

# **Safety Priority Index System (SPIS), Oregon Adjustable Safety Index (OASIS), and Crash Summary Reports (CSR) System User Guide**



**Oregon Department of Transportation  
Traffic-Roadway Section**

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## Introduction to SPIS and OASIS

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### Safety Priority Index System

The Safety Priority Index System is a method originally developed in 1986 by the Oregon Department of Transportation (ODOT) for identifying potential safety problems on state highways. SPIS complies with the Federal Highway Safety Improvement Program (HSIP) and has been accepted by the Federal Highway Administration (FHWA) as fulfilling the requirements of the HSIP.

When Oregon began developing its Safety Management System in response to the 1991 ISTEA, it identified SPIS as one of several essential building blocks. SPIS has been recognized as an effective problem identification tool for evaluating state highways for segments with higher crash histories.

Several modifications to SPIS have been implemented over the years. Following the study, “An Evaluation of the Safety Priority Index System (SPIS),” completed by Dr. Robert Layton of the Transportation Research Institute at Oregon State University modifications were implemented in the 1998 SPIS reports. In 2005 the programs were rewritten in response to changes to the Crash Database, improvements to the reports were incorporated.

The current version includes a rewrite of the SPIS programs to include all public roads in Oregon (not just state highways). The new SPIS includes public roads that have data on Average Daily Traffic (ADT), generally that is all State Highways, and City Streets and County Roads that are functionally classed (collector and above).

The system includes both a component that produces Annual SPIS reports for both On-State Roadways (State Highways only) and Off-state Roadways (non-State Highways). Also included is a tool for performing “adjustable” SPIS calculations called the Oregon Adjustable Safety Index System (OASIS), it allows users to vary the SPIS formulas and thresholds.

### Annual SPIS

Annual SPIS was rewritten to accommodate the addition of all public roads into the reporting system. SPIS is a method of identifying potential locations that have exhibited high instances of crash activity for further investigation. Locations that exhibit a high number of crashes may or may not have remedies to reduce the frequency of crashes. A careful investigation is required to determine the causes or root problem of the crashes and even then a relatively high occurrence of crashes may only be due to the sporadic nature of crashes. The goal of investigating these locations is to systematically investigate sites where there is potential to reduce the risk, occurrence and/or severity of crashes and apply limited safety money to produce the highest benefit.

The new SPIS presented a difficult problem for extracting data from several sources, translating data so it could be used together and reporting the data in an understandable method. After looking at off-the-shelf systems, Standard SQL databases, data warehousing, and Geographic

Information Systems (GIS), it was decided that a GIS held the most potential for successfully combining the data and a standard SQL database for analyzing and reporting.

After development of the system it became clear it may be the only way to handle the diversity of data and lack of common referencing systems between State Highways, City Streets and County Roads.

### **Use of SPIS**

SPIS is used as a “network screening” tool. A network screening tool is a process for looking at the entire system and to prioritize sites that might benefit most from a safety improvement. Those sites can then be studied in more detail to “diagnose” common patterns, contributing factors, and identify appropriate safety improvements. Once diagnosed a comparison of benefits and costs can be performed to compare the economic benefits, societal benefits and other factors in order to prioritize projects.

SPIS scores should not be used to prioritize projects. Projects ranked according to SPIS scores may require high investment and may not result in the best return on investment. Safety funds are limited and should be prioritized on the basis of a project costs and crash reduction benefits. Other factors may enter into the type of countermeasure selected such as public acceptance, community desires and accommodating all users.

### **Annual SPIS Reports**

The SPIS reports were reformatted to closely match the previous Annual SPIS Reports. A Geographic Information System (GIS) was used to extract the data from several sources. The data for on-state and off-state roadways lacked a common reference system to match data or to report data, so using GIS provides a common reference system (latitude and longitude) to determine locations and calculate scores.

For on-state highway reports, the reference system used to locate SPIS segments is Highway number and milepoint, which is common to ODOT. For off-state roadway reports (city streets and county roads) there was no common reference system available, so the project developed a new system. Relying on distance and direction from a reference point (also latitudes and longitudes are available). Because many Counties use milepoints, milepoint fields were included in the database design but the report columns are blank. ODOT intends to include that data into their GIS processes in the future.

There are several items within the reports that are common to both on-state and off-state reports, such as city and county jurisdiction, the total number of crashes, the crashes by severity and SPIS score and rank.

### **Oregon Adjustable Safety Index System**

The Oregon Adjustable Safety Index System (OASIS) was developed as an online safety analysis tool that is capable of performing “SPIS like” safety analysis and allows users to vary the SPIS calculations. Not only may specific types of crashes be analyzed but parameters that may be changed including segment length, number of crash data years and the SPIS formula defaults like the weightings of the formulas. The OASIS tool allows the user to create custom safety analyses of the data within the system.

Because of the possible scope of changes to the various setting in OASIS only a licensed professional engineer with specific expertise in Roadway Safety should be resetting the defaults and using the program. An understanding of the fundamental concepts of roadway safety techniques, crash data and analysis are key to using the system.

Users must identify the purpose or intended outcome of the analysis, identify the reference population (select types of crashes or all crashes), select their equations and parameters to evaluate safety (which equation and settings are most applicable) and evaluate the results of their analysis. If the analyst has selected the right parameters and equations the higher magnitude scores should lead to good sites for investigation.

Once the analysis is complete and sites have been identified the next step is to diagnose the problems at the site. Because a particular site has been “flagged” by the system does not mean that it is a good site for improvement. The point of any diagnosis is to develop an understanding of the common crash types and the problem area, uncover an understanding of the crash mechanisms and finally recommend cost effective solutions that improve the safety of the site.

Scores should not be used to prioritize projects. After a diagnosis of the problems an economic comparison should be performed and the projects should be prioritized based on benefits and costs.



## Section 1

# Safety Priority Index System

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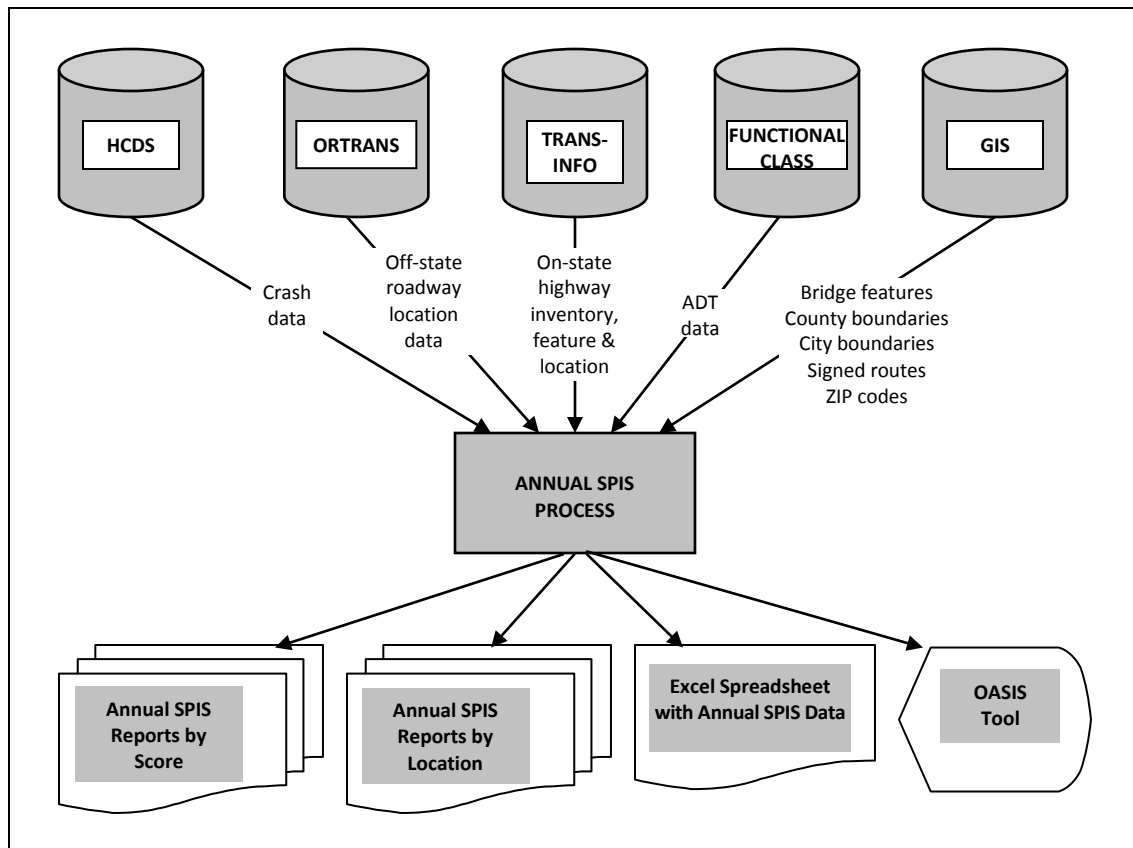
## Section 1-1 Sources of SPIS Data

The SPIS process locates qualifying annual SPIS segments and calculates annual SPIS scores for these public roadway segments using the following data sources:

- Statewide crash database (HCDS) maintained by the ODOT Crash Analysis and Reporting Unit for number, location and severity of crashes
- Oregon Transportation Network (ORTRANS) system for off-state roadway location information
- TransInfo for on-state highway inventory, feature and location information
- ODOT Federal Functional Class System database for average daily traffic (ADT) counts

Other GIS data used in locating off-state highway SPIS segments include:

- Bridge features
- County boundaries
- City boundaries
- Signed routes
- ZIP codes





## Section 1-2

### Sources of Annual SPIS Crash Data

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The annual SPIS process uses crash data (number, location and severity) from the Crash Data System maintained by the ODOT Crash Analysis and Reporting (CAR) Unit. The base data is compiled from individual driver and police crash reports submitted to the Oregon Department of Transportation as required by ORS 811.720. Please note: property damage only (PDO) crashes are no longer used in the SPIS calculation which started in 2018 SPIS year.

Motor vehicle traffic crashes must be reported when they result in:

- More than \$2,500 in damages to a vehicle or property
- Death or injury of a person (no matter how minor the injury)
- Any vehicle towed due to damage

Data on a particular crash may **not** be in the ODOT database if it involved:

- Less than \$2,500 in damages (i.e., did not meet reporting threshold)
- A non-motorized vehicle only (i.e., bicycle)
- A “hit and run” with a parked vehicle or property
- Only one vehicle and driver did not report it and no police were present to report it
- Multiple vehicles and drivers who “agreed” not to report the event and no police were present to report it
- License suspensions with non-compliant drivers and the crash reporting has been delayed in the Driver and Motor Vehicle Services Division’s process
- Serious injury litigation or an ongoing criminal investigation and the crash report hasn’t been submitted yet

Individual drivers bear responsibility for submitting crash report forms. Therefore, ODOT cannot guarantee the database captures all qualifying crashes nor assure the accuracy of details pertaining to a single crash.

The crash database captures data on all fatal crashes based on the criteria set by the “Manual on Classification of Motor Vehicle Traffic Accidents.” A crash involving a death is not included in the crash database if the fatality:

- Was ruled by the State Medical Examiner to be the result of a medical illness (i.e., not a result of crash injury), intentional homicide or suicide
- Occurred more than 30 days after the crash event
- Occurred on private property (e.g., driveway, parking lot, etc.)
- Did not occur on a traffic way (e.g., beach, wilderness trail, etc.)
- Occurred as an industrial crash (e.g., motorized equipment ran over worker at work)
- Did not involve a motor vehicle (e.g., bicyclist vs. pole, pedestrian vs. train, etc.)

### Crash Data in Oregon

Crash data in Oregon is collected from two sources, primarily from citizen reports and secondarily from enforcement. Enforcement files a police report in about 40% of the reported



crashes, but not all crashes are reported. Some crashes that qualify to be reported go unreported, and a large number of crashes do not qualify to be reported.

Motor vehicle crashes must be reported when:

- There is more than \$2,500 damage to a vehicle or other property
- Someone is injured (no matter how minor) or killed.
- Any vehicle is towed.

Some crashes do not make it into the crash database, i.e:

- 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.
- Occasionally there will be a serious injury litigation or ongoing criminal investigation that holds up the record.
- 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.

Crash data is received from DMV after DMV collates driver reports and police reports and records any driver violations or suspensions. Crash data is coded into the crash database, with data specific to the individuals and the vehicles and general data about the crash, type, location, errors, etc. The database validates codes before loading to the master file. In addition data analysts run specified queries to validate data. Any errors are corrected before the year end file is finalized. If errors are found afterwards the analysts can go back and correct the file.

Crash data is available via pre-formats summary reports, data extracts and maps. The Crash Analysis & Reporting (CAR) Unit also produces year end annual reports and rates. The data is also used to develop the SPIS and also to produce GIS maps/layers in TransGIS. CAR also receives and produces multiple requests from various sources, generally for queries of the crash data, outputs varies in the form of maps, reports, diagrams, access databases, and summaries.

Direct access to crash reports are available at <https://tvc.odot.state.or.us/tvc/>.

## Crash Data Quality

Even with the extensive efforts to collect all data, and do so accurately, not all crashes are recorded and those that are may not be accurate. Some Jurisdictions may have access to more information about crashes that were either unreported or did not meet the reporting thresholds. To be able to compare data from city to city and from jurisdiction to jurisdiction, SPIS should not be supplemented with additional data. Even if the additional data was to be supplemented for an entire jurisdiction, the SPIS data would only be useful for comparison purposes within that jurisdiction, because the additional data would bias that jurisdiction's comparisons with other jurisdictions. Using the Crash data solely from the State Crash data file provides an unbiased source of reported crashes for comparison purposes.

That is not to say that additional data is not useful, it can be very useful when diagnosing conditions at individual sites. The data can help to point out additional errors or problems at a particular site.

### **Other Considerations**

Studies have shown that crashes with greater severity are reported with greater reliability than crashes of lower severity. Oregon's data appears to exhibit this tendency, especially as it applies to Property Damage Only (PDO's) crashes. PDO's have been shown to be under reported in Oregon as compared to other states crash data. This can cause problems with determining if a change is an actual change in crashes or a change in severity or a mixture of the two. It is important to recognize that this condition exists if the objective is to reduce all crashes, but may not be as important depending if the jurisdiction's objective is to reduce fatal and serious injury crashes.

