INTELLIGENT TRANSPORTATION SYSTEM STANDARDS DEVELOPMENT

Kansas Department of Transportation

Presenter:
Therese Polum, PE (MN, KS)
Associate
SRF Consulting Group, Inc.

SRF Consulting Group, Inc.
Engineers
Planners
Designers

BACKGROUND

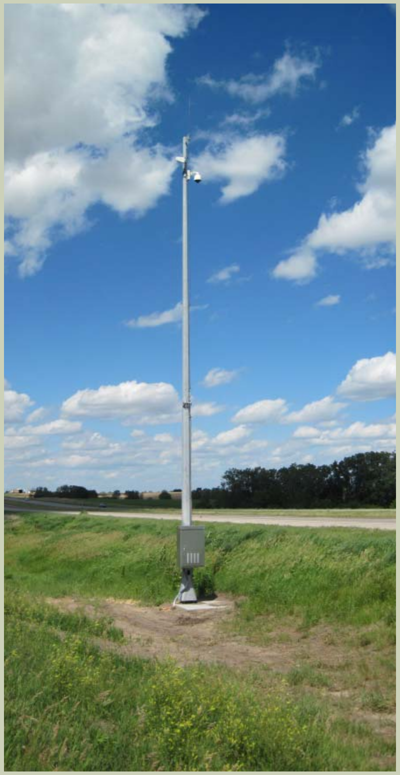
- Kansas DOT starting to deploy significant ITS projects.

- Project designers had to develop project specific standards for each individual PS&E.

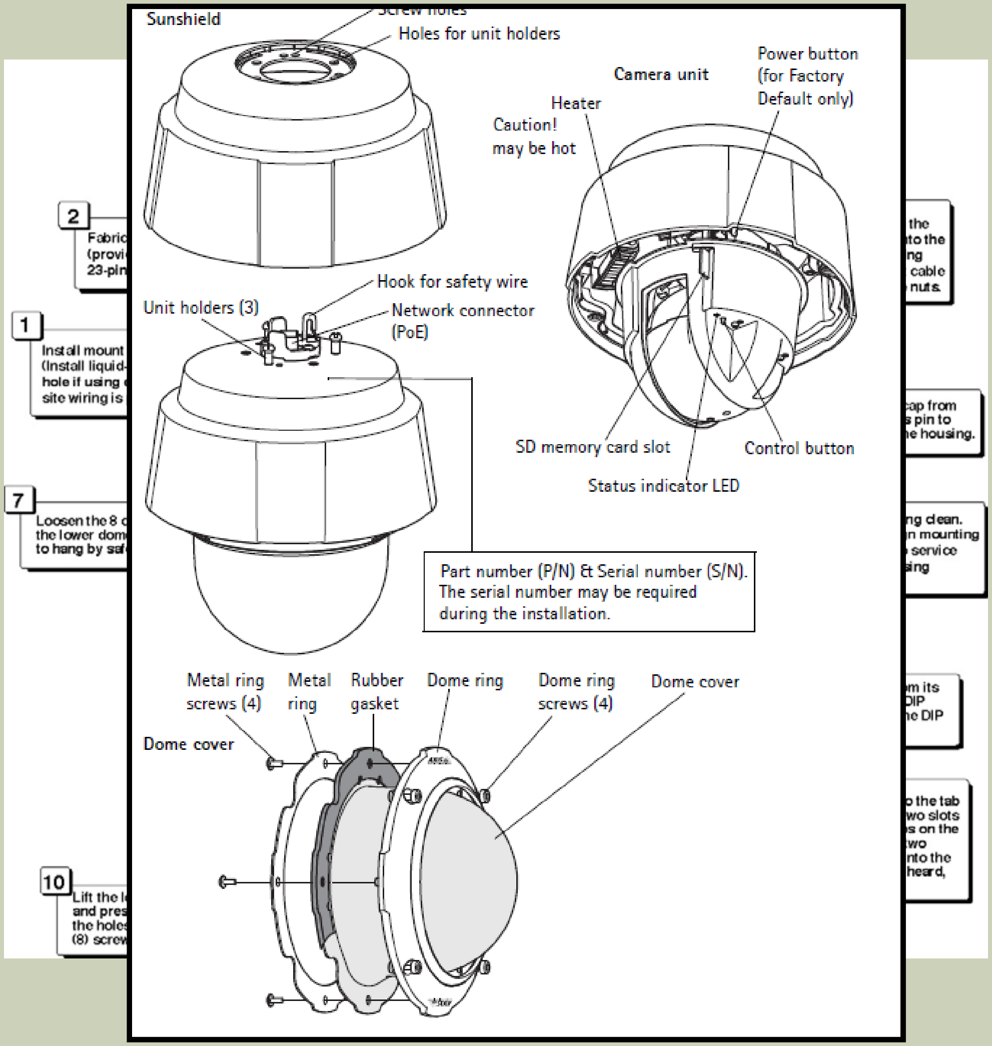
- Kansas DOT noticed the results of the time and effort put into this task by each individual project designer.

BACKGROUND

- Development of rural DMS and CCTV PS&E.
- Need to provide designers a standard set of ITS specifications and details as a building block to ITS design.
- Near future encompassed an increase of ITS deployments throughout the state, both rural and urban.



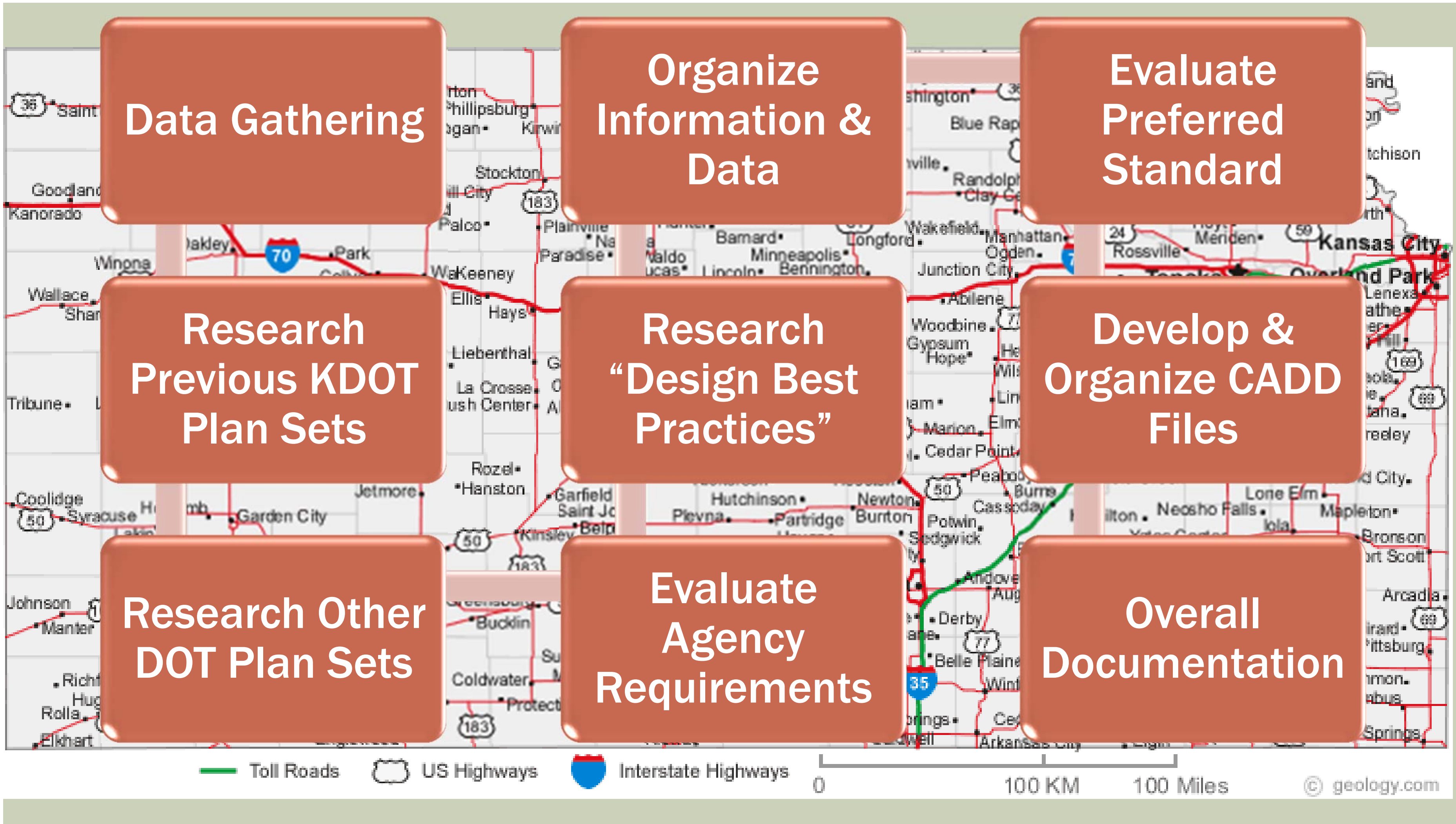
BACKGROUND


Sunshield
Screw holes
Holes for unit holders
Camera unit
Power button (for Factory Default only)
Heater
Caution! may be hot
Hook for safety wire
Unit holders (3)
Network connector (PoE)
SD memory card slot
Control button
Status indicator LED
Part number (P/N) & Serial number (S/N). The serial number may be required during the installation.
Metal ring screws (4)
Metal ring
Rubber gasket
Dome ring
Dome ring screws (4)
Dome cover
Dome cover

THE GOAL

- Provide designers with a standard set of specification and details.
- Specifically these standards are to be:
  - Easily inserted into PS&E packages
  - Editable for project specific items and future updates
- Project included:
  - Details
  - Specifications
  - Typical ITS Unit Cost List
  - ITS Average Bid Tabulations
  - ITS Design Principals (best practice)
  - Structural Evaluation Report

PROCESS


Data Gathering
Organize Information & Data
Evaluate Preferred Standard
Research Previous KDOT Plan Sets
Research "Design Best Practices"
Develop & Organize CADD Files
Research Other DOT Plan Sets
Evaluate Agency Requirements
Overall Documentation
Toll Roads
US Highways
Interstate Highways
0
100 KM
100 Miles
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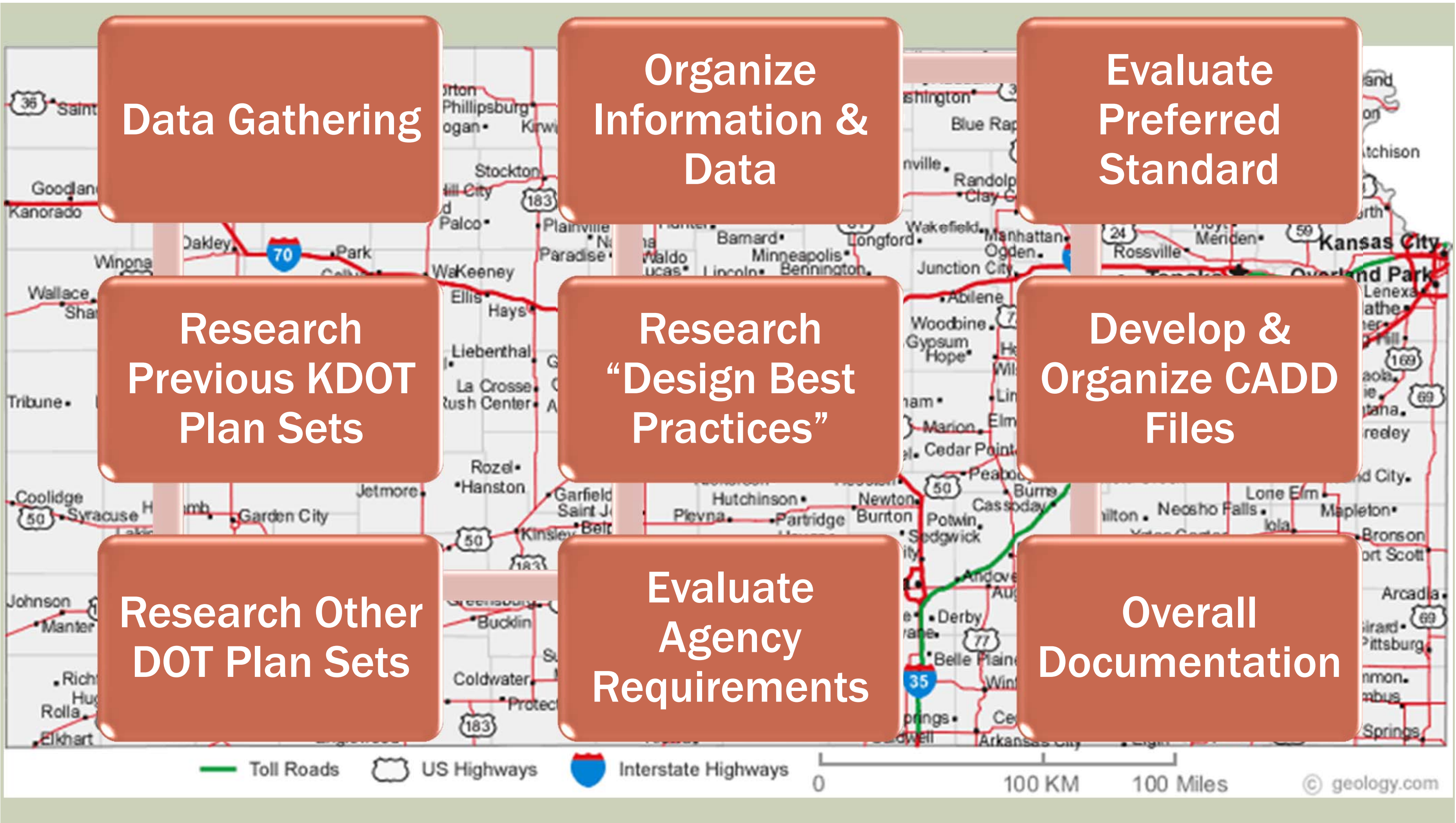
DATA GATHERING

