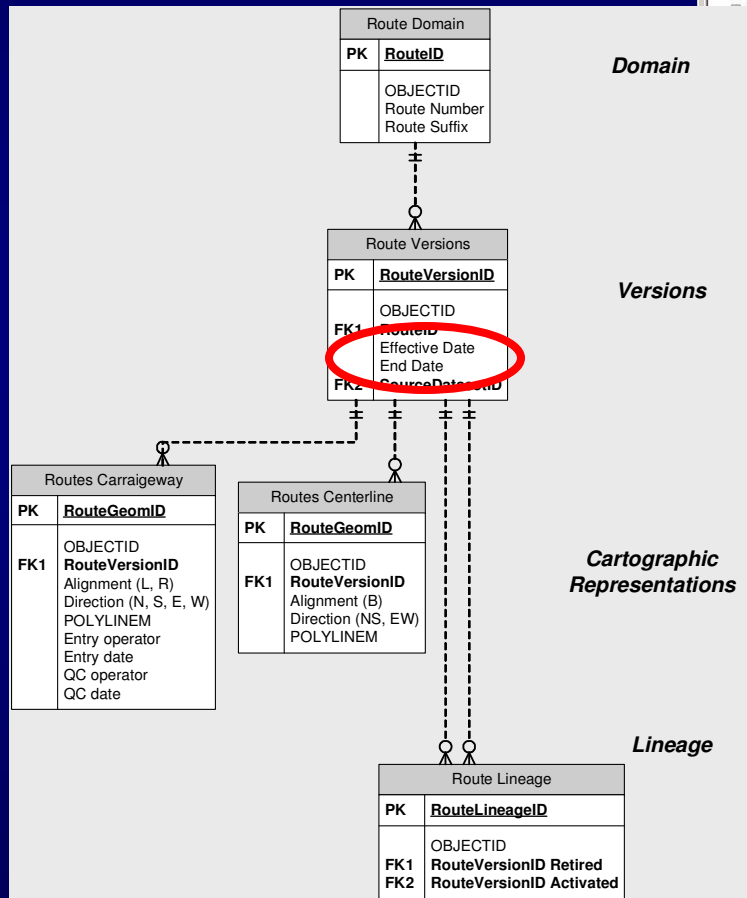
# Logical Data Model



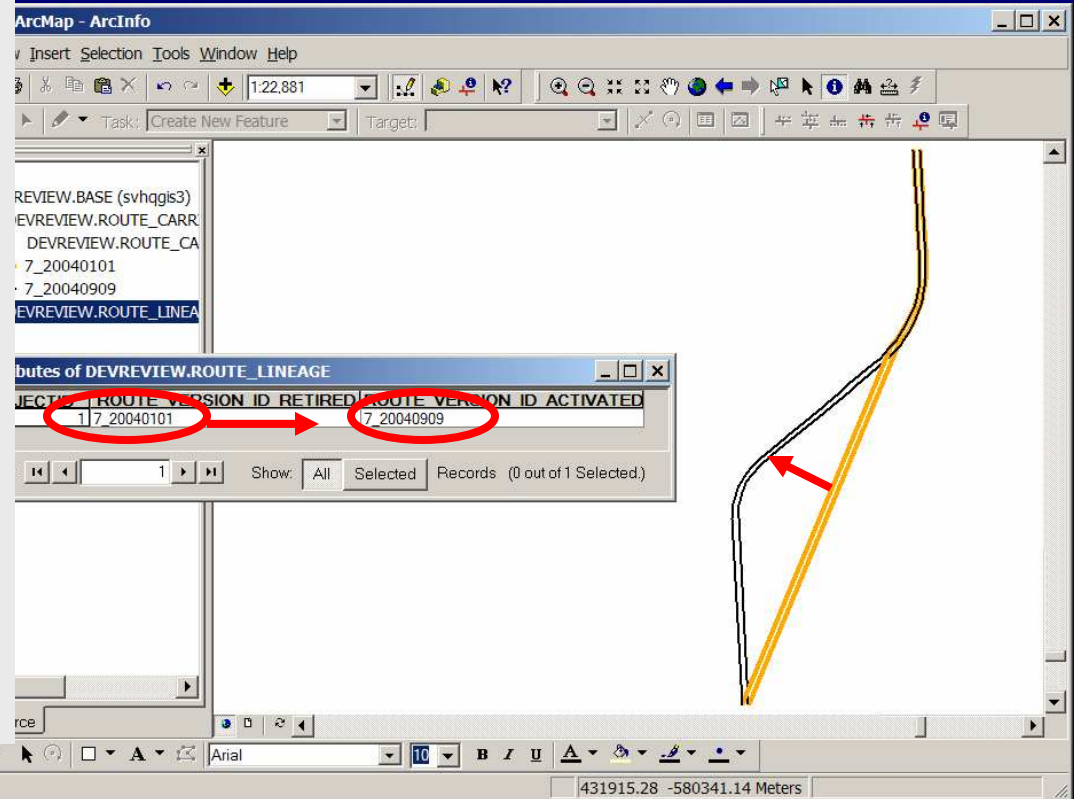
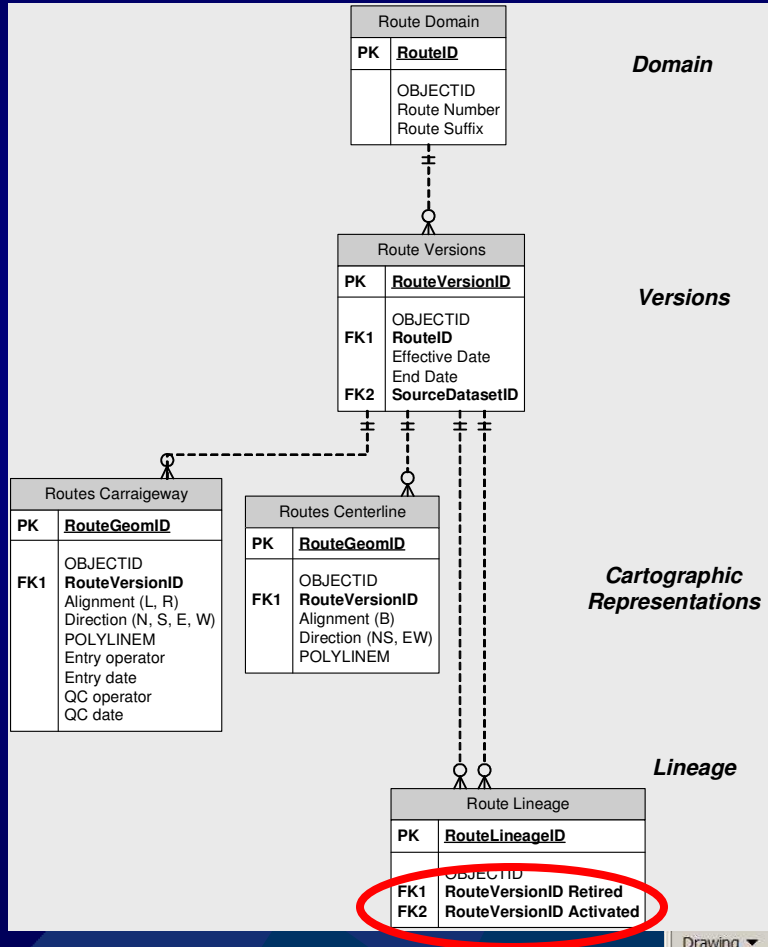
# Routes Functional Area



