



**Safety Priority Index System
(SPIS)**



Why use SPIS (or something like it)?

- Identify and rank sites most likely to benefit from crash reduction countermeasures
- Prioritize safety on roadway system
- Make safety a factor in decision making
- Answer public concerns about road safety



How a good safety program protects

(those using the roadway, agency from litigation, funds from misuse)

- Prioritizes decisions using an established, data-driven process.
- Documents safety spending decisions
- Sets aside designated funds for safety
- Receives approval at highest policy setting level
 - Get council or commission to approve and support



How a good safety program protects –

- If we identify it and don't fix it, aren't we in trouble?
 - *No, as long as you follow policy set by highest levels*
 - *“You have limited funds and can't fix everything”*
- If we don't know about it, we aren't liable, right?
 - *Wrong, you can be held liable regardless, especially if you should have known or someone informed you (e.g., “the public complained several times about the intersection”)*



Safety Priority Index System (SPIS)

- About SPIS
- “Sliding window” concept
- Annual SPIS reports
- SPIS formula, scores & rankings
- Project Development of New SPIS



About SPIS

- Roadway network safety screening method
- Primary tool used by ODOT since 1986
- Looks at linear crash data along Roadway
 - does not add in side street crashes at intersections
- Annual SPIS Uses:
 - 3 years of crash data
 - 0.10-mile “sliding” window
 - 3 crash measures



About SPIS

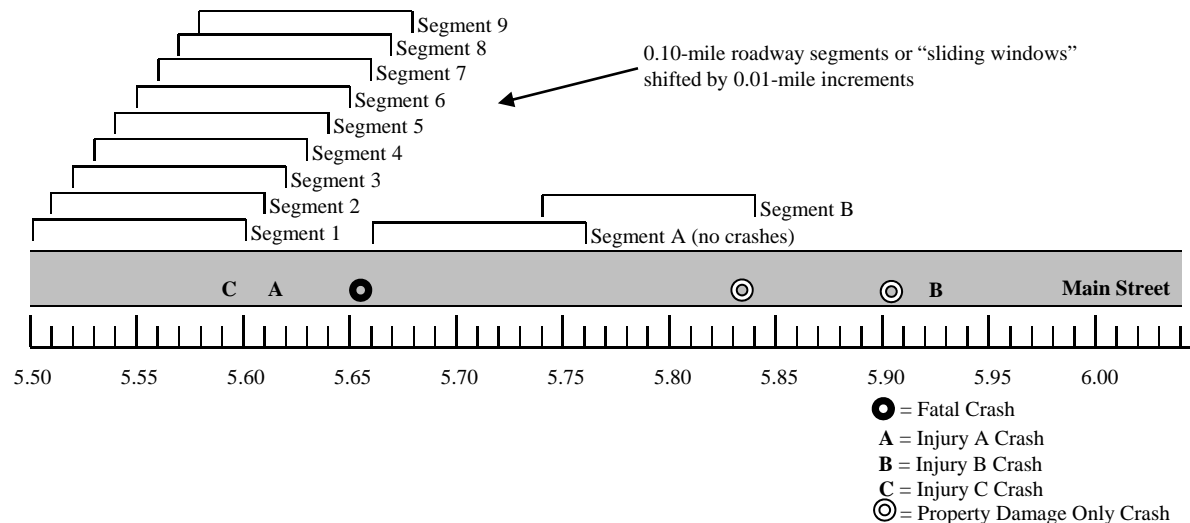
- SPIS is just a model, one way to prioritize
- Crash histories are subject to random variations, one year will be high, the next low
- SPIS does not account for RTM*

* RTM (regression to mean): Do anything or nothing today at a high crash site and it may look like it improved next year (i.e., natural variation looks like real change).