- Details and Specifications
  - Obtain details and specifications that have been used in past Kansas DOT ITS PS&E's to establish specification outline.
  - No consistency in CADD file format.
- ITS Unit Cost List, Average Bid Tabs, Design Best Practices
  - Gather information from past Kansas DOT ITS PS&E's and from correspondence from past projects.

PROCESS



- Data Gathering
- Research Previous KDOT Plan Sets
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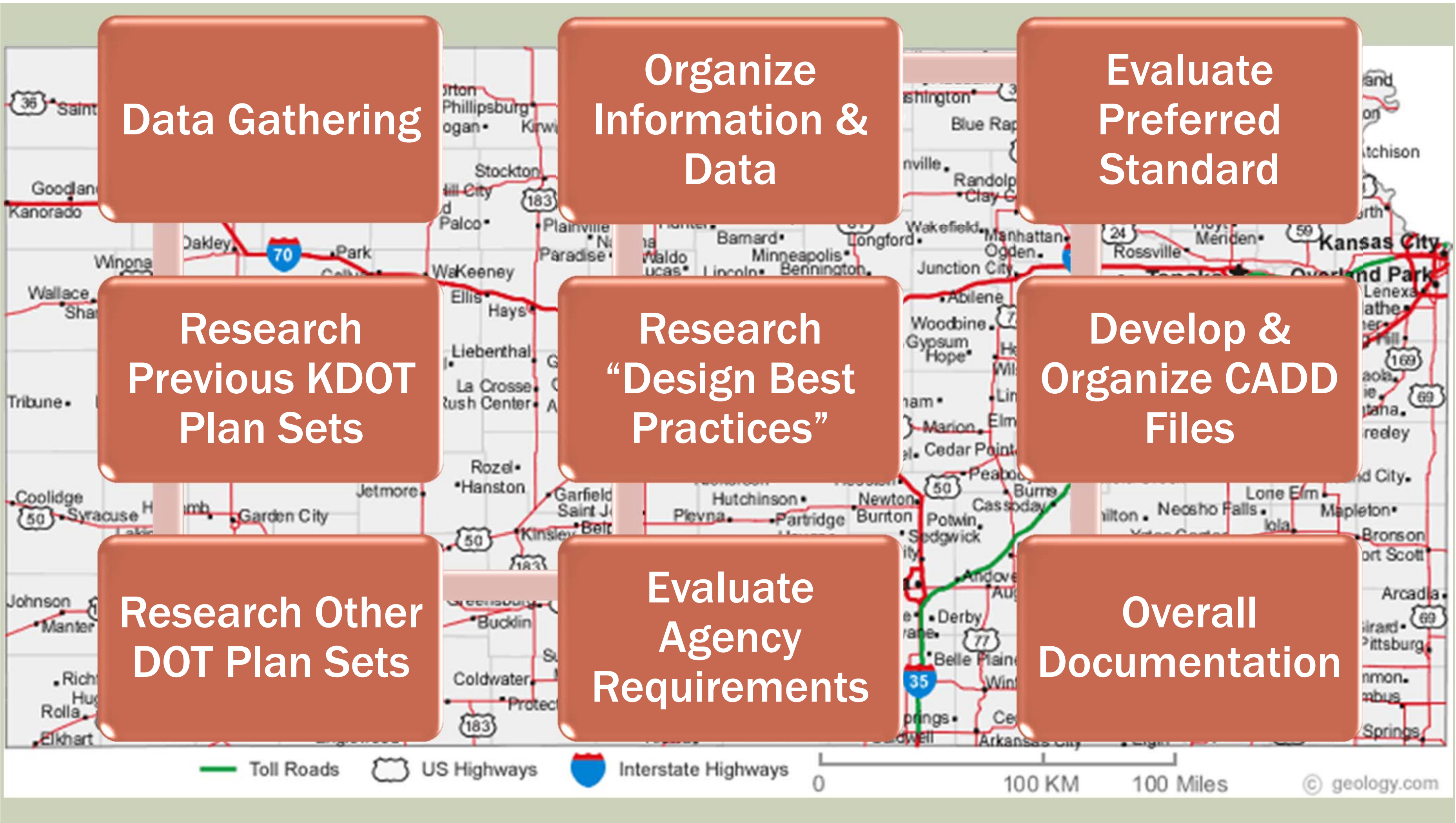
RESEARCH PAST PLAN SETS

- ITS on State Highway I-70 (Vanus)
- Wichita TMC Final Deployment (Telvent, PB, Iteris)
- ITS on State Highway US-69 Johnson County (KHA)
- ITS on State Highway K-10 and K-7 Johnson County (KHA)
- Salina Area DMS (SRF)
- AMBER Alert DMS and CCTV (SRF)
- Wichita TMC Test Project (Telvnet)
- I-635 ITS Project (KHA)
- I-70 Corridor - Speedway ITS Deployment (KHA)

PROCESS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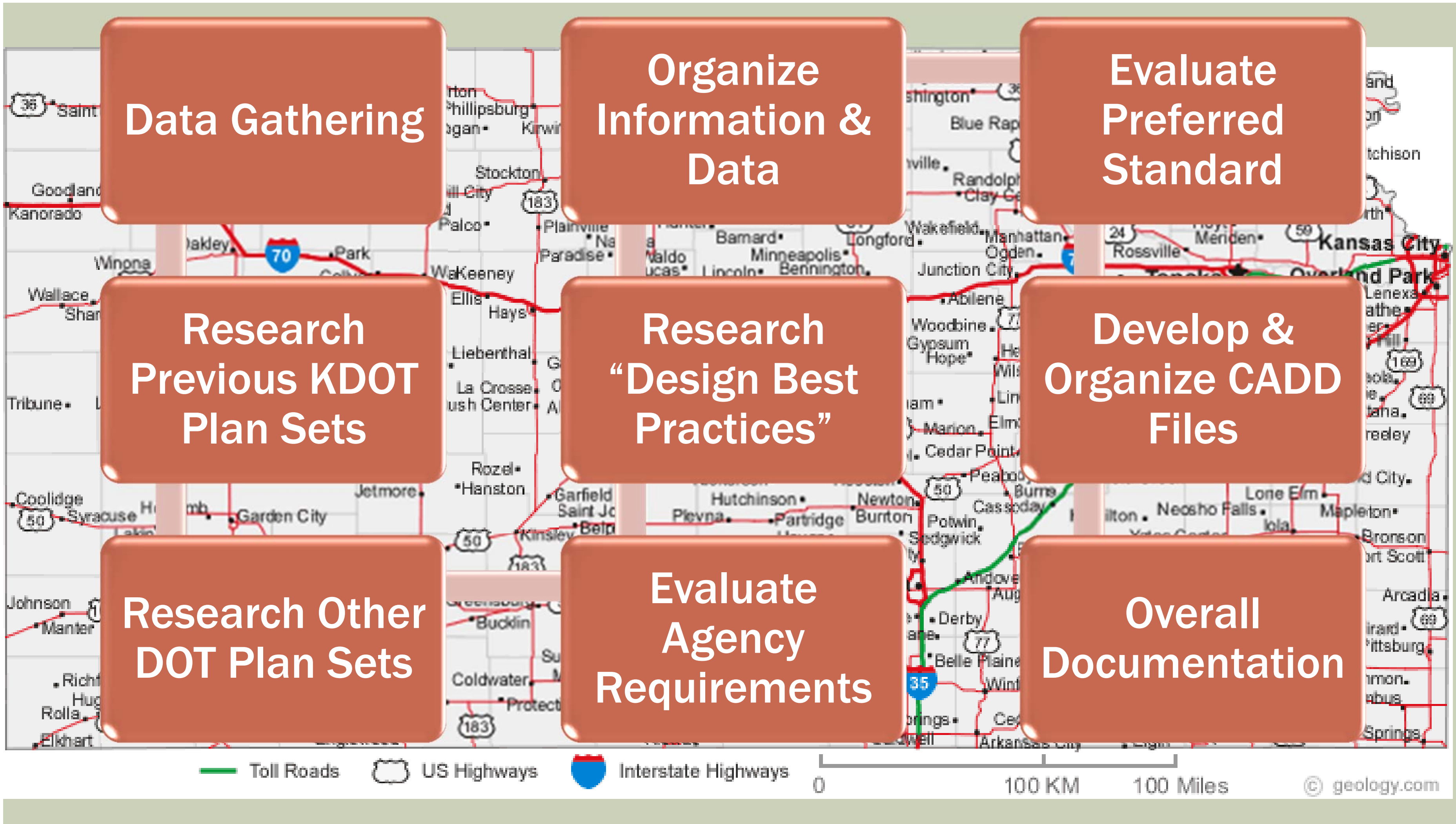
RESEARCH OTHER DOT PLAN SETS