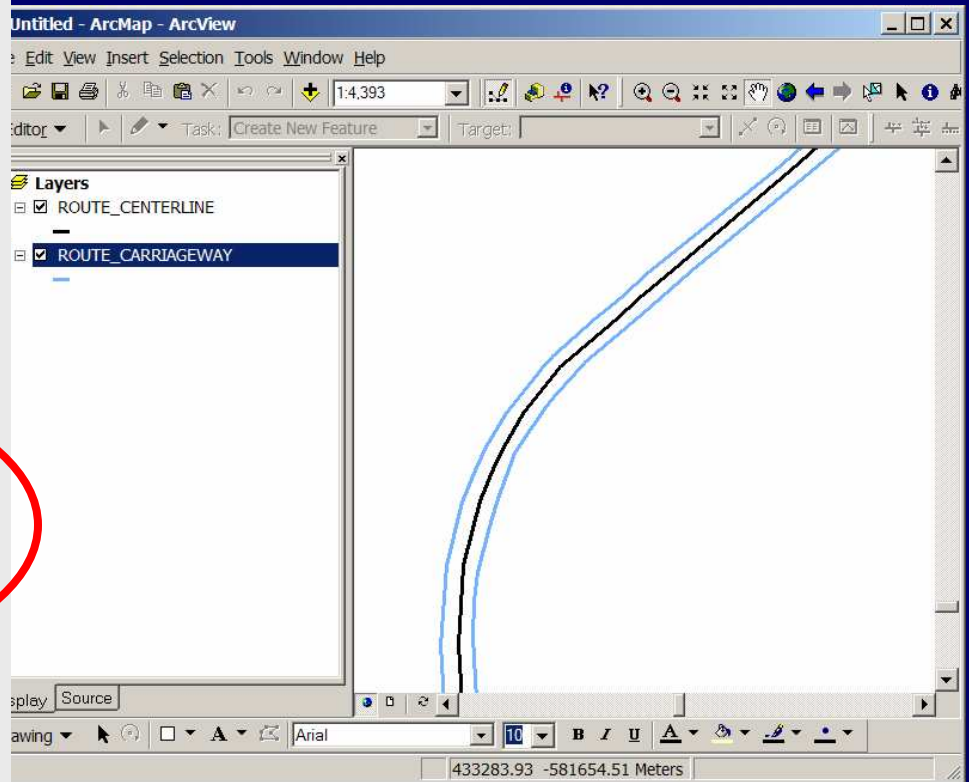
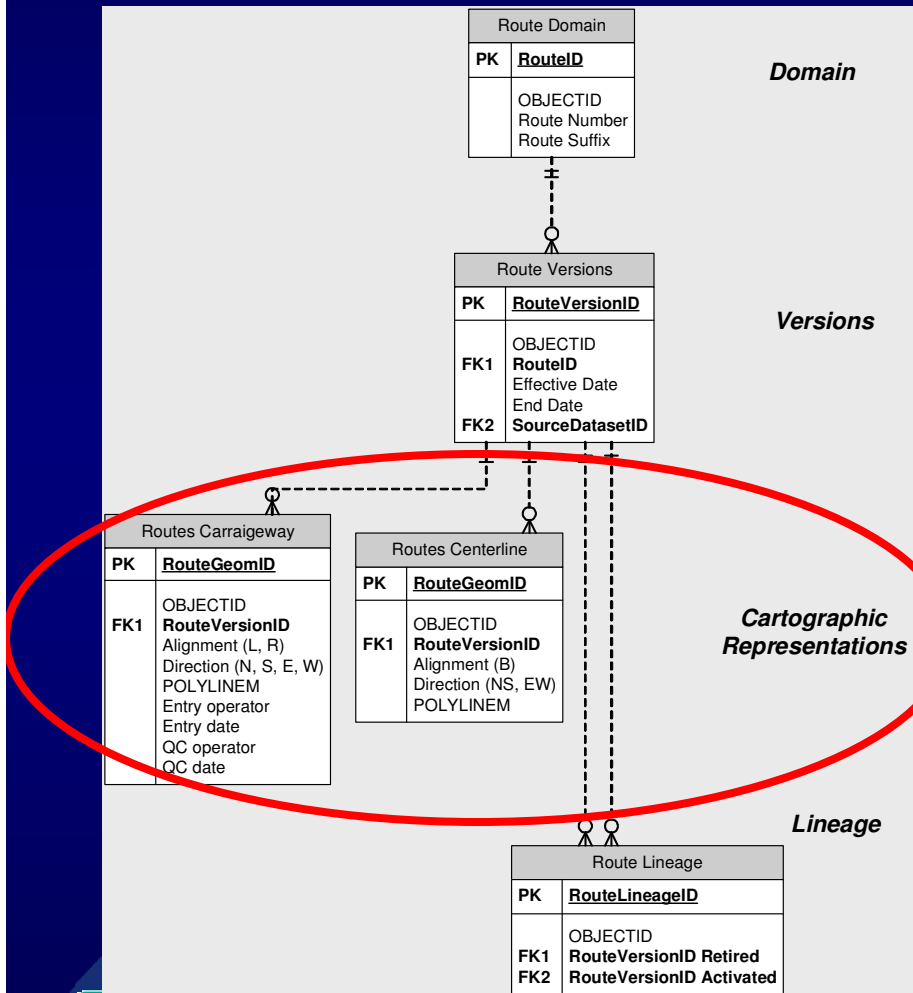
# Routes: Versions



