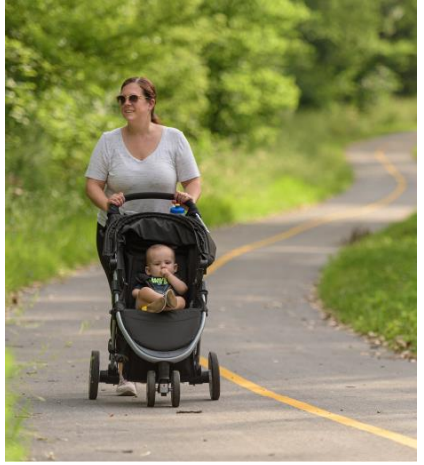
Chicago Metropolitan Agency for Planning

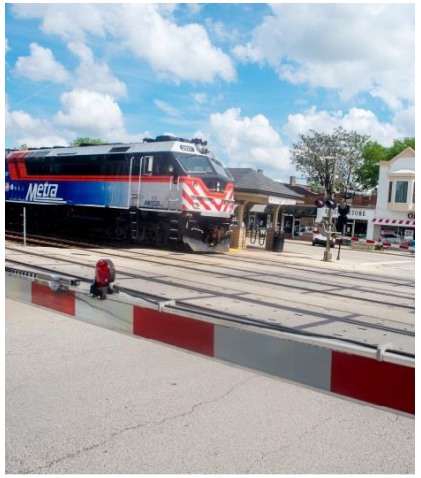
Transportation Technology and Operations Coalition

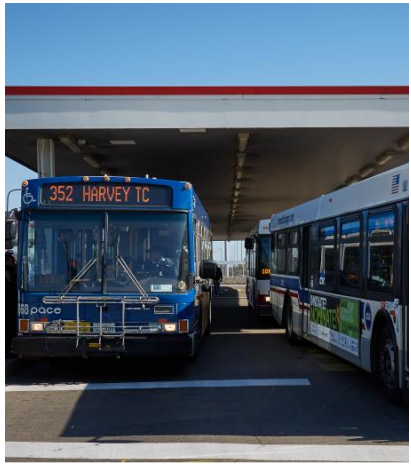
May 2, 2024

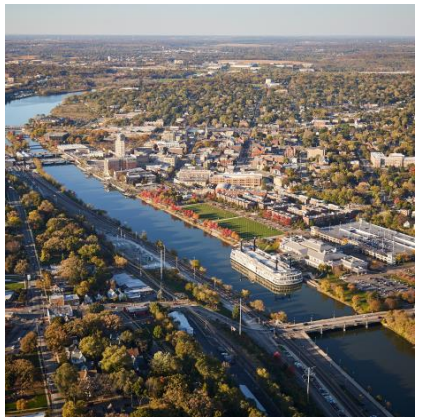
9:30 – 11:30 a.m.

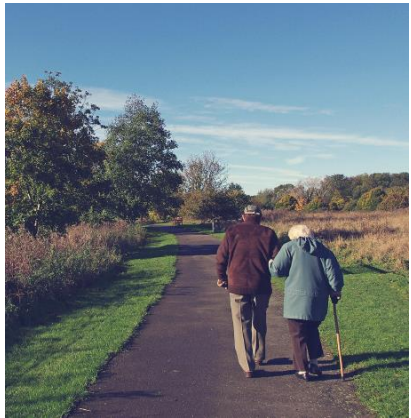
When you are not speaking, please mute your microphone to reduce background noise.











1.0 Welcome

Stephen Zulkowksi, DuDOT (Chair)

2.0 Agency updates

Open discussion among TTOC members regarding current work projects, topics of interest for upcoming meetings, etc.

3.0 CMAP announcements

Aaron Brown and Noah Harris, CMAP

4.0 Traffic signal asset condition study

Professor Ryan Fries, SIU-Edwardsville

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OPTIMUM TRAFFIC SIGNAL CONDITION ASSESSMENT AND STRATEGIC MAINTENANCE PLANNING (ICT R27-251)

Progress Update, May 2024

Ryan Fries, Ph.D., P.E.

Professor, Civil Engineering

COMPONENTS TO INCLUDE IN TRAFFIC SIGNAL ASSET MANAGEMENT

- Included (Number of Questions)
  - Foundations (3)
  - Bases (4)
  - Junctions and conduits (3)
  - Poles/Posts (4)
  - Aerial Connections (5)
  - Displays (5)
  - Cabinet (7)
  - Power
  - Detection (2)

- Excluded
  - Signal timing
  - Coordination/ communication
- Take inventory of
  - Signs mounted on mast arms
  - Emergency vehicle preemption
  - Transit signal priority
  - And more!

DEVELOPING ASSESSMENT METHODS

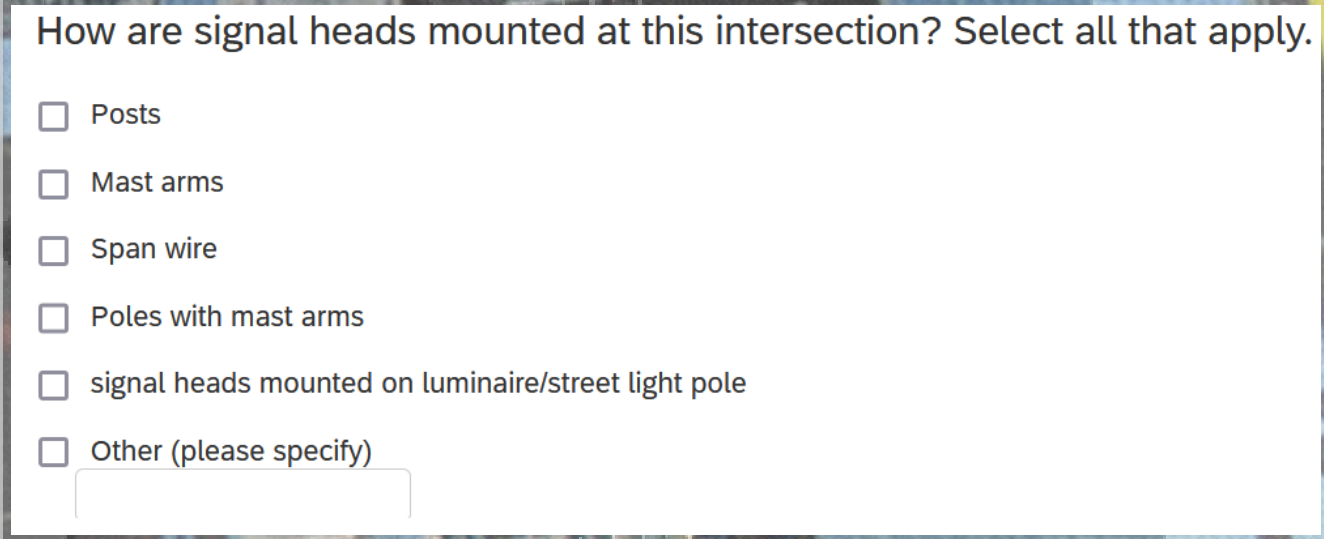
- Synthesized current practices and recent research
  - PennDOT, 2020
  - MnDOT, 2020
  - VDOT, 2014
- Technical review panel feedback
- Guided by technician interviews
- Tested with fieldwork

ASSESSMENT TOOL ORGANIZATION

1. Introductory Questions
2. Special-Case Signal Components
3. Structural Components
    1. Foundations
    2. Bases
    3. Junctions/Conduits
    4. Aerial Structural Connections
    5. Poles
    6. Mast Arms/Span Wires
    7. Signal Head Connection
4. Power
5. Cabinet
    4. Controller
    5. MMU
    6. Communication/Detection

INTRODUCTORY QUESTIONS

- Video introduction
- Where
  - Intersection name
  - Signal number
- When
- Who
- Responsible agency



SPECIAL-CASE SIGNAL COMPONENTS

Which of the following signal head features are present at this intersection? Select all that apply.