PROCESS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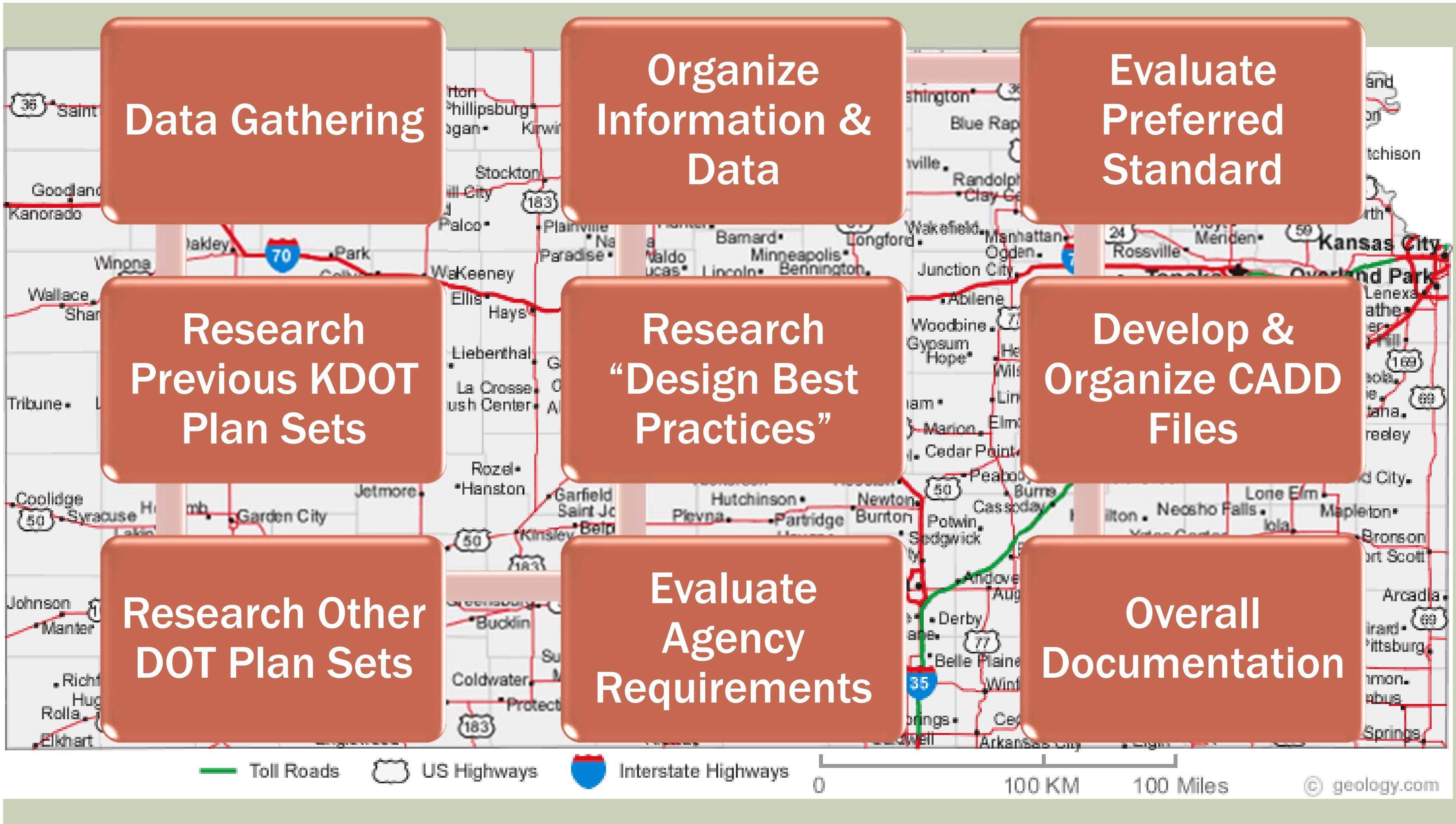
EVALUATE AGENCY REQUIREMENTS

- AASHTO
- ANSI
- ASTM
- FHWA
- TIA/EIA
- NEMA
- NFPA
- NTCIP
- Equipment and manufacturing Vendors
- Product data sheets

PROCESS



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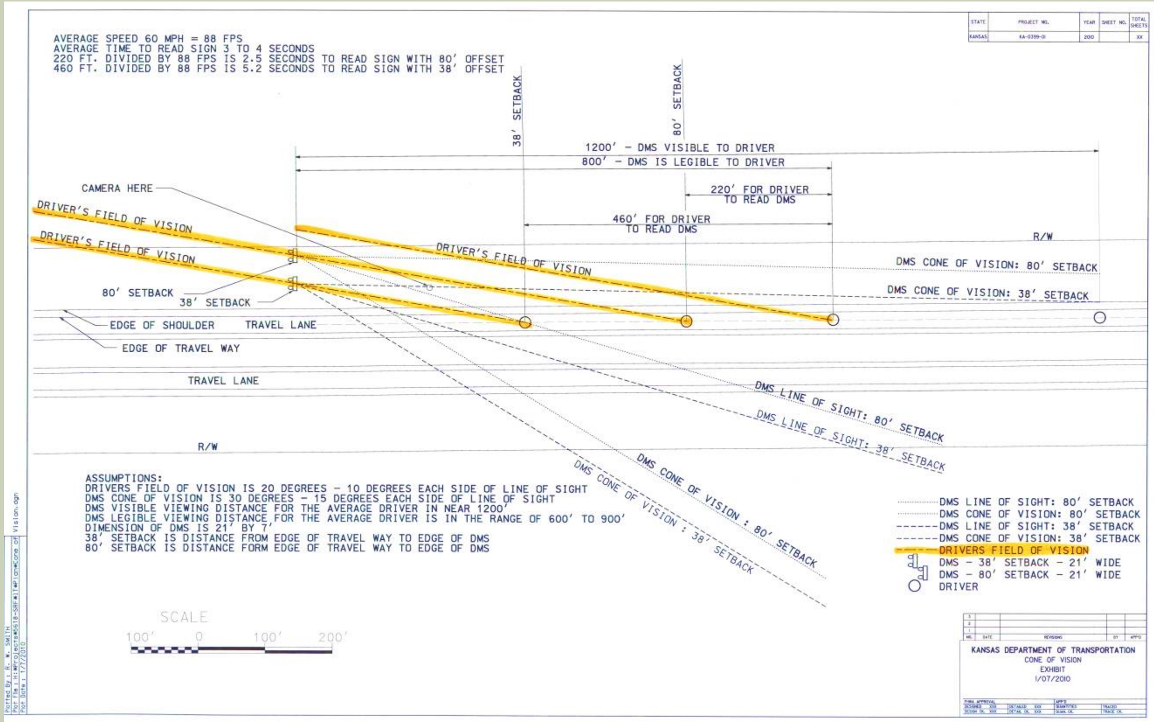
RESEARCH DESIGN BEST PRACTICE

- DMS Placement
- CCTV Placement
- Clear Zone
- Guardrail Use
- Concrete Barrier Use
- Cross-Sections
- Ditch Profiles
- Sight Lines



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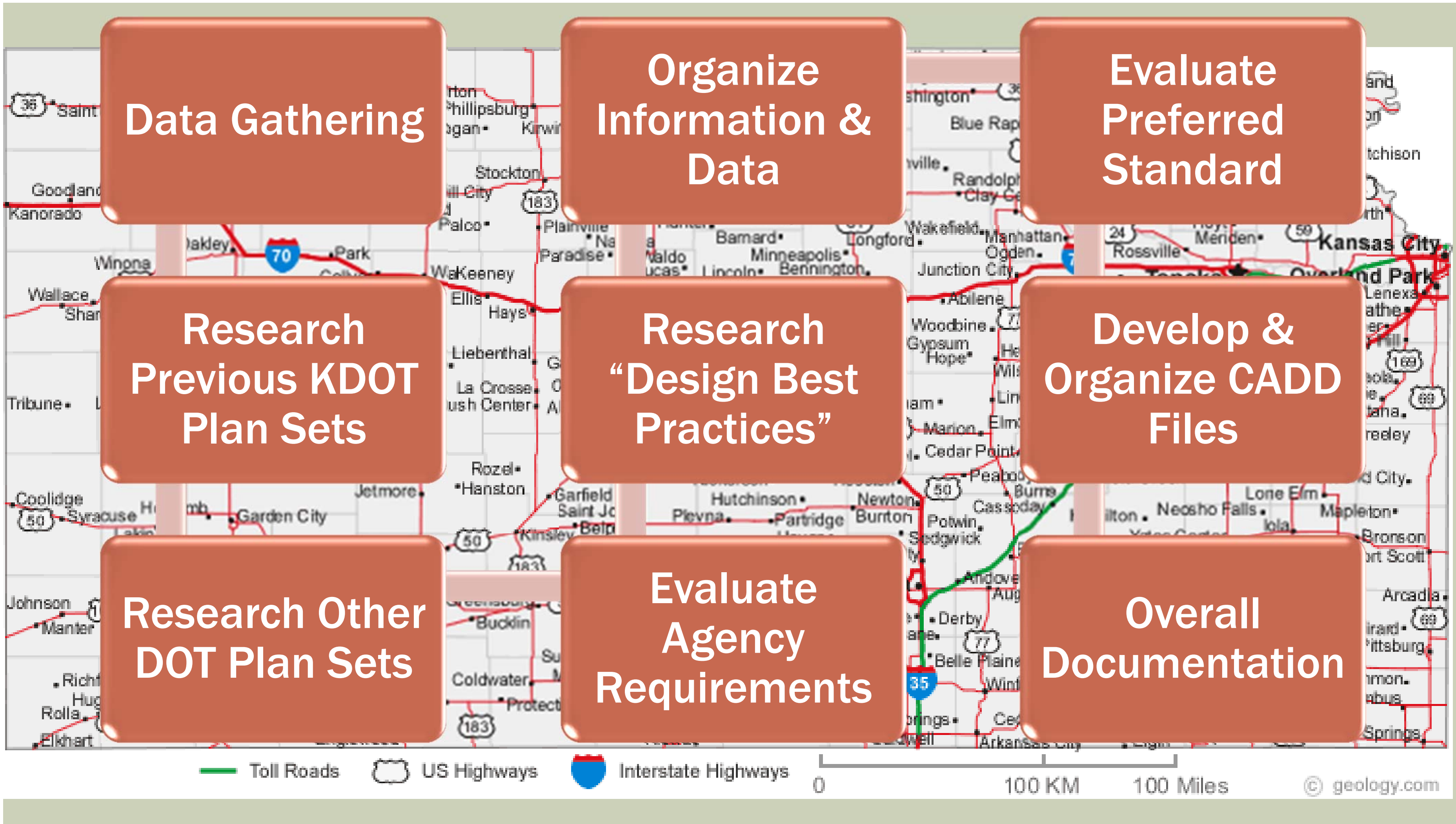
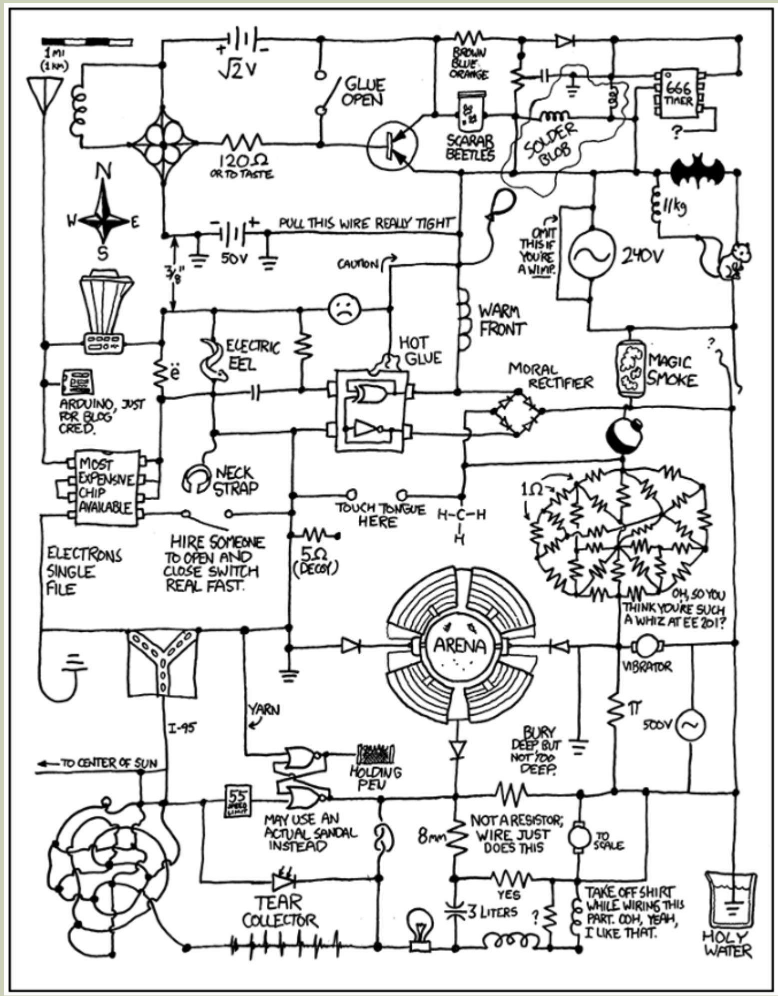


NOW WHAT?

