MDOT EAMS
Business Process Description

Process Stage: To-Be

Process Name: Publish Road Network – Phase 1

Parent Business Process / Facet: Location Referencing Management

Process Owner: DTMB / CSS in cooperation with MDOT

Primary Deliverables / Products:

1. A new (Version x) of the Michigan Geographic Framework (MGF) database.
2. Migration files to enable the update of MDOT GIS and business application databases to MGF Version x.
3. Version x MDOT Geospatial Data Repository (MGDR) database for MDOT EAMS and other GIS users.
4. Version x Oracle Spatial SDE (GLOBAL) database for MDOT GIS users.
5. Version x EAMS database tables containing updated PR-MP and CS-MP location references.
6. Version x TMS, MAP and other MDOT business application databases containing updated PR-MP and CS-MP location references.

Primary Client: MDOT

Process Cycle and Duration: Yearly at present. The cut-off date is normally at the end of February, and the new MGF Version is available for MDOT use in April.

Future Vision - To Be Determined

Description:
The Publish Road Network business process is used to create a new production release (Version x) of the Michigan Geographic Framework (MGF) spatial database that reflects changes made within the past year based upon requests received from Michigan stakeholders including MDOT. MGF Version x is published from an Oracle Spatial edit environment operated by the Department of Technology, Management and Budget Centre for Shared Services (DTMB / CSS) by DTMB and MDOT staff. Migration files generated by this process are used by DTMB business application and spatial support staff, and by MDOT GIS staff, to create new Version x spatial and textual databases for use by MDOT business users.

This process is triggered by a specified cut-off date that locks down the MGF edit environment. At present, it is run annually commencing at the end of February. In addition to new Version x spatial databases that reflect the updated road network along with numerous other feature classes, PR-MP and CS-MP locations within MDOT business applications are updated to reflect the Version x network. This is accomplished through custom migration scripts that are specific to each application database that is migrated. A number of transportation LRS event tables are included within the core MGF product.

In EAMS Phase 1, the MGF road network is updated within the DTMB / CSS MGF edit environment and published on a periodic basis (to be determined) as a new “Version” for consumption by EAMS and other business users.

Existing business processes are revised to consume the MGF Version x migration files within the EAMS environment and update the road network, MDOT LRMs and EAMS asset LRS locations to Version x. This will also include the updating of LRS locations within any foreign tables that are managed by EAMS (to be determined).

Business processes for the updating of LRS locations within MDOT business applications that are not managed by EAMS are unchanged.

Participants:

Department / Agency	Actors	Description of Role
MDOT	EAMS Support Team	Create MGF Version x MGDR database for MDOT GIS application users, and migration files to assist in the TMS migration process step.
DTMB	Spatial Support Team	Create MGF Version x Oracle Spatial SDE database and ArcGIS Server tile caches for MDOT GIS and business application use.
DTMB	Business Application Support	Migrate PR-MP and CS-MP locations within MDOT business application databases to MGF Version x.
DTMB	MGF Team	Carry out year-end processes to create and publish MGF Version x.

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1H		The process begins with a directive to lock down the MGF edit environment in preparation for creation of the Version x MGF database.
2H		The MGF PR Segment lengths are validated against the Michigan Accident Location Index (MALI) PR Segment lengths. Any discrepancies are resolved to ensure that the two databases are synchronized.
2I		The MGF edit environment database is used as input to process step **2H**. This database contains spatial PR Segment network definitions and MALI data tables.
3F		The current Sufficiency database contains CS-MP logical network section definitions and associated lengths that have been adjusted throughout the year as MGF updates occur. It is used as input to the final Sufficiency Reconciliation process step (**4H**) that occurs prior to publishing MGF Version x.

Future Vision - To Be Determined

Index	Process Step	Description
3H	Re-Mile Point MGF Data	All Mile Points along each PR Segment within the MGF database are recalculated using the latest segment lengths.
4F	Sufficiency Database (Version x)	This database contains CS-MP logical network section definitions and associated lengths that have been updated by the Sufficiency Reconciliation process step (**4H**).
4H	Sufficiency Reconciliation	This process step compares the logical CS-MP network stored in the Sufficiency database against the spatial CS-MP network stored within the MGF edit environment database. Any discrepancies are resolved to ensure that the two databases are synchronized. Once it is completed, the Sufficiency Database has been updated to Version x.
5G	MGF Version x	The MGF Version x database is created as the output from the Publish process step (**5H**). It forms the basis for the generation of subsequent Framework migration files and the creation of MDOT Version x spatial databases for GIS and business application use.
5H	Publish MGF Version x	The DTMB MGF Team creates the MGF Version x spatial database (**5G**) and the Framework migration files associated with it (**6H**).
6B	EAMS Database	The EAMS database contains tables with LRS Event locations referencing assets and other business data against the current road network.
6E	EAMS Framework Migration	This step uses the MGF Version x Migration Files (**6H**) to update EAMS Database (**6B**) PR-MP LRS Event locations to Version x. This process is performed using back end database scripts similar to those used for the migration of LRS Event locations within other MDOT business databases such as TMS and MAP.
6H	MGF Version x Migration Files	The migration files include the following: • MGF Statewide Files • Old and new MALI files • Working Transactions • Migration Table • Metadata and MGF appendices • PR/CS Equivalency Table • Sufficiency Working and Report Files with full PR and CS Referencing
7A	Process GeoData	The MDOT EAMS Support Team accesses the MGF Version x database (**5G**) to create a new road centerline and other MGF basemap layers within the MDOT ArcGIS environment. These layers are used as input to the MGF Version x Spatial Migration process (step **8A**).
7B	MDOT Geospatial Data Repository	The MGDR contains spatial data feature layers used by EAMS and other business applications. Ii is accessible via ArcSDE and ArcGIS Server.

Future Vision - To Be Determined

Index	Process Step	Description
8A	MGF Version x EAMS Spatial Migration	The MDOT GIS Team saves the existing MGF feature layers, associated LRM Routes and LRS event feature geometry as history layers. The new MGF Version x feature layers including the road centerline network and other basemap layers (administrative boundaries, etc.) are then stored within the updated MGDR (**9B**) for use by MDOT business users and applications. MDOT Business LRMs (process step **9A**), LRS Event spatial features (step **10A**), and TMS Migration Files (process step **12A)** are also created.
8E	TMS Framework Migration	The TMS Framework Migration process step creates a new transitional TMS Version x Database (**9E**) using the current TMS Database (**8F**), MDOT Version x TMS Migration Files (**12B**) and MGF Version x Migration Files (**6H**) as inputs. Once this is completed, the TMS-Sufficiency Update (process step **10F**) is carried out. There are two sub-processes executed: • TMS Foxpro migration programs • TMS Oracle migration procedures
8F	TMS Database	The current TMS database is used as input to the TMS Framework Migration process (step **8E**).
9A	Build PR-MP, CS-MP & Route-MP Routes	ArcGIS LRS Route systems are created for the PR-MP, CS-MP and Route-MP LRMs and stored within the Version x MS SQL SDE database (**9B**).
9B	MGF Version x MDOT Geospatial Data Repository	The MGF Version x MGDR contains the MGF Version x road network database, boundary layers, other MGF features, LRM Routes and MGF core LRS events. Other MDOT business data is linked to the road network through PR-MP and CS-MP LRMs.
9E	TMS Version x Database (Post Migration)	This transitional database contains updated PR-MP locations for business tables. It is created by process step **8E** and used as input to the TMS-Sufficiency Update process step (**10F**).
9F	Sufficiency File (post reconcile with MGF)	This file contains Version x CS-MP LRM data following completion of the Sufficiency Reconciliation process step (**4H**).
10A	Relocate EAMS LRS Events	The updated LRS locations within the EAMS database (**10B**) are used as input to create new LRS event features which are stored within the MGF Version x MGDR (**11B**).
10B	EAMS Database	As per **6B**. Following completion of process step **6E**, this database now has LRS locations within business tables updated to MGF Version x.
10D	MGF Version x Oracle Spatial Migration	This step initiates the process to create the MGF Version x Oracle Spatial SDE (**11C**). Shapefiles are extracted from the MGF Version x MGDR (**9B**) and converted to SDO. TMS business events are input from the Version x Sufficiency Database (**10E**), the Version x MAP Database (**11E**) and other MDOT Version x business application databases (**12E**).

Future Vision - To Be Determined

Index	Process Step	Description
10E	TMS Version x Database (Post Migration, Post Sufficiency)	Once the TMS - Sufficiency Update process step (**10F**) has been completed, the TMS Database contains MGF Version x CS-MP locations.
10F	TMS – Sufficiency Update	This process step creates Version x Sufficiency tables within the final TMS Version x database (**10E**).
11B	MGF Version x MDOT Geospatial Data Repository	The MGDR now contains MGF Version x LRS event features.
11C	MGF Version x Oracle Spatial SDE (GLOBAL)	This database contains MGF Version x Oracle Spatial SDE data that is created through process steps **10D** and **11D**.
11D	Build PR-MP, CS-MP & Route-MP Routes	The PR-MP, CS-MP and Route-MP LRM Routes are created using the MGF Version x road network feature attributes and stored in the MGF Version x Oracle Spatial SDE Database (**11C**).
11E	MAP Database	The MAP Database contains business table PR-MP locations that are updated to Version x following completion of the MAP Framework Migration process step (**11F**).
11F	MAP Framework Migration	This step uses the MGF Version x Migration Files (**6H**) to update MAP Database (**11E**) PR-MP locations to Version x.
12A	Create TMS Migration Files	The MDOT GIS Team creates migration files (**12B**) for use by the TMS Framework Migration process step (**8E**).
12B	MDOT GIS Version x TMS Migration Files	These files include updated City Boundary, Zip Code and Lane Quantity PR-MP locations.
12C	MGF Version x Tile Cache	These files are accessed by ArcGIS Server applications to optimize map draw times for MGF Version x base layers.
12D	Build ArcGIS Server Tile Cache	This is a second process step as part of the MGF Version x Spatial Migration (**10D**) and uses the SDO shapefiles to create an ArcGIS Server tile cache (**11C**).
12E	Other Bus. App. Databases (MAP-X, PHD, PRFINDER, CRASH, etc.	Other MDOT business application database table PR-MP locations are updated to Version x following completion of the MAP Framework Migration process step (**11F**). These databases include MAP-X, PHD, PRFINDER and CRASH.
12F	Other MDOT Bus. App. Framework Migrations	This step uses the MGF Version x Migration Files (**6H**) to update PR-MP locations within other MDOT business application databases (**12E**) to Version x.

Future Vision - To Be Determined

Index	Process Step	Description
13D	Road Network Spatial Data Updated to Version x	All MDOT spatial data has been updated to MGF Version x.
13F	LRS Locations Updated to Version x	LRS locations within EAMS and other selected MDOT business applications have been updated to MGF Version x.

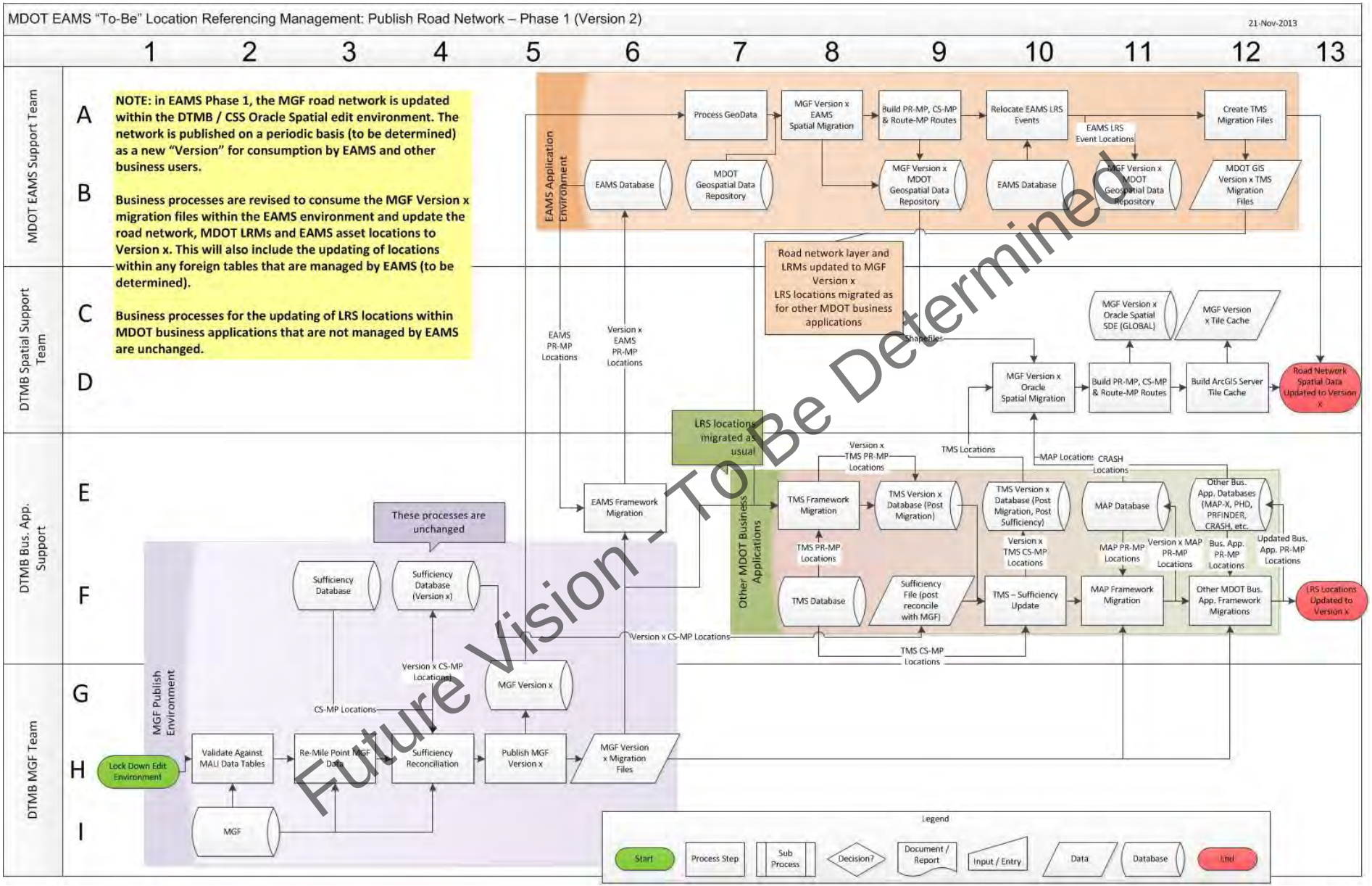
Change Log:

Version	Authors	Description	Date
1	Dave Loukes (OPUS)	First Draft for submission to MDOT – process map only	25-Sept-2013
2	Dave Loukes (OPUS)	Second Draft for internal review and discussion – process map only	8-Oct-2013
3	Dave Loukes (OPUS)	Second Draft for submission to MDOT – process map and process description	26-Nov-2013

Attached:

1. To-Be Business Process Map: Publish Road Network – Phase 1 (Version 3) dated 21-Nov-2013.

Future Vision - To Be Determined



Future Vision - To Be Determined

MDOT EAMS
Business Process Description

Process Stage: To-Be

Process Name: Access Spatial Road Network Data

Parent Business Process / Facet: Location Referencing Management

Process Owner: MDOT

Primary Deliverables / Products: Spatial road network data available for use within MDOT GIS and business applications

Primary Client: MDOT

Process Cycle and Duration: As required to support MDOT GIS and business applications

Description:
The Access Spatial Road Network Data business process is used by MDOT staff to access MDOT road network spatial data stored within the MDOT Geospatial Data Repository (MGDR) in support of asset management. Access is enabled through various software applications including web clients, desktop GIS and ArcGIS Server Map Services and Map Services.

This process is triggered by a spatial data access request from an MDOT software application.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Business User	Access spatial data to meet asset management business needs.
MDOT	GIS Team	Access spatial data to meet asset management and user support business needs; maintain MDOT spatial data.
DTMB	Spatial Support Team	Maintain MDT spatial data.

Process Map: (See Attached)

Future Version - To Be Determined

Process Steps Descriptions:

Index	Process Step	Description
1A	Spatial Data Access	A spatial data access request is initiated by an MDOT business user through a web client (**2A**), desktop GIS (**2B**) or mobile device (**2C**).
1D	Spatial Data Access	A spatial data access request is initiated by an MDOT EAMS Team individual through desktop GIS (**2D**).
2A	Web Clients	A web client software application is employed by an MDOT business user to access spatial data through Web Services (**4E**).
2B	Desktop GIS	A desktop GIS application is employed by an MDOT business user to access spatial data through Map Services (**3E**).
2C	Mobile Device	A mobile device is employed by an MDOT business user to access spatial data through Map Services (**3E**).or Web Services (**4E**).
2D	Desktop GIS	A desktop GIS application is employed by an MDOT EAMS Team individual to access spatial data through Map Services (**3E**).or ArcSDE directly (**2G**).
2G	ArcSDE	ArcSDE is used to access MDOT spatial data stored in the MDOT Geospatial Data Repository (MGDR).
2H	MDOT Geospatial Data Repository	MDOT vector spatial data used by EAMS is stored within the MGDR, which contains the MGF road network layer and associated Linear Referencing Methods (LRMs), MDOT LRS Events, other MGF basemap feature layers, and other layers used by MDOT business applications.
3E	Map Services	ArcGIS Server Map Services are used by desktop and mobile client applications to access spatial data feature layers stored within the MGDR.
3F	ArcGIS Server	An ArcGIS Server application is employed to provide Map Services (**3E**) and Web Services (**4E**) to permit access to MGDR spatial data.
3H	MGF Version x Tile Cache	Tile Cache data is created from MGDR feature layers (**2H**), and is accessed through ArcGIS Server Map Services (**3E**) and Web Services (**4E**). Tile caches are used to improve the performance of map redraws at various map scales.
4E	Web Services	ArcGIS Server Web Services are used by web browser client and mobile device applications to access spatial data stored within the MGDR.

Future Vision - To Be Determined

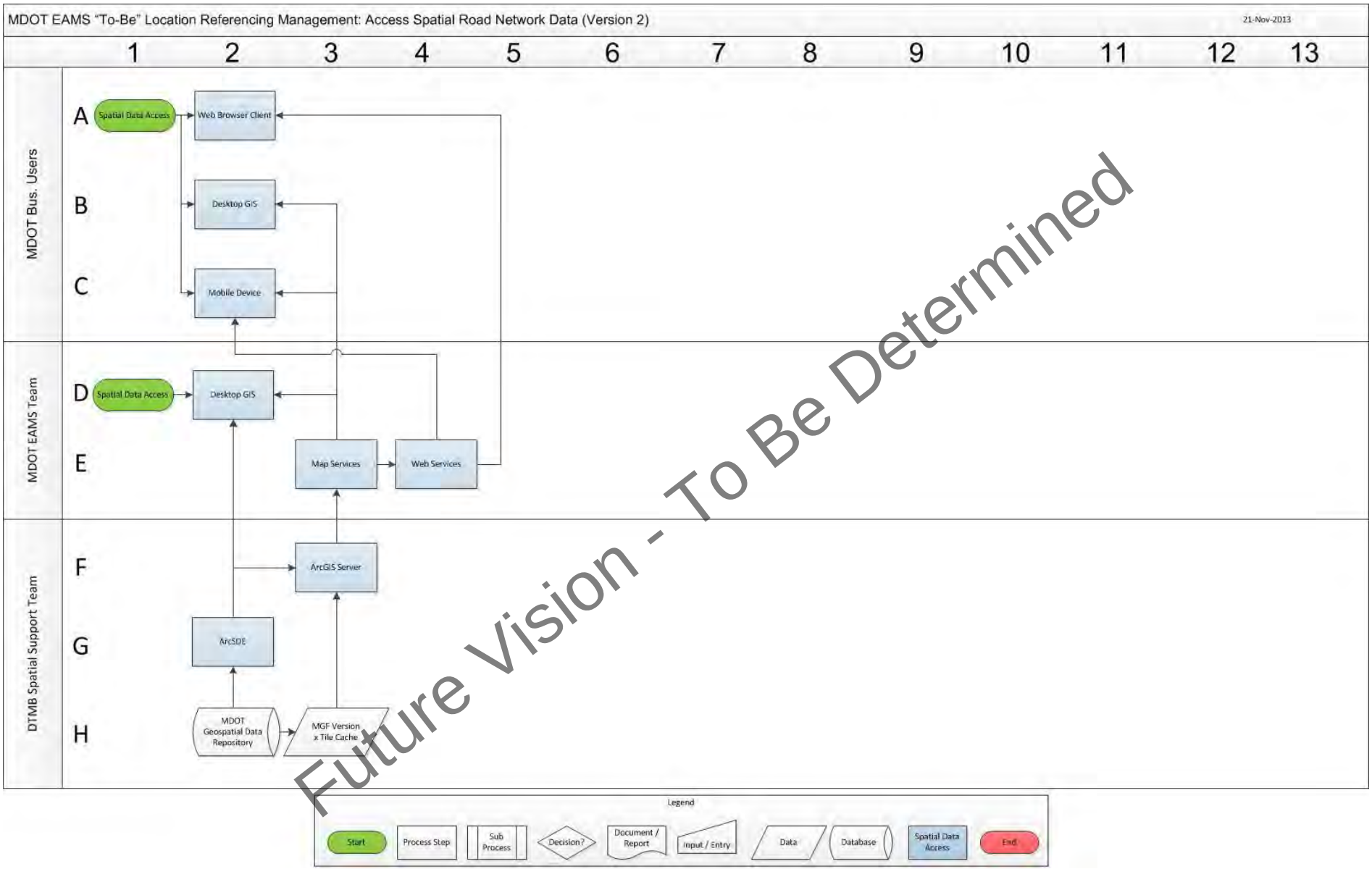
Change Log:

Version	Authors	Description	Date
1	Dave Loukes (OPUS)	First Draft for submission to MDOT – process map only	25-Sept-2013
2	Dave Loukes (OPUS)	Second Draft for submission to MDOT – process map and draft process description	26-Nov-2013

Attached:

1. To-Be Business Process Map: Access Spatial Road Network Data (Version 2) dated 21-Nov-2013.

Future Vision - To Be Determined



Future Vision - To Be Determined

MDOT EAMS
Business Process Description

Process Stage:	To-Be
Process Name:	Locate Business Data for Asset Management – Phase 1
Parent Business Process / Facet:	Location Referencing Management
Process Owner:	MDOT
Primary Deliverables / Products:	EAMS asset locations
Primary Client:	MDOT
Process Cycle and Duration:	Project based, for Design and Construction projects Work Order based, for Maintenance activities

Future Vision - To Be Determined

Description:

The EAMS Phase 1 Locate Business Data for Asset Management business process is used to capture the location of MDOT road network assets from existing MDOT business activities. There are two main business process streams involved:

1. Design and Construction Projects.
2. Maintenance Activities.

The key underlying assumptions are that:

1. Asset locations will be initially captured in a format that is compliant with MDOT field survey standards.
2. CAD data layering standards and attribute coding conventions have been established that will enable the transfer of assets into the EAMS GIS environment.
3. Asset locations (and attributes) will be captured as a by-product of existing business processes – asset specific inventory surveys will no longer be required.

Design and Construction Projects

Asset locations are captured from field surveys and stored within Design and Construction Engineering Data files in a format suitable for use with MDOT roadway design software.

This process is triggered by a request for a field survey. These surveys are carried out as required to support MDOT Design and Construction projects. The transfer of new asset locations and supporting attributes to EAMS from As-Built Data files is enabled by MDOT standards for location referencing and CAD layer coding.

Maintenance Activities

Asset locations are captured as a by-product of routine maintenance activities using mobile technologies.

This process is triggered by a maintenance work order issued by MDOT or Local Agency staff.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Field Survey Staff	Collect asset inventory in the field upon request to support Design and Construction projects using MDOT approved survey methods; create initial CAD files.
MDOT	Design Staff	Create new assets using MDOT design software; create additional Design CAD files and drawings to support Construction activities.
MDOT	Construction Staff	Conduct field inspections; update Design CAD files to create electronic CAD As-Built drawing files; liaise with EAMS support staff to support transfer of asset locations from CAD to GIS.
MDOT	EAMS Team	Facilitate transfer of asset locations from CAD to EAMS; facilitate transfer of asset locations from maintenance files to EAMS.
MDOT/DTMB	Application Support	Host / support the EAMS application environment.
MDOT	Maintenance Staff	Issue work orders; complete maintenance activities; verify local agency maintenance work.
Local Agency	Maintenance Staff	Issue work orders; complete maintenance activities.

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1C	Field Survey Request	A request for a field survey is issued by MDOT Design project staff.
1L	Work Order	A Maintenance Work Order is issued by MDOT Maintenance staff.
1N	Work Order	A Maintenance Work Order is issued by a Local Agency.
2A	Capture Assets (GPS, LiDAR, Total Station)	Assets are captured by MDOT field survey staff using approved survey procedures and equipment (GPS, LiDAR, total stations) and stored in Survey Files (**2B**).
2B	Survey Files	MDOT Survey Files contain asset coordinate locations and attributes in a format suitable for the creation of initial CAD Files (process step **3A**) and Engineering Data files (process step **4A**).
2I	EAMS Database (Assets, Plans, Accomplishments, etc)	The EAMS database includes LRS Event tables containing locations of assets, work plans, accomplishments and other information required in support of MDOT maintenance and asset management activities.

Future Vision - To Be Determined

Index	Process Step	Description
2L	Complete Maintenance Activity	A maintenance activity is completed by MDOT Maintenance staff in fulfillment of a Work Order (**1L**). The location(s) of any affected assets are captured as a by-product of this activity (**2M**) in addition to accomplishment data.
2M	Affected Asset Locations	The location(s) of any affected assets are captured as a by-product of the MDOT maintenance activity (**2L**). Locations are captured as coordinates to MDOT standards using GPS embedded within mobile technologies.
2N	Complete Maintenance Activity	A maintenance activity is completed by Local Agency staff in fulfillment of a Work Order (**1N**)
3A	Create CAD Files	Initial Engineering Data files (**4D**) are created using MDOT CAD software by field survey staff. These are used to create new assets (process step **4C**).
3B	CAD Files (2D, 3D, Alignment, DTM)	The initial CAD files include: two-dimensional (2D), three-dimensional (3D), Alignment and Digital Terrain Model (DTM).
3I	MDOT Geospatial Data Repository	The MDOT Geospatial Data Repository (MGDR) contains spatial data used by EAMS and other MDOT business applications. These data include the MGF road centerline network, Linear Referencing Method (LRM) definitions and associated LRS Event locations, and other MGF basemap layers.
4C	Create New Assets (CAD)	New assets are created by MDOT Design staff using CAD design software. These assets are added to project Engineering Data files (**4D**).
4D	Engineering Data (Alignment, Construction, Drainage, DTM, 3D Model,, etc.)	Project Engineering Data files include: Alignment, Construction, Drainage and other CAD layers. These are used as input to the Construction Inspection process step (**5E**).
4L	Verified Asset Locations	Verified asset locations resulting from a Local Agency Maintenance activity (**2N**) are stored for subsequent processing.
4M	Verify Work	MDOT maintenance staff verify the work completed under a Local Agency Work Order. As part of this process step, associated asset locations are verified.
4N	Affected Asset Locations	The location(s) of any affected assets are captured as a by-product of the Local Agency maintenance activity (**2N**). **Note:** at this point, the assumption is made that at least some Local Agencies will capture locations as coordinates to MDOT standards using GPS embedded within compatible mobile technologies.
5E	Construction Inspection	MDOT Construction staff conduct field inspections and create a Construction Inspection Survey File (**5F**). **Note: as part of this process step, checks will need to be made to determine whether any existing assets have been removed / abandoned or replaced.**

Future Vision - To Be Determined

Index	Process Step	Description
5F	Construction Inspection Survey File	The Construction Inspection Survey File records the As-Built location of the roadway and its associated assets. It is used as input to the Update Assets process step (**6E**).
5K	Process Asset Location Records	The MDOT EAMS Team receives Affected Asset Locations (**4N**) and Verified Asset Locations (**4L**) from MDOT Maintenance and processes them. Each location record is then subjected to a series of logic checks commencing with step **6K**.
5M	MDOT Geospatial Data Repository	The MGDR is used to assist in the maintenance work verification process step (**4M**).
6E	Update Assets	Assets and their locations are updated using data from the Construction Inspection Survey File (**5F**) and stored within the As-Built Project Data files (**6F**).
6F	As-Built Project Data (Alignment, Drainage, Asset Layers, DTM, 3D Model, etc.)	The As-Built Project Data files contain the final locations of assets resulting from the Construction project.
6J	Retire Asset Location	If the location relates to an asset that has been removed or abandoned, then the asset location is retired (end dated) in the MGDF (**7I**).
6K	Removed / Abandoned Asset?	If the asset has been removed or retired, then the location is removed (step **6J**). Otherwise, the next logic check is carried out (**7K**).
7E	File Project Data	Related project data is filed in an MDOT projects database as part of closing out the project. A notification (**7F**) is sent to the EAMS Team.
7F	Notify EAMS Team	The EAMS Team is notified via email that a new Construction As-Built Project Data file (**6F**) has been created.
7I	MDOT Geospatial Data Repository	New and modified asset locations are stored within the MGDR. Assets that have been retired or abandoned have their locations retired (end dated).
7J	Retire Asset Location	If the location relates to an asset that has been replaced, then the location of the replaced asset is retired (end dated) in the MGDF (**7I**). A new asset location is then created (process step **8J**).
7K	Replaced Asset?	If the asset has been replaced, then the old location is retired (step **7J**). Otherwise, the next logic check is carried out (**8K**).
8G	Import As-Built Asset Locations	The EAMS Team accesses the As-Built Project Data files (**6F**) and extracts the asset records for the recently completed project. This data is processed (step **9G**) to capture new and revised asset locations.

Future Vision - To Be Determined

Index	Process Step	Description
8J	Create New PR-MP Asset Event feature	A new asset PR-MP event feature is created and saved within the MGDR (**7I**).
8K	New Asset?	If the asset is new or has been replaced, the location is used to create a new event feature (step **8J**). Otherwise, a check is made to see if the locational accuracy of an existing asset has been improved (process step **9K**).
9G	Process Asset Records	Individual asset location records are examined within each asset layer to determine whether a new asset (process step **10G**) or an improved asset location (process step **10H**) has been captured.
9K	Improved Location Accuracy?	If the asset location has been improved, it is stored in the MGDR (**7I**) along with updated metadata. Otherwise, a check is made to see if there are additional records (step **11J**).
10G	New Asset?	If the As-Built location is for a new asset, a new event feature is created ((process step **11G**). Otherwise, a check is made to see whether the accuracy of an existing asset location has been improved (process step **10H**).
10H	Improved Location Accuracy?	If the accuracy of an existing asset location has been improved, the asset location and associated metadata is saved within the MGDR (step **12H**). Otherwise, the next asset record is processed (step **9G**).
10K	Update Asset Location & Metadata	The updated asset location and metadata are saved to the MGDR (**7I**).
11G	Create New PR-MP Asset Event feature	A new As-Built asset PR-MP LRS Event feature is created and saved within the MGDR (**12I**). A check for more records is then made (step **12G**).
11J	More Records?	If more maintenance asset records exist, the next record is processed (step **5K**). Otherwise, the maintenance asset location stream is completed (step **12J**).
12G	More Records?	If additional As-Built asset records exist, the next asset record is processed (step **9G**). Otherwise, the Design and Construction stream is completed (step **13G**).
12H	Update Asset Location & Metadata	If the location of an existing asset has been improved, the new location and its associated metadata is used to update the MGDR (**12I**).
12I	MDOT Geospatial Data Repository	The MGDR contains EAMS asset LRS Event locations captured through field survey and maintenance processes.
12J	Done	Storing of the asset location along with any associated attributes ends the Maintenance stream of the business process.
13G	Done	Storing of the asset location along with any associated attributes ends the Design and Construction stream of the business process.

Future Vision - To Be Determined

Change Log:

Version	Authors	Description	Date
1	Dave Loukes (OPUS)	First Draft for submission to MDOT – process map only	1-Oct--2013
2	Dave Loukes (OPUS)	Final Draft for submission to MDOT – process map and description	26-Nov-2013

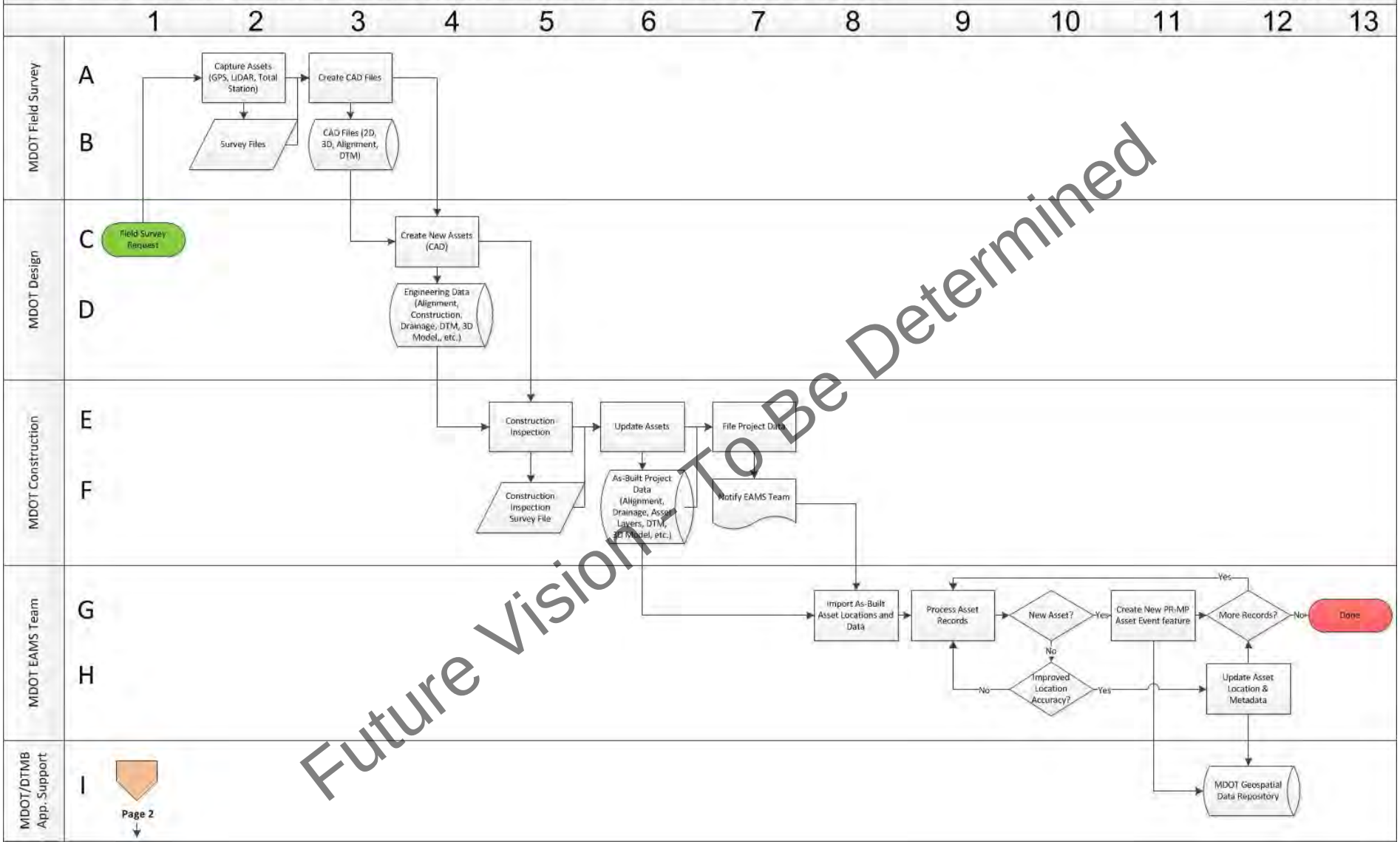
Attached:

1. EAMS To-Be Business Process Map: Locate Business Data for Asset Management – Phase 1 (Version 2) dated 21-Nov-2013.

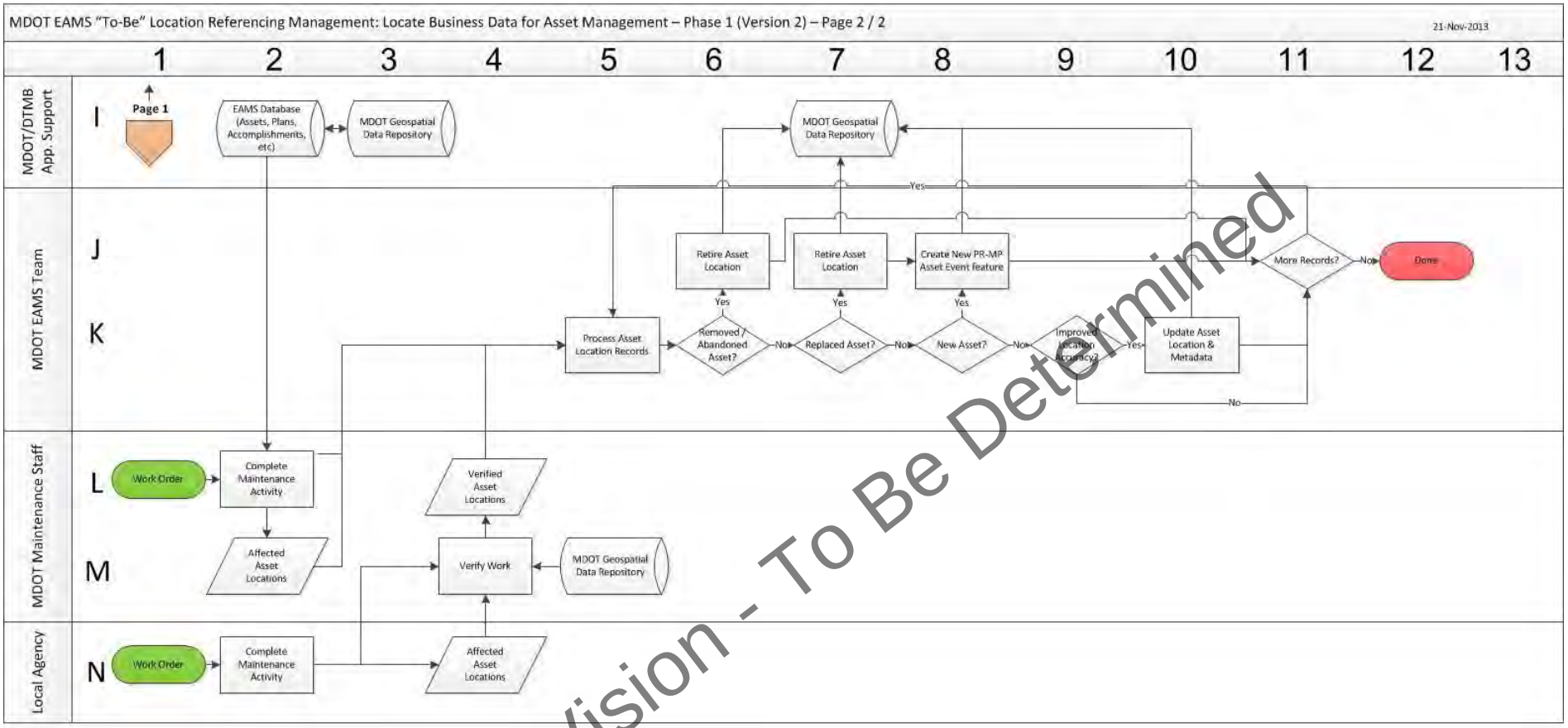
Future Vision - To Be Determined

MDOT EAMS "To-Be" Location Referencing Management: Locate Business Data for Asset Management – Phase 1 (Version 2) – Page 1 / 2

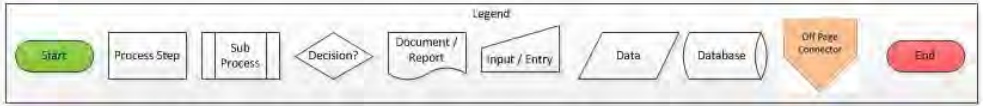
21-Nov-2013



Future Vision To Be Determined



Future Vision - To Be Determined



MDOT EAMS
Business Process Description

Process Stage: To-Be

Process Name: Update & Publish Road Network – Future Vision

Parent Business Process / Facet: Location Referencing Management

Process Owner: MDOT in cooperation with DTMB / CSS

Primary Deliverables / Products:

1. Michigan Geographic Framework (MGF) Revisions:
   - Road network spatial data & attributes
   - MGF PR-MP Business Linear Referencing Method (LRM)
   - MGF PR-MP Event table locations
   - Michigan Accident Location Index (MALI) PR-MP Event table locations
2. MDOT LRS Data:
   - MDOT Business LRMs (CS-MP, Route-MP, etc.)
   - MDOT EAMS LRS Event table locations
   - MDOT other business application LRS Event table locations (registered with EAMS)
3. MDOT Geospatial Data Repository (MGDR):
   - MGF road network updates replicated
   - LRM changes replicated
   - Business LRS Event locations replicated
4. MGF Version Publications:
   - A new (Version x) of the Michigan Geographic Framework (MGF) database.
   - Migration files to enable the update of non-MDOT GIS and business application databases to MGF Version x.
   - Version x Oracle Spatial SDE (GLOBAL) database for MDOT GIS users.
   - Version x MDOT business application databases containing updated PR-MP and CS-MP location references – for those applications whose LRS locations are not managed by EAMS.