SPIS Segment “Sliding Window”

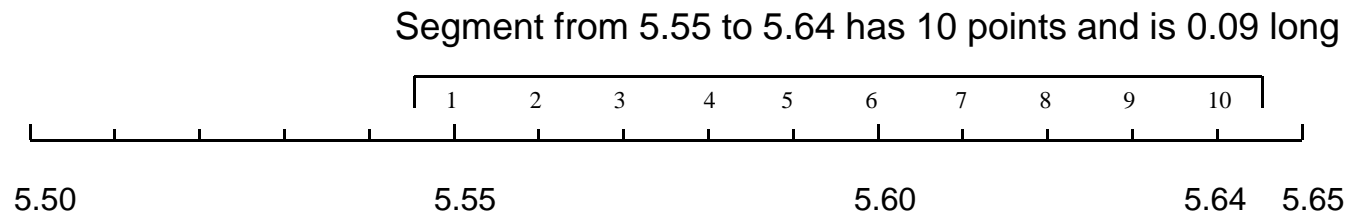
- 0.10-mile “window” segment slides 0.01-mile & recalculates SPIS score for each qualified segment
- Single crash location captured in multiple SPIS segments
- SPIS score calculated & reported for each qualified segment





SPIS Segment “Sliding Window”

- The 0.10-mile “window” segments is a misnomer (in a sense).
- A segment that is 0.09 in length (from begin to end) contains ten 0.01 mileposts.
- Now to further confuse you -- the segment is actually a 10th of a mile in length (or is it?)



Hint: The segment contains a half a hundredth on both side of the begin and end mileposts



Annual SPIS Reports

- Public roadway segments with SPIS scores and percentile ranking
- Sites with highest scores **may not be** the most likely to benefit from crash reduction measures
 - Investigate SPIS sites to determine if appropriate for crash reduction measures
- Not all top SPIS sites have cost effective fixes
 - Identify sites with best benefit-to-cost ratio
- ODOT uses for basis of FHWA 5 Percent Report



SPIS Formula, Score & Rankings

- SPIS formula combines crash frequency, rate and severity
 - Overcomes weakness of any one indicator
- SPIS score only calculated for “qualified” annual SPIS segments
 - 1 fatal or 3 other crashes of any severity in 3 calendar years within same 0.10-mile segment
 - ADT captured by SPIS process



SPIS Formula, Score & Rankings

- **SPIS score = Frequency + Rate + Severity**
 - Based on most recent 3 full calendar years of crash data
- **Crash Frequency (25%)**
 - 150 crashes in 0.10 mile produces maximum score of 25
- **Crash Rate (25%)**
 - 7 crashes per mvm produces maximum score of 25
- **Crash Severity Ranking (50%)**
 - Fatal and Injury A crashes 100 points each
 - Injury B and C crashes 10 points each
 - PDO crashes 1 point each
 - 300 points produces maximum score of 50



SPIS Score Calculation Examples

Top 5% SPIS Example (historically about 54)

1	Fatal crashes	20,000	ADT
2	Injury A crashes		
4	Injury B crashes	15.17	Frequency portion
5	Injury C crashes	7.80	Rate portion
8	PDO crashes	50.00	Severity portion
20	Total crashes	72.97	SPIS score

Top 15% SPIS Example (historically about 37)

0	Fatal crashes	14,200	ADT
1	Injury A crashes		
0	Injury B crashes	10.95	Frequency portion
3	Injury C crashes	4.99	Rate portion
4	PDO crashes	22.33	Severity portion
8	Total crashes	38.27	SPIS score

- Frequency reaches score of 20 at about 50 crashes & maximum score of 25 at 150 crashes
- Rate depends on ADT and reaches maximum score of 25 at rate of 7 crashes per mvm
- Severity reaches maximum score of 50 with 3 F&A or 2 F&A and 10 B&C
- Microsoft Excel SPIS score calculator available



SPIS Score Percentile Rankings

- Top 10% Cutoff SPIS Score
 - 90% of SPIS segments fall below this score
 - Determined using on-state highway SPIS data only
 - Same cutoff score applies to on-state & off-state SPIS rankings
- Example
 - 41,700 on-state highway SPIS segments
 - SPIS 10% segment = #4,170 (41,700 x 10%); its SPIS score = 42.38
 - Top 10% cutoff SPIS score = 42.38
 - All SPIS segments with SPIS score \geq 42.38 in top 10%
- ODOT investigates top 5% to identify SPIS segments to include in FHWA 5 Percent Report



Project Development

- Requirement of SAFETEA-LU
 - Each state have the ability to analyze the top 5% of all public roads
- Scope
 - Add City and County Roads
 - Develop an Adjustable SPIS
 - Reduce Annual Maintenance
 - Enhance Crash Summary