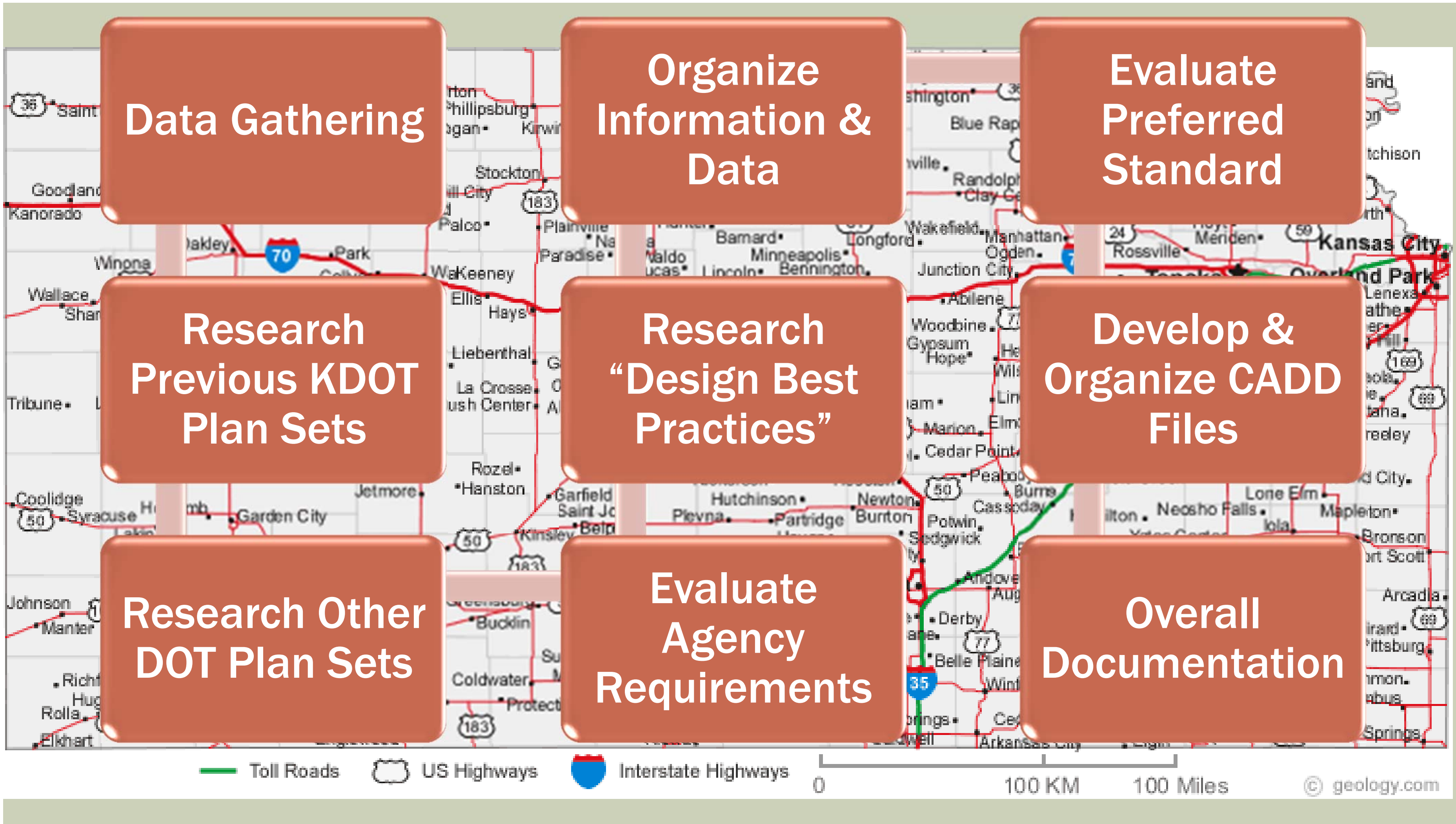


Resource:
Circuit Diagram
http://xkcd.com/730/
Xkcd A Webcomic of Romance, Sarcasm, Math, and Language

ORGANIZE PROJECT

- Organize details – what do we have and what is missing?
- Organize specifications – what do we have and what is missing?
- Recognize unique characteristics to the state of Kansas.
- Recognize that these are living documents, allow room for technology updates.

PROCESS



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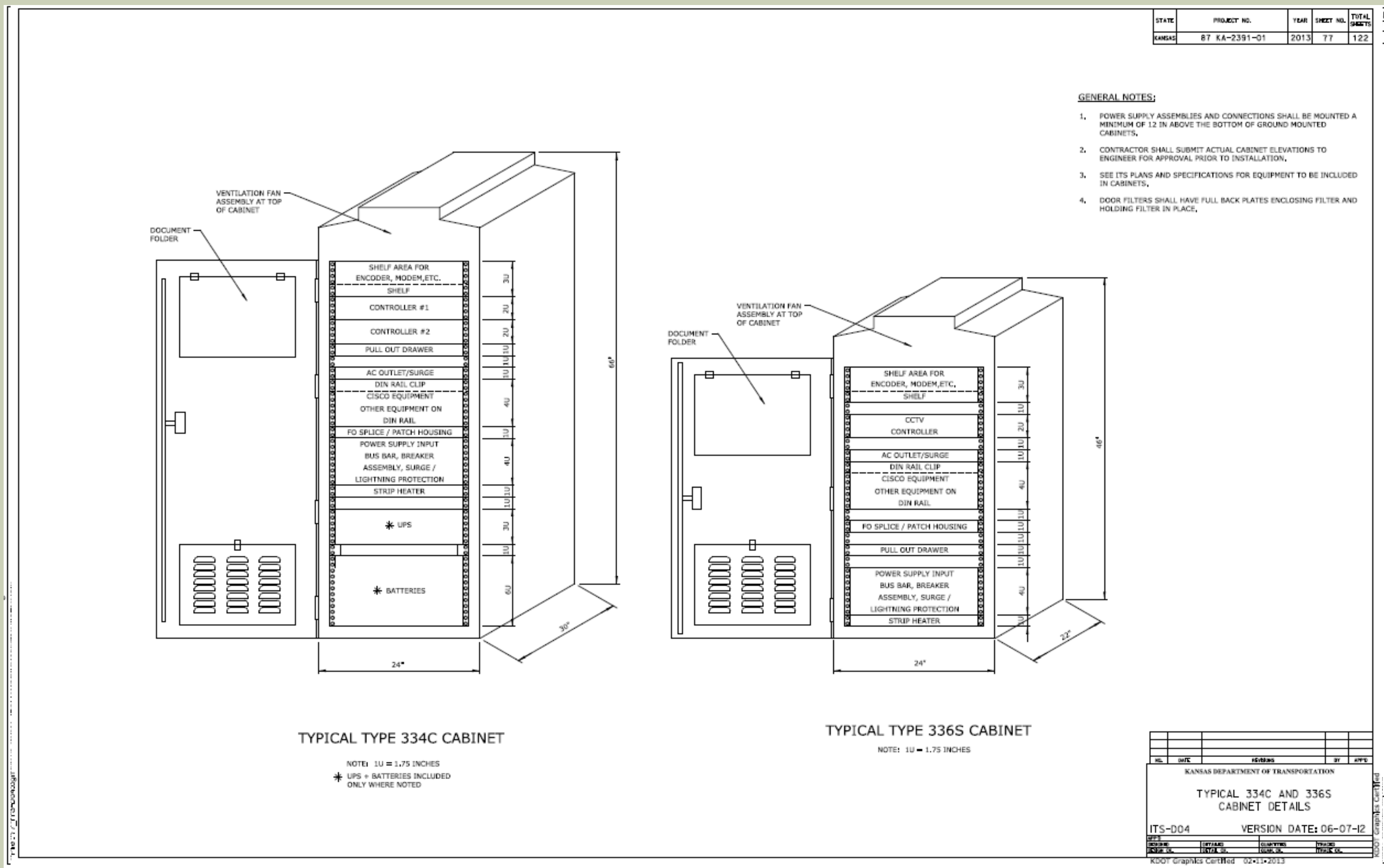
STANDARD DETAILS

- Original List – 14 details
  - Legend and abbreviations
  - General notes
  - Cable, conduit, and device legend
  - Typical 334C and 334S cabinet details
  - ITS conduit structural attachment detail
  - DMS orientation detail
  - Pull box detail
  - Splice vault detail
  - Lighting suppression detail
  - Detector pole detail
  - Field power supply detail
  - Electrical service diagrams
  - Typical power arrangement
  - ITS Example Plan Sheet

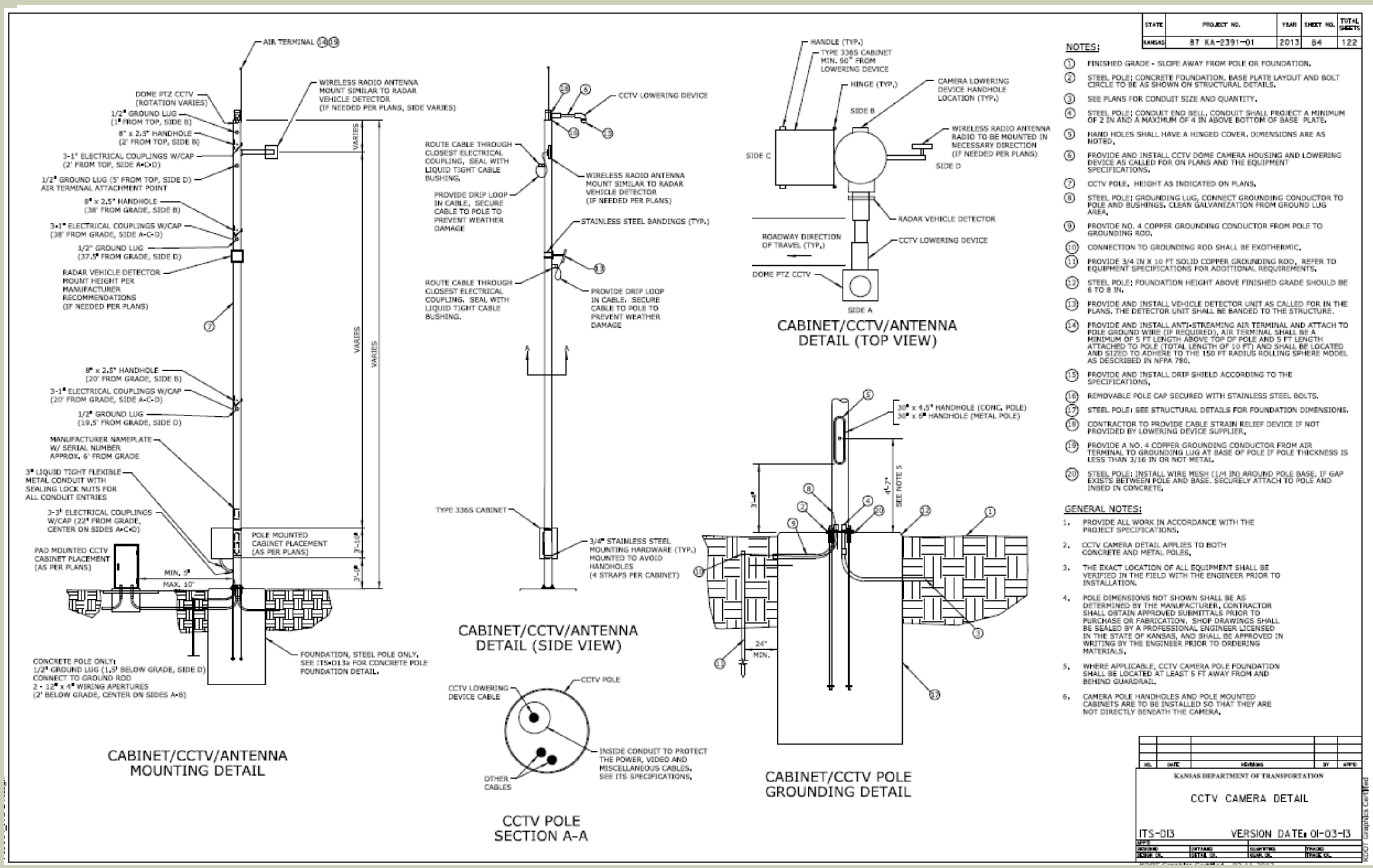
- Today's List – 28 details

ITS Equipment Detail Title	Version Date	File Name
Legend and Abbreviations	06-07-2012	ITS-D01
ITS General Notes	02-11-2014	ITS-D02
Cable, Conduit, and Device Legend	02-11-2014	ITS-D03
Cable, Conduit, and Device Legend	04-28-2014	ITS-D03A
Cable, Conduit, and Device Legend	04-28-2014	ITS-D03B
Typical 334C and 336S Cabinet Details	02-11-2014	ITS-D04
ITS Cabinet Details	06-07-2012	ITS-D05
ITS Cabinet Foundation Details	02-11-2014	ITS-D06
ITS Pull Box Details	02-11-2014	ITS-D07
ITS Pull Box Details - Electrical	04-28-2014	ITS-D07A
ITS Pull Box Details – Communications	02-11-2014	ITS-D07B
Fiber Optic Rectangular Splice Vault Detail	02-11-2014	ITS-D08
Fiber Optic Round Splice Vault Detail	03-05-2014	ITS-D09
Conduit Structural Attachment and Trench Details	02-11-2014	ITS-D10
Field Power Supply Assembly Details	02-11-2014	ITS-D11
Step Down Transformer Detail	04-04-2013	ITS-D11a
Electrical Service Location Summary	02-11-2014	ITS-D12
CCTV Camera Pole Detail Concrete and Steel	02-11-2014	ITS-D13
CCTV Camera Concrete Pole Foundation Detail	01-03-2013	ITS-D13a
CCTV Orientation Detail	03-05-2014	ITS-D14
DMS Orientation Detail One Post / Two Post	06-07-2012	ITS-D15
DMS, CCTV, ITS Cabinet Placement Detail	02-11-2014	ITS-D16
ITS Example Plan	04-28-2014*	ITS-D17
ITS Cross Section Example	02-28-2014*	ITS-D18
ITS Detector Pole Detail	02-28-2014	ITS-D19
Typical Enclosure Details	02-28-2014	TE202
CCTV Pole Detail Folding Standard	06-07-2012**	ITS-D20
CCTV Pole Installation Detail Folding Standard	06-07-2012**	ITS-D21
Pole Mounted Cabinet Folding Standard	06-07-2012**	ITS-D22
CCTV Pole Foundation Detail Folding Standard	06-07-2012**	ITS-D23
Ground-Mounted DMS Structural Details (Sheet 1 of 2)	01-03-2013 – update in progress	ITS-D24
Ground-Mounted DMS Structural Details (Sheet 2 of 2)	01-03-2013 – update in progress	ITS-D25
ITS Equipment Specifications	04-30-2014	ITS-S01 to ITS-S14