There are differences between states reporting thresholds and differences among definitions of different crash types. This can lead to difficulties in comparing data between states. The difference, although slight, may exist between jurisdictions within the state, for instance if one city has a higher priority for police crash reporting than another and thereby has better crash data. That is why most comparisons are limited to either fatal crashes or fatal and serious injury crashes. Differences may also exist between the definitions of injury scales, for example what constitutes a serious injury crash.

Crash data may contain only partial information, a citizen report or even police report may fail to check that the crash occurred in a school zone or work zone or that the citizen was on a cell phone when the crash occurred.

In summary the crash database is only partial information, may contain inaccurate or incomplete information, may not be uniform for all crash severities, may vary over time and may differ from jurisdiction to jurisdiction. For all the limitations contained in the data, Oregon still has a large representative sample of data and is fairly unbiased (biased only in the severity of the crash), statistically this data can be used to make inferences about the roadways in Oregon.

### **Variations in the Crashes (randomness and change)**

Variations in crash data occur due to randomness of the data and change in condition of the roadway (i.e., snow or ice). These variations are inherent in the data as opposed to the limitations of data due to the method it is collected.

Natural variations due to crashes occur year to year, due to the fact the crashes naturally fluctuate over time at any given site. This is why SPIS uses three years of crash data. From year to year crash data at a particular site may fluctuate up or down but an average over three years or five years tends to reduce fluctuations. In other words short term averages may vary significantly from the longer term average crash frequencies.

The random nature of crashes makes it more difficult to determine whether changes in crash frequencies are due to changes in site conditions or are due to natural variations. When a

relatively high crash frequency is detected it is statistically probable that following period will have relatively low crash frequencies. This tendency is called regression to the mean.

### **Surrogates for Crash Data**

Surrogates for crash data such as traffic violations or tire skid marks can be useful to making more reliable decisions. They may be a significant predictor of crash activity, but may actually have strong correlation or weak correlation to actual crashes. In cases where actual crashes should be present in sufficient numbers (i.e. intersection crashes) to help prioritize decisions but there are only violations present maybe the surrogate is not a good indicator. Where crashes are less frequent (i.e. pedestrian crashes) , surrogates such as speeding behaviors may play a significant role in prioritizing which corridors might be best for treatment. Where surrogates are the only available information it may be best to use only low cost systematic improvements that can be widespread, this way if some of the sites benefit and others don't, there is a low cost risk to investing in safety.

Although higher violations usually do not correlate to higher crashes, the reverse is usually true, higher crashes typically follow along with higher violations. Where crashes have been high and a countermeasure reduces crashes, violations have been shown to reduce 50%.



## Section 1-3

### Extract, Translate and Load Data Process

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The ETL process stands for Extract, Translate and Load data for the SPIS system. Data is compiled from several sources, Crash data, Oregon Transportation Network (ORTRANS, off-state roadways), TransInfo (on state roadways -State Highway inventory data), and other data from Geographic Information Systems.

Different jurisdictions use different location referencing systems, even different data may use different referencing systems and be comprised of one or more referencing methods. The referencing system provides “protocol” for locating features on a roadway system. The referencing system enables mapping and location of traffic characteristics, crashes, roadway intersections, etc.

The elements contained in the TransInfo used to identify a unique location on a state highway, connection or frontage road include a Highway Number, a Highway Suffix, Roadway ID, Mileage Type and overlapping Mileage Code. Counties have Road ID numbers and some have milepoints. Cities have a variety of methods, such as Street name, node and distances (distance from an intersection or other known point).

In order to support a statewide system that produces results from the same platform a common reference system is highly desirable. A Geographic Information System (GIS) provides a powerful tool for combining this data. GIS is an essential component of SPIS, the same process would be extremely difficult using conventional data systems.

A GIS is a computer-based tool used to gather, transform, manipulate, analyze, and produce information that can be loaded into a conventional SQL database for reporting. As a data integration tool for SPIS crash data, traffic volumes, roadway network and references, the data can be tied or referenced to a particular location on a roadway map and analyzed using GIS software. GIS Coordinates (latitude and longitude) provide a reference system for the location of data points and SPIS segments on the roadway system. The GIS coordinates can then be referenced back to known points on the roadway system.

The SPIS process compiles the data on a GIS base layer, a digital mapping file that is used as a basis for combining existing data for SPIS on roadways in Oregon in a common reference system. The system uses geographic coordinates to provide latitude and longitude measurements for the location of data points on the earth's surface.

Once the data is analyzed a collection of data items can be arranged for processing and loading to the database. The organization of data in the database is prescribed by the SPIS application so that it can be further processed and reported. The records are used for producing the annual SPIS reports. An additional application called OASIS (Oregon Adjustable Safety Index System) can be used to query the database in different ways and standard reports can be produced.

## Data Difficulties

There are always difficulties when working with real world data. One of the notable difficulties with SPIS is when road numbers change or jurisdictions change. Data prior to the change is coded to prior road numbers or jurisdictions. Data after the change is coded to the new road number or jurisdiction. Seldom is the data entered prior to a change ever updated, this would require extra resources and can be a lot of work. When it is feasible to move the old data over to the new name, number or jurisdiction it is. But for many reasons it is not feasible. Because of the sheer number of crashes in the crash data system it is not feasible to change past data or even build systems to account for the particular changes.

When using SPIS be aware that whenever there has been a recent jurisdiction change, road number change, name change or remileposting it might affect the data. The analyst is warned that in these instances the system is not designed to take into account these changes and may have to make special efforts to check the data around these changes. This may require the analyst to inquire into past crashes at the old location and reconcile the old and new data to check for safety issues. The good news is that these difficulties are usually remedied over just a few years.

ODOT has a spreadsheet tool (SPIS Calculator) developed for manually inputting crash data and traffic volume data to calculate the SPIS score for a particular segment that might be of use when trying to combine old and new data.



## Section 1-4 Annual SPIS Score Calculation and Formulas

The Safety Priority Index System (SPIS) score is calculated for qualifying 0.10-mile segments<sup>1</sup> of roadways based on the frequency, rate and severity of crashes occurring within each segment over a three-year period. Please note: property damage only (PDO) crashes are no longer used in the SPIS calculation which started in 2018 SPIS year.

The SPIS score is the sum of three indicator values ( $IV_{Freq} + IV_{Rate} + IV_{Severity}$ ), where:

- $IV_{Freq}$  (Crash Frequency Indicator Value) equals 25 percent of the SPIS score
- $IV_{Rate}$  (Crash Rate Indicator Value) equals 25 percent of the SPIS score
- $IV_{Severity}$  (Crash Severity Indicator Value) equals 50 percent of the SPIS score

The higher a SPIS score, the higher the potential safety needs for the identified roadway segment. The highest SPIS score possible is 100. This is reached when a 0.10-mile segment over three calendar years has:

- 150 or more total crashes,
- Seven or more crashes per million entering vehicles, and
- A combined severity rating equal to or greater than 300.

### Crash Frequency Indicator Value Calculation

Crash frequency refers to the number of reported crashes occurring in a defined length of roadway during a defined period of time. Many agencies use crash frequency to compare the number of crashes at one location to the number of crashes at another location, typically over similar periods of time and similar lengths of roadway.

While crash frequency provides a simple way to rank roadway safety, it may tend to be over exaggerated on roadway segments with high volumes and thus high numbers of crashes.

The Crash Frequency Indicator Value,  $IV_{Freq}$ , is a value between 0 and 25 determined using a logarithmic distribution based on total number of crashes. With a logarithmic distribution, the CFI value increases quickly and then levels out near a maximum value.

$$IV_{Freq} = \left[ \frac{\text{LOG}(\text{TotalCrashes} + 1)}{\text{LOG}(150 + 1)} \right] (25)$$

**Guidance:** The maximum Crash Frequency Indicator Value of 25 is obtained when the total number of crashes reaches 150 crashes on the same 0.10-mile segment over a three-year period.

<sup>1</sup> A public roadway segment qualifies as an annual SPIS segment if it has:

- At least one fatal crash or one injury A crash or three injury crashes over a three-year period that has been captured in the statewide crash database, and
- An average daily traffic (ADT) count that has been captured in the Oregon Transportation Network (ORTRANS) system

## Crash Rate Indicator Value Calculation

Crash rate is another method to compare crashes at one location to another location in relation to some measure of exposure (typically traffic volumes). Crash rates normalize the frequency of crashes based on traffic volumes.

Crash rate is a simple measure but may overemphasize low volume segments with low numbers of crashes, which tends to offset crash frequency.

The Crash Rate Indicator Value,  $IV_{Rate}$ , is a value between 0 and 25 determined by using a logarithmic distribution based on crash rate per million entering vehicles given the average daily traffic (ADT) volume.

$$IV_{Rate} = \left[ \frac{\text{LOG} \left( \left( \frac{\text{TotalCrashes} (1,000,000)}{(3\text{yr})(365\text{days})(ADT)} \right) + 1 \right)}{\text{LOG}(7 + 1)} \right] (25)$$

**Guidance:** The maximum Crash Rate Indicator Value of 25 is obtained when the crash rate reaches seven crashes per million entering vehicles in the same 0.10-mile segment over a three-year period.

## Crash Severity Indicator Value Calculation

Crash severity (sometimes referred to as equivalent property damage only) assigns weighting to crashes by severity. The severity rating for a crash is the severity of the most severe injury received. Agencies typically use this measure to give more relative weight to more serious types of crashes or may weight the severity by the cost of the crash.

The Crash Severity Indicator is a linear function that uses a relative cost crash for each severity. The indicator uses 100 as representative of the cost of Fatal and Injury A crashes, 10 as representative of the cost of injury B and C crashes. Generally speaking a Fatal and Injury A crash costs 100 times a PDO crash, and the Injury B and C crashes cost ten times the PDO crash. PDO crashes are no longer used in SPIS calculations.

Crash severity may tend to overemphasize segments with a low frequency of severe crashes depending on the weighting.

The Crash Severity Indicator Value,  $IV_{Severity}$ , is a value between 0 and 50 determined by a weighted crash severity sum where:

- FATAL = the number of Fatal crashes
- $INJ_A$  = the number of Class A (severe injury) crashes
- $INJ_B$  = the number of Class B (moderate injury) crashes
- $INJ_C$  = the number of Class C (minor injury) crashes

**Note:** The classification of a crash as Fatal, Class A, Class B or Class C is determined by the most severe injury that results from the crash.

$$IV_{\text{Severity}} = \left[ \frac{100(FATAL + INJ_A) + (10)(INJ_B + INJ_C)}{(300)} \right] (50)$$

**Guidance:** The maximum Crash Severity Indicator Value of 50 is obtained when the crash severity component  $[100(FATAL + INJ_A) + 10(INJ_B + INJ_C)]$  is equal to or greater than 300 for the same 0.10-mile segment over a three-year period.

Use the online SPIS calculator with the following examples.

### Example 1

A .10-mile segment of Beaverton-Hillsdale Highway in Washington County was the site of 20 crashes during calendar years 2008 through 2010, including:

- 1 Fatal crash
- 2 Class A injury crashes
- 4 Class B injury crashes
- 5 Class C injury crashes
- 8 PDO crashes (No longer used in SPIS calculations)

The ADT for this roadway segment is 20,000. The calculated indicator values and SPIS score for this SPIS segment are:

- Crash Frequency Indicator Value ( $IV_{\text{Freq}}$ ) = 12.78
- Crash Rate Indicator Value ( $IV_{\text{Rate}}$ ) = 5.25
- Crash Severity Indicator Value ( $IV_{\text{Severity}}$ ) = 50.00
- **SPIS Score ( $IV_{\text{Freq}} + IV_{\text{Rate}} + IV_{\text{Severity}}$ ) = 68.03**

### Example 2

A 0.10-mile segment of Egan Avenue in Burns was the site of two crashes during calendar years 2008 through 2010, including:

- 1 Class B injury crash
- 1 PDO crash (No longer used in SPIS calculations)

The ADT for this roadway segment is 1,000. This roadway segment does not meet the minimum number of crashes (one fatal or one injury A crash or three injury crashes) during the three calendar years required for a SPIS score calculation: **It has no SPIS score.**

### Example 3

A 0.10-mile segment of Oak Street in Brookings was the site of four crashes during calendar years 2008 through 2010, including:

- 3 Class C injury crashes



The ADT for this roadway segment is 39,000. The calculated indicator values and SPIS score for this SPIS segment are:

- Crash Frequency Indicator Value ( $IV_{\text{Freq}}$ ) = 6.91
- Crash Rate Indicator Value ( $IV_{\text{Rate}}$ ) = 0.82
- Crash Severity Indicator Value ( $IV_{\text{Severity}}$ ) = 5.00
- **SPIS Score ( $IV_{\text{Freq}} + IV_{\text{Rate}} + IV_{\text{Severity}}$ ) = 12.72**



## Section 1-5

### Annual SPIS Segment “Sliding Window”

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The SPIS process uses a 0.10-mile “sliding window” that moves along a roadway in 0.01 increments to identify qualifying annual SPIS segments for which to calculate SPIS scores. To qualify as an annual SPIS segment, a 0.10-mile long roadway segment must have an average daily traffic (ADT) volume and been the site of at least one fatal crash or one injury A crash or three injury crashes of any severity during the past three calendar years.

More specifically, the SPIS sliding window process follows these steps:

1. Locate the site of a crash along a public roadway.
2. Overlay a 0.10-mile sliding window segment so that the crash site is at the leading end of the segment.
3. Determine if the segment qualifies as an annual SPIS segment. *If qualified*, calculate and report the annual SPIS score on the annual SPIS report.
4. Shift/Slide the segment by a 0.01-mile increment.
5. Repeat Steps 3 and 4 until the 0.10-mile sliding window does not contain a crash site.
6. Locate the next crash site along the roadway and repeat Steps 2 through 6 until all identified crash sites along the roadway have been evaluated. Repeat the process for all public roadways with an available ADT.