Primary Client: MDOT

Process Cycle and Duration:

1. *MGF Road Network Revisions, MDOT LRS Data, MGDR*: continuous, based upon update requests received during each calendar year.
2. *MGF Version Publication*: to be determined, based upon non-MDOT client requirements

Future Vision - To Be Determined

Description:
The Update & Publish Road Network business process will be used to make changes to the Michigan Geographic Framework (MGF) spatial database road network layer based upon change requests received from Michigan stakeholders including MDOT. These changes will be made using the functionality contained within the EAMS Road Network Management module, within an agreed spatial edit environment to be determined at a future date beyond EAMS Phase 1. This environment will be hosted by the Department of Technology, Management and Budget Center for Shared Solutions (DTMB / CSS) and shared by DTMB and MDOT staff responsible for road network updates.

All changes to the MDOT trunkline network component of the MGF will be made by the MDOT Trunkline Specialist in order to ensure that Route and Control Section definitions, attributes and associated LRMs are correctly handled to enable the ongoing integration of MDOT business data based upon LRS locations.

This process is triggered by a change request. Changes are processed as received until a cut-off date is reached for publication of the next MGF version (release). Subsequent change requests will be held for processing against the new MGF version once it is published. However, it is expected that these delays will be minimal.

Publication of MGF Versions will still be required for consumption by non MDOT users. It is expected that these process tasks will be simplified as integration of County files is no longer required (as of 2013). Furthermore, no reconciliation with MALI and Sufficiency is required as LRM definitions and MGF / MDOT event locations are updated by the EAMS Road Network Management module as network changes occur.

Note: implementation of this future vision EAMS business process and the associated MGF edit environment tools will require further discussion between MDOT and DTMB / CSS.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Data Source	Identify trunkline network change and submit change request
MDOT	Network Editor	Verify and process trunkline network changes to update the MGF
MDOT	EAMS Application	Host the road network editing environment
DTMB	Network Editor	Process non-trunkline network changes to update the MGF
DTMB	Staff (various)	Identify non-trunkline network change and submit change request; accept change requests; forward trunkline change requests to MDOT Network Editor; verify non-trunkline network changes and assign to a DTMB Network Editor; monitor status of requests through completion.
External Agency	Various	Identify non-trunkline network change and submit change request. External agencies may include other State of Michigan agencies, Counties and Municipalities.

Process Map: (See Attached)

Future Vision - To Be Determined

Process Steps Descriptions:

Index	Process Step	Description
1A	Request for Change	A request for change is submitted by an MDOT Data Source. These requests will go directly to the MDOT Network Editor.
1F	Request for Change	A request for change is submitted by a DTMB Staff person. These requests will be sent to a DTMB staff coordinator.
1G	Request for Change	A request for change is submitted by an External Agency. These requests will be sent to a DTMB staff coordinator.
2E	Source Data	Data supporting the change request is supplied by DTMB staff. Source data may be received in the form of shape files, orthophotos, field / GPS surveys, CAD files, or other media formats.
2F	Verify Request & Assign Editor	DTMB staff verifies the request and assigns a Network Editor.
2G	Source Data	Data supporting the change request is supplied by an External Agency. Source data may be received in the form of shape files, orthophotos, field / GPS surveys, CAD files, or other media formats.
3B	Verify Request	Trunkline requests will be verified by the MDOT Network Editor.
3E	Trunkline Network?	If the request involves the trunkline network, it is forwarded to the MDOT Network Editor for further verification (step **3B**). Otherwise, it is sent to a DTMB Network Editor for further verification (step **4E**).
4A	Source Data	Data supporting the change request is supplied by an MDOT Data Source. Most (90%) of source data is currently supplied as CAD files, although some GPS survey data is also received. **Note:** in the future, it is anticipated that an increasing amount of source data will be supplied as GPS survey files.
4B	Update Geometry & Basic Attributes	MGF trunkline road network geometry changes and basic attributes are entered by the MDOT Network Editor.
4D	EAMS / MGF Edit Environment Spatial Database	The EAMS / MGF Edit Environment Spatial Database contains the MGF road network features, other MGF layers, EAMS LRM Route definitions, and MGF / EAMS Event locations that are registered against the edit environment MGF road network.
4E	Update Geometry & Basic Attributes	MGF non-trunkline road network geometry changes and basic attributes are entered by a DTMB Network Editor.
5E	Road PR Segment?	If the change involves a road segment that contains PR-MP linear referencing, this data must be updated (**6E**). Otherwise, the change proceeds to final processing (**9E**).

Future Vision - To Be Determined

Index	Process Step	Description
6B	Update PR-MP attributes & Segment Definitions	The MDOT Network Editor updates the PR-MP attributes for the affected trunkline MGF PR Segments. These changes are then used by the EAMS Road Network Management module to update Business LRM definitions (Subprocess step **6C**) and associated LRS Event locations (Subprocess step **7C**) within the EAMS / MGF Edit Environment Spatial Database (**6D**).
6C	Update Business LRM Definitions	The EAMS Road Network Management module uses the PR Segment attributes to update the PR-MP LRM and other MDOT Business LRMs (Route-MP, CS-MP, etc.) within the EAMS / MGF Edit Environment Spatial Database (**6D**).
6D	EAMS / MGF Edit Environment Spatial Database	The EAMS / MGF Edit Environment Spatial Database now contains updated MGF road network geometry, attributes, LRM definitions and LRS Event locations based upon the edits made.
6E	Update PR-MP attributes & Segment Definitions	The DTMB Network Editor updates the PR-MP attributes for the affected non-trunkline MGF PR Segments. These changes are then used by the EAMS Road Network Management module to update Business LRM definitions (Subprocess step **6C**) and associated LRS Event locations (Subprocess step **7C**) within the EAMS / MGF Edit Environment Spatial Database (**6D**).
7B	Update Road Classification Data	The MDOT Network Editor updates the road classification attributes for the affected trunkline MGF road centerline features. This data is used to update associated LRS Event locations in Subprocess **7C**.
7C	Update MGF / MALI / MDOT Event Locations	The EAMS Road Network Management module updates LRS Event locations in the EAMS / MGF Edit Environment Spatial Database (**6D**), MALI Tables (**8E**) and other MDOT business applications that are registered with EAMS (**8A**).
8A	MDOT Business Applications (TMS, MAP, Sufficiency, etc.)	Other MDOT business applications that have LRS Events registered with EAMS will have their LRS locations updated by the Road Network Management module as network changes occur.
8E	MALI Tables	Crash locations and any other LRS Events contained within the MALI tables are updated as network changes occur.
9B	Close Change Request	The change request is closed out by the MDOT Network Editor and the MGF Audit Database (**9C**) is updated.
9C	MGF Audit Database	The MGF Audit Database tracks all revisions and associated change requests. **Note: the functionality to update this database may or may not be imbedded within EAMS. Further discussion is required with the DTMB / CSS MGF Team as to how this should best be implemented.**
9E	Close Change Request	The change request is closed out by the DTMB Network Editor and the MGF Audit Database (**9C**) is updated.

Future Vision - To Be Determined

Index	Process Step	Description
10C	Replicate Changes to MDOT Geospatial Data Repository	Changes made to MGF road network geometry / attributes, LRMs and associated LRS Event spatial locations, and other MGF basemap features are replicated to the MGDR database (**10D**) so that they are available for use by EAMS and other MDOT business applications. This ends the road network update component of this process. A check is made (**11C**) to see if a new MGF Version should be published at this time.
10D	MDOT Geospatial Data Repository	The MGDR contains EAMS road network geometry / attributes, business LRMs and associated LRS Event spatial feature locations, and other MGF basemap features. It also contains other MDOT enterprise spatial data required to support business applications.
10F	Lock Down Edit Environment	If a new MGF Version is to be published at this time, the Edit environment is locked down to prevent further updating.
11C	Publish MGF Version?	If a new MGF Version should be published at this time, the Publish component of this process is initiated (step **10F**). Otherwise, the process is terminated (step **13E**).
11F	Publish MGF Version x	This process step publishes a new MGF Version. A Version x spatial database (**12F**) and associated migration files (**13F**) are generated. **Notes:** **1. It is expected that custom processing required prior to publishing the Version x files should be minimal as no LRS database reconciliations are needed.** **2. The specific details concerning tasks required will need to be determined as part of the planning / requirements definition for this future EAMS state.**
12F	MGF Version x	The MGF Version x database contains updated spatial basemap features. It is currently produced annually, but could be produced more frequently if needed to support non-MDOT client business requirements.
13E	Done	The Update & Publish Road Network process is completed.
13F	MGF Version x Migration Files	The migration files include the following: • MGF Statewide Files • Old and new MALI files • Working Transactions • Migration Table • Metadata and MGF appendices **Note: it is assumed that the following files will no longer be required, as MDOT applications including Sufficiency that use CS-MP LRM location referencing will be registered with EAMS and have their LRS Event locations updated as changes occur:** • PR/CS Equivalency Table • Sufficiency Working and Report Files with full PR and CS Referencing

Future Vision - To Be Determined

Change Log:

Version	Authors	Description	Date
1	Dave Loukes (OPUS)	First Draft for submission to MDOT – process map only	25-Sep-2013
2	Dave Loukes (OPUS)	Final draft process map and description for submission to MDOT	26-Nov-2013

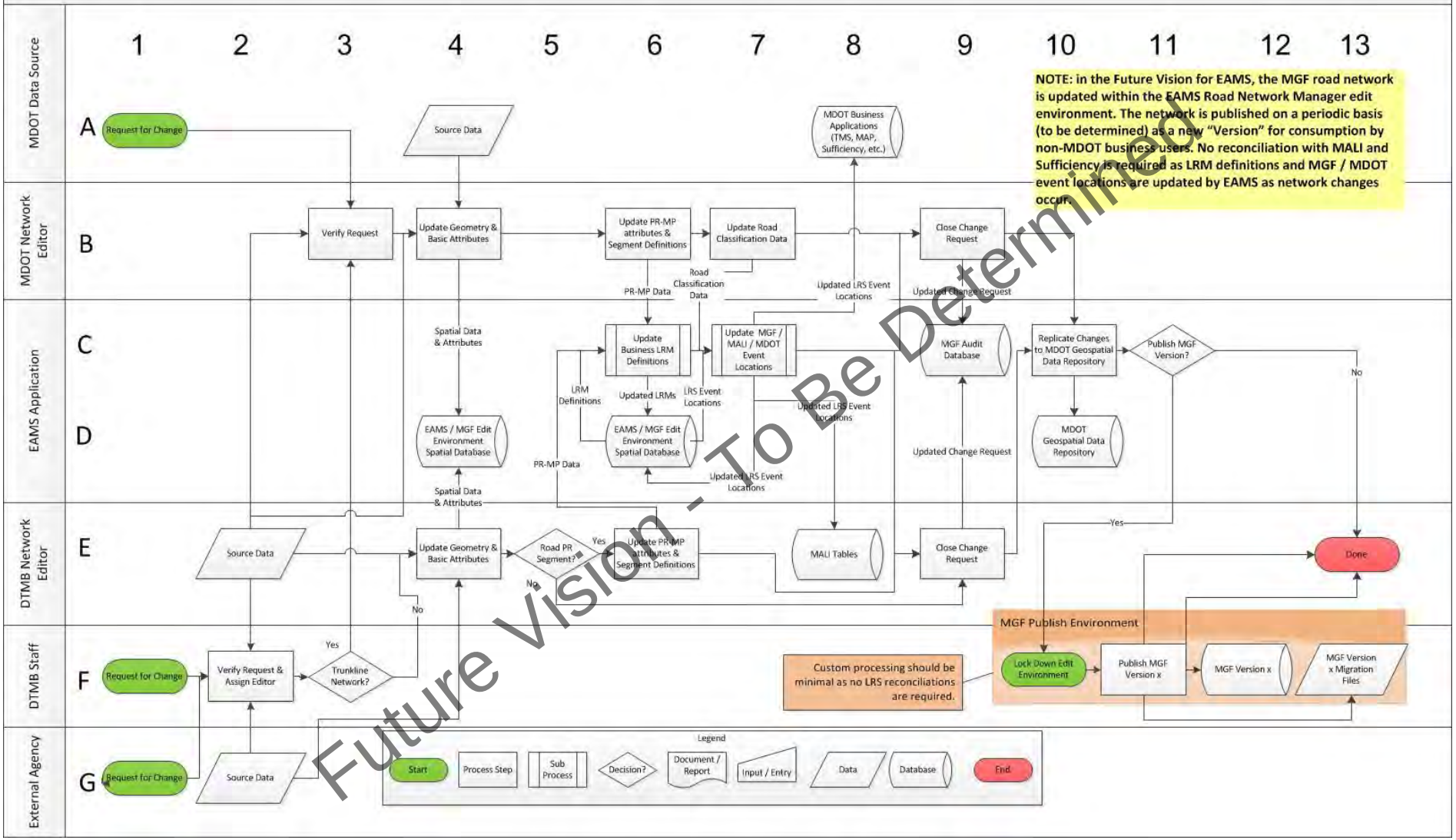
Attached:

1. MDOT EAMS "To-Be" Location Referencing Management: Update & Publish Road Network – Future Vision (Version 2) dated 26-Nov-2013.

Future Vision - To Be Determined

MDOT EAMS "To-Be" Location Referencing Management: Update & Publish Road Network – Future Vision (Version 2)

26-Nov-2013



Future Vision - To Be Determined

MDOT EAMS
Business Process Description

Process Stage:	To-Be
Process Name:	Locate Business Data for Asset Management – Future Vision
Parent Business Process / Facet:	Location Referencing Management
Process Owner:	MDOT
Primary Deliverables / Products:	EAMS asset locations Enhanced Geospatial Data Repository (MGDR)
Primary Client:	MDOT
Process Cycle and Duration:	Project based, for Design and Construction projects Work Order based, for Maintenance activities

Future Vision - To Be Determined

Description:

In the Future Vision for the EAMS Locate Business Data for Asset Management business process, selected Design and Construction spatial data is stored within the MDOT Geospatial Data Repository (MGDR) as additional feature layers. When a Survey Request is issued, spatial data is checked out from the MGDR for the project area and downloaded onto mobile devices for use by field crews. **Note: these are the only changes from the EAMS Phase business process.**

This business process is used to capture the location of MDOT road network assets from existing MDOT business activities. There are two main business process streams involved:

1. Design and Construction Projects.
2. Maintenance Activities.

The key underlying assumptions are that:

1. Asset locations will be initially captured in a format that is compliant with MDOT field survey standards.
2. CAD data layering standards and attribute coding conventions have been established that will enable the transfer of assets into the EAMS GIS environment.
3. Asset locations (and attributes) will be captured as a by-product of existing business processes – asset specific inventory surveys will no longer be required.

Design and Construction Projects

Asset locations are captured from field surveys and stored within Design and Construction Engineering Data files in a format suitable for use with MDOT roadway design software. Prior to the commencement of the field survey, existing data for the project area is extracted from the MGDR for use by the field crew.

This process is triggered by a request for a field survey. These surveys are carried out as required to support MDOT Design and Construction projects. The transfer of new asset locations and supporting attributes to EAMS from As-Built Data files is enabled by MDOT standards for location referencing and CAD layer coding.

Maintenance Activities

Asset locations are captured as a by-product of routine maintenance activities using mobile technologies.

This process is triggered by a maintenance work order issued by MDOT or Local Agency staff.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Field Survey Staff	Collect asset inventory in the field upon request to support Design and Construction projects using MDOT approved survey methods; create initial CAD files.
MDOT	Design Staff	Create new assets using MDOT design software; create additional Design CAD files and drawings to support Construction activities.
MDOT	Construction Staff	Conduct field inspections; update Design CAD files to create electronic CAD As-Built drawing files; liaise with EAMS support staff to support transfer of asset locations from CAD to GIS.
MDOT	EAMS Team	Facilitate transfer of asset locations from CAD to EAMS; facilitate transfer of asset locations from maintenance files to EAMS.
MDOT/DTMB	Application Support	Host / support the EAMS application environment.
MDOT	Maintenance Staff	Issue work orders; complete maintenance activities; verify local agency maintenance work.
Local Agency	Maintenance Staff	Issue work orders; complete maintenance activities.

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1C	Field Survey Request	A request for a field survey is issued by MDOT Design project staff.
1L	Work Order	A Maintenance Work Order is issued by MDOT Maintenance staff.
1N	Work Order	A Maintenance Work Order is issued by a Local Agency.
2A	Check Out Project Spatial Data	As an initial step, the MDOT Field Survey crew extracts spatial data for the project area (**2B**) from the MGDR (**12I**).
2B	Project Spatial Data	Project data extracted from the MGDR may include As-Built data layers such as Alignment, Drainage, Assets, DTM, 3D Models and other information.

Future Vision - To Be Determined

Index	Process Step	Description
2I	EAMS Database (Assets, Plans, Accomplishments, etc)	The EAMS database contains LRS Event tables containing locations of assets, work plans, accomplishments and other information required in support of MDOT maintenance and asset management activities.
2L	Complete Maintenance Activity	A maintenance activity is completed by MDOT Maintenance staff in fulfillment of a Work Order (**1L**). The location(s) of any affected assets are captured as a by-product of this activity (**2M**) in addition to accomplishment data.
2M	Affected Asset Locations	The location(s) of any affected assets are captured as a by-product of the MDOT maintenance activity (**2L**). Locations are captured as coordinates to MDOT standards using GPS embedded within mobile technologies.
2N	Complete Maintenance Activity	A maintenance activity is completed by Local Agency staff in fulfillment of a Work Order (**1N**)
3A	Capture Assets (GPS, LiDAR, Total Station)	Assets are captured by MDOT field survey staff using approved survey procedures and equipment (GPS, LiDAR, total stations) and stored in Survey Files (**3B**).
3B	Survey Files	MDOT Survey Files contain asset coordinate locations and attributes in a format suitable for the creation of CAD Files (process step **4A**) and initial Engineering Data files (process step **5A**).
3I	MDOT Geospatial Data Repository	The MDOT Geospatial Data Repository (MGDR) contains spatial data used by EAMS and other MDOT business applications. These data include the MGF road centerline network, Linear Referencing Method (LRM) definitions and associated LRS Event locations, and other MGF basemap layers.
4A	Create CAD Files	Initial Engineering Data files (**5D**) are created using MDOT CAD software by field survey staff. These are used to create new assets (process step **5C**).
4B	CAD Files (2D, 3D, Alignment, DTM)	The initial CAD files include: two-dimensional (2D), three-dimensional (3D), Alignment and Digital Terrain Model (DTM).
4L	Verified Asset Locations	Verified asset locations resulting from a Local Agency Maintenance activity (**2N**) are stored for subsequent processing.
4M	Verify Work	MDOT maintenance staff verify the work completed under a Local Agency Work Order. As part of this process step, associated asset locations are verified.
4N	Affected Asset Locations	The location(s) of any affected assets are captured as a by-product of the Local Agency maintenance activity (**2N**). **Note:** at this point, the assumption is made that at least some Local Agencies will capture locations as coordinates to MDOT standards using GPS embedded within compatible mobile technologies.

Future Vision - To Be Determined

Index	Process Step	Description
5C	Create New Assets (CAD)	New assets are created by MDOT Design staff using CAD design software. These assets are added to project Engineering Data files (**5D**).
5D	Engineering Data (Alignment, Construction, Drainage, DTM, 3D Model,, etc.)	Project Engineering Data files include: Alignment, Construction, Drainage and other CAD layers. These are used as input to the Construction Inspection process step (**5F**).
5K	Process Asset Location Records	The MDOT EAMS Team receives Affected Asset Locations (**4N**) and Verified Asset Locations (**4L**) from MDOT Maintenance and processes them. Each location record is then subjected to a series of logic checks commencing with step **6K**.
5M	MDOT Geospatial Data Repository	The MGDR is used to assist in the maintenance work verification process step (**4M**).
6E	Construction Inspection	MDOT Construction staff conduct field inspections and create a Construction Inspection Survey File (**6F**). **Note: as part of this process step, checks will need to be made to determine whether any existing assets have been removed / abandoned or replaced.**
6F	Construction Inspection Survey File	The Construction Inspection Survey File records the As-Built location of the roadway and its associated assets. It is used as input to the Update Assets process step (**7E**).
6J	Retire Asset Location	If the location relates to an asset that has been removed or abandoned, then the asset location is retired (end dated) in the MGDF (**7I**).
6K	Removed / Abandoned Asset?	If the asset has been removed or retired, then the location is removed (step **6J**). Otherwise, the next logic check is carried out (**7K**).
7E	Update Assets	Assets and their locations are updated using data from the Construction Inspection Survey File (**6F**) and stored within the As-Built Project Data files (**7F**).
7F	As-Built Project Data (Alignment, Drainage, Asset Layers, DTM, 3D Model, etc.)	The As-Built Project Data files contain the final locations of assets resulting from the Construction project.
7I	MDOT Geospatial Data Repository	New and modified asset locations are stored within the MGDR. Assets that have been retired or abandoned have their locations retired (end dated).
7J	Retire Asset Location	If the location relates to an asset that has been replaced, then the location of the replaced asset is retired (end dated) in the MGDF (**7I**). A new asset location is then created (process step **8J**).
7K	Replaced Asset?	If the asset has been replaced, then the old location is retired (step **7J**). Otherwise, the next logic check is carried out (**8K**).

Future Vision - TO Be Determined

Index	Process Step	Description
8E	File Project Data	Related project data is filed in an MDOT projects database as part of closing out the project. A notification (**8F**) is sent to the EAMS Team. **In the Future Vision business process, selected spatial data layers (to be determined) are stored within the MGDR for subsequent use by MDOT staff.**
8F	Notify EAMS Team	The EAMS Team is notified via email that a new Construction As-Built Project Data file (**7F**) has been created.
8G	Import As-Built Asset Locations	The EAMS Team accesses the As-Built Project Data files (**6F**) and extracts the asset records for the recently completed project. This data is processed (step **9G**) to capture new and revised asset locations.
8J	Create New PR-MP Asset Event feature	A new asset PR-MP event feature is created and saved within the MGDR (**7I**).
8K	New Asset?	If the asset is new or has been replaced, the location is used to create a new event feature (step **8J**). Otherwise, a check is made to see if the locational accuracy of an existing asset has been improved (process step **9K**).
9E	MDOT Geospatial Data Repository	The MGDF contains As-Built data for Construction projects.
9G	Process Asset Records	Individual asset location records are examined within each asset layer to determine whether a new asset (process step **10G**) or an improved asset location (process step **10H**) has been captured.
9K	Improved Location Accuracy?	If the asset location has been improved, it is stored in the MGDR (**7I**) along with updated metadata. Otherwise, a check is made to see if there are additional records (step **11J**).
10G	New Asset?	If the As-Built location is for a new asset, a new event feature is created ((process step **11G**). Otherwise, a check is made to see whether the accuracy of an existing asset location has been improved (process step **10H**).
10H	Improved Location Accuracy?	If the accuracy of an existing asset location has been improved, the asset location and associated metadata is saved within the MGDR (step **12H**). Otherwise, the next asset record is processed (step **9G**).
10K	Update Asset Location & Metadata	The updated asset location and metadata are saved to the MGDR (**7I**).
11G	Create New PR-MP Asset Event feature	A new As-Built asset PR-MP LRS Event feature is created and saved within the MGDR (**12I**). A check for more records is then made (step **12G**).
11J	More Records?	If more maintenance asset records exist, the next record is processed (step **5K**). Otherwise, the maintenance asset location stream is completed (step **12J**).

Future Vision - To Be Determined

Index	Process Step	Description
12G	More Records?	If additional As-Built asset records exist, the next asset record is processed (step **9G**). Otherwise, the Design and Construction stream is completed (step **13G**).
12H	Update Asset Location & Metadata	If the location of an existing asset has been improved, the new location and its associated metadata is used to update the MGDR (**12I**).
12I	MDOT Geospatial Data Repository	The MGDR contains EAMS asset LRS Event locations captured through field survey and maintenance processes. In the Future Vision business process, it also contains selected As-Built feature layers (to be determined).
12J	Done	Storing of the asset location along with any associated attributes ends the Maintenance stream of the business process.
13G	Done	Storing of the asset location along with any associated attributes ends the Design and Construction stream of the business process.

Change Log:

Version	Authors	Description	Date
1	n/a	Not issued	n/a
2	Dave Loukes (OPUS)	Draft for submission to MDOT – process map and description. **Note: Version 2 used to keep in synch with other BP diagrams and descriptions.**	26-Nov-2013

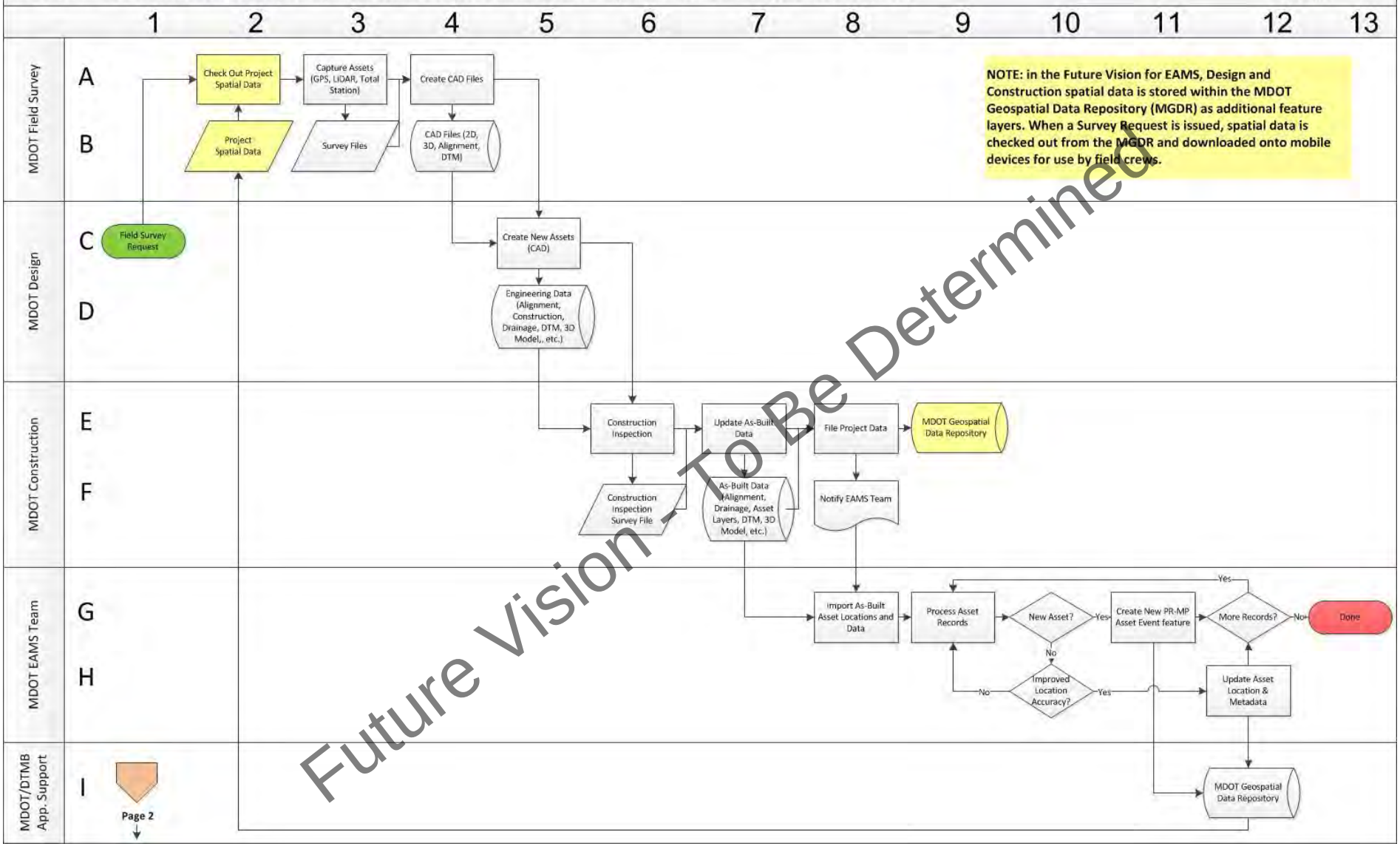
Attached:

1. EAMS To-Be Business Process Map: Locate Business Data for Asset Management – Future Vision (Version 2) dated 21-Nov-2013.

Future Vision - To Be Determined

MDOT EAMS "To-Be" Location Referencing Management: Locate Business Data for Asset Management – Future Vision (Version 2) – Page 1 / 2

21-Nov-2013

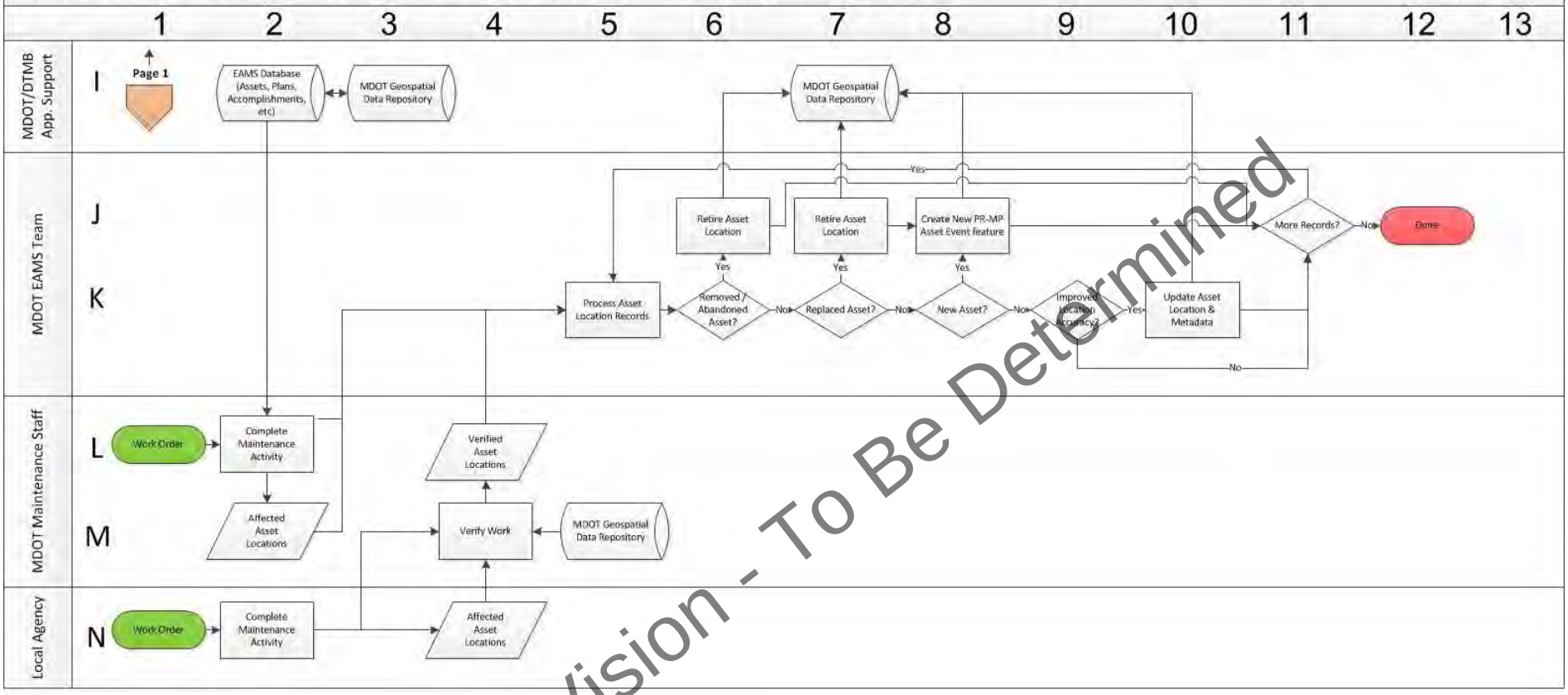


NOTE: in the Future Vision for EAMS, Design and Construction spatial data is stored within the MDOT Geospatial Data Repository (MGDR) as additional feature layers. When a Survey Request is issued, spatial data is checked out from the MGDR and downloaded onto mobile devices for use by field crews.

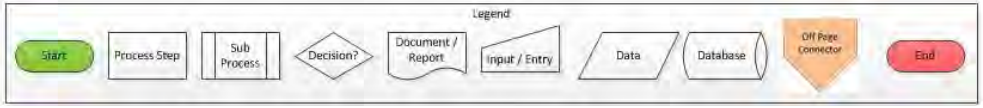
Future Vision - To Be Determined

MDOT EAMS "To-Be" Location Referencing Management: Locate Business Data for Asset Management – Future Vision (Version 2) – Page 2 / 2

21-Nov-2013



Future Vision - To Be Determined



2. Maintenance

2.1 As – Is Maintenance Processes

The business processes involved with managing maintenance are the main focus for the EAMS. The following processes have been documented to further describe the requirements:

MDOT Direct Forces

- Maintenance Program Budget Planning
- Routine Highway Maintenance by MDOT Direct Forces
- Routine Bridge Maintenance by MDOT Direct Forces
- Maintenance Reporting by MDOT Direct Forces

Local Agencies

- Routing Highway Maintenance by Local Agencies
- Maintenance Reporting by Local Agencies

MDOT
Business Process

Process Stage: As-Is

Process Name: Maintenance Program Budget Planning

Parent Business Process / Facet: Highway Maintenance

Process Owner: Region

Primary Deliverables / Products: Allocated Budget

Primary Client: Region and Central Office

Process Cycle and Duration: Annual

Description:

Budget Planning for highway maintenance is carried out on an annual basis and involves all levels of management within MDOT as well as Office of Administration, Statewide Services.

Participants:

Department / Agency	Actors	Description of Role
Office of Administration, Statewide Services		Budget Monitoring
MDOT	Highway Operations, Statewide Maintenance Budget Team	Budget Allocation to the Regions
	Regions	
	Transportation Service Centers	
	Garage Supervisor	Day to Day Management of MDOT Maintenance Garage

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1A	Receives Overall Budget Appropriation	The Office of Administration, Statewide Services receives the overall budget appropriation for statewide highway maintenance.
1B	Calculates Contingency	The Statewide Budget Team calculates the contingency to be held back for the state. A. Additional winter maintenance contingency is assigned to the budget by the regions on the basis

Index	Process Step	Description
		of 30% of the previous 5 year winter average maintenance costs. for the entire state. Regions and OAS have varying amounts of winter contingency to fulfill the 30% statewide winter contingency.
1C,E, F	Heavy/Other Maintenance Needs	The Region, TSC and Garage Supervisor compile a list of their heavy maintenance and other needs to be considered later in the processes.
2B	Allocate the Budget to OAS OFS and 7 Regions	The Statewide Budget Team allocates the budget to OAS OFS and 7 Regions.
2C	Build Responsibility Budget	The Region builds the Responsibility Budget by organization codes and expenditure type
3C	Responsibility Budget	The responsibility budget
4A	Budget	Budget data is available for loading into WebFancy
4D	Receive Budget Allocation	The Transportation Service Center receives their budget allocation.
5A	Load Budget into WebFANCY	The budget data is loaded into WebFancy.
5D	LAPS Budgets	Budgets are created for local agencies.
6A	Budget Monitoring	The OAS occasionally monitors the budget.
6C	Budget Monitoring	The Region monitors the budget on a regular basis.
6D	Customizes Maintenance Plan at Activity Level	The TSC customizes the maintenance plan at the activity level for TSC / Garages and contract agencies.
6E	Budget Monitoring	The TSC monitors the budget on a regular basis
7A	Winter Maintenance Contingency	In the spring, based on the severity of the winter season, the winter maintenance contingency is redistributed to the Regions,

Index	Process Step	Description
		OAS and OFS based on winter overruns, critical maintenance projects and other statewide needs.
7D	Adjustments Made based on Winter Season, other Needs	Adjustments are made to the maintenance plan as necessary.
8B	Allocate Revised Budget	Highway Operations Statewide Maintenance Budget Team allocate the “revised” budget to central office and 7 regions.
9C	Revised Budget Allocated to Region and Central Office	Budget revised and allocated.

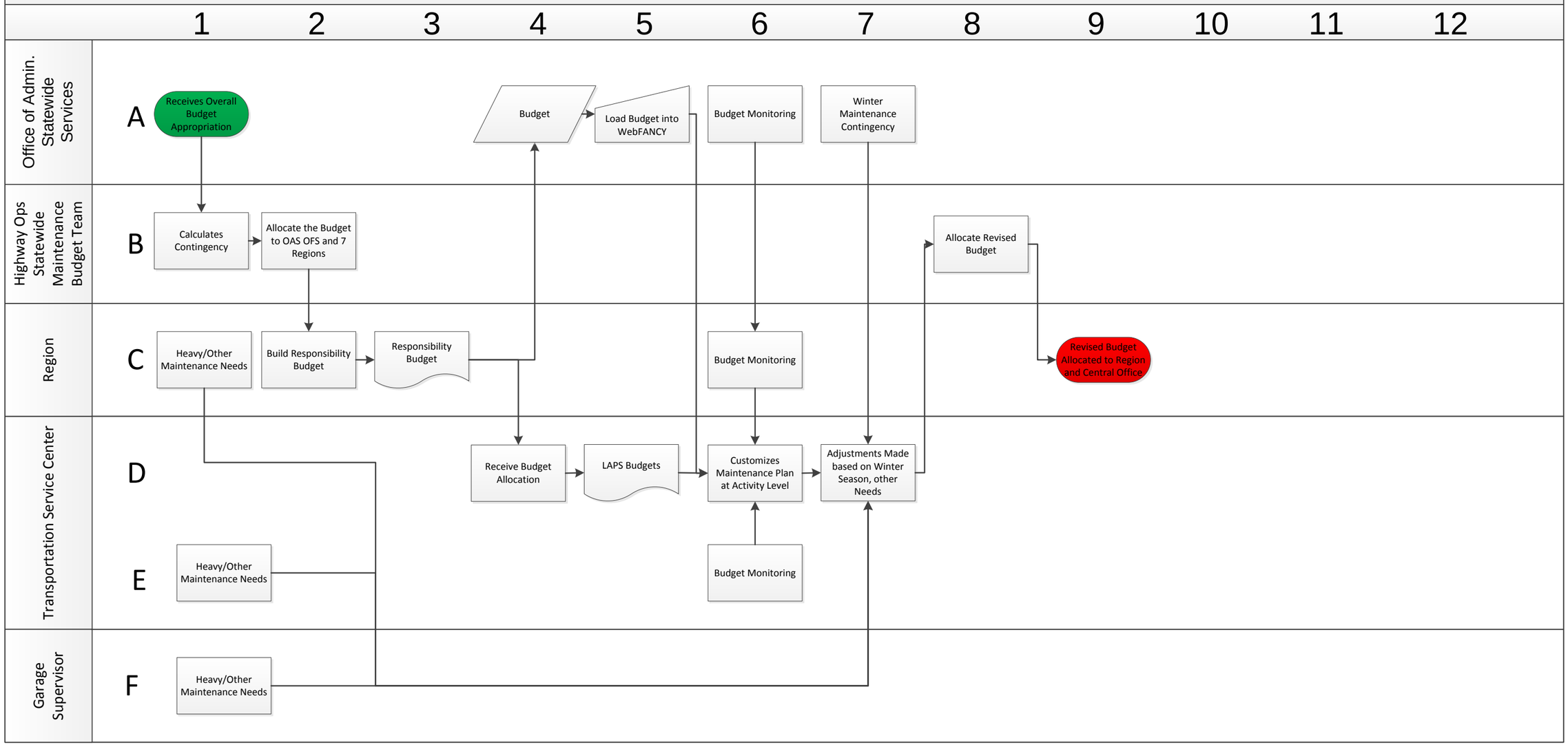
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	06-Sep-2013

Attached:

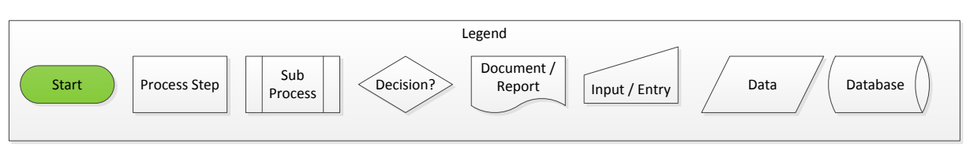
MDOT: Maintenance Program Budget Planning (Version 3)

14-Aug-2013



Forms and Reports

Responsibility Budget



MDOT
Business Process

Process Stage: As-Is

Process Name: Routine Highway Maintenance by MDOT

Parent Business Process / Facet: Highway Maintenance

Process Owner: Garage Supervisor

Primary Deliverables / Products: Completed Highway Maintenance

Primary Client: Region / Public

Process Cycle and Duration: Daily or Weekly

Description:

MDOT has it's own crews to perform highway maintenance. The Garage Supervisor performs road inspections weekly or daily depending on the need and type of road. The inspections are then used to plan and carry out work either by the crew itself or by region or statewide forces depending on whether it is capital, maintenance or electrical work. The TSC may engage a contractor for capital preventative maintenance.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Garage Supervisor	Inspects highways, plans and carries out work
	Region	Capital work
	Region or Statewide crew	Performs Electrical work
	Transportation Service Center	Planning
Public		Registers Complaints, Inquiries or Requests

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1B	Daily or Weekly Roadway Inspection	The Garage Supervisor carries out daily and weekly highway inspections.
1F	Complaint, Inquiry or Request	The public may register a complaint, inquiry or request. This may trigger a roadway inspection.