- [ ] Retroreflective backplates
- [ ] Flexible backplates
- [ ] Louvered backplates
- [ ] Directional Louvers
- [ ] Heater visors or snow cones lens cover
- [ ] Elongated visors or tunnel visors
- [ ] Other (please specify)

Which special operation features are present at the intersection?

- [ ] Cellular modems/routers for communication
- [ ] Emergency Vehicle Preemption (EVP) system (functioning)
- [ ] Flashing yellow arrow
- [ ] License plate recognition camera(s)
- [ ] Programmable Visibility (PV) Signal Head
- [ ] Accessible Pedestrian Signal (APS) buttons present and functioning
- [ ] LED street name signs
- [ ] Mast-arm mounted street name signs (please specify location)
- [ ] PTZ Camera
- [ ] Railroad interconnect
- [ ] Red light running enforcement system
- [ ] Transit signal priority (TSP) system (functioning)
- [ ] Video detection system
- [ ] Other (please specify)

FOUNDATIONS

- **Inspect pole and post foundations**.Document cracks propagating from anchor bolts, especially vertical cracks. Any rust staining present along the cracks should be documented. The cracking could indicate overloading of the bolts or appreciable corrosion on the embedded portions of the anchor bolts. Sound the pedestal with a hammer to detect locations of delamination. The delaminated areas will give a hollow sound when sounded with a hammer. All spalling, honeycombing, and scaling should be documented. Any exposed reinforcing should be documented along with any associated section loss.

Good, no evidence of active corrosion of the steel. Could have discoloration, efflorescence, and/or superficial cracking in the concrete, but without affect on strength and/or serviceability. If metal foundations present, the surface coatings are intact and functional.	**Fair**, minor cracks and spalls may exist, but none larger than 1/32". Protective coatings may have areas of deterioration. If metal foundation, surface rust, surface pitting, has formed or is forming.	**Poor**, concrete may have cracks larger than 1/16" and/or reinforcement damage/exposure. Rebar corrosion may be present but no significant effects on strength and/or serviceability	**Critical**, concrete is chipped and or steel reinforcement exposed and corroding. Presence of Alkali-Silica Reaction (PICTURE). Damage merits analysis of strength.	**Unknown**, the foundation is inaccessible and/or buried and could not be assessed.

BASES

Inspect the connection between the foundation and base plate. Visually inspect (if not obscured by a grout pad) for loose nuts and damage. …

Assess connection for tightness by attempting to rock the pole. If any motion is suspected, first check the snugness of all nuts using a wrench. If motion is suspected, but bolts are snug, strike bolts with a hammer, and listen for a ringing sound. If the sound is abnormal or lacks ringing (e.g. thud), check for corrosion. If a hollow sound is present, an ultrasonic test should be conducted to investigate the presence and location of a crack. Note any cracks in the base near the bolts.

Good, components are not missing, there is no deterioration or misalignment. The elements are fully engaged, tight, and in new or like-new condition.	Fair, components are not missing, minor corrosion (PICTURE) of the elements may be present. The elements are fully engaged with no deterioration or misalignment.	Poor, moderate corrosion (PICTURE) of the elements may be present. Anchor nuts are not fully engaged or bolts are misaligned. Washers are missing (if specified on design plans). One or two loose nuts may be observed, but do not significantly affect the strength and/or serviceability of the structure. If chosen, note location of this component.	Critical, broken, bent or missing components or significant corrosion (PICTURE) with 30% or greater section loss of one or more anchor bolts leading to questionable strength. If chosen, note location of this component.	Not Inspected: The anchor bolts are buried and/or inaccessible.
○	○	○	○	○

JUNCTION BOXES AND HANDHOLES

- Inspect junction boxes and handholes. Visually inspect junction boxes and handholes to identify open handholes, damaged lids, rodent nesting, cracks in box walls, or signs of water intrusion. Check if the handhole is heavy duty or standard duty, check the ground around the handhole, and note if the handhole needs to be raised or lowered. Open if there are concerns and confirm frame and lids are grounded. (See IDOT Highway Standards).

Good, covers all present and snug. boxes intact and functioning well. No signs of rodent or water damage.	Fair, covers are present but some show evidence of water intrusion/leaks or rodent/insect infestation. Minor settlement or erosion may be present (PICTURE), but no concern about function of boxes or conduits.	Poor, one or more damaged covers (PICTURE) with evidence of water intrusion, settlement, or rodent infestation. Concrete is cracked/ broken/ crumbling, but there is no immediate trip hazard to pedestrian and bicyclists. Maintenance needed on boxes or conduits in the near term.	Critical, one or more covers are missing or cause a fall/trip hazard. Needs to be rebuilt/raised/lowered to match the sidewalk, bike path or roadway. Immediate attention needed to repair or replace boxes and/or conduits. Please explain.
○	○	○	○

AERIAL WELDED CONNECTIONS

- Inspect welded aerial connections. Visually confirm there are no cracks in or near welds. Check the top and bottom of vertical connections for cracks. Look for bending or deformation of connection or surrounding area. Drones or Bucket-trucks are the preferred methods of observing welded connections. Binoculars are an acceptable substitute for assessment of structures younger than 18 years, or as approved by the area's Traffic Signal Engineer or Electrical Services Supervisor. Structures older than 18 years or with welds in critical condition should be assessed in-detail.

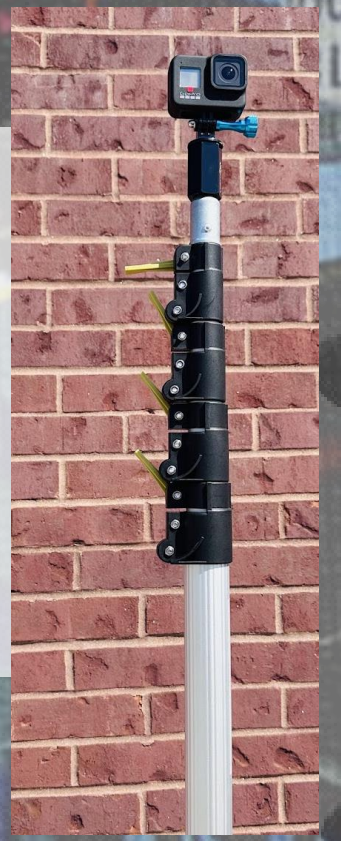
Good, no cracks in or near welds (especially the top and bottom of vertical connections); no bending or deformation of connection or surrounding area.	Fair, minor corrosion (PICTURE) in or near welds.	Poor, moderate corosion (PICTURE); slight bending or deformation of connection (PICTURE) or surrounding area.	Critical, significant corrosion in/near weld (PICTURE); Any visible cracks in or near welds, notable bending or deformation of connection or surrounding area. Multiple elements warrant ultimate strength and/or serviceability analysis. Please explain.
○	○	○	○