Project Development

- Initiated in fall of 2008
- First 6 months in discovery mode
 - Looking at off the shelf products, GIS and data warehouses
- Next year piloting a GIS proof of concept
 - Included five months attempting to get traffic volumes on the local road layer
- By August of 2010 the SPIS Architecture was complete
- Architecture review and requirements by February 2011
- SPIS ETL (Extract, Translate and Load) complete September 2011 for partial data and February 2012 for a full load
 - Discovered data gaps in GIS linework
- Report development was concurrent to ETL.
- SPIS went to production on March 27th 2012



Project Development

- Scope stayed very steady
- Had to remove ability for OASIS to save queries and have logon ID's
- Removed Map requirements from project to products made outside of SPIS
- Proof of Concept was required to flesh out the requirements for a GIS SPIS
- System requirements had to be reworked when it was realized that the SPIS data model was inadequate
- Requirements for a history report was dropped when it was discovered that the new process would make it very difficult to replicate.



Project Development

Moral of the Story

- We worked hard to stay within scope, not adding things
- We had to remove several non-critical parts
- It was much harder than we were led to believe
- We encountered several problems with data
 - Data that looks good at a macro level (i.e., a map) reveals problems when it has to work at the micro level (i.e., 1/100th of a mile)



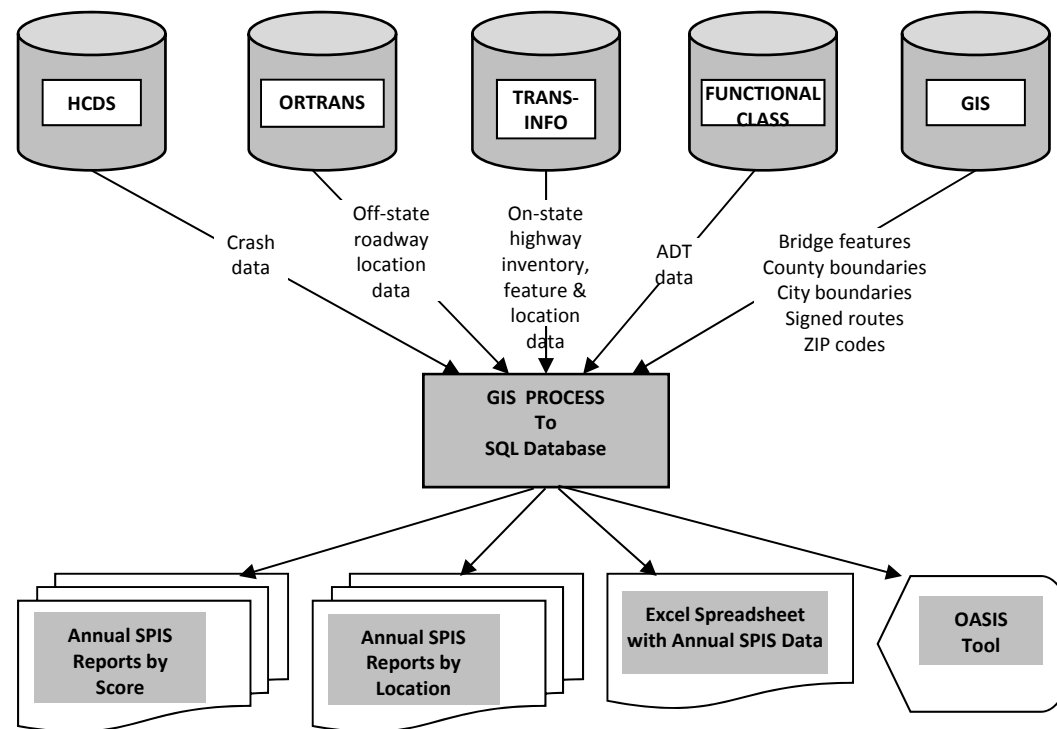
GIS SPIS

- Sources of data
- Data processing
- GIS layers
- Reporting
- Data Difficulties/Improvements/Results