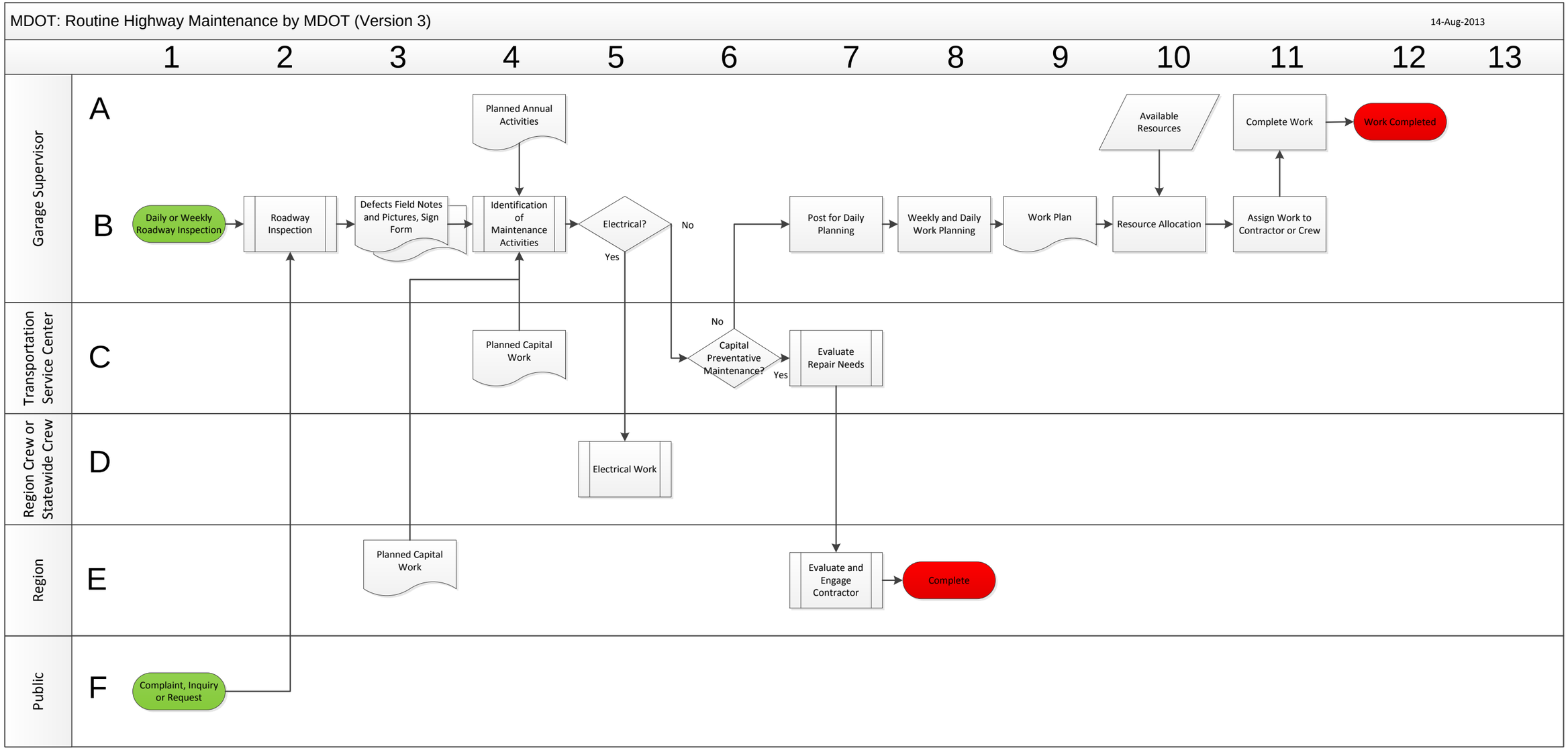
Index	Process Step	Description
2B	Roadway Inspection	Roadway inspections is done on a regular daily and weekly cycle.
3B	Defects Field Notes and Pictures, Sign Form	Defects, field notes and pictures as well as a sign form are all collected in the inspection.
3E	Planned Capital Work	Capital Work that has been planned by the Region is also considered in the identification of activities.
4A	Planned Annual Activities	Annual Maintenance activities are included in the identification of maintenance activities.
4B	Identification of Maintenance Activities	Maintenance needs identified by road inspection, annual planned activities, and capital work identified either by the region or the TSC is considered in the identification of activities by the Garage Supervisor.
4C	Planned Capital Work	The TSC has capital work planned that has to be considered in the identification of maintenance activities.
5B	Electrical?	Highway needs are assessed by the local agency contract supervisor to see if there are any electrical requirements. If so those are sent to the Region or Statewide electrical crew.
5D	Electrical Work	Electrical work is performed by the Region Crew or the Statewide Crew.
6C	Capital Preventative Maint?	The Transportation Service Center evaluates the needs resulting from the inspections. Any Capital preventative maintenance is handled by the TSC, otherwise the local agency handles the repairs.
7B	Post for Daily Planning	Repairs are posted for daily planning.
7C	Evaluate Repair Needs	The capital preventative maintenance repair needs are evaluated by the TSC.
7E	Evaluate and Engage Contractor	The capital preventative maintenance repair needs are evaluated by the Region and a contractor is engaged to complete the work.
8B	Weekly and Daily Work Planning	Work is planned on a weekly basis and modified daily.

Index	Process Step	Description
8E	Complete	Preventative Maintenance is complete.
9B	Work Plan	Weekly Work plan.
10A	Available Resources	Resources which are available to the garage supervisor such as fleet, equipment, materials and labor.
10B	Resource Allocation	The Garage supervisor matches the work plan with the resources that are available to complete the work.
11A	Complete Work	The work is completed according to plan.
11B	Assign Work to Contractor or Crew	Work is assigned to the contractor or crew.
12A	Work Completed	The Highway Maintenance work is completed.

Change Log:

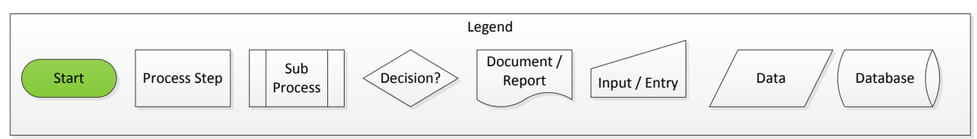
Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	10-Sep-2013

Attached:



Forms and Reports

Sign Maintenance Form



MDOT
Business Process

Process Stage: As-Is

Process Name: Routine Bridge Maintenance

Parent Business Process / Facet: Highway Maintenance

Process Owner: Garage Supervisor

Primary Deliverables / Products: Completed Maintenance activities

Primary Client: Public

Process Cycle and Duration: Annual

Description:

MDOT has an annual inspection program that feeds the development of planned maintenance and capital planning activities on bridges. Repairs, maintenance are carried out by the garage staff while capital work is done through the region under contract.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Regional Bridge Inspectors	Perform Annual Inspections on Bridges
	Regoinal Bridge Engineer	
	Region Crew or Statewide Crew	
	Transportation Service Center	
	Bridge Supervisor	
Public		

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1A	Bi-Annual Inspection Cycle	Bridges are inspected by trained bridge inspectors on a bi-annual cycle.
1G	Complaint, Inquiry or Request	Complaints, inquires and requests are submitted by the public about deficiencies or safety concerns with regards to bridges.

Index	Process Step	Description
2A	Bridge Inspections	Bridges are inspected using the National Bridge Inspection standard.
3A	Bridge Inspection Form & Photos	Bridge inspections are recorded on a form for loading into MBIS. Photos are kept regionally in individual photo logs.
3D	Planned Annual Activities	The garage plans annual maintenance activities based on knowledge and experience.
3E	Defects Field Notes and Pictures, Sign Form	Information from the bridge inspection is made available to the Garage Supervisor, including defects, field notes pictures and signing form.
4A	Input into MBIS	Bridge inspection data is entered into MBIS (Pontis) from the form. This may be live loaded in some cases.
4B	Plan Capital Work	The Regional bridge engineer uses MBIS to create a capital program.
4E	Identification of Maintenance Activities	The Garage Supervisor puts together the information from the inspections, and the planned activities to identify a program of activities for the year.
5A	Bridge Inventory and Condition	Bridge inventory and condition data is used through MBIS for capital planning activities.
5E	Electrical?	Activities that are electrical in nature are identified and separated from the program and are not under the contract of the local agency given to a regional or statewide crew with that capability.
6B	Capital Preventative Maintenance?	The Bridge Engineer then examines the activity program to identify any preventative maintenance on bridges and separates it from the program.
7B	Evaluate and Engage Contractor	The Regional Bridge Engineer will evaluate preventative maintenance needs identified by the TSC and engage a contractor to complete the work.
7C	Evaluate Repair Needs	The TSC evaluates the repair needs that are considered preventative maintenance and sent to the Regional Bridge Engineer.
7E	Post for Daily Planning	Activities are posted to the Garages for weekly and daily work planning.
8B	Complete	Electrical work is completed by contractor.

Index	Process Step	Description
8E	Weekly and Daily Work Planning	The Garage Supervisor plans their work for the day and the next week, using the maintenance activities which were posted.
9E	Work Plan	The Garage Supervisors daily and weekly planning results in a work plan.
10D	Available Resources	Resources which are available to the garage supervisor such as fleet, equipment, materials and labor.
10E	Resource Allocation	The Garage supervisor matches the work plan with the resources that are available to complete the work.
11D	Complete Work	The work is completed according to plan.
11E	Assign Work to Contractor or Crew	Work is assigned to the contractor or crew.
12D	Work Completed	The Bridge Maintenance work is completed.

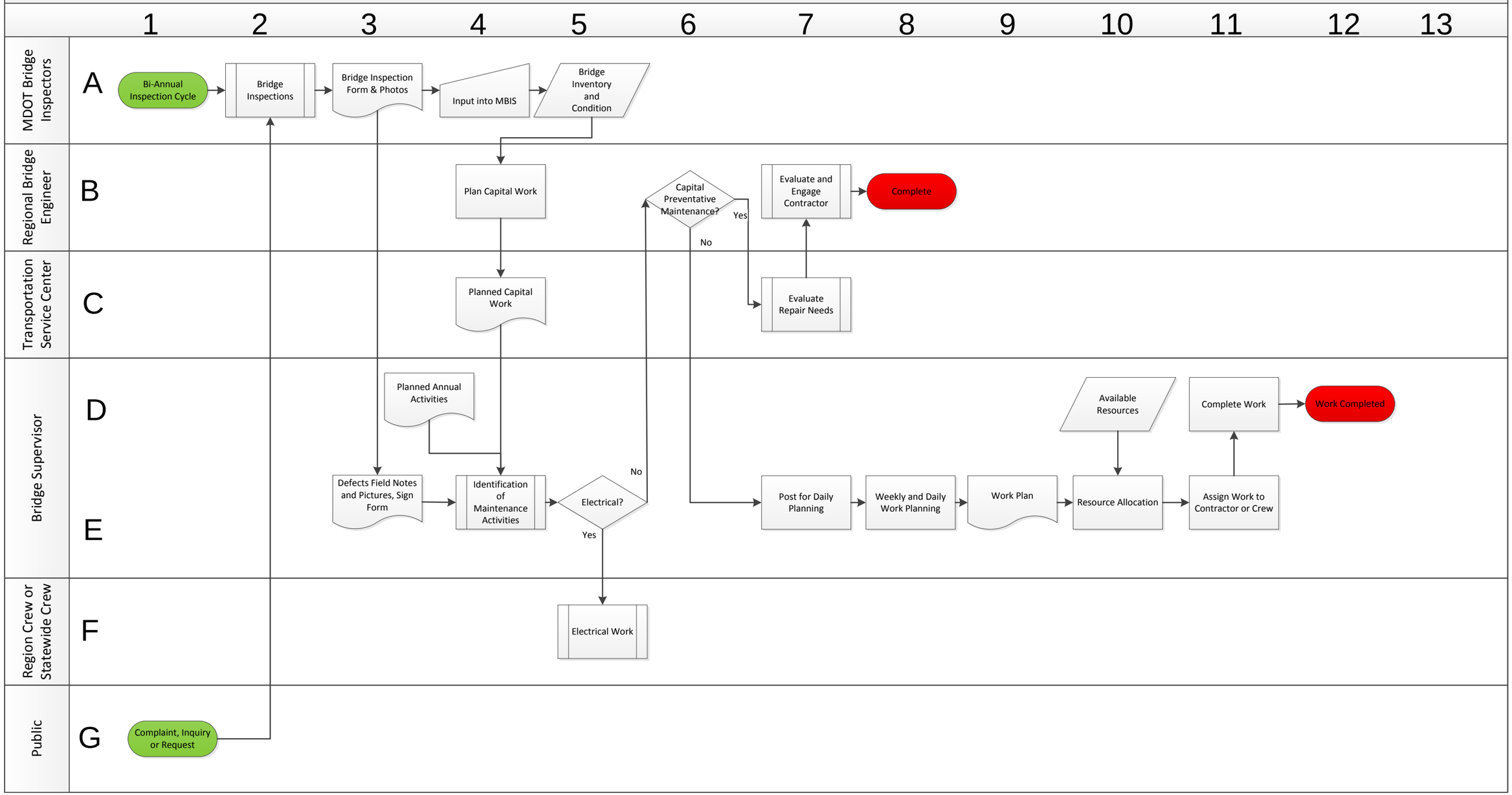
Change Log:

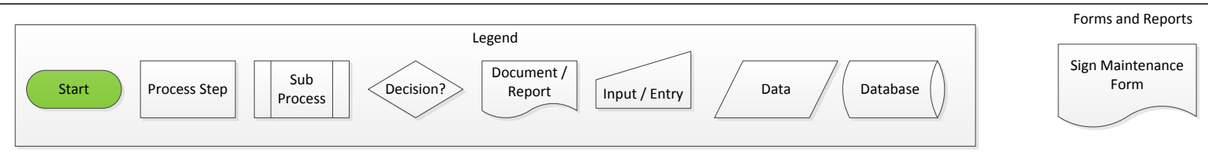
Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	09-Sep-2013
1	John MacNaughton (OPUS)	Minor edits from 06-Nov-2013 Meeting	18-Nov-2013
1	John MacNaughton	Minor edits from Greg B.	27-Nov-2013

Attached:

MDOT: Routine Bridge Maintenance by MDOT (Version 3)

27-Nov-2013





MDOT
Business Process

Process Stage: As-Is

Process Name: Maintenance Reporting by MDOT

Parent Business Process / Facet: Highway Maintenance

Process Owner: MDOT Garage Supervisor

Primary Deliverables / Products: Weekly Expenditure data

Primary Client: Finance / Office of Administrative Services

Process Cycle and Duration: Weekly

Description:

MDOT's Direct Forces perform highway maintenance work and record expenditures that must be entered into MAIN and MIDB for budget comparison and tracking of expenses.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Garage Supervisor	Is responsible for the day to day management of the Maintenance Garage
	Region	
	Transportation Service Center	
	Employee	
Office of Administrative Services		
Finance		

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1D	Daily Work Completed	Work is completed on a daily basis.
1H	Bi-Weekly Timesheet	A Bi-Weekly Timesheet is created from DCDS.

Index	Process Step	Description
2C	Records Labour, Equipment, Materials & Acc. By Route In Timesheet Or DCDS	The Garage Supervisor records Labour, Equipment, Materials and Acc. By route in timesheet or DCDS.
2H	Timekeeper Enter Labour, Equipment actuals into DCDS	The Timekeeper in the TSC enters Labour, Equipment actuals into DCDS.
3D	Send Non-Payroll, Non-Stores expenses For approval	Non-Payroll / Non-Stores expenses are sent for approval. These may be hired equipment or purchased materials.
4D	Materials From Stores Entered into MaintStar (Stores)	Materials that have been issued from stores are entered into MaintStar (stores system).
4E	Approve?	The Garage Supervisor has to approve the non-payroll items.
4F	Approve?	The Garage Supervisor has to approve labour and equipment in DCDS.
4H	DCDS	DCDS is the interface for MIDB to enter labor and equipment expenses for highway maintenance.
5D	MaintStar	MaintStar is the Fleet Management Program that MDOT uses to track the inventory and services of all MDOT owned vehicles and equipment. MaintStar is also used to create work orders for needed equipment services and repairs and calculates our cost of maintaining our equipment fleet.
5E	Certified Non-Payroll expenditures (Materials)	After non-payroll expenditures are approved they are considered “certified”. A report is created and they are keyed into MAIN.
6D	Weekly Export File	A weekly export file is created from MaintStart with all the materials from stores used in maintenance activities to import into MAIN.
6E	Enter into MAIN	Certified non-payroll expenditures are entered into MAIN.
7D	MAIN	MAIN is the interface for entering information into MIDB for Materials and non-payroll expenses.
7G	MIDB	Michigan Information Database (MIDB) is the central financial database for the state.

Index	Process Step	Description
8G	Weekly Expenditure Data	MIDB updates WebFancy on a weekly basis through a database update.
9A	Comparison to Plans	The Office of Administrative Services (OAS) will compare actuals and annual budgets.
9B	Comparison to Plans	The Region will compare actuals and annual budgets.
9G	WebFancy	WebFancy is a financial reporting system that runs on the Web. It was developed for, and is used by, employees at MDOT. WebFancy will create a wide variety of financial reports with varying levels of expenditure and budget detail.
10G	Complete	Reporting is complete.

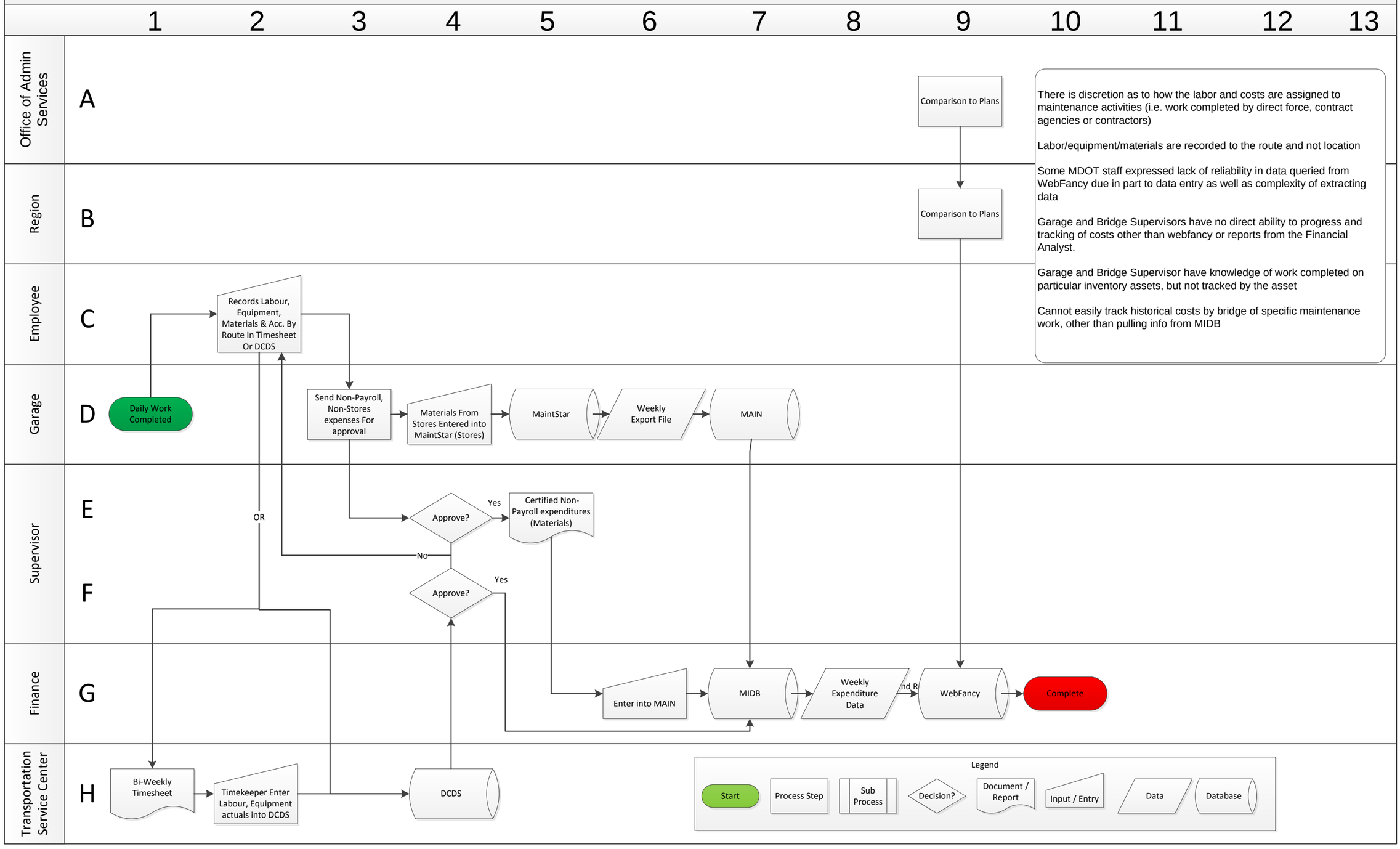
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	09-Sep-2013
2	John MacNaughton (OPUS)	Edits from 6-Nov-2013 Meeting	18-Nov-2013

Attached:

MDOT: Maintenance Reporting by MDOT (Version 3)

18-Nov-2013



MDOT
Business Process

Process Stage: As-Is

Process Name: Routine Hwy Maintenance by Local Agencies

Parent Business Process / Facet: Highway Maintenance

Process Owner: Local Agency

Primary Deliverables / Products: Completed Highway Maintenance

Primary Client: Transportation Service Center

Process Cycle and Duration: Daily / Weekly

Description:

Highway maintenance in Michigan is often carried out by local agencies such as a county or city. These agencies work as an extension to MDOTs own forces under contract.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Region	Capital work
	Region or Statewide crew	Performs Electrical work
	Transportation Service Center	Planning
Local Agency	Local Agency Contract Supervisor	
Public		Registers Complaints, Inquiries or Requests

Process Map: (See Attached)

Process Steps Descriptions:

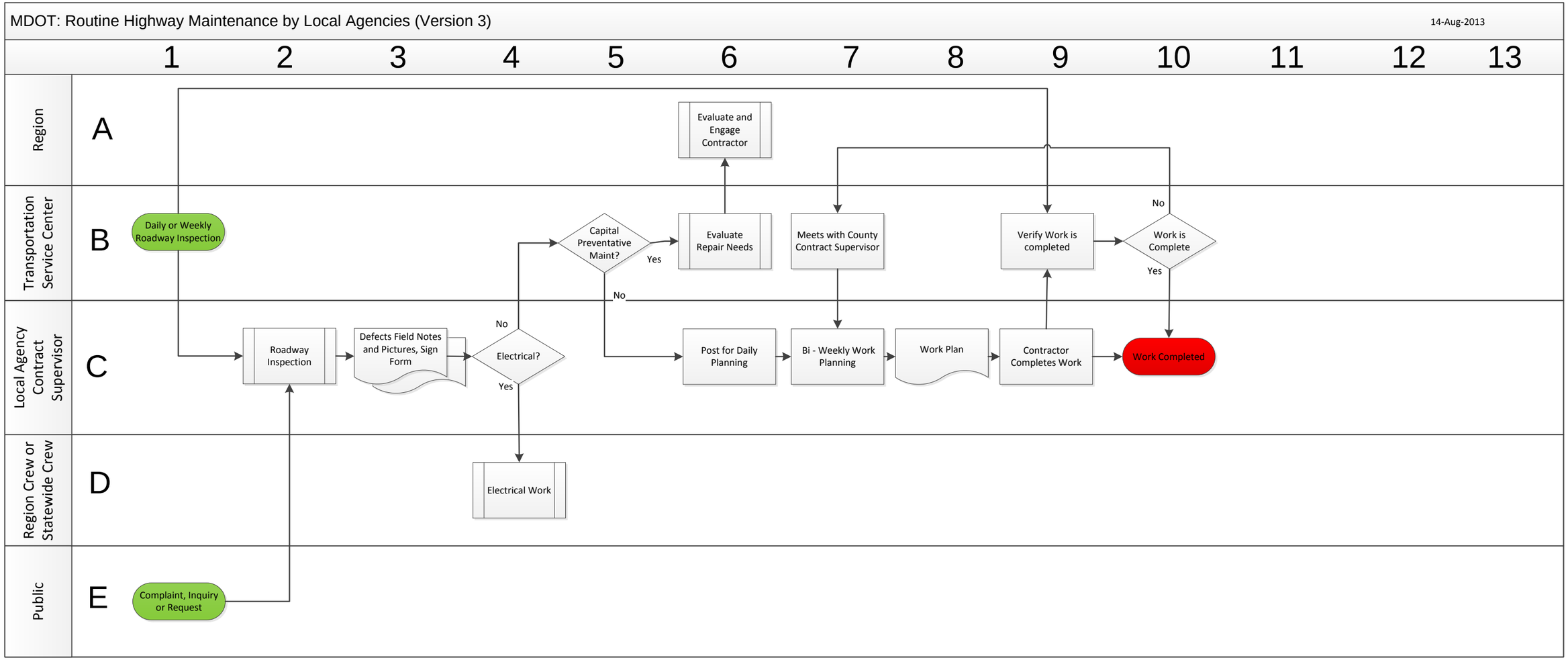
Index	Process Step	Description
1B	Daily or Weekly Roadway Inspection	The Transportation Service Center carries out daily and weekly highway Inspections.
1E	Complaint, Inquiry or Request	A complaint Inquiry or request is made by the public regarding a highway.

Index	Process Step	Description
2C	Roadway Inspection	A roadway inspection is done on a regular daily and weekly cycle.
3C	Defects Field Notes and Pictures, Sign Form	Defects, field notes and pictures as well as a sign form are all collected in the inspection.
4C	Electrical?	Highway needs are assessed by the local agency contract supervisor to see if there are any electrical requirements. If so those are sent to the Region or Statewide electrical crew.
4D	Electrical Work	Electrical work is performed by the Region Crew or the Statewide Crew.
5B	Capital Preventative Maint?	The Transportation Service Center evaluates the needs resulting from the inspections. Any Capital preventative maintenance is handled by the TSC, otherwise the local agency handles the repairs.
6A	Evaluate and Engage Contractor	The capital preventative maintenance repair needs are evaluated by the Region and a contractor is engaged to complete the work.
6B	Evaluate Repair Needs	The capital preventative maintenance repair needs are evaluated by the TSC.
6C	Post for Daily Planning	Repairs are posted for daily planning.
7B	Meets with County Contract Supervisor	The TSC meets with the County Contract Supervisor to plan work on a bi-weekly basis.
7C	Bi - Weekly Work Planning	The local agency has a bi-weekly work plan based on it's meetings with The TSC.
8C	Work Plan	The work plan is a two week plan that encompasses all the highway maintenance the supervisor will undertake.
9B	Verify Work is completed	The TSC verifies that work is completed.
9C	Contractor Completes Work	The contractor completes the work.
10C	Work Completed	Work is completed according to plan.

Change Log:

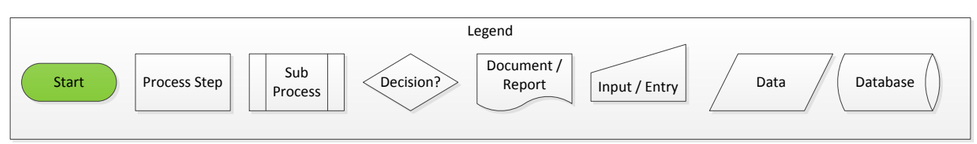
Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	09-Sep-2013

Attached:



Forms and Reports

Sign Maintenance Form



MDOT
Business Process

Process Stage: As-Is

Process Name: Maintenance Reporting by Local Agencies

Parent Business Process / Facet: Highway Maintenance Reporting

Process Owner: MDOT Maintenance Coordinator

Primary Deliverables / Products: Local agencies expenditure data

Primary Client: Office of Admin Services

Process Cycle and Duration: Weekly

Description:

MDOT often contracts maintenance work to local agencies such as a county. The activity costing must be collected for this work in terms of labor equipment and materials. The local agency provides this information and it is loaded through LAPS for inclusion into MIDB for loading into WebFancy, comparison to budgets, and generating payables to counties as well as recoverable from the Federal Government.

Participants:

Department / Agency	Actors	Description of Role
Local Agency	Accounts Receivable	
MDOT	Maintenance Coordinator – Transportation Service Center	Responsible for maintenance coordination in a geographic region
	Region	Monitor Maintenance Plans and actuals
Office of Admin Services		Monitor Maintenance Plans and actuals

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1C	Report Labour, Equipment & Materials	The Local Agency completes work and submits a weekly report with the Labour Equipment and Materials.

Index	Process Step	Description
1E	Activity Report / Invoice	An activity report is sent to the MDOT Maintenance Coordinator at the TSC.
2C	Enter Accomplishment into Activity Report	Enter accomplishment, and resource usage information into an Activity Report.
2E	Approve?	The Maintenance Coordinator reviews the activity report for approval.
3E	Key activity data into LAPS	The Maintenance Coordinator keys the information into LAPS. Most Local Agencies will include # hours Equipment and materials. Some do not, particularly when work is contracted out.
4E	LAPS	Local Agency Payments System (LAPS) Streamlines the payment process for local agency maintenance contracts. It is a cross-functional information system consisting of five modules to track and process billing information. The system is primarily responsible for collecting routine and non-routine bills submitted by local contract agencies; validating billing transactions against MDOT data; assisting in review and approval of bills; auditing bills; generating vouchers for payment; and maintaining and forecasting budgets.
5E	Approve Billing?	The Maintenance Coordinator at the TSC reviews the billing data for approval.
6E	MIDB	Michigan Information Database (MIDB) is the central financial database for the state.
7E	Weekly Expenditure Data	Data from MIDB is used to update WebFancy on a weekly basis.
8E	WebFancy	WebFancy is a financial reporting system that runs on the Web. It was developed for, and is used by, employees at MDOT. WebFancy will create a wide variety of financial reports with varying levels of expenditure and budget detail.
9A	Comparison With Monthly, Quarterly and Annual Plans	The Office of Administrative Services (OAS) will compare actuals and annual budgets. Counties are compared on a monthly basis, while cities are compared on a quarterly basis.
9B	Comparison With Monthly, Quarterly and Annual Plans	The Region will compare actuals and annual budgets. Counties are compared on a monthly basis, while cities are compared on a quarterly basis.
9E	Comparison	WebFancy can generate a comparison of actuals and budgets for monitoring.

Index	Process Step	Description
10A	Complete	The reporting cycle is complete.

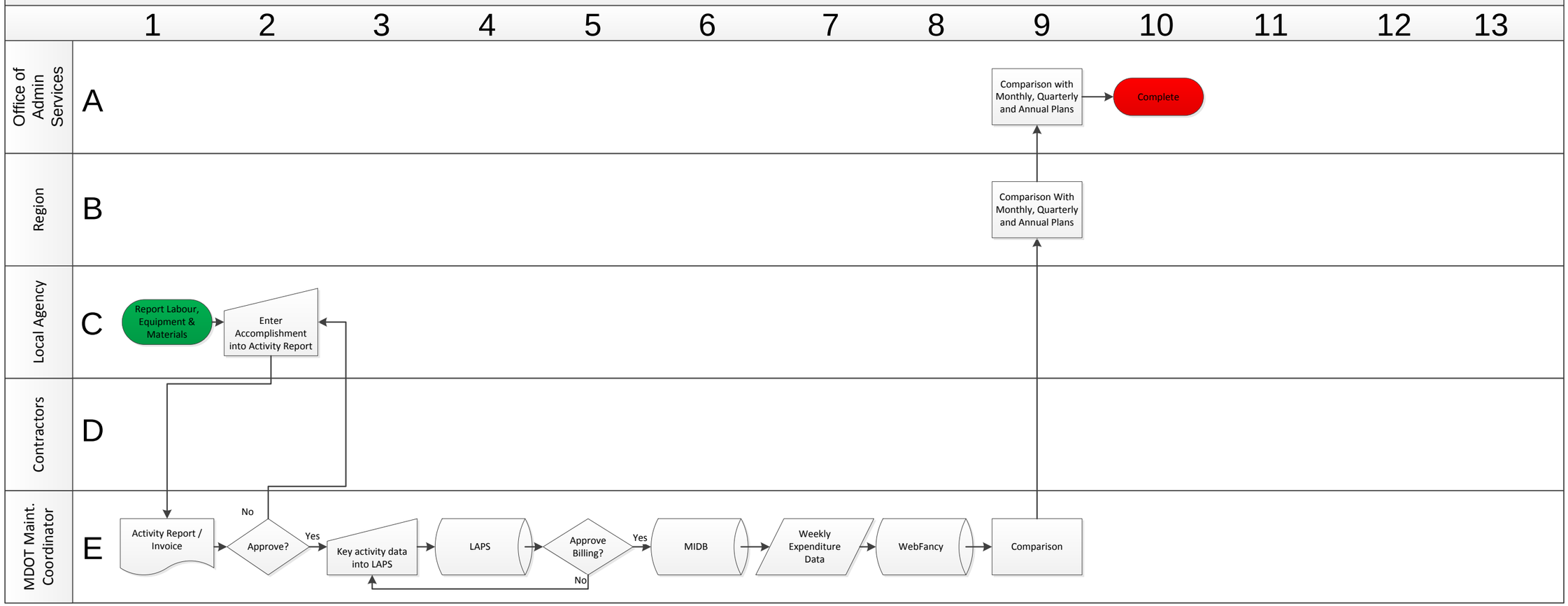
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	06-Sep-2013
1	John MacNaughton (OPUS)	Minor Edits from the 06-Nov-2013 Meeting	18-Nov-2013

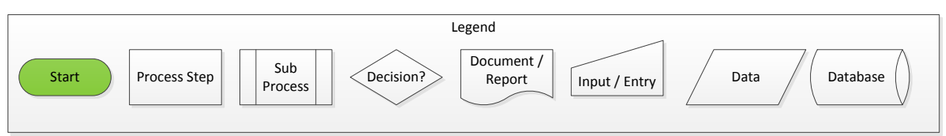
Attached:

18-Nov-2013

MDOT: Maintenance Reporting by Local Agencies (Version 3)



Forms and Reports



2.2 To-Be Maintenance Processes

The To-Be processes are how MDOT envisions the process with the addition of a new EAMS. The Same processes as in section 2.1 have been modeled and are included in this section

MDOT Direct Forces

- Maintenance Program Budget Planning
- Routine Highway Maintenance by MDOT Direct Forces
- Routine Bridge Maintenance by MDOT Direct Forces
- Maintenance Reporting by MDOT Direct Forces

Local Agencies

- Routing Highway Maintenance by Local Agencies
- Maintenance Reporting by Local Agencies

MDOT
Business Process

Process Stage: To-Be

Process Name: Maintenance Program Budget Planning

Parent Business Process / Facet: Highway Maintenance

Process Owner: Region

Primary Deliverables / Products: Allocated Budget

Primary Client: Region and Central Office

Process Cycle and Duration: Annual

Description:

Budget Planning for highway maintenance is carried out on an annual basis and involves all levels of management within MDOT as well as Office of Administration, Statewide Services.

Participants:

Department / Agency	Actors	Description of Role
Office of Administration, Statewide Services		Budget Monitoring
MDOT	Highway Operations, Statewide Maintenance Budget Team	Budget Allocation to the Regions
	Regions	
	Transportation Service Centers	
	Garage Supervisor	Day to Day Management of MDOT Maintenance Garage

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1A	Receives Overall Budget Appropriation	The Office of Administration, Statewide Services receives the overall budget appropriation for statewide highway maintenance.

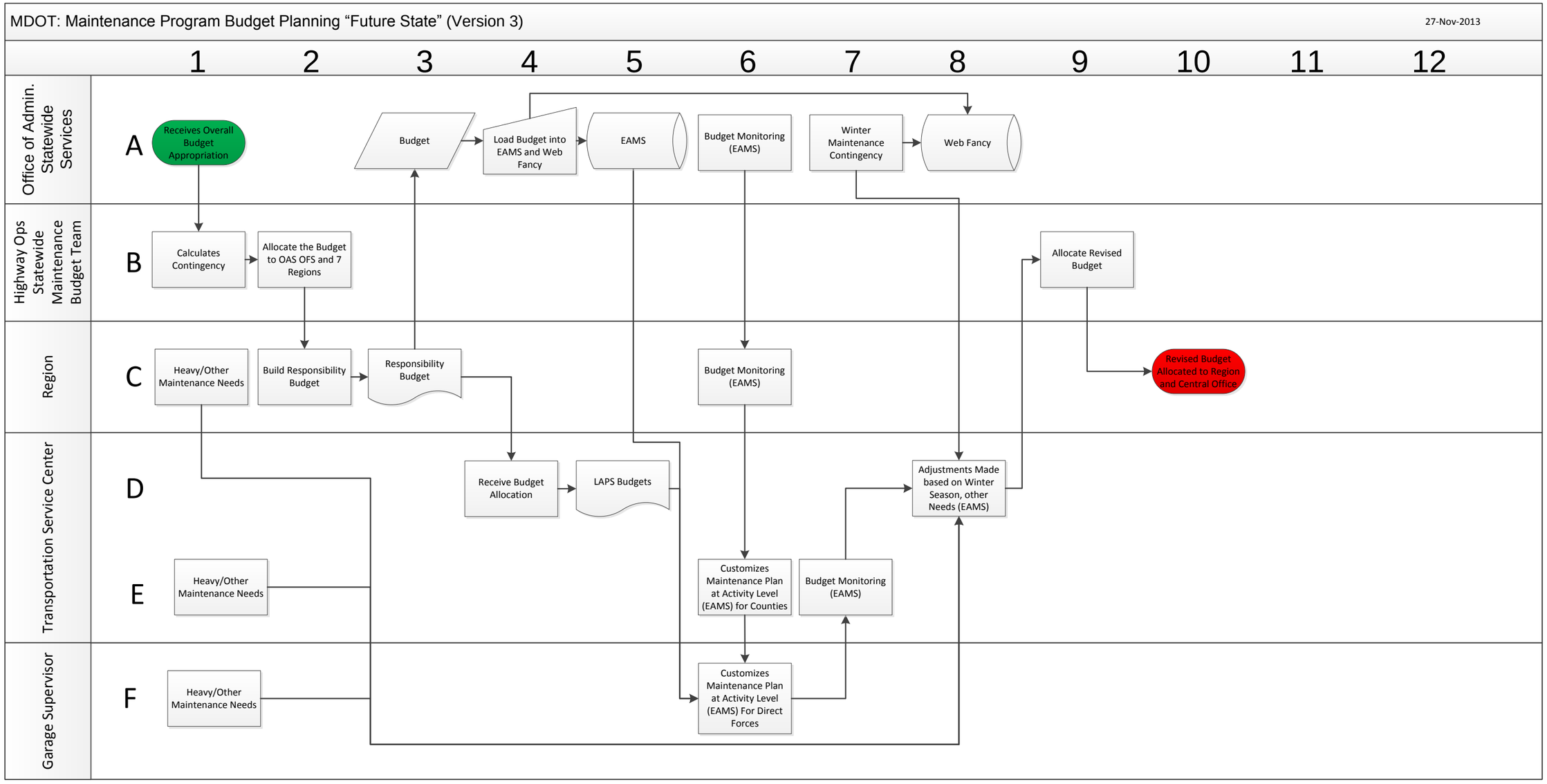
Index	Process Step	Description
1B	Calculates Contingency	The Statewide Budget Team calculates the contingency to be held back for the state. A. Additional winter maintenance contingency is assigned to the budget by the regions on the basis of 30% of the previous 5 year winter average maintenance costs. for the entire state. Regions and OAS have varying amounts of winter contingency to fulfill the 30% statewide winter contingency.
1C,E, F	Heavy/Other Maintenance Needs	The Region, TSC and Garage Supervisor compile a list of their heavy maintenance and other needs to be considered later in the processes.
2B	Allocate the Budget to OAS OFS and 7 Regions	The Statewide Budget Team allocates the budget to OAS OFS and 7 Regions.
2C	Build Responsibility Budget	The Region builds the Responsibility Budget by organization codes and expenditure type
3A	Budget	Budget data is available for loading into WebFancy
3C	Responsibility Budget	The responsibility budget
4A	Load Budget into EAMS and Web Fancy	The budget data is loaded into WebFancy.
4D	Receive Budget Allocation	The Transportation Service Center receives their budget allocation.
5A	EAMS	EAMS accepts the Budget.
5D	LAPS Budgets	Budgets are created for local agencies.
6A	Budget Monitoring (EAMS)	The OAS occasionally monitors the budget.
6C	Budget Monitoring (EAMS)	The Region monitors the budget on a regular basis.