STANDARD DETAILS – CABINET DETAIL
2009 TO PRESENT



STANDARD DETAILS – CCTV POLE DETAIL
2009 TO PRESENT



EQUIPMENT SPECIFICATIONS

- Equipment specifications were found to need updates to reflect current code requirements and current technology requirements.
- Duplicate specifications were removed, including items that are covered in the Kansas Standard Specifications for Road and Bridge Construction.

EQUIPMENT SPECIFICATIONS

- HDPE Conduit Example

July 2010 example:
Non Metallic Conduit
Install HDPE Conduit according to the manufacturer's instruction. All HDPE conduit and materials shall have a minimum SDR of 11 and be compliant with ASTM D3035

December 2011 example:
Non Metallic Conduit/HDPE Conduit
Install HDPE conduit according to the manufacturer's instructions. All HDPE conduit and materials shall have a minimum SDR of 11 and be compliant with ATSM D3035. All non-metallic conduits shall be color-coded red for electrical cables, green for communication cable and fiber optic cable, and black for the spare conduits. All conduit and fittings shall be listed by UL, and conform to NEC standards.

EQUIPMENT SPECIFICATIONS

- HDPE Conduit Example

Current 2014 example:
Non Metallic Conduit/HDPE Conduit
Provide HDPE conduit that is schedule 80 and UL listed. Provide color coded conduit as required for installation location. KDOT installation area: provide red for electrical cables, green conduit for communication and fiber optic cable, and black conduit for spare. KC Scout Installation area: provide yellow conduit for electrical cables, blue conduit for communication and fiber optic cables, and black conduit for spare. Install HDPE conduit according to manufacturer's instruction

PROCESS

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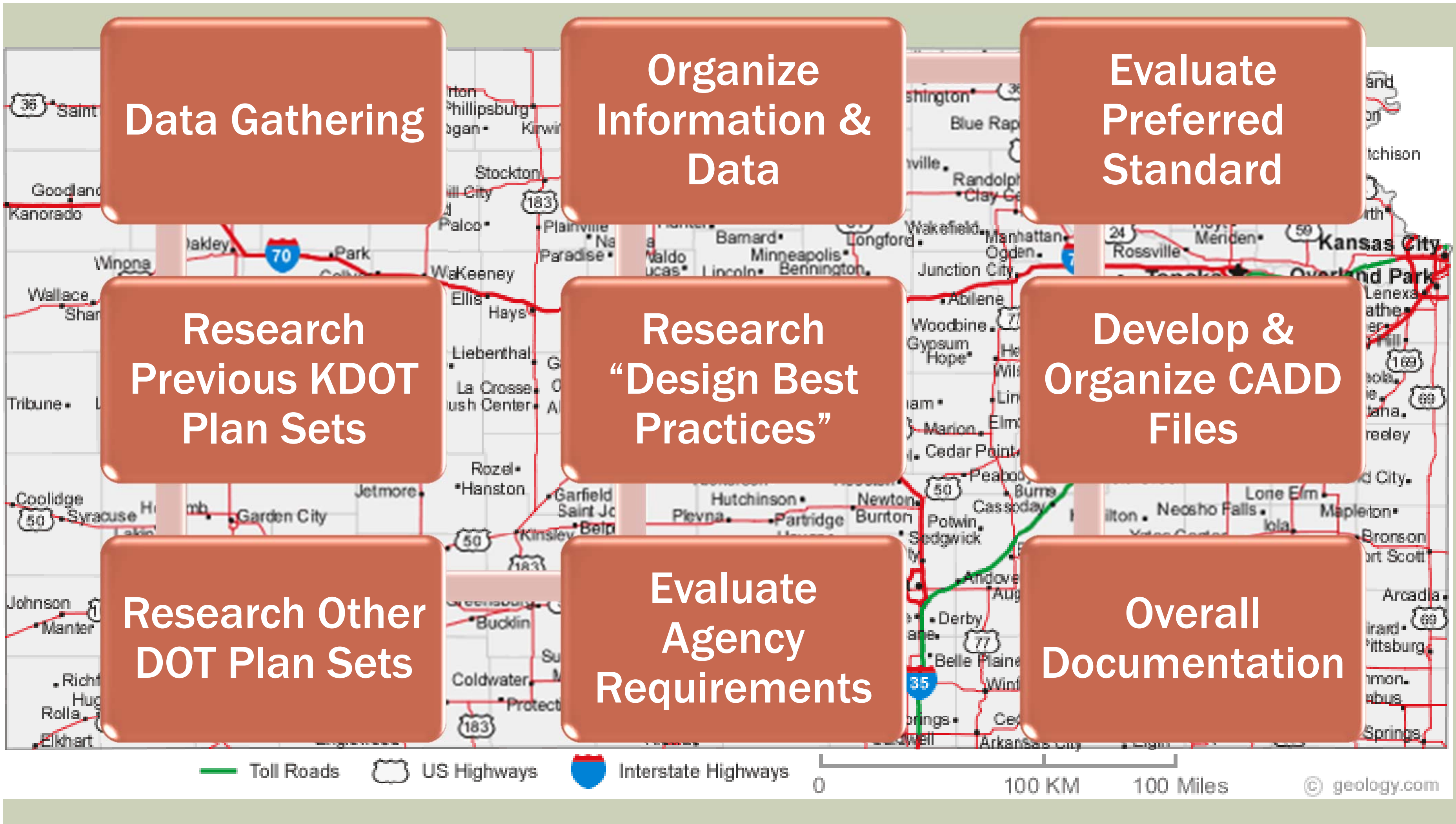
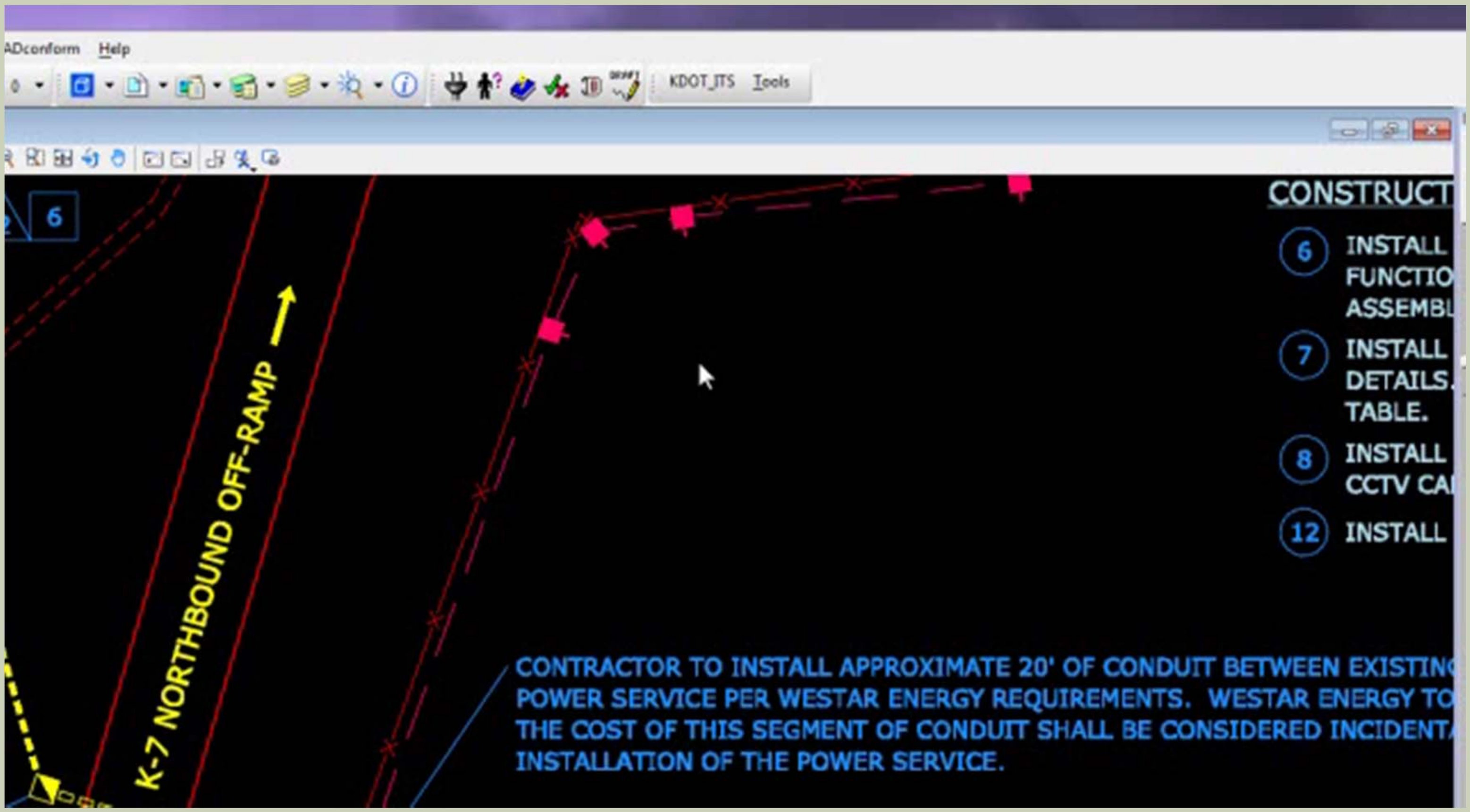


MICROSTATION

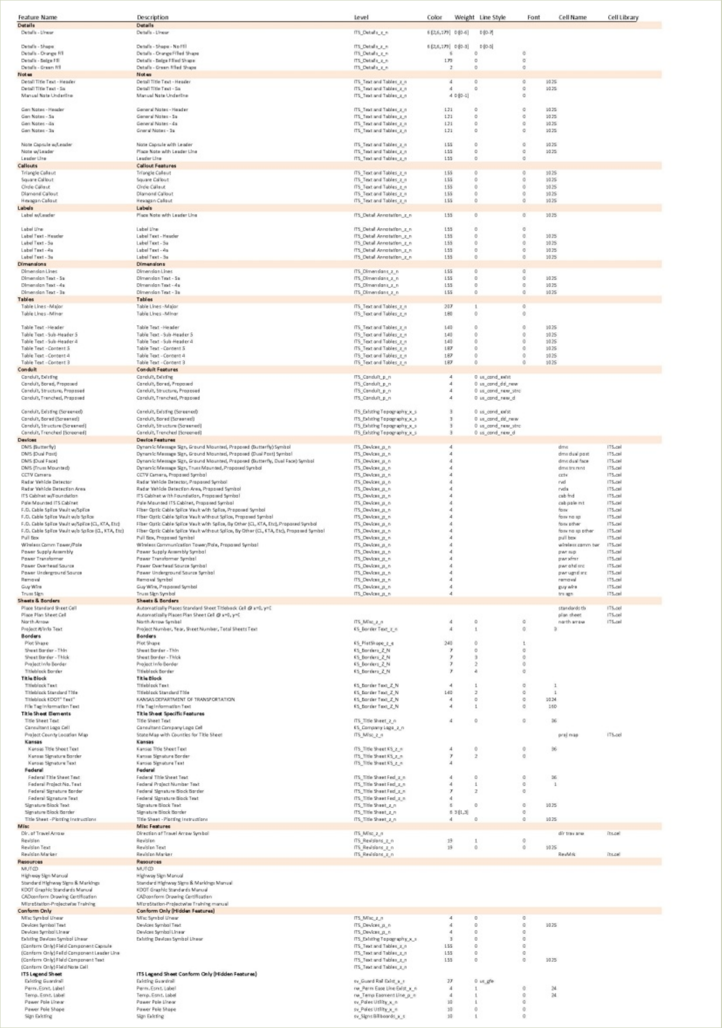
- KDOT Graphics Certified File and ITS Cell Library



MICROSTATION

- Kansas DOT ITS Workspace Development
  - Level library for ITS.
  - CADconform feature table.
  - Final deliverables are all KDOT Graphics Certified.