MAST ARM AGING CONSIDERATIONS

- Cantilever design
- Wind
  - Natural and truck-induced
  - Vortex shedding
  - Galloping

MAST ARM CONDITION ANALYSIS

- 96 Mast Arms
  - 24 Intersections
  - Southwestern Illinois
- Aged 10-25 years old
- Telescoping camera



Categories	Condition Rating		
What to inspect	Good (1)	Poor (2)	Critical (3)
Cracks/Scars/Crater Pit (A)	Shall not have any cracks, scars, or crater pits.	Shall not have any cracks at weld's face or toe. May have small scars or crater pits on weld face.	Has one or more cracks at or near the weld's face or toe. May have scars or crater pits on or near weld.
Roughness/Porosity (B)	Should be smooth and clean, no roughness around the weld.	May have the presence of minor roughness around the weld, but not on the weld face.	Has minor roughness around weld toe and on weld face
Corrosion/Oxidation (C)	May have minor corrosion/oxidation around the weld.	May have moderate corrosion or oxidation around the weld.	May have severe corrosion or oxidation on or around the weld, causing section loss.

EXAMPLE WELD CONDITIONS OBSERVED

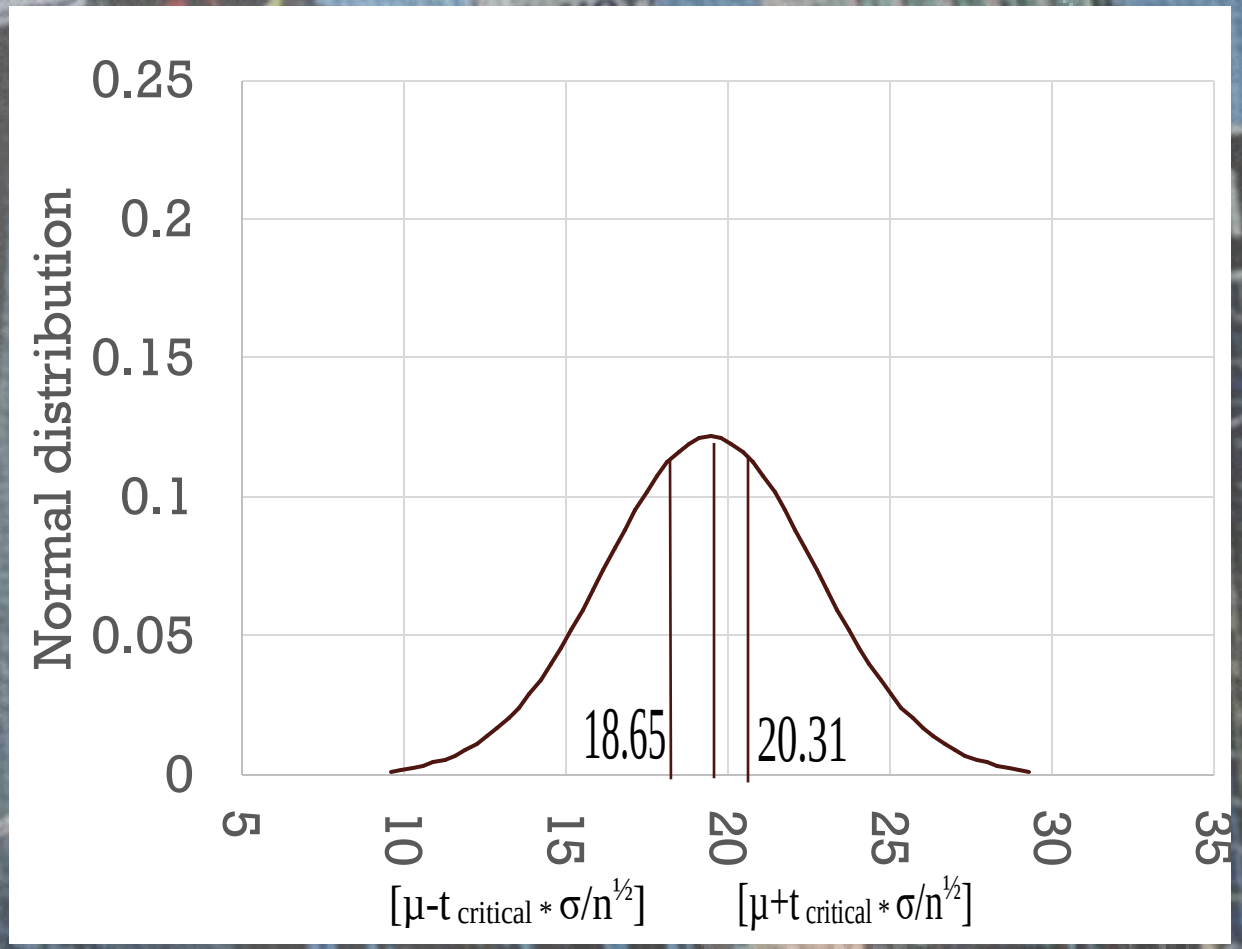
Good

Poor

Critical

MAST ARM FINDINGS

Limiting State Analysis: Critical Condition

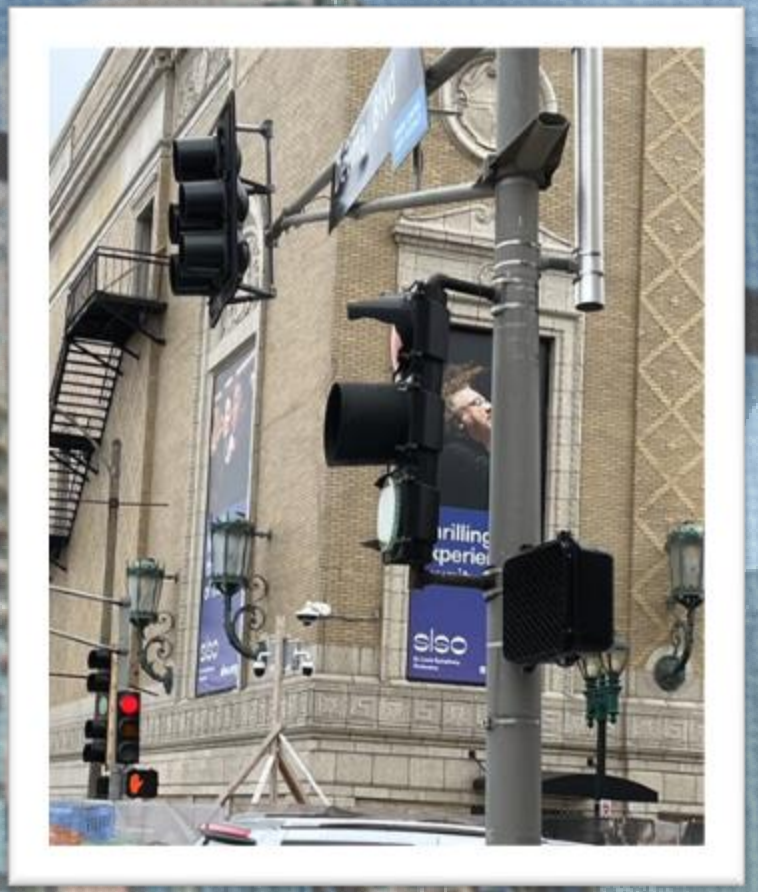


ASSESSING POLE DAMAGE

- **Inspect poles and posts for dents/damage.** Visually inspect poles/posts to identify any dents or vehicle impact damage. Record the following for any notable dents.
- **Pictures:**
- A close-up picture that shows the dent, with a ruler for size reference
- A picture showing the location of the dent compared to access holes and/or welded plates
- **Measurements:**
- The vertical and horizontal distance from the dent to access holes or welded plates (e.g. bottom plate)
- Depth of dent, relative to the original pole/post shape