Index	Process Step	Description
6E	Customizes Maintenance Plan at Activity Level (EAMS) for Counties	The TSC customizes the maintenance plan at the activity level for TSC / Garages and contract agencies.
6F	Customizes Maintenance Plan at Activity Level (EAMS) for Counties	The Garages and contract agencies customizes the maintenance plan at the activity level.
7A	Winter Maintenance Contingency	In the spring, based on the severity of the winter season, the winter maintenance contingency is redistributed to the Regions, OAS and OFS based on winter overruns, critical maintenance projects and other statewide needs.
7E	Budget Monitoring (EAMS)	The TSC monitors the budget on a regular basis.
8D	Adjustments Made based on Winter Season, other Needs (EAMS)	Adjustments are made to the maintenance plan as necessary.
9B	Allocate Revised Budget	Highway Operations Statewide Maintenance Budget Team allocate the “revised” budget to central office and 7 regions.
10C	Revised Budget Allocated to Region and Central Office	Budget revised and allocated.

Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	27-Nov-2013-2013

Attached:


MDOT: Maintenance Program Budget Planning "Future State" (Version 3)
27-Nov-2013
1
2
3
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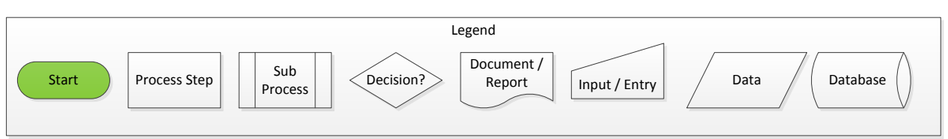
11
12
Office of Admin. Statewide Services
Highway Ops Statewide Maintenance Budget Team
Region
Transportation Service Center
Garage Supervisor
A
B
C
D
E
F
Receives Overall Budget Appropriation
Budget
Load Budget into EAMS and Web Fancy
EAMS
Budget Monitoring (EAMS)
Winter Maintenance Contingency
Web Fancy
Calculates Contingency
Allocate the Budget to OAS OFS and 7 Regions
Allocate Revised Budget
Heavy/Other Maintenance Needs
Build Responsibility Budget
Responsibility Budget
Budget Monitoring (EAMS)
Revised Budget Allocated to Region and Central Office
Receive Budget Allocation
LAPS Budgets
Adjustments Made based on Winter Season, other Needs (EAMS)
Heavy/Other Maintenance Needs
Customizes Maintenance Plan at Activity Level (EAMS) for Counties
Budget Monitoring (EAMS)
Heavy/Other Maintenance Needs
Customizes Maintenance Plan at Activity Level (EAMS) For Direct Forces


Legend
Start
Process Step
Sub Process
Decision?
Document / Report
Input / Entry
Data
Database

Forms and Reports
Responsibility Budget
LAPS Budgets

MDOT
Business Process

Process Stage: To-Be

Process Name: Routine Highway Maintenance by MDOT

Parent Business Process / Facet: Highway Maintenance

Process Owner: Garage Supervisor

Primary Deliverables / Products: Completed Highway Maintenance

Primary Client: Region / Public

Process Cycle and Duration: Daily or Weekly

Description:

MDOT has it's own crews to perform highway maintenance. The Garage Supervisor performs road inspections weekly or daily depending on the need and type of road. The inspections are then used to plan and carry out work either by the crew itself or by region or statewide forces depending on whether it is capital, maintenance or electrical work. The TSC may engage a contractor for capital preventative maintenance.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Garage Supervisor	Inspects highways, plans and carries out work
	Region	Capital work
	Region or Statewide crew	Performs Electrical work
	Transportation Service Center	Planning
Public		Registers Complaints, Inquiries or Requests

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1B	Daily or Weekly Roadway Inspection	The Garage Supervisor carries out daily and weekly highway inspections.
1F	Complaint, Inquiry or Request	The public may register a complaint, inquiry or request. This may trigger a roadway inspection.

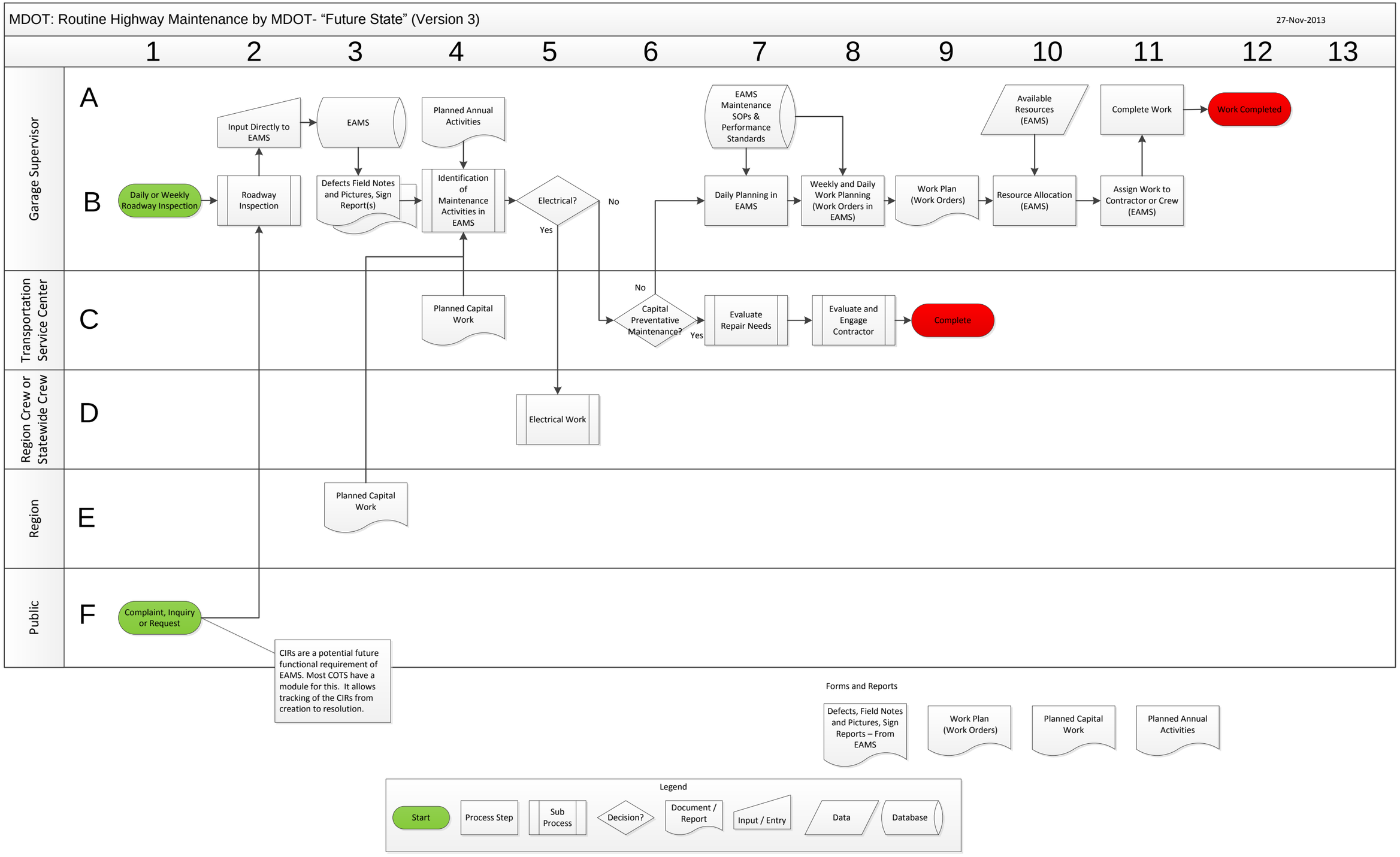
Index	Process Step	Description
2A	Input Directly to EAMS	Roadway Inspections can be entered directly into EAMS.
2B	Roadway Inspection	Roadway inspections is done on a regular daily and weekly cycle.
3A	EAMS	The EAMS accepts the inspection data, and provides it in the form of reports.
3B	Defects Field Notes and Pictures, Sign Report(s)	Defects, field notes and pictures as well as a sign form are all collected in the inspection.
3E	Planned Capital Work	Capital Work that has been planned by the Region is also considered in the identification of activities.
4A	Planned Annual Activities	Annual Maintenance activities are included in the identification of maintenance activities.
4B	Identification of Maintenance Activities in EAMS	Maintenance needs identified by road inspection, annual planned activities, and capital work identified either by the region or the TSC is considered in the identification of activities by the Garage Supervisor.
4C	Planned Capital Work	The TSC has capital work planned that has to be considered in the identification of maintenance activities.
5B	Electrical?	Highway needs are assessed by the local agency contract supervisor to see if there are any electrical requirements. If so those are sent to the Region or Statewide electrical crew.
5D	Electrical Work	Electrical work is performed by the Region Crew or the Statewide Crew.
6C	Capital Preventative Maint?	The Transportation Service Center evaluates the needs resulting from the inspections. Any Capital preventative maintenance is handled by the TSC, otherwise the local agency handles the repairs.
7A	EAMS Maintenance SOPs & Performance Standards	EAMS supplies supervisors with standard operating procedures and performance standards which aid the planning and monitoring of work.
7B	Daily Planning in EAMS	Repairs are posted for daily planning.

Index	Process Step	Description
7C	Evaluate Repair Needs	The capital preventative maintenance repair needs are evaluated by the TSC.
8B	Weekly and Daily Work Planning	Work is planned on a weekly basis and modified daily.
8C	Evaluate and Engage Contractor	The capital preventative maintenance repair needs are evaluated by the Region and a contractor is engaged to complete the work.
9B	Work Plan (Work Orders)	Weekly Work plan.
9C	Complete	Preventative Maintenance is complete.
10A	Available Resources (EAMS)	Resources which are available to the garage supervisor such as fleet, equipment, materials and labor.
10B	Resource Allocation (EAMS)	The Garage supervisor matches the work plan with the resources that are available to complete the work.
11A	Complete Work	The work is completed according to plan.
11B	Assign Work to Contractor or Crew (EAMS)	Work is assigned to the contractor or crew.
12A	Work Completed	The Highway Maintenance work is completed.

Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	27-Nov -2013

Attached:


MDOT: Routine Highway Maintenance by MDOT- "Future State" (Version 3)
27-Nov-2013
1 2 3 4 5 6 7 8 9 10 11 12 13
Garage Supervisor
Transportation Service Center
Region Crew or Statewide Crew
Region
Public
A
B
C
D
E
F
Daily or Weekly Roadway Inspection
Roadway Inspection
Input Directly to EAMS
EAMS
Defects Field Notes and Pictures, Sign Report(s)
Planned Annual Activities
Identification of Maintenance Activities in EAMS
Electrical?
Yes
No
Planned Capital Work
Capital Preventative Maintenance?
No
Yes
Evaluate Repair Needs
Evaluate and Engage Contractor
Complete
Electrical Work
Planned Capital Work
EAMS Maintenance SOPs & Performance Standards
Daily Planning in EAMS
Weekly and Daily Work Planning (Work Orders in EAMS)
Work Plan (Work Orders)
Available Resources (EAMS)
Resource Allocation (EAMS)
Assign Work to Contractor or Crew (EAMS)
Complete Work
Work Completed
Complaint, Inquiry or Request
CIRs are a potential future functional requirement of EAMS. Most COTS have a module for this. It allows tracking of the CIRs from creation to resolution.
Forms and Reports
Defects, Field Notes and Pictures, Sign Reports – From EAMS
Work Plan (Work Orders)
Planned Capital Work
Planned Annual Activities
Legend
Start
Process Step
Sub Process
Decision?
Document / Report
Input / Entry
Data
Database

MDOT
Business Process

Process Stage: To-Be

Process Name: Routine Bridge Maintenance

Parent Business Process / Facet: Highway Maintenance

Process Owner: Garage Supervisor

Primary Deliverables / Products: Completed Maintenance activities

Primary Client: Public

Process Cycle and Duration: Annual

Description:

MDOT has an annual inspection program that feeds the development of planned maintenance and capital planning activities on bridges. Repairs, maintenance are carried out by the garage staff while capital work is done through the region under contract.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Regional Bridge Inspectors	Perform Annual Inspections on Bridges
	Regoinal Bridge Engineer	
	Region Crew or Statewide Crew	
	Transportation Service Center	
	Bridge Supervisor	
Public		

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1A	Bi-Annual Inspection Cycle	Bridges are inspected by trained bridge inspectors on a bi-annual cycle.
1G	Complaint, Inquiry or Request	Complaints, inquires and requests are submitted by the public about deficiencies or safety concerns with regards to bridges.

Index	Process Step	Description
2A	Bridge Inspections	Bridges are inspected using the National Bridge Inspection standard.
3A	Bridge Inspection Form & Photos	Bridge inspections are recorded on a form for loading into MBIS. Photos are kept regionally in individual photo logs.
3D	Planned Annual Activities	The garage plans annual maintenance activities based on knowledge and experience.
3E	Defects Field Notes and Pictures, Sign Form	Information from the bridge inspection is made available to the Garage Supervisor, including defects, field notes pictures and signing form.
4A	Input into MBIS	Bridge inspection data is entered into MBIS (Pontis) from the form. This may be live loaded in some cases.
4B	Plan Capital Work	The Regional bridge engineer uses MBIS to create a capital program.
4C	Planned Capital Work	The TSC has a listing of planned capital work that is compiled from the MIBridge.
4E	Identification of Maintenance Activities	The Garage Supervisor puts together the information from the inspections, and the planned activities to identify a program of activities for the year.
5A	Bridge Inventory and Condition	Bridge inventory and condition data is used through MBIS for capital planning activities.
5D	EAMS	EAMS accepts the Maintenance Activities from the identification process.
5E	Electrical Not in Contract?	Activities that are electrical in nature are identified and separated from the program and are not under the contract of the local agency given to a regional or statewide crew with that capability.
5F	Electrical Work	Electrical Work is given to the statewide or regional crew.
6B	Capital Preventative Maintenance?	The Bridge Engineer then examines the activity program to identify any preventative maintenance on bridges and separates it from the program.
7B	Evaluate and Engage Contractor	The Regional Bridge Engineer will evaluate preventative maintenance needs identified by the TSC and engage a contractor to complete the work.

Index	Process Step	Description
7C	Evaluate Repair Needs	The TSC evaluates the repair needs that are considered preventative maintenance and sent to the Regional Bridge Engineer.
7E	Daily Planning in EAMS	Activities are posted to the Garages for weekly and daily work planning.
8B	Complete	Electrical work is completed by contractor.
8E	Weekly and Daily Work Planning (Work Orders in EAMS)	The Garage Supervisor plans their work for the day and the next week, using the maintenance activities which were posted.
9E	Work Plan	The Garage Supervisors daily and weekly planning results in a work plan.
10D	Available Resources (EAMS)	Resources which are available to the garage supervisor such as fleet, equipment, materials and labor.
10E	Resource Allocation (EAMS)	The Garage supervisor matches the work plan with the resources that are available to complete the work.
11D	Complete Work	The work is completed according to plan.
11E	Assign Work to Contractor or Crew (EAMS)	Work is assigned to the contractor or crew.
12D	Work Completed	The Bridge Maintenance work is completed.

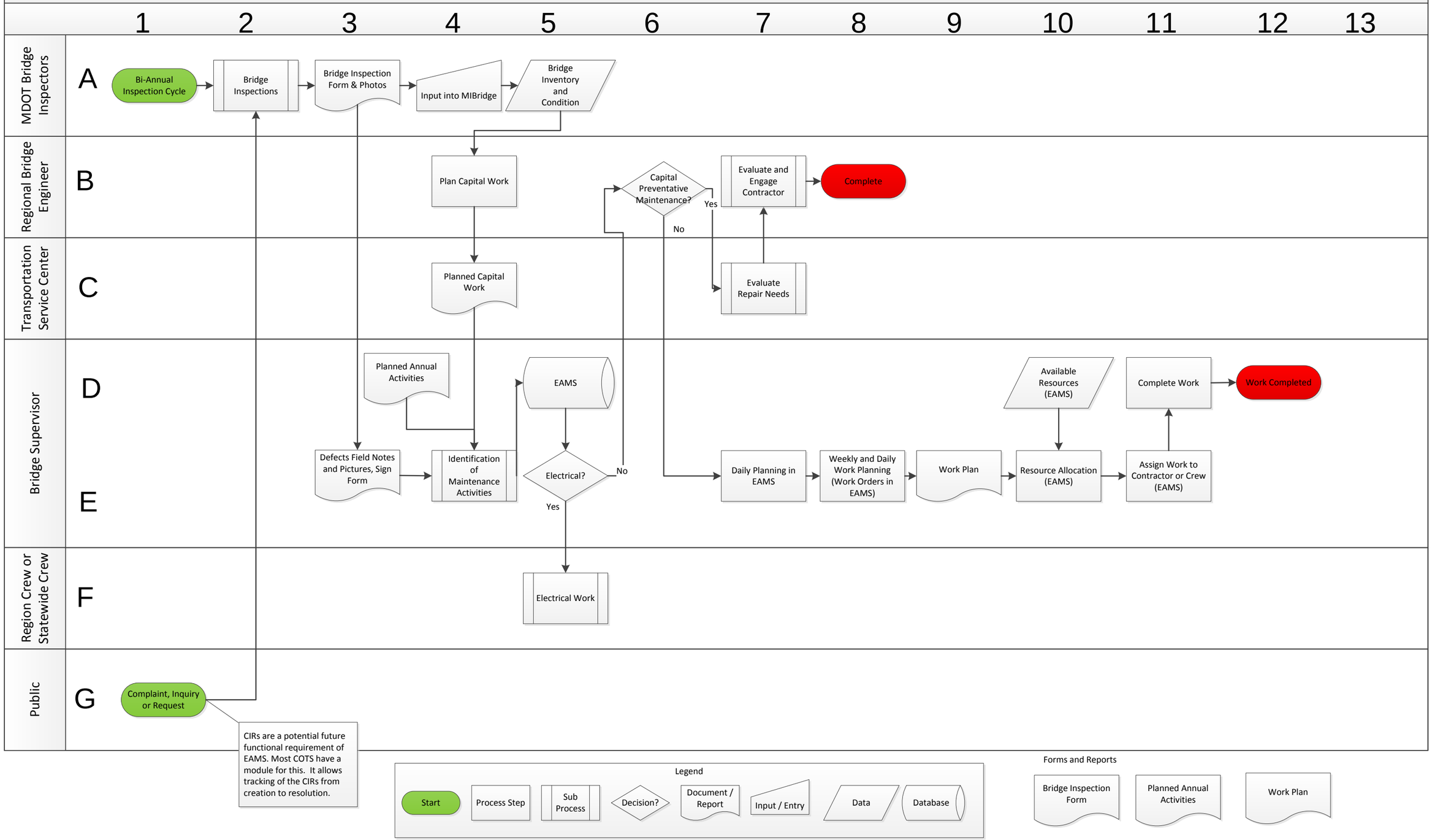
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	09-Sep-2013

Attached:

MDOT: Routine Bridge Maintenance by MDOT "Future State" (Version 3)

27-Nov-2013



MDOT
Business Process

Process Stage: To-Be

Process Name: Maintenance Reporting by MDOT

Parent Business Process / Facet: Highway Maintenance

Process Owner: MDOT Garage Supervisor

Primary Deliverables / Products: Weekly Expenditure data

Primary Client: Finance / Office of Administrative Services

Process Cycle and Duration: Weekly

Description:

MDOT's Direct Forces perform highway maintenance work and record expenditures that must be entered into EAMS and transferred to MAIN and MIDB for budget comparison and tracking of expenses.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Garage Supervisor	Is responsible for the day to day management of the Maintenance Garage
	Region	
	Transportation Service Center	
	Employee	Performs maintenance work and can enter timesheet information
Office of Administrative Services		
Finance		

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1C	Daily Work Completed	Work is completed on a daily basis.

Index	Process Step	Description
2C	EAMS	EAMS accepts the Labour, Equipment Materials & Acc By Route
2D	Records Labour, Equipment, Materials & Acc. By Route In Timesheet Or DCDS	The Garage Supervisor records Labour, Equipment, Materials and Acc. By route in timesheet or DCDS.
2H	TimeSheet Report For Entry into DCDS From EAMS	A Bi-Weekly Timesheet is created from EAMS for Input into DCDS.
3B	DCDS	DCDS Accepts Non-Labor data from EAMS
3C	Send Non-Payroll, Non-Stores expenses For approval	Non-Payroll / Non-Stores expenses are sent for approval. These may be hired equipment or purchased materials.
3G	Timekeeper Input	The Timekeeper keys in the information from the report into DCDS. In the future this could be automated to be transferred directly to DCDS from EAMS.
3H	Employee Time Input into DCDS	The Employee will key the labor information into DCDS. In the future this could be automated.
4C	Materials From Stores Entered into MaintStar (Stores)	Materials that have been issued from stores are entered into MaintStar (stores system).
4D	Approve?	The Garage Supervisor has to approve the non-payroll items.
4E	Approve?	The Garage Supervisor has to approve labour and equipment in DCDS.
4F	DCDS	DCDS is the interface for MIDB to enter labor and equipment expenses for highway maintenance.
5C	MaintStar	MaintStar is the Fleet Management Program that MDOT uses to track the inventory and services of all MDOT owned vehicles and equipment. MaintStar is also used to create work orders for needed equipment services and repairs and calculates our cost of maintaining our equipment fleet.
6C	Weekly Export File	A weekly export file is exported from MAIN and transferred to MIDB.

Index	Process Step	Description
6F	Non-Payroll, Non-Stores expenses Transferred to MIDB	Non-Payroll, Non Stores expenses are sent to MIDB after they have been approved by the supervisor.
7C	MAIN	MAIN is the interface for entering information into MIDB for Materials and non-payroll expenses.
8F	MIDB	Michigan Information Database (MIDB) is the central financial database for the state.
9A	Comparison to Plans	The Office of Administrative Services (OAS) will compare actuals and annual budgets.
9B	Comparison to Plans EAMS	The Region will compare actuals and annual budgets.
9F	Weekly Export File	A weekly export file is created from MaintStart with all the materials from stores used in maintenance activities to import into MAIN.
10F	WebFancy	WebFancy is a financial reporting system that runs on the Web. It was developed for, and is used by, employees at MDOT. WebFancy will create a wide variety of financial reports with varying levels of expenditure and budget detail.
12F	Complete	Reporting is complete.

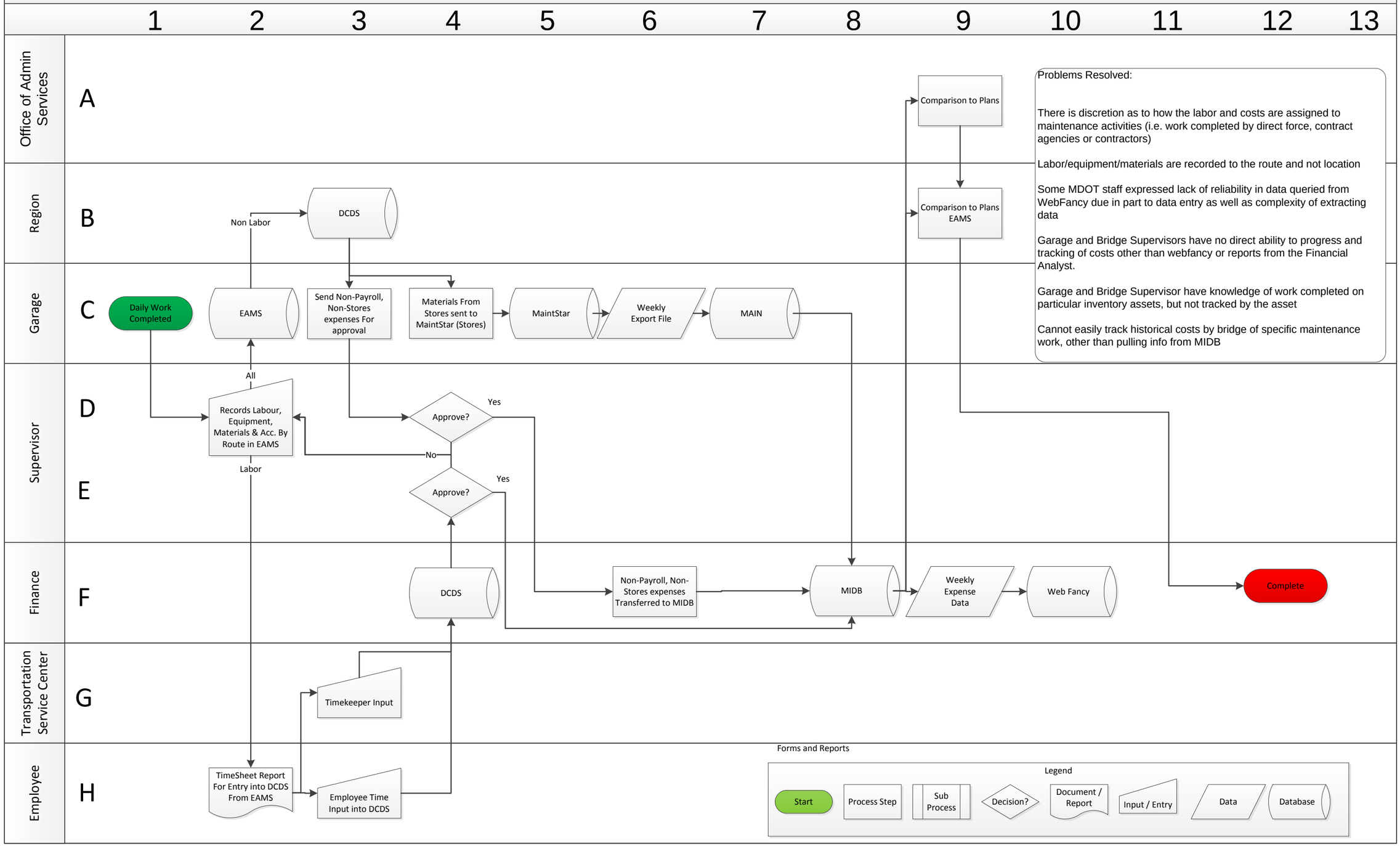
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	27-Nov-2013

Attached:

MDOT: Maintenance Reporting by MDOT "Future State" (Version 3)

27-Nov-013



Problems Resolved:

There is discretion as to how the labor and costs are assigned to maintenance activities (i.e. work completed by direct force, contract agencies or contractors)

Labor/equipment/materials are recorded to the route and not location

Some MDOT staff expressed lack of reliability in data queried from WebFancy due in part to data entry as well as complexity of extracting data

Garage and Bridge Supervisors have no direct ability to progress and tracking of costs other than webfancy or reports from the Financial Analyst.

Garage and Bridge Supervisor have knowledge of work completed on particular inventory assets, but not tracked by the asset

Cannot easily track historical costs by bridge of specific maintenance work, other than pulling info from MIDB

MDOT
Business Process

Process Stage: To-Be

Process Name: Routine Hwy Maintenance by Local Agencies

Parent Business Process / Facet: Highway Maintenance

Process Owner: Local Agency

Primary Deliverables / Products: Completed Highway Maintenance

Primary Client: Transportation Service Center

Process Cycle and Duration: Daily / Weekly

Description:

Highway maintenance in Michigan is often carried out by local agencies such as a county or city. These agencies work as an extension to MDOTs own forces under contract.

Participants:

Department / Agency	Actors	Description of Role
MDOT	Region	Capital work
	Region or Statewide crew	Performs Electrical work
	Transportation Service Center	Planning
Local Agency	Local Agency Contract Supervisor	
Public		Registers Complaints, Inquiries or Requests

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1B	Daily or Weekly Roadway Inspection	The Transportation Service Center carries out daily and weekly highway Inspections.
1G	Complaint, Inquiry or Request	A complaint Inquiry or request is made by the public regarding a highway.

Index	Process Step	Description
2D	Roadway Inspection	A roadway inspection is done on a regular daily and weekly cycle.
3D	EAMS	EAMS accepts the roadway inspection data.
3E	Defects Field Notes and Pictures, Sign Report	Defects, field notes and pictures as well as a sign information is made available in a report for planning.
4E	Electrical Not in Contract?	Highway needs are assessed by the local agency contract supervisor to see if there are any electrical requirements which are not in the contract scope. If so those are sent to the Region or Statewide electrical crew.
4F	Electrical Work	Electrical work is performed by the Region Crew or the Statewide Crew.
5B	Capital Preventative Maint?	The Transportation Service Center evaluates the needs resulting from the inspections. Any Capital preventative maintenance is handled by the TSC, otherwise the local agency handles the repairs.
6A	Evaluate and Engage Contractor	The capital preventative maintenance repair needs are evaluated by the Region and a contractor is engaged to complete the work.
6B	Evaluate Repair Needs	The capital preventative maintenance repair needs are evaluated by the TSC.
6C	Create and Assign Work order in EAMS	Create and assign work orders in EAMS. These work orders can be created by the TSC and assigned to the Local Agency Contract Supervisor.
6D	Daily Planning in EAMS	The Supervisor can do his or her daily planning in EAMS. Standard operating procedures and performance standards are available in EAMS to aid in planning and monitoring of projects.
7A	Work Completed	The contractor who is engaged completes the work.
7B	Meets with County Contract Supervisor	The TSC meets with the County Contract Supervisor to plan work on a bi-weekly basis.
7D	Bi - Weekly Work Planning (EAMS)	The local agency has a bi-weekly work plan based on it's meetings with The TSC. This can all be done within EAMS.
8D	Work Plan	The work plan is a two week plan that encompasses all the highway maintenance the supervisor will undertake.

Index	Process Step	Description
9B	Verify Work is completed (EAMS)	The TSC verifies that work is completed.
9D	Contractor Completes Work	The contractor completes the work.
10B	Work is Complete	If the work is verified complete the Work order can be closed.
10C	Work Completed	Work is completed according to plan.

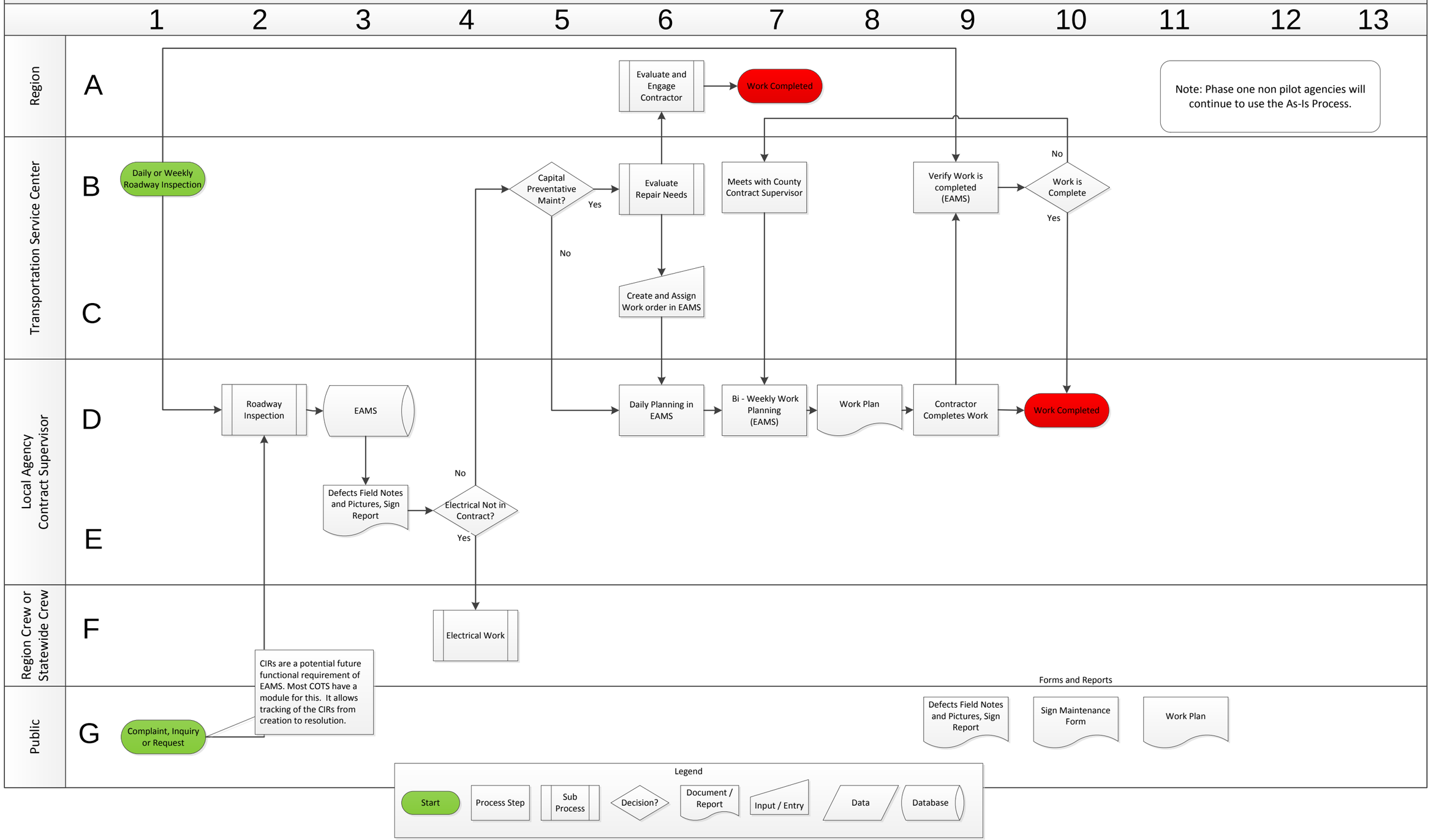
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	27-Nov -2013

Attached:

MDOT: Routine Highway Maintenance by Local Agencies “Future State” (Version 3) Phase 1 Pilot Counties Only

27-Nov-2013



MDOT
Business Process

Process Stage: To-Be

Process Name: Maintenance Reporting by Local Agencies

Parent Business Process / Facet: Highway Maintenance Reporting

Process Owner: MDOT Maintenance Coordinator

Primary Deliverables / Products: Local agencies expenditure data

Primary Client: Office of Admin Services

Process Cycle and Duration: Weekly

Description:

MDOT often contracts maintenance work to local agencies such as a county. The activity costing must be collected for this work in terms of labor equipment and materials. The local agency provides this information and it is loaded through EAMS and LAPS for inclusion into MIDB for loading into WebFancy, comparison to budgets, and generating payables to counties as well as recoverable from the Federal Government.

Participants:

Department / Agency	Actors	Description of Role
Local Agency	Accounts Receivable	
MDOT	Maintenance Coordinator – Transportation Service Center	Responsible for maintenance coordination in a geographic region
	Region	Monitor Maintenance Plans and actuals
Office of Admin Services		Monitor Maintenance Plans and actuals

Process Map: (See Attached)

Process Steps Descriptions:

Index	Process Step	Description
1C	Report Labour, Equipment & Materials	The Local Agency completes work and submits a weekly report with the Labour Equipment and Materials.

Index	Process Step	Description
1E	EAMS	EAMS accepts Accomplishment from Local Agencies.
2C	Enter Accomplishment into Activity Report	Enter accomplishment, and resource usage information into an Activity Report.
2E	Activity Report / Invoice	An activity report is sent to the MDOT Maintenance Coordinator at the TSC.
3E	Approve?	The Maintenance Coordinator reviews the activity report for approval.
4E	Send Accomplishment Data to LAPS	The Maintenance Coordinator Triggers a Transfer of the information into LAPS from EAMS. Most Local Agencies will include # hours Equipment and materials. Some do not, particularly when work is contracted out.
5E	LAPS	Local Agency Payments System (LAPS) Streamlines the payment process for local agency maintenance contracts. It is a cross-functional information system consisting of five modules to track and process billing information. The system is primarily responsible for collecting routine and non-routine bills submitted by local contract agencies; validating billing transactions against MDOT data; assisting in review and approval of bills; auditing bills; generating vouchers for payment; and maintaining and forecasting budgets.
6E	Approve Billing?	The Maintenance Coordinator at the TSC reviews the billing data for approval.
7E	MIDB	Michigan Information Database (MIDB) is the central financial database for the state.
8E	Weekly Expenditure Data	Data from MIDB is used to update WebFancy on a weekly basis.
9E	WebFancy	WebFancy is a financial reporting system that runs on the Web. It was developed for, and is used by, employees at MDOT. WebFancy will create a wide variety of financial reports with varying levels of expenditure and budget detail.
10A	Comparison With Monthly, Quarterly and Annual Plans	The Office of Administrative Services (OAS) will compare actuals and annual budgets. Counties are compared on a monthly basis, while cities are compared on a quarterly basis.
10B	Comparison With Monthly, Quarterly and Annual Plans	The Region will compare actuals and annual budgets. Counties are compared on a monthly basis, while cities are compared on a quarterly basis.

Index	Process Step	Description
10E	Comparison	WebFancy can generate a comparison of actuals and budgets for monitoring.
11A	Complete	The reporting cycle is complete.