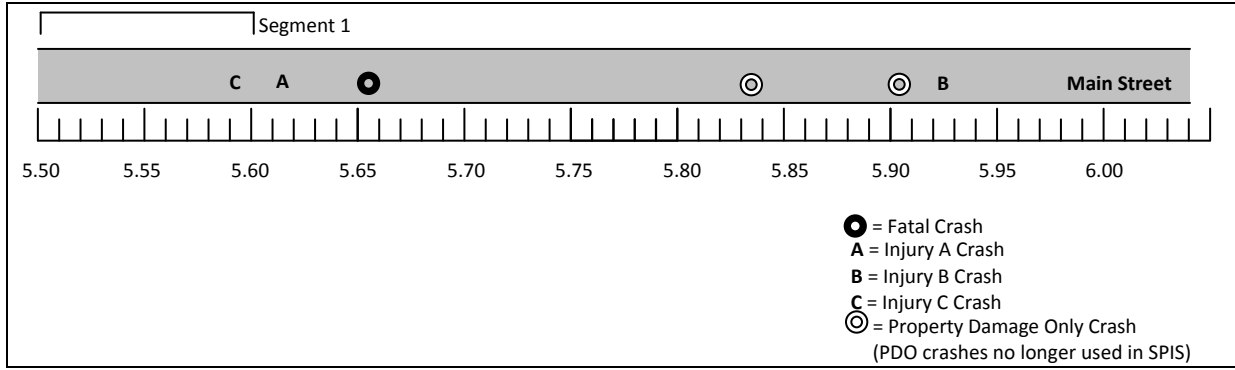
With the sliding window approach:

- A crash may be associated with more than one qualifying annual SPIS segment.
- For each qualifying annual SPIS segment, a SPIS score appears on the annual SPIS report.
- The annual SPIS report may contain multiple, overlapping annual SPIS segments that encompass the same crash.

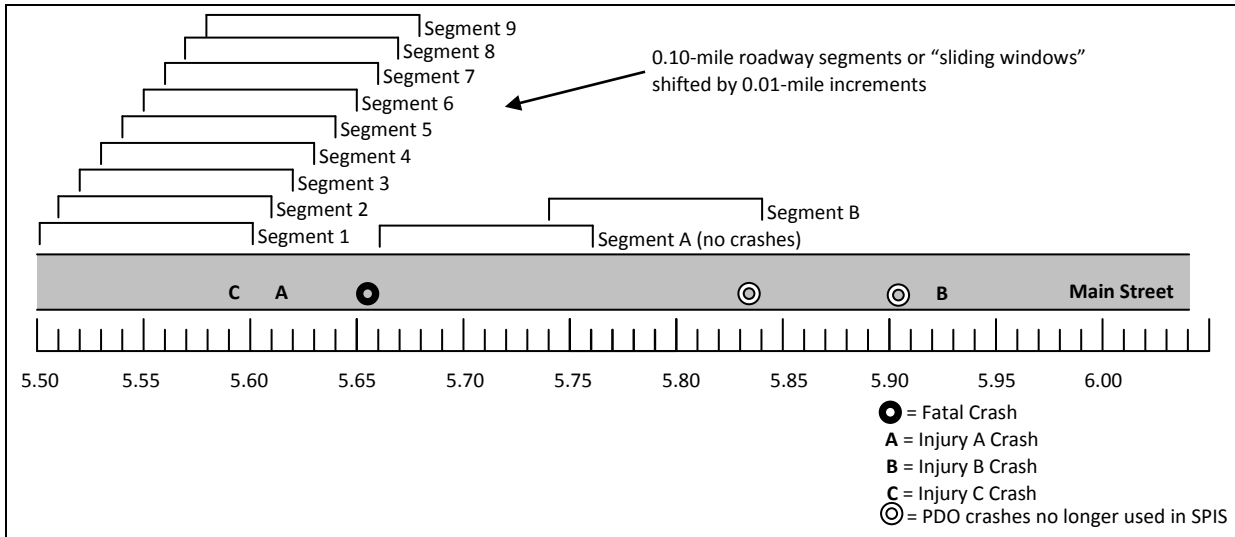
If there is a fatal crash or injury A crash or more than three injury crashes coded to the same location, it is not unusual to have 10 repeat SPIS segments with the same crashes (see below for an example of three repeat segments). In fact if there are enough crashes on a particular segment of roadway, the SPIS segments may be contiguous for several tenths of a mile.

#### Annual SPIS Segment Sliding Window Example

The SPIS process locates a crash (C) on Main Street. A 0.10-mile segment is overlaid along Main Street so that the crash site is at the leading end of the segment.



A SPIS score is **not** calculated for this first segment (Segment 1) as the one Injury C crash does **not** qualify it as an annual SPIS segment. The window slides by 0.01-mile.



Segment 2 also does not qualify as an annual SPIS segment, so no SPIS score is calculated. The segment window slides another 0.01-mile.

Segment 3 includes the Injury C and Injury A crashes. With one injury A crash, it does qualify as an annual SPIS segment, so a SPIS score is calculated beginning with this segment.

The window continues to slide in 0.01-mile increments, calculating a SPIS score, and Segment 7 which includes the two non-fatal crashes and a fatal crash.

Segment 7 qualifies as an annual SPIS segment with the fatal crash (and also because of the injury A crash and the injury crashes within it). A SPIS score is calculated and reported on the annual SPIS report.

The window continues to slide in 0.01-mile increments, determining if each segment qualifies as an annual SPIS segment.

Segments 8 and 9 also qualify as annual SPIS segments, so annual SPIS scores are calculated and reported on the annual SPIS report.

The window continues to slide in 0.01-mile increments, repeating the screening process, until it does not contain a crash site (Segment A). The SPIS process then shifts to the next crash site along the roadway (Segment B) and repeats the sliding window screening process to identify qualified annual SPIS segments.

As illustrated above with Segments 7, 8 and 9, one crash may qualify multiple, overlapping segments as annual SPIS segments. Each qualifying annual SPIS segment has an associated annual SPIS score. On the annual SPIS report, these overlapping annual SPIS segments appear as a group as shown in the illustration below.

Ed Name		Ed No.	MP	Segment Begin Location		Segment End Location		City	Intersection	ADT	Crash	Fatal	A	B	C	PDO	Percent	SPIS
AAA																		
Main Street		100	56.95	Intersection of Big Mountain Drive		135380 \ 260	0.09 \ 167	Tree City		14000	11	3	2	1	1	4	95	106.22
Main Street		100	56.97	Intersection of Big Mountain Drive		135485 \ 283	0.09 \ 77	Tree City		7000	7	2	0	0	1	4	95	53.83
Main Street		100	56.99	Intersection of Big Mountain Drive		135591 \ 319	0.09 \ 241	Tree City		17500	11	2	1	2	1	5	95	73.67
Main Street		100	57.14	Intersection of Big Mountain Drive		136383 \ 304	0.09 \ 317	Tree City		18000	22	1	5	5	5	6	95	142.30
Main Street		100	57.19	Intersection of Big Mountain Drive		136647 \ 2	0.09 \ 163	Tree City		8000	17	1	3	4	5	4	95	109.70
Main Street		100	57.30	Intersection of Big Mountain Drive		137228 \ 276	0.09 \ 306	Tree City		5	17	0	5	4	4	4	95	124.23
Main Street		100	57.34	Intersection of Big Mountain Drive		137439 \ 330	0.09 \ 165	Tree City		17500	13	0	3	4	4	2	95	83.04
Main Street		100	57.35	Intersection of Big Mountain Drive		137492 \ 319	0.09 \ 144	Tree City		5500	12	1	3	3	4	1	95	104.46
Main Street		100	57.36	Intersection of Big Mountain Drive		137544 \ 285	0.09 \ 29	Tree City		10000	10	1	3	3	3	0	95	96.42
Main Street		100	57.42	Intersection of Big Mountain Drive		137843 \ 334	0.09 \ 303	Tree City		20000	10	1	3	1	4	1	95	91.44

Segments 7, 8 and 9

**Note:** Prior to 2011, the SPIS process used the sliding window approach to screen each state highway from beginning mile point to ending mile point, 0.01-mile at a time, to identify qualifying 0.10-mile segments for which to calculate annual SPIS scores. The above approach, screening only where crashes occur, became effective in 2011.



## Section 1-6 Using Annual SPIS

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SPIS uses crash history to determine where potential safety problems may exist. The SPIS method provides a uniform way to look at crash history and rank segments (or sites) on the network of Oregon highways. There are a variety of ways to analyze and rank crash data (see the Highway Safety Manual for all the different methods to rank and analyze crash data). SPIS provides a relative ranking of sites, but a higher SPIS score does not indicate which sites might be more or less beneficial to treat.

A jurisdiction may consider using SPIS as a way to look for potential safety projects. SPIS can be an integral part of the process by which safety projects may be selected, but by no means the only information used.

The following process should be used to determine where specific safety projects might be justified using SPIS:

1. Review top SPIS locations to determine where and what possible safety improvements might be considered. Other possible locations to examine might include areas where safety concerns have been expressed or where other methods have identified potential safety concerns.
2. Diagnose the safety problem and select alternative safety measures. Refer to the Highway Safety Manual, the Crash Modification Factors Clearinghouse or ODOT Safety Investigations Manual for more information about diagnosing and selecting cost effective projects.
3. Evaluate the costs and benefits of potential safety improvements for various alternative safety improvements. Given limited funding, first priority should be given to sites that have the best benefit to cost ratio or the highest reduction in fatal and serious injury crashes, not the highest SPIS score.
4. Develop a program of projects using the benefit/costs and other factors to determine the relative priority of projects.

**Note:** The SPIS score is not a valid method for prioritizing projects; it does not include any measure of benefit or potential crash reduction – that must be determined by engineering investigation.

### Understanding SPIS and Different Ranking Methods

Many agencies may use a straight forward Crash Frequency method, where crash locations are ranked by the number of crashes that occur within the segment or intersection. This method tends to over emphasize high volume locations because of high numbers of conflicts and relatively high number of crashes.

A Crash Rate method compares the number of crashes with the number of vehicles or vehicle miles at a particular site or within a particular segment. The rate is typically put in terms of “crashes per million vehicles” or “crashes per million vehicle miles.” This method has been used successfully for ranking intersections for many years. The method tends to correct for high

volume locations that have higher numbers of crashes, but may tend to favor locations with relatively low crash numbers and low volumes.

The Crash Severity method attempts to account for the monetary difference of crashes by weighting the crashes based on degree of injury (severity of the crash). The Crash Severity method is sometimes referred to as the Equivalent Property Damage Only method, where greater value is given to more severe crashes. The weighting given to different severities of crashes can be tied to the relative cost difference of crashes. This method may overcorrect for small numbers of crashes or on high speed facilities.

The following defines the various categories of crash severity:

- **Fatal Crash** is where one or more persons were fatally injured.
- **Injury A Crash (severe or serious injury)** is where the most severe injury was that someone sustained a severe injury and was “incapacitated” usually in the form of a broken bone or severe bleeding or is taken to the hospital.
- **Injury B Crash (moderate injury)** is where the most severe injury was that someone had moderate injury usually visible injuries such as lumps abrasions and minor bleeding.
- **Injury C Crash (minor injury)** is where the most severe injury in the crash was that someone reports an injury, a pain or ache, but no injury is apparent.
- **Property Damage Only (PDO)** Crashes are where no injuries were sustained and only property was damaged. Note: PDO crashes are no longer used in calculating SPIS scores.

None of the methods above (or used within SPIS) correct for regression to the mean. More simply put there is a lot of variation in crash data. A site that has a high number of crashes one year may exhibit a lower number the next year (or regress towards the mean), in other words the high number of crashes does not necessarily mean you would expect that years total to be equal to the average or mean number of crashes for a period of years. The more years of crash data and the more consistent the data and the more confidence you can expect in the data.

## Annual SPIS Scores

SPIS is an attempt to balance the best of the three previous methods. SPIS combines Crash Frequency, Crash Rate and Crash Severity into one combined score or ranking. The three methods or indicators are weighted and summed to yield a SPIS score.

- Crash Frequency is weighted 25%
- Crash Rate is weighted 25%
- Crash Severity is weighted 50%

SPIS is evaluated every 0.01 miles for a 0.10 of a mile segment length. The system uses a sliding window to look at every 0.01 miles of highway. The system uses 3 years of crash data.

Within Crash Frequency and Crash Rates the individual severities of the crashes (fatals, serious injury, etc.) are typically weighted equally. But within Crash Severity, fatal and serious injury crashes are given weights of 100, moderate and minor injury are given weights of 10 and PDO's are given the weight of 0. These weights are assigned based on an approximate relative difference of the economic costs for each severity of crash.

The use of the three indicators compensates some of the shortcomings of any one measure alone. Combining all three indicators within one score helps to achieve a balanced approach that might otherwise over-emphasize one method or the other.



## Section 1-7 Annual SPIS Cutoff Values

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### Annual SPIS Scores

Annual SPIS generates scores based on the summation of the three indicator values; SPIS combines the values for the total SPIS score.

The three indicators are weighted and summed to yield a SPIS score.

- Crash Frequency is weighted 25%
- Crash Rate is weighted 25%
- Crash Severity is weighted 50%

Every tenth of a mile that has either one fatal or 1 injury A crash or three injury crashes receives a SPIS score.

### Annual SPIS Cut-off Values and Percentile Ranks

Each SPIS score is assigned a percentile rank, 95<sup>th</sup> percentile (the highest 5% SPIS scores or top 5%), 90<sup>th</sup> percentile (the highest top 10% SPIS scores or top 10%), 85<sup>th</sup> percentile and so on, all the way down to 5<sup>th</sup> percentile (the lowest 5% SPIS scores). These percentile ranks are based on SPIS cut-off values. The SPIS cut-off values are just the SPIS score that above or equal to the score is in an upper percentile and below which the score is in a lower percentile.

For instance if 42.14 was the top ten cut-off value (or 90<sup>th</sup> percentile cut-off), any score equal or above 42.14 would be in the top 10%. Any score less than 42.14 would be below the top 10%. Each percentile has an associated cut-off value. (See table on next page)

The cut-off values for percentile ranks are based solely on State Highway SPIS scores. The cut-off values on state highways are then applied to county reports and interchange ramps (connections) The on-state highway sites are ranked in score order and divided equally into 5% increments in order to determine the cut-off value for each percentile.

For instance, if there are 100,000 SPIS sites on state highways ranked in score order highest to lowest, then the 5,000<sup>th</sup> site would be the cut-off value for the 95<sup>th</sup> percentile. Any site with a score equal or above that cut-off value is given a 95<sup>th</sup> percentile in other words any site with a score equal to or above that cut-off value is in the top 5%.

The 10,000<sup>th</sup> site's score is the cut-off value for the 90<sup>th</sup> percentile. Any site with a score equal or higher than the cut-off value for the 90<sup>th</sup> percentile but lower than the 95<sup>th</sup> percentile cut-off value is given a 90<sup>th</sup> percentile. Anything equal to or higher than the 90<sup>th</sup> percentile cut-off is in the top 10%. The score of the 15,000<sup>th</sup> site is the cut-off value for the 85<sup>th</sup> percentile (top 15%), the score of the 20,000<sup>th</sup> site is the cut-off value for the 80<sup>th</sup> percentile, and so on.