- Width of dent, measured along the circumference of the pole/post
- Length of the dent, "measured straight across the largest dimension of the dent"
- Thickness of pole material
- Circumference of pole adjacent to dent location

SIGNAL HEADS

- Cracks and Damage
- Mounting
- Alignment
- Pedestrian Signal Heads
- Lights and Lenses



POWER

- Bushings (if applicable)
- Grounding system
- Service disconnect

SIGNAL CABINET

- Inspect cabinet anchoring and doors. Assess the operation of doors, locks, and police access, when applicable. Gently rock cabinet to identify signs of looseness. If cabinet connection to foundation is questionable, strike bolts gently with a hammer and listen for a ringing sound (not a thud).

Good, no evidence of corrosion, bending, or cracks. Cabinet remains securely attached to the foundation and no issues observed.	Fair, possible minor corrosion, but no bending or cracks. Cabinet remains securely attached.	Poor, corrosion stains are evident, or minor bend or crack in a bolt. Cabinet remains securely attached.	Critical, broken or missing bolt heads or significant corrosion. One or more bolts do not produce a ringing sound when struck with a hammer. Cabinet connection to foundation is questionable.
○	○	○	○

SIGNAL CONTROLLER LIFESPAN

- Published sources
- Environmental modeling
- Expert opinion
  - Current Practices

Signal Controller Expected life, years (Source)
20 (San Jose DOT, 2010)
15 (Pennsylvania DOT, September 2020), (Colorado DOT, 2016), (Kloos & Bugas-Schramm, 2005)
5-10 (Indiana DOT response, (Minnesota DOT, 2020))
7 (Ontario Ministry of Transportation response, (Minnesota DOT, 2020)
13.5 (Markow, 2008)
8.2 for the state, 9.6 for the County, 9.8 for the City/Municipality, with 9.4 as the national average (NOCE and ITE, 2019)

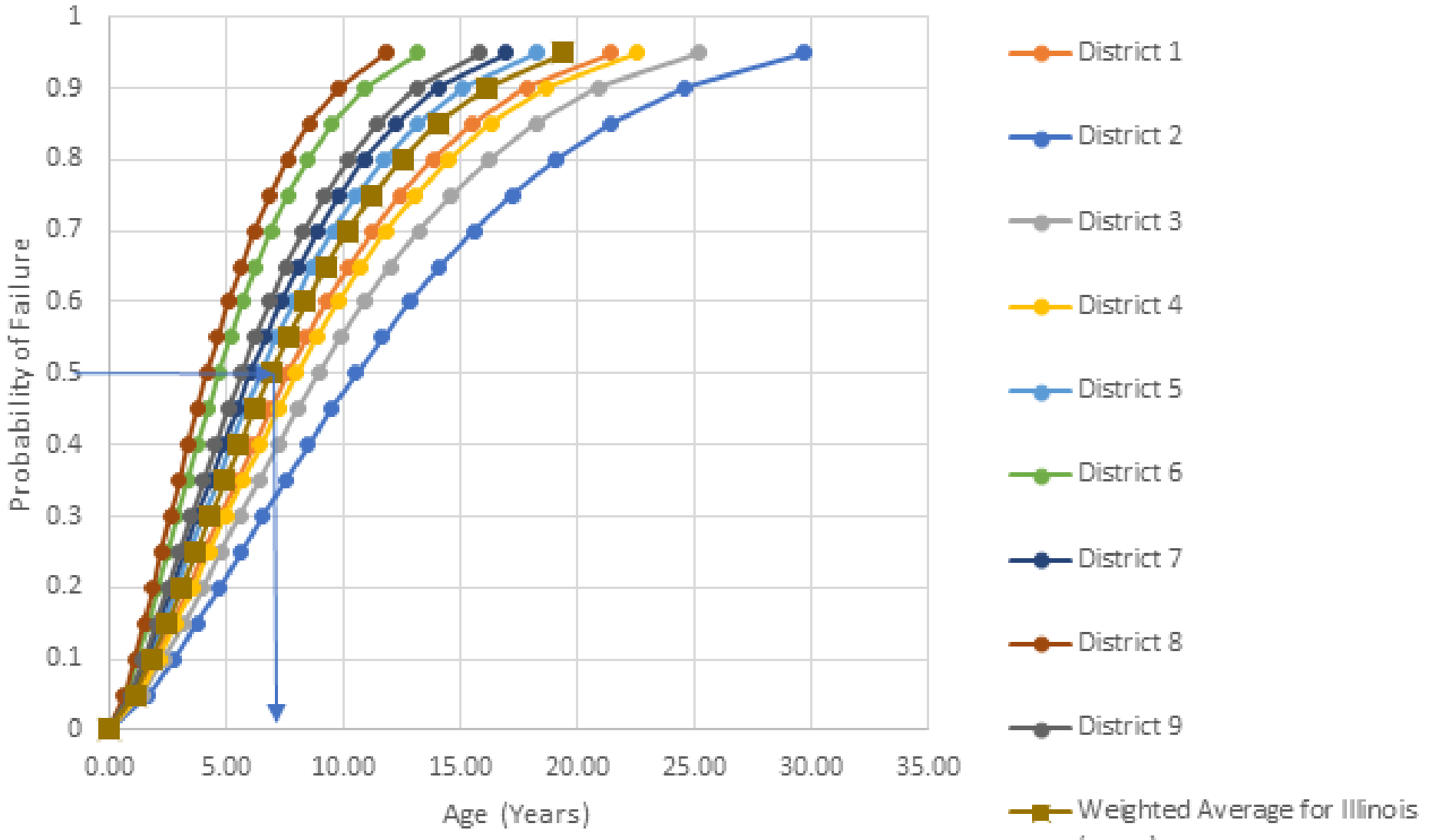
SIGNAL CONTROLLER ENVIRONMENTAL MODELING