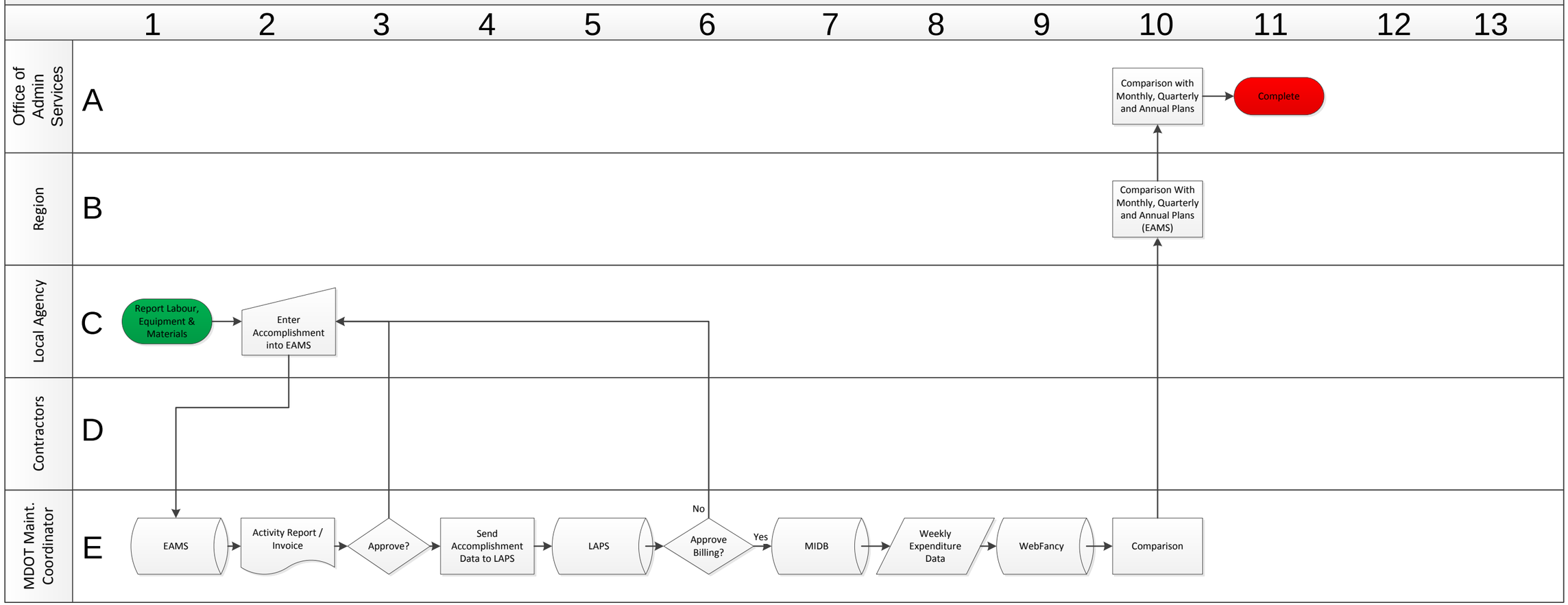
Change Log:

Version	Authors	Description	Date
1	John MacNaughton (OPUS)	First Draft	27-Nov-2013

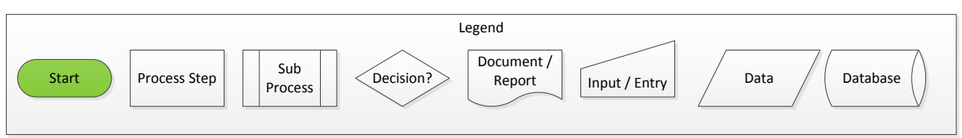
Attached:

MDOT: Maintenance Reporting by Local Agencies “Future State” (Version 3)

27-Nov-2013



Forms and Reports



3. Sign Maintenance

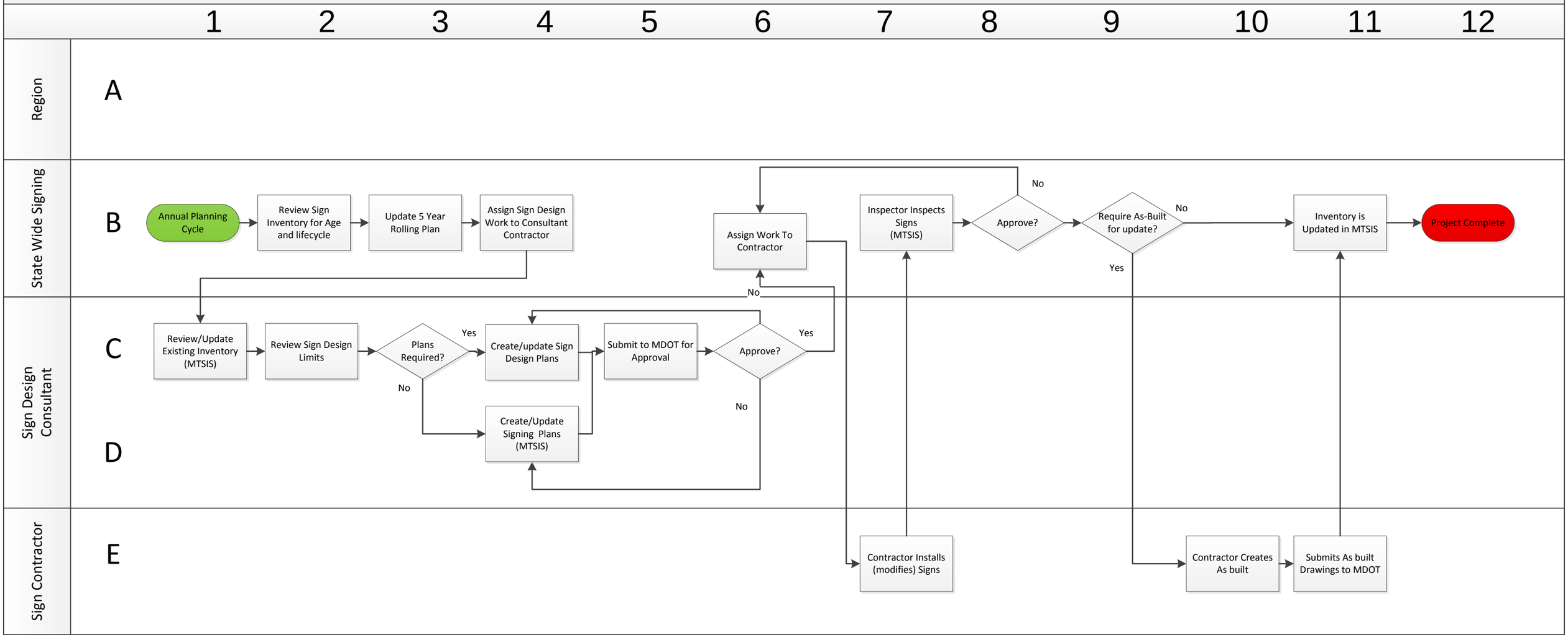
3.1 As – Is Sign Maintenance Processes

The business processes involved with maintenance of signs are included in the EAMS. The following processes have been documented to further describe the requirements:

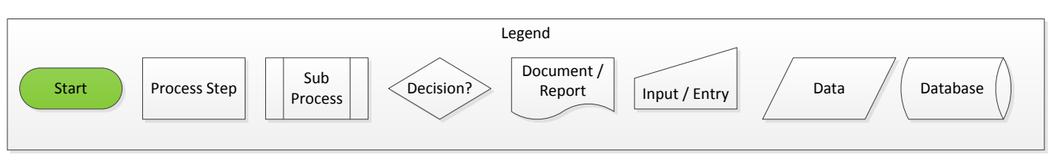
- Annual Sign Program
- Unplanned Sign Maintenance

MDOT: Annual Sign Program Plans (Version 1)

17-Dec-2013

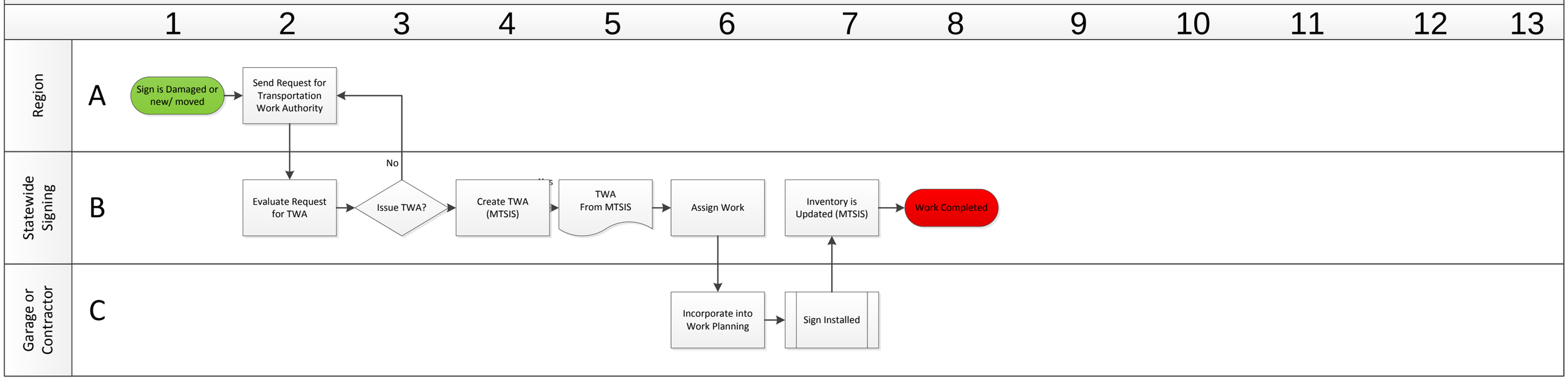


Forms and Reports

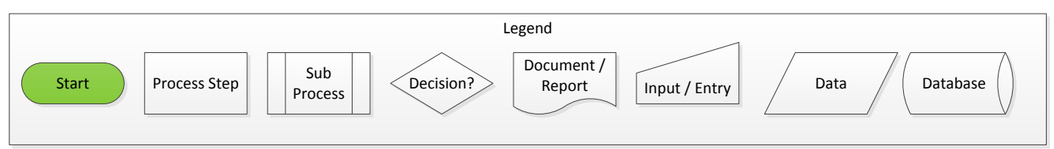


MDOT: Unplanned / Sign Maintenance (Version 1)

17-Dec-2013



Forms and Reports



Michigan Department Of Transportation

Attachment A – Solution Requirements
Enterprise Asset Management System

Contents

Introduction (Minimum Mandatory Requirements Checklist) 1

1. General 9

2. Road Network Management 31

3. Asset Inventory Management 44

4. Maintenance Management 52

5. Application Integration 73

6. Technical Requirements 78

EAMS Solution Requirements

This document contains functional and technical requirements for the EAMS COTS solution that is being procured through this Phase 1 RFP. The following instructions are intended for vendors who must complete this document and submit it as part of their proposal.

Each of the requirements requires a response from the vendor. They have been prioritized and weighted by importance by MDOT, and labeled within the column **M/ H- L** with one of the following ratings:

M – **M**andatory, requirement must be met by the proposed solution;

H – **H**igh, requirement is highly desirable and should be met by the proposed solution;

L – **L**ow, requirement is desirable to provide additional value within the proposed solution.

NOTE: BIDDERS ARE ADVISED THAT FAILURE TO MEET THE MINIMUM MANDATORY REQUIREMENTS LISTED WITHIN THIS DOCUMENT WILL RESULT IN DISQUALIFICATION FROM FURTHER CONSIDERATION IN THIS BID PROCESS.

Vendors must complete the two shaded columns for each requirement as follows:

a) If your proposed COTS solution complies with all aspects of the requirement and is currently a standard feature, place a "**Y**" in the column labeled "**Y-N-M**" and provide the following information:

   - In the "**Description of Solution**" column, describe in sufficient detail how the proposed solution fully complies with the requirement. If required, you may also provide additional supporting information and screen shots to demonstrate the functionality. This additional supporting information is to be included in an appendix that is directly referenced to the functional requirement number.

b) If your proposed COTS solution does **NOT** fulfill this requirement, place an "**N**" in the column labeled "**Y-N-M**" and provide the following information:

   - In the "**Description of Solution**" column, describe the impact of not meeting the requirement.

c) If your proposed COTS solution does not currently comply with the requirement, but could be modified through configuration, programming or source code changes which, in your opinion, would result in the solution reaching full compliance with the requirement, place an "**M**" in the column labeled "**Y-N-M**" and provide the following information:

   - In the "**Description of Solution**" column, clearly describe the modification, how it will be accomplished, and how it will comply with the requirement. The clarity of this explanation may affect the scoring of your proposal.

   - All such modifications are considered to be part of the solution being proposed and included in the bid price. If the modification will not be complete by the implementation date, Contractor must specify an anticipated date when the modification would be added to the solution, at no additional cost to the State. The State reserves the right to reject the Contractor's proposed date and consider the solution not in compliance.

- Contractor must provide assurance that the proposed modification will be fully supported in future releases of the underlying COTS software at no additional cost to the State beyond any applicable software and maintenance fees related to the license.

Note: Your response to each requirement should contain adequate information for evaluation by the joint evaluation committee (JEC) without referencing other responses in your proposal. The JEC will be the final judge on whether or not the solution meets the requirement.

Below, a check list for minimum mandatory requirements has been provided to ensure that Bidders have provided their responses to these mandatory requirements.

Minimum Mandatory Requirements Checklist

The Mandatory Requirements Checklist is to ensure that the Bidder answers each mandatory (M) requirement as outlined in Article 3 Section 3.021 Step 1: Minimum Mandatory Requirements.

1.1 Manage Users, and Roles, Access by Module, Admin Unit (Manage Users)

No Mandatory Requirements.

1.2 Reporting

No.	Requirement	M/ H-L	Answered
1.2.1	*Use of standard, configurable reports.*	*M*	Y
1.2.2	*Ability to construct user defined and permanent reports using imbedded application tools.*	*M*	Y

1.3 GIS

No.	Requirement	M/ H-L	Answered
1.3.1	*Mapping within the EAMS application is compatible with ArcGIS Server.*	*M*	Y

1.4 UX – User Experience

No.	Requirement	M/ H-L	Answered
1.4.1	*The system will provide access to the User Guide from each screen using context-sensitive help.*	*M*	Y

1.5 Mobile Access

No.	Requirement	M/ H-L	Answered
1.5.1	*Ability to use the mobile interface for accessing the EAMS for creating and managing work orders.*	*M*	Y
1.5.2	*Ability to use the mobile interface for accessing the EAMS for inspections. Users should be able to Create, Read, Update Deactivate / Delete inspections as per the user's permission.*	*M*	Y

1.6 Manage Configuration of Codes, Fields, UI Elements, Workflows

No.	Requirement	M/ H-L	Answered
1.6.1	*Ability for an administrator, using in application tools, to create, update, deactivate, user interface elements for standard and configurable functionality, attribute fields etc.*	*M*	Y
1.6.2	*Ability for an administrator to create, update, deactivate/delete MDOT specific codes, terminology, choice lists, labels, verification domains, etc. using tools within the application.*	*M*	Y

1.7 Manage Digital Documents, Drawings and Images

No Mandatory Requirements.

1.8 Contractors and Local Agencies

No.	Requirement	M/ H-L	Answered
1.8.1	*Function as an autonomous business unit, having access to the software in a similar fashion to MDOT Garages, but with access limited to the agencies' or contractors' area of responsibility and the assets therein.*	*M*	Y

2.1 General Location Referencing

No.	Requirement	M/ H-L	Answered
2.1.1	*The solution must provide support for imperial units (feet, miles) linear measures for:* • *Datum definition* • *LRM section lengths* • *Inquiry and reporting of measures*	*M*	Y

2.2 Temporal Data Management

No Mandatory Requirements.

2.3 Multiple LRM Support

No.	Requirement	M/ H-L	Answered
2.3.1	*Support for MDOT LRMs – The solution must support the following specific LRMs as defined within the MDOT Location Referencing Standards:* • *PR Segment – Mile Point (PR-MP)* • *Control Section – Mile Point (CS-MP)* • *Route – Mile Point (Route-MP)*	*M*	Y

2.4 Location Translation

No Mandatory Requirements.

2.5 Road Network Reporting

No Mandatory Requirements.

2.6 Support for MDOT Location Referencing Business Processes

No Mandatory Requirements.

3.1 Manage Asset Inventory Library

No.	Requirement	M/ H-L	Answered
3.1.1	*Create, Read, Update Deactivate/Delete (CRUD) Asset types. Nonstandard asset types will be fully configurable and have the same behavior characteristics as standard asset types.*	*M*	Y
3.1.2	*Have the ability to define the attributes associated with each type of asset. Attributes will be any data type, with the ability to manage in excess of 100 unique attributes per asset type.*	*M*	Y
3.1.3	*Define complex assets with multiple elements, each with its own set of attributes. Attributes for elements will be configurable, be of any data type. The system will be able to manage in excess of 100 attributes per component.*	*M*	Y

3.2 Field Data Integration

No.	Requirement	M/ H-L	Answered
3.2.1	*The solution should provide functionality to enable EAMS assets to be updated and time stamped as changes occur through integrated business process workflows that capture changes using GPS enabled field data collection systems. The Vendor is requested to specify whether additional software modules are needed to meet this requirement and if additional licensing costs are incurred.*	*M*	Y

3.3 Manage Inspections and Condition Information

No.	Requirement	M/ H-L	Answered
3.3.1	*Define condition inspections for asset types*	*M*	Y
3.3.2	*Define Regulatory inspections for asset types*	*M*	Y
3.3.3	*Record individual Condition Inspections on Assets, include asset specific and user condition indices, date, time, inspector. These will be linked to assets in the asset inventory.*	*M*	Y

4.1 Maintenance Program and Budget Planning

No.	Requirement	M/ H-L	Answered
4.1.1	*Create, Read, Update Deactivate/Delete (CRUD) Programs with multiple sub budgets, to which projects and Work Orders can be assigned.*	*M*	Y
4.1.2	*Define preventative and scheduled maintenance on asset types. Set cycle time*	*M*	Y

No.	Requirement	M/ H-L	Answered
	for inspections, operations activities, maintenance etc.		
4.1.3	*Prioritize maintenance activities and compare planned maintenance with accomplishments in order to determine deferred maintenance at the end of the year to support budget requests.*	*M*	Y
4.1.4	*Create, read, update, delete / deactivate annual work plans based on need identified through planned work orders. Plans should be Tied to budgets and hierarchical.*	*M*	Y
4.1.5	*Create, read, update, delete / deactivate flexible schedules (daily, weekly, bi-weekly, monthly) for maintenance activities based on annual work plan*	*M*	Y

4.2 Manage Work Orders

No.	Requirement	M/ H-L	Answered
4.2.1	*Ability to Create, Read, and Deactivate/Delete work orders.*	*M*	Y
4.2.2	*Attach work orders to specific assets or to a location along a linear asset such as a highway.*	*M*	Y
4.2.3	*Users can choose a work order type and debit the expenses to a particular budget item and program. Costs show up as committed for planned work orders and expenditures for costs actually incurred.*	*M*	Y
4.2.4	*Use work orders to assign staff, crews, equipment and vehicles.*	*M*	Y
4.2.5	*Use work orders to plan the use of materials.*	*M*	Y
4.2.6	*Use work orders to plan the use of contract labor, equipment and crews.*	*M*	Y
4.2.7	*Use work orders to estimate the budget of a project by calculating the expenditures automatically from the estimated use of either standard plans or individually entered plans (labor, equipment and materials)*	*M*	Y
4.2.8	*Use work orders to record accomplishment in terms of a pre-defined configurable quantity.*	*M*	Y
4.2.9	*Use work orders to record use of labor, equipment, vehicles, materials and hired contractors*	*M*	Y
4.2.10	*Use work orders to track the actual expenditures on a project.*	*M*	Y

4.3 Manage Work Orders – Sign Specific Requirements

No Mandatory Requirements.

4.4 Manage Workers and Crews

No.	Requirement	M/ H-L	Answered
4.4.1	*Create, Read, Update and Deactivate/Delete crew types, crews.*	*M*	Y
4.4.2	*Assign Workers to Crews, admin units, regions etc.*	*M*	Y

4.5 Manage Fleet and Equipment

No.	Requirement	M/ H-L	Answered
4.5.1	*Create, Read, Update and Deactivate/Delete Equipment type, vehicle types and vehicles*	*M*	Y
4.5.2	*Ability to assign equipment or vehicles to a particular admin unit or crew.*	*M*	Y

4.6 Manage Customer Service

No Mandatory Requirements.

4.7 Performance

No.	Requirement	M/ H-L	Answered
4.7.1	*Record, track and report on performance of maintenance activity achievements and Level of Service.*	*M*	Y
4.7.2	*Use analytical tools to compare performance to standard levels of service for accomplishment, quality and budget, at the work order, crew, garage, region and statewide levels.*	*M*	Y

5.1 Road Network Application Integration

No Mandatory Requirements.

5.2 External Application Integration

No Mandatory Requirements.

6.1 System Architecture

No.	Requirement	M/ H-L	Answered
6.1.1	*The system employs web architecture using browser accessing a central database through software on a server.*	*M*	Y

6.2 Software Licensing

No Mandatory Requirements.

6.3 RDBMS / Applications / Database Management

No Mandatory Requirements.

6.4 Security

No Mandatory Requirements.

6.5 General Commercial Software Considerations

No Mandatory Requirements.

6.6 Reporting

No.	Requirement	M/ H-L	Answered
6.6.1	*The software delivers standard reports.*	*M*	Y
6.6.2	*The system includes user defined query and reporting using state standard tools that allow the user to examine asset data and patterns in asset data.*	*M*	Y

6.7 Auditing

No Mandatory Requirements.

The business requirements have been structured into specific categories that align with the strategic, tactical and operational need of the EAMS solution (see Table 1). Each area subsequently includes a series of process requirements that identify what the product should do in order to fulfill the business need.

Table 1: EAMS Phase 1 Requirement Area Categories

No.	Category	Priority Area	Description
1.0	Functional	General	Functionality that is applicable to the overall EAMS solution across all modules
2.0	Functional	Road Network Management	Functionality that is applicable to the EAMS Road Network Management module
3.0	Functional	Asset Inventory Management	Functionality that is applicable to the EAMS Asset Inventory Management module
4.0	Functional	Maintenance Management	Functionality that is applicable to the EAMS Maintenance Management module
5.0	Functional	Application Integration	Functionality that is applicable to integration
6.0	Technical	All	Operational capability that is required to meet state standards for security, usability etc.

1. General

This section describes EAMS functionality that is needed across all application modules.

1.1. Manage Users, and Roles, Access by Module, Admin Unit (Manage Users)

Administrators need to be able to add, modify and de-activate users as well as assign them specific roles and permissions according to groups such as administrative unit and send broadcast messages to all users.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.1.1	Create, Read, Update, Deactivate/Delete (CRUD) user defined user roles for controlling access to functionality within the system. Roles should be based on the user's position within MDOT and their required use of the system.	H	Y	Accomplished through 'Setup Users' in the Administration menu (See Appendix 1 General [Part 1 of 2] for screenshot page 2). This is a standard feature.
1.1.2	Create, Read, Update, Deactivate/Delete (CRUD) user defined, administration units, for the use of controlling permissions to access data related to geographic areas (Regions) or sub Areas (Maintenance Responsibility Areas) for direct forces, as well as establish separate admin units for contract forces.	H	Y	Use 'Setup Users' and create roles based upon geographically named regions (See Appendix 1 General [Part 1 of 2]for screenshot page 3). This is a standard feature.
1.1.3	Assign specific end users roles, and Administrative Units to users either individually based on their position or as a group based on the administrative unit or position within MDOT.	H	Y	Done through 'Setup Users' (See Appendix 1 General [Part 1 of 2] for screenshot page 4). This is a standard feature.
1.1.4	Manage Attributes regarding user's employment information. Specifically information from the global database that includes their name, position, admin unit, geographic area, rates, collective bargaining agreement, and any other information required.	H	Y	Accomplished in Resource Manager -> Personnel. Configure the personnel form to store additional required attributes. Attach the agreements as

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				document attachments to the personnel records. (See Appendix 1 General [Part 1 of 2] for screenshot page 5). This is a standard feature of Resource Manager which is included in our proposed solution.
1.1.5	Produce a User Activity Report. At minimum the report will show the last time a user was logged in.	H	Y	System Administrators have access to this through 'Setup Users' (See Appendix 1 [Part 1 of 2] General for screenshot page 6). This is a standard feature.
1.1.6	The system will let administrators add or remove a broadcast message.	H	Y	Standard feature (See Appendix 1 [Part 1 of 2] General for screenshot page 7)
1.1.7	When a broadcast message is added, it will appear to all users immediately and at login. It will require users to dismiss it.	H	Y	Standard feature (See Appendix 1 [Part 1 of 2] General for screenshot page 8)
1.1.8	When adding a broadcast message, the administrator can choose to send a warning email to users in selected user groups or TSC(s).	H	Y	Standard feature (See Appendix 1 [Part 1 of 2] General for screenshot page 9)

1.2. Reporting

Reporting in the EAMS should be enabled by a report design engine that will enable a user or administrator to design a report based on their knowledge of the information available to them within the interface. Those reports should be managed and made available either to the group or individually based on their roles and administrative unit permissions. Use of real-time statistics as well to supply desktop widget style information (i.e. dashboards) to supervisors, managers, and executive based on periodic (daily, weekly, monthly) Key Performance Indicators (KPIs).

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.2.1	*Use of standard, configurable reports.*	*M*	Y	VUEWorks contains an internal 'Dynamic Reports' engine with a robust report designer. (See Appendix 1 General [Part 1 of 2] for screenshot page 10). This is a standard feature.
1.2.2	*Ability to construct user defined and permanent reports using imbedded application tools.*	*M*	Y	VUEWorks contains an internal 'Dynamic Reports' engine with a robust report designer. (See Appendix 1 General [Part 1 of 2] for screenshot page 11). This is a standard feature.
1.2.3	Ability to use industry standard tools such as Crystal Reports to construct reports that are resident within the application as well as externally available.	H	Y	VUEWorks' database contains a series of standard SQL views that are used to connect to 3rd party reporting tools (See Appendix 1 General [Part 1 of 2] for screenshot page 12). This is a standard feature.
1.2.4	Hierarchical reporting of budgets, planned work, assets, accomplishments, expenditures, service requests, work orders, labor costs, vehicle costs, condition summaries, urgent work, etc.	H	Y	VUEWorks Dynamic Reporting supports unlimited grouping (See Appendix 1 General [Part 1

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				of 2] for screenshot page 13). This is a standard feature.
1.2.5	Reports will be secured to the various business unit, contractor or local agency. For example: users from a specific entity will only be able to produce reports with data that belongs to it.	H	Y	Access to report templates can be secured by individual user or role (See Appendix 1 General [Part 1 of 2] for screenshot page 14). This is a standard feature.
1.2.6	Reporting will be flexible by date range. Choose fiscal year, month, week, day, etc. Historical data within the system will be available for all reporting.	H	Y	Accomplished through the use of date filters (See Appendix 1 General [Part 1 of 2] for screenshot page 15). This is a standard feature.
1.2.7	Reporting will be flexible by location. Choose LRS, administrative area, user defined polygon etc. Historical data within the system will be available for all reporting.	H	Y	Reports can be tied to VUEWorks selection sets, which in turn can be created spatially or through LRS queries (See Appendix 1 General [Part 1 of 2] for screenshot page 16). This is a standard feature.
1.2.8	Ability for system to generate predefined “canned” reports.	H	Y	VUEWorks can be configured with an unlimited number of canned reports (See Appendix 1 General [Part 1 of 2] for screenshot page 17). This is a standard feature.
1.2.9	Ability to capture and report specific heavy maintenance project information as requested by SPMAC (Statewide Pavement Management Advisory Committee)	H	Y	Users can connect to external databases such as

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				MicroPAVER to import pavement and project data for analysis and reporting in VUEWorks (See Appendix 1 General [Part 1 of 2] for screenshot page 18). This is a standard feature.
1.2.10	Ability to provide real time data on operational performance measures and quantities from the data contained in the EAMS using desktop style widgets. These may include but are not limited to: overtime hours by region, salt used by snow event, miles of road cleared by class by snow event, cost of treatment by km by crew, etc.	H	Y	Users can create an unlimited number of dashboard widgets (gadgets), which in turn can be made available by user or role. (See Appendix 1 General [Part 1 of 2] for screenshot page 19). This is a standard feature.
1.2.11	The desktop style widgets provide high level statistics, but will provide direct access to more detailed data or reports depending on the context (drill down statistics). For example: an overtime report for a Region should provide functionality to drill down to the Garage level and then to the Employee level.	H	Y	Drill down ability is available as a standard feature in the Facilities module (See Appendix 1 General [Part 1 of 2] for screenshot page 20).
1.2.12	The desktop style widgets are supplied as part of the COTS and can be constructed easily using imbedded application tools and MDOT standard development tools	H	Y	The software contains the ability to construct dashboard widgets through the User Interface (See Appendix 1 General [Part 1 of 2] for screenshot page 21). This is a standard feature.
1.2.13	Access to data will be based on user, role and administrative unit. Certain reports should only report the data available to the person (role) requesting the report by their admin unit or geographic area.	H	Y	Access to report templates can be secured by individual user or role (See

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				Appendix 1 General [Part 1 of 2] for screenshot page 22). This is a standard feature.

1.3. GIS

The management of geographic information as pertaining to the assets and work events within the system. These will be absolute references, linear references or both. This usually entails interfacing with a commercial GIS Software solution.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.3.1	*Mapping within the EAMS application is compatible with ArcGIS Server.*	*M*	Y	VUEWorks utilizes ArcGIS Server for all mapping operations (See Appendix 1 General [Part 1 of 2] for screenshot page 23).. This is a standard feature.
1.3.2	The EAMS has an ArcGIS for Desktop extension for viewing and query of data.	L	Y	VUEWorks is browser-based and access to GIS data is available to all users vie REST services. (See Appendix 1 General [Part 1 of 2] for screenshot page 24). This is a standard feature.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.3.3	Imbedded application mapping has basic navigation including but not limited to: • Zoom • Pan • View attributes • Select by attributes • Select by feature • Measure distance • Measure area • Zoom to asset • Zoom to an area of Interest (County, City, Region, TSC) • Zoom to an address • Search for asset by attribute • Zoom to LRS location in any defined LRM • Display the LRS location at a specified network location in any defined LRM	H	Y	All basic mapping functions are provided. Search pages can be configured by the user or implementer using the User Interface to accomplish more advanced queries of the GIS and the LRS VUEWorks / Esri Roads and Highways includes a REST API for translating LRS locations from one LRM to another. This will be leveraged in the display of an asset's LRS locations within VUEWorks All standard features (See Appendix 1 General [Part 1 of 2] for screenshot pages 25-26).
1.3.4	Imbedded application advanced functionality: • Create a work order on a selected asset spatial representation • Find location based on linear reference • Find work orders based on proximity	H	Y	The map is always accessible for spatial selection. (See Appendix 1 General [Part 1 of 2] for screenshot page 27). This is a standard feature.
1.3.5	Create, read, update deactivate/delete work orders and service requests directly from the spatial view	H	Y	The map is always accessible for spatial selection. (See Appendix 1 General [Part 1 of 2] for screenshot page 28-29). This is a standard feature.
1.3.6	Create, read, update deactivate/delete assets and groups of assets and other	H	Y	The map is always

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	features such as work orders from the spatial view			accessible for spatial selection (See Appendix 1 General [Part 1 of 2] for screenshot pages 28-29). This is a standard feature.
1.3.7	Produce a Quick Map for printing including the information that is displayed in the current spatial view	H	Y	Always available through the User Interface - Print Map button. (See Appendix 1 General [Part 1 of 2] for screenshot page 30). This is a standard feature.
1.3.8	Provide a mobile version of the spatial functionality	H	Y	Full VUEWorks application can be used on mobile devices as a standard feature that support a browser, such as tablets and laptops. The native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets. This is a standard feature.
1.3.9	Mobile Mapping: Show the current location on the mobile map using the device's GPS	H	Y	The native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets. This is a standard feature.
1.3.10	Mobile Mapping: Use the GPS to geotag pictures and snap them to a nearby asset.	H	Y	This depends on the device that is used. Photos can be

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				linked to geospatial asset features (See Appendix 1 General [Part 1 of 2] for screenshot page 31). This is a standard feature.
1.3.11	Mobile mapping has basic navigation including but not limited to: • Zoom • Pan • View attributes • Select by attributes • Select by feature • Measure distance • Measure area • Zoom to asset • Search for asset by attribute	H	Y	Full VUEWorks application can be used on mobile devices that support a browser, such as tablets and laptops (See Appendix 1 General [Part 1 of 2] for screenshot page 32). This is a standard feature. Esri Mobile apps support this as a standard feature.
1.3.12	Mobile Mapping: Use the GPS location to search for nearby work orders, service requests and assets based on the device's GPS position.	H	Y	MobileVUE provides this capability on multiple mobile devices such as phones and tablets. These are standard features for the Work Order module, the Service Request module and Core. All of these products are included in this proposal.
1.3.13	Mobile Mapping: Create, read, update deactivate/delete work orders and service requests directly from the spatial view	H	Y	MobileVUE provides this capability on multiple mobile devices such as phones and tablets. The Work Order and Service Request modules include these as standard features

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				respectively. Both modules are part of the proposed solution.
1.3.14	Mobile Mapping: Create, read, update deactivate/delete assets and groups of asset attributes from the spatial view	H	Y	Full VUEWorks application can be used on mobile devices that support a browser, such as tablets and laptops a standard feature. Esri Mobile apps support this as a standard feature
1.3.15	Mobile Mapping: Produce a Quick Map for printing including the information that is displayed in the current spatial view	H	Y	The full VUEWorks application can be used on mobile devices that support a browser, such as tablets and laptops (See Appendix 1 General [Part 1 of 2] for screenshot page 33). This is a standard feature.

1.4. UX – User Experience

A person's perceptions and responses that result from the use or anticipated use of a product, system or service. Not confined to functionality, but also the behavior that would result in the use of the product.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.4.1	*The system will provide access to the User Guide from each screen using context-sensitive help.*	*M*	Y	Standard feature accessible from the Main Module Interface which is available from every screen. (See Appendix 1 General [Part 2 of 2] for

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				screenshot page 2)
1.4.2	The system will provide a visual indicator, such as an hourglass or progress bar, when the user needs to wait longer than 3-4 seconds for the system to finish processing a request.	H	Y	Common behavior throughout the application. (See Appendix 1 General [Part 2 of 2] for screenshot page 3). This is a standard feature.
1.4.3	The system will provide useful error messages, explaining in plain language the problem that occurred and what the user should do to recover from the error.	H	Y	Common behavior throughout the application. (See Appendix 1 General [Part 2 of 2] for screenshot page 4). This is a standard feature.
1.4.4	The system will not require the user to remember information from one screen to the next in the same session. For example, if they enter a Control Section (CS) # on the first screen, the system should remember the CS # on future screens.	H	Y	The main map view within VUEWorks works independently of each module, therefore keeping track of the information as the user moves between screens. This is a standard feature.
1.4.5	Important functions/features of the system (as determined during design) will be available from a common menu that is available on all screens (e.g., the user does not have to navigate to a different screen to find the menu).	H	Y	Common feature throughout the application (See Appendix 1 General [Part 2 of 2] for screenshot page 5). This is a standard feature.
1.4.6	The system will be in compliance with the Section 508 Federal Accessibility Standards for ADA compliance.	H	M	Screens can be edited to gain full compliance including text tags
1.4.7	The system will be in compliance with the e-Michigan web standards.	H	M	Screens can be edited to gain full compliance. For

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				instance we can use text tags rather than color alone as an information indicator. Additionally we could use text instead of images for page titles and other areas based upon the wishes of MDOT.
1.4.8	Color coding alone will not be used to signify information (ADA standard).	H	Y	Screens can be edited to use text tags to identify information.
1.4.9	The system will not require users to scroll horizontally to see an entire screen.	H	Y	The application conforms to the resolution of the client machine. (See Appendix 1 General [Part 2 of 2] for screenshot page 7). This is a standard feature.
1.4.10	When there is an option to print, the information will be put into a printer-friendly format: no color, cleanly fits on an 8x10 page, date and time stamp.	H	Y	Common behavior throughout the application (See Appendix 1 General [Part 2 of 2] for screenshot page 8). This is a standard feature.
1.4.11	The system will provide a visual indicator denoting required fields.	H	Y	A combination of glyphs, bold, italic, boxing and color is used to signify information, such as required fields. (See Appendix 1 General [Part 2 of 2] for screenshot page 9). This is a standard feature.
1.4.12	When there are sequential tasks using multiple screens to complete, a visual	H	Y	Common behavior

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	indicator will be used to show the user where they are in the process and how much farther they have to go.			throughout the application (See Appendix 1 General [Part 2 of 2] for screenshot page 10). This is a standard feature.
1.4.13	The software will immediately acknowledge the user's commands. Overall the response to each action a user takes should be met with little or no lag time. Provide feedback that the specified task is getting accomplished	L	Y	Common behavior throughout the application. This is a standard feature.
1.4.14	The software will be designed in such a way that data entry screens can be easily used to enter screen data without the user of a mouse.	L	Y	Entry field navigation using Tab and Shift-Tab and arrow keys is common behavior throughout the application. (See Appendix 1 General [Part 2 of 2] for screenshot page 11). This is a standard feature.
1.4.15	The software will have aspects of its interface that help a user with their specific way of working. (e.g., Remember directories, settings etc.) so the user doesn't have to repeat things in their workflow every instance	L	Y	The user's current state is restored the next time they log into the system. The user can also set up preferences for most parts of the application (See Appendix 1 General [Part 2 of 2] for screenshot page 12). These are standard features.
1.4.16	Dual Screens can increase productivity. The software should have some aspects, e.g. Mapping, where dual screens can be taken advantage of.	L	Y	The application can be used across multiple screens. (See Appendix 1 General [Part 2 of 2] for screenshot page 13). This is a standard feature.
1.4.17	Data input by the user should be verified as being valid. Where possible utilize	L	Y	Common behavior

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	look up controls such as drop boxes, or pick lists, auto fill may also be beneficial.			throughout the application. (See Appendix 1 General [Part 2 of 2] for screenshot page 14). This is a standard feature.

1.5. Mobile Access

Users of an EAMS are operational and therefore mobile by nature. Mobile access to the EAMS should be focused on providing the user with a user experience tailored to a tablet, with the appropriate field functionality. It should be available on widely available consumer and ruggedized hardware.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.5.1	*Ability to use the mobile interface for accessing the EAMS for creating and managing work orders.*	*M*	Y	The full VUEWorks application standard feature can be used on mobile devices that support a browser, such as tablets and laptops. The standard native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets
1.5.2	*Ability to use the mobile interface for accessing the EAMS for inspections. Users should be able to Create, Read, Update Deactivate / Delete inspections as per the user's permission.*	*M*	Y	The full VUEWorks application standard feature can be used on mobile devices that support a browser, such as tablets and laptops. The standard native VUEWorks mobile application, MobileVUE, provides this capability on

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				multiple mobile devices such as phones and tablets (See Appendix 1 General [Part 2 of 2] for screenshot pages 15-16)
1.5.3	Ability to use the mobile interface for accessing the Asset Library to collect inventory, create, read, update and deactivate / delete records etc.	H	Y	The full VUEWorks application standard feature can be used on mobile devices that support a browser, such as tablets and laptops. The standard native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets (See Appendix 1 General [Part 2 of 2] for screenshot pages 17-19)
1.5.4	Ability to use the mobile interface for managing service requests.	H	Y	The full VUEWorks application standard feature can be used on mobile devices that support a browser, such as tablets and laptops. The standard native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets
1.5.5	Ability to use the mobile interface to capture the GPS coordinates of assets,	H	Y	The native VUEWorks

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	work activities and other maintenance related data items.			mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets (See Appendix 1 General [Part 2 of 2] for screenshot page 20-22). This is a standard feature.
1.5.6	Take geotagged and directional photos of assets and attach directly to an inspection, work order, asset record, service request etc.	H	Y	The native VUEWorks mobile application, MobileVUE, provides this capability on multiple mobile devices such as phones and tablets (See Appendix 1 General [Part 2 of 2] for screenshot page 23). This is a standard feature.

1.6. Manage Configuration of Codes, Fields, UI Elements, Workflows

A COTS EAMS needs to be highly configurable and easily customized by the organization, letting administrators, power users and end users do most of the changes to the software themselves.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.6.1	*Ability for an administrator, using in application tools, to create, update, deactivate, user interface elements for standard and configurable functionality, attribute fields etc.*	*M*	Y	VUEWorks is a highly configurable application that is configured through the User Interface by users who have the proper permissions (See Appendix 1 General [Part 2 of 2] for screenshot page 24). This

No.	Requirement	**M/ H-L**	Y-N-M	Description of Solution
				is a standard feature.
1.6.2	*Ability for an administrator to create, update, deactivate/delete MDOT specific codes, terminology, choice lists, labels, verification domains, etc. using tools within the application.*	*M*	Y	VUEWorks is a highly configurable application that is configured through the User Interface by users who have the proper permissions (See Appendix 1 General [Part 2 of 2] for screenshot page 25). This is a standard feature.
1.6.3	Workflows are customizable, in that MDOT business process may be facilitated and enhanced by using workflows within the software. Process sequence, approval gates, automatic notification and triggering of automated functions.	L	Y	Common behavior throughout the application. (See Appendix 1 General [Part 2 of 2] for screenshot page 26). This is a standard feature.
1.6.4	The system will not allow blank code numbers, blank descriptions, or duplicate values to be created in code tables.	H	Y	Standard feature available only to users who have the proper permissions.
1.6.5	The system will only let administrators add or change code values when it does not affect the referential integrity of existing data in the system.	H	Y	Only available to users who have the proper permissions. Cannot delete configuration items that are in use, maintaining integrity of the system. (See Appendix 1 General [Part 2 of 2] for screenshot page 27). This is a standard feature.
1.6.6	The system will not allow a code value to be removed from any code table if that value was used in the business data earlier.	H	Y	Cannot delete configuration items that are in use, maintaining integrity of the system. (See Appendix 1

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				General [Part 2 of 2] for screenshot page 27). This is a standard feature.
1.6.7	The system will provide a way for administrators to determine the sort order of each code table.	H	M	Currently the system only supports alphabetic sorting. Planned feature enhancement will allow Administrators to determine the sort order - alphabetic ascending, descending or in the order entered into the system. This will be a standard feature.
1.6.8	The system will let administrators attach a picture to code table values e.g., arrows).	H	Y	VUEWorks utilizes icons throughout the application that can reference another image file to meet this requirement. This is a standard feature.

