User Guide for the ArcGIS Web Application OK-EFRA (Oklahoma EHS Flow and Risk Assessment)

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OK-EFRA

The purpose of the ArcGIS application OK-EFRA (Oklahoma EHS Flow and Risk Assessment) is to inform LEPCs, first responders, and other local parties in Oklahoma counties as to what extremely hazardous substances (EHS) may be transported on county roads and highways. The application also includes an assessment of EHS incident risk to serve as input to their emergency preparedness planning activities. The ArcGIS application is one of several outputs of the project, and more information is available on our website: https://www.okehs.org/

The information that forms the basis for OK-EFRA was derived from the results of a research effort funded by the Oklahoma Department of Emergency Management and Homeland Security and conducted by a research team at Oklahoma State University, Stillwater, OK with technical guidance and expertise provided by the Oklahoma Department of Environmental Quality.

The source data was collected by the OSU research team through an online survey of facilities in the state that store EHS on-site and send and/or receive such EHS materials on a regular basis. It is important to note that this survey data only includes EHS shipments on roadways, not by rail, pipeline, or other transportation; therefore, only roadway EHS shipments are shown in the ArcGIS application. Furthermore, the survey data was collected in 2018, so it may not include all EHS transported in the county currently.

The OSU research team developed methodologies and associated mathematical models to estimate the EHS flows and EHS incident risk on Oklahoma roadways. The information presented in OK-EFRA is limited to the data provided by Oklahoma facilities that responded to the survey. The estimates of EHS flow and risk levels could serve as valuable input to emergency response planning activities.

The ArcGIS application has layers for EHS flow, incident risk, and risks related to NFPA (National Fire Protection Association) categories. The NFPA categories are part of the NFPA 704 standard for the identification of hazardous materials. They include potential health, flammability, and instability hazards given as a number from 0-4 (4 being the most severe hazard). The "Special Hazard" category at the bottom of the NFPA diamond is not included in our application. The application also includes filters for EHS material and flow volume, incident and NFPA category risk levels, and counties. These features allow the user to see the desired information at various levels of detail in a seamless manner. County-level filters allow parties such as LEPCs to focus on the regions that are of interest to them. The user can also click on a road link and scroll through the details (frequency, annual amount, etc.) of all the EHS flow information shown visually.

The user guide provided here has been prepared by the OSU research team to assist end-users in accessing and working with the ArcGIS OK-EFRA application. It includes several illustrative examples and screenshots to make it easier for the user to work with the ArcGIS application.

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Section 1. Getting Started

The ArcGIS application has been designed to be accessible through web browsers on any desktop, laptop, tablet, or smartphone. At the time this document was prepared, no issues were reported about compatibility with web browsers including Firefox, Chrome, Microsoft Edge, and Safari.

Figure 1 shows the home page of the application in its current form.
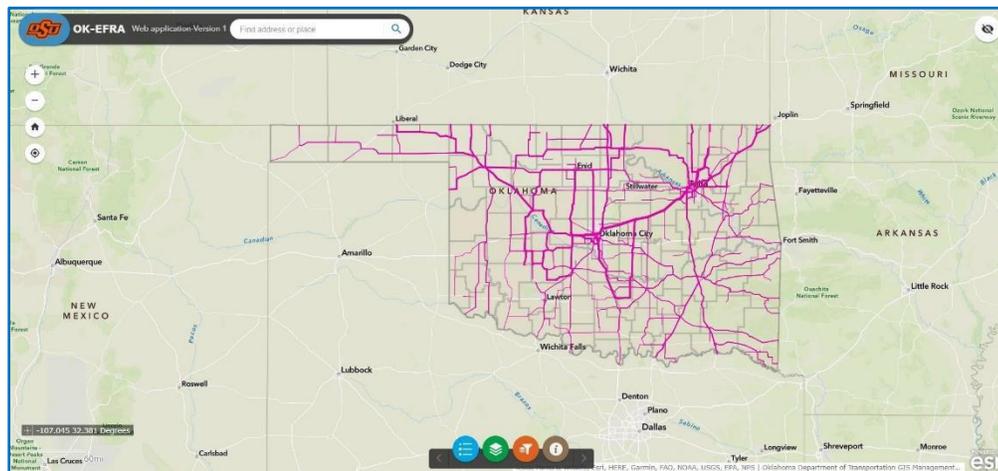
Figure 1. OK-EFRA Home Page

The home page primarily displays the map of the state of Oklahoma. The colored lines are the road networks within the state, on which the estimated total EHS flows are shown. The county boundaries are also visible on the map.

Section 2. Understanding the Controls

The control buttons are available at the top-left of the homepage, as seen in Figure 2a, and the bottom-center of the homepage, as seen in Figure 2b.
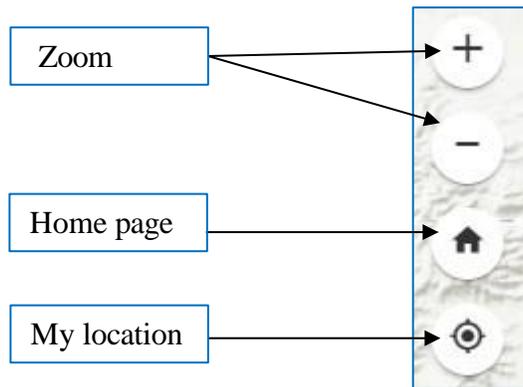
Figure 2a. Control Buttons at the Top-Left of the Home Page
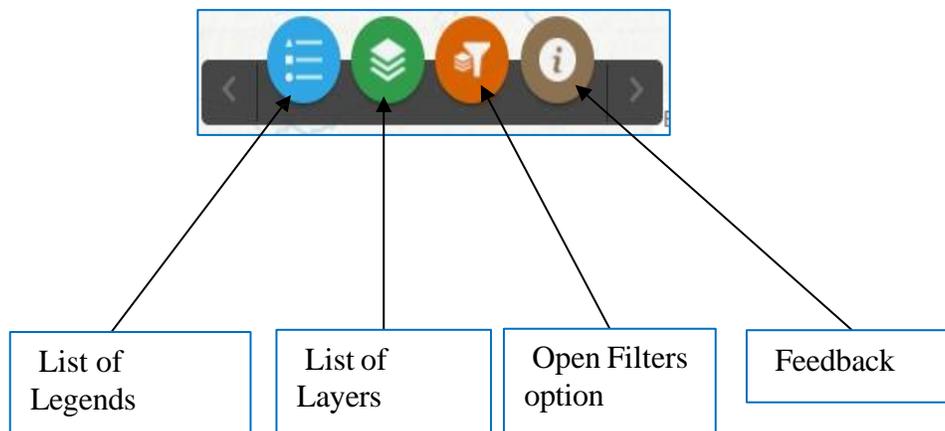
Figure 2b. Control Buttons at the Bottom-Center of the Home Page