# Routes: Lineage



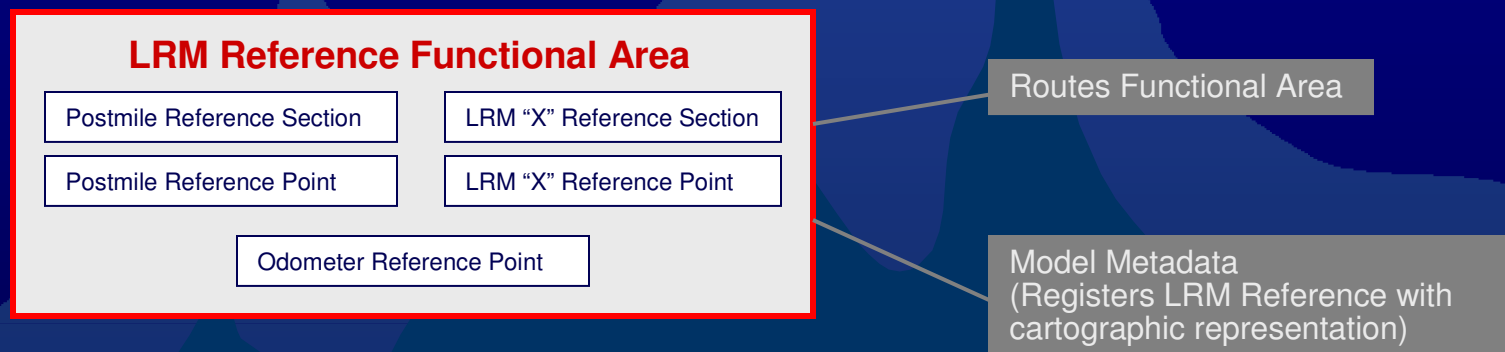
# Routes: Cartographic Representations



# LRM Reference Functional Area

**LRM Reference Section:** Route extent of monotonic LRM measures and along which any LRM alpha qualifiers remain constant. Provides ranges of valid LRM measures for each section.

**LRM Reference Point:** Identifiable location along a reference section that adds positional fidelity to LRM-Route Measure conversion.

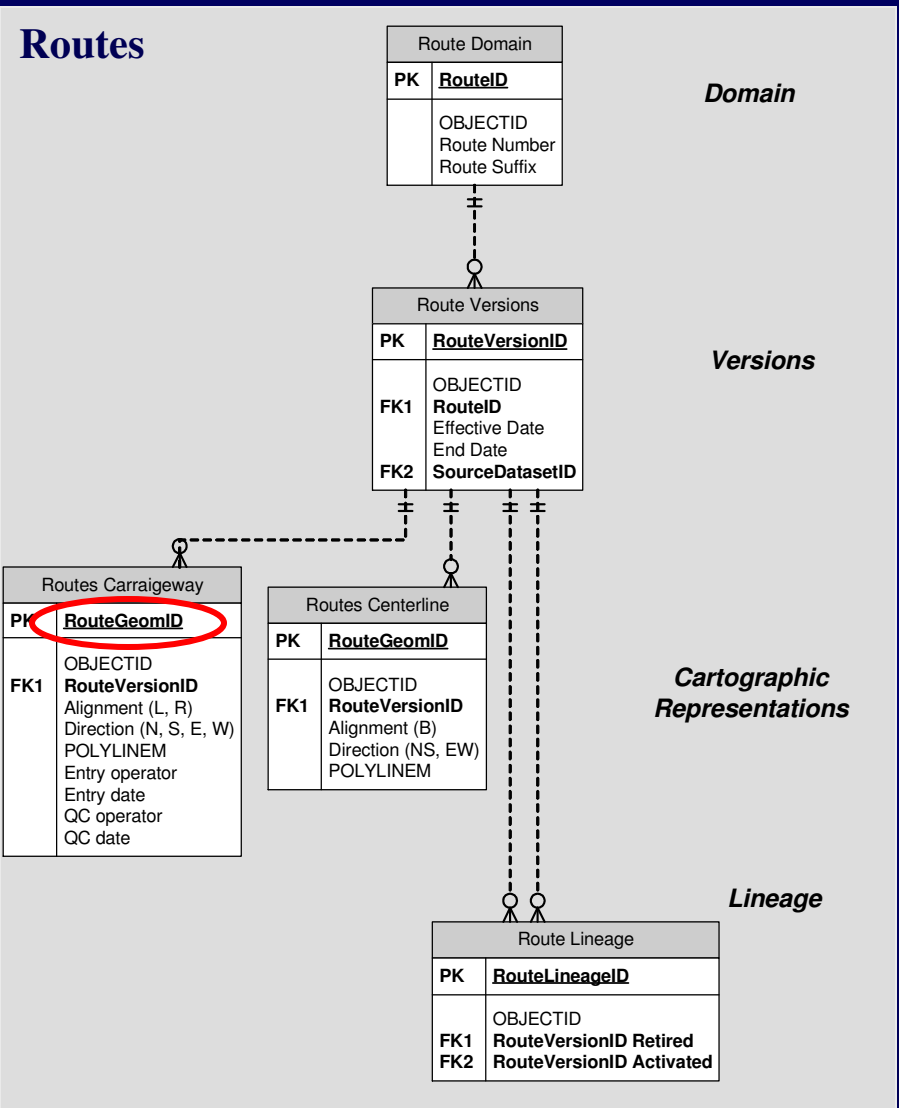
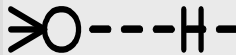