1.7. Manage Digital Documents, Drawings and Images

Assets, Inspections, Work Orders and many other objects within the EAMS have documents associated with them. They need to be stored and managed in a way that they are readily available both system wide and in the individual objects.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.7.1	Ability to attach documents such as text, MS Word, PDF, scans, engineering drawings, images etc. to entities within the EAMS.	H	Y	Document attachment is a common feature through the application. Documents can be attached to Assets, work orders, service requests, Condition Assessment records, etc. (See Appendix 1 General

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				[Part 2 of 2] for screenshot page 28). This is a standard feature.
1.7.2	Attach documents to assets and other events simultaneously (e.g., if you attach a digital image to an inspection of a bridge, it is also attached to the bridge).	H	Y	This is a standard feature.
1.7.3	Search for images via asset or event such as an inspection or a work order, date, location or other attribute.	H	Y	Manage Document Links provides the ability to search for documents attached to all elements within the system. (See Appendix 1 General [Part 2 of 2] for screenshot page 29). This is a standard feature.
1.7.4	Display document in a convenient interface that can be viewed by event, or date, or asset.	H	Y	Manage Document Links provides the ability to search for documents attached to all elements within the system. (See Appendix 1 General [Part 2 of 2] for screenshot page 30). This is a standard feature.
1.7.5	Many documents will be pre-viewable with the EAMS, native applications will be called to open the documents.	H	Y	This is controlled by the mime type mapping of the Web server. (See Appendix 1 General [Part 2 of 2] for screenshot page 31). This is a standard feature.
1.7.6	CRUD permissions will be controlled by user, role, and administrative unit.	H	Y	Only users with proper permissions can make modifications to the attached documents. By

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				using these permissions, users can be granted access to different Document Libraries, and locked out of others. (See Appendix 1 General [Part 2 of 2] for screenshot page 32). This is a standard feature.
1.7.7	Version control on documents	L	Y	VUEWorks can track specific versions of documents that are stored locally or in a document management system. This is a standard feature.

1.8. Contractors and Local Agencies

MDOT uses both contractors and local agencies that need to function as an autonomous unit within the EAMS. They need to be restricted to seeing their own data, on the trunk-line assets within their area of responsibility. They have their own resources that must be managed in the system similar to MDOT staff and equipment.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
1.8.1	*Function as an autonomous business unit, having access to the software in a similar fashion to MDOT Garages, but with access limited to the agencies' or contractors' area of responsibility and the assets therein.*	*M*	Y	Controlled access by individual user or role. (See Appendix 1 General [Part 2 of 2] for screenshot page 33). This is a standard feature.
1.8.2	Record Accomplishment for invoicing of MDOT	H	Y	Recording of accomplishments is done through work orders (See Appendix 1 General [Part 2 of 2] for screenshot page 34). This is a standard feature of the Work Order module which is included as part of this proposal.
1.8.3	Management of Work Orders and Crews, Materials and Equipment within the EAMS but with autonomy from other business units.	H	Y	Controlled access by individual user or role. Users in the particular contractor role will only have access to resources available to that role (permission group). (See Appendix 1 General [Part 2 of 2] for screenshot page 35). These are standard features of the Work Order and Resource Manager modules respectively. Both modules are included in this

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				proposed solution.
1.8.4	Gives the Maintenance Supervisor within MDOT the ability to monitor and interact with the contractor or local agency regarding planned work, service requests, budgets, programs, work orders etc.	H	Y	Supervisors can be given access to contractor roles, thus giving them visibility into the work done and managed by the contractor. (See Appendix 1 General [Part 2 of 2] for screenshot page 36). These are planned features of a number of VUEWorks modules, all of which are included in this proposal.

2. Road Network Management

This section describes functionality that is needed in support of the Road Network Management priority area.

2.1 General Location Referencing

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.1.1	*The solution must provide support for imperial units (feet, miles) linear measures for:* • *Datum definition* • *LRM section lengths* • *Inquiry and reporting of measures*	*M*	Y	Datum definition is supported through the Roads and Highways Centerline feature class. LRM section lengths are supported through the LRS Network route geometry. Query and reporting of measures is supported through the Roads and Highways REST API and the Identify Route Locations Tool. (See Appendix 2 Road Network Management for more detail pages 2 to 6) These are standard features.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.1.2	The solution should provide support for 3-D geometry and specific functionality to: • Load 3-D network geometry as part of network definition. • Build and maintain 3-D network topology. • Maintain 3-D spatial arc distances as a basis for linear datum definition and interpolation of offset position.	L	Y	Roads and Highways supports the ArcGIS Topology model as well as digital terrain models for applying 3-D length to the measure values of routes (See Appendix 2 Road Network Management for more detail page 6)
2.1.3	The solution must support the following generic forms of linear referencing within a Linear Referencing Method (LRM): • Route – Measure (distance from origin) • Reference Point - Measure	H	Y	Roads and Highways supports both interpolative and referent offset LRMs. (See Appendix 2 Road Network Management for more detail pages 6-7)
2.1.4	The solution must support the specification of a Cross Sectional Position (XSP) as a component of any defined LRM: • As a user defined XSP code (e.g., Left, Centerline, Right) • As an absolute perpendicular distance measurement	H	Y	Roads and Highways supports an extensible data model that can capture and maintain XSP attributes. (See Appendix 2 Road Network Management for more detail 7-8)
2.1.5	The solution should be capable of offsetting a LRS Event feature position from the road centerline based upon its XSP definition. Vendors are specifically requested to describe in detail how this is accomplished.	L	M	XSP events can be offset if they are registered as external R&H events or if they are located using core ArcGIS functionality, which can be enhanced or automated using Python scripting. (See Appendix 2 Road Network Management for more detail pages 8-9)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.1.6	The solution must support concurrent road network editing such that: • Multiple concurrent edit sessions against a specific database are possible. • Feature locking is enabled to prevent multiple users from making concurrent changes to any LRM section or any associated road network spatial feature or linear datum element.	H	Y	Roads and Highways supports concurrent edit sessions through the ArcGIS versioning model. In addition to this, Roads and Highways prevents editors of routes and events to edit against routes that are already being edited in another version until those edits are complete. (See Appendix 2 Road Network Management for more detail pages 9-10)
2.1.7	The solution must be capable of storing both a LRS location and coordinate location for any LRS Event feature.	H	Y	Roads and Highways event data stores both geometry (x,y) and measure information for all routes and events. (See Appendix 2 Road Network Management for more detail page 10)
2.1.8	The solution must be capable of fully supporting the MDOT Location Referencing Standards, which are attached with this RFP.	H	Y	Roads and Highways extends and enhances the NCHRP 20-27 model suggested by the MDOT Location Referencing Standards. (See Appendix 2 Road Network Management for more detail page 10-11)

2.2 Temporal Data Management

The solution must provide functionality to manage the location of highway assets throughout the asset life cycle (support temporal data management) through integrated workflows within the EAMS Road Network Management module.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.2.1	Road Network Features - road network spatial features are updated and time stamped as changes occur. Spatial history is retained and accessible through system date specification.	H	Y	LRS history is tracked and managed through Roads and Highways time-aware LRS and augmented by ArcGIS editor tracking and geodatabase archiving. (See Appendix 2 Road Network Management for more detail page 11-13)
2.2.2	Linear Referencing Methods (LRMs) - Associated LRM definitions are updated to reflect geometric changes and other situations such as Route renumbering. LRM history is retained and accessible through system date specification.	H	Y	Temporality is maintained through the Roads and Highways time-aware LRS for all types of highways changes. (See Appendix 2 Road Network Management for more detail pages 13-14)
2.2.3	Linear Event Features - Associated LRS event feature locations are updated to reflect geometric changes. Business rules are applied at the asset class level to determine whether assets are retired or relocated when changes occur. Event history is retained and accessible through system date specification.	H	Y	Event locations are managed through Roads and Highways event behavior and are temporally linked to the configuration of the route through route editing activities. (See Appendix 2 Road Network Management for more detail pages 14-17)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.2.4	Cross Reference Polygons – area spatial features that are used for aggregation and reporting of assets (e.g., MDOT Regions, political boundaries) are updated and time stamped as changes occur. Spatial history is retained and accessible through system date specification.	H	M	A geoprocessing model can be created with COTS ArcGIS geoprocessing tools to generate and maintain spatially derived event data. Once created, the geoprocessing model can be made available inside of ArcGIS Desktop for users or can be published as a web service to be consumed by any external applications that can make a request to the web service. (See Appendix 2 Road Network Management for more detail pages 17-18)
2.2.5	The solution should have both batch loaders and core asset load functionality included within the software to load business data against the road network at any point in time for which the network is defined – not just the current network date.	H	M	A geoprocessing model can be created with COTS ArcGIS geoprocessing tools to batch load event data based on one temporal view of the LRS and then update event measures based on the current temporal view of the LRS. (See Appendix 2 Road Network Management for more detail pages 18-19)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.2.6	The solution should have the capability to maintain an audit log of changes that can be accessed through a system inquiry function and either directly printed or exported to a report file in PDF, HTML, XML, or CSV file format. This audit log should be available for changes made to Anchor Section geometry, LRMs and business data events.	L	Y	Roads and Highways maintains an LRS Edit Log table that tracks all edits, who made them, when they were made and what type of edit was performed. (See Appendix 2 Road Network Management for more detail pages 19-20)

2.3 Multiple LRM Support

The solution must provide functionality to integrate and manage roadway location data from MDOT business applications that encompass multiple LRMs into the MGF PR Segment based LRS network datum through integrated workflows within the EAMS Road Network Management module.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.3.1	*Support for MDOT LRMs – The solution must support the following specific LRMs as defined within the MDOT Location Referencing Standards:* • *PR Segment – Mile Point (PR-MP)* • *Control Section – Mile Point (CS-MP)* • *Route – Mile Point (Route-MP)*	*M*	Y	Supported through the configuration and maintenance of Roads and Highways LRS Networks. (See Appendix 2 Road Network Management for more detail page 20). This is a standard feature.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.3.2	MDOT business LRMs are registered against the PR Segment linear datum and managed as changes occur. New LRMs are defined as needed using the same approach.	H	Y	New LRMs can be added to the ALRS network and have data loaded against them. The Remove Centerline Geometry Duplication ensures that one and only one centerline feature is used to generate route geometries at any given location. (See Appendix 2 Road Network Management for more detail page 20)
2.3.3	MDOT LRS business events are located against the PR Segment linear datum and then can be reported / analyzed against any defined LRM. Locations are managed and updated as changes occur.	H	Y	Event data is materialized as a feature class and can be analyzed against other event data from other LRMs through spatial overlay. (See Appendix 2 Road Network Management for more detail page 21)
2.3.4	LRM Gaps - The solution must support the following LRM Gap functionality: • Measures may continue across the gap. • Measures may be discontinuous across the gap (length of gap not included in measure values beyond it).	H	Y	Gaps are fully supported in Roads and Highways. Gaps may be configured for calibration purposes to continue across the gap or be discontinuous through a step value, an addition of an arbitrary length, or an addition of a Euclidian distance. (See Appendix 2 Road Network Management for more detail page 22)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.3.5	LRM Overlaps - The solution must support the following LRM Overlap functionality: • Multiple Routes may exist along any section of geometry. • Assets may be reported against any overlapping Route. • A Route (LRM) may be assigned priority for reporting of assets where overlaps occur.	H	Y	Overlaps are fully supported in Roads and Highways. Route priority can be configured in Roads and Highways by creating route dominance rules to determine what happens to events when the underlying, overlapping route changes. (See Appendix 2 Road Network Management for more detail page 22-23)

2.4 Location Translation

The solution should provide functionality to translate asset location references amongst the various MDOT business LRMs and the MGF PR-MP LRM, and between LRMs and other geospatial referencing methods (coordinates, indirect referencing) through integrated workflows within the EAMS Road Network Management module.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.4.1	Translation between defined LRMs is available to all EAMS applications.	H	Y	The Roads and Highways Server REST API provides endpoints to translate route measures from one LRM to another. (See Appendix 2 Road Network Management for more detail page 24)
2.4.2	Translation between coordinates and LRMs is available to all EAMS applications and batch loaders.	H	Y	The Roads and Highways Server REST API provides (See Appendix 2 Road Network Management for more detail page 24)
2.4.3	Translation between indirect location references and coordinates / LRMs is	L	Y	Translation from route and

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	available to all EAMS applications. An indirect location reference is defined as a reference to the identifier of an existing spatial feature (e.g., a Property ID or Bridge Number).			measure plus offset, x,y plus offset, feature or event location plus offset are all supported by leveraging the Roads and Highways Server REST endpoint for obtaining a route location and then adding or subtracting the requisite offset. (See Appendix 2 Road Network Management for more detail pages 24-25)

2.5 Road Network Reporting

The solution should provide functionality to visualize / analyze / map / report road network assets through integrated workflows within the EAMS Road Network Management module.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.5.1	EAMS users can visualize / analyze / map / report on road network assets against any defined LRM using both spatial and textual database tools.	H	Y	Roads and Highways events are materialized as feature classes which have full support for creating the spatial overlays used in generating feature based reports. They also store route and measure information that can support tabular based reports. (See Appendix 2 Road Network Management for more detail page 25)
2.5.2	EAMS users can produce customized Straight Line Diagrams (SLDs) encompassing specific assets against any defined LRM.	H	Y	Road Analyzer is Transcend's Straight Line Diagramming (SLD) solution. Road Analyzer contains a database driven, interactive straight-line diagramming environment, with an integrated location map and video log display. All data displayed on the screen is placed using basic linear referencing methods from a relational database. Road Analyzer supports the ability to utilize multiple LRMs and can convert between LRMs on

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				the fly (See Appendix 2 Road Network Management for more detail pages 25-31).
2.5.3	Dynamic Segmentation – the solution must provide functionality to segment the road network for analysis and reporting purposes based upon changes in specified attribute value within one or more linear event classes (e.g., segment the network based upon changes in Functional Class and surface type).	H	Y	The Roads and Highways Roadway Characteristics Editor has a Return Attribute Set option that dynamically segments event layers and returns an individual record for each contiguous, unique occurrence of event attribute combinations. (See Appendix 2 Road Network Management for more detail page 32-33)
2.5.4	Cross References - the solution should provide functionality to define and maintain linear cross reference feature classes (e.g., Highway Classification, Traffic Section) as linear events. Cross references are used to dynamically segment the network for user inquiry, display and reporting purposes. It must be possible to specify the location of cross references using any defined LRM.	L	Y	Roads and Highways supports the interrogation and reporting of cross reference events through the Roads and Highways Server REST API. Additionally, the Translate Events from LRM to LRM geoprocessing tool can support creating additional publication layers across multiple LRMs. (See Appendix 2 Road Network Management for more detail pages 33-34)

2.6 Support for MDOT Location Referencing Business Processes

The Road Network Management module of the EAMS solution should provide functionality to replicate and where possible improve existing and proposed MDOT business processes associated with location referencing management through integrated workflows.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.6.1	The Vendor should describe how their proposed COTS Road Network Management module can support and improve upon the following EAMS Phase 1 “To-Be” Location Referencing business processes:: • Update Road Network • Publish Road Network • Locate Business Data for Asset Management In particular, the Vendor is requested to comment on how their software can consume periodic published versions of the Michigan Geographic Framework (MGF) road centerline network spatial data and associated migration files so that LRS data stored in EAMS can remain synchronized with the MGF.	H	Y	Roads and Highways redlining capability combined with ArcGIS Workflow Manager and the ArcGIS Detect Feature Changes geoprocessing tool. (See Appendix 2 Road Network Management for more detail pages 34-35)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
2.6.2	The Vendor should describe how their proposed COTS Road Network Management module can support and improve upon the following EAMS *Future Vision* "To-Be" Location Referencing business processes: • Update & Publish Road Network • Locate Business Data for Asset Management In particular, the Vendor is requested to comment on how their software can be effectively integrated within an enterprise geospatial technology architecture hosted by DTMB for maintaining the MGF.	H	Y	Integration with MGF will follow a specific process flow: 1. Routes are updated in MGF 2. Redlines are pushed to Roads and Highways 3. Routes are updated in Roads and Highways 4. EAMS event locations are automatically synchronized to route edits 5. EAMS routes and events are published 6. Publication data is distributed to the enterprise (See Appendix 2 Road Network Management for more detail page 35-36)

3. Asset Inventory Management

This section describes functionality that is needed in support of the Asset Inventory Management priority area.

3.1 Manage Asset Inventory Library

Managing an asset registry, attribute information, component element information as well as hierarchical asset relationships across multiple asset types.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
3.1.1	*Create, Read, Update Deactivate/Delete (CRUD) Asset types. Nonstandard asset types will be fully configurable and have the same behavior characteristics as standard asset types.*	*M*	Y	Fully supported for both spatial (GIS) assets as well as vertical assets (Facilities). (See Appendix 3 Asset Inventory Management for screenshot page 2) This is a standard feature.
3.1.2	*Have the ability to define the attributes associated with each type of asset. Attributes will be any data type, with the ability to manage in excess of 100 unique attributes per asset type.*	*M*	Y	Fully supported for both spatial (GIS) assets as well as vertical assets (Facilities). (See Appendix 3 Asset Inventory Management for screenshot page 3). This is a standard feature.
3.1.3	*Define complex assets with multiple elements, each with its own set of attributes. Attributes for elements will be configurable, be of any data type. The system will be able to manage in excess of 100 attributes per component.*	*M*	Y	Fully supported by the Facilities module. (See Appendix 3 Asset Inventory Management for screenshot page 4). This is a standard feature.
3.1.4	Define the type of location referencing used for each type of asset (absolute, linear or both), compatible with MDOT GIS technology. (Esri)	H	Y	Fully supported for both spatial (GIS) assets as well as vertical assets (Facilities

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				module).
3.1.5	Define allowable association of assets in a hierarchical Parent / Child relationship. These relationships are to be usable for roll up reporting, queries, budgeting etc. Referential integrity will not allow a Parent asset to be deleted or deactivated without dealing first with the Child assets, or all at the same time.	H	Y	Fully supported by the Facilities module. (See Appendix 3 Asset Inventory Management for screenshot page 5)
3.1.6	Store, retrieve and display documents (images, drawings, etc.) associated to an asset.	H	Y	Document attachment is a common feature through the application. Documents can be attached to both spatial (GIS) assets and vertical assets (Facilities). (See Appendix 3 Asset Inventory Management for screenshot page 6)
3.1.7	Assign user and system unique IDs to assets. Once an asset has been referenced, this ID should either remain static or be changed in all references to the asset.	H	Y	Fully supported for both spatial (GIS) assets as well as vertical assets (Facilities). (See Appendix 3 Asset Inventory Management for screenshot page 7)
3.1.8	Search assets by name, ID or other attributes, both by type and globally, by administrative unit or by parent asset.	H	Y	Fully supported for both spatial (GIS) assets as well as vertical assets (Facilities). (See Appendix 3 Asset Inventory Management for screenshot page 8)
3.1.9	Facilitates the bulk loading of assets, attributes and locations easily.	H	Y	Configurable import utilities are part of the system. (See Appendix 3 Asset Inventory Management for screenshot

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				page 9)
3.1.10	The system will let administrators lock individual attribute fields for an asset type.	H	Y	Although VUEWorks does not provide field-level security within the application, it can inherit security configurations managed within ArcGIS Server.
3.1.11	Control access to CRUD rights for the asset library through both user roles and administrative units. Rights will extend down to individual attributes, or groups of attributes within an asset type.	H	Y	Configurable through user control administration (See Appendix 3 Asset Inventory Management for screenshot page 10)

3.2 Field Data Integration

The Road Network Management module of the EAMS solution should provide functionality to capture changes to roadway assets as a by-product of on-going construction and maintenance activities using GPS enabled field data collection systems and CAD integration.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
3.2.1	*The solution should provide functionality to enable EAMS assets to be updated and time stamped as changes occur through integrated business process workflows that capture changes using GPS enabled field data collection systems. The Vendor is requested to specify whether additional software modules are needed to meet this requirement and if additional licensing costs are incurred.*	*M*	Y	VUEWorks can display the timestamp recorded against GIS data by exposing the data fields that are managed in the geodatabase. The fields are stored as attributes in the geodatabase and will update as the geodatabase is edited over time. ArcGIS for Server is leveraged by both the VUEWorks and Roads and

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				Highways solution. ArcGIS for Server supports the capability to track edits through web feature services. These web feature services can facilitate receiving updated information on EAMS assets that are the result of GPS field data collection systems. As a quality control measure, Esri's COTS Data Reviewer and Workflow Manager extension products for Desktop (delivered as part of the Roads and Highways solution) can be used to define data quality checks, review changes and manage the overall workflows between field-based data collection through GPS and the EAMS assets.
3.2.2	The solution should provide functionality for loading of road network LRM asset data using configurable batch loaders, including comprehensive validation and full error reporting. The following location options should be supported: • LRM location • Coordinate location – translated to LRM location as part of load process The Vendor is requested to document the functionality provided, including input data requirements, to ensure that coordinate locations are snapped to the correct road network geometry.	H	M	A geoprocessing model can be created with COTS ArcGIS geoprocessing tools to batch load event data based on one temporal view of the LRS and then update event measures based on the current temporal view of the LRS.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				(See Appendix 3 Asset Inventory Management for screenshot pages 11-12)
3.2.3	The solution should provide functionality to enable EAMS assets to be updated and time stamped as changes occur through integrated business process workflows that capture changes in CAD. The Vendor is requested to specify whether additional software modules are needed to meet this requirement and if additional licensing costs are incurred.	L	Y	VUEWorks can display the timestamp recorded against GIS data by exposing the data fields that are managed in the geodatabase. The fields are stored as attributes in the geodatabase and will update as the geodatabase is edited over time. As CAD data is updated, the resulting conversion to geodatabase format will capture this information. ArcGIS Data Reviewer and Workflow Manager extension products for Desktop (delivered as part of the Roads and Highways solution) can be leveraged to filter and detect changes to assets initiated by edits performed in CAD. The solution would consume CAD layers either through WMS web services or directly through the periodic loading of native CAD files. Changes detected can be flagged for inclusion into the EAMS asset

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				database. This process can be automated and governed by Workflow Manager while incorporating data quality and review/approval checks.

3.3 Manage Inspections and Condition Information

Manage Inspections, inspection data both general and specific to asset types.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
3.3.1	*Define condition inspections for asset types*	*M*	Y	Fully configurable condition forms, which can be associated with Asset Types (See Appendix 3 Asset Inventory Management for screenshot page 13). This is a standard feature.
3.3.2	*Define Regulatory inspections for asset types*	*M*	Y	Accomplished through condition forms and/or work order forms. (See Appendix 3 Asset Inventory Management for screenshot page 14). These are standard features.
3.3.3	*Record individual Condition Inspections on Assets, include asset specific and user condition indices, date, time, inspector. These will be linked to assets in the asset inventory.*	*M*	Y	Condition forms can be configured to support this. Condition records are associated with assets over

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				time. (See Appendix 3 Asset Inventory Management for screenshot page 15). This is a standard feature of the Condition module which is included in this proposed solution.
3.3.4	Define Performance inspections for work performed by work order or contract which include but are not limited to, accomplishment verification, quality of work and defects/non-compliance recording.	H	Y	Accomplished through work order forms and workflows. (See Appendix 3 Asset Inventory Management for screenshot page 16)
3.3.5	Asset specific condition recording (e.g., highways require linear referenced condition information, bridges require component information and Bridge Condition Index calculations, signs require retro reflectivity).	H	Y	An unlimited number of configurable condition forms can be created to capture different condition information specific to certain Asset Types. (See Appendix 3 Asset Inventory Management for screenshot pages 17-19)
3.3.6	Search for inspections by type, asset, inspector, date, other inspection attributes.	H	Y	Condition records can be queried using the Condition Filter page. (See Appendix 3 Asset Inventory Management for screenshot page 19)
3.3.7	Provide ability to create standard and user defined queries within the system to show assets in order of condition, or in groups of condition classes by most recent inspection.	H	Y	Saved filters can be created and managed using the Condition Filter page. (See Appendix 3 Asset Inventory Management for screenshot page 20)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
3.3.8	Provide ability to create standard and user defined queries within the system to show contract non-compliances. Summarize the current outstanding by contractor.	L	Y	Saved filters can be created and managed using the Condition Filter page. These filters can be applied to select non-compliance assets which can in turn be displayed on the map, in the Facility Manager and/or reported against. (See Appendix 3 Asset Inventory Management for screenshot page 21)

4. Maintenance Management

This section describes functionality that is needed in support of the Maintenance Management priority area.

4.1 Maintenance Program and Budget Planning

Budget Planning for highway maintenance is carried out on an annual basis with Region, TSC and Garages identifying their preventative and scheduled maintenance needs and developing alternative programs based on budget allocations. Programs and projects have budget allocations which need to be compared to actual expenditures on a daily, weekly, monthly and annual basis. Budgets are broken down into sub budgets and allocated to different administrative units such as a region or garage. Non Maintenance Program projects also have budgets that must be tracked whether they are capital, disaster recovery, or accident repairs.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.1.1	*Create, Read, Update Deactivate/Delete (CRUD) Programs with multiple sub budgets, to which projects and Work Orders can be assigned.*	*M*	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 2). This is a standard feature of the Budget Forecasting module which is included in the proposed solution.
4.1.2	*Define preventative and scheduled maintenance on asset types. Set cycle time for inspections, operations activities, maintenance etc.*	*M*	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 3). This is a standard feature of the Work Order module which is included in the proposed solution.
4.1.3	*Prioritize maintenance activities and compare planned maintenance with accomplishments in order to determine deferred maintenance at the end of the year to support budget requests.*	*M*	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2]

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				for screenshot page 4). This is a standard feature of the modules which are included in the proposed solution.
4.1.4	*Create, read, update, delete / deactivate annual work plans based on need identified through planned work orders. Plans should be Tied to budgets and hierarchical.*	*M*	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 5). This is a standard feature of the modules which are included in the proposed solution.
4.1.5	*Create, read, update, delete / deactivate flexible schedules (daily, weekly, bi-weekly, monthly) for maintenance activities based on annual work plan*	*M*	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 6). This is a standard feature of the modules which are included in the proposed solution.
4.1.6	Flexible hierarchical budget structure. MDOT has Statewide, Region, Transportation Service Center, Garages, County Road Commissions, Municipalities, and other local agencies. They must fit in a budget and financial accounting structure.	H	Y	Fully supported by the work order system. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 7)
4.1.7	Control access to CRUD rights for the budgets, Programs, and PCA Codes through both user roles and administrative units.	H	Y	Configurable through user administration control (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 8)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.1.8	Option to pre-fill the planning tool using multi-year averages of either accomplishment or hours (constrained, unconstrained, and deferred) to create new needs-based plan with the ability for user to modify as needed.	H	Y	This information can be configured in the Budget Forecasting and Projects modules and used to plan for maintenance activities and cost.
4.1.9	Provide suggested list of preventative and scheduled maintenance based on asset type and date of last scheduled maintenance of that type.	H	Y	Supported by work order system. As these critical dates are loaded, the user can query the "Pending" work orders created to satisfy the life-cycle maintenance plan for this asset.
4.1.10	Linkage to work orders, and inspections to reset the schedule time when completed.	H	Y	All work orders have the ability to be associated with a project that is defined in the Projects module.
4.1.11	Determine performance based budgets between regions, counties, garages, etc.	H	Y	Standard and ad hoc reporting will support this analysis. Also dashboards can be set up on a Region, County or Garage-level to compare performance data.
4.1.12	Determine maintenance needs systematically based on condition	H	Y	Fully supported by work order and condition system (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 9)
4.1.13	Create, read, update, delete / deactivate constrained and unconstrained work plans at any time throughout the year and graph resource needs (labor, equipment and materials) for both constrained and unconstrained work plans,	H	Y	The creation of the work plan is completed in VUEWorks' Budget

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	and track changes			Forecasting and Projects modules, but the reporting function and the analysis would occur outside the VUEWorks application (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 10).
4.1.14	Compare plans to actual work completed to calculate deferred maintenance.	H	Y	Fully supported in the Projects module (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 11)

4.2 Manage Work Orders

Use Work Orders to package up tasks that are carried out on a particular asset or group of assets. Work is planned as a work order, then scheduled, resources are allocated, and accomplishment is recorded along with project cost and effort information. Materials equipment and vehicles used are charged. The work order is then debited to a specific project/program. Staff timekeeping can also be generated from work orders.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.2.1	*Ability to Create, Read, and Deactivate/Delete work orders.*	*M*	Y	Fully supported by and a standard feature of the Work Order module. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 12). The Work Order module is included in this proposed solution.
4.2.2	*Attach work orders to specific assets or to a location along a linear asset such*	*M*	Y	Work orders can be attached to specific assets

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	as a highway.			in the system or dynamic segments can be created for work along a linear asset. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot). This is a standard feature of the Work Order module which is included as part of this proposed solution.
4.2.3	*Users can choose a work order type and debit the expenses to a particular budget item and program. Costs show up as committed for planned work orders and expenditures for costs actually incurred.*	*M*	Y	Supported as Funding sources and estimated vs. actual costs. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 13). This is a standard feature of the modules which are included as part of this proposed solution.
4.2.4	*Use work orders to assign staff, crews, equipment and vehicles.*	*M*	Y	Fully supported by and a standard feature of the Work Order module. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 14). The Work Order module is included as part of this proposed solution.
4.2.5	*Use work orders to plan the use of materials.*	*M*	Y	Fully supported by and a standard feature of the Work Order module. (See Appendix 4 Maintenance

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				Management [Part 1 of 2] for screenshot page 15). The Work Order module is included as part of this proposed solution.
4.2.6	*Use work orders to plan the use of contract labor, equipment and crews.*	*M*	Y	Fully supported by and a standard feature of the Work Order module. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 16). The Work Order module is included as part of this proposed solution.
4.2.7	*Use work orders to estimate the budget of a project by calculating the expenditures automatically from the estimated use of either standard plans or individually entered plans (labor, equipment and materials)*	*M*	Y	Fully supported by and a standard feature of the Projects and Work Order modules. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 17). These modules are included as part of this proposed solution.
4.2.8	*Use work orders to record accomplishment in terms of a pre-defined configurable quantity.*	*M*	Y	Fully Supported by and a standard feature of the Projects and Work Order Modules (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 18). These modules are included as part of the proposed solution.
4.2.9	*Use work orders to record use of labor, equipment, vehicles, materials and*	*M*	Y	Fully supported by and a

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	hired contractors			standard feature of the Work Order module. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 19)
4.2.10	*Use work orders to track the actual expenditures on a project.*	*M*	Y	Work orders can be associated with a project for rollup reporting and tracking. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 20). This is a standard feature of the Work Order module which is included as a part of this proposed solution.
4.2.11	Assign Work Orders to a responsible supervisor.	H	Y	Work orders can be assigned to an individual user or a role. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 21)
4.2.12	Use work orders to plan and schedule work. Work orders will be as easy to move around for a supervisor as and outlook calendar.	H	Y	Fully supported by the Work Order module (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 22)
4.2.13	Create Read, Update Deactivate /Delete (CRUD) Work Order types. Nonstandard work order types will be fully configurable (Attributes, interface etc) and have the same behavior characteristics as standard types.	H	Y	An unlimited number of work order forms can be created and associated with different work activities. (See Appendix 4 Maintenance Management

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				[Part 1 of 2] for screenshot page 23)
4.2.14	Work Orders can contain one or more PCA Codes which will be used to code labor equipment and materials cost and effort.	H	Y	This can be supported by fields on a work order form. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 24)
4.2.15	Use work orders to compare planned work to actual in terms of expenditures, labor, equipment, materials usage.	H	Y	Accomplished by linking work orders to projects. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 25)
4.2.16	Use work orders to gather together work performed on a group of assets, either as a long term program or budget, or as a short term work plan.	H	Y	Work orders can be attached to assets and projects. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 26)
4.2.17	Show work orders spatially on a map for a given time interval.	H	Y	Accomplished through work order points on the map. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 27)
4.2.18	Search spatially for work orders.	H	Y	Work orders can be selected on the map spatially. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 28)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.2.19	Use the number of assets or the length of the assets when they are linear to pro-rate the labor, equipment, and materials expenditures within a work order or group project. Allow the supervisor to weight the assets if one asset required more work than others.	H	Y	Fully supported by the Work Order module (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 29)
4.2.20	Ability to track all costs associated with emergency response work for a particular incident (e.g., flooding, storm damage, high load hit, etc.).	H	Y	Can be accomplished by establishing an emergency response Project and then all work done through work orders can be associated with this Project. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 30)
4.2.21	Ability to query/view hours spent on each activity by location on the highway network per pay period for Direct Forces and Contract Maintenance (as available).	H	Y	Fully supported by the core searching features (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 31)
4.2.22	Ability to apply, reference, and generate standard operating procedures as well as performance standards for a work order type.	H	Y	Accomplished by defining a Work Flow and associating it with a Work Order Type (Form). (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 33)
4.2.23	Evaluation tool to measure how efficiently crews perform when compared to planned performance.	H	Y	This is handled using Find/Manage/Report functionality in VUEWorks.
4.2.24	Search for work order by assignment, asset, date, type, administrative unit, budget etc.	H	Y	Fully query capability across all work orders is supported on the Work Order Filter tab. Common

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				queries can be saved to named filters, making searching much more efficient. (See Appendix 4 Maintenance Management [Part 1 of 2] for screenshot page 34)

4.3 Manage Work Orders – Sign Specific Requirements

Sign maintenance either occurs as a result of the annual sign maintenance program, an event such as an accident that knocks down a sign, or through other maintenance or capital work where signs need to be removed, modified or re-arranged. Planned sign maintenance involves both a five year and annual plan that results in consultants developing a "design" before a contract is let. Planned sign maintenance projects have Job #s. Unplanned sign work requires a Transportation Work Authorization (TWA) after which work is usually carried out by MDOT forces. Job #s are not assigned for unplanned work. After completion of the contract or the maintenance work, the sign inventory is updated to reflect the changes.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.1	When more than one sign is selected for a sign installation, the system will automatically arrange the cluster of signs according to MDOT's Roadside Installation Grid.	L	Y	Fully supported by VUEWorks Core (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 2)
4.3.2	The system will show when an asset in inventory is included in an active contract, TWA or maintenance Project.	H	Y	Each project, work order and work activity is accessible at the asset level.
4.3.3	The system will provide read-only information from MDOT's SafeStat (Oracle) database for signal data which may impact the TWA or contract design. Information will include Signal Head, Pedestrian Signal, Case Sign and Turn Arrow information for normal status records.	L	Y	Fully supported through data linking (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 3)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.4	The system will let users attach one or more pictures to a contract showing any installation changes. The inventory will be updated with the picture(s) when the contract is complete.	L	Y	Fully supported through data linking (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 4)
4.3.5	When user first views a map, the mapping technology will automatically zoom in to the CS-MP or PR-MP location identified on the Job # or TWA.	L	Y	Fully supported by VUEWorks Core (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 5)
4.3.6	The system will interface with MDOT's MAP (Oracle) database to pull in Job # data and the associated CS-MP and/or PR-MP locations.	H	Y	Configurable through data linking (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 6)
4.3.7	If the project has a Job# then the system will interface with MDOT's MAP (Oracle) database to check for changes in CS-MP data since the contract was last updated.	H	M	Although this is handled through Data Linking, a custom integration would have to be built to handle how often the integration activity would occur (e.g. hourly, weekly, monthly).
4.3.8	The system will limit the inventory which can be included in a contract to the CS-MP range defined on the Job # or project # or a job-level defined distance from the range.	H	Y	During the import process the "Quantity" of a Job can be set up for the Work Order.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.9	The system will provide a warning message if an inventory record which is already included in another active contract, TWA or maintenance project is selected for inclusion in the contract	H	M	Currently, quantities are tracked and reported based on inventory availability. This would be a simple modification to track inventory or materials that are “reserved”.
4.3.10	The inspector can update a contract when actual asset specifications vary from the contract specifications, but are acceptable.	H	Y	Fully supported through Condition module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 8)
4.3.11	The system will provide a report which details the deviations from the design found during inspection.	L	Y	Fully supported through Condition module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 9)
4.3.12	The system will allow inspection information to be entered over a period of time as the project progresses.	H	Y	Fully supported through Condition module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 10)
4.3.13	The system will require entry of the inspector’s name when closing a contract.	L	Y	Fully supported through Condition module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 11)
4.3.14	When the inspector records that the inspection is complete, they must select a contractor.	L	Y	The contractor selection can be made “Required”, so the Condition record cannot be closed until a contractor is selected.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.15	When an inspection is marked complete, the system will update the inventory information based on the contract specifications.	H	Y	The materials used will be tracked within the Work Order, so this information will be available.
4.3.16	The system will let users close only part of a contract, by selecting one or more CS's.	L	Y	This is a workflow defined by the client and VUEWorks can handle Parent-Child relationships within the Work Order module. Part of a Contract can be held open as other parts are closed.
4.3.17	When a user closes only part of a contract, the inventory will update the portion of the contract that was closed.	L	Y	Once inventory usage is copied to "Actuals" it is removed from the current count.
4.3.18	For each part of a contract that is closed, another inspection and inspector's name will be required.	L	Y	These are fields that can be set to "Required" on the form.
4.3.19	The system will provide a confirmation message when a user tries to close a contract, verifying that they actually want to close the contract.	H	Y	This functionality exists as part of the Core and Work Order products.
4.3.20	When a contract is closed, the system will send an email to the creator of a contract, administrators, anyone who has the authority to change the contract, the assigned consultant, and the assigned contractor to notify them of the closing.	L	Y	Fully supported through the Work Order module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 14)
4.3.21	If the project has a job number then the system will provide the date of closing to MDOT's MAP (Oracle) database which will trigger the closing of the job in the MAP database.	H	M	This is a project-specific function that will be defined and implemented as part of this project.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.22	Once a contract is closed, it cannot be reopened in the future.	L	Y	This is controlled by permissions in the “Setup Users” portion of VUEWorks Core.
4.3.23	The system will keep closed contract records for a configurable amount of time, which can be set by administrators. Once the time expires, the records will be permanently deleted from the database.	H	M	This is typically handled by the batch routine that is synchronizing this data from the Oracle database. For example, any contract older than xxxx – exclude from the synchronization process.
4.3.24	The system will allow the creation of a model design to plan out a future contract, which can be converted into a contract when a Job # becomes available.	L	Y	VUEWorks can plan out projects using the Budget Forecasting and Projects module. These can then be converted into actual contracts once a Job # is available.
4.3.25	The system will let the administrator and the creator of the model design modify the model design.	H	Y	These are completely configurable in the Work Order – Form Designer.
4.3.26	The system will let the administrator and the creator of the model design add users with modify authority on the model design.	H	Y	Users can be added as part of the “Notification” list which grants them access to the Contract.
4.3.27	The system will let users highlight the use of non-standard assets in the model design.	L	Y	Any GIS or Facility Asset can be added to the model design.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.28	The system will provide information from MDOT's TCS (Oracle) database for traffic control orders which may impact the model design. Information will include CS, Begin and End MP, Zone Type, Speed Limit, To and From Street Names, Status of TCO and access to the signed TCS .pdf document (currently stored in ProjectWise).	L	M	The Oracle database connection will be handled through Data Linking and a custom transaction tool to synchronize data between databases.
4.3.29	The system will provide an informational message if an inventory record on the model design is part of an active contract, TWA or maintenance job.	H	M	This is a minor modification to the existing functionality that tracks inventory "on-hand", but will be set up to notify the user of inventory "Reserved".
4.3.30	Model designs can be modified or deleted by the administrator or users with modify authority on the model design.	H	Y	VUEWorks – Setup Users will handle the users and their access.
4.3.31	When a user tries converting a model design to a contract, the system will check if selected asset installations are part of an active contract, TWA or maintenance project. If found, a warning message will be displayed.	H	M	This is a minor modification to the existing functionality that tracks Assets, but will be set up to notify the user of Assets that are "Reserved".
4.3.32	When a user tries converting a model design to a contract, the system will check if selected asset installations have changed in inventory since being pulled into the model. If changed, an error message will be displayed and the model design will not be converted to a contract.	H	Y	Assets can be added to a Project and then verified before converting to a contract.
4.3.33	When a user tries converting a model design to a contract, the system will check if selected asset installations fall within CS/MP range of job#. If assets do not fall within range, an error message will be displayed and the model design will not be converted to a contract.	H	M	The Oracle database connection will be handled through Data Linking and a custom transaction tool will be written to synchronize data between databases.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.3.34	If the user receives any errors while converting a model design to a contract, they have the option to modify the model design to fix the errors, to close the design, or to exit without making any changes.	H	M	This is a Workflow design, which is future functionality for VUEWorks (4Q 2014).
4.3.35	When a model design becomes a contract, the system will delete the model design.	L	Y	The user has the option to delete or not-delete the model during the conversion process.