Section 2.1 – List of Legends

By clicking on the 'List of Legends' button (the blue circle from Figure 2b), the application will display all legends used in the map. This is shown in Figure 3.
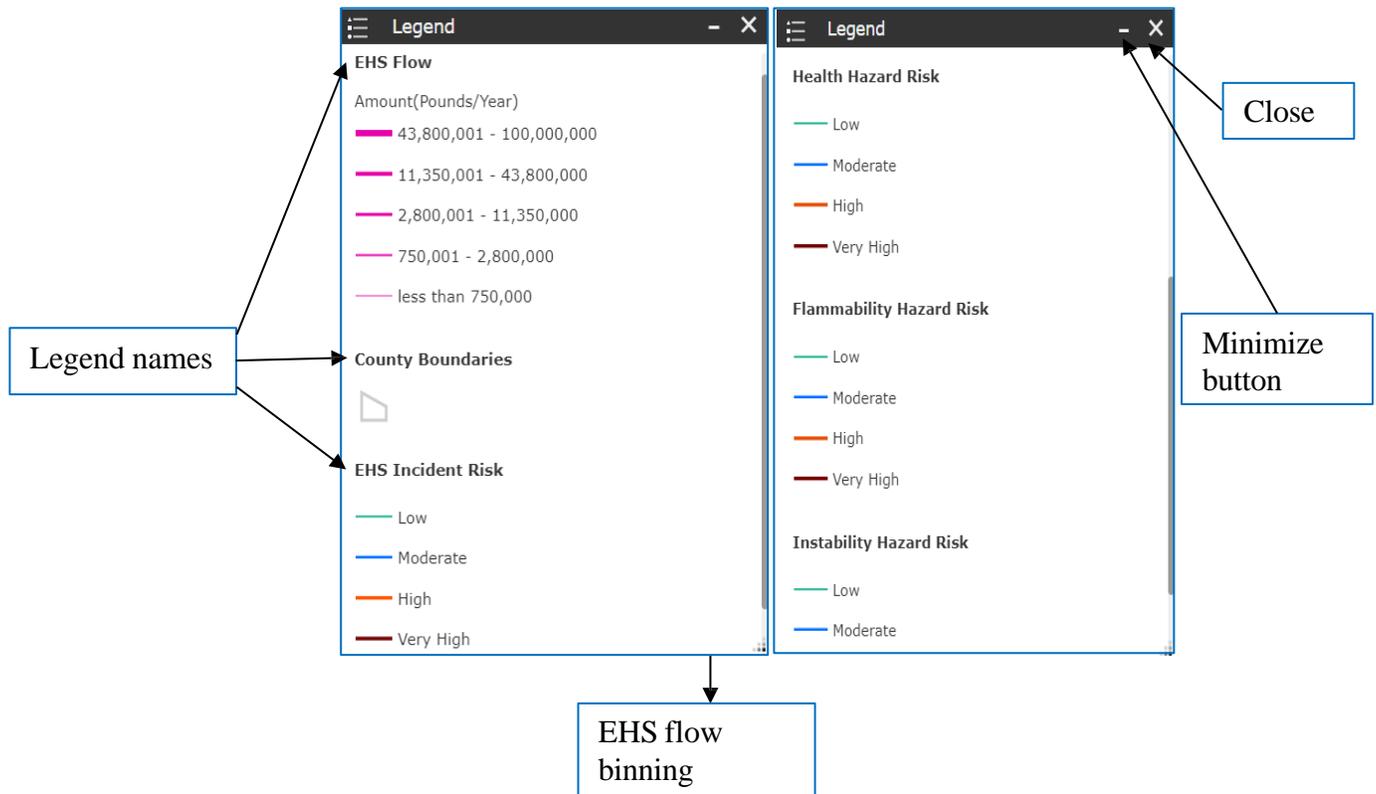
Figure 3. List of Legends

Section 2.2 – List of Layers

By clicking on the 'List of Layers' (the green circle from Figure 2b) button, the application will display a list of all ArcGIS layers used in OK-EFRA application. Each layer can be added/removed from the map using the blue- colored check box seen on the left-hand side of the layer name (see Figure 4).

Users can add one or more layers at any given time. However, it is best to only add the layers that appear on roadways one at a time, so their colors don't overlap and become skewed.

Use the small triangular drop-down to the left of the layer names to get the list of legends used on the layer. The 'List of Legends' button will also display the legends for every layer that is currently added.

Click triangle to see the list of legends for that layer

Layer Names

Selection Dropdown

Search
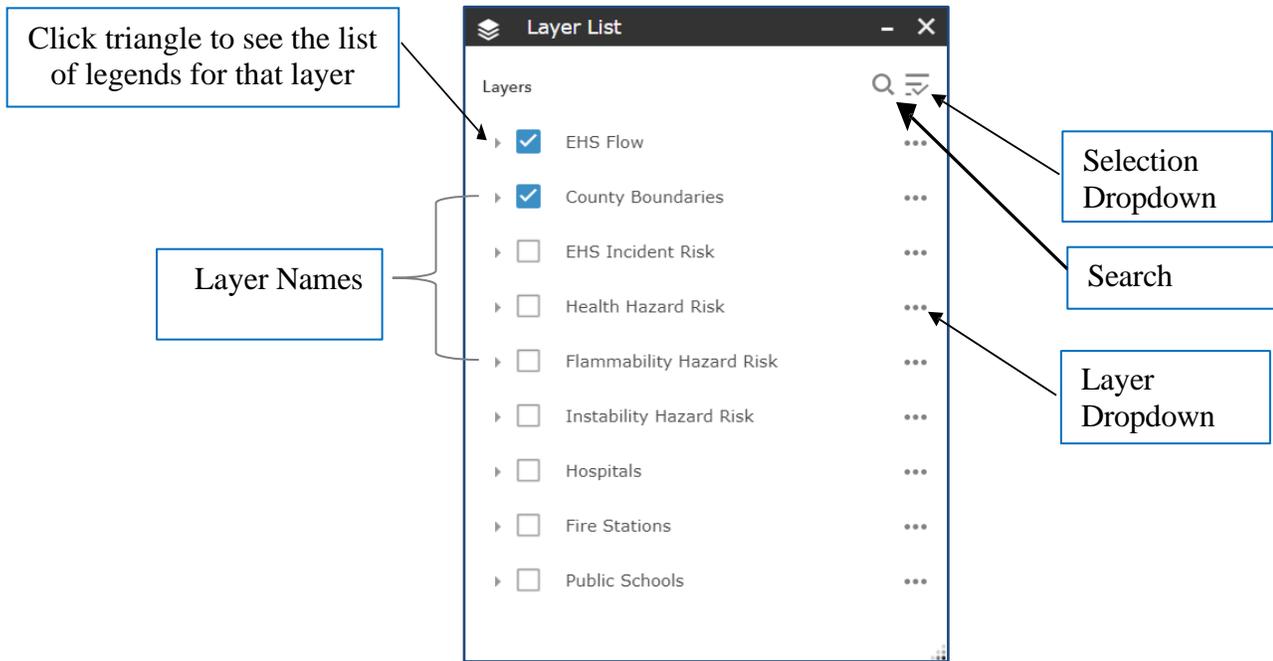
Layer Dropdown

Figure 4. List of Layers

The details of the selection drop-down button (top-right corner of Figure 4) are presented in Figure 5.