# Reference Data Tie to Route Version

## Postmile LRM Reference

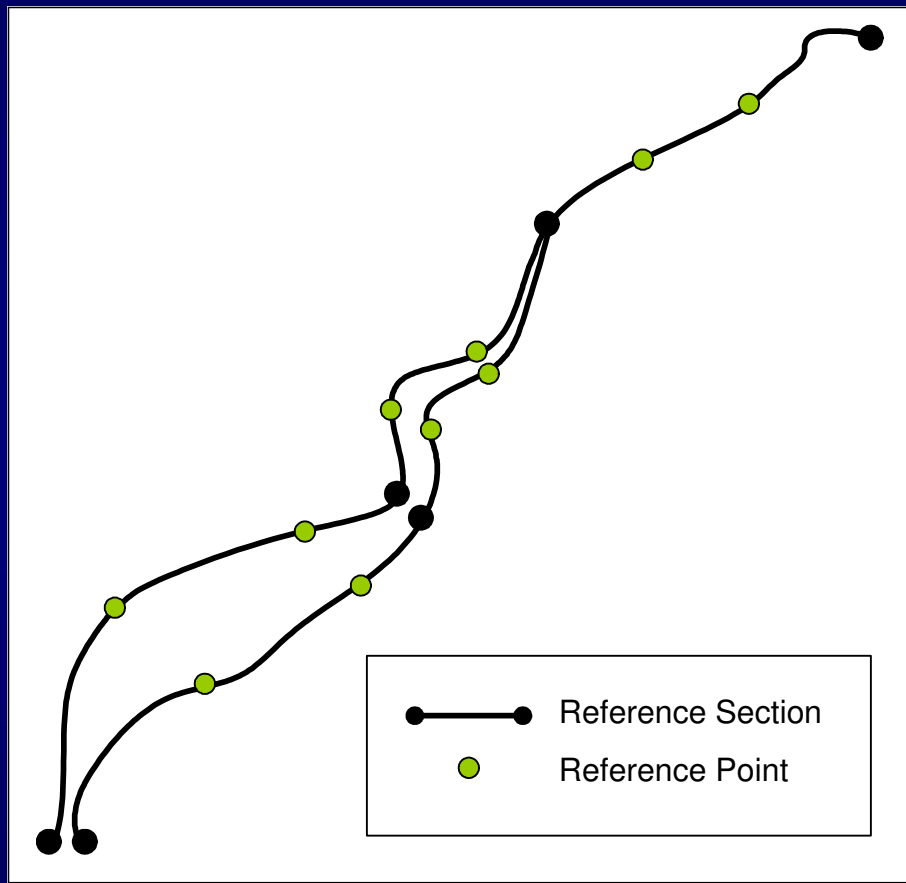
Postmile Reference Point	
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<b>FK1</b>	<b>OBJECTID</b> <b>ReferenceSectionID</b>
	Postmile Route Measure SourceRowID Quality Type Landmark Notes Entry Operator Entry Date QC Operator QC Date

Postmile Reference Section	
<b>PK</b>	<b>ReferenceSectionID</b>
<b>FK1</b>	<b>OBJECTID</b> <b>RouteNumber</b> <b>RouteGeomID</b>
<b>FK2</b>	<b>SourceDatasetID</b>
	County Route Number Route Suffix Postmile Prefix Postmile Begin Postmile End Postmile Suffix Route Measure Begin Route Measure End SourceDatasetID SourceRowID Quality Begin Quality End Type Begin Type End Landmark Begin Landmark End Notes Begin Note End Entry Operator Entry Date QC Operator QC Date