Oregon Department of Transportation														Region		
2011 - On-State, All SPIS Sites - By Score														Statewide		
Rd	Rte	Rdwy	BMP	EMP	ADT	Crash	Fatal	A	B	C	PDO	City	County	Connection	Percent	SPIS
001	I-5	1	283.49	283.58	115,700	3	1	1	0	1	0	Wilsonville	Clackamas		90	42.19
001	I-5	1	283.50	283.59	115,700	3	1	1	0	1	0	Wilsonville	Clackamas		90	42.19
047	US-26	1	73.26	73.35	117,465	22	0	0	2	12	8	Portland	Multnomah		90	42.19
281	OR-281	1	0.23	0.33	11,800	12	0	1	0	2	9	Hood River	Hood River	MONTELLO AVENUE	90	42.18
164	OR-164	1	1.52	1.61	2,881	5	0	1	2	1	1		Marion	ANKENY HILL RD.	90	42.18
154	OR-154	1	4.06	4.15	3,940	6	0	1	1	2	2		Yamhill	SE ALDERMAN RD	90	42.18
035	OR-42	1	71.69	71.78	5,193	7	1	0	1	2	3		Douglas	BROCKWAY RD	90	42.18
068	OR-213	1	6.16	6.25	22,400	20	0	0	4	7	9	Portland	Multnomah	SE HENRY ST.	90	42.17
091	OR-99W	1	35.62	35.70	22,900	14	0	1	0	3	10	McMinnville	Yamhill	NE 27TH	90	42.16
091	OR-99W	1	35.63	35.71	22,900	14	0	1	0	3	10	McMinnville	Yamhill	NE 27TH	90	42.16
003	OR-43	1	10.15	10.26	19,014	13	0	1	1	2	9	West Linn	Clackamas	BUCK ST	90	42.15
091	OR-99W	1	62.27	62.36	11,638	8	0	1	3	2	2		Polk	HOFFMAN RD	90	42.14
123	US-30BY	1	6.09	6.17	18,933	23	0	0	3	6	14	Portland	Multnomah	PACIFIC HIGHWAY E	90	42.14
141	OR-141	1	4.95	5.04	9,815	17	0	0	1	8	8	Tigard	Washington	PACIFIC HIGHWAY W	90	42.14
091	OR-99W	1	35.64	35.72	23,037	14	0	1	0	3	10	McMinnville	Yamhill	NE 27TH	90	42.14
123	US-30BY	1	0.55	0.64	21,000	24	0	0	1	8	15	Portland	Multnomah	HWY. 123 (NW BRIDGE AVE.) M.P. (2)0.42	85	42.13
029	OR-8	1	12.77	12.86	17,400	20	0	0	3	7	10	Hillsboro	Washington	SE 7TH AVE.	85	42.13
092	US-30	1	1.87	1.97	43,201	15	0	1	0	4	10	Portland	Multnomah	HWY. 092(2W) M.P. 1.87	85	42.13
009	US-101	1	358.69	358.78	14,095	10	1	0	1	3	5		Curry	LEG. TO W HOFFELDT LN.	85	42.12

SPIS Top 10% Cut-off value

For on-state highways, off-state roadways and interchange ramps the on-state cut-off values are applied to determine the percentile ranks for all sites. Primarily, on-state highways were chosen as the basis for the cut-off scores so that the cut-off scores would remain stable between the old system and the new system. Secondly, sites above the top 10% and top 15% on-state highways SPIS cut-off scores have been found to have relatively good potential for cost effective safety improvements.

Very High SPIS scores (top 5%) do not necessarily correlate well with cost effective solutions, in fact some solutions to high SPIS scores may be very expensive and not cost effective. High SPIS scores (top 15%) may be said to generally exhibit higher crash activity than would normally be expected. Lower SPIS scores (below 80 percentile) do seem to correlate with more random crash activity and more regression to the mean.



# Section 1-8 Understanding the Annual SPIS Report

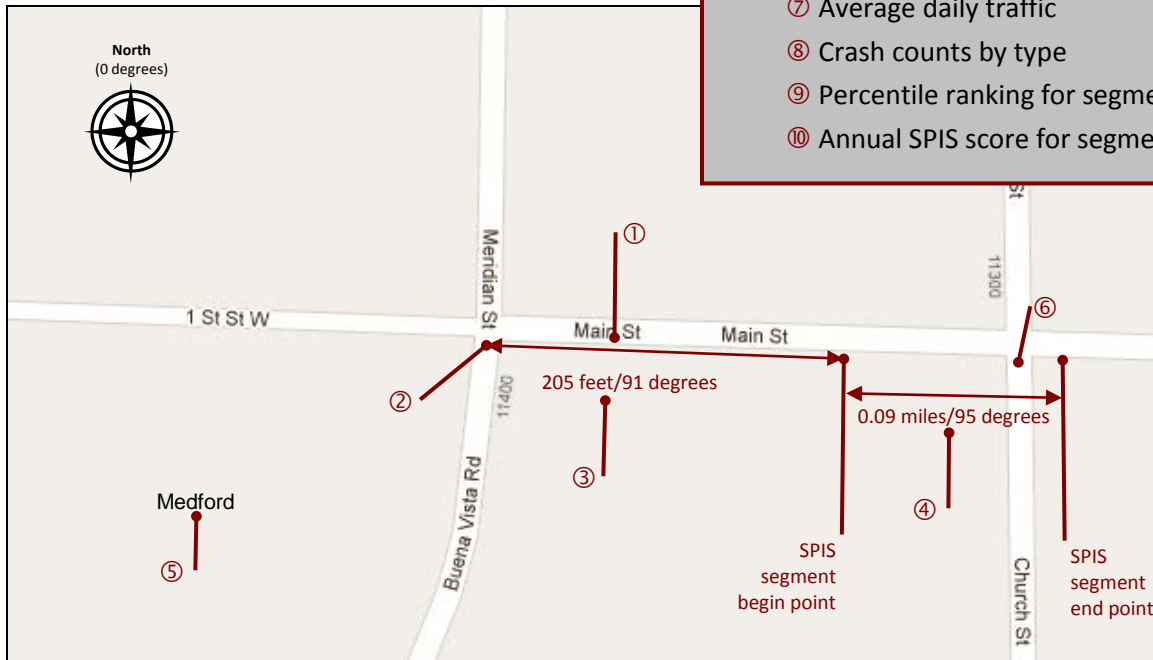
## Off-state Highway Reports

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 to End **	City	Intersection	ADT	Crash	Fatal	A	B	C	PDO	Percent	SPIS
E Main St		0.00	N BARTLETT ST	205 \ 91	95	Medford	Church Street	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				15,970	10	0	1	0	1	8	85	37.05
E Main St		0.00	N BARTLETT ST	53 \ 236		Medford		5,618	11	0	0	2	5	4	85	37.04
E Main St		0.00	N BARTLETT ST	0 \ 0	55	Medford		5,664	11	0	0	2	5	4	85	36.98
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										
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

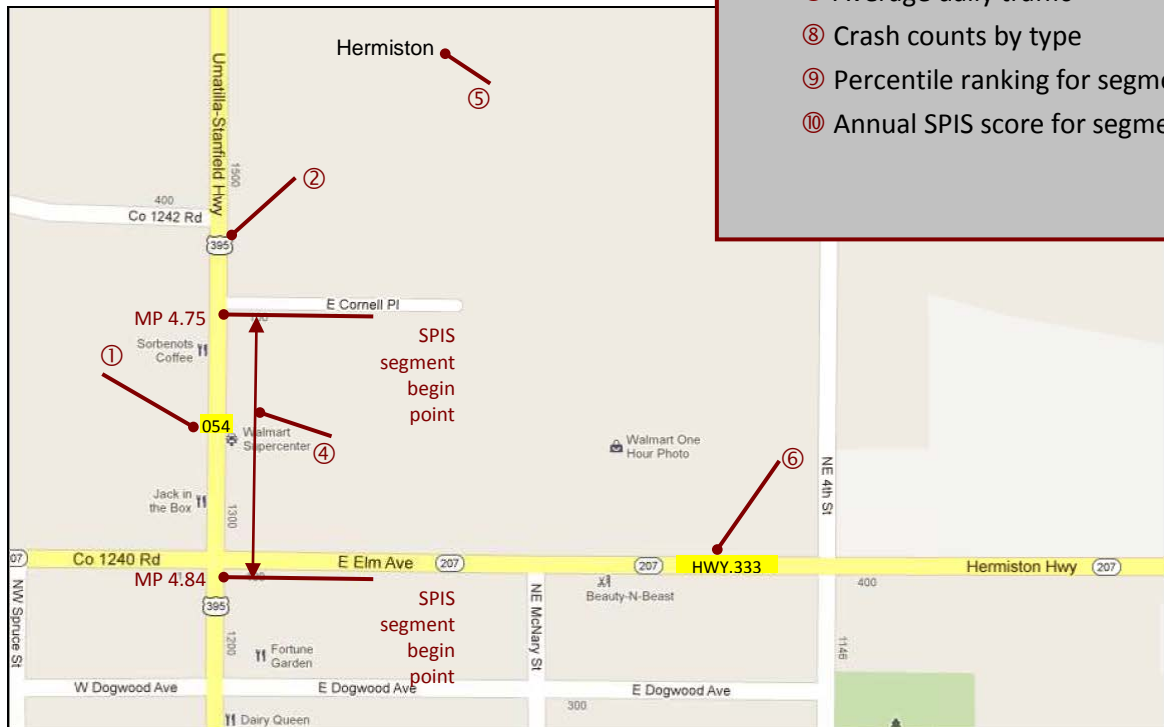


## On-state Highway Reports

Oregon Department of Transportation															Region 5	
2011 - On-State, All SPIS Sites - By Score																
Rd	Rte	Rdwy	BMP	EMP	ADT	Crash	Fatal	A	B	C	PDO	City	County	Connection	Percent	SPIS
054	US-395	1	4.75	4.84	17,800	26	1	1	1	8	15	Hermiston	Umatilla	HWY. 333 (NW ELM AVE.) M.P. 7.05	95	76.61
054	US-395	1	4.77	4.86	17,800	26	1	1	1	8	15	Hermiston	Umatilla	HWY. 333 (NW ELM AVE.) M.P. 7.05	95	76.61
054	US-395	1	4.82	4.91	17,800	26	1	1	1	9	14	Hermiston	Umatilla	HWY. 333 (NW ELM AVE.) M.P. 7.05	95	76.61
054	US-395	1	4.74	4.83	17,800	25	1	2	1	7	14	Hermiston	Umatilla	HWY. 333 (NW ELM AVE.) M.P. 7.05	95	76.16
054	US-395	1	4.76	4.85	17,800	25	1	1	1	8	14	Hermiston	Umatilla			
054	US-395	1	4.81	4.90	17,800	25	1	1	1	9	13	Hermiston	Umatilla			
054	US-395	1	4.78	4.87	17,800	24	1	1	1	8	13	Hermiston	Umatilla			
054	US-395	1	4.79	4.88	17,800	24	1	1	1	8	13	Hermiston	Umatilla			
054	US-395	1	4.80	4.89	17,800	24	1	1	1	9	12	Hermiston	Umatilla			
054	US-395	1	4.83	4.92	17,800	24	1	1	1	9	12	Hermiston	Umatilla			
054	US-395	1	5.37	5.46	18,618	25	0	0	3	11	11	Hermiston	Umatilla			

**KEY:**

- ① Road (State Highway Number)
- ② State Route Number
- ③ Roadway ID
- ④ Segment begin point to end point
- ⑤ City (if within city limits)
- ⑥ Intersecting road within segment
- ⑦ Average daily traffic
- ⑧ Crash counts by type
- ⑨ Percentile ranking for segment
- ⑩ Annual SPIS score for segment





## Section 1-9 On-State Segment Length Discrepancy

Annual SPIS and OASIS reports for on-state roadways describe the locations of qualified segments using the ODOT milepoint system. (Note: Property Damage Only (PDO) crashes are no longer used in SPIS or OASIS calculations.)

Oregon Adjustable Safety Index System Reports

**Preview Report Data**

Report Name: On-State, Top 10% Sites Sorted By Score  
Segment Count: Previewing the first 100 of 299 total segments

Region	Route	Highway Number	Highway Name	Begin Milepoint	Begin Mileage Type	End Milepoint	End Mileage Type	Weighted ADT	Crash Count	Fatal	A	B	C	PDO	Score	Percent
5	US-395	054	Umatilla-Stanfield	4.77	0	4.86	0	17,800	26	1	1	1	8	15	76.61	95
5	US-395	054	Umatilla-Stanfield	4.82	0	4.91	0	17,800	26	1	1	1	9	14	76.61	95
5	US-395	054	Umatilla-Stanfield	4.75	0	4.84	0	17,800	26	1	1	1	8	15	76.61	95
5	US-395	054	Umatilla-Stanfield	4.76	0	4.85	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.81	0	4.90	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.74	0	4.83	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.80	0	4.89	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.78	0	4.87	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.79	0	4.88	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	4.83	0	4.92	0	17,800	25	1	1	1	8	14	76.16	95
5	US-395	054	Umatilla-Stanfield	5.37	0	5.46	0	18,618	25	0	0	3	11	11	51.02	95

**Note:** Qualified OASIS segments for on-state roadways are identified by begin and end ODOT milepoints.



**Note:** On OASIS reports for off-state roadways, segment locations are described using reference locations and latitude and longitude, not ODOT milepoints.

While the on-state reports (both annual SPIS and OASIS) use the ODOT milepoint system to report qualified segment locations, it calculates these locations using the ODOT Safety Priority Index System (SPIS) linear reference system (LRS). The SPIS LRS removes the equations and other inconsistencies from the ODOT highway milepoint LRS.

The SPIS LRS and ODOT milepoint LRS both track points along on-state roadways. However, each system may identify and label those points differently. For example, the chart below shows a series of ODOT milepoints on US Highway 26 and the corresponding SPIS LRS system equivalents:

ODOT Milepoint Location	Corresponding SPIS LRS Location
4.993267	5.08
5.002534	5.09
5.011802	5.10
5.021070	5.11
5.030338	5.12
5.039976	5.13
5.099977	5.14
5.109682	5.15
5.119793	5.16
5.129903	5.17
5.140013	5.18
5.150124	5.19
5.160234	5.20

As a result of these differences, on the on-state highway reports, a qualified segment may appear with a length longer or shorter than what was selected. This “scaling” between the tow LRS’s occurs partially because the ODOT milepoint LRS is not exactly the length of the highway and the SPIS LRS is based on accurate latitudes and longitudes.