4.4 Manage Workers and Crews

Workers are resources used within the EAMS. Their Time is charged to work orders by supervisors. Workers can belong to a particular crew and charged to a work order or a task as a group. Workers can be loaned or borrowed from one crew to another if required. Temporary Crews can be created to accommodate a seasonal requirement.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.4.1	*Create, Read, Update and Deactivate/Delete crew types, crews.*	*M*	Y	This is a standard feature of the Resource Manager and Work Order modules which fully support the management and use of crews. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 17). These modules are included in this proposed solution.
4.4.2	*Assign Workers to Crews, admin units, regions etc.*	*M*	Y	Fully supported through and a standard feature of the Work Order and Resource Manager modules (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				page 18). These modules are included in this proposed solution.
4.4.3	Assign multiple rates for use on work orders when recording labor performed by a worker. These will be flexible enough to cover all types of collective agreements	H	Y	Resource Manager supports an unlimited number of rate types. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 19)
4.4.4	Ability to transfer a worker from one Crew/Admin Unit/Region to another	H	Y	This can be recorded through Time Recorder and doesn't need to be associated with a work order. A worker can be moved through the Resource Manager module.
4.4.5	Record Leave of all types as well as non-work order time, debit a program or budget	H	Y	Fully supported through Work Order module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 20)
4.4.6	Track a Worker's qualifications and course work. Alert a supervisor when a worker's qualifications are running out.	L	Y	The Personnel portion of the Resource Manager module can track specific certifications and their expiration.
4.4.7	Ability to loan and borrow workers between Crews/Admin Units/Regions etc.	H	Y	Workers can be utilized on another Unit/Region's work orders. A user with access to the resources of another Unit/Regions can cross-associate. (See Appendix 4 Maintenance Management

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				[Part 2 of 2] for screenshot page 21)

4.5 Manage Fleet and Equipment

Manage information regarding the vehicles and equipment that are to be used against work orders.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.5.1	*Create, Read, Update and Deactivate/Delete Equipment type, vehicle types and vehicles*	*M*	Y	Fully supported through the connection between the Facilities and Resource Manager modules (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 22). This is a standard feature of these modules which are included in this proposed solution.
4.5.2	*Ability to assign equipment or vehicles to a particular admin unit or crew.*	*M*	Y	Fully supported ability to assign equipment to a worker or particular crew. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 23). This is a standard feature.
4.5.3	Ability to store rates, either based on classification or individual vehicle for use in project cost accounting in work orders.	H	Y	Equipment can have an unlimited number of Rate Types associated with it. When the equipment is used on a work order or Time Record, the rate type

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				can be selected. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 24)

4.6 Manage Customer Service

MDOT has both internal and external complaints, inquiries and requests that need to be tracked, considered in planning of activities and resolved. These are tracked in a logical work flow.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.6.1	Track customer Complaint Inquiry or Requests as well as response time and resolutions.	H	Y	Fully supported through the Service Request module. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 25)
4.6.2	Track customer contact information.	H	Y	Fully supported through the Service Request module (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 26)
4.6.3	Tie Customer complaints to specific locations, linear or absolute, on the trunk highways and/or attached to specific assets as well.	H	Y	Service requests can be spatially referenced either by a spatial point or by associating them with specific assets. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 27)
4.6.4	Create a service request from a CIR and assign it to staff to resolve.	H	Y	Service requests can be assigned to individuals or a

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				role. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 28)
4.6.5	Provide real-time statistics on service requests. i.e. open, closed in a particular period, average time to resolution etc.	H	Y	All resolution information is tracked with each service request and is available to be queried on the Service Request Filter form. All fields, including durations, are available for filtering and reporting. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 29)
4.6.6	Allow anyone with access to the system to enter a service request and assign it to be reviewed i.e. if staff identify a need and wish to put it in the system to be considered for maintenance or heavy maintenance.	H	Y	Any user of the system can be granted permission to enter service requests.
4.6.7	Service Requests should carry an urgency rating and a description of the problem	H	Y	The Service Request Form is fully configurable to include whatever information the agency deems necessary. All fields on a Service Request are available for filtering and reporting.
4.6.8	Service Requests should have the ability to be converted to a Work Order with a complete estimate on cost and effort.	H	Y	Work orders can be generated from service requests. The type of work order can be associated with the particular service request issue type and can be automatically generated.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				(See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 30)

4.7 Performance

Through the use of software tools and analytics, supervisors, managers and executive can compare business units, and Regions with one another, standard operating procedures and performance standards.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
4.7.1	*Record, track and report on performance of maintenance activity achievements and Level of Service.*	*M*	Y	Robust reporting of all data within the system is available. (See Appendix 4 Maintenance Management [Part 2 of 2] for screenshot page 31)
4.7.2	*Use analytical tools to compare performance to standard levels of service for accomplishment, quality and budget, at the work order, crew, garage, region and statewide levels.*	*M*	Y	Level-of-Service can be set in the Budget Forecasting module.
4.7.3	Linkage to Performance Guide Resource Material for each Activity which are available within the work order for use planning, estimating, and recording work accomplishment. It can also be used to compare a work order to the expected accomplishment and show differences.	H	Y	These materials can be stored as a Linked Document and attached to an Asset, Facility, Service Request or Work Order record in VUEWorks.

5. Application Integration

This section describes functionality that is needed in support of the Application Integration priority area.

5.1 Road Network Application Integration

The Road Network Management module of the EAMS solution should provide functionality to integrate with other EAMS modules to support advanced asset management capabilities within MDOT.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
5.1.1	Full location management functionality as previously specified is available to support the EAMS Phase 1 implementation across all modules.	H	Y	Requirements are met. The EAMS solution is built on Esri's Roads and Highways and fully integrated within VUEWorks AMS/MMS core which enables full location management natively and can be leveraged across all EAMS modules without any additional configuration required.
5.1.2	Full location management functionality as previously specified is available to support subsequent EAMS implementation phases and application modules. The Vendor should specify additional COTS modules that can be integrated with EAMS to support advanced asset management capabilities.	L	Y	Requirements are met. The EAMS solution is built on Esri's Roads and Highways and fully integrated within VUEWorks AMS/MMS core which enables full location management natively and can be leveraged across all EAMS modules without any additional configuration required. New or additional COTS modules added to the EAMS solution are already available with full

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				location management functionality and include strategic asset management components such as Condition, Risk, Valuation, Budget Forecasting and Projects modules.
5.1.3	The solution should provide functionality to manage and automatically update location references associated with business data events stored in external business application databases. The Vendor should specify in detail how this is accomplished.	H	Y	Roads and Highways supports the concepts and management of centralized roadway LRS management so business systems don't duplicate effort managing copies of an LRS. Published web services from Roads and Highways are available and open to any external business system that can consume these web services so the external business application databases can be integrated to keep measures in alignment with roadway edits.
5.1.4	The solution should provide functionality to inquire, analyze and report against business data events stored in external business application databases. The Vendor should specify in detail how this is accomplished.	H	Y	Requirement are met – Roads and Highways supports an open data model and configuration that supports access, display, query and reporting against business data events that are either

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				stored in the geodatabase "Internal Events" or stored outside of the geodatabase in a separate database "External Events". Business data events stored in an external business application database can be registered with the Roads and Highways Advanced Linear Referencing System (ALRS). Once these external business events are registered with the ALRS, a read-only connection is established to the external data source, allowing Roads and Highways to access, display, query and report on this data as either a single query or combined query with multiple other event data sources. This can be particularly beneficial when a certain question or need arises to see the relationship between multiple data sources and layers, such as pavement, traffic volumes, functional classification, crashes and

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
				road maintenance history.

5.2 External Application Integration

The EAMS solution should provide functionality to integrate with other MDOT corporate applications.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
5.2.1	Allows for the interfacing with other systems by using a strategy of Database linking directly, or with intermediate tables	H	Y	The Data Linking functionality of the system allows the association of external data with all assets in the system. This external data can be queried, viewed and reported against. VUEWorks' SQL Server based database is open architected. The database also contains a series of standard SQL views which can be used by other systems. (See Appendix 5 Application Integration for screenshot page 3)
5.2.2	Allows for the interfacing with other systems by using a strategy of passing parameters to another system to execute or accept in a command.	H	Y	Data linking is a standard feature and can be extended to connect VUEWorks to other systems programmatically. (See Appendix 5 Application Integration for screenshot page 4)

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
5.2.3	Allows for the interfacing with other systems by using a strategy of a standard vendor supplied API.	H	Y	The system provides a series of Web Services that can be used by other systems for 2-way data communication (See Appendix 5 Application Integration for screenshot page 4-5).
5.2.4	Allows for the interfacing with other systems by using a strategy using services in a Services Oriented Architecture (SOA) or similar solution.	H	Y	The system provides a series of Web Services that can be used by other systems for 2-way data communication.
5.2.5	Allows for the interfacing with other systems by using a strategy using Electronic Data Interchange (EDI) i.e. batch text file processing.	H	M	Feature not currently available, but could be built as a custom piece of the solution.

6. Technical Requirements

This section describes technical requirements needed in support of the EAMS Solution.

6.1 System Architecture

The platform and architecture being used, as well as the capacity and compatibility with the State's current technologies.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.1.1	*The system employs web architecture using browser accessing a central database through software on a server.*	*M*	Y	VUEWorks is a web-enabled GIS-integrated enterprise asset management solution. This is inherent so considered standard.
6.1.2	The system places no limit on record size (no. of records).	H	Y	There are no limits on the size of a geodatabase other than any limitations specific to the supported RDBMS to be used. There are general guidelines and best practices for querying and returning business data using ArcGIS Server, however. In general, returns on web-based queries should be limited 1,000 geospatial records or fewer for optimum performance (Best Practice).
6.1.3	The software is expandable and portable, with specific reference to the system capacity requirements presented in this RFP.	H	Y	Since VUEWorks is web-based, it can scale within an organization very easily.
6.1.4	The system is fully self-contained and capable of being operated by State staff	H	Y	VUEWorks can be

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	with no dependency on Vendor services for its routine operation.			maintained by non-technical IT resources.
6.1.5	The system server is compatible with the State's technical architecture and is sized suitable for the system specified.	H	Y	VUEWorks' specifications are based on the required concurrent user count and IT architecture as provided by the State.
6.1.6	The system is an open system, with no dependency on the use of specific models or models of equipment operating systems.	H	Y	MS Windows Server OS required
6.1.7	The system keeps a log of each transaction which alters the database. Logs are date and time stamped to allow the system to reconstruct activity for any period.	H	M	Planned feature enhancement
6.1.8	The system is capable of using multiple database servers in a load balancing configuration.	H	Y	ArcGIS Server and SQL Server
6.1.9	The system is capable of using multiple application servers in a load balancing configuration for the purposes of scaling up the number of users.	H	Y	This is true of the entire VUEWorks solution.

6.2 Software Licensing

Specifics about the licensing and Royalty arrangement.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.2.1	The software license is for perpetual use for a fixed fee without additional royalties or service fees, except for ongoing software maintenance.	H	Y	
6.2.2	The system offers Application Programming Interfaces (APIs) that enable the State to develop custom interfaces to all modules.	L	Y	APIs consist of database views and Web Services that are fully documented.

6.3 RDBMS / Applications / Database Management

Outlines the State's requirements for the software to operate on preferred relational database technology.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.3.1	The system is available with State's standard relational database management system.	H	Y	MS SQL Server
6.3.2	Full-text indexing and a full-text database search feature are available to provide easy retrieval of records.	L	Y	Available through standard tools within SQL Server
6.3.3	All computer information systems and applications operate in a secure manner and comply with State Enterprise IT Security Policy and Procedures as found on the website: http://www.michigan.gov/dmb/0,1607,7-150-56355-107739--,00.html	H	Y	VUEWorks can be set up to run with an HTTPS: prefix to encrypt data passing between the application server and the user desktop.
6.3.4	The system must ensure that the integrity and confidentiality of data is protected by safeguards to prevent release of information without proper consent.	H	Y	VUEWorks permission module is used to control access on a user basis. Application database is secured by policies set directly on the server.
6.3.5	The system must ensure that the integrity and confidentiality of data accessed from mobile devices meets with policy 1315.00 Storage of Sensitive Information on Mobile Devices and Portable Media.	H	Y	All mobile access is secured by an authentication layer that is set up against each user accessing the application remotely.

6.4 Security

The state has standards for security including access control, passwords, and Activity Logging

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.4.1	The system will provide secure access at database level and integrate with MDOT Systems Access Manager (SAM) and provide security at application and individual operator levels.	H	Y	VUEWorks can integrate with Active Directory at the agency level.
6.4.2	The system will integrate with State Single Sign-on (SSO) system and provide secure access control based upon unique user login.	H	Y	Standard and configurable
6.4.3	The system to integrate with SSO and use the SAM feature to check each user's access privileges at login, and automatically disable or enable client functions (in real time) based upon the user's profile.	H	Y	Standard and configurable
6.4.4	The system to integrate with MDOT's SAM system and provide varying levels of access within the application, such as administrators, view only, or scheduling only.	H	M	Connection to our user/role permissions.
6.4.5*	The system provides an enforced minimum length for passwords.	H	M	Can be added with minor modification.
6.4.6*	The system provides an enforced requirement for user passwords to be automatically prompted for change after a defined period has passed, such as 30, 60 or 90 days.	H	M	Can be added with minor modification.
6.4.7*	The system provides users with the capability to change their own passwords.	H	Y	Done through the User Interface
6.4.8*	The system provides its feature to disable user IDs after a specified number (3) of consecutive invalid login attempts.	H	M	After 3 failures, the session is terminated, but the User ID is not disabled
6.4.9*	The system enters passwords in a non-display field.	H	Y	Standard and configurable
6.4.10*	The system encrypts passwords when they are routed over the network.	H	Y	Standard and configurable
6.4.11*	The system encrypts passwords in system storage.	H	Y	Standard and configurable
6.4.12*	Logs unauthorized access attempts by date, time, User ID, device and location.	L	M	Can be added
6.4.13	The system maintains an audit trail of all security maintenance performed by date, time, user ID, device and location, with easy access to information.	L	M	Can be added

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.4.14	Provides security reports of users and access levels.	L	M	Can be added, report of users and role permissions
6.4.15	Provides detailed reports of backups completed and backups failed.	L	M	This is a feature of SQL Server

if a vendor answers yes to 6.4.1 through 6.4.4 then simply answer Y to these requirements and comment SSO compatible in the Solution Description. If the solution does not conform or must be modified, indicate solution in typical fashion.

6.5 General Commercial Software Considerations

The State has specific requirements for Commercial Off the Shelf (COTS) packages.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.5.1	The software uses an industry standard relational database management system.	H	Y	The VUEWorks COTS asset management system solution supported database is SQL Server 2005 and newer
6.5.2	The Vendor will provide complete data model and schema details for the purposes of report interface development, including: Entity Relationship diagrams, a system model and a physical model.	H	Y	This information will be provided to the State
6.5.3	The software will operate effectively on State and non-state hardware as defined by Vendor with Vendor-supplied upgrade recommendations.	H	Y	The DTS Team will comply with this
6.5.4	The software operates in a recognized industry standard operating environment.	H	Y	The VUEWorks COTS asset management system solution supported operating systems are Windows Server 2003 and newer
6.5.5	The software provides a Graphical User Interface (GUI) that is user-friendly and provides data, calculation, reporting, and communication capabilities to State users.	H	Y	All browser-based.
6.5.6	The system is modular in design to accommodate phased implementation and	H	Y	Can be phased by module

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	future expansion.			and by agency group/unit
6.5.7	The modularity allows the capabilities of the core systems to function without the entire system complement.	H	Y	Standard feature of VUEWorks
6.5.8	Additional modules may be integrated into the system without a major impact to the installed components.	H	Y	Standard feature of VUEWorks
6.5.9	All modules of the system are integrated and designed to work together using a single input and a common database with no redundant data entry or data storage.	H	Y	Standard feature of VUEWorks
6.5.10	The system supports paperless processing through the use of electronic documents that are routed for electronic signatures through user-defined approval paths.	H	M	Service request and work order workflow is currently under development.
6.5.11	The system prevents transaction data from being posted in the system unless all members on the approval path have approved the associated electronic document.	H	M	Workflow capabilities are currently under development.
6.5.12	The system has the ability to accept and output transactions in standard electronic data interchange (EDI) formats.	H	M	Can be developed
6.5.13	The system has the ability to accept batch entry from external sources while ensuring the same edits and validations as the online system.	H	M	This would be custom to the specific application that is being integrated.
6.5.14	Response times, at local and remote sites, for the major on-line processes stated above will meet business requirements.	H	Y	Dependent upon network connection speeds at each location.
6.5.15	The software provides the capability of transferring data to and from the host/server to the client for processing on other software packages.	H	Y	Most data exchange formats are supported.
6.5.16	The system provides the capability to access scanned images that are attached to various elements of the database.	H	Y	Done through document linking
6.5.17	The system provides the capability for expansion in order to take advantage of technology such as optical scanning and imaging in order to reduce data entry workload.	H	Y	Done through document linking
6.5.18	The system includes comprehensive field edits to prevent incomplete or	H	Y	Combination of required

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	incorrect data from entering the system.			fields and field validation
6.5.19	The system ensures data integrity and controls processing without hard-coded logic	H	Y	Combination of required fields and field validation
6.5.20	The system must ensure that all errors are written to an error log.	H	Y	Can be viewed in the Event Viewer in the application
6.5.21	The system must allow for an administrator to view, filter, sort, and search the error log.	H	M	View only, no filtering
6.5.22	The system must allow for an administrator to archive error log entries based upon user-defined criteria.	L	M	Can be added
6.5.23	The system must allow for a user to define an alert message to be executed upon the occurrence of an error.	H	M	Can be added
6.5.24	The system has the ability to provide point-in-time recovery of data to the last completed transaction.	H	Y	SQL Server provides this ability.
6.5.25	The system has the ability to allow for continued use of the system during backup.	L	Y	SQL Server provides this ability.
6.5.26	The system has the ability to provide a complete backup and recovery process for all database tables and system files.	L	Y	SQL Server provides this ability.
6.5.27	The system has the ability to create on request backups.	L	Y	SQL Server provides this ability.
6.5.28	The backup and archival features of the system proposed can be initiated automatically or by manual request.	H	Y	SQL Server provides this ability.
6.5.29	For any information not hosted on State sites or facilities, the Vendor will provide full daily database backup with hourly incremental backup. Daily backups must be stored at an offsite facility for a minimum of 7 days.	H	Y	The DTS Team will comply with this requirement
6.5.30	The system must comply with DTMB and MDOT standards for data archiving and purging.	H	Y	The DTS Team will comply with this requirement

6.6 Reporting

Standards for reporting, reporting technology and administration.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.6.1	*The software delivers standard reports.*	*M*	Y	Through a robust Dynamic Report system. This is a standard feature.
6.6.2	*The system includes user defined query and reporting using state standard tools that allow the user to examine asset data and patterns in asset data.*	*M*	Y	VUEWorks SQL Server based database is open architected. The database also contains a series of standard SQL views which can be used by other systems or in SQL Server Management Studio directly. This is a standard feature.
6.6.3	The online query capability enables non-technical end-users to extract information from EAMS to allow for further analyses of the data using other software tools.	H	Y	All reports and filter results can be exported to various data formats, including Excel.
6.6.4	The standard (e.g., regularly scheduled, recurring) reporting environment allows standard reports to be scheduled, executed, viewed on-line, printed (centrally or remotely) and dispersed (including the use of report distribution management software)	H	Y	Through Crystal Reports or SQL Server Reporting Services
6.6.5	The standard (e.g., regularly scheduled, recurring) reporting environment allows offices and work locations to control which standard reports they do and do not receive.	H	Y	Standard part of reporting tools
6.6.6	The standard (e.g., regularly scheduled, recurring) reporting environment allows the State to control the information that appears on standard reports so that data security is maintained.	H	Y	Standard part of reporting tools
6.6.7	The system provides methods for retaining and modifying previously built queries.	H	Y	Called Saved Filters. These can be managed and access granted to users and roles
6.6.8	The system provides security and control mechanisms that limit the abuse of ad	H	Y	A maximum number of

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
	hoc queries (e.g., attempted access to restricted data, attempted execution of a query that would run for several hours, etc.).			records requested can be set against an ad hoc query.
6.6.9	The system provides the use of transaction databases, external files, or a "data warehouse" for user defined reporting.	H	Y	As long as user-access is granted, this information will be available to the user.
6.6.10	The System can provide reports in a number of standard formats including but not limited to: PDF, MS Word, MS Excel, CSV, Text).	H	Y	Large list for Dynamic Reports

6.7 Auditing

Requirements regarding auditing of the database for both security and monitoring.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.7.1	The system enables the user to modify data entry transactions that have already been posted to the database while maintaining an audit trail of the change.	H	M	Can be added
6.7.2	The system's internal control functionality ensures that the data entry and processing associated with a business event has been completed before updating the database.	H	M	Can be added
6.7.3	The system has the ability to maintain a historical record of all changes made to any item within the system (e.g., data element, business rule, process control, software program), the ID of the person or process that made the change, the before images of the affected data records, and the date and time the change was made.	H	M	Can be added
6.7.4	The system must ensure that all system events for software, hardware, interfaces, operating system, network, etc. are written to a system event log in a manner that facilitates debugging of all system problems.	H	Y	All VUEWorks errors are posted to the Event Viewer
6.7.5	The system offers the ability to query, view, filter, and sort the system audit trail. The system is able to store the queries.	H	M	This is currently only available using the database tools in SQL/Oracle.

No.	Requirement	M/ H-L	Y-N-M	Description of Solution
6.7.6	The system has the ability to identify and track data back to its input source (e.g., imaged document, keyed from form, interface file, etc.).	H	M	Can be developed
6.7.7	The system has the ability to audit all override of edits and audits and identify the login ID, date, and time.	H	M	Can be developed

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Table 1: Project Cost Summary

No.	Project Cost(s)	Cost ($)
A.	**COTS Software Acquisition** (includes COTS and any third party software) Give breakdown in Table 2.	$ 656,344.00
B.	**Project Initiation Services** (includes Project Kick-off Meetings and COTS Software Orientation Workshop) Give breakdown in Table 5	$ 85,400.00
C.	**Requirements and Solution Architecture Validation Services** (includes EAMS Software Requirements Validation and Solution Configuration Specifications) Give breakdown in Table 5	$ 322,568.00
D.	**Installation and Configuration Services** (includes EAMS Software Installation and COTS Configuration) Give breakdown in Table 5	$ 676,298.00
E.	**Implementation Services** (includes Data Conversion / Migration, Interfaces/Integration, Testing, Production Go-live and Performance Warranty Period) Give breakdown in Table 5	$ 1,516,009.00
F.	**Training/Knowledge Transfer/Transition** Give breakdown in Table 6	$ 176,728.00
G.	**Documentation** Give breakdown in Table 6	$ 35,610.00
H.	**Maintenance and Support** Give breakdown in Table 7	$ 566,436.00
I.	**Reserved** Give breakdown in Table 8	$ -
J.	**Other Services** Give breakdown in Table 9	$ 207,500.00
	Total Project Cost	**$ 4,242,893.00**

Note: The above amounts will be subject to hold back as referenced to Article 1, Section 1.600 of the Contract.

Table 2: Breakdown of COTS Software License Costs – including Third Party Software – EAMS Phase 1

No.	Software License(s) Cost	Product Name and Version	Unit Cost ($)	Proposed Licenses	Total Cost ($)
	Commercial Off The Shelf (COTS)				
	Road Network Management	ArcGIS Server and Desktop Software (See quotation for license detail)	$ 111,344.00	Enterprise	$ 111,344.00
	Asset Inventory Management	VUEWorks Web-based AMS	$ 250,000.00	Enterprise	$ 250,000.00
	Maintenance Management	VUEWorks Web-based MMS	$ 180,000.00	Enterprise	$ 180,000.00
	Other (specify):				$ -
	Straight Line Diagram	Road Analyzer V 2.20	$ 60,000.00	Enterprise	$ 60,000.00
	Video Log Interface	Video Log Module for Road Analyzer V 2.20	$ 25,000.00	Enterprise	$ 25,000.00
	Roads and Highways Productivity Tools	Roads and Highways Productivity Tools V 1.0	$ 30,000.00	Enterprise	$ 30,000.00
	Total COTS Software License Costs				**$ 656,344.00**
	Third Party Software				
	Report writers	N/A			$0
A.	Testing tools: (such as issues tracking, defect testing, load/stress testing, configuration management (List and provide cost separately for each item)	Free - Agile-based Web software available to MDOT and project team for defect tracking, and transparent monitoring of all implementation tasks			
	1	Not applicable			$0
	2	Not applicable			$0
	3	Not applicable			$0
	Other system utilities (such as backup and disaster recovery, etc.)				
	1	Not applicable			$0
	2	Not applicable			$0
	Server software	Not applicable			$0
	Any other software (List):				
	1	Not applicable			$0
	2	Not applicable			$0
	Total Cost of Software Licenses including COTS and Third Party Software **(transfer total to Row A of Table 1)**				**$ 656,344.00**

Table 3: Reserved

Table 4: Reserved

Table 5: COTS Implementation Services and Deliverables Costs

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	Project Initiation Services	Project Manager	120	$ 22,200.00
		Single Point of Contact	16	$ 1,920.00
		AMS Subject Matter Expert	40	$ 7,600.00
		Assistant Project Manager	40	$ 6,000.00
		Systems/Application Leader	40	$ 6,000.00
		AMS Technical Leader	40	$ 8,000.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist		$ -
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -
B.	*(Project Kick-off Meetings, COTS Software Orientation Workshop)*	LRS/SLD Project Manager	56	$ 10,640.00
		LRS/SLD Business Analyst		$ -
		LRS/SLD Technical Architect		$ -
		LRS/SLD Senior Developer		$ -
		R&H Implementation Lead	50	$ 12,800.00
		AMS Business Process Expert		$ -
		R&H Implementation Lead		$ -
		R&H Project Manager	40	$ 10,240.00
		R&H Database Lead		$ -
		R&H Implementation Specialist		$ -
		AMS Business Process Expert		$ -
				$ -
				$ 85,400.00
				(transfer total to Table 1 - B)

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
		Project Manager	240	$ 44,400.00
		Single Point of Contact	40	$ 4,800.00
		AMS Subject Matter Expert	120	$ 22,800.00
		Assistant Project Manager	80	$ 12,000.00
		Systems/Application Leader	40	$ 6,000.00
		AMS Technical Leader	40	$ 8,000.00
		Systems/Application Manager	40	$ 6,000.00
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -
C.	**Requirements and Solution Architecture Validation Services** *(EAMS Software Requirements Validation, Solution Configuration Specifications)*	LRS/SLD Project Manager	100	$ 19,000.00
		LRS/SLD Business Analyst	240	$ 42,000.00
		LRS/SLD Technical Architect	60	$ 11,400.00
		LRS/SLD GIS Analyst	40	$ 4,400.00
		LRS/SLD Senior Developer	40	$ 5,800.00
		LRS/SLD Database Administrator	40	$ 6,200.00
		LRS/SLD Data Analyst		$ -
		R&H Implementation Lead	240	$ 61,440.00
		R&H Project Manager	60	$ 15,360.00
		R&H Database Lead	28	$ 5,768.00
		R&H Implementation Specialist	200	$ 41,200.00
		AMS Business Process Expert		$ -
				$ 322,568.00 **(transfer total to Table 1 - C)**

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	Installation and Configuration Services			**Contractor must provide individual implementation costs by category below and then transfer the combined total to Table 1 - D**
D.	**Software Installation**	Project Manager	240	$ 44,400.00
		Single Point of Contact	40	$ 4,800.00
		AMS Subject Matter Expert	40	$ 7,600.00
		Assistant Project Manager	80	$ 12,000.00
		Systems/Application Leader	40	$ 6,000.00
		AMS Technical Leader	200	$ 40,000.00
		Systems/Application Manager	40	$ 6,000.00
		Sr. Systems Integration Specialist	20	$ 3,000.00
		Systems Integration Specialist	160	$ 20,800.00
		System Architect	150	$ 19,500.00
		Business Analyst	420	$ 46,200.00
		Implementation Specialist	420	$ 58,800.00
		AMS Configuration/Developer		$ -
		LRS/SLD Project Manager	16	$ 3,040.00
		LRS/SLD Business Analyst	46	$ 8,050.00
		LRS/SLD Technical Architect	26	$ 4,940.00
		LRS/SLD GIS Analyst	42	$ 4,620.00
		LRS/SLD Senior Developer	4	$ 580.00
		LRS/SLD Developer	30	$ 2,850.00
		LRS/SLD Database Administrator	60	$ 9,300.00
		LRS/SLD Data Analyst	8	$ 880.00
		R&H Implementation Lead	16	$ 4,096.00
		R&H Project Manager	4	$ 1,024.00
		R&H Database Lead	20	$ 4,120.00
		R&H Implementation Specialist	20	$ 4,120.00
		AMS Business Process Expert		$ -
				$ 316,720.00

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	COTS Configuration	Project Manager	240	$ 44,400.00
		Single Point of Contact	30	$ 3,600.00
		AMS Subject Matter Expert	40	$ 7,600.00
		Assistant Project Manager	80	$ 12,000.00
		Systems/Application Leader	40	$ 6,000.00
		AMS Technical Leader	120	$ 24,000.00
		Systems/Application Manager	40	$ 6,000.00
		Sr. Systems Integration Specialist	20	$ 3,000.00
		Systems Integration Specialist	160	$ 20,800.00
		System Architect	80	$ 10,400.00
		Business Analyst	100	$ 11,000.00
		Implementation Specialist	300	$ 42,000.00
		AMS Configuration/Developer	300	$ 33,000.00
		LRS/SLD Project Manager	20	$ 3,800.00
		LRS/SLD Business Analyst	24	$ 4,200.00
		LRS/SLD Technical Architect	40	$ 7,600.00
		LRS/SLD GIS Analyst	80	$ 8,800.00
		LRS/SLD Senior Developer	40	$ 5,800.00
		LRS/SLD Developer	60	$ 5,700.00
		LRS/SLD Database Administrator	60	$ 9,300.00
		LRS/SLD Data Analyst	10	$ 1,100.00
		LRS/SLD Tester/Technical Writer	36	$ 4,140.00
		R&H Implementation Lead	90	$ 23,040.00
		R&H Project Manager	80	$ 20,480.00
		R&H Database Lead	43	$ 8,858.00
		R&H Implementation Specialist	160	$ 32,960.00
		AMS Business Process Expert		$ -
				$ 359,578.00
	D.1 Combined Total Installation and Configuration Costs			**$ 676,298.00**

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	Implementation Services			**Contractor must provide individual implementation costs by category below and then transfer the combined total to Table 1 - E**
	E.1 Data Conversion / Migration	Project Manager	60	$ 11,100.00
		Single Point of Contact	16	$ 1,920.00
		AMS Subject Matter Expert	16	$ 3,040.00
		Assistant Project Manager	16	$ 2,400.00
		Systems/Application Leader	40	$ 6,000.00
		AMS Technical Leader		$ -
		Systems/Application Manager	24	$ 3,600.00
		Sr. Systems Integration Specialist	80	$ 12,000.00
		Systems Integration Specialist	160	$ 20,800.00
		System Architect	80	$ 10,400.00
		Business Analyst	32	$ 3,520.00
		Implementation Specialist		$ -
		AMS Configuration/Developer	120	$ 13,200.00
		LRS/SLD Project Manager	24	$ 4,560.00
		LRS/SLD Business Analyst	65	$ 11,375.00
		LRS/SLD Technical Architect	36	$ 6,840.00
		LRS/SLD GIS Analyst	60	$ 6,600.00
		LRS/SLD Senior Developer		$ -
		LRS/SLD Developer	80	$ 7,600.00
		LRS/SLD Database Administrator	150	$ 23,250.00
		LRS/SLD Data Analyst	40	$ 4,400.00
		LRS/SLD Tester/Technical Writer	18	$ 2,070.00
		R&H Implementation Lead	21	$ 5,376.00
		R&H Project Manager	20	$ 5,120.00
		R&H Database Lead	50	$ 10,300.00
		R&H Implementation Specialist	320	$ 65,920.00
		AMS Business Process Expert		$ -
				$ 241,391.00

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	Interfaces/Integration	Project Manager		$ -
		Single Point of Contact		$ -
		AMS Subject Matter Expert		$ -
		Assistant Project Manager		$ -
		Systems/Application Leader		$ -
		AMS Technical Leader		$ -
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist		$ -
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -
		LRS/SLD Project Manager		$ -
		LRS/SLD Business Analyst		$ -
		LRS/SLD Technical Architect		$ -
		LRS/SLD GIS Analyst		$ -
		LRS/SLD Senior Developer		$ -
		LRS/SLD Developer		$ -
		LRS/SLD Database Administrator		$ -
		LRS/SLD Data Analyst		$ -
		LRS/SLD Tester/Technical Writer		$ -
		R&H Implementation Lead		$ -
		R&H Project Manager		$ -
		R&H Database Lead		$ -
		R&H Implementation Specialist		$ -
		AMS Business Process Expert	80	$ 13,600.00

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	MiBridge:			$
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00
	MIDB (LAPS):			
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	TMS (GLOBAL):			$
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00
	MainStar:			$
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	PA:			$
		Project Manager		$ -
		Single Point of Contact		$ -
		AMS Subject Matter Expert		$ -
		Assistant Project Manager		$ -
		Systems/Application Leader		$ -
		AMS Technical Leader		$ -
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist		$ -
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -
	PDRP:			$
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	PAB:			
		Project Manager		$ -
		Single Point of Contact		$ -
		AMS Subject Matter Expert		$ -
		Assistant Project Manager		$ -
		Systems/Application Leader		$ -
		AMS Technical Leader		$ -
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist		$ -
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -
	M5 FleetFocus:			
		Project Manager	32	$ 5,920.00
		Single Point of Contact	8	$ 960.00
E.		AMS Subject Matter Expert	24	$ 4,560.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	16	$ 2,400.00
		AMS Technical Leader	16	$ 3,200.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer	24	$ 2,640.00

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	SCAS:			
		Project Manager	16	$ 2,960.00
		Single Point of Contact	8	$ 960.00
		AMS Subject Matter Expert	12	$ 2,280.00
		Assistant Project Manager	6	$ 900.00
		Systems/Application Leader	8	$ 1,200.00
		AMS Technical Leader	8	$ 1,600.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	20	$ 3,000.00
		Systems Integration Specialist	40	$ 5,200.00
		System Architect	16	$ 2,080.00
		Business Analyst	16	$ 1,760.00
		Implementation Specialist	20	$ 2,800.00
		AMS Configuration/Developer	12	$ 1,320.00
	ProjectWise:			
		Project Manager		$ -
		Single Point of Contact		$ -
		AMS Subject Matter Expert		$ -
		Assistant Project Manager		$ -
		Systems/Application Leader		$ -
		AMS Technical Leader		$ -
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist		$ -
		Systems Integration Specialist		$ -
		System Architect		$ -
		Business Analyst		$ -
		Implementation Specialist		$ -
		AMS Configuration/Developer		$ -

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	ArcGIS Server / ArcSDE:			
		Project Manager	160	$ 29,600.00
		Single Point of Contact	40	$ 4,800.00
		AMS Subject Matter Expert	80	$ 15,200.00
		Assistant Project Manager	40	$ 6,000.00
		Systems/Application Leader	20	$ 3,000.00
		AMS Technical Leader		$ -
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	20	$ 3,000.00
		Systems Integration Specialist	40	$ 5,200.00
		System Architect	10	$ 1,300.00
		Business Analyst		$ -
		Implementation Specialist	20	$ 2,800.00
		AMS Configuration/Developer	20	$ 2,200.00
	Other (specify):			$
	E.2 Total Interfaces / Integration			**$ 396,680.00**

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
		Project Manager	24	$ 4,440.00
		Single Point of Contact		$ -
		AMS Subject Matter Expert	30	$ 5,700.00
		Assistant Project Manager	12	$ 1,800.00
		Systems/Application Leader	24	$ 3,600.00
		AMS Technical Leader	24	$ 4,800.00
		Systems/Application Manager		$ -
		Sr. Systems Integration Specialist	80	$ 12,000.00
		Systems Integration Specialist	80	$ 10,400.00
		System Architect	12	$ 1,560.00
		Business Analyst	12	$ 1,320.00
		Implementation Specialist	40	$ 5,600.00
		AMS Configuration/Developer		$ -
		LRS/SLD Project Manager	24	$ 4,560.00
		LRS/SLD Business Analyst	12	$ 2,100.00
		LRS/SLD Technical Architect	12	$ 2,280.00
		LRS/SLD GIS Analyst	40	$ 4,400.00
		LRS/SLD Senior Developer	24	$ 3,480.00
		LRS/SLD Developer		$ -
		LRS/SLD Database Administrator	40	$ 6,200.00
		LRS/SLD Data Analyst	40	$ 4,400.00
		LRS/SLD Tester/Technical Writer	24	$ 2,760.00
		R&H Implementation Lead	20	$ 5,120.00
		R&H Project Manager	20	$ 5,120.00
		R&H Database Lead	50	$ 10,300.00
		R&H Implementation Specialist	100	$ 20,600.00
		AMS Business Process Expert		$ -
	E.3 Pilot Projects			**$ 122,540.00**

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	E.4 Testing: (i.e. Unit, System, Integration,	Project Manager	200	$ 37,000.00
		Single Point of Contact	80	$ 9,600.00
		AMS Subject Matter Expert	320	$ 60,800.00
		Assistant Project Manager	80	$ 12,000.00
		Systems/Application Leader	320	$ 48,000.00
		AMS Technical Leader	160	$ 32,000.00
		Systems/Application Manager	80	$ 12,000.00
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	120	$ 15,600.00
		System Architect	80	$ 10,400.00
		Business Analyst	240	$ 26,400.00
		Implementation Specialist	240	$ 33,600.00
		AMS Configuration/Developer	80	$ 8,800.00
	Performance (load and stress), Parallel Testing, User Acceptance Testing (UAT), and other)	LRS/SLD Project Manager	20	$ 3,800.00
		LRS/SLD Business Analyst	40	$ 7,000.00
		LRS/SLD Technical Architect	20	$ 3,800.00
		LRS/SLD GIS Analyst	60	$ 6,600.00
		LRS/SLD Senior Developer	32	$ 4,640.00
		LRS/SLD Developer	54	$ 5,130.00
		LRS/SLD Database Administrator	20	$ 3,100.00
		LRS/SLD Data Analyst	40	$ 4,400.00
		LRS/SLD Tester/Technical Writer	80	$ 9,200.00
		R&H Implementation Lead	20	$ 5,120.00
		R&H Project Manager	16	$ 4,096.00
		R&H Database Lead	60	$ 12,360.00
		R&H Implementation Specialist	100	$ 20,600.00
		AMS Business Process Expert		$ -
				$ 402,046.00

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	E.5 Production Go-Live	Project Manager	80	$ 14,800.00
		Single Point of Contact	40	$ 4,800.00
		AMS Subject Matter Expert	40	$ 7,600.00
		Assistant Project Manager	40	$ 6,000.00
		Systems/Application Leader	80	$ 12,000.00
		AMS Technical Leader	32	$ 6,400.00
		Systems/Application Manager	16	$ 2,400.00
		Sr. Systems Integration Specialist	40	$ 6,000.00
		Systems Integration Specialist	120	$ 15,600.00
		System Architect	32	$ 4,160.00
		Business Analyst	24	$ 2,640.00
		Implementation Specialist	120	$ 16,800.00
		AMS Configuration/Developer	80	$ 8,800.00
		LRS/SLD Project Manager	20	$ 3,800.00
		LRS/SLD Business Analyst	16	$ 2,800.00
		LRS/SLD Technical Architect	40	$ 7,600.00
		LRS/SLD Senior Developer	20	$ 2,900.00
		LRS/SLD Database Administrator	16	$ 2,480.00
		LRS/SLD Data Analyst	54	$ 5,940.00
		LRS/SLD Tester/Technical Writer	4	$ 460.00
		R&H Implementation Lead	24	$ 6,144.00
		R&H Project Manager	24	$ 6,144.00
		R&H Database Lead	80	$ 16,480.00
		R&H Implementation Specialist	100	$ 20,600.00
		AMS Business Process Expert		$ -
				$ 183,348.00

Table 5

No.	Category	Resources Required (Contractor to identify IT classification)	Total # of hours (Contractor to identify # of hours per resource)	Total cost ($) (Contractor must transfer category totals to Table 1)
	E.6 Performance Warranty Period	Project Manager	80	$ 14,800.00
		Single Point of Contact	80	$ 9,600.00
		AMS Subject Matter Expert	60	$ 11,400.00
		Assistant Project Manager	40	$ 6,000.00
		Systems/Application Leader	60	$ 9,000.00
		AMS Technical Leader		$ -
		Systems/Application Manager	60	$ 9,000.00
		Sr. Systems Integration Specialist	60	$ 9,000.00
		Systems Integration Specialist	120	$ 15,600.00
		System Architect	60	$ 7,800.00
		Business Analyst	60	$ 6,600.00
		Implementation Specialist	160	$ 22,400.00
		AMS Configuration/Developer		$ -
		LRS/SLD Project Manager	24	$ 4,560.00
		LRS/SLD Business Analyst	32	$ 5,600.00
		LRS/SLD Technical Architect	24	$ 4,560.00
		LRS/SLD GIS Analyst	16	$ 1,760.00
		LRS/SLD Senior Developer	16	$ 2,320.00
		LRS/SLD Developer	16	$ 1,520.00
		LRS/SLD Database Administrator	16	$ 2,480.00
		LRS/SLD Data Analyst	40	$ 4,400.00
		LRS/SLD Tester/Technical Writer	20	$ 2,300.00
		R&H Implementation Lead	20	$ 5,120.00
		R&H Project Manager	20	$ 5,120.00
		R&H Database Lead	20	$ 4,120.00
		R&H Implementation Specialist	24	$ 4,944.00
		AMS Business Process Expert		$ -
				$ -
				$ 170,004.00
	Totals E:			**$ 1,516,009.00**
	Combined Total Implementation Services and Deliverables Costs (totals from rows B, C, D.1, E.1, E.2, E.3, E.4, E.5, E.6)			**$ 2,600,275.00**

Table 5

Table 6: Breakdown of Training and Documentation Cost

No.	Category	Cost ($)
F.	**Train the Trainer Training**	
	Technical training	$ 25,500.00
	System Administrator training	$ 18,450.00
	End User training: Road Network Editor	$ 28,188.00
	End User training: Asset Editor	$ 15,240.00
	End User training: Maintenance Editor	$ 12,440.00
	End User training: SLD	$ 6,580.00
	End User training: Road Analyzer	$ 15,810.00
	End User training: R&H/R&H Productivity Tools	$ 29,420.00
	End User training: Inquiry User	$ 10,400.00
	Other Proposed Training (List):	
	1 Field Maintenance Tools (on site with Maintenance Offices)	$ 14,700.00
	2	
	3	
	Total Training Cost	**use cell below**
	(transfer total to Table 1 - F)	**$ 176,728.00**
G.	**Training Documentation**	**use cell below**
	(transfer total to Table 1 - G)	**$ 35,610.00**
	Total Training and Documentation Cost	**$ 212,338.00**

Table 7: Recurring Costs: Software License and Maintenance and Support*

*See Article 1, Section 1.601, Subsection 2 for annual summary of costs.