$$y(g) = e^{-\left(\frac{g}{\alpha}\right)^{\beta}}$$

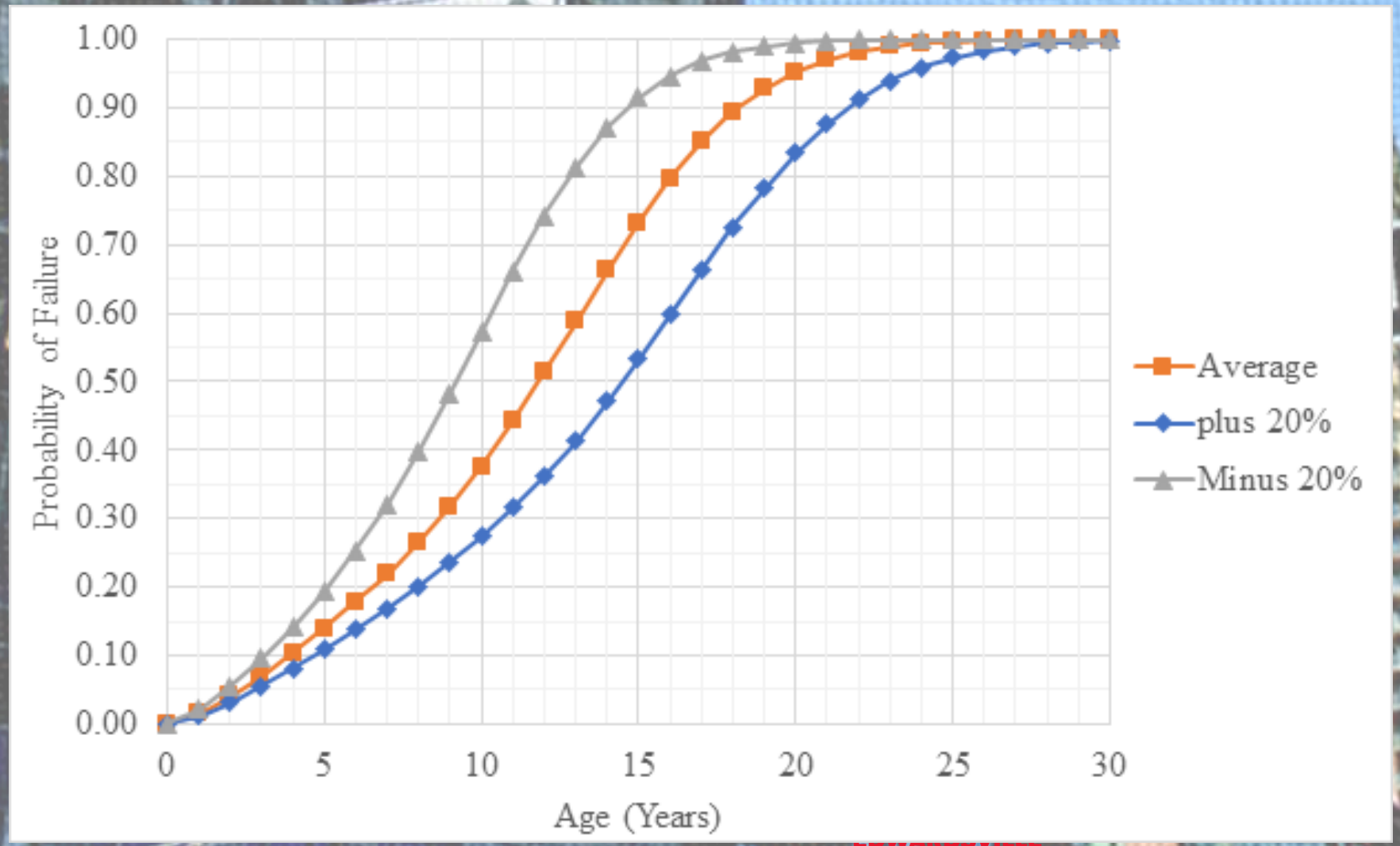
$$\begin{aligned}\alpha = \exp\big(&9.343 \\ &- 0.101 * (\text{average wind speed in mph}) \\ &- 0.108 * (\text{average annual temperature in °F}) \\ &+ 0.139 * (1 \text{ if pre-timed or semi-actuated signal, 0 otherwise}) \\ &- 0.288 * (1 \text{ if on a city street, 0 otherwise}) \\ &- 0.583 * (1 \text{ if supported by a mast arm, 0 otherwise}) \\ &+ 0.352 * (1 \text{ if part of a closed loop or hardwire interconnected}) \\ &- 0.319 * (1 \text{ if fiber-optic cables, 0 otherwise})\big)\end{aligned}$$