**Oregon Adjustable Safety Index System Reports**

**Available Reports**

- Top 10% by Score
- Top 10% by Location
- All Sites by Score
- All Sites by Location

Export Selected Reports

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**Your Selections**

Crash years (hide)  
2008 - 2010

Segment Length (hide)  
0.10 mile

Segment Qualifier (hide)  
1 fatal or 1 severity A or 3 crashes

Jurisdiction (hide)  
ODOT Region 1

Collision Types (show)

Weather Conditions (show)

Light Conditions (show)

Road Surface Conditions (show)

Special Conditions (show)

Crash Frequency (hide)

Max Value: 150  
Score Weight: 25  
Fatal Weight: 1

**Preview Report Data**

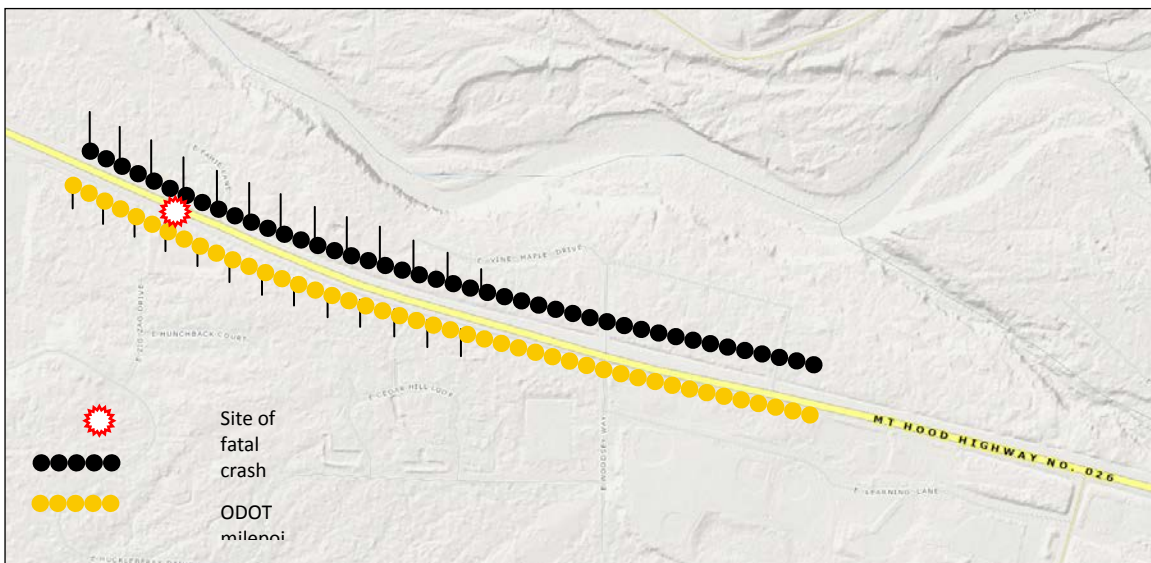
Report Name: On-State, Top 10% Sites Sorted By Score  
Segment Count: Previewing the first 100 of 1,944 total segments

Region	Route	Highway Number	Highway Name	Begin Milepoint	Begin Mileage Type	End Milepoint	End Mileage Type	Weighted ADT	Crash Count	Fatal	A	B	C	PDO	Score	Percent
1	OR-213	160	Cascade Hwy South	2.91	0	3.00	0	33,866	69	0	7	4	28	30	83.81	95
1	US-30BY	123	Northeast Portland	11.23	0	11.33	0	29,400	63	0	0	5	24	34	83.76	95
1	US-30BY	123	Northeast Portland	11.24	0	11.34	0	29,400	63	0	0	6	23	34	83.76	95
1	US-26	026	Mt. Hood	5.02	0	5.16	0	25,760	58	0	1	5	25	27	83.75	95
1	US-26	047	Sunset	73.65	0	73.74	0	69,300	58	0	1	5	25	27	83.75	95
1	US-26	026	Mt. Hood	9.87	0	9.96	0	18,571	58	0	1	5	25	27	83.75	95
1	US-26	026	Mt. Hood	9.88	0	9.96	0	18,571	58	0	1	5	25	27	83.75	95
1	US-30BY	123	Northeast Portland	11.25	0	11.35	0	29,400	63	0	0	5	24	34	83.76	95
1	US-30BY	123	Northeast Portland	11.19	0	11.30	0	29,400	63	0	0	5	24	34	83.76	95
1	US-30BY	123	Northeast Portland	11.18	0	11.28	0	29,400	63	0	0	5	24	34	83.76	95
1	US-26	026	Mt. Hood	4.97	0	5.11	0	24,926	55	0	1	5	22	27	83.33	95
1	US-26	026	Mt. Hood	9.79	0	9.88	0	18,127	45	0	1	4	15	25	83.31	95
1	OR-213	068	Cascade Hwy North	4.74	0	4.83	0	26,577	57	0	1	4	20	32	83.27	95
1	US-26	026	Mt. Hood	5.03	0	5.17	0	25,926	56	0	1	4	25	26	83.24	95
1	US-30BY	123	Northeast Portland	11.22	0	11.32	0	29,400	60	0	0	5	22	33	83.13	95

**Segment Length**

Qualified OASIS segment may appear longer or shorter than selected Segment Length.

**Example:** OASIS identifies a qualifying crash location on US Highway 26. Using the SPIS LRS system, it calculates the qualifying .10-mile segment as from 5.11 to 5.20. The ODOT milepoint equivalent for this qualifying segment is from 5.021070 (rounded to 5.02) to 5.160234 (rounded to 5.16).



Therefore, OASIS reports this segment – using the ODOT milepoint system – with a **Begin Milepoint** at 5.02 and an **End Milepoint** at 5.16. These ODOT milepoints suggest a longer

segment than the selected **Segment Length** of **0.10 mile**, but the actual segment length is 0.10 mile under the SPIS LRS system.

This apparent problem with scaling actually seems to indicate an error, but in reality it is more accurate than just using the ODOT milepoint system directly. The actual measured segment length in the SPIS LRS is closer to an actual tenth of a mile.

This same system also corrects errors of past SPIS systems. In the old SPIS when an equation was encountered, the old SPIS would incorrectly determine the length of the segment and often times may have misordered the crashes occurring in the segments. ODOT depended on analysts to investigate and currently plot the crashes to determine the true SPIS score. The new system eliminates many of the errors of the old system using the new SPIS LRS.

Although the new system is more reliable than the old system anytime you compile data from different sources there are bound to be data inconsistencies. Data sources changes, identifiers change, and references change. The analyst needs to be aware that the business of matching data and producing reports is a messy business and the analyst is responsible for checking the data and results before using the data to support conclusions.



**Section 2**  
**Oregon Adjustable Safety Index System**



## Section 2-1

### Introduction to OASIS

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The [Oregon Adjustable Safety Index System](#) (OASIS) was developed as an online safety analysis tool that is capable of performing “SPIS like” safety analysis and allows users to vary the SPIS calculations. Not only may specific types of crashes be analyzed but parameters that may be changed including segment length, number of crash data years and the SPIS formula defaults like the weightings of the formulas. The OASIS tool allows the user to create custom safety analyses of the data within the system.

No guarantee is made or implied and while every effort has been made to ensure that the program works correctly and performs the necessary calculations correctly, it is up to the user to check the results from any reports. There is no implied significance or fitness for any specific purpose and the interpretation of the results is solely the responsibility of the user.

Interpretation of the results of the analysis should be performed by a licensed professional engineer, one that is specifically experienced in roadway safety techniques and knowledgeable about the processes and data within the SPIS system and the ODOT crash system. An understanding of the fundamental concepts of roadway safety techniques and crash analysis is key to using the system.

Users of the system are warned that the system is primarily a “flagging” tool, to identify locations for further investigation. The purpose of which is to diagnose sites that may benefit from cost effective safety improvements. The user is also warned to not place too much emphasis on the value of the score generated, but to instead think in terms of order of magnitude differences.

Users must identify the purpose or intended outcome of the analysis, identify the reference population (select types of crashes or all crashes), select their equations and parameters to evaluate safety (which equation and settings are most applicable) and evaluate the results of their analysis. If the analyst has selected the right parameters and equations the higher magnitude scores should lead to good sites for investigation.

Once the analysis is complete and sites have been identified the next step is to diagnose the problems at the site. Because a particular site has been “flagged” by the system does not mean that the site is a good site for improvement. The point of a diagnosis is to develop an understanding of the common crash types and the problem area, uncover an understanding of the crash mechanisms and finally recommend cost effective solutions that improve the safety of the site.





## Section 2-2

### Introduction to OASIS Data

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The [Oregon Adjustable Safety Index System](#) (OASIS) uses the data from the SPIS ETL process. The ETL process stands for Extract, Translate and Load data for the SPIS system. Data is compiled from several sources, Crash data, Oregon Transportation Network (ORTRANS, off-state roadways), TransInfo (on state roadways -State Highway inventory data), and other data from Geographic Information Systems.

OASIS uses the same referencing system as the annual SPIS. GIS Coordinates (latitude and longitude) provide a reference system for the location of data points and SPIS segments on the roadway system. The GIS coordinates can then be referenced back to known points on the roadway system.

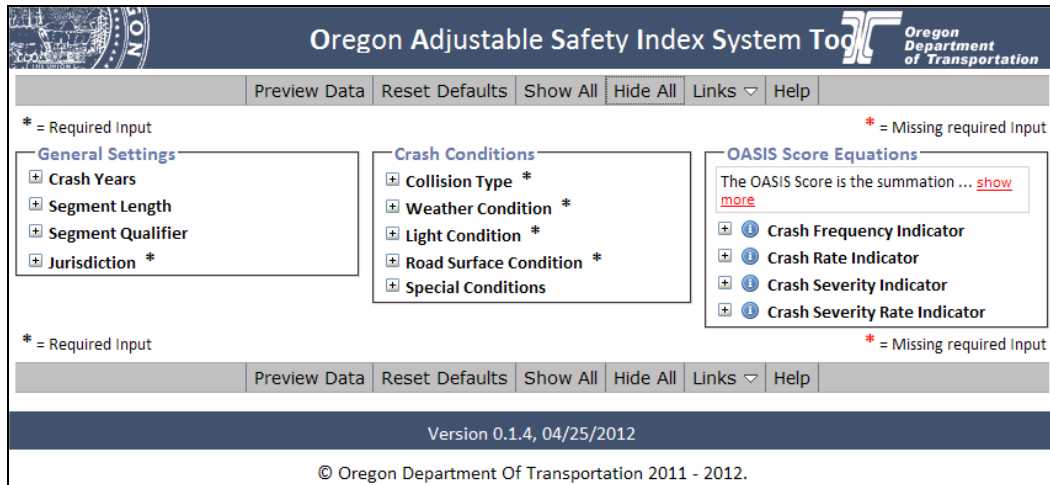
The SPIS process compiles the data on a GIS base layer for both annual SPIS and OASIS. A digital mapping file is used as a basis for combining existing data for SPIS on roadways in Oregon in a common reference system. The system uses geographic coordinates to provide latitude and longitude measurements for the location of data points on the earth's surface.

For OASIS, data on different lengths of segments is pre-processed to help speed up the queries. The data for OASIS is analyzed and arranged for rapidly processing queries from the OASIS tool. The organization of data in the database is prescribed by the OASIS application so that it can be further filtered and reported. OASIS can produce a variety of reports.



## Section 2-3 OASIS General Settings

The [Oregon Adjustable Safety Index System](#) (OASIS) is an online safety analysis tool capable of performing similar analyses as the ODOT Safety Priority Index System (SPIS).



Using the OASIS tool, users may perform a “SPIS-like” analysis, but have the option to vary the parameters to create custom reports from the data within the system. For example, users may:

- Modify the **General Settings** (e.g., crash years, segment length, segment qualifier and jurisdiction)
- Select specific types of **Crash Conditions** to analyze (e.g., collision type, weather, light, road surface and special)
- Modify the **OASIS Score Equations** (e.g., crash frequency, rate, severity and severity rate)

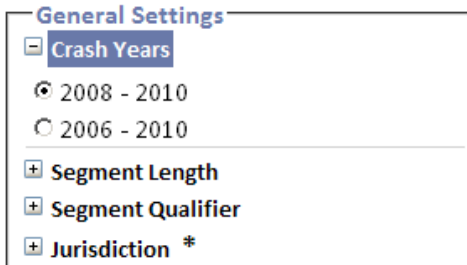
### Modifying General Settings

OASIS uses four **General Settings** which default to the same values as the annual SPIS reports. These four settings and their default values are as follows:

General Setting	Default Value
Crash Years	Most recent three calendar years of crash data (e.g., 2008-2010)
Segment Length	0.10 mile
Segment Qualifier	1 Fatal or 1 injury A or 3 injury Crashes
Jurisdiction	On-State Roadways, Region 1 (i.e., state highways only in ODOT Region 1)

OASIS users may select other values for these **General Settings** to address their specific situations and safety analysis concerns.

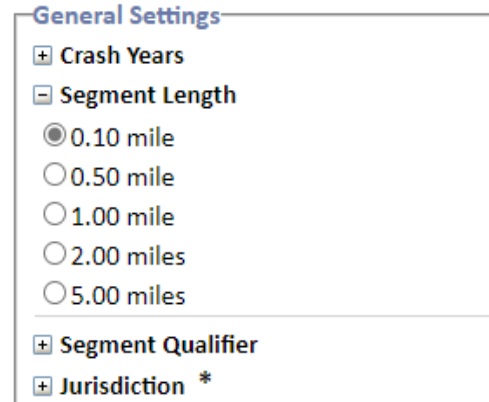
### Crash Years



SPIS uses a three-calendar-year sampling period of crash data in order to reduce variations in crashes and roadway character (e.g., traffic volumes and development patterns). Using a longer sampling period (i.e., five calendar years) with OASIS may help to stabilize crash data, especially when crash data is sparse and roadway character changes are minimal.

### Segment Length

Like number of years, segment length also stabilizes the crash data if roadway character is similar for the entire length. The SPIS segment length default value of 0.10 mile identifies individual intersections; this is typically more useful for identifying motor vehicle crashes. For bike and pedestrian crashes, however, clustering intersections into longer segments may help to identify corridors that may benefit from safety countermeasures to reduce these crash types.