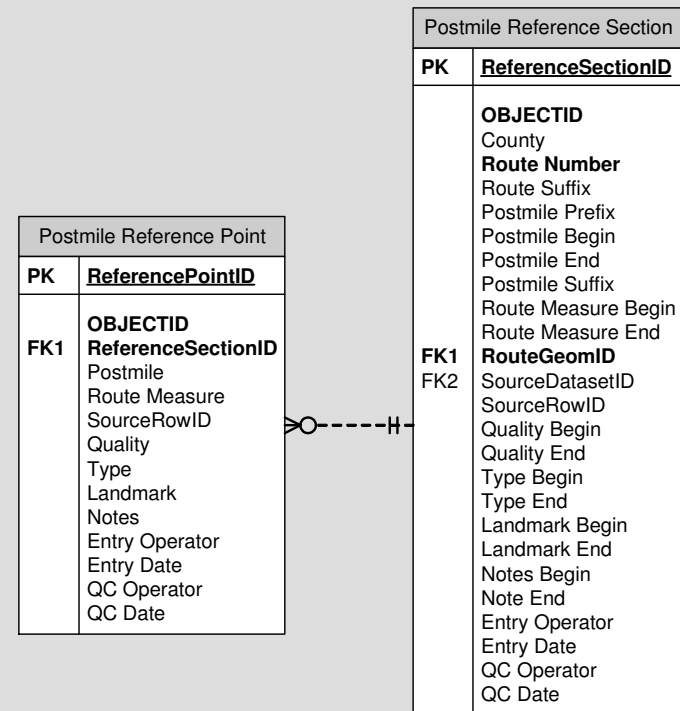


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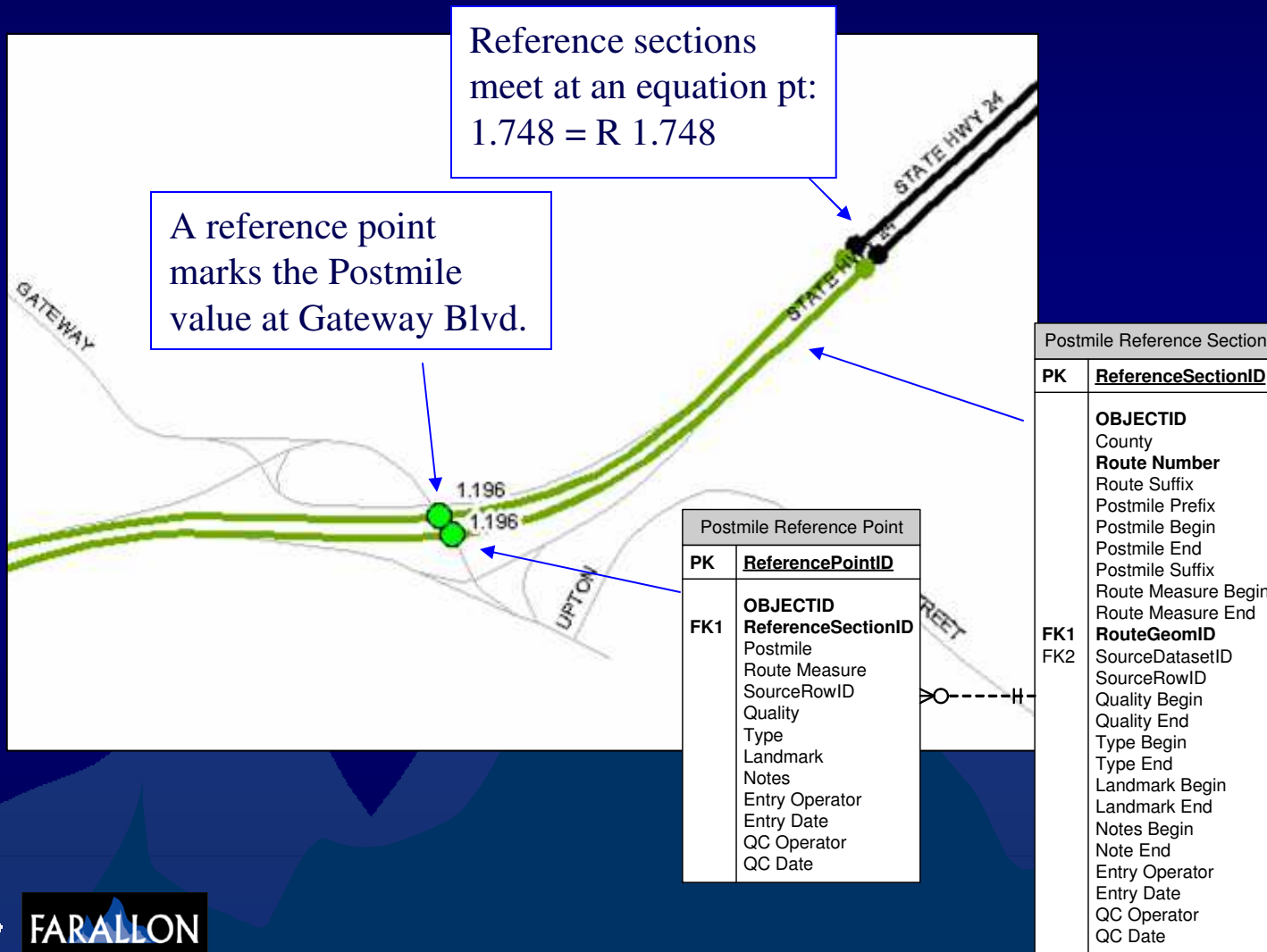
# Postmile LRM Reference



## Postmile LRM

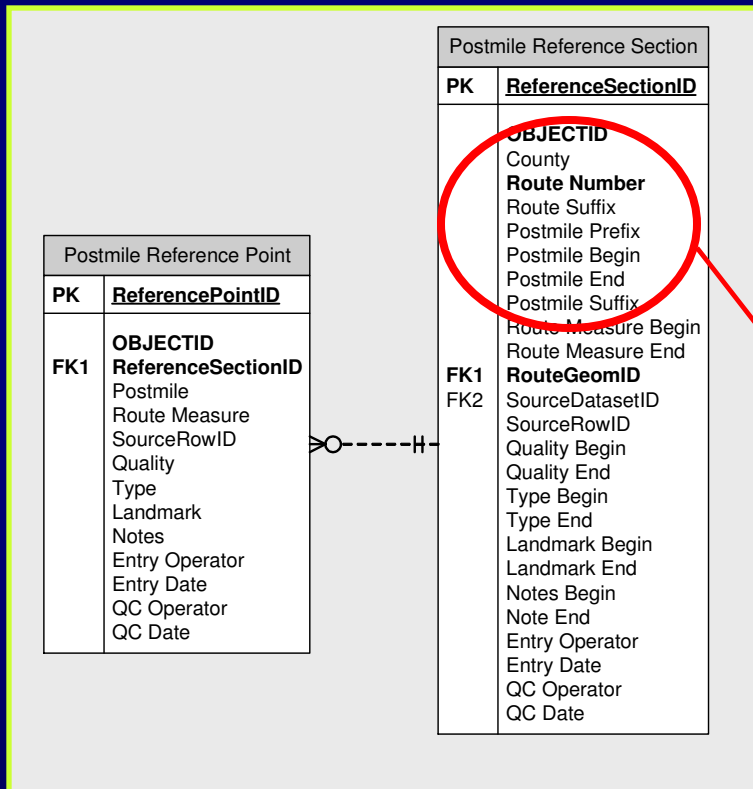


# Postmile LRM Reference



# Efficient Postmile Validation

## Postmile Reference Data



## User Input

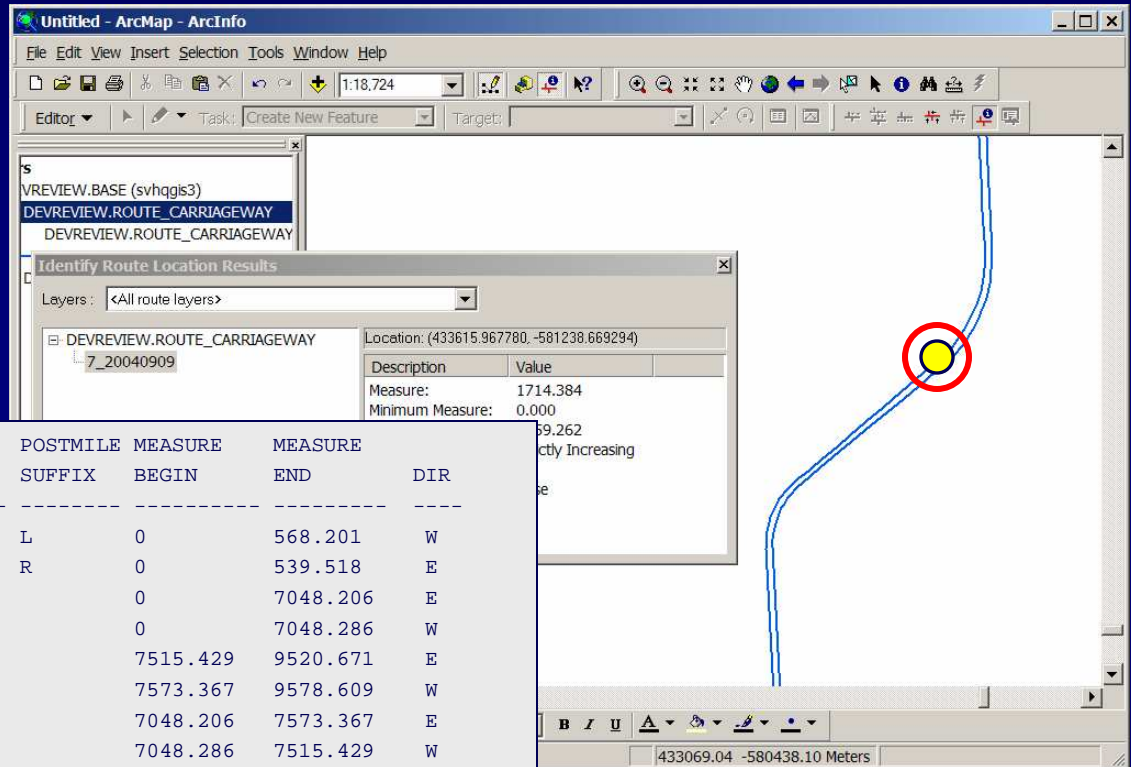
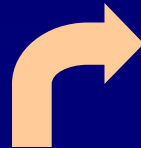
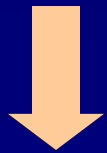
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ALA	24	U	T	.85	L	INVALID
CC	24		R	7.5		VALID