Turn all layers on

Turn all layers off

Expand all layers

Collapse all layers

1. **Turn all layers on –** Clicking on this button will turn on all the ArcGIS layers in the map.
2. **Turn all layers off –** Clicking on this button will turn off all the ArcGIS layers in the map.
3. **Expand all layers –** Clicking on this button will expand dropdowns – all legends will be visible.
4. **Collapse all layers –** Clicking on this button will collapse all the expanded layers – all legends will not be visible henceforth.

Figure 5. Selection Dropdown

The details about the layer drop-down button (bottom-right of Figure 4) are presented in Figure 6.
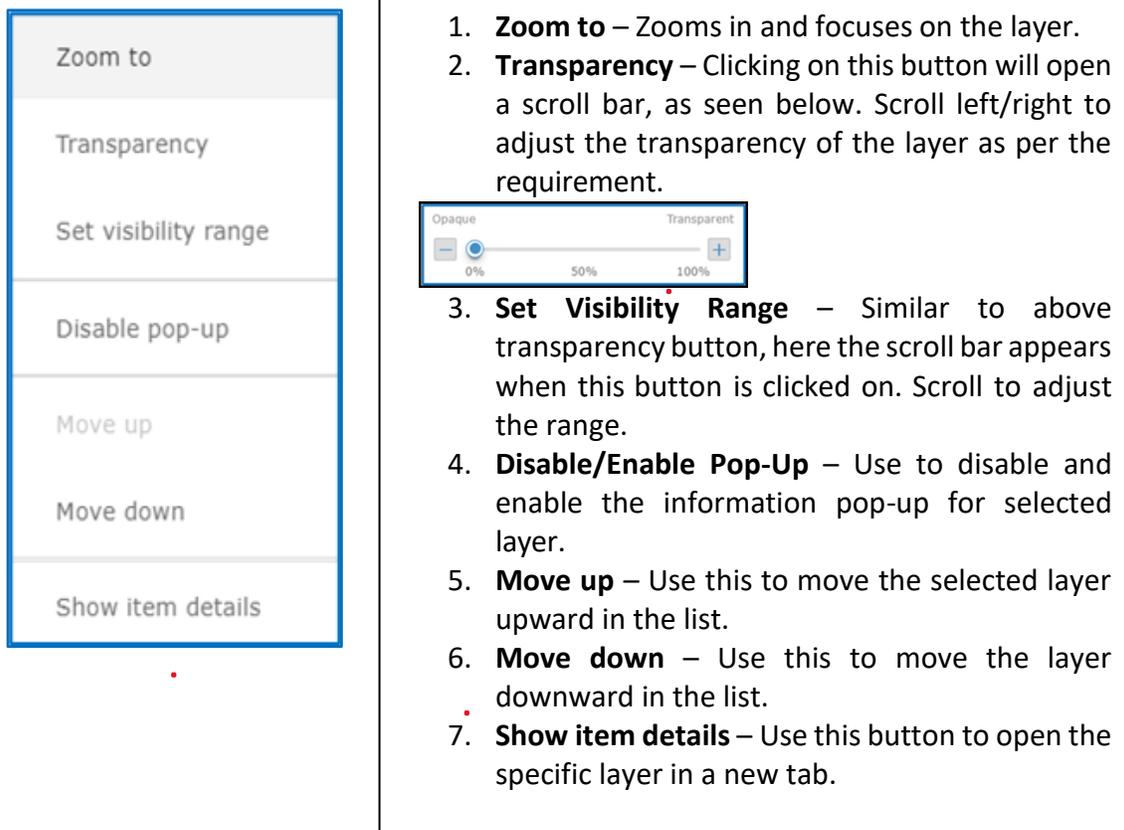
1. **Zoom to** – Zooms in and focuses on the layer.
2. **Transparency** – Clicking on this button will open a scroll bar, as seen below. Scroll left/right to adjust the transparency of the layer as per the requirement.

3. **Set Visibility Range** – Similar to above transparency button, here the scroll bar appears when this button is clicked on. Scroll to adjust the range.
4. **Disable/Enable Pop-Up** – Use to disable and enable the information pop-up for selected layer.
5. **Move up** – Use this to move the selected layer upward in the list.
6. **Move down** – Use this to move the layer downward in the list.
7. **Show item details** – Use this button to open the specific layer in a new tab.

Figure 6. Layer Drop-down

Section 2.3 – Filters

The Filter option (the orange circle from Figure 2b), acts as a sophisticated version of queries. The user can categorize, combine, and omit specific data to be displayed on the map.

Clicking on the 'Filter' button, the application will display a dialog box list to customize the map visualization. As per the filter criteria of the user's choice, different map layers are displayed as per different criteria. For example, the user can display the map as per 'EHS Chemical Name', as per each 'County', or as per 'the model/level of Risk'. Select the criteria and click 'Apply.' Finally, click 'Reset' to return to the original map. Figure 7 displays the various filter groups in the dropdown list and provides a description of each filter.
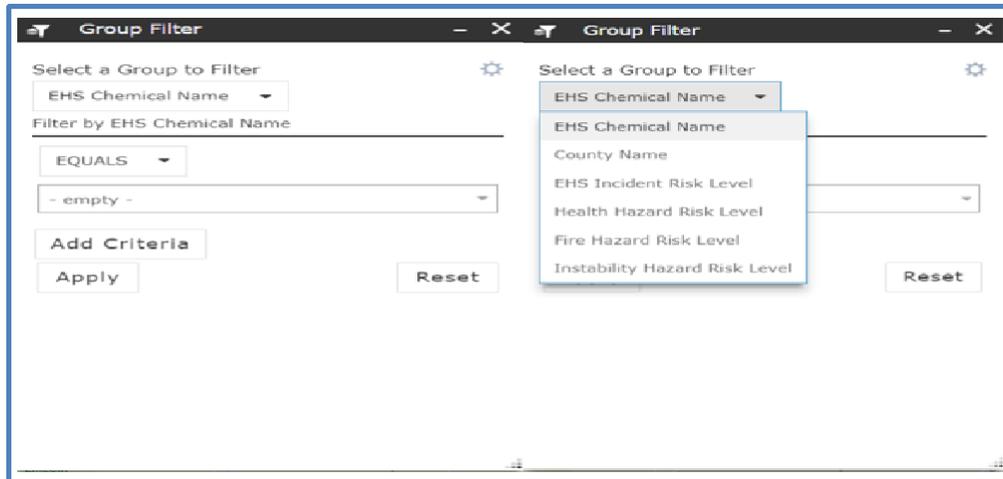
EHS Chemical Name – Provides a list of options as per different EHS materials to be selected. Example: Ammonia, Chlorine, Sodium Cyanide, etc.