Name	Description
TE_ITS_Conduit_p_n	ITS conduit runs
TE_ITS_Cabinets_p_n	ITS cabinet assemblies
TE_ITS_Detectors_p_n	ITS detection devices
TE_ITS_Cameras_p_n	ITS cameras
TE_ITS_DMS_p_n	ITS dynamic message signs
TE_ITS_Misc_p_n	ITS miscellaneous items
TE_ITS_Splice_Vaults_p_n	ITS fiber optic cable splice vaults
TE_ITS_Text_and_Charts_p_n	ITS text and charts
TE_ITS_Existing_Topography_x_s	Screened Existing Topography



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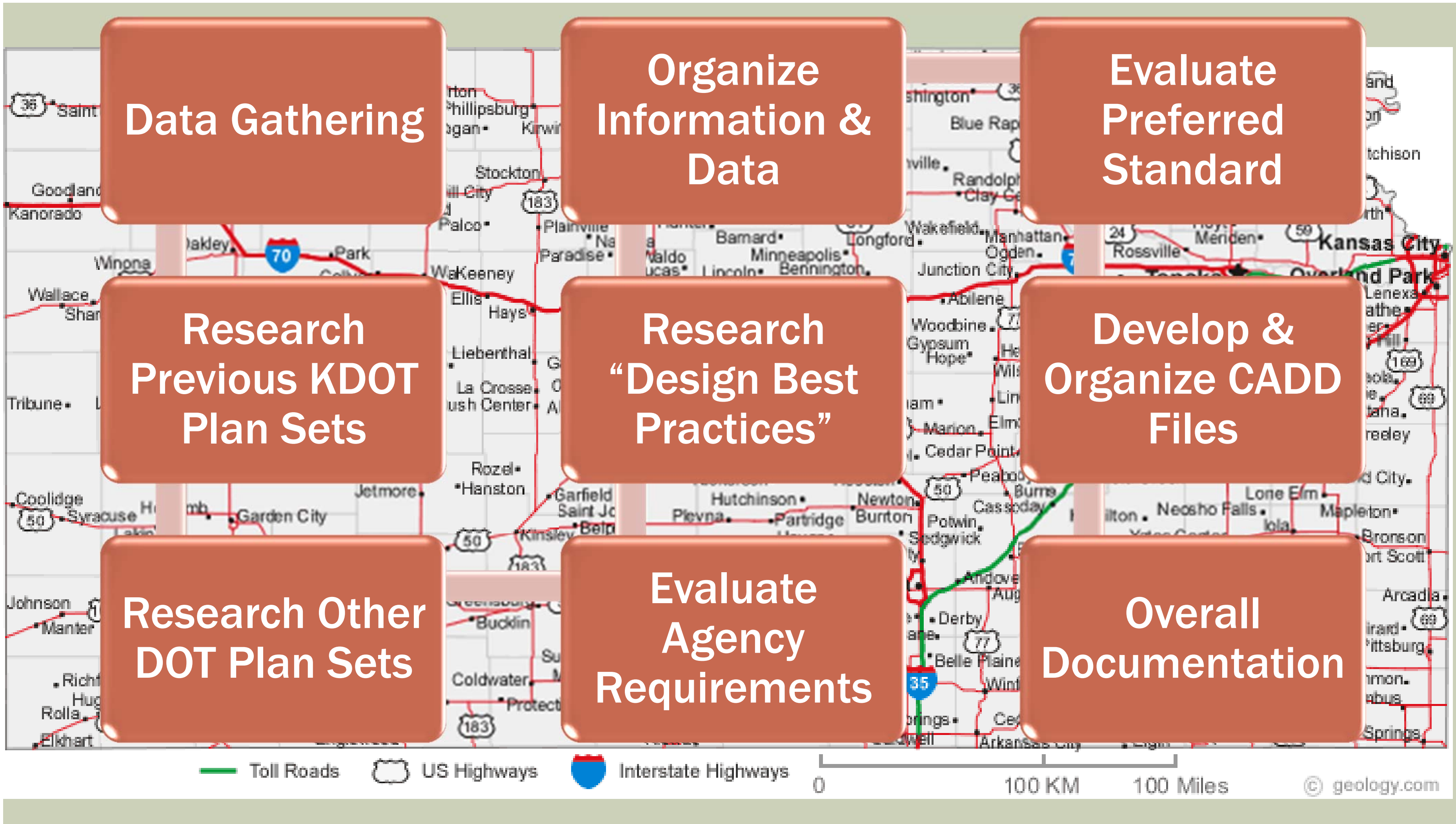
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PRODUCT

- ITS Standard Details – Microstation and PDF.
- ITS Standard Specifications – Microstation and PDF.
- Typical ITS Unit Costs – spreadsheet.
- ITS Design Principals (best practice) – word document.
- Structural Evaluation Report.
- Process to track and produce updates as necessary.