GIS SPIS

The GIS SPIS uses data from several data sources and loads into GIS





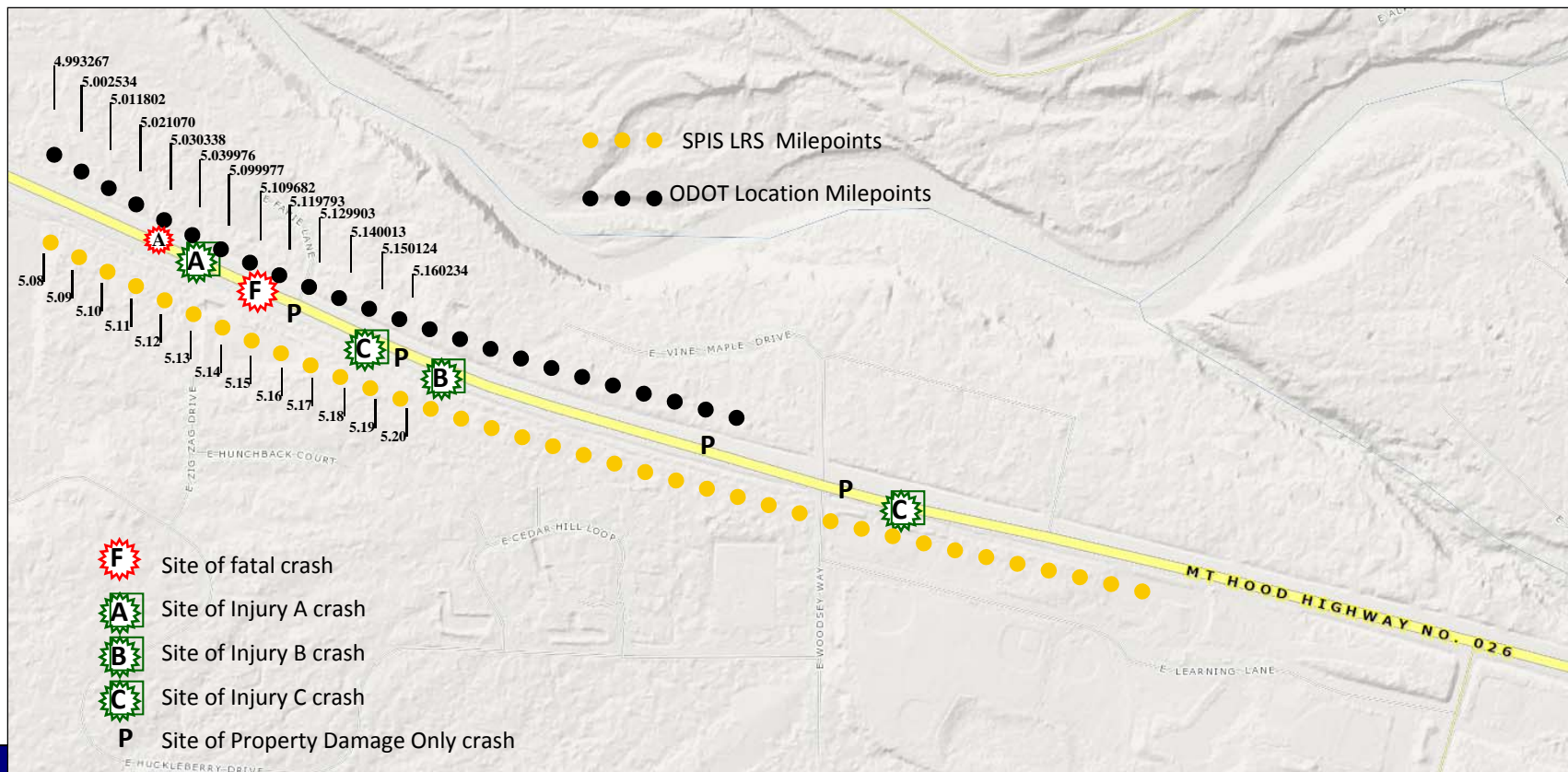
GIS SPIS

- The data is compiled on a GIS layer
- A SPIS Linear Referencing system is created
- The collection of data is analyzed
- Segments are determined and crashes assigned
- Data is loaded from GIS to a conventional SQL database



GIS SPIS

In order to support all public roads, the GIS SPIS produces a common reference system in GIS, a SPIS LRS and then translates back to the local LRS (on-state use milepoints, off-state use reference points)





GIS SPIS - Reporting

- Reports of the data can be generated from the SQL database
 - Top 10% by location
 - Top 10% by score
 - All Sites by location
 - All sites by score
 - Investigation Report
 - Excel All Sites by location (detailed report)