County Name – Provides a list of different counties from the State to be selected. Selecting one county would refine the map to display the data for only the county chosen. Example: Payne, Tulsa, etc.

Risk – Provides options segregated as per the risk model. To display Very High, High, Moderate, Low.

Four risk models are displayed in the Filter:

- *EHS Incident Risk*: incident risk on a road link based on incident probability, shipment frequency, and population density (impact factor).
- *Health Hazard Risk*: based on incident probability, weighted average of the NFPA[*] 704 ratings for health category of EHS on road link, and population density.
- *Flammability Risk*: based on incident probability, weighted average of the NFPA[*] 704 ratings for flammability category of EHS on road link, and population density
- *Instability Hazard Risk*: based on incident probability, weighted average of the NFPA[*] 704 ratings for instability category of EHS on road link, and population density

*NFPA - National Fire Protection Association

Figure 7. Filtering by Group

The user can customize the map to show the details of a particular EHS by selecting 'EHS Chemical Name' in the 'Select a Group to Filter' dropdown. Select the criteria and click 'Apply.' Click 'Reset' to go back to the original map. This process is demonstrated in figure 8.
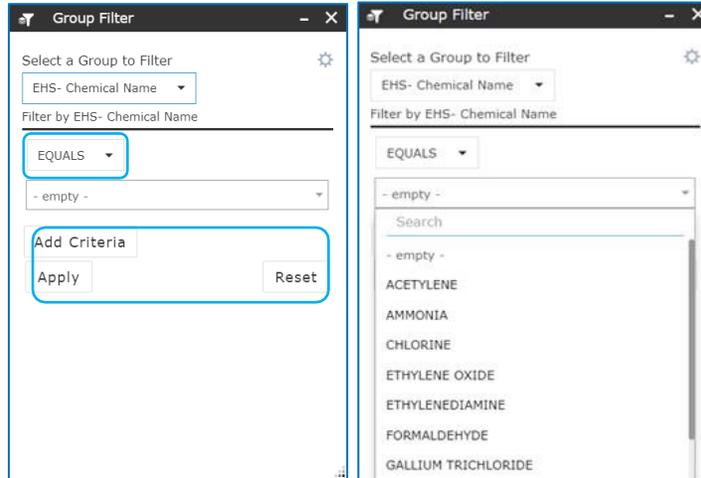
Figure 8. EHS Selection

The user has a drop-down menu to select the matching criteria as per their requirements. This is shown in Figure 9 and explained below.
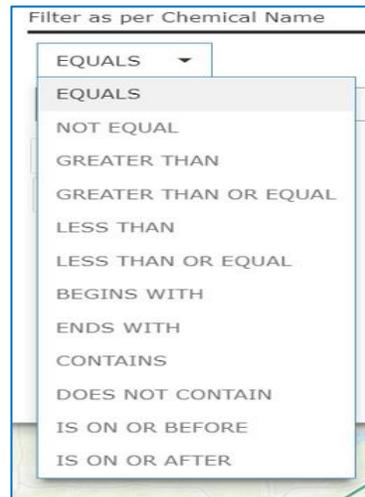
Figure 9. Criteria Selection

The user can apply multiple criteria to display more than one layer of the same filter group on the map. The user can use the option 'Add Criteria' to select your choice of criteria to be added. Select the criteria and click 'Apply'. Click 'Reset' to get back to the original map. Figure 10 highlights these functions, while figure 11 shows the display once the user clicks 'Add Criteria'. Both are shown on the next page.

For example, here are the steps if the user wants to display ammonia and chlorine on the map (two criteria of the same filter group):
Select "EHS – Chemical Name" as the group to filter by → Select 'EQUALS' as the criteria → Select your first choice of EHS - Chemical (here ammonia) → Click 'Add Criteria' → Select "And or 'Or' in the next dropdown → Select 'EQUALS' as the criteria →   Select your choice of EHS - Chemical (here chlorine) → Click 'Apply' → Click on close ('X') to see the map.

The above method works if the two desired layers are of the same group. If the groups are different, do not click "Add Criteria." Instead, filter by the first criteria, and then click "Apply" to add that layer. Finally, change the group name without resetting and add the second filter.

For example, here are the steps if a user wants to display ammonia transported in Atoka County: Select "EHS – Chemical Name" as the group to filter by → Select 'EQUALS' as the criteria → Select your first choice of EHS - Chemical (here ammonia) → Click 'Apply' → Select 'County' as the next group to filter by → Select 'EQUALS' as the criteria →   Select your choice of County (here Atoka) → Click 'Apply' → Click on close ('X') to see the map.
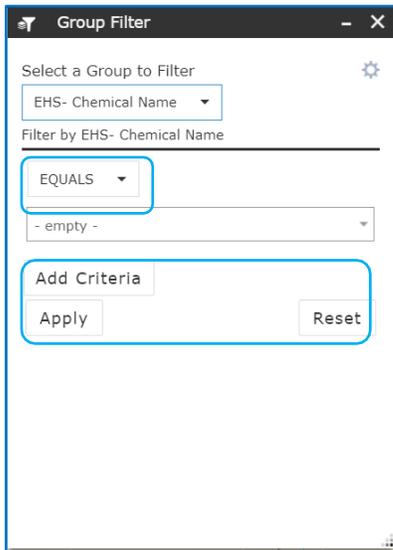
1. **Add Criteria –** Option to place multiple criteria to refine your filter.
2. **Apply –** Click 'Apply' to add the selected filter or multiple filters selected.
3. **Reset –** Displays the original map, removing the previously applied filters.

Figure 10. Add Other Criteria
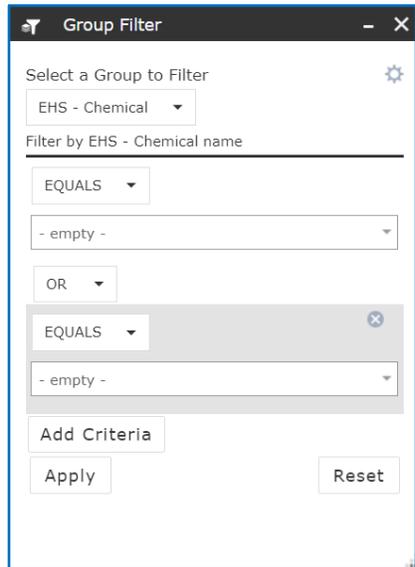
Figure 11. Multiple Criteria of the Same Group Added

Section 3 – Interactive pop-ups (Roadways)

The information about a road link is shown in Figure 12. This is found by first clicking on the roadway link of interest.