### Increasing Crash Years and Segment Lengths

For lower volume roads and streets, using the SPIS default values for crash years and segment length to identify and address “high-crash” locations can often yield unsatisfactory results. This is due to the relatively low crash numbers and the random nature of crash occurrences on lower volume roadways. In these situations, OASIS users may select longer segment lengths and five calendar years to identify roads and streets with potential safety issues. Using low cost, systematic solutions for these lower volume roadways, which focus on the most common crash types, can be most cost effective.

### Varying Crash Years and Segment Lengths

Using OASIS to conduct a variety of analyses with different segment lengths and crash years may help to identify/select the optimal period and length to use to stabilize crash data patterns. The goal is to reduce or eliminate crash data variability, which may be referred to as regression to the mean. This can also improve the accuracy of the assessment of the benefit-to-cost-ratio of any potential remedy for an identified roadway site.

Comparing OASIS results using different segment lengths and crash years may also allow for the development of different strategies for specific sites, for street blocks, for clustering intersections, for corridors and for systematic approaches statewide.

### Segment Qualifier

The segment qualifier determines what type or number of crashes qualifies as an OASIS segment. The default for annual SPIS is “1 Fatal or 1 injury A crash or 3 injury Crashes”, but the analyst may want change the qualifier to be less stringent or more stringent.

For less stringent selections such as “1 Injury Crash” or “2 injury Crashes”, OASIS will produce more qualifying sites, thus the Top 10% will produce more results to search through. Used in conjunction with an OASIS filter with few crashes (such as ped and bike crashes only) this might be particularly useful.

For more stringent selections such as “1 Fatal or 1 Severity A Crash” less sites will be selected but may limit the selection to only sites with more severe crashes occurring.

Selecting “3 Injury crashes” may be useful in eliminating frequency of high severity sites with only one fatal crash from consideration since many of these crashes are random and on lower volume roads may rise to the top 10% sites.

**General Settings**

- Crash Years
- Segment Length
- Segment Qualifier
  - 1 Injury Crash
  - 2 Injury Crashes
  - 3 Injury Crashes
  - 1 Fatal or 1 Severity A Crash
  - 1 Fatal or 3 Injury Crashes
  - 1 Fatal or 1 Severity A or 3 Injury Crashes

---

- Jurisdiction \*

**Jurisdiction**

With OASIS users may select to use crash data for either on-state or off-state roadways. With on-state roadways (i.e., state highways), users may select to use crash data for state highways in a single ODOT region or all ODOT regions. With off-state roadways (i.e., city streets and county roads), users may select to use crash data from one, two or three Oregon counties. Any county selected will also include crash data for the cities within its boundaries.

**General Settings**

- Crash Years
- Segment Length
- Segment Qualifier
- Jurisdiction \*
  - On-State Roadways
 

Select one. 1 currently selected.

    - Region 1
    - Region 2
    - Region 3
    - Region 4
    - Region 5
    - All Regions
  - Off-State Roadways



## Section 2-4 Crash Conditions

The [Oregon Adjustable Safety Index System](#) (OASIS) is an online safety analysis tool capable of performing similar analyses as the ODOT Safety Priority Index System (SPIS).

Using the OASIS tool, users may perform a “SPIS-like” analysis, but have the option to vary the parameters to create custom reports from the data within the system. For example, users may:

- Modify the **General Settings** (e.g., crash years, segment length, segment qualifier and jurisdiction)
- Select specific types of **Crash Conditions** to analyze (e.g., collision type, weather, light, road surface and special)
- Modify the **OASIS Score Equations** (e.g., crash frequency, rate, severity and severity rate)

### Selecting Crash Conditions

**Crash Conditions** refer to the circumstances surrounding a reported crash, including the **Collision Type**, **Weather Condition**, **Light Condition**, **Road Surface Condition** and other **Special Conditions**. Crash and crash condition data comes from the statewide crash database (HCDS) maintained by the Crash Analysis and Reporting Unit of ODOT.

OASIS users may select the specific options within each crash condition category to include/exclude in an OASIS query to address their specific situations and safety analysis concerns. For example, a user may select to include only crashes involving pedestrians, or only rear-end crashes, or only crashes when it was raining or only rear-end crashes involving pedestrians when it was raining. The default is to include/select all crash conditions in an OASIS query.

### Collision Type

**Collision Type** refers to the physical relationship of the vehicle(s) at the time of collision based on the intended path of travel. Collision types include:

- **Angle:** Two or more vehicles collide while traveling on crossing paths.
- **Backing:** A vehicle backing in a traffic lane collides with another vehicle.
- **Fixed Object or Other Object:** A vehicle strikes a fixed or other object on the roadway or off roadway.
- **Head-on:** Two vehicles collide head on while traveling in opposite directions on parallel paths.
- **Non-collision:** Only one vehicle is involved and is not classifiable as another collision (i.e., rollover, etc.).
- **Parking Maneuver:** A vehicle in the act of entering or leaving a parked position is involved in a collision.
- **Pedestrian:** The first harmful event is any impact between a motor vehicle in traffic and a pedestrian.
- **Rear-end:** A vehicle traveling in the same direction or parallel on the same path as another vehicle, collides with the rear end or a second vehicle.
- **Sideswipe – Meeting:** Two vehicles collide while traveling in opposite directions on parallel paths.
- **Sideswipe – Overtaking:** Two vehicles collide while traveling in the same direction on parallel paths.
- **Turning Movement:** One or more vehicles in the act of a turning maneuver collide with another vehicle.
- **Miscellaneous:** All animal crashes except when animal is drawing vehicle.

**Crash Conditions**

**Collision Type \***

- Angle
- Backing
- Fixed Object or Other Object
- Head-on
- Non-collision
- Parking Maneuver
- Pedestrian
- Rear-end
- Sideswipe - Meeting
- Sideswipe - Overtaking
- Turning Movement
- Miscellaneous

[Check All](#)   [Uncheck All](#)

Click **Check All** to select all collision types or **Uncheck All** to deselect all collision types. Default is with all selected.

**Weather Condition**

**Weather Condition** refers to the atmospheric conditions at the time of a crash. Weather conditions include:

- Ash
- Clear
- Cloudy
- Dust
- Fog
- Rain
- Sleet
- Smoke
- Snow
- Unknown

**Weather Condition \***

- Ash
- Clear
- Cloudy
- Dust
- Fog
- Rain
- Sleet
- Smoke
- Snow
- Unknown

[Check All](#)   [Uncheck All](#)

Click **Check All** to select all weather conditions or **Uncheck All** to deselect all weather conditions. Default is with all selected.

**Light Condition**

**Light Condition** refers to the amount of light available at the time of a crash. Light conditions include:

- Darkness – no street lights
- Darkness – with street lights
- Dawn (Twilight)
- Daylight
- Dusk (Twilight)
- Unknown

Click **Check All** to select all light conditions or **Uncheck All** to deselect all light conditions. Default is with all selected.

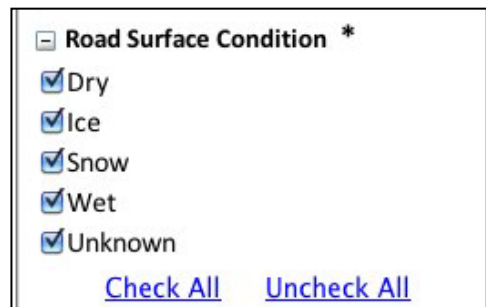


**Road Surface Condition**

**Road Surface Condition** refers to the condition of the road surface at the time of a crash. Road surface conditions include:

- Dry
- Ice
- Snow
- Wet
- Unknown

Click **Check All** to select all road conditions or **Uncheck All** to deselect all road conditions. Default is with all selected.



**Special Conditions**

**Special Conditions** refer to other location, vehicle or participant level events or factors involved in a reported crash. Some of these categories may suffer from under reporting for various reasons. For example, **Cell Phone Involved** is primarily based on self-reporting and, therefore, may tend to be under-reported.

With each special condition, the user may select to include or exclude those crashes involving that special condition. For example, if a user selects to include **Work Zone Involved** crashes, then only crashes that occurred in a work zone are included in the query. If a user selects to exclude these crashes, then only crashes that did not occur in a work zone are included in the OASIS query.

Special conditions include:

- **Work Zone Involved** includes all crashes in utility, maintenance or construction areas.
- **Speed Involved** includes all crashes where at least one driver involved in the crash was exceeding the posted speed. It also includes crashes where the crash report indicates a driver was exceeding speeds that were prudent for the existing conditions, but was traveling within the posted limits. Within HCDS, this code is system-generated.
- **Alcohol or Drugs Involved** includes crashes where an active participant in the crash had been using or was reported to have been using alcohol or drugs; an active participant is a person who was in a position of control during the crash, such as a driver, pedestrian or pedal-cyclist. Within HCDS, this code is system-generated.
- **Bike Involved** includes all crashes involving a bicycle or tricycle. Within HCDS, this code is generated from Participant Type.
- **Pedestrian Involved** includes all crashes involving a pedestrian. Within HCDS, this code is generated from Participant Type.
- **Truck Involved** includes all crashes involving a truck tractor, with or without trailer or mobile home in tow, truck with non-detachable bed, panel truck, self-propelled crane, tow truck, fire truck, refuse packer, leach packer or log grapppler. Within HCDS, this code is generated from Vehicle Type.
- **Deer or Elk Involved** includes all crashes involving deer or elk (wapiti). Within HCDS, this code is generated from Crash Level Events.
- **Cell Phone Involved** includes all crashes involving cell phone use by driver. Within HCDS, this code is generated from Crash Level Events. Cell phone use would primarily be self-reported and therefore may tend to be under-reported.
- **Intersection Involved** indicates the crash occurred at the intersection, or resulted from an activity, behavior or control related to the movement of traffic units through an intersection.
- **Roadway Departure Involved** indicates the crash involved a vehicle that departed its lane of travel prior to the first harmful event.

**Crash Conditions**

**Collision Type \***

**Weather Condition \***

**Light Condition \***

**Road Surface Condition \***

**Special Conditions**

Choose special conditions ... [show more](#)

**Work Zone Involved \***

Include

Exclude

**Speed Involved \***

Include

Exclude

**Alcohol or Drugs Involved \***

Include

Exclude

**Pedestrian or Bike Involved \***

Include

Exclude

**Truck Involved \***

Include

Exclude

**Deer or Elk Involved \***

Include

Exclude

**Cell Phone Involved \***

Include

Exclude

[Check All](#) [Uncheck All](#)



- **Curve Involved** indicates that a horizontal curve was present and related to the occurrence of the crash.
- **Signalized Involved** indicates that information related to the presence of a traffic signal or a “through green arrow” controlling the intersection was provided on the crash report.

Click **Check All (Uncheck All)** to select (deselect) all special conditions. Default is with none selected.

By checking one special condition to **Include**, only those crashes that involved that special condition will be used in the OASIS process. By checking one special condition to **Exclude**, only crashes **not** involving that special condition will be used in the OASIS process. Similarly, by checking more than one special condition to **Include** in the OASIS process, only crashes involving all of the checked special conditions will be used in the OASIS process. By checking more than one special condition to **Exclude**, crashes involving all of the checked special conditions will **not** be used in the OASIS process.

Finally, by checking one or more special conditions to **Include** and one or more special conditions to **Exclude**, crashes that meet **all** of the **Include** options, except those meeting **all** of the **Exclude** options, will be used in the OASIS process.



## Section 2-5 OASIS Score Equations

The [Oregon Adjustable Safety Index System](#) (OASIS) is an online safety analysis tool capable of performing similar analyses as the ODOT Safety Priority Index System (SPIS).

Using the OASIS tool, users may perform a “SPIS-like” analysis, but have the option to vary the parameters to create custom reports from the data within the system. For example, users may:

- Modify the **General Settings** (e.g., crash years, segment length, segment qualifier and jurisdiction)
- Select specific types of **Crash Conditions** to analyze (e.g., collision type, weather, light, road surface and special)
- Modify the **OASIS Score Equations** (e.g., crash frequency, rate, severity and severity rate)

### Modifying OASIS Score Equations

The OASIS score for a selected roadway segment during a selected time period is the sum of four calculated indicators: **Crash Frequency Indicator**, **Crash Rate Indicator**, **Crash Severity Indicator** and **Crash Severity Rate Indicator**.

The total of all indicators combined equals the OASIS score. The maximum OASIS score is 100. The higher the OASIS score, the higher the potential safety needs for the identified roadway segment.

#### Crash Frequency Indicator

Crash frequency refers to the number of reported crashes occurring in a defined length of roadway during a defined period of time. Many agencies use crash frequency to compare the number of crashes at one location to the number of crashes at another location, typically over similar periods of time and similar lengths of roadway.

While crash frequency provides a simple way to rank roadway safety, it may tend to be over exaggerated on roadway segments with high volumes.

OASIS calculates the **Crash Frequency Indicator (CFI)** using a logarithmic distribution based on the number of crashes in the selected time period for the selected segment length. With a logarithmic distribution, the CFI value increases quickly and then levels out near a maximum value.

The CFI calculation is:

$$IV_{Freq} = \left[ \frac{\text{LOG}[A(\text{FATAL}) + B(\text{INJ}_A) + C(\text{INJ}_B) + D(\text{INJ}_C) + 1]}{\text{LOG}(\text{MAX}_{Freq} + 1)} \right] (W_{Freq})$$

Where:

- FATAL = the number of Fatal (K) crashes
- $\text{INJ}_A$  = the number of severe injury crashes (Class A)
- $\text{INJ}_B$  = the number of moderate injury crashes (Class B)
- $\text{INJ}_C$  = the number of minor injury crashes (Class C)
- A, B, C, and D = the weighting parameters for injury severity and can be equal to 1 or 0 with a range from 0 to 10,000
- $W_{Freq}$  = the weighting parameter for CFI; the default value is 25, but it can vary from 0 to 100
- $\text{MAX}_{Freq}$  = the maximum value the CFI can reach; the default value is 150, and there is no maximum value
  - **Guidance:**  $\text{MAX}_{Freq}$  should resemble the maximum number of crashes expected (or 95th percentile) for a given roadway segment; on higher volume roads, 150 to 300 crashes may be expected in a 0.1- mile segment; for longer segments, it varies by the class of the road. Note: PDO crashes were removed from this formula and the OASIS data.

### Crash Rate Indicator

Crash rate is another method to compare crashes at one location to another location in relation to some measure of exposure (typically traffic volumes). Crash rates normalize the frequency of crashes based on traffic volumes.

The **Crash Rate Indicator (CRI)** is a value determined using a logarithmic distribution. Crash rate as used in OASIS is defined as the number of reported crashes for a given length of roadway divided by a given period of time and the amount of traffic volume.