NCHRP, 2012

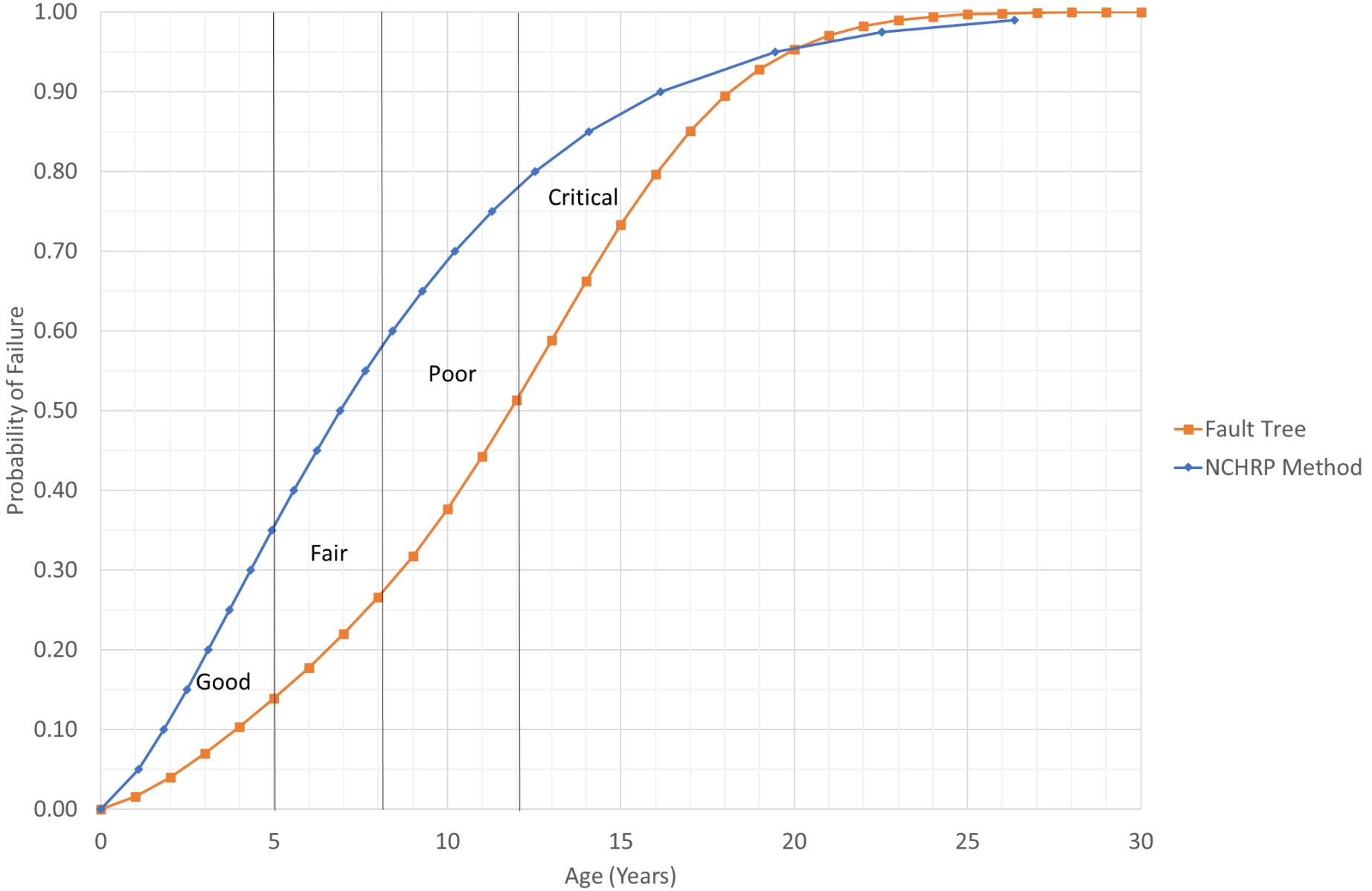
ENVIRONMENTAL MODELING FINDINGS



EXPERT OPINION FINDINGS



SIGNAL CONTROLLER LIFESPAN ESTIMATES FOR ILLINOIS



MMU

Document MMU updates. Document make and model of equipment. Document firmware installed and last date tested (see sticker).

Good, regular documenting of make, model, firmware version, and last testing date was observed.	Fair, one or two pieces of information is/are missing. Available documents match the current MMU.	Poor, more than two replacement/update documents are missing; however, the documents are accurate as per the MMU currently inside the cabinet.	Critical, there is a mismatch between current MMU inside the cabinet and the documented MMU. Records require update (Please explain).	No documentation present
○	○	○	○	○

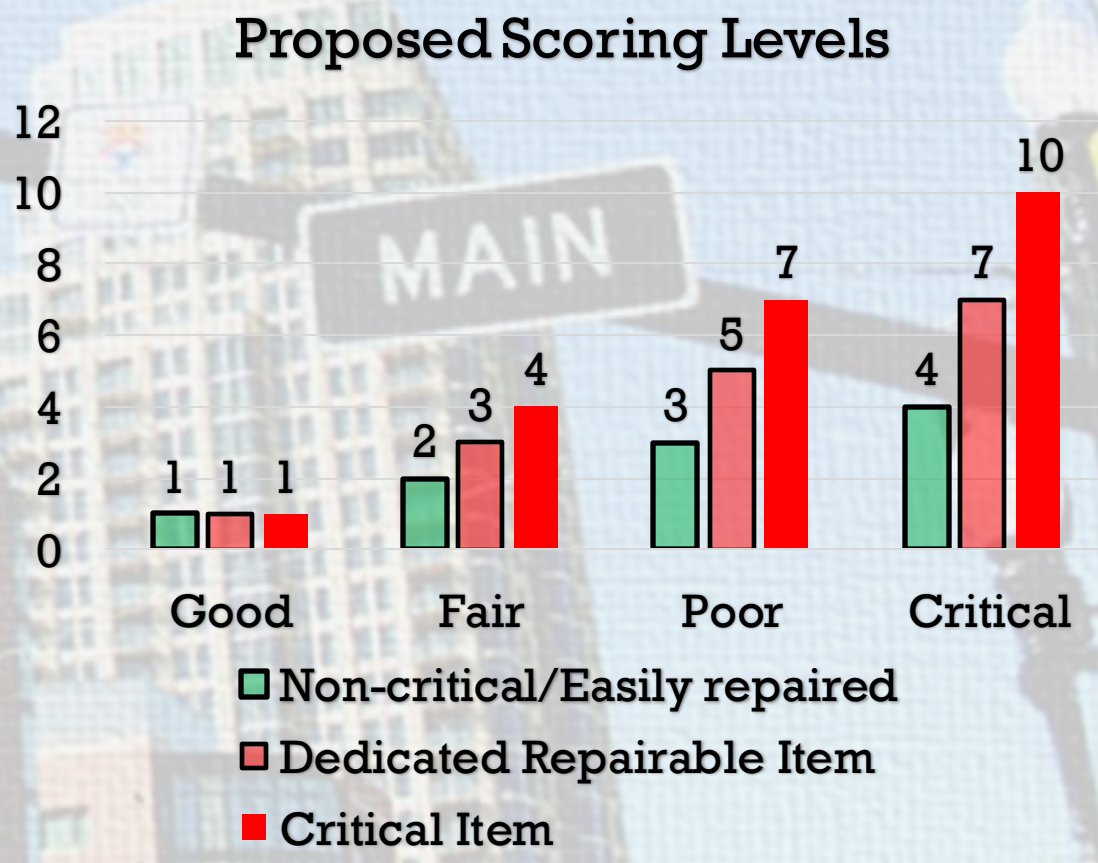
DETECTION

- Inspect vehicle detection. Verify actuation of detectors by observing intersection operation and cabinet indications. Update signal documentation as-necessary. Consider settings such as sensitivity, pulse/presence, extend/delay, and call holds.

Good, detector equipment is working well; no issues identified.	Fair, one or more detectors on through approaches are showing fault, signal actuation is affected and intersection may not be running efficiently.	Poor, one ore more the detectors on turning approaches or side-streets have failed, signal is using recall because of the failure, or signal is not meeting demand due to sensor issues.	Critical, multiple detectors on turning and through approaches have failed. Detectors require immediate repair (Please explain).	Not applicable, intersection does not have vehicle detection.
○	○	○	○	○

CONDITION SCORING

- Scoring absent from review sheet
- Three categories of components
  - Non-critical/Easily repaired
  - Dedicated Repairable Item
  - Critical Item
- Scores vary by category



OTHER GUIDANCE

- Assessing aerial components
  - Drones
  - Telescoping Go-Pro
- Inspectors tool list
- Suggested changes to signal maintenance agreement

CONCLUSIONS

- Lead to increased consistency
  - Assessment methods
  - Condition ratings
- Foundation to signal asset management
  - Identify current state
  - Establish goals
  - Quantify funding needs

QUESTIONS AND DISCUSSION

5.0 Rail-system planning data

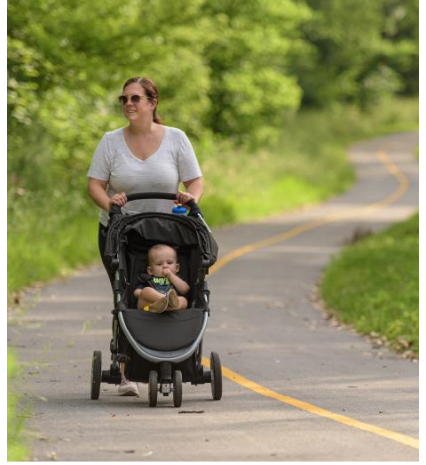
Thomas Murtha, CMAP

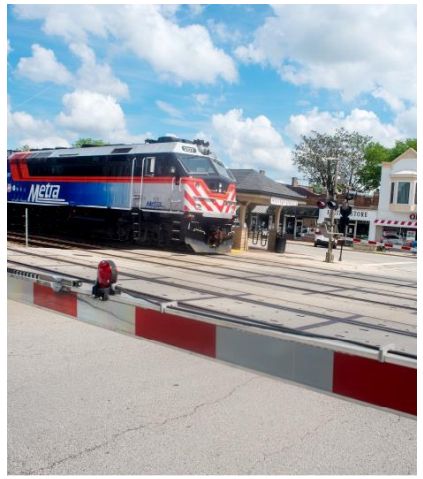
Chicago Metropolitan Agency for Planning