Scroll left/right through the Records

Selected road link is highlighted

Record Number

Close the pop-up

Maximize

(1 of 11)

Road Link Information

Chemical Name : *AMMONIA*
Frequency per year : *52*
Container Type : *Tanker*
Amount (Pounds/Year) : *4159959*
Overall Traffic Per Year : *3184088*
County : *Rogers*

Zoom to
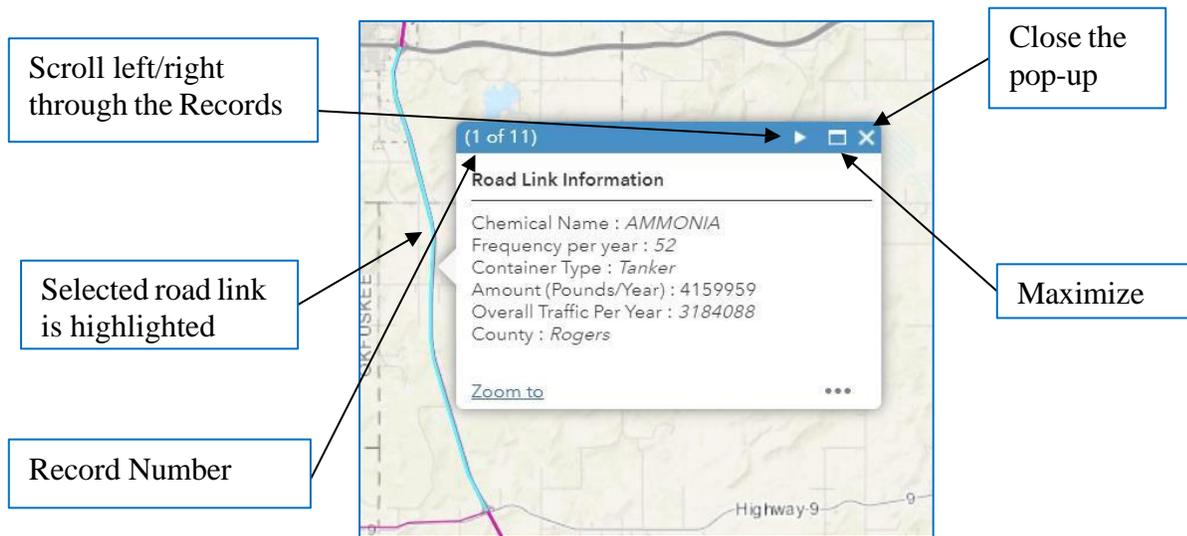
Figure 12. Interactive Pop-Up (Roadways)

The information about the road link is displayed in a pop up. The snapshot in Figure 12 shows the record for the selected road link. Click on a road link to display its pop-up.

The key information that could be retrieved from the pop up in Figure 12 is as follows:

- EHS on that Road (Frequency and weight of total reported shipments per year).

A different pop up (designated by the record number) is assigned if there is a different EHS, varying quantity or a different container type on the same road link. Thus, multiple pop ups may be present for the same road link. For example, in figure 12, the user is looking at pop up 1 out of 11 EHS shipments to examine on that roadway link.

- Overall Traffic per year (all vehicles, not just EHS)
- County information

If a roadway link spans multiple counties, the county shown is the one that contains the greatest portion of the selected roadway.

*Note that road link information is based on the EHS flow layer that was selected. Selecting a risk layer will provide some additional (or different) information.

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Section 4 – Examples

Example 1

Objective – Show all roadways in the state that transport EHS.

Steps: Home → Click on 'Layers List' option → Check 'EHS Flow' layer and 'County Boundaries' layer → Uncheck all other layers → Click on close ('X') to see the map

Step 1

Step 2
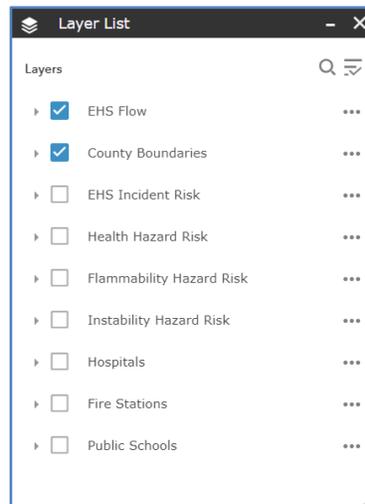
Result
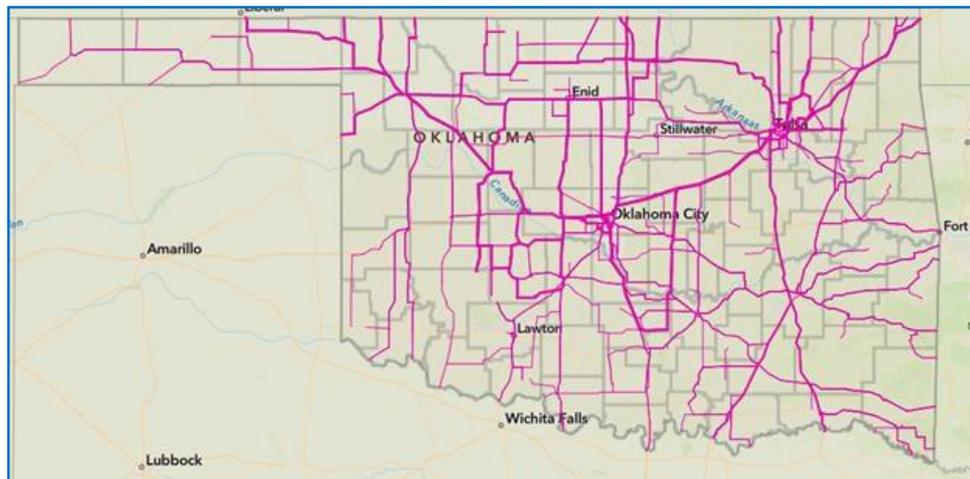
Figure 13. EHS Flow on Oklahoma Roadways

Example 2

Objective – Learn more about the EHS Incident risks associated with Oklahoma counties and identify all risk levels for the road links.

Steps: Home → Click on 'Layers List' option → Check 'EHS Incident Risk' layer and 'County Boundaries' layer → Uncheck all other layers → Click on close ('X') to see the map.