COUNTY	ROUTE NUM	ROUTE SUFFIX	POSTMILE PREFIX	POSTMILE BEGIN	POSTMILE END	POSTMILE SUFFIX
ALA	24	U	T	.403	.755	L
ALA	24	U	T	.416	.75	R
ALA	24		R	1.847	6.241	
CC	24			.502	1.748	
CC	24		R	0	.456	
CC	24		R	1.748	8.863	
CC	24			8.863	9.684	
CC	24	XH		9.684	24.264	X



# Forward Postmile

CC 24 R2.246

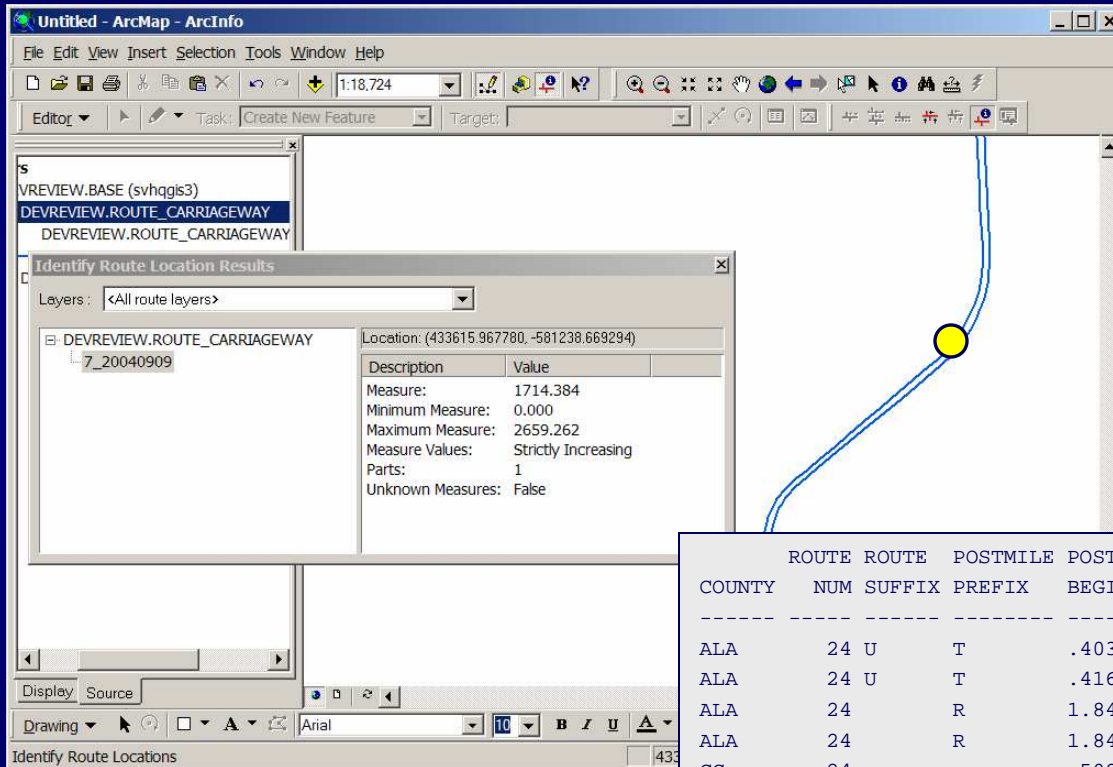


COUNTY	ROUTE NUM	ROUTE SUFFIX	POSTMILE PREFIX	POSTMILE BEGIN	POSTMILE END	POSTMILE SUFFIX	MEASURE BEGIN	MEASURE END	DIR
ALA	24	U	T	.403	.755	L	0	568.201	W
ALA	24	U	T	.416	.75	R	0	539.518	E
ALA	24		R	1.847	6.241		0	7048.206	E
ALA	24		R	1.847	6.241		0	7048.286	W
CC	24			.502	1.748		7515.429	9520.671	E
CC	24			.502	1.748		7573.367	9578.609	W
CC	24		R	0	.456		7048.206	7573.367	E
CC	24		R	0	.456		7048.286	7515.429	W
CC	24		R	1.748	8.863		9520.671	21270	E
CC	24		R	1.748	8.863		9578.609	21285	W
CC	24			8.863	9.684		21270	22823.266	E
CC	24			8.863	9.684		21285	22367.126	W
CC	24		XH	9.684	24.264	X	0	22964.247	E
CC	24		XH	9.684	24.264	X	0	22984.811	W