Annual SPIS Reports (on-state)



Oregon Department of Transportation

Region

2011 - On-State, Top 10% SPIS Groups - By Hwy, MP

2

Rte	Rdwy	BMP	EMP	Length	ADT	Crash	Fatal	A	B	C	PDO	City	County	Connection	Percent	SPIS
001	Pacific															
I-5	1	187.91	188.05	0.14	43,500	17	0	1	2	5	9		Lane	GOSHEN-DIVIDE HIGHWAY	90	47.91
I-5	1	200.89	201.07	0.18	36,900	8	0	2	2	1	3		Lane		90	51.95
I-5	1	214.91	215.08	0.17	37,400	5	2	0	0	1	2		Linn		90	45.65
I-5	1	236.91	237.08	0.17	57,900	15	0	1	2	5	7		Linn		90	45.87
I-5	1	251.92	252.09	0.17	68,500	25	1	0	3	7	14	Salem	Marion		90	52.89
I-5	1	277.91	278.07	0.16	83,600	22	1	0	4	5	12		Marion		90	51.88



Annual SPIS Reports (off-state)

Oregon Department of Transportation
2011 - Off-State, All SPIS Sites - By Score

County: Jackson

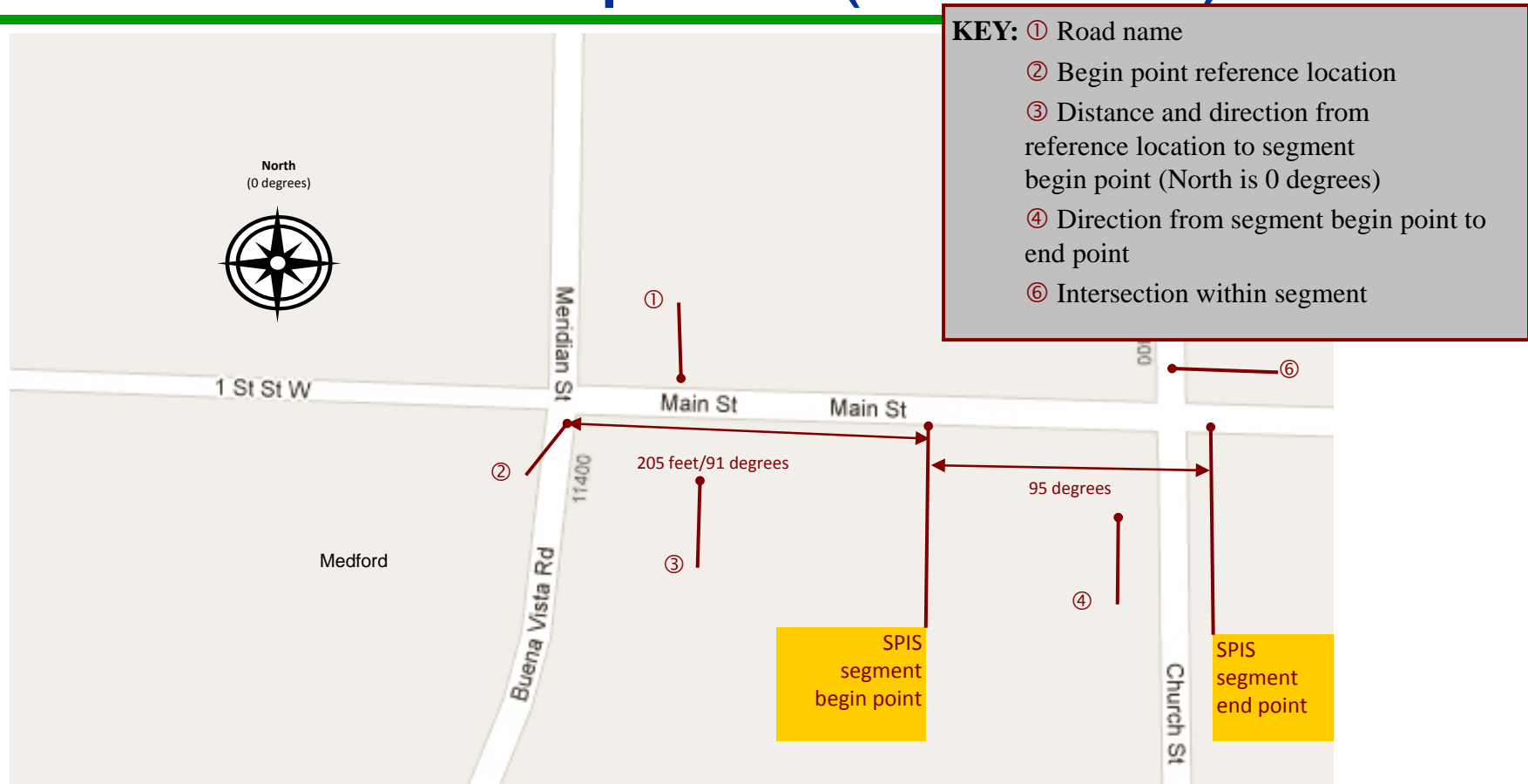
Rd Name	Rd No.	MP	Segment Begin Location Ref. Location Desc.	Dist. \ Dir. *	Direction from Begin City to End **	Intersection	ADT	Crash	Fatal	A	B	C	PDO	Percent	SPIS
E Main St		0.00	N BARTLETT ST	106 \ 236	55	Medford	5,572	11	0	0	2	5	4	85	37.11
Table Rock Rd	778	0.00	MORNINGSIDE ST	53 \ 0	180	Medford	10,156	12	0	0	2	7	3	85	37.08
Biddle Rd		0.00	MEADOWBROOK DRIVE	845 \ 271	90		15,970	10	0	1	0	1	8	85	37.05
E Main St		0.00	N BARTLETT ST	53 \ 236	55	Medford	5,618	11	0	0	2	5	4	85	37.04
E Main St		0.00	N BARTLETT ST	0 \ 0	55	Medford									
E Pine St		0.00	N 10TH ST	212 \ 236	64	Central Point									
W 4th St		0.00	N FIR ST	0 \ 0	55	Medford									
E Main St		0.00	N RIVERSIDE AVENUE	212 \ 235	57	Medford									
E McAndrews Rd		0.00	POPLAR DRIVE	106 \ 270	90	Medford									
E Main St		0.00	N RIVERSIDE AVENUE	159 \ 235	59	Medford									