Step 1

Step 2
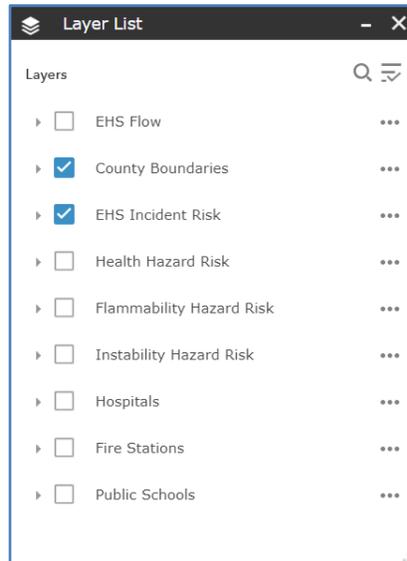
Result

Figure 14. EHS Incident Risk on Oklahoma Roadways

Example 3

Objective – To visualize the Flammability Risk in a specific county.

It is necessary to click 'Reset' prior to applying any new Filter, so that the previous filtered layer does not affect the current results. 'Reset' button is available in the 'Filter' option.

Steps: Click 'Layers' option → Check 'Flammability Risk' & 'County Boundaries' option → Close the layers option → Click 'Filters' option → Select 'County' in the first dropdown menu → Select 'EQUALS' as the criteria → Select your choice of county (here Oklahoma) → Click 'Apply' → Click on close ('X') to see the map.
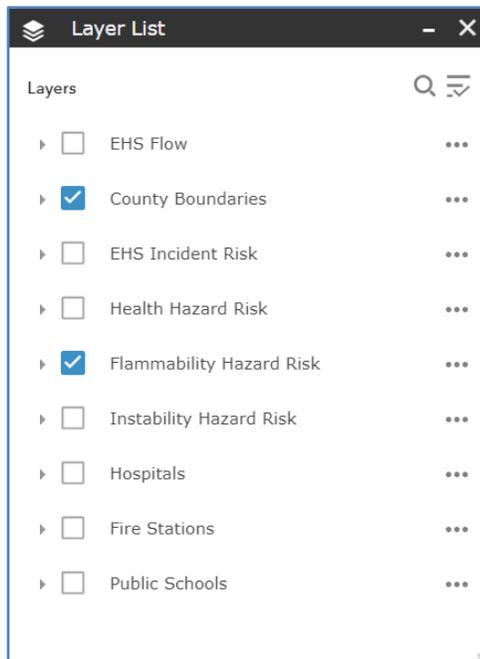
Step 1

Step 2

Step 3

Step 4
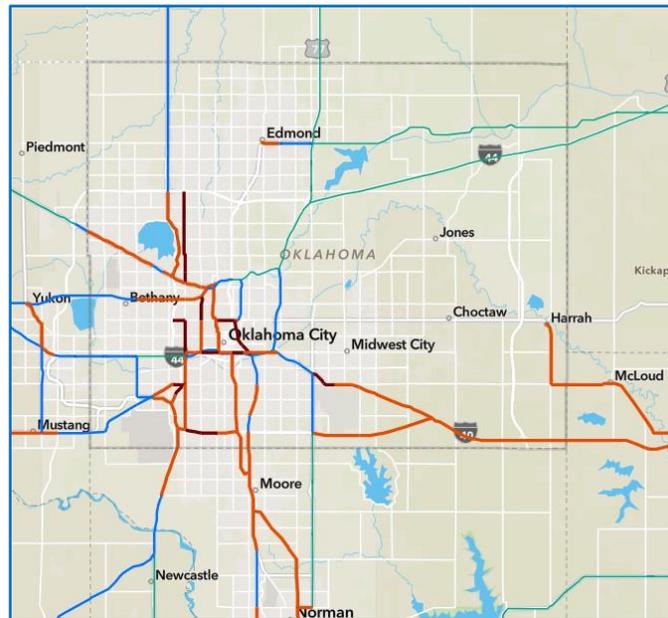
Results

Figure 15. Oklahoma County Flammability Risk

Figure 15 shows the result of visualizing the flammability risk in a specific county (here, Oklahoma). The user can click on the 'Legend' button to help distinguish between the various levels of flammability hazard risk on the Oklahoma county roadways.

Note: It is important to reset the filter when the task is completed, so that it does not affect the results displayed for the succeeding filters applied. ('Reset' button is available in the 'Filter' option)

Example 4

Objective – To visualize the flow of a specific EHS (here Chlorine).

Steps: Click 'Layers' option → Check 'EHS Flow' & 'County Boundaries' option → Uncheck all other layers → Close the layers option → Click 'Filters' option → Select 'EHS Chemical Name' in the first dropdown menu → Select 'EQUALS' as the criteria → Select Chlorine → Click 'Apply'→ Click ('X')