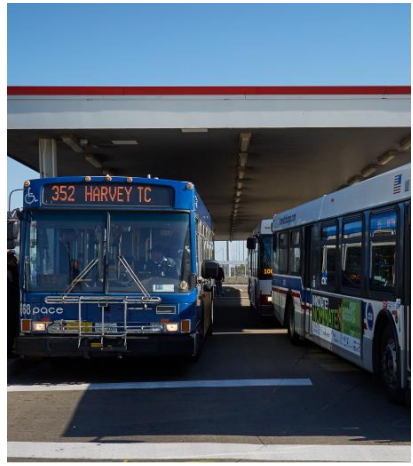
Rail Data Update

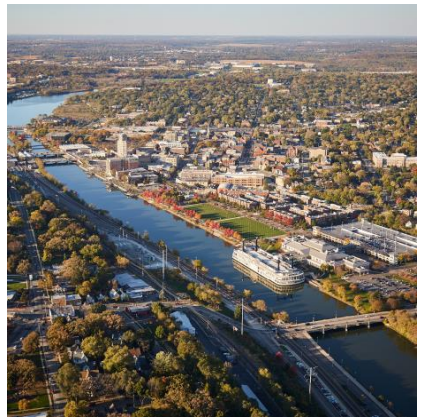
Tom Murtha, Senior Planner

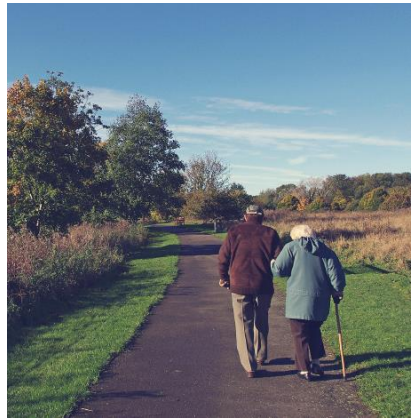
Chicago Metropolitan Agency for Planning







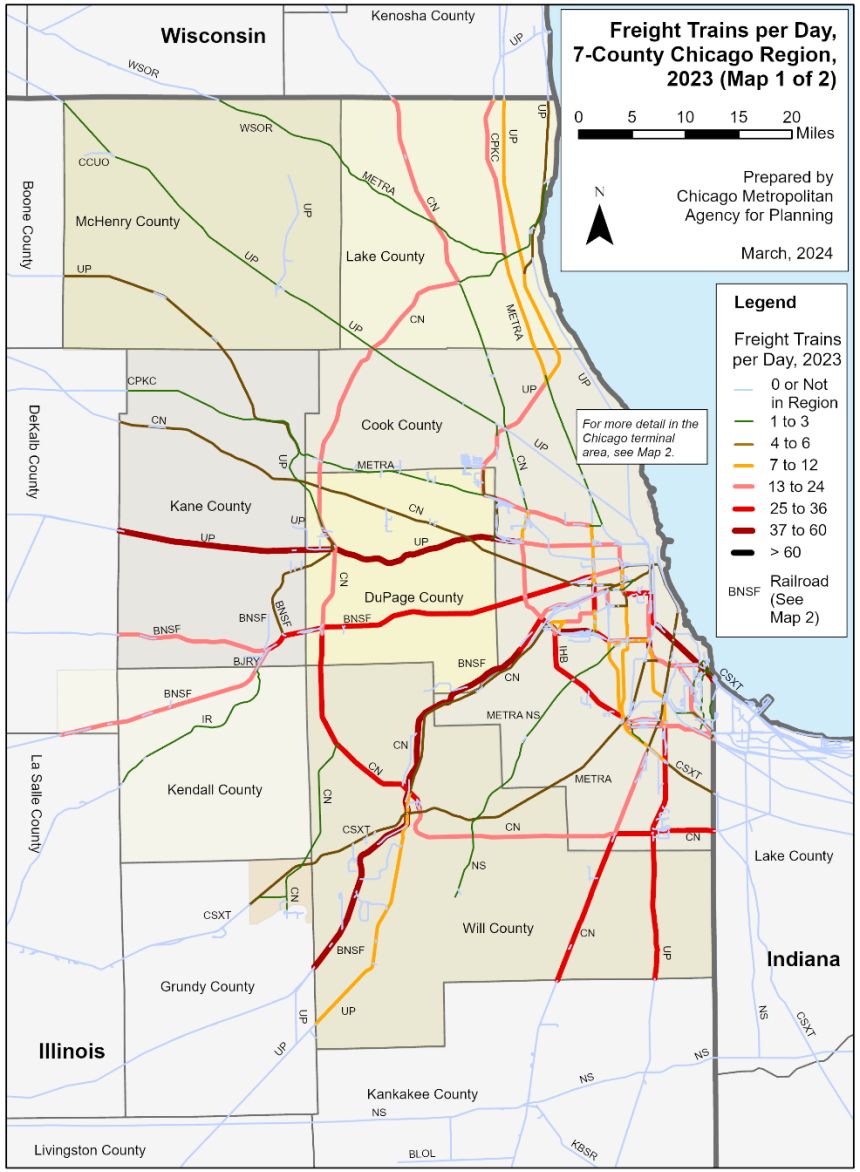




Estimates of freight trains per day were lower in 2023 than in 2018.

New: Used signal preempt data from Lake County

Find maps at https://www.cmap.illinois.gov/mobility/freight/freight-data-resources



Estimate by CMAP represents the average weekday, excluding switching and equipment moves.
Source: National Transportation Database (NTD), 2011. Updated with rail-highway interconnect data, FRA, STB, and ICC dockets and databases, CN EJE Operations Monitoring, Google Earth, field data collection, and personal communications. Missing data was interpolated.
Figures include overhead trackage rights for many railroads. Owners are shown, not overhead rights.
See http://www.cmap.illinois.gov/mobility/freight/freight-data-resources.