E Pine St		0.00	MEADOWBROOK DRIVE	898 \ 271	91	Central Point									
E McAndrews Rd		0.00	POPLAR DRIVE	53 \ 270	90	Medford									
E Main St		0.00	N RIVERSIDE AVENUE	106 \ 234	61	Medford									
E Pine St		0.00	N 10TH ST	53 \ 234	69	Central Point									
E Pine St		0.00	N 10TH ST	159 \ 235	66	Central Point									
S Columbus Avenue		0.00	STEWART AVENUE	53 \ 3	160	Medford									
S Stewart Avenue	505	0.00	STEWART AVENUE	0 \ 0	157	Medford									
S Columbus Avenue		0.00	STEWART AVENUE	106 \ 1	163	Medford									
S Columbus Avenue		0.00	STEWART AVENUE	159 \ 1	168	Medford									
S Columbus Avenue		0.00	STEWART AVENUE	212 \ 1	172	Medford									

KEY:

- ① Road name
- ② Begin point reference location
- ③ Distance and direction from reference location to segment begin point (North is 0 degrees)
- ④ Direction from segment begin point to end point
- ⑤ City (if within city limits)
- ⑥ Intersection within segment
- ⑦ Average daily traffic
- ⑧ Crash counts by type
- ⑨ Percentile ranking for segment
- ⑩ Annual SPIS score for segment



Annual SPIS Reports (off-state)



Excel Spreadsheets also have lat and long, use <http://www.findlatitudeandlongitude.com/>



GIS SPIS – Data Difficulties

- When Road numbers or names change
- When Jurisdictions change
 - Recent jurisdiction or name changes impact data, the road may not have the crashes from all three years
- Data sources are from different years
- Process dependent annual data completion from several sources
- Mileposting (state highways)
 - Although more accurate, segment milepoint begin and end are inconsistent (i.e., appear to be less than 0.10)