Crash rate is a simple measure but may overemphasize low volume segments with low numbers of crashes, which tends to offset crash frequency.

The CRI calculation is:

$$IV_{Rate} = \left[ \frac{\text{LOG} \left( \left( \frac{A(FATAL) + B(INJ_A) + C(INJ_B) + D(INJ_C)}{(3yr)(365days)(ADT)} \right) (1,000,000) + 1 \right)}{\text{LOG}(MAX_{Rate} + 1)} \right] (W_{Rate})$$

Where

- FATAL = the number of Fatal (K) crashes
- INJ<sub>A</sub> = the number of severe injury crashes (Class A)
- INJ<sub>B</sub> = the number of moderate injury crashes (Class B)
- INJ<sub>C</sub> = the number of minor injury crashes (Class C)
- A, B, C, and D = the weighting parameters for injury severity and can be equal to 1 or 0 with a range from 0 to 10,000.
- W<sub>Rate</sub> = the weighting parameter for CRI; the default value is 25, but it can vary from 0 to 100
- MAX<sub>Rate</sub> = the maximum value the CRI can reach; the default value is 7, and there is no maximum value
  - **Guidance:** MAX<sub>Rate</sub> should resemble the practical maximum number of crashes expected (or the 95th percentile); for lower volume roads the maximum rate might be as high as 15 or 20 crashes per million vehicle miles. For longer segments, rates will typically decrease. Note: PDO crashes were removed from this formula.

### Crash Severity Indicator

Crash severity (sometimes referred to as equivalent property damage only) assigns weighting to crashes by severity. The severity rating for a crash is the severity of the most severe injury received. Agencies typically use this measure to give more relative weight to more serious types of crashes or may weight the severity by the cost of the crash.

The **Crash Severity Indicator (CSI)** in OASIS is a linear function that uses a relative cost crash for each severity. The default uses 100 as representative of the cost of Fatal and Injury A crashes, 10 as representative of the cost of injury B and C crashes. Other models of crash severity weighting may be used.

Crash severity may tend to overemphasize segments with a low frequency of severe crashes depending on the weighting.

The CSI calculation is:

$$IV_{Severity} = \left[ \frac{A(FATAL) + B(INJ_A) + C(INJ_B) + D(INJ_C)}{(MAX_{Severity})} \right] (W_{Severity})$$

Where:

- FATAL = the number of Fatal (K) crashes
- $INJ_A$  = the number of severe injury crashes (Class A)
- $INJ_B$  = the number of moderate injury crashes (Class B)
- $INJ_C$  = the number of minor injury crashes (Class C)
- A and B = the weighting parameters for Fatal and injury A severity crashes; the default value is 100, with a range from 0 to 10,000
  - **Guidance:** The weighting parameter values indicate a general level of significance. In the past, this level was based on estimate of cost, the cost of a fatal (K) or injury A crash was approximately 100 times a PDO crash (similar to an equivalent PDO (weighting based on cost)
- C and D = the weighting parameters for injury B and C severity crashes; the default value is 10, with a range from 0 to 10,000
  - **Guidance:** The weighting parameter values indicate a general level of significance. In the past, this level was based on estimate of cost where the cost of an injury B or C crash was approximately 10 times the cost of a PDO crash
- $W_{Severity}$  = the weighting parameter for severity index; the default value is 50, but can vary from 0 to 100
- $MAX_{Severity}$  is the maximum value the CSI can reach; the default value is 300, with no maximum value
  - **Guidance:**  $MAX_{Severity}$  represents the maximum value typically encountered for the length of roadway segment selected. Note: PDO crashes were removed from this formula.

### Crash Severity Rate Indicator

Crash severity rate is a combination of the crash severity and the crash rate measures. It is similar to crash severity, only with a rate associated to account for traffic volume and based on a logarithmic function.

Similar to crash severity, the **Crash Severity Rate Indicator (CSRI)** in OASIS uses a relative cost crash for each severity. The default uses 100 as representative of the cost of Fatal and Injury A crashes, 10 as representative of the cost of injury B and C crashes and 1 as representative of a PDO crash. Generally speaking a Fatal and Injury A crash costs 100 times a PDO crash, and the Injury B and C crashes cost ten times the PDO crash. Other models of crash severity weighting may be used.

Crash severity rate may tend to over emphasize low volume roads (like crash rates) or low frequency of severe crashes depending on the weighting.

The CSRI calculation is:

$$IV_{SeverityRate} = \frac{\text{LOG}\left(\left(\frac{A(FATAL) + B(INJ_A) + C(INJ_B) + D(INJ_C)}{(3yr)(365days)(ADT)}\right)(1,000,000) + 1\right)}{\text{LOG}(MAX_{SeverityRate} + 1)} (W_{SeverityRate})$$

Where:

- FATAL = the number of Fatal (K) crashes
  - INJ<sub>A</sub> = the number of severe injury crashes (Class A)
  - INJ<sub>B</sub> = the number of moderate injury crashes (Class B)
  - INJ<sub>C</sub> = the number of minor injury crashes (Class C)
  - ADT = average daily traffic
  - A, B, C, and D = the weighting parameters for injury severity and can be equal to 1 or 0 with a range 0 – 10,000.
  - W<sub>SeverityRate</sub> = the weighting parameter for the CSRI; it can vary from 0 to 100
  - MAX<sub>SeverityRate</sub> = the maximum value the CSRI can reach; it can vary from 0 to 100
- Note: PDO crashes were removed from this formula.

### Guidance for Settings in Indicator Values

For each indicator, you may specify a **Maximum Value, Weighting and Crash Severity Weight**, or accept the default value for these three factors, to use in the indicator calculation.

#### Maximum Value

**Maximum Value** refers to the point where the indicator will equal the weighting. When the maximum value is met or exceeded, then the indicator equals the weighting. For example, if the maximum value of an indicator is met or exceeded and the weighting is 25 percent, the indicator value will equal 25.

Injury Crash Severity Rate	
<b>Indicator</b>	
Maximum Value:	7 *
Weighting:	0 *
<b>Crash Severity Weight</b>	
Fatal:	100 *
Severity A:	100 *
Severity B:	10 *
Severity C:	10 *

The maximum value of the indicators can be problematic. The default maximum values are set 0.10-mile sections. The equations are not “normalized” for section length. The maximum number of crashes will increase as the section is lengthened, but not at a linear rate; as the section increases in length, the crashes per mile decreases.

This means the maximum value must account for an added section length. If the maximum value is set too low, the indicator may not take into account some of the worst sections. The excess over the maximum is then not considered in the indicator. It is probably better if a maximum value is set too high to provide “cushion” between the maximum and the largest values found in the indicator. This becomes more of a problem when longer sections of highway are examined.

## Weighting

**Weighting** refers to the percentage the indicator value contributes to the overall OASIS score. It also equals the highest value for the calculated indicator.

The sum of the percentages of the indicator values must add to 100 percent. The highest possible score for a site is 100 (if all maximum values are met) and the sum of the indicator values may not exceed 100. The default weightings of the Crash Frequency Indicator and Crash Rate Indicator are both 25 percent. Both of these use the number of crashes as their basis. Thus, by assigning both of these 25 percent and the Crash Severity Indicator with 50 percent, it balances the indicators and does not unfairly balance the site selection towards higher numbers of crashes. Weighting between the indicators should be selected carefully, depending on what is trying to be achieved.

For longer sections where the objective is to treat certain conditions or certain types of crashes, it may be more expeditious to use only one indicator, such as Crash Severity Indicator or Crash Frequency Indicator, by setting its weighting to 100 percent. This may aid in providing a better understanding of the impacts of investments.

## Crash Severity Weight

**Crash Severity Weight** refers to the level of significance assigned to one crash severity rating (i.e., Fatal, A, B, or C ) compared to another when calculating each indicator that contributes to an OASIS score.

Within the CFI and CRI, it should typically default to equal values for severity of the crash (default values for these indicators are 1).

In the CSI formula, the fatal and severe injury A crashes are given the same default weight. The primary reason for this is to not give too much dominance to a fatal crash. Fatal or severe injuries tends to dissipate the same amount of energy in the crash, the difference may be wearing a seat belt, having an air bag or an older vehicle. Giving a high weight to fatal because of the extreme severity tends to weigh the fatal too heavy. Mixing fatal and injury A crashes together makes a balanced approach and eliminates a dominance of fatal crashes that otherwise are rare events.

Users may choose to take into account the impact energy within a crash. The injury severity of the crash provides a good surrogate measure of impact energy. For instance, the energy of a fatal crash and severe injury crash are usually similar, it may depend more on the physical condition of the person as to how much injury is sustained. The objective of the indicator is to reflect the relative severity or potential of a site.

Injury A and Injury B have enough occurrence within the crash history and relatively little difference between weighting that they may easily be considered for separate weighting. Typically, injury B crashes have higher energies of impact than injury C crashes, which are essentially equivalent.

Using the monetary worth of a crash severity is another option and is the primary basis for the SPIS defaults; injury B and C may be combined. Although fatal and

injury A crashes are drastically different economically, combining the two makes sense as stated above and does not lend a dominance to fatal so that the system is “chasing” fatal crashes.

There are many sources of various costs depending on various factors that are included, almost any variety and answer is available. Based on the relative order of magnitude of the costs represented in SPIS, defaults are 100 times the cost of a PDO crash for fatal and injury A, 10 times the cost of a PDO crash for injury B and C.

PDO crashes require some judgment since they are subject to more variability and are no longer included in the OASIS formulas. PDO crashes are suspected to be vastly under-reported. The elimination of PDO crashes and use of high severity crashes only can be useful, but also subject to more variability. A site with a high number of PDO crashes may be explained by low speeds and low risk, but lack of injury crashes may not necessarily indicate the measure of the risk associated with the site.





## Section 2-6

### OASIS Reports

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The [Oregon Adjustable Safety Index System](#) (OASIS) was developed as an online safety analysis tool that is capable of performing “SPIS like” safety analysis and allows users to vary the SPIS calculations. Not only may specific types of crashes be analyzed but parameters that may be changed including segment length, number of crash data years and the SPIS formula defaults like the weightings of the formulas. The OASIS tool allows the user to create custom safety analyses of the data within the system.

#### **OASIS Reports**

OASIS has four reports available to the user. The first two produce reports of the top 10% OASIS scores for the jurisdiction selected. They sort either by score or by location. The second two produce reports of all scores also sorted by score or by location.

The results are shown in a preview of data online and can be exported and saved in a file. The file produced is in XML format. XML is a standard format used on the internet and is the default format for many products such as Microsoft Office or Apple products, so it will open files in products such as Microsoft Excel.

The reports include complete information on the segments. This includes all the information that is on the standards annual SPIS reports and more, including segment ID, latitudes and longitudes (off-state) and all the separate component values for each indicator.

#### **OASIS Top 10% and Percentile Rank**

OASIS performs percentile ranking in the same basic fashion as annual SPIS, but because the user may specify only one jurisdiction, it performs the percentile ranking based only on that particular jurisdiction. Meaning it bases a top 10% on the scores it sees only for the particular jurisdiction and not on any top 10% ranking from annual SPIS.

This is done so that any particular jurisdiction may truly establish their own top 10% if they desire. There is an available jurisdiction selection in OASIS for on-state All Regions. A jurisdiction wishing to compare a method in OASIS for their jurisdiction to what would occur for on-state highways could do so.

## **Section 3**

# **Crash Summary Report (CSR)**

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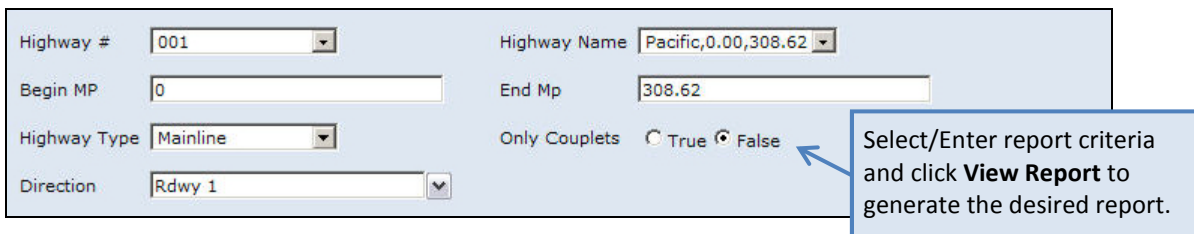
## Section 3-1

### Crash Summary Reports

ODOT has established a report server on the ODOT intranet where you may access the summary and detail versions of the [Crash Summary Report](#). These reports capture on-state roadway crash data for the most recent three calendar years; this is the same data used by the annual SPIS reports and the OASIS tool. This tool is available for use only by ODOT employees.

### Generate a Report

1. Go to the CSR Homepage by clicking on the following link:  
<http://transnet.odot.state.or.us/hwy/trs/Web%20Pages/CRS.aspx>
2. Click **Detail Report** to generate a **Crash Summary Report by Milepoint** or click **Summary Report** to generate a **Crash Summary Report**.
3. Select/enter your Crash Summary Report criteria from the following:
  - a. **Highway #** – Select from the drop-down menu. Default is **001**.
  - b. **Highway Name** – This field auto fills based on selected Highway #.
  - c. **Begin MP** – This field auto fills based on selected Highway #. You may enter a different beginning milepoint, to adjust the highway segments captured in the report.
  - d. **End MP** – This field auto fills based on selected Highway #. You may enter a different ending milepoint, to adjust the highway segments captured in the report.
  - e. **Highway Type** – Choices include **Mainline** or **Spurs**. Default is **Mainline**.
  - f. **Only Couplets** – Choices include **True** or **False**. Default is **False**.
  - g. **Direction** – Choices include **Roadway 1**, **Roadway 2** or **Both**. Default is **Roadway 1**.



Highway #	001	Highway Name	Pacific,0.00,308.62
Begin MP	0	End Mp	308.62
Highway Type	Mainline	Only Couplets	<input type="radio"/> True <input checked="" type="radio"/> False
Direction	Rdwy 1		

4. Click **View Report**. The page refreshes and displays the specified report.
5. The corresponding report window opens, displaying the default report (for Highway #001 from beginning milepoint 0 to ending milepoint 308.62).