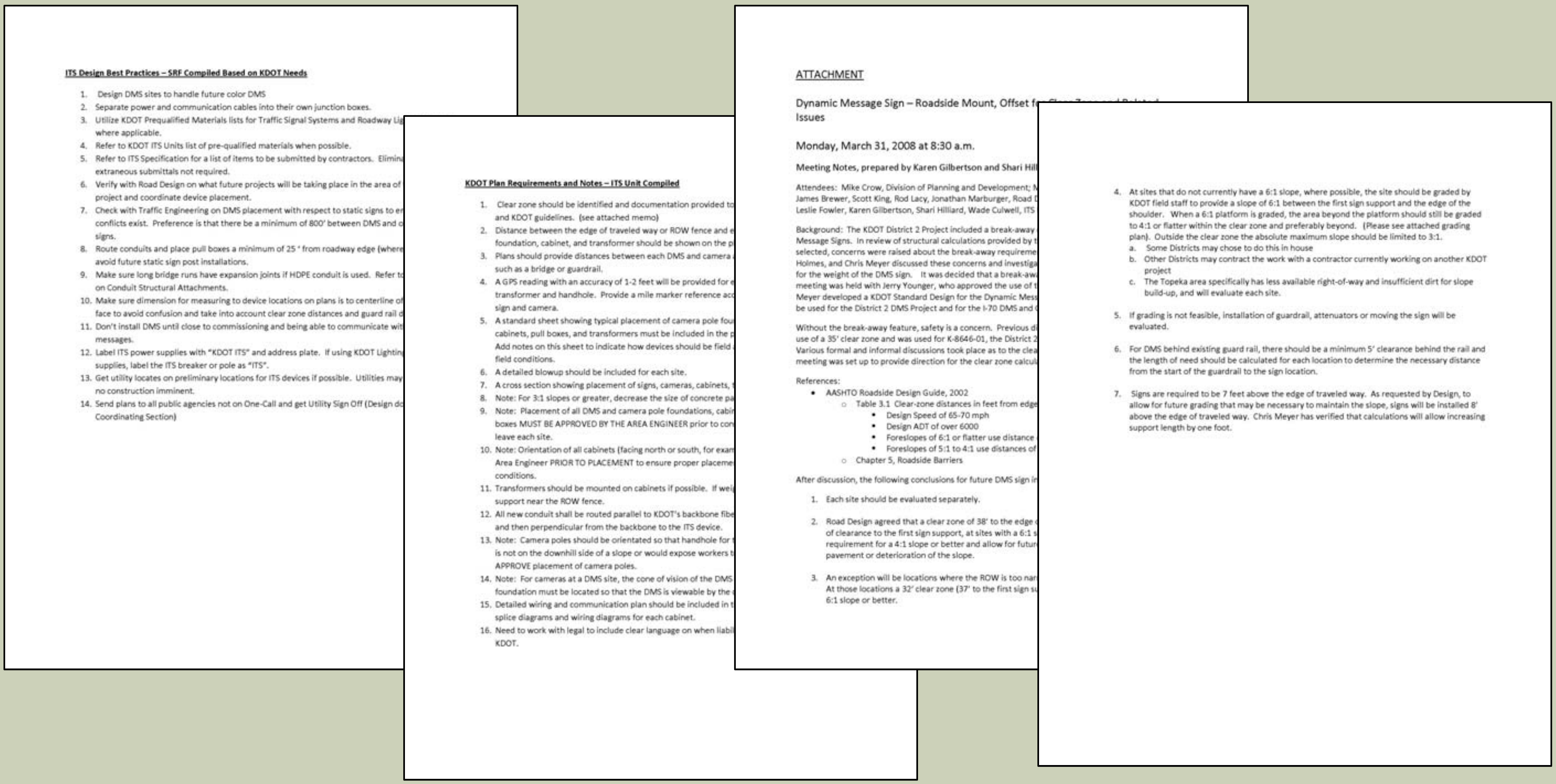
PRODUCT

- ITS Unit Costs

Project and Company:		69-46 K-8251-11 Clarkson Construction Co. 5-20-09	69-46 K-8251-07 Clarkson Construction Co. 5-20-09	635-105 K-4890-05 Capital Electric 7-15-09	87 K-9123-07 Rex Shick 9-23-08	106 KA-0399-01 Phillips Southern 6-15-10	Project Unknown Contractor Unknown Date In 2008	87 K-9123-06 Atlas Electric LLC 8-17-10	35-46N-0542-01 Capital Electric 5-23-12	87KA 2391-01 Atlas Electric LLC 3-19-13	70-21 KA 0732-01 Ideker Inc. 2-19-13	87 KA-2336-01 Atlas Electric LLC 6-19-12	87 KA-2336-01 Phillips Southern 6-19-12	70-105 KA 1503-01 Custom Lighting Service 6-20-12	35-46 N -0542-01 Capital Electric 5-23-12	Average Bid Tabs
Bid Item:	Unit															
3-1/C #1/0 Power Cable	LF			$2.75				$3.58								$3.17
3-1/C #1 Power Cable	LF							$2.72								$2.72
3-1/C #2 Power Cable	LF	$2.82	$2.82	$2.05			$5.25	$2.05	$3.63	$9.00		$6.60	$2.30		$3.63	$4.02
3-1/C #4 Power Cable	LF			$1.40		$1.85	$4.00	$1.42	$2.61	$5.84					$2.61	$2.82
3-1/C #6 Power Cable	LF			$1.10	$1.39	$0.96	$2.80	$1.20	$1.93	$3.80	$2.56	$3.90	$1.14	$4.30	$1.93	$2.25
3-1/C #8 Power Cable	LF	$1.60	$1.60	$0.90					$1.63					$3.70	$1.63	$1.84
18 AWG 24 V AC Power	LF										$17.71					$17.71
22 AWG Shielded Twisted Pair Wire	LF									$0.50	$17.62	$0.60	$1.79			[illegible]
2-Conduit HDPE, Bored (2")	LF	$17.99	$17.99				$17.00					$12.00				$16.25
2-Conduit HDPE, Trenched (2")	LF	$11.89					$11.25			$4.20	$8.55	$4.10	$6.55	$8.20	$7.78	$7.82
2-Conduit HDPE, Trenched (3")	LF														$29.70	$29.70
2-Conduit HDPE, Trenched (4")	LF	$14.63														$14.63
2FT Antenna 11 GHz	EA									$1,372.00		$600.00	$725.62			[illegible]
2-RMC Conduit Trenched (2")	LF										$24.75	$20.00	$24.72			$23.16
334C Pad Mounted Cabinet, Foundation Assembly	EA							$5,825.00		$6,830.00	$6,792.50	$6,540.00	$5,251.18			$6,247.74
336S Pole Mounted Cabinet Assembly	EA							$4,921.00		$5,200.00						$5,060.50
Above Ground Junction Box	EA									$150.00						$150.00
Cabinet Foundation	EA			$1,909.00												$1,909.00
Cable in Duct (OD)	LF				$12.94	$3.28										$8.11
Camera Lowering Device	EA									$7,500.00		$6,438.00	$3,572.12			[illegible]
Camera Pole & Lowering Device, 45'	EA			$12,342.00					$12,908.19					$12,336.80	$12,908.19	$12,623.80
Camera Pole Foundation, 45'	EA			$3,057.00					$848.14					$3,551.40	$848.14	$2,076.17
Camera Pole Foundation, 50'	EA	$3,300.00	$3,300.00													$3,300.00
Camera Pole Foundation, 70'	EA								$913.95					$3,847.00	$913.95	[illegible]
Camera Pole, 50'	EA	$9,000.00	$9,600.00													$9,300.00
Camera Pole, Dual Lowering device, Foundation, 60'	EA							$24,554.00								$24,554.00
Camera Pole, Folding Std. & Foundation, 50'	EA					$10,721.00										$10,721.00
Camera Pole, Lowering device, Foundation, 45'	EA							$16,162.00								$16,162.00
Camera Pole, Lowering device, Foundation, 60'	EA							$18,874.00								$18,874.00
Camera Pole, Lowering device, Foundation, 70'	EA								$15,128.36					$23,332.90		$19,230.63
Cat 5 UPT Patch Cable	EA										$289.56					$289.56
Cat 5 UPT Patch Cable 1.8 Meter	EA									$6.00		$7.00	$26.44			$13.15
Cat 5/6 Cable	LF				$1.89	$0.77										$1.33
CCTV Camera Assembly (IP Equipment and Associated Equipment)	EA													$4,285.80	$3,148.31	$3,717.06
CCTV Concrete Pole (45ft total length) Lowering Device and Composite Cable	EA													$13,647.20		$13,647.20
CCTV Concrete Pole (55ft total length) Lowering Device and Composite Cable	EA										$28,511.00					$28,511.00
CCTV Concrete Pole and Foundation 70' (Total Height)	EA									$10,800.00		$10,680.00	$19,879.08	$17,530.20	$15,128.36	$14,803.53
CCTV Controller Assembly	EA	$6,500.00	$6,500.00							$4,425.00						$5,808.33
CCTV Interface Unit	EA	$6,840.00	$1,100.00													[illegible]
CCTV Power Supply	EA										$270.00					$270.00
CCTV Surge Protection	EA										$925.00					$925.00
CCTV Video Encoder	EA										$2,975.00	$2,500.00				$2,737.50
Cellular Modem (Raven X)	EA					$902.53		$2,240.00								$1,571.27
Conduit HDPE, Bored (2")	LF	$12.20	$12.20			$28.49			$21.52	$9.20	$20.59		$16.59	$13.00	$21.52	$17.26
Conduit HDPE, Bored (3")	LF							$12.25								$12.25
Conduit HDPE, Trenched (2")	LF	$9.75	$9.75	$7.90	$13.56	$9.85		$3.80	$7.78							$8.91
Conduit HDPE, Trenched (3")	LF	$11.28	$11.28	$7.95				$4.70	$29.70							$12.98
Conduit HDPE, Trenched (4")	LF	$12.50	$12.50													$12.50
Conduit Repair per Section	EA								$459.00		$527.50			$1,017.30	$459.00	[illegible]
Conduit Routing Clamps	EA								$3,495.06						$3,495.06	$3,495.06
Conduit, Metallic, On Structure (2")	LF	$17.99			$20.00	$11.84		$10.00	$34.27	$10.00				$34.20	$34.27	$21.57
Conduit, Metallic, power supply assembly (2")	LF									$9.00						$9.00
Controller Cabinet (ground mount)	EA			$4,189.00												$4,189.00
Detector Pole & Foundation	EA							$2,850.00								$2,850.00
Detector Pole Foundation, 40'	EA	$2,570.00														$2,570.00
Detector Pole, 40'	EA	$4,500.00														$4,500.00
DMS Structure & Footings (I beam, ground mounted)	EA					$6,410.00										$6,410.00
DMS Structure Butterfly (Dual Face)	EA							$79,531.00								$79,531.00
DMS Structure Butterfly (single Face)	EA							$71,250.00								$71,250.00
Electric Service Box/Pull Box	EA	$1,200.00	$1,830.00		$2,200.00	$1,385.66		$760.00	$1,416.85	$1,085.00	$1,950.00	$950.00	$1,447.00	$1,362.90	$1,416.85	$1,417.02
Encoder	EA	$3,700.00		$2,233.00	$2,500.00	$2,641.33		$2,400.00					$3,304.79			$2,796.52
Fiber Distribution Unit (FDU)	EA								$784.51						$784.51	$784.51
Fiber Optic Cable, 12 SMFO	LF		$2.36	$1.05				$1.48	$2.29	$1.60	$2.82			$2.40	$2.29	$2.04
Fiber Optic Cable, 48 SMFO	LF	$3.13	$3.81	$1.35					$4.90						$4.90	$3.62
Fiber Optic Cable, 6 SMFO	LF	$2.13				$1.43						$2.00	$7.19			$3.19
Fiber Optic Cable, 96 SMFO	LF							$2.34		$2.45						$2.40
Fiber Optic Media Converter	EA	$1,200.00	$1,200.00	$1,075.00		$361.11										[illegible]
Fiber Optic Patch Panel w/ 12 SM LC Connectorcords LC-LC Connector	EA										$817.15					$817.15
Fiber Optic Simplex patch cords LC-LC Connector	EA									$48.00	$80.71	$142.00	$166.03			$109.19
Fiber Optic Simplex patch cords ST-SC Connector	EA											$113.00	$130.86			$121.93
Fiber Optic Simplex Pigtail w/ LC Connector 1 Meter	EA										$148.81					$148.81
Fiber Optic Splice	EA			$16.60					$90.34	$48.00	$700.31	$73.00	$404.65	$78.60	$90.34	$187.73
Fiber Optic Splice Enclosure large	EA									$705.00	$2,750.00					$1,727.50
Fiber Optic Splice Enclosure Small	EA									$683.00		$510.00	$1,854.14	$524.20	$839.37	[illegible]
Fiber Optic Splice Tray	EA									$40.00		$40.00	$94.59			$58.20
Ground Mount Cabinet and Foundation	EA								$1,747.77						$1,747.77	$1,747.77
Install CCTV (supplied by KDOT)	EA				$1,130.00	$130.66					$8,872.07	$180.00	$1,108.39			[illegible]
Install Cisco Switch, 2955	EA			$38.00		$65.33										$51.67

PRODUCT

- ITS Design Principals (best practice)



ITS Design Best Practices – SRF Compiled Based on KDOT Needs

1. Design DMS sites to handle future color DMS
2. Separate power and communication cables into their own junction boxes.
3. Utilize KDOT Prequalified Materials lists for Traffic Signal Systems and Roadway Lig
where applicable.
4. Refer to KDOT ITS Units list of pre-qualified materials when possible.
5. Refer to ITS Specification for a list of items to be submitted by contractors. Elimina
extraneous submittals not required.
6. Verify with Road Design on what future projects will be taking place in the area of
project and coordinate device placement.
7. Check with Traffic Engineering on DMS placement with respect to static signs to en
conflicts exist. Preference is that there be a minimum of 800' between DMS and o
signs.
8. Route conduits and place pull boxes a minimum of 25 ' from roadway edge (where
avoid future static sign post installations.
9. Make sure long bridge runs have expansion joints if HDPE conduit is used. Refer to
on Conduit Structural Attachments.
10. Make sure dimension for measuring to device locations on plans is to centerline of
face to avoid confusion and take into account clear zone distances and guard rail d
11. Don't install DMS until close to commissioning and being able to communicate wit
messages.
12. Label ITS power supplies with "KDOT ITS" and address plate. If using KDOT Lightin
supplies, label the ITS breaker or pole as "ITS".
13. Get utility locates on preliminary locations for ITS devices if possible. Utilities may
no construction imminent.
14. Send plans to all public agencies not on One-Call and get Utility Sign Off (Design do
Coordinating Section)

KDOT Plan Requirements and Notes – ITS Unit Compiled

1. Clear zone should be identified and documentation provided to
and KDOT guidelines. (see attached memo)
2. Distance between the edge of traveled way or ROW fence and e
foundation, cabinet, and transformer should be shown on the p
3. Plans should provide distances between each DMS and camera
such as a bridge or guardrail.
4. A GPS reading with an accuracy of 1-2 feet will be provided for e
transformer and handhole. Provide a mile marker reference acc
sign and camera.
5. A standard sheet showing typical placement of camera pole fou
cabinets, pull boxes, and transformers must be included in the p
Add notes on this sheet to indicate how devices should be field
field conditions.
6. A detailed blowup should be included for each site.
7. A cross section showing placement of signs, cameras, cabinets,
8. Note: For 3:1 slopes or greater, decrease the size of concrete pa
9. Note: Placement of all DMS and camera pole foundations, cabin
boxes MUST BE APPROVED BY THE AREA ENGINEER prior to con
leave each site.
10. Note: Orientation of all cabinets (facing north or south, for exam
Area Engineer PRIOR TO PLACEMENT to ensure proper placeme
conditions.
11. Transformers should be mounted on cabinets if possible. If wei
support near the ROW fence.
12. All new conduit shall be routed parallel to KDOT's backbone fibe
and then perpendicular from the backbone to the ITS device.
13. Note: Camera poles should be orientated so that handhole for
is not on the downhill side of a slope or would expose workers t
APPROVE placement of camera poles.
14. Note: For cameras at a DMS site, the cone of vision of the DMS
foundation must be located so that the DMS is viewable by the
15. Detailed wiring and communication plan should be included in t
splice diagrams and wiring diagrams for each cabinet.
16. Need to work with legal to include clear language on when liabil
KDOT.

ATTACHMENT

Dynamic Message Sign – Roadside Mount, Offset f
Issues

Monday, March 31, 2008 at 8:30 a.m.

Meeting Notes, prepared by Karen Gilbertson and Shari Hil

Attendees: Mike Crow, Division of Planning and Development;
James Brewer, Scott King, Rod Lacy, Jonathan Marburger, Road
Leslie Fowler, Karen Gilbertson, Shari Hilliard, Wade Culwell, ITS

Background: The KDOT District 2 Project included a break-away
Message Signs. In review of structural calculations provided by t
selected, concerns were raised about the break-away requireme
Holmes, and Chris Meyer discussed these concerns and investiga
for the weight of the DMS sign. It was decided that a break-aw
meeting was held with Jerry Younger, who approved the use of t
Meyer developed a KDOT Standard Design for the Dynamic Mess
be used for the District 2 DMS Project and for the I-70 DMS and

Without the break-away feature, safety is a concern. Previous di
use of a 35' clear zone and was used for K-8646-01, the District 2
Various formal and informal discussions took place as to the clea
meeting was set up to provide direction for the clear zone calcul

References:

- AASHTO Roadside Design Guide, 2002
  - Table 3.1 Clear-zone distances in feet from edge
    - Design Speed of 65-70 mph
    - Design ADT of over 6000
    - Foreslopes of 6:1 or flatter use distance
    - Foreslopes of 5:1 to 4:1 use distances of
  - Chapter 5, Roadside Barriers

After discussion, the following conclusions for future DMS sign in

1. Each site should be evaluated separately.

2. Road Design agreed that a clear zone of 38' to the edge
of clearance to the first sign support, at sites with a 6:1 s
requirement for a 4:1 slope or better and allow for futur
pavement or deterioration of the slope.

3. An exception will be locations where the ROW is too nar
At those locations a 32' clear zone (37' to the first sign su
6:1 slope or better.