GIS SPIS – Crash Data Difficulties

- Oregon is primarily a citizen reporting state, only about 6 states do not have the requirement for a police report.
- Studies from other states have shown crashes with greater severity are reported with greater reliability than crashes of lower severity.
 - It is suspected that almost 50% of reportable PDO crashes go unreported when one or more drivers agree not to report.
- Crashes may also be non-reportable when:
 - Do not meet reporting thresholds.
 - Hit and run with a parked vehicle or property.
 - Involve multiple vehicles who do not report and no enforcement present.
 - Does not involve a motor vehicle, i.e. bike vs. pedestrian or pedestrian vs. train.
 - Ruled the injury cause was a medical illness.
 - Intentional homicide or suicide.
 - Crash occurs on private property or not on traffic way (i.e., beach).
 - Was an industrial accident, i.e., backing over worker with equipment.



GIS SPIS - Improvements

- Z mileage and other inconsistencies (primarily on State Highways) are handled correctly
- Length of SPIS segments exact
- Crashes are located more accurately
- Rdwy 1 and 2 are combined more accurately



GIS SPIS – Results for 2012

- 4655 Top 10% On-State sites
 - 2111 Top 10% Off-State sites
 - Off-state represents 30% of the total Top 10% sites
 - The counties with the highest number of Top 10 sites:
 - Multnomah 854
 - Washington 252
 - Marion 228
 - Clackamas 216
 - Lane 134
 - The rest had below 100 Top 10% sites each...
- (80% of Multnomah County miles is City of Portland)
- } 4 counties make up 75%



Oregon Adjustable Safety Index System

- About OASIS
- OASIS data
- General Settings
- Crash Conditions
- Equations



OASIS

- OASIS is capable of performing the SPIS reports
- Users may select only specific crash types or conditions
- Users can vary-
 - Formula defaults
 - Injury Severity
 - Segment length
 - Number of years



OASIS

- OASIS uses the data from SPIS data load process
- OASIS has State Highway Ramps and connections also (not in Annual SPIS)
- Data is compiled in a GIS and then loaded to the SPIS database at the same time Annual SPIS is processed
- Data is compiled for different segment lengths to speed the query process



OASIS General Settings

- Crash Years: 3 or 5 years
- Segment Length: 0.10, 0.20, 0.50, 1.0, 2.0 or 5.0 miles
- Segment Qualifier:
 - 1 crash
 - 2 crashes
 - 3 crashes
 - 1 fatal or 3 crashes
 - 1 fatal or 1 Injury A or 3 crashes
- Jurisdiction:
 - On-state
 - Any ODOT region or all state highways
 - Off-state
 - 1, 2, or 3 Counties



OASIS – Crash Conditions

- Collision Type
- Weather Condition
- Light Condition
- Road Surface Condition
- Special Conditions



OASIS – Equations

- Four Score Equations
 - Three from SPIS and a fourth (new)
- Adjustments for
 - Severity (F, A, B, C, and PDO)
 - Weights
 - Maximum Values



OASIS

Demo of OASIS

<https://sahara.odot.state.or.us/tad/oasisapp/index.htm>



Other

- Crash Summary Reports
- Things to work on
- Rolling Out SPIS
- Available Resources



Crash Summary Report

- State Highways Only>>>>

[CSR - Report Manager](#)



Things to come or still work on

- Mapping (top 10% or top 15%)
 - May be static maps
 - May be GIS tool for queries and maps
- Crosswalk table/report for Crash Id's to SPIS segments
- Talk to Transportation Development about additional tools for analysis in GIS



Rolling out the new GIS SPIS

- Soft Roll out the first year
 - Start with a small amount of cities and counties in 2012
 - Make available to any agency in 2013
- A city or county can participate with ODOT in submitting Top 5% reports
 - Just submit investigations of top 5% prior to September 1 of each year.

<http://safety.fhwa.dot.gov/hsip/fivepercent/>



Available Resources

- SPIS reports and OASIS online
- ODOT Traffic-Roadway Section (TRS) SPIS website
 - <http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/spis.shtml>
- Documentation for new GIS SPIS
 - http://www.oregon.gov/ODOT/HWY/TRAFFIC-ROADWAY/gis_spis_documentation.shtml
- FHWA 5 Percent Report website
 - <http://safety.fhwa.dot.gov/hsip/fivepercent/>



Questions?

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