No.	Cost Categories	Proposed Licenses	Annual Cost ($)					Total Cost ($)
			Year 1	Year 2	Year 3	Year 4	Year 5	
H.	**Annual Software License Costs**							
	COTS Software License Costs by Module							
	Commercial Off The Shelf (COTS)							
	Road Network Management	Enterprise	$0	$ 30,609.00	$ 30,609.00	$ 30,609.00	$ 30,609.00	$ 122,436.00
	Asset Inventory Management	Enterprise	$0	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 50,000.00	$ 200,000.00
	Maintenance Management	Enterprise	$0	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 36,000.00	$ 144,000.00
	Other (specify):	N/A						
	Straight Line Diagram	Enterprise	$0	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 40,000.00
	Video Log Interface	Enterprise	$0	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 5,000.00	$ 20,000.00
	Roads and Highways Productivity Tools	Enterprise	$0	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 10,000.00	$ 40,000.00
	Total COTS Software License Cost							**$ 566,436.00**
	Third Party Software							
	Report writers							$ -
	Testing tools: (such as issues tracking, defect testing, load/stress testing, configuration							
	1 Not Applicable							$ -
	2 Not Applicable							$ -
	3 Not Applicable							$ -
	Other system utilities (such as backup and disaster recovery, etc.)							
	1							$ -
	2							$ -
	Server software							$ -
	Any other software (List):							
	1 Not Applicable							$ -
	2 Not Applicable							$ -
	Total Third Party Software License Cost							**$ -**
	Total Software License Recurring Cost							**$ 566,436.00**
	Software Maintenance and Support Cost *(includes helpdesk)*		don't	use	this	row		**$ -**
	Total Software and Maintenance and Support Recurring Cost **(transfer total to Table 1 - H)**							**$ 566,436.00**

Notes for Completion of Table 7:

1. Within each cost category, the Total Cost is computed as the sum of the Annual Costs (Year 1 through Year 5).
2. The Total COTS Software License Cost is computed as the sum of the Total Cost for each proposed software module.
3. The Total Third Party Software License Cost is computed as the sum of the Total Cost for each proposed software module.
4. The Total Software License Recurring Cost is computed as the sum of the Total COTS Software License Cost and the Total Third Party Software License Cost.
5. The Total Software and Maintenance and Support Recurring Cost is computed as the sum of the Total Software License Recurring Cost and the Total Cost for Software Maintenance and Support.
6. The anniversary date for the billing of annual Software License and Maintenance and Support costs shall be established at the day following the completion of the Warranty Period.

Table 8: Reserved

Table 9: Other Services Rate Card – Key Staff

No.	Staffing Category	Name(s) of Key Staff	Firm Fixed Hourly Rate	Est. Hours (5 year total)	Extended Price ($) (Rate x Hours)
J.	Project Manager	Sangeeta Reddy	$ 185.00	500	$ 92,500.00
	System Architect	Kirsten Koehn	$ 130.00	500	$ 65,000.00
	Trainer	Charles Brown	$ 100.00	500	$ 50,000.00
	Key Staff Rate Card Estimated Cost (transfer total to Table 1 - J)	N/A	N/A	1,500	**$ 207,500.00**

Table 10: Other Services Rate Card – Other Staff

No.	Staffing Category	Name(s) of Key Staff	Firm Fixed Hourly Rate
J.	Single Point of Contact	Greg Yarbrough	$ 120.00
	Assistant Project Manager	William Land	$ 150.00
	AMS Subject Matter Expert	Jason Amadori	$ 190.00
	Systems/Application Leader	Brian Sovik	$ 150.00
	AMS Technical Leader	Dave Paine	$ 200.00
	Systems/Application Manager	Kim Hubble	$ 150.00
	Sr. Systems Integration Specialist	Jeff Germain	$ 150.00
	Systems Integration Specialist	Bob Binckes	$ 130.00
	Business Analyst	Julie Wilson	$ 110.00
	Implementation Specialist	Andrew Carr	$ 140.00
	AMS Configuration/Developer	Max Cutrell Jeremy Folds Steve Railsback Nick Volpe	$ 110.00
	LRS/SLD Project Manager	Jesse Jay	$ 190.00
	LRS/SLD Business Analyst	Bill Schuman Bryan Kelley	$ 175.00
	LRS/SLD GIS Analyst	Rakesh Patel	$ 110.00
	LRS/SLD Technical Architect	Steve Korzekwa	$ 190.00
	LRS/SLD Senior Developer	Rusty Green	$ 145.00
	LRS/SLD Developer	Deepa Kini Yu Luo Jodie Locklear	$ 95.00
	LRS/SLD Database Administrator	Kristi Barry	$ 155.00
	LRS/SLD Data Analyst	Chris Kerr	$ 110.00
	LRS/SLD Tester/Technical Writer	Janet McGrath	$ 115.00
	R&H Implementation Lead	Adrian Litton	$ 256.00
	R&H Project Manager	Jackie Magnant	$ 256.00
	R&H Database Lead	Sylvia Casas	$ 206.00
	R&H Implementation Specialist	Mathew Kabak	$ 206.00
	AMS Business Process Expert	Robert Cooney	$ 170.00
	Future Enhancement/Rate Card Estimated Cost	N/A	N/A

Notes for Tables 9 and 10:

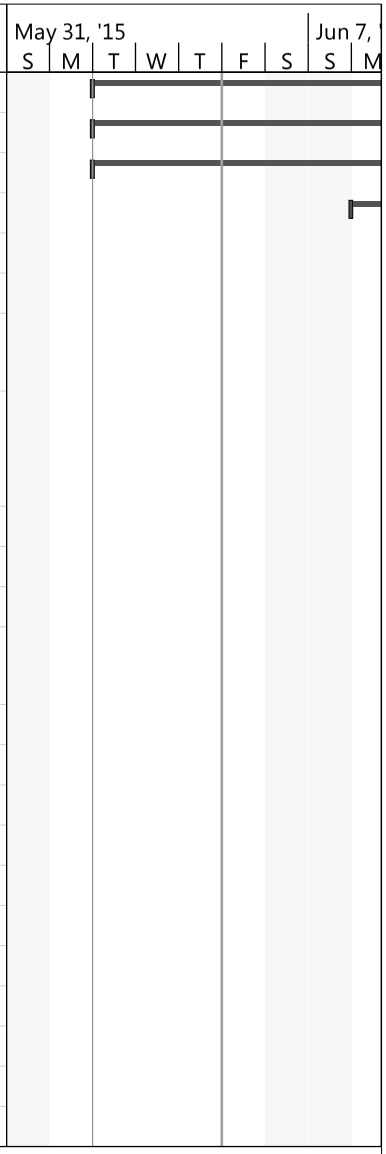
1. Hourly rates quoted are firm, fixed, all inclusive rates for the duration of the contract. Travel and other expenses will not be reimbursed.
2. The State intends to establish funding for up to 1,500 hours over the five year life of the application as a contingency for other services. Actual funding will occur on a yearly basis, and there is no guarantee as to the level of funding, if any, available to the project.

3. Within Table 9, the State has provided representative "Estimated Hours" for Key Staff. Contractor is advised that both the "Estimated Hours" and "Extended Price" derived from this estimate are non-binding and will be used at the State's discretion to determine best value to the State.

4. The parties agree that the Services/Deliverables to be rendered by Contractor using the Table 9 and Table 10 rate cards applicable to this Contract will be defined and described in detail in separate Statements of Work. Contractor shall not be obliged or authorized to commence any work to implement a Statement of Work until authorized via a purchase order issued against this Contract.

5. Unless otherwise agreed by the parties, each Statement of Work will include each item listed in Article 1, Section 1.601 for new work.

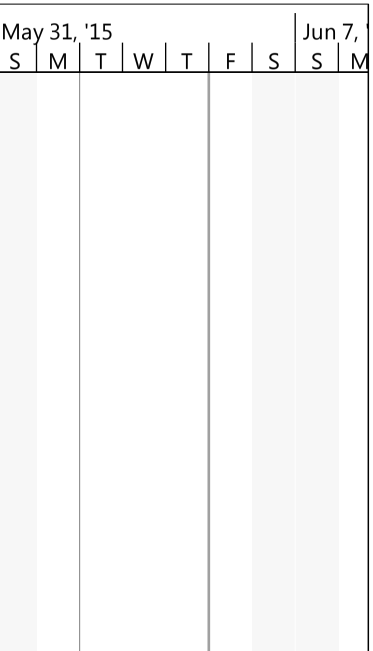
ID		Task Name	Duration	Start	Finish	Predecessors
1		**EAMS Implementation Plan**	**555 days**	**Tue 6/2/15**	**Mon 7/17/17**	
2		**GATE 1**	**23 days**	**Tue 6/2/15**	**Thu 7/2/15**	
3		**COTS Software Acquisition**	**6 days**	**Tue 6/2/15**	**Tue 6/9/15**	
6		**Project Initiation Services**	**19 days**	**Mon 6/8/15**	**Thu 7/2/15**	
17		MDOT Plan Review and Acceptance	5 days	Fri 7/3/15	Thu 7/9/15	16
18		GATE 1 Acceptance	1 day	Fri 7/10/15	Fri 7/10/15	
19		**GATE 2 - Requirements and Solution Architecture Validation Services**	**44 days**	**Mon 7/13/15**	**Thu 9/10/15**	
25		MDOT Roadway Network Management Requirements Document and Solution Architecture Review and Acceptance	14 days	Fri 9/11/15	Wed 9/30/15	24
26		GATE 2 Acceptance	1 day	Thu 10/1/15	Thu 10/1/15	25
27		**GATE 3 - Installation and Configuration Services**	**25 days**	**Mon 7/13/15**	**Fri 8/14/15**	
34		GATE 3 Acceptance	1 day	Mon 8/17/15	Mon 8/17/15	33
35		**GATE 4 COTS System Focused Configurations (Tier II)**	**112 days**	**Tue 8/18/15**	**Wed 1/20/16**	
36		**GATE 4a Lane Inventory**	**27 days**	**Tue 8/18/15**	**Wed 9/23/15**	
44		GATE 4a Acceptance	1 day	Thu 9/24/15	Thu 9/24/15	43
45		**GATE 4b Signs**	**27 days**	**Fri 9/25/15**	**Mon 11/2/15**	
53		GATE 4b Acceptance	1 day	Tue 11/3/15	Tue 11/3/15	52
54		**GATE 4c Guardrails**	**27 days**	**Wed 11/4/15**	**Thu 12/10/15**	
62		GATE 4c Acceptance	1 day	Fri 12/11/15	Fri 12/11/15	61
63		**GATE 4d Culverts**	**27 days**	**Mon 12/14/15**	**Tue 1/19/16**	
71		GATE 4d Acceptance	1 day	Wed 1/20/16	Wed 1/20/16	70
72		MDOT Tier II Final Testing and Acceptance	10 days	Thu 1/21/16	Wed 2/3/16	71
73		Gate 4 Acceptance	1 day	Thu 2/4/16	Thu 2/4/16	72
74		**Gate 5 - SLD Design and Implementation**	**134 days**	**Fri 8/7/15**	**Wed 2/10/16**	



Project: MDOT_TAMS_Schedule
Date: Fri 6/5/15

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

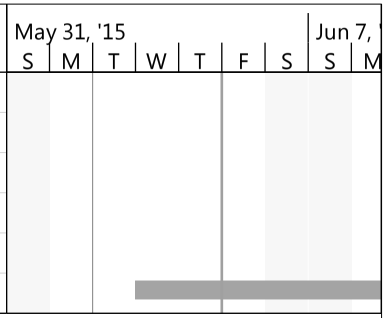
ID		Task Name	Duration	Start	Finish	Predecessors
80		MDOT SLD Testing and Acceptance	1 day	Thu 2/11/16	Thu 2/11/16	79
81		Gate 5 Acceptance	1 day	Fri 2/12/16	Fri 2/12/16	80
82		**Gate 6 - Esri Roads and Highways Design and Implementation**	**280 days**	**Fri 8/7/15**	**Thu 9/1/16**	
87		MDOT Testing	1 day	Fri 9/2/16	Fri 9/2/16	86
88		Gate 6 Acceptance	1 day	Mon 9/5/16	Mon 9/5/16	87
89		**Gate 7 - FINAL: Module Level Configuration: Recheck for any conflicts in all Processes across Modules**	**60 days**	**Thu 4/14/16**	**Wed 7/6/16**	
90		**Maintenance Management**	**20 days**	**Thu 4/14/16**	**Wed 5/11/16**	
95		**Asset Management Modules**	**20 days**	**Thu 5/12/16**	**Wed 6/8/16**	
105		FINAL: SLD Configuration: Recheck for any conflicts in all processes	20 days	Thu 6/9/16	Wed 7/6/16	104
106		MDOT Testing and Acceptance	7 days	Thu 7/7/16	Fri 7/15/16	105
107		Gate 7 Acceptance	1 day	Mon 7/18/16	Mon 7/18/16	106
108		**Gate 8 - Implementation Services - Interfaces and Integration**	**165 days**	**Mon 8/17/15**	**Fri 4/1/16**	
119		MDOT Testing and Acceptance	7 days	Mon 4/4/16	Tue 4/12/16	118
120		Gate 8 Acceptance	1 day	Wed 4/13/16	Wed 4/13/16	119
121		**Gate 9 - ArcGIS Server/ArcSDE & Roads & Highwa**	**240 days**	**Fri 8/7/15**	**Thu 7/7/16**	
127		MDOT Testing and Acceptance	7 days	Fri 7/8/16	Mon 7/18/16	126
128		Gate 9 Acceptance	1 day	Tue 7/19/16	Tue 7/19/16	127
129		**Gate 10 - Pilot Projects**	**100 days**	**Thu 4/14/16**	**Wed 8/31/16**	
134		MDOT Testing and Acceptance	7 days	Thu 9/1/16	Fri 9/9/16	133
135		Gate 10 Acceptance	1 day	Mon 9/12/16	Mon 9/12/16	134
136		**Gate 11 - Training**	**52 days**	**Thu 6/9/16**	**Fri 8/19/16**	
146		Gate 11 Acceptance	1 day	Mon 8/22/16	Mon 8/22/16	145



Project: MDOT_TAMS_Schedule
Date: Fri 6/5/15

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

ID		Task Name	Duration	Start	Finish	Predecessors
147		**Gate 12 - Documentation**	**328 days**	**Thu 4/14/16**	**Mon 7/17/17**	
148		**Documentation**	**50 days**	**Thu 4/14/16**	**Wed 6/22/16**	
154		**Maintenance and Support**	**268 days**	**Thu 7/7/16**	**Mon 7/17/17**	
161		**Knowledge Transfer**	**5 days**	**Thu 12/8/16**	**Wed 12/14/16**	
164		Gate 12 Acceptance	1 day	Thu 12/15/16	Thu 12/15/16	163
165		**Reserve Bank of Hours/Other Services**	**391 days**	**Wed 6/3/15**	**Wed 11/30/16**	**4**



Project: MDOT_TAMS_Schedule
Date: Fri 6/5/15

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

Attachment D - Breakdown of Hardware and Related Software

Table 1: Hardware

Item	Brand, Model # and Description	Specifications	Cost ($): State will provide from existing Contracts	Comments
Computers	N/A	Dual Core Windows Desktop with 4 GB of RAM	$3,000	VUEWorks® runs in a web browser
Storage		N/A		At least 10Gb free on machine for performance
CD/DVD Backup Device		N/A		Not required to run VUEWorks solution
Rack w/ Power Supply		N/A		Not required to run VUEWorks solution, but recommended if purchasing a server
Screen	N/A	Vertical resolution greater than 768	$500	Any recent monitor can be used.
Any other Hardware (list)	N/A	Quad Core Server with GB 16 of RAM for both ArcGIS Server Machine and SQL Server Machine	$15,000	Server specifications are for optimal performance, but the most recent technology is recommended.
		TOTAL	**$18,500**	

Table 2: Related Software

Software Component License	Product Name and Version	# of Licenses	Cost ($): State will provide from existing Contracts	Comments
Report writers		N/A		VUEWorks ships with a royalty-free report designer. 3rd party reporting tools are supported but not required such as Crystal Reports, Websphere, etc.
Testing tools (such as issues tracking, defect tracking, load/stress testing, configuration management.)		N/A		Recommended as per the MDOT IT policies. VUEWorks utilizes agile web software for testing and defect tracking (Redmine, SilverCatalyst, etc.), but can use as per MDOT IT policies
Other system utilities		N/A		
Server software	SQL Server 2008R2 or newer	1		SQL Server is the VUEWorks database server. VUEWorks provides integrated data linking for any other ODBC compliant database as well such as Oracle, DB2, Access, etc.

Attachment D - Breakdown of Hardware and Related Software

PC Software		N/A		
Any other software (list)	Esri Roads and Highways for Server Enterprise Standard Windows Up to Four Cores License	1	$9,000	
	Esri Roads and Highways for Server Enterprise Standard Windows Additional Cores License	8	$18,000	
	Esri Roads and Highways for Server Enterprise Standard for Windows Up to Four Cores Staging Server License	1	$4,836	
	Esri Roads and Highways for Server Enterprise Standard for Windows Additional Cores Staging Server License	4	$4,836	
	Esri Roads and Highways for Desktop Concurrent Use License	4	$36,000	
	ArcGIS Workflow Manager for Server Enterprise Standard (Windows) Up to Four Cores License	1	$9,000	
	ArcGIS Workflow Manager for Server Enterprise Standard (Windows) Additional Core License	8	$18,000	

Attachment D - Breakdown of Hardware and Related Software

	ArcGIS Data Reviewer for Server Enterprise Standard for Windows Up to Four Cores License	1	$9,000	
	ArcGIS Data Reviewer for Server Enterprise Standard Additional Core License	8	$18,000	
	ArcGIS Workflow Manager for Server Enterprise Standard (Windows) Up to Four Cores Staging Server License	1	$4,836	
	ArcGIS Data Reviewer for Server Enterprise Standard for Windows Up to Four Cores Staging Server License	1	$4,836	
	VUEWorks Asset Management Software	Enterprise	$250,000	
	VUEWorks Maintenance Management Software	Enterprise	$180,000	
	Road Analyzer V 2.20	Enterprise	$60,000	
	Video Log Module for Road Analyzer V. 2.20	Enterprise	$25,000	
	Roads and Highways Productivity Tools V 1.0	Enterprise	$30,000	
		TOTAL	**$681,344**	

Michigan Department Of Transportation

Enterprise Asset Management System (EAMS) Attachment E – Location Referencing Standards

FINAL VERSION 1.0

July 26, 2013

KPMG

cutting through complexity™

Document Revision History

Ver.	Made By	Date	Section	Description
0.1	Dave Loukes	2013-05-26		First draft for internal team review
0.2	Dave Loukes	2013-05-30		Draft submitted to MDOT for review
0.3	Dave Loukes	2013-06-27		Final draft submission incorporating feedback from MDOT June 10 workshop
1.0	Dave Loukes	2013-07-26		Final submission incorporating feedback from MDOT July 10 workshop

Contents

1. Introduction 1

2. Location Referencing Management 5

3. Coordinate Referencing Standards 13

4. Linear Referencing Standards 20

5. Indirect Referencing Standards 58

6. Data Lineage Standards 64

Appendix A. Code Tables 69

Appendix B. Michigan GeoRef Coordinate System Specifications 105

Appendix C. NCHRP Data Model Overview 108

Glossary of Terms 113

1. Introduction

1.1 Background

The Michigan Department of Transportation (MDOT or the Department) is working in cooperation with the Department of Technology, Management and Budget (DTMB) to analyze, procure, and implement an enterprise-wide Enterprise Asset Management System (EAMS).

The purpose of this overall project is to develop an EAMS to improve the business processes and enabling information systems that support the management of MDOT's assets. This EAMS will also support the Department in adopting a performance-based operational system (PBOS) to deliver the Department's core highway maintenance services. An effective EAMS will help MDOT maximize the value of its assets by improving utilization, increasing performance, reducing capital and operating costs, and extending life. Additionally, the proposed EAMS will enable the whole-life optimal management of MDOT's assets. This applies to both physical assets such as equipment and infrastructure as well as non-physical assets such as computer and accounting systems. An EAMS supports the Department's goal of adopting a performance-based approach to delivering highway maintenance services.

The EAMS implementation is being done incrementally. The initial project includes the following functional areas:

a) Road Network Management

b) Asset Inventory Management

c) Highway Maintenance Management

d) Integration Support

Fundamental to the successful implementation of the EAMS is the integration of business data across both existing and proposed application system boundaries. It is envisioned that this integration will be facilitated by consistent location referencing data management. This functionality will be imbedded in the Road Network Management module of EAMS. This module will:

- Manage the location of highway assets throughout the asset life cycle (support temporal data management);
- Integrate roadway data from multiple Linear Referencing System (LRS) networks into the Michigan Geographic Framework (MGF) Physical Road (PR) segment based LRS network;
- Translate asset location references amongst the various MDOT business Linear Referencing Methods (LRMs) and the MGF PR Segment - Mile Point (PR-MP) LRM, and between LRMs and other geospatial referencing methods (coordinates, indirect referencing);
- Visualize / analyze / map / report road network assets, including the capability to produce customized Straight Line Diagrams (SLDs);
- Support MDOT and DTMB standards for location metadata fields; and
- Operate in the enterprise geospatial technology architecture hosted by DTMB in support of MDOT Geographic Information System (GIS) enabled applications deployment.

MDOT / DTMB have well established road network management processes. The intent for this initial project is to align the planned EAMS functionality and workflows with these established processes as appropriate.

To support the overall data integration objectives of EAMS, MDOT has approved the development of updated corporate location referencing data standards. These standards will include:

- *LRS standards* – to locate infrastructure assets, incidents, and roadway characteristics that are referenced against MDOT trunkline highways;
- *Coordinate location referencing standards* - for the location of MDOT data that is referenced against the Michigan coordinate system and the statewide GIS base map standard defined by the MGF, a dataset provided by the Center for Shared Solutions (CSS), a unit in the Center for Shared Solutions and Technology Partnerships (CSSTP) of DTMB;
- *Indirect location referencing standards* - for the location of MDOT data relative to the position of political and administrative areas (for example: MDOT Regions, State House Districts) and other digital map features (for example: bridges); and
- *Data lineage standards* – to incorporate feature level metadata attributes for inventory locations.

The above location referencing data standards will be periodically updated to reflect changes in State of Michigan and MDOT spatial data management policy and to ensure that the Department can effectively leverage new GIS and data collection technologies.

1.2 Purpose of This Document

This document defines overall standards for location referencing in MDOT as applicable for use in Department IT applications. They have been developed based upon existing MDOT standards and enhanced where necessary to support the Department's EAMS implementation. The standards are intended to maximize the potential for information integration and sharing both in MDOT and between MDOT and other agencies. In particular, they will support the ongoing collaboration between MDOT and DTMB/CSSTP in the maintenance of the MGF.

The standards contained in this document apply to new MDOT computer applications, and for the coding of data to be recorded into application databases that are expected to be integrated in support of the EAMS initiative. They have been approved for use by MDOT management. These standards are intended to be used by applications designers and developers as well as MDOT staff responsible for maintaining inventory data in support of overall asset management practice in the Department.

Field procedures manuals will be developed to help ensure that data collected by MDOT crews and external agencies / contractors meets departmental requirements for location accuracy and data quality. As these are developed, they will be referenced in subsequent versions of this document.

1.3 MDOT Location Management Vision

MDOT's long term vision for location management in support of enterprise asset management and other business needs is to:

- Capture location references at the source as a component of normal business processes;
- Share location information widely through integrated location management applications, tools and business practices; and

- Retain the accuracy of coordinate locations as captured in the field through state plane coordinates or geographic coordinates for use within MDOT's IT application environment to support business needs.

In support of this vision, MDOT will work with DTMB and other stakeholders to incrementally move toward improved spatial accuracy in EAMS as more accurate statewide GIS base mapping becomes available.

The standards in this document have been developed to support the level of accuracy currently attainable in the existing MGF statewide road network spatial database. They will be updated over time as improved mapping becomes available.

1.4 Document Contents

This document contains the following sections:

- *Section 1.0: Introduction (this section)* provides background, describes the document purpose, and outlines its content;
- *Section 2.0: Location Referencing Overview* presents an overview of location referencing methods that are commonly used in Geographic Information Systems;
- *Section 3.0: Coordinate Location Referencing Standards* describes the coordinate location referencing standards for use in MDOT;
- *Section 4.0: Linear Location Referencing Standards* describes the linear location referencing standards for use in MDOT;
- *Section 5.0: Indirect Location Referencing Standards* describes the indirect location referencing standards for use in MDOT;
- *Section 6.0: Data Lineage Standards* describes the data lineage standards that are to be used in association with the location referencing standards described previously;
- *Appendix A: Data Coding Tables* contains tables of standard codes to be assigned as part of the MDOT location data standards;
- *Appendix B: Michigan GeoRef Coordinate System Specifications* contains the specifications for the Michigan GeoRef coordinate system framework; and
- *Appendix C: NCHRP Data Model* contains a brief description of the NCHRP 20-27-2 linear data model.

1.5 Related Documents

The following documents are intended for use in support of the location referencing data standards contained herein (Note: version numbers reflect the status of standards in use as of May 2013):

1. *The Michigan Geographic Framework Program and Product Prospectus*, MGF Version 12, May 25, 2012 (CSS).
2. *Standards for Establishing & Modifying Physical Road Numbers, Mile Points & Point Identifiers in the Michigan Geographic Framework Transportation Referencing System*, document produced in cooperation with the Michigan Center for Geographic Information, November 14, 2005.
3. *Framework Standards for Representing Divided Roads*, MDOT internal undated document.
4. *PR Referencing Standards for Roundabouts*, CSS online webpage document.

5. *Michigan Geographic Framework Field Definitions (Arc Attribute Table)*, MGF Version 12b, May 30, 2012 (CSS).

1.6 Department Contacts

1.6.1 Document Contact

This document is subject to revision. For further information concerning these standards, or to obtain the latest version of this document, please contact:

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2. Location Referencing Management

2.1 Location Referencing Overview

Location referencing in modern GIS enabled asset management systems falls into three general classes or methods:

- *Coordinate referencing* – assets are located using geographic (Lat / Long) or projected (X, Y) coordinates with elevations to define their absolute position;
- *Linear referencing* – assets are located along a constrained path (road or Route) using measured distances from known points (Linear Reference Points); and
- *Indirect referencing* – assets are located by reference to the identifier of an existing spatial feature (for example: a Property ID or Bridge Number).

There are advantages and disadvantages to each of the above methods in support of transportation asset management systems as summarized in Table 1.

Table 1: Comparison of Referencing Methods for Transportation Asset Management

Method	Advantages	Disadvantages
Coordinates	Native referencing method in GIS Directly supports Global Positioning System (GPS) based field data collection Best supports the collection of highly accurate engineering and asset data with elevations Enables the collection of asset data from As-Built Computer-aided Design (CAD) files	Support for multiple road network attributes may require excessive segmentation in order to capture all changes Analysis involving multiple asset classes (such as crashes on paved roads) based upon location may require buffered spatial overlay
Linear	Best supports network based data integration, analysis and reporting GIS dynamic segmentation techniques eliminate the need for excessive road network segmentation Does not require GIS for many table based inquiries	Requires GIS dynamic segmentation functionality (varies by vendor) Requires ongoing synchronization of spatial (GIS) and logical LRS data models as changes occur Location data collection may be cumbersome and error prone without GPS Elevations are not normally collected
Indirect	Location inherited from linked feature	Location accuracy is relative to the coverage area bounded by / included in the linked feature

Each of the above categories of location referencing is further described in the following sections.

2.2 Coordinate Location Referencing

Coordinate referencing is the simplest method of assigning location to a data record. This is accomplished by storing the map coordinates in the record and then using these coordinates to display the data location on a digital map. Coordinates may be expressed either in terms of latitude and longitude, or as X and Y (Easting and Northing, respectively) distance offsets in a defined system of measure (feet, meters, etc.) from a defined point of origin in a rectangular coordinate system. Increasingly, elevations are included as part of coordinate referencing to support three-dimensional (3-D) analyses in CAD and GIS.

2.3 Linear Location Referencing

Linear referencing involves the location of road features such as signs and other phenomena such as accident locations through the use of linear measurements from a known reference point. These are collectively referred to as events. An LRS consists of the following components:

- A linear set or datum of anchor points and anchor sections. These are often referred to as nodes and links. The anchor sections or links are sections of road between the anchor points or nodes. Within MDOT, the PR Segments defined within the MGF serve as the linear datum.
- One or more groups or networks of links and nodes that are constructed from the linear datum. An example network would be the set of all MDOT trunkline roads.
- One or more LRMs that are based upon ordered sets of links and nodes. These ordered sets introduce the concept of direction of travel or traversal. Within MDOT, Control Sections were historically used as a primary LRM. The PR Segment – Mile Point (PR-MP) LRM is the current standard for linear referencing of business data within MDOT. It is based upon locations defined relative to the beginning of individual PR Segments.

The above definition of a LRS is based upon the work done as part of the US Department of Transportation National Co-operative Highway Research Program (NCHRP) Project 20-27-2, which defined a generic data model for transportation network linear referencing. Figure 1 depicts the components of a LRS based upon this terminology. A synopsis of the NCHRP 20-27-2 data model is contained in Appendix C of this document. A more comprehensive description of this data model is contained in the final NCHRP project report[1].

[1] National Cooperative Highway Research Program. *A Generic Linear Model Data Model for Linear Referencing Systems. NCHRP 20-27-2: NCHRP Research Results Digest 218*, September 1997.

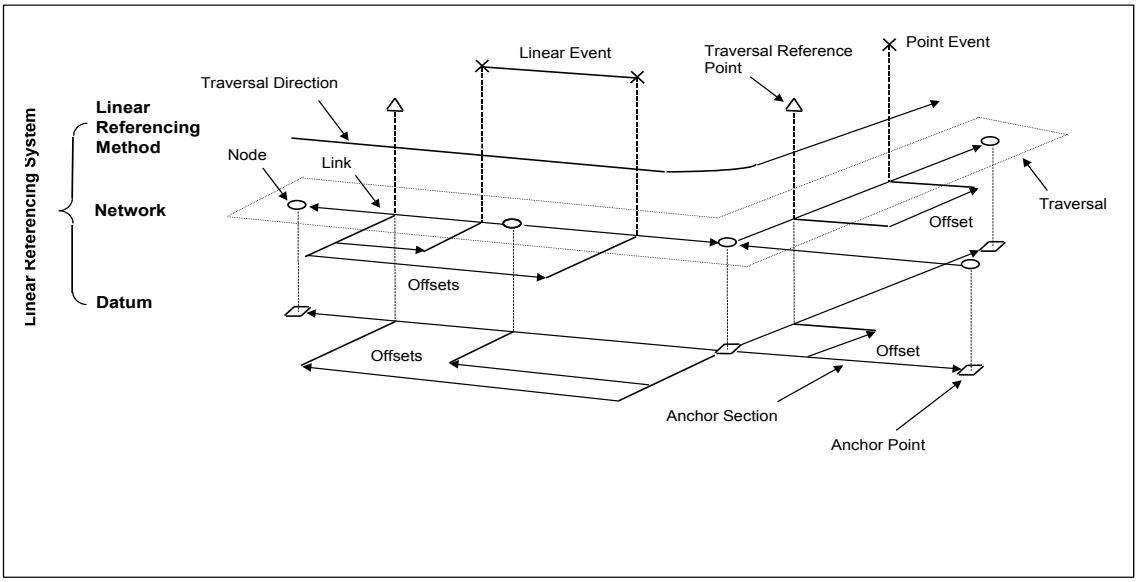

Figure 1: Linear Referencing System

Note also that both a cardinal direction (traversal direction) and a system of measurement units form part of each LRM.

2.3.1 Reference Points

In an LRS, Linear Reference Points (LRPs) may be established along a Route or Traversal as intermediate points from which distance offset measurements may be made. In the existing MDOT PR Segment – Mile Point (PR-MP) LRS, LRPs are defined at the Beginning Mile Point (BMP) and Ending Mile Point (EMP) locations of each PR Segment. These are normally established at physically identifiable (both in the field and on a digital road network map) locations that are unlikely to change (such as major intersections), although in some cases PR Segments break at County boundaries as well.

In addition to these formally established LRPs, individual inventory features may be used as secondary reference points as necessary for the convenience of field staff and / or for compatibility with legacy LRMs. Examples may include mile markers and administrative boundary points.

2.3.2 LRS Events

Road inventory, associated condition ratings, and specific time based activities or occurrences (such as project locations or accidents) that are located along a transportation network using LRS offset measurements are known as events. Events in a LRS are divided into two distinct categories:

- Point events occur at a finite position along the network, and are therefore located using only a single offset measurement from a reference point. Examples of point events include sign and signal locations, culverts, catch basins, and accidents.
- Linear events occur along a continuous section of road, and are therefore located using two offset measurements (beginning and end) from a reference point. Examples of linear events include guide rail, median barriers, curb and gutter sections, speed zones, road surface type, and contract limits.

Figure 2 illustrates the location of point events along a route. Figure 3 shows how linear events are similarly located.

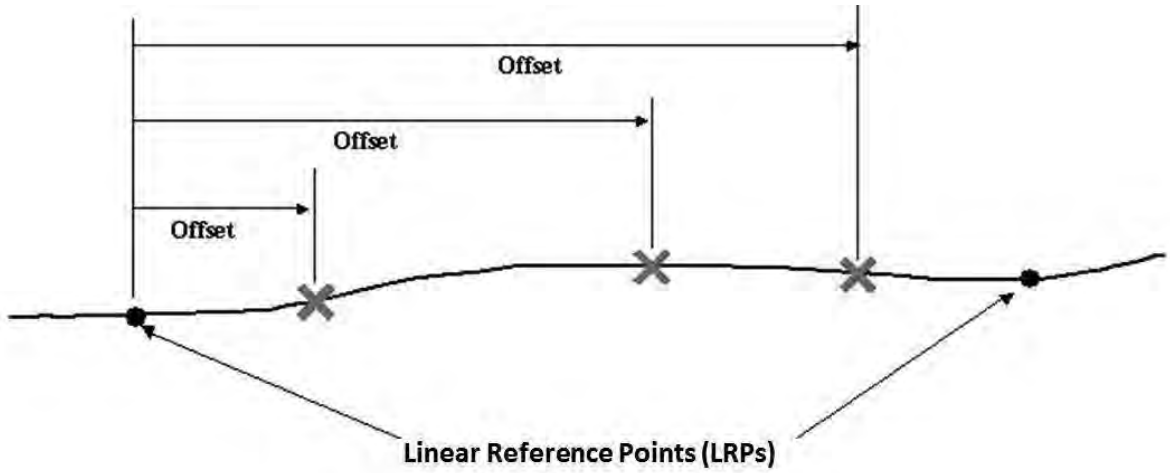

Figure 2: Location of Point Events

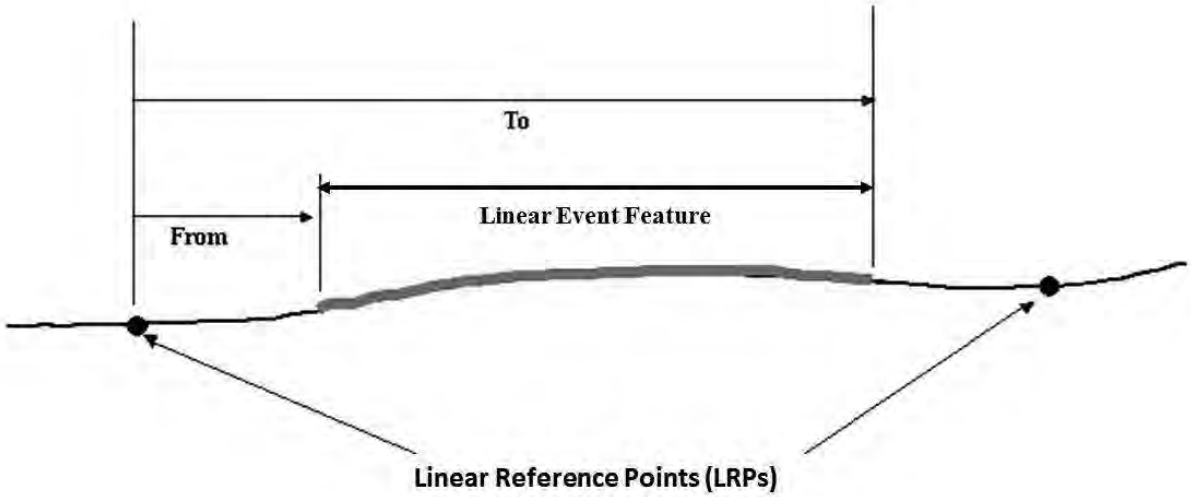

Figure 3: Location of Linear Events

2.4 Indirect Location Referencing

Indirect referencing links data to a GIS map through a feature key. The unique identifier that forms the feature key is stored both in the GIS map and the attribute database record that is to be linked to it. Figure 4 illustrates this concept using a bridge feature example.