Step 1

Step 2
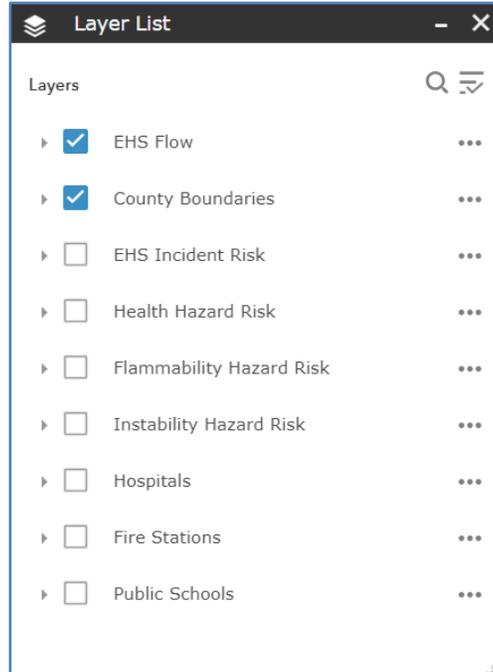
Step 3

Step 4
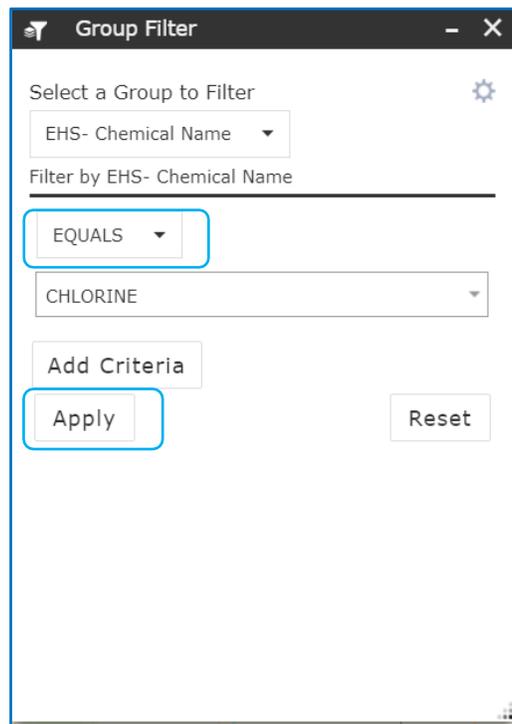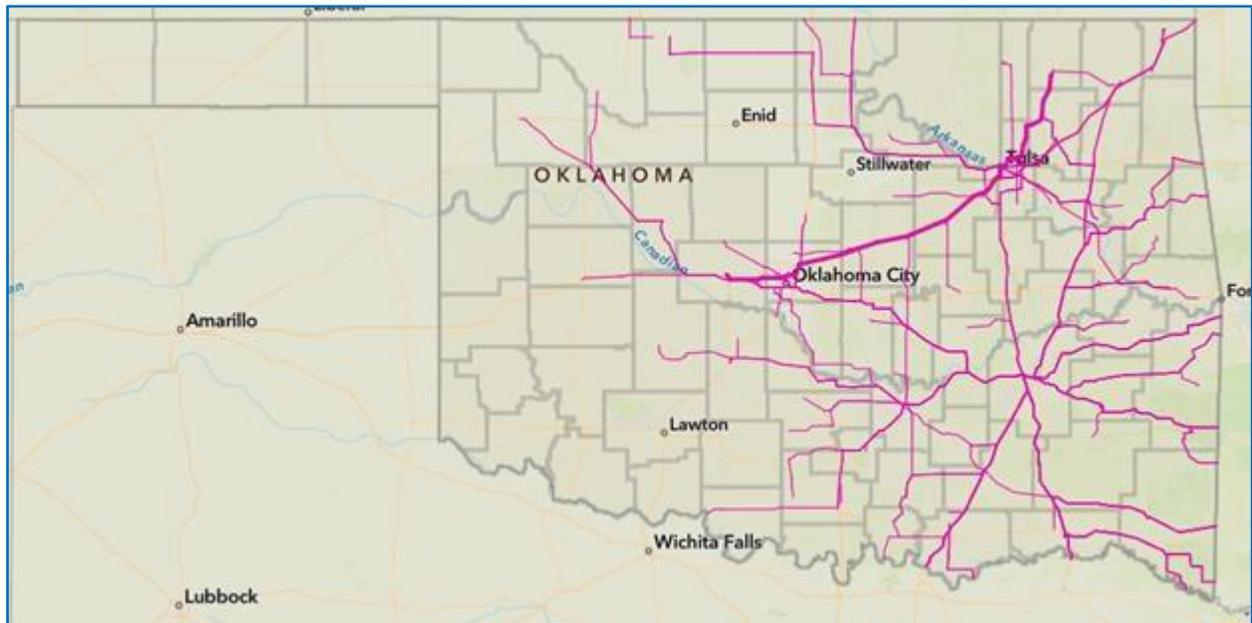
Result

Figure 16. Chlorine Flows on Oklahoma Roadways

Figure 16 shows the result of visualizing the flow of a specific EHS (here, chlorine). The user can click on the 'Legend' button to help distinguish between the various amounts of chlorine flow across the state.

Objective – Identify road links with high EHS incident risk levels in a specific county (here Tulsa)

Steps: Home → Click on 'Layers List' option → Check layer 'EHS Incident Risk' layer & 'County Boundaries' layer → Uncheck all other layers → Click on close ('X') → Click on the 'Filter' option → Choose 'County' from 'Select a group to filter' drop-down → Choose 'Equals' from the next drop-down → Choose 'Tulsa' from the counties drop-down → Click on 'Apply' → Click on close ('X') → Click on the 'Filter' option → Choose 'EHS Incident Risk Level' from 'Select a group to filter' drop-down → Choose 'Equals' from the next drop-down → Choose 'High' from the drop-down → Click on 'Apply' → Click on close ('X')

Step 1

Step 2
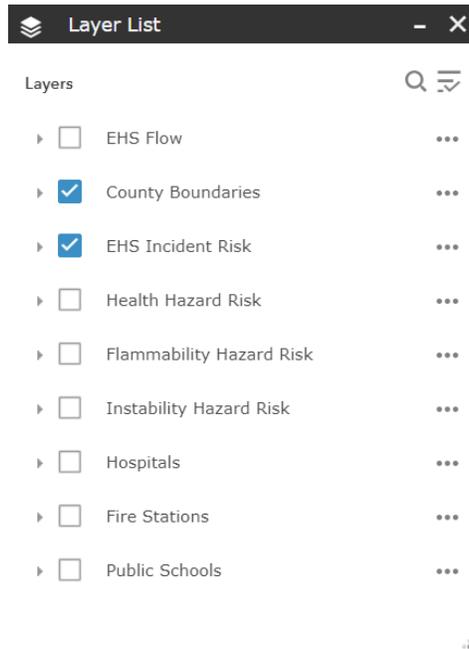
Step 3

Step 4
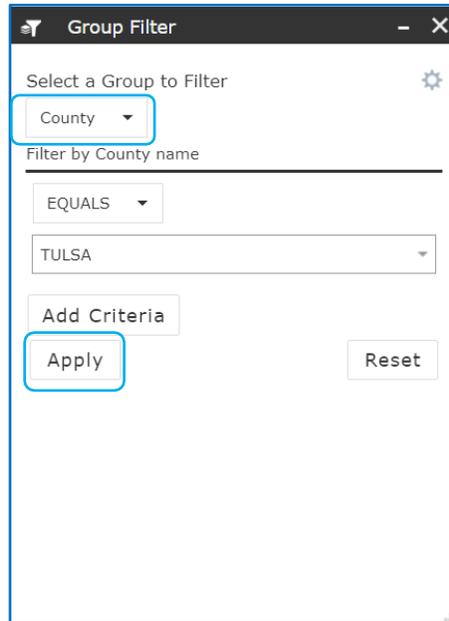
Step 5
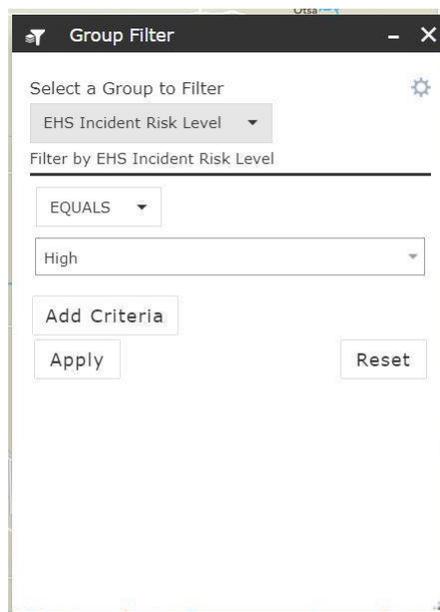
Results
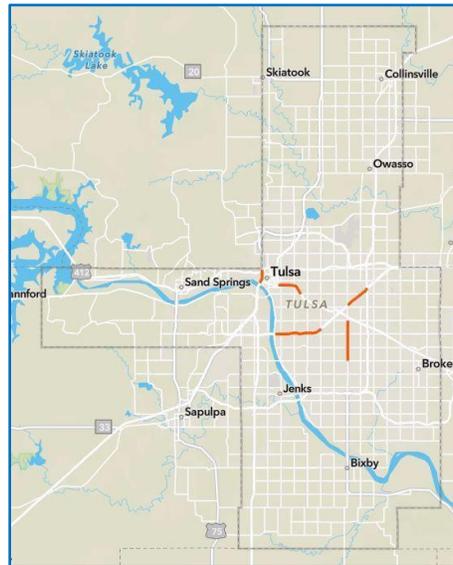
Figure 17. EHS High Incident Risk on Roadways in Tulsa County