4. At sites that do not currently have a 6:1 slope, where possible, the site should be graded by KDOT field staff to provide a slope of 6:1 between the first sign support and the edge of the shoulder. When a 6:1 platform is graded, the area beyond the platform should still be graded to 4:1 or flatter within the clear zone and preferably beyond. (Please see attached grading plan). Outside the clear zone the absolute maximum slope should be limited to 3:1.
   a. Some Districts may chose to do this in house
   b. Other Districts may contract the work with a contractor currently working on another KDOT project
   c. The Topeka area specifically has less available right-of-way and insufficient dirt for slope build-up, and will evaluate each site.

5. If grading is not feasible, installation of guardrail, attenuators or moving the sign will be evaluated.

6. For DMS behind existing guard rail, there should be a minimum 5' clearance behind the rail and the length of need should be calculated for each location to determine the necessary distance from the start of the guardrail to the sign location.

7. Signs are required to be 7 feet above the edge of traveled way. As requested by Design, to allow for future grading that may be necessary to maintain the slope, signs will be installed 8' above the edge of traveled way. Chris Meyer has verified that calculations will allow increasing support length by one foot.

DMS SUPPORT STRUCTURE EVALUATION

SRF Consulting Group, Inc. | Engineers Planners Designers

May 3, 2011 SRF No. 7322.0010C

Ms. Shari Hillard, P.E.
Kansas Department of Transportation
Eisenhower State Office Building
700 S.W. Harrison
Topeka, KS 66603

SUBJECT: KDOT ITS Standards Project, 106 KA-1188-02
DMS Support Structure Evaluation

Dear Ms. Hillard:

In conformance with our proposal dated November 4, 2010 we are pleased to present this evaluation of the rural DMS support structures.

Scope of Work

SRF's scope of work for task 3.1 included the following items:

- Evaluate the current two-post DMS support structure utilized by KDOT.
- Evaluate static breakaway support structures.
- Evaluate a butterfly support structure.

Investigation

We considered five different DMS unit manufacturers when evaluating the structural supports. These DMS were chosen as a representation of the most common DMS in use around the country that are of similar display size as the current Addco DMS used by KDOT, which is also included. The variation in sign case dimensions and weights are shown in the table below. Structural details of each are included in Appendix A.

Sign manufacturer	Model	External Case Dimensions	Weight
Adaptive	AX8700-27x108-18A	25' 0" x 7' 5" x 1' 1"	1520 lbs
Addco	13x5 HFM SD Brick2	21' 4-1/4" x 7' 0" x 4-1/4"	1080 lbs
Daktronics	Vanguard VF-24X0-27x90-66-X	21' 6" x 7' 10-3/16" x 1' 3"	1660 lbs
LEDSTAR	95 - 27x90 Variable Message Sign	20' 8-1/8" x 6' 8-3/4" x 1' 1-1/2"	1650 lbs
Skyline	LEDVMS-L-3-18F-27x090-1+	22' 6-5/8" x 8' 1-7/16" x 1' 8-1/4"	2770 lbs

www.srfconsulting.com
One Carlson Parkway North, Suite 150 | Minneapolis, MN 55447-4443 | 763.475.0010 Fax: 763.475.2429
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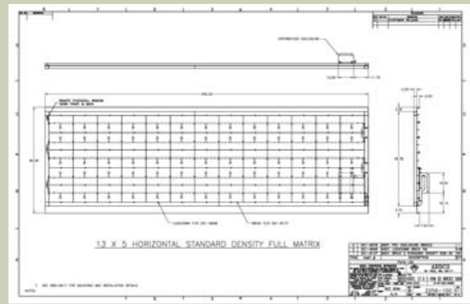
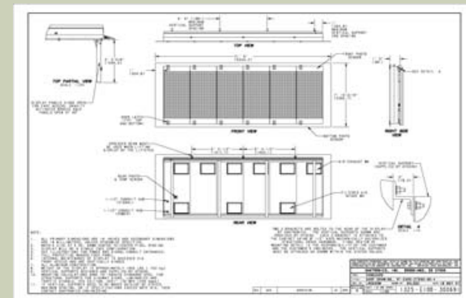
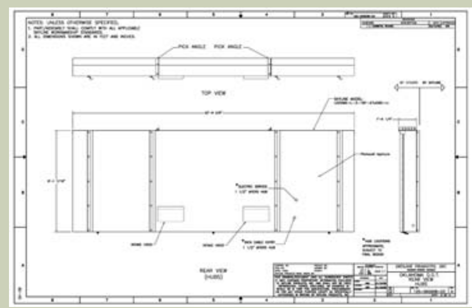
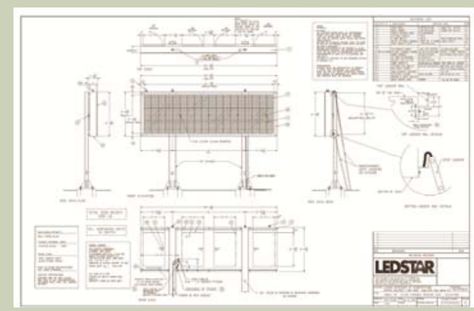




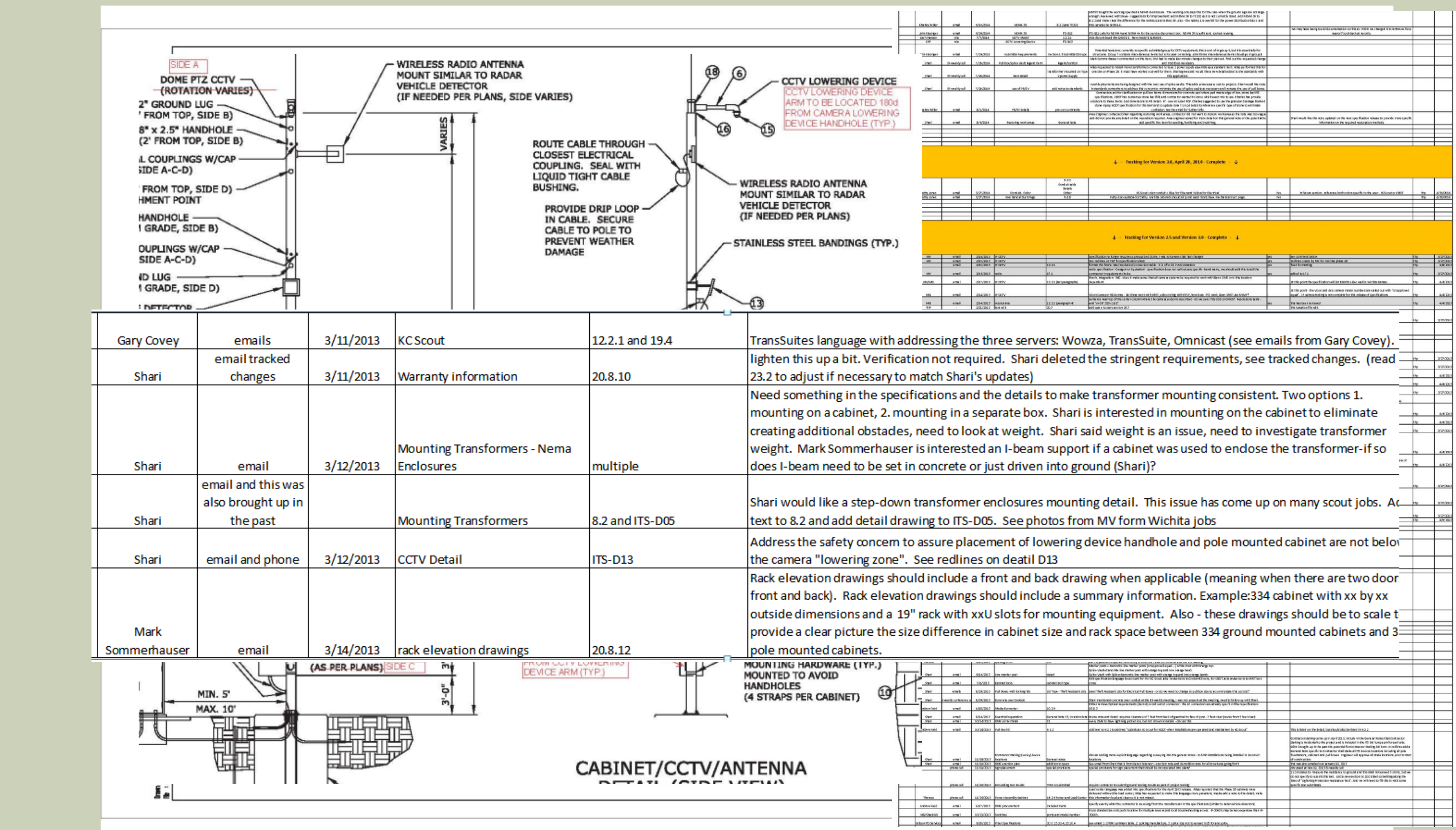




UPDATES

- How are standard updates recognized and handled?
  - Design engineer notes updates as they arise.
  - Design engineer notifies Kansas DOT ITS engineer.
  - Kansas DOT ITS engineer reviews updates.
  - Updates (approved and not approved) are tracked on a spreadsheet and a “red line” PDF tracking updates is created.
  - As appropriate, standards updates are released.
  - Release includes a ”red line” PDF of changes along with final PDF and Microstation files.

UPDATES



Gary Covey	emails	3/11/2013	KC Scout	12.2.1 and 19.4	TransSuites language with addressing the three servers: Wowza, TransSuite, Omnicast (see emails from Gary Covey).
Shari	email tracked changes	3/11/2013	Warranty information	20.8.10	lighten this up a bit. Verification not required. Shari deleted the stringent requirements, see tracked changes. (read 23.2 to adjust if necessary to match Shari's updates)
Shari	email	3/12/2013	Mounting Transformers - Nema Enclosures	multiple	Need something in the specifications and the details to make transformer mounting consistent. Two options 1. mounting on a cabinet, 2. mounting in a separate box. Shari is interested in mounting on the cabinet to eliminate creating additional obstacles, need to look at weight. Shari said weight is an issue, need to investigate transformer weight. Mark Sommerhauser is interested an I-beam support if a cabinet was used to enclose the transformer-if so does I-beam need to be set in concrete or just driven into ground (Shari)?
Shari	email and this was also brought up in the past		Mounting Transformers	8.2 and ITS-D05	Shari would like a step-down transfomer enclosures mounting detail. This issue has come up on many scout jobs. Ac text to 8.2 and add detail drawing to ITS-D05. See photos from MV form Wichita jobs
Shari	email and phone	3/12/2013	CCTV Detail	ITS-D13	Address the safety concern to assure placement of lowering device handhole and pole mounted cabinet are not belov the camera "lowering zone". See redlines on deatil D13
Mark Sommerhauser	email	3/14/2013	rack elevation drawings	20.8.12	Rack elevation drawings should include a front and back drawing when applicable (meaning when there are two door front and back). Rack elevation drawings should include a summary information. Example:334 cabinet with xx by xx outside dimensions and a 19" rack with xxU slots for mounting equipment. Also - these drawings should be to scale t provide a clear picture the size difference in cabinet size and rack space between 334 ground mounted cabinets and 3 pole mounted cabinets.

CREDITS

Many Thanks to the Project Team and Support Resources

- Leslie Spencer Fowler - KDOT
- Shari Hilliard - KDOT
- Jonathan Mushock – KDOT
- Abe Rezayazdi – KDOT
- Carmen Bakarich - KDOT
- Steven Baalman - KDOT
- Robert Bidwell - KDOT
- Bill Kritikos - KDOT
- Tom Hein - KDOT
- Dale Holsey – KDOT
- Lee Ann Legge – KDOT
- Karen Peterson - KDOT
- Cathy Jones – KC Scout
- Mark Sommerhauser – KC Scout
- Gary Covey – KC Scout
- Multiple Vendors and Manufactures
- John Kissinger - KHA
- Tyler Wiles – formerly KHA
- Andrew Reid - formerly KHA
- Charles Miller - HNTB
- Matt Volz - formerly SRF
- Mark Gallagher – SRF
- Steve McHenry - SRF
- Zach Hanson – SRF
- Therese Polum - SRF

Thank you

Therese Polum, PE (MN, KS)
thpolum@srfconsulting.com

SRF Consulting Group

Consulting Group, Inc.