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# Reverse Postmile



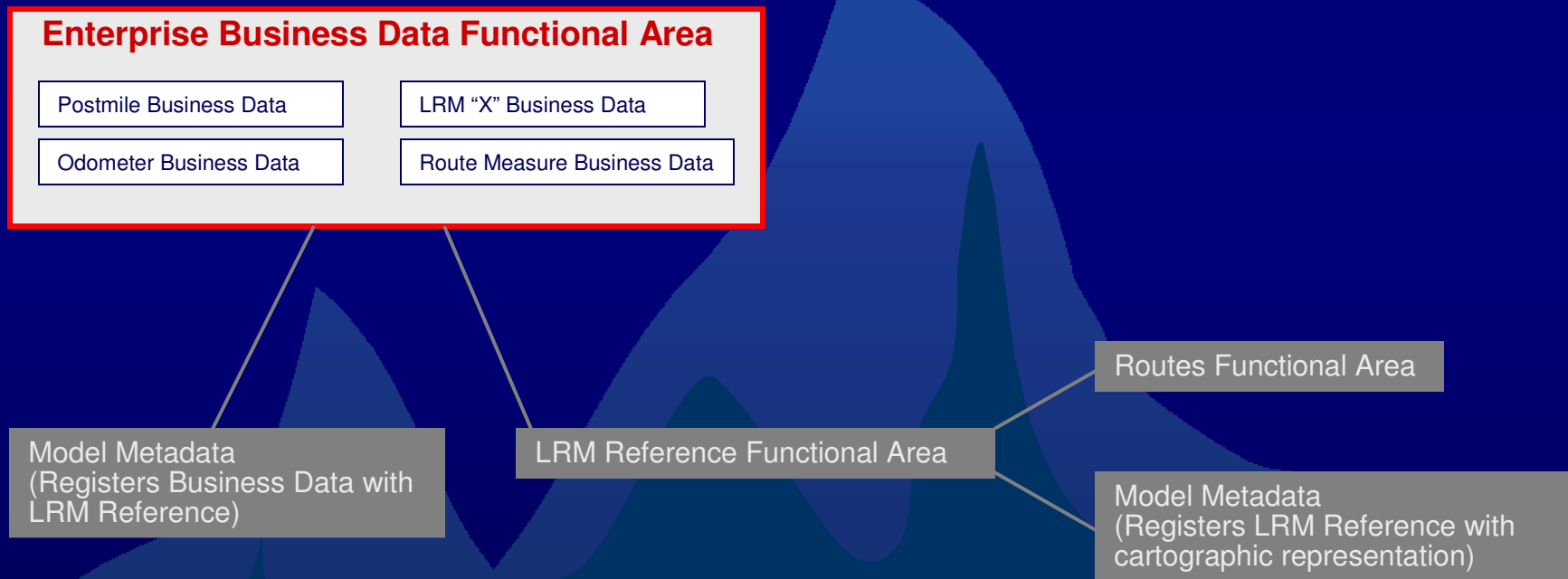
CC 24 R2.246

COUNTY	ROUTE NUM	ROUTE SUFFIX	POSTMILE PREFIX	POSTMILE BEGIN	POSTMILE END	POSTMILE SUFFIX	MEASURE BEGIN	MEASURE END	DIR
ALA	24	U	T	.403	.755	L	0	568.201	W
ALA	24	U	T	.416	.75	R	0	539.518	E
ALA	24		R	1.847	6.241		0	7048.206	E
ALA	24		R	1.847	6.241		0	7048.286	W
CC	24			.502	1.748		7515.429	9520.671	E
CC	24			.502	1.748		7573.367	9578.609	W
CC	24		R	0	.456		7048.206	7573.367	E
CC	24		R	0	.456		7048.286	7515.429	W
CC	24		R	1.748	8.863		9520.671	21270	E
CC	24		R	1.748	8.863		9578.609	21285	W
CC	24			8.863	9.684		21270	22823.266	E
CC	24			8.863	9.684		21285	22367.126	W
CC	24	XH		9.684	24.264	X	0	22964.247	E
CC	24	XH		9.684	24.264	X	0	22984.811	W



# Enterprise Business Data Functional Area

**Enterprise Business Data:** LRS business data of enterprise-wide interest stored within the geodatabase.



# Enterprise Business Data

## Postmile LRM

Interstate Hwy System	US Hwy System	State Hwy System
<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Reference Date
Template - LinearEvents	Named Hwy System	Scenic Hwy System
<b>OBJECTID</b> County Route Name Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Event Data Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Designation (name) Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Designation (E or OD) Reference Date