Figure 17 shows the result of visualizing only roadway links with a high incident risk in Tulsa County. This result was achieved by filtering by two different types of criteria (county and incident risk).

Example 6

Objective – Reading the pop ups for the risk levels identified in Example 5.

Steps: After completing the steps in Example 5 →　Click on the road links highlighted in orange (displayed in figure 17).

The pop ups display various information associated with the road link corresponding to the layers and filters currently active.

The key information that could be retrieved from the pop ups is as follows:

- EHS on that Road (Frequency and weight of total reported shipments per year).

A different pop up (designated by the record number) is assigned if there is a different EHS, varying quantity or a different container type on the same road link. Thus, multiple pop ups may be present for the same road link. For example, in figure 12, the user is looking at pop up 1 out of 11 EHS shipments to examine on that roadway link.

- Overall Traffic per year (not just EHS traffic)
- County information

If a roadway link spans multiple counties, the county shown is the one that contains the greatest portion of the selected roadway.

*Note that road link information is based on the EHS incident risk layer that was selected. Selecting a different risk layer will provide some additional (or different) information.

Results
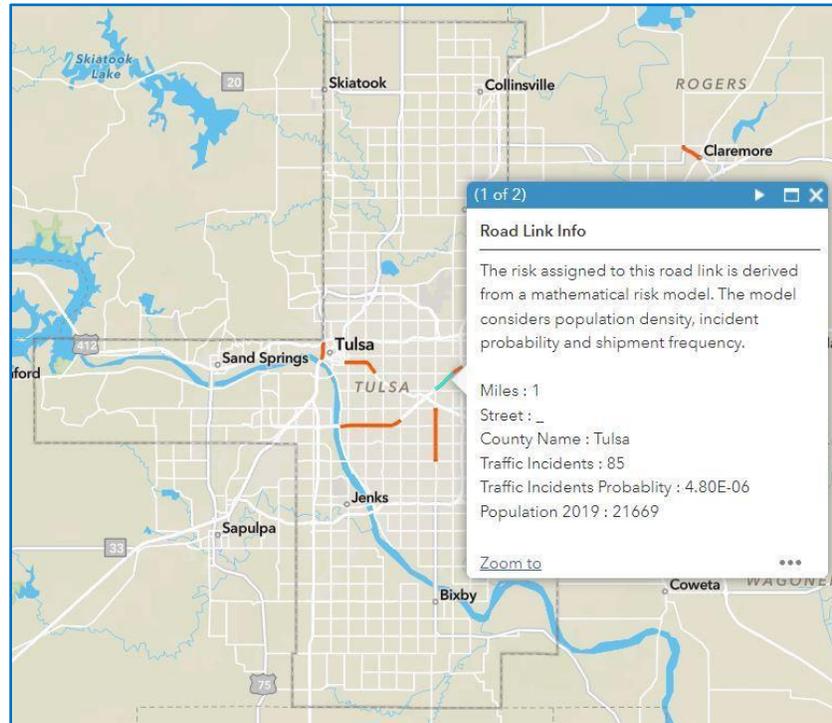
Figure 18. Pop-up of EHS Incident Risk on Roadways in Tulsa County

Figure 18 shows the pop up witnessed when clicking on a roadway link after visualizing the EHS incident flow in Example 5.

*Note that the traffic incidents listed include all types of traffic, not just those transporting EHS.
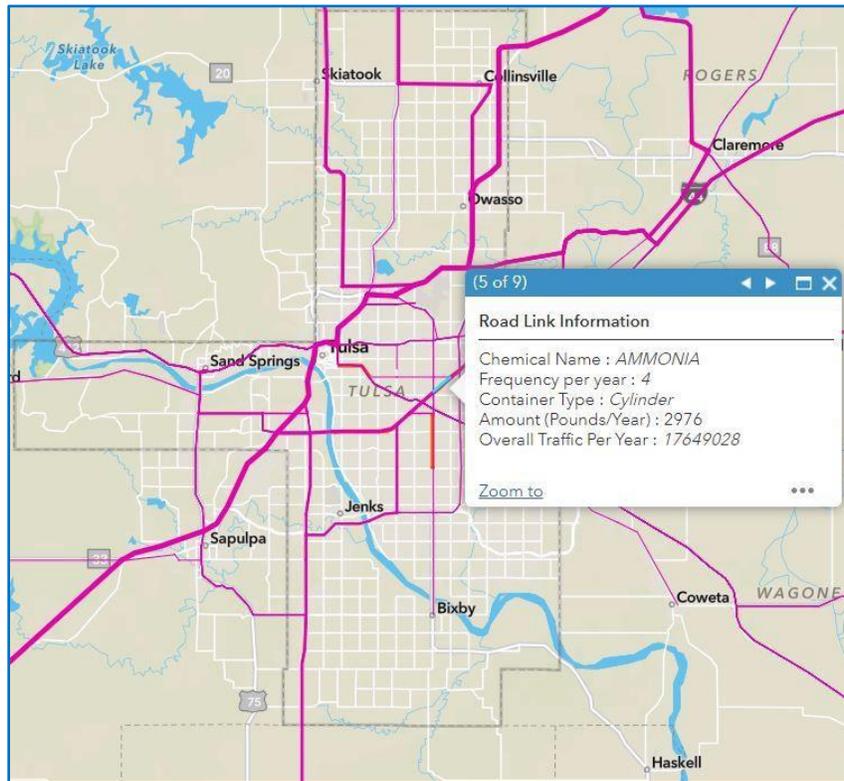
Figure 19. Pop-up of EHS Flow on Roadways in Tulsa County

Figure 19 shows the pop up witnessed when clicking on a roadway link after visualizing the EHS flow. This pop up is related to the EHS Flow, not the EHS Incident Risk. Therefore, the user needs to turn on the 'EHS Flow' layer and then click on one of the roadway links to see this pop up.