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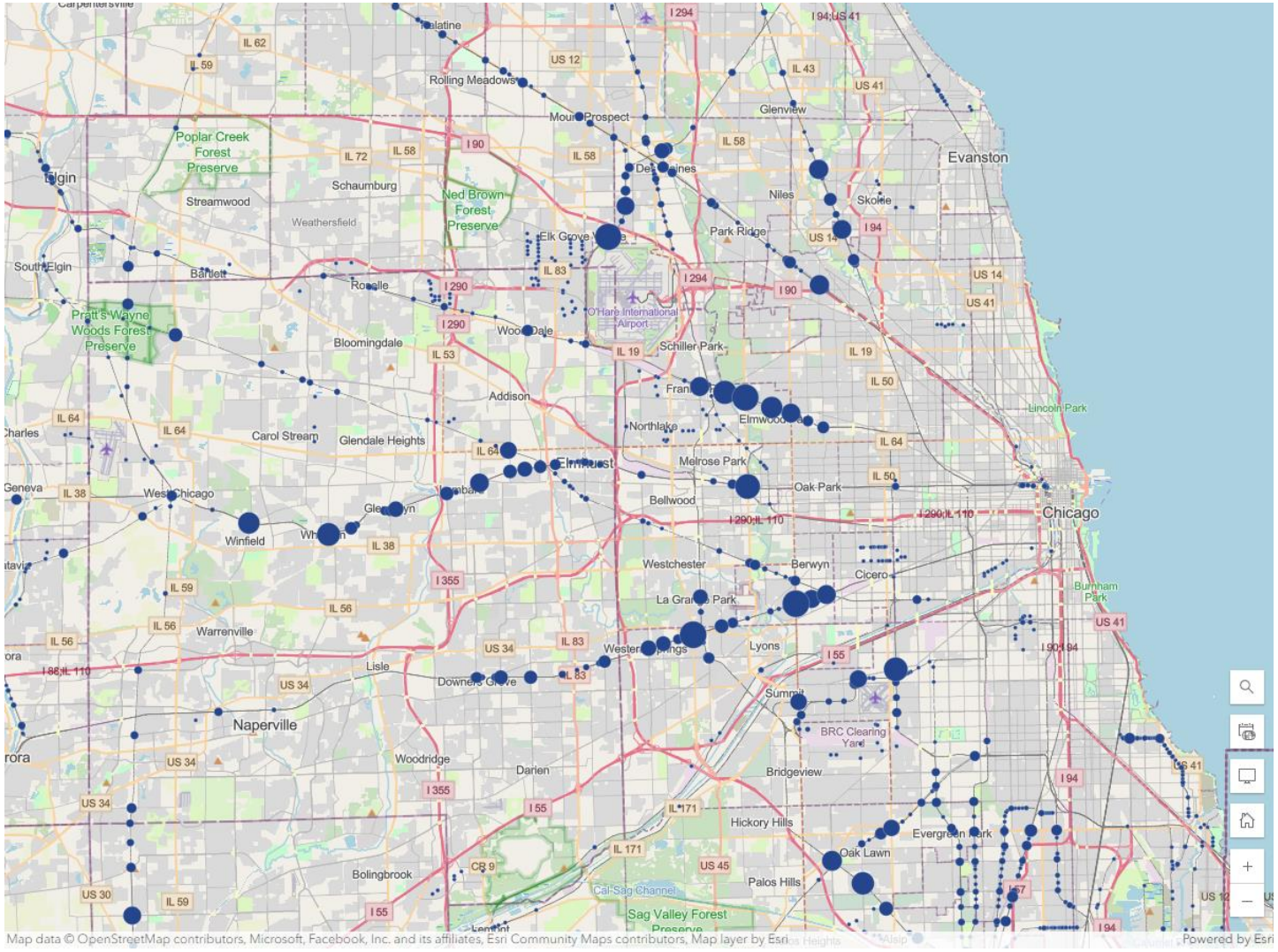
Motorists' grade-crossing delay was 20% lower in 2023 than in 2018.

New: Truck volumes converted to passenger-car equivalents.

Find map here:



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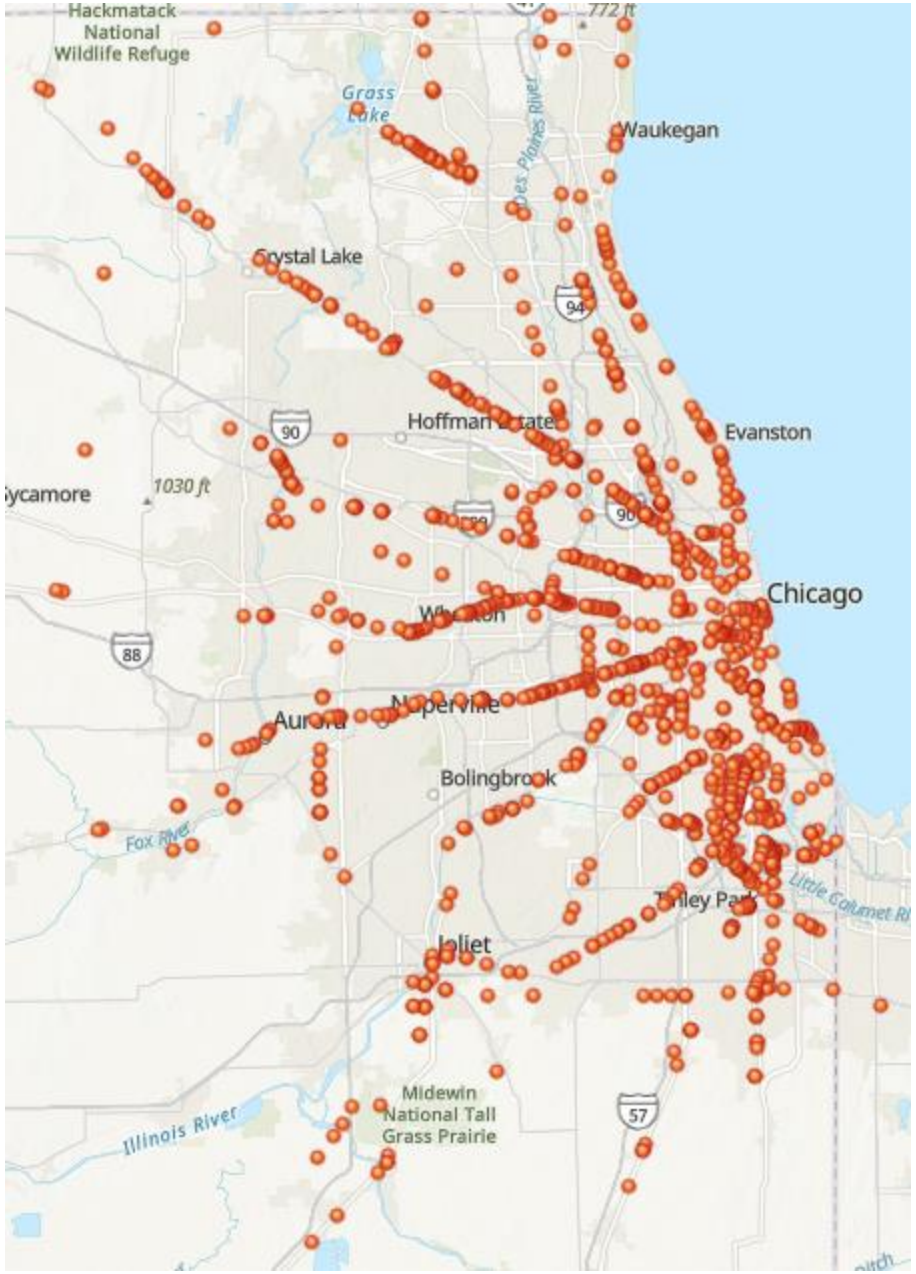
CMAP mapped 1200+ collisions identified by ICC from 2012 through 2021. Includes all motorist and crossing collisions. Additionally, this uniquely includes pedestrian collisions away from crossings.

Map:

Geodatabase:



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Thank you!

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6.0 Adjournment

Next meeting:

August 1, 2024

Location: TBD

Chicago Metropolitan Agency for Planning

Transportation Technology and Operations Coalition

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