Postmile LRM Reference

Highway Routes

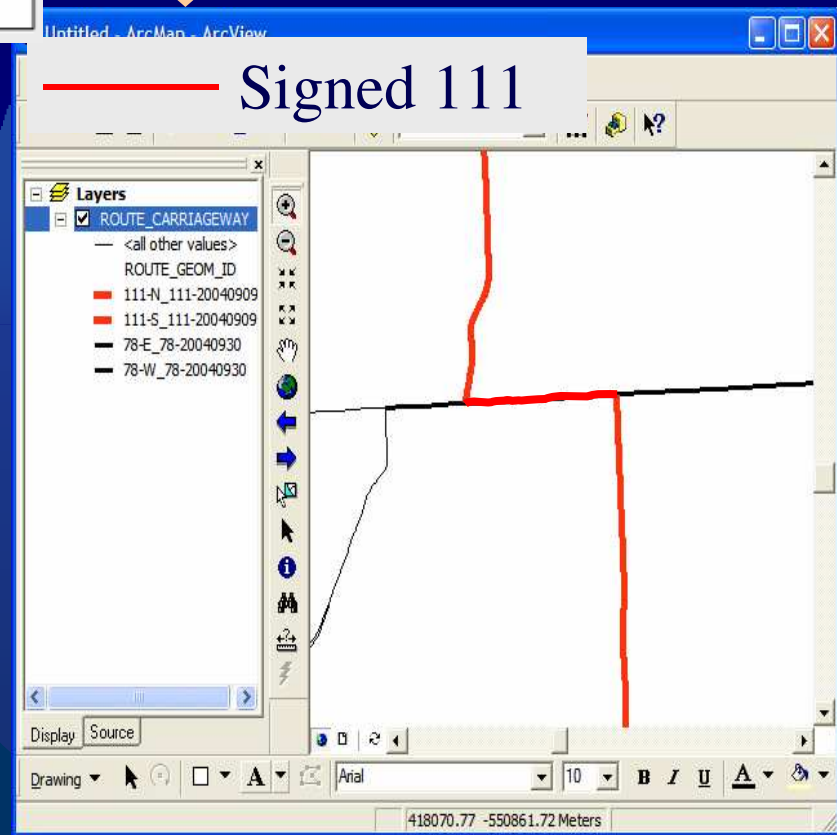
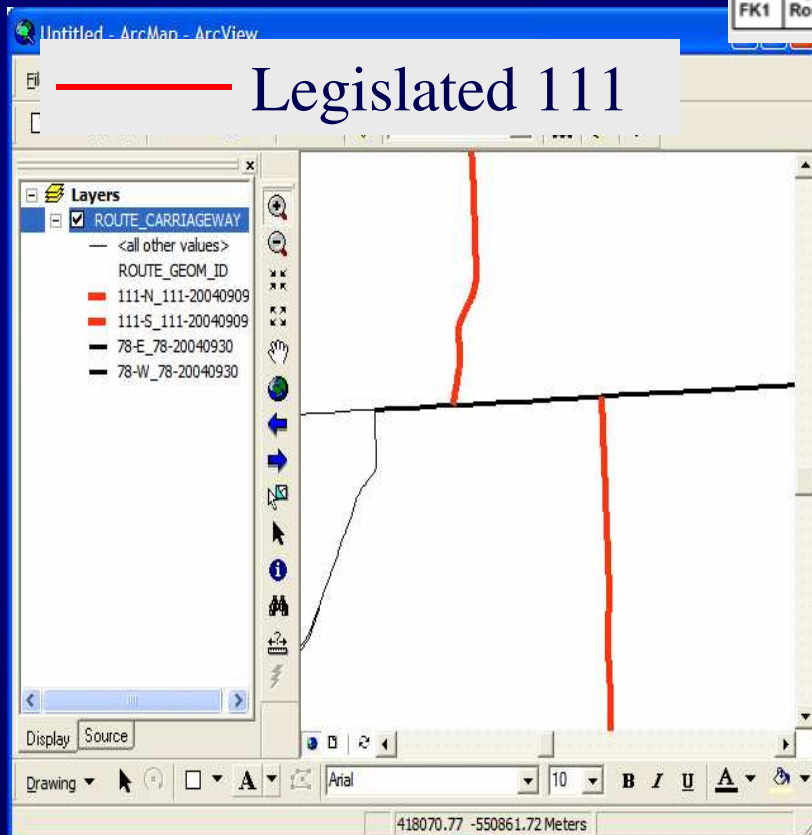
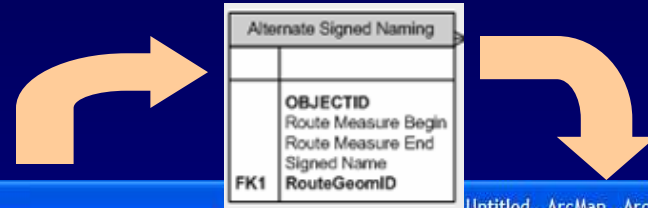
## Route Measure LRM

Alternate_Signed_Naming	Historical_Naming
<b>OBJECTID</b> Route_Measure_Begin Route_Measure_End Signed_Name FK1 Route_Geom_ID	<b>OBJECTID</b> Route_Measure_Begin Route_Measure_End Historical_Name FK1 Route_Geom_ID

Ties to temporal version



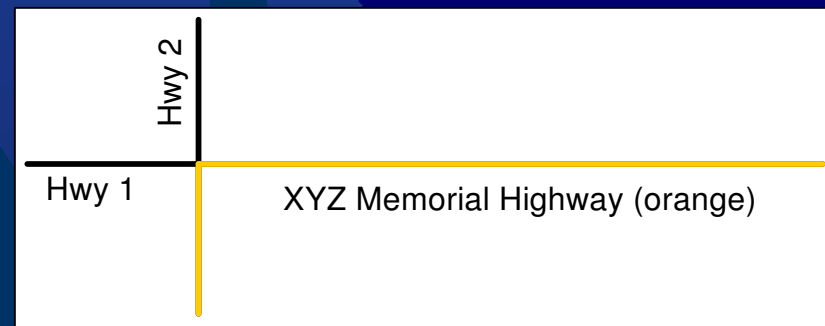
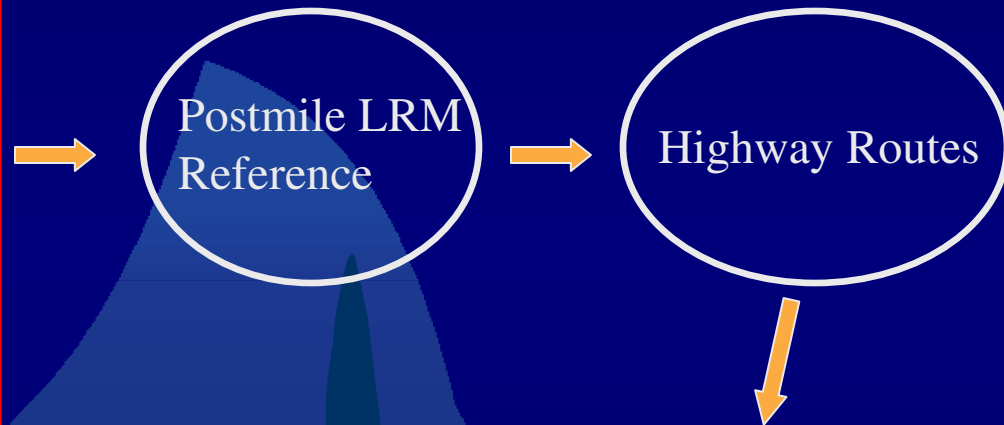
# Route Measure Business Data Example



# Postmile Business Data Example

## Postmile LRM Business Data

Interstate Hwy System	US Hwy System	State Hwy System
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Template - LinearEvents	Named Hwy System	Scenic Hwy System
<b>OBJECTID</b> County Route Name Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Event Data Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Designation (name) Reference Date	<b>OBJECTID</b> County Route Number Route Suffix Postmile Low Prefix Postmile Low Postmile Low Suffix Postmile High Prefix Postmile High Postmile High Suffix Designation (E or OD) Reference Date



# Relationship To Industry Standard Models

- ◇ Reference network / datum
- ◇ Multiple cartographic representations
- ◇ Multiple LRMs
- ◇ Spatiotemporal
- ◇ Functional areas
  - n Business data
  - n Location referencing
  - n Routes
  - n Datum



# Conclusions

- ◆ Geodatabase model supports Caltrans' Postmile and future LRMs through “loose coupling” of LRM Reference
- ◆ Geodatabase model supports alternative cartographies, temporal versioning, and auditing
- ◆ Successful modeling enabled by Caltrans' management and technical commitment



# Thanks for attending

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