Figure 1: Crash Summary Report by Milepoint (Detail View)

Home > TADMaint > SPI > AppReports > CSR > Detail

Highway #  Highway Name \_\_\_\_\_  
 Begin MP  End Mp \_\_\_\_\_  
 Direction  Select report parameters using the dropdown menus above. Press "View Reports" button to disp

1 of 68 100%

**Oregon Department of Transportation**  
 2018 Crash Summary Report (2015-2017 Data) (No PDO crashes included)  
 by Milepoint  
 Monday, February 1, 2021  
 Pacific MP 0 to MP 308.63

HW	RDWY	MP	ADT	Tot Acc	Inter Acc	Fatal	Crashes			ANG	Head On	Turn	Rear End	Fixed Obj	Side Swipe		Ped	Back	Park	Non Col	Misc	Wet	Lit	Trk	Sno Ice	SPIS Score	Top 10
							A	B	C						M	O											
001	1	0.87	16,800	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0			
001	1	1.36	16,800	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0			
001	1	1.45	16,800	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0			
001	1	3.00	16,800	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1			
001	1	3.01	16,800	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1			
001	1	3.60	16,800	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	13.72	10
001	1	3.67	16,800	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	13.72	10
001	1	3.68	16,800	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	13.72	10
001	1	3.70	16,800	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	13.72	10
001	1	3.93	16,800	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	43.72	85

Figure 2: Crash Summary Report (Summary View)

Home > TADMaint > SPI > AppReports > CSR > Summary

Highway #  Highway Name   
 Begin MP  End Mp   
 Direction

1 of 1 100%

**Oregon Department of Transportation**  
 2018 Crash Summary Report 2015-2017 (No PDO crashes included)  
 Monday, February 1, 2021  
 Pacific  
 001 MP 0 to MP 308.63

Crash Totals		Injury and Fatal Crashes	
Head On	10	Injury A (Most Severe)	129
Angle	1	Injury B (Moderate)	979
Turning	17	Injury C (Least Severe)	2,727
Rear End	2,450	<b>TOTAL Injury Crashes</b>	<b>3,835</b>
Side Swipe		<b>FATAL Crashes</b>	<b>46</b>
Meeting	1		
Overtaking	470		
Fixed Object	782		
Pedestrian	20		
Backing	4		
Parking	0		
Non-Collision	76		
Miscellaneous	50		
<b>Total Crashes</b>	<b>3,881</b>		





Safety Priority Index System (SPIS) Summary		Additional Statistics	
Highest SPIS Value	74.83	Daylight Crashes	2,637
Lowest SPIS Value	12.11	Truck Involved Crashes	451
Top 10% Cutoff	49.19	Intersection Crashes	72
Total SPIS Sites on Top 10% List	267	Wet Crashes	1,102
		Snow/Ice Involved Crashes	140
		Speed Involved	842
		Driver Impaired	183
		Work Zone Involved	79
		Deer/Elk Involved	36
		Pedal cycle Involved Crashes	0
		Cell Phone/ Crashes	24
		*Average Daily Traffic (ADT)	74,550
		Computed Injury Crash Rate	0.15
		ADT at First Crash	16,800
		ADT at Last Crash	132,300
		First Crash at MP	0.87
		Last Crash at MP	308.38

\* The Average Daily Traffic (ADT) was the newest year available when the data sets for this tool were compiled. V2.0

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6. Use the toolbar functions to navigate the report, change the report view, find text in a report, export/save the report, refresh the window, print the report, or export the report data, as follows:



- a. Use the arrows to navigate to the **First**, **Previous**, **Next** or **Last Page** of the report.
- b. Select the desired **Zoom** level from the drop-down menu.
- c. Enter text in the box and click **Find** to search for the entered text in the report. Click **Next** to locate the next occurrence of the text in the report.
- d. Click **Export**  to display file format options (XML, CSV, PDF, MHTML, Excel, TIFF or Word file) and select the format you want to use to save the report.
- e. Click **Refresh**  to refresh the window (not the report data).
- f. Click **Print**  to open the Print dialog box. Specify the printing criteria and click **OK** to print the report.
- g. Click **Export to Data Feed**  to open the File Download dialog box. Click **Find** to locate an online program to open the data feed file or click **Save** to open the Save As dialog bog to save as a data feed.

## Appendix 1

### Glossary of Terms

Term	Definition
<b>5 Percent Report</b>	The annual report which states submit to the FHWA identifying at least the top 5 percent of public roads currently exhibiting the most severe safety needs.
<b>ADT</b>	Average daily traffic. The average number of vehicles using a roadway each day. SPIS uses the most current ADT data available.
<b>Annual SPIS Report</b>	A report generated by the ODOT Traffic-Roadway Safety (TRS) section that ranks public roadway segments based on a calculated SPIS score. It is the basis for the annual 5 Percent Report that ODOT submits to the FHWA.
<b>CDS</b>	Crash Data System. The statewide crash database maintained by the ODOT Crash Analysis and Reporting Unit.
<b>City Street</b>	A roadway maintained and owned by a city. Also classified as an off-state roadway. <i>See State Highway or County Road.</i>
<b>Class A</b>	A crash resulting in severe, incapacitating injuries that prevent a person from walking, driving or continuing normally. <i>See Injury A.</i>
<b>Class B</b>	A crash resulting in moderate, non-incapacitating injuries where it is evident to observers that an injury has occurred (i.e., bruises, minor bleeding). <i>See Injury B.</i>
<b>Class C</b>	A crash resulting in minor injuries that may not be evident to observers that an injury has occurred, but the injured person may complain of pain. <i>See Injury C.</i>
<b>Contiguous Annual SPIS Segment Group</b>	A consecutive series of qualified annual SPIS segments on a single state highway, all of which have annual SPIS scores at or above the top 10 percent cutoff SPIS score. <i>See Top 10% Cutoff SPIS Score.</i> An annual SPIS report of these groups is <b>only</b> available for on-state highways. It is <b>not</b> available for off-state roadways.
<b>County Road</b>	A roadway maintained and owned by a county. A county road may be within city limits. Also classified as an off-state roadway. <i>See State Highway or City Street.</i>
<b>Couplet</b>	A pair of one-way roadways of a divided highway (typically on different named streets), approximately parallel with traffic flow in opposite directions and separated by accessible land uses.
<b>Crash</b>	A crash involving at least one motor vehicle on a public roadway in Oregon that resulted in death, injury or more than \$2,500 in property damage.
<b>Crash Severity</b>	The severest injury resulting from a crash. For example, if a crash results in two Injury Bs and a fatality, it is classified as a fatal crash. If a crash results in one Injury B and two Injury As, it is classified a Class B crash.
<b>Crash Year</b>	The year a crash occurred. This is <b>not</b> the SPIS year.
<b>Fatal Crash</b>	A crash in which a person dies within 24 hours of the crash as a result of injuries

	received in the crash.
<b>Fatality</b>	A person dies within 24 hours of a crash as a result of injuries received in the crash.
<b>FHWA</b>	Federal Highway Administration. A division of the United States Department of Transportation that specializes in highway transportation.
<b>Functional Class</b>	A grouping of roadways based on the character of service the roadways were intended to provide (e.g., arterial, collector, etc.).
<b>GIS</b>	Geographical Information System. A system designed to capture, store, manipulate, analyze, manage and present all types of geographically referenced data.
<b>Injury A</b>	Severe, incapacitating injuries that prevent a person from walking, driving or continuing normally.
<b>Injury B</b>	Moderate, non-incapacitating injuries where it is evident to observers that an injury has occurred (i.e., bruises, minor bleeding).
<b>Injury C</b>	Minor injuries that may not be evident to observers that an injury has occurred, but the injured person may complain of pain.
<b>Injury Crash</b>	A crash that results in the injury or death of a person. It may be classified as Fatal (with fatalities), Class A (with severe injuries), Class B (with moderate injuries) or Class C (with minor injuries).
<b>Jurisdiction</b>	The roadway owner (e.g., state, city, county).
<b>Location</b>	A position on a roadway where one or more crashes have occurred.
<b>LRS</b>	Linear reference (or referencing) system. A reference system in which the locations of features are identified by a relative measure along a linear element, for example a mile point along a road.
<b>Mileage Equation OASIS</b>	This is used as a method to account for changes in mileage of the state highway system without re-mileposting the entire highway, for example when realignment occurs, taking out a curve, the highway may actually shorten. An equation may occur at a point to account for the difference i.e, 2.06 back = 2.08 ahead. Oregon Adjustable Safety Index System. OASIS is a online tool and can be "adjusted" for variable lengths (0.10, 0.20, 0.50, 1.00, 2.00 or 5.00 miles), 3 or 5 years of crash data and various other changes from the defaults used for annual SPIS.
<b>Off-state</b>	Refers to a public roadway, excluding on-state highways.
<b>On-state</b>	Refers to a state highway owned and maintained by ODOT.
<b>Other Public Roadways</b>	Any road or street not under the jurisdiction of or maintained by the state, a county or city, but which is open to public travel. Examples include roads on tribal or federal lands.
<b>Overlapping Mileage</b>	Referenced as Z-Mileage. Overlapping mileage occurs when section of state highway is lengthened due to new construction. A Z shows up next to the "begin" or "end" milepoint.
<b>PDO</b>	A crash that results in property damage only, no longer used in CSR.
<b>Percentile Rank</b>	The percentage of SPIS scores that are the same or lower than a selected SPIS score, based on 5-percentage point ranges. For example, a SPIS score that is

	higher than 95 percent of all SPIS scores is at the 95th percentile. However, a SPIS score that is higher than 90 percent of all SPIS scores is at the 90 <sup>th</sup> percentile (i.e., it is in the top 10 percent), but, it is below and not within the top 5 percent (95 <sup>th</sup> percentile) of all SPIS scores.
<b>Public Roadway</b>	Any road or street under the jurisdiction of and maintained by a public authority and open to public travel.
<b>Qualified Annual SPIS Segment</b>	A .10-mile section on a public roadway that has an ADT and either three or more injury crashes or one fatal crash or one injury A crash over a three calendar year period.
<b>Roadway ID</b>	Roadway ID is unique to state highways. A state highway may have divided roadways for different directions of travel, like in the case of a couplet. The Roadway ID is used to uniquely identify the two separate roadways.
<b>Road Name or Number</b>	Road name and numbers are those names or numbers designated by the Road jurisdiction and is used as a unique identifier for the road jurisdiction. For State Highways they may be called State Highway name or number (sometimes referred to as the state highway index number). Road names and numbers are used to uniquely identify a roadway, street or highway.
<b>Route Number</b>	The Route number (i.e, I-405, US 26 or OR 207) is a number assigned to a designated path to facilitate travel on main highways. Not all routes are on state highways, some may be on city streets or county roads. Routes generally run over multiple unique road numbers and may have multiple jurisdictions.
<b>SAFETEA-LU</b>	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users. This federal legislation enacted in 2005, requires states to submit an annual report on a minimum of 5 percent of their public roadway locations exhibiting the most severe safety needs.
<b>Segment</b>	A length of roadway defined by a begin-point and an end-point along a route that is unique within an LRS.
<b>SPIS</b>	Safety Priority Index System. The method developed by ODOT to identify potential safety problems on state highways and public roadways and includes both annual SPIS and OASIS.
<b>SPIS Score</b>	A calculated value for a qualified annual SPIS segment based on ADT and crash history over a three calendar year period.
<b>SPIS Segment</b>	A .10-mile section on a public roadway that has an ADT and either three or more injury crashes or one fatal crash or one injury A crash over a three year period. Also referred to as a qualified annual SPIS segment or a SPIS site.
<b>SPIS Year</b>	The year the annual SPIS process is run. This is <b>not</b> the year a crash occurred. The annual SPIS process includes data from the prior three calendar years. For example, the 2011 SPIS process uses crash data from 2010, 2009 and 2008.
<b>SPIS Site</b>	<i>See SPIS Segment.</i>
<b>State Highway</b>	A roadway maintained and owned by ODOT. Also referred to as an on-state highway. <i>See County Road or City Street.</i>
<b>State Highway System</b>	Public roads owned and operated by the State of Oregon through the Oregon Department of Transportation. The state highway system includes interstates. The state highway system does not include state-owned roads managed by State Parks, State Forests, Oregon Department of Fish and Wildlife, college campuses or other state institutions.



<p><b>Top 10% Cutoff SPIS Score</b></p>	<p>The SPIS score associated with the state highway SPIS segment below which 90 percent of all state highway SPIS segments fall. For example, the annual SPIS report for all state highways identifies 41,700 SPIS segments. When ranked from highest to lowest, the top 10% cutoff SPIS score would be the SPIS score associated with roadway segment number 4,170 (<math>41,700 \times 10\% = 4,170</math>) on the list of 41,700 SPIS sites. If this SPIS score is 44.32, then 44.32 is the top 10% cutoff SPIS score. All SPIS sites within each ODOT region and county with a SPIS score at or above 44.32 are considered within the top 10 percent of SPIS sites.</p>
<p><b>Weighted ADT</b></p>	<p>The sum of all ADTs within a single segment where each ADT is multiplied by the percentage of distance it represents within the total segment. For example, a five-mile segment has an ADT of 5,000 for one mile and 10,000 for four miles. The weighted ADT for the five-mile segment equals 9,000 [<math>(5,000 \times 20\%) + (10,000 \times 80\%)</math>]. When an ADT applies to an entire segment, the weighted ADT for the segment equals the ADT.</p>

## Appendix 2

### Available Resources

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#### **ODOT Traffic-Roadway Section – Highway Safety website**

<http://www.oregon.gov/ODOT/Engineering/Pages/Highway-Safety.aspx>

- All Roads Transportation System (ARTS) Program  
<https://www.oregon.gov/odot/Engineering/Pages/ARTS.aspx>
- Highway Safety Investigation Manual
- Safety Priority Index System documentation
  - ODOT SPIS contacts and Annual SPIS Reports
- Crash Data Reports/System
- Analysis Tools and Data
- Highway Safety Information Clearinghouse
- Safety Research Summaries
- Other ODOT Safety Programs and Resources

#### **ODOT Traffic-Roadway Section – On-State SPIS website**

<http://www.oregon.gov/ODOT/Engineering/Pages/SPIS-Reports-On-State.aspx>

#### **ODOT Traffic-Roadway Section – Off-State SPIS website**

<http://www.oregon.gov/ODOT/Engineering/Pages/SPIS-Reports-Off-State.aspx>

#### **ODOT Crash Data System**

<https://tvc.odot.state.or.us/tvc/>

#### **ODOT Crash Statistics and Reports**

<http://www.oregon.gov/ODOT/Data/Pages/Crash.aspx>

#### **ODOT TransGIS**

<http://gis.odot.state.or.us/transgis/>

#### **FHWA Highway Safety Improvement Program (HSIP) reporting website**

<https://safety.fhwa.dot.gov/hsip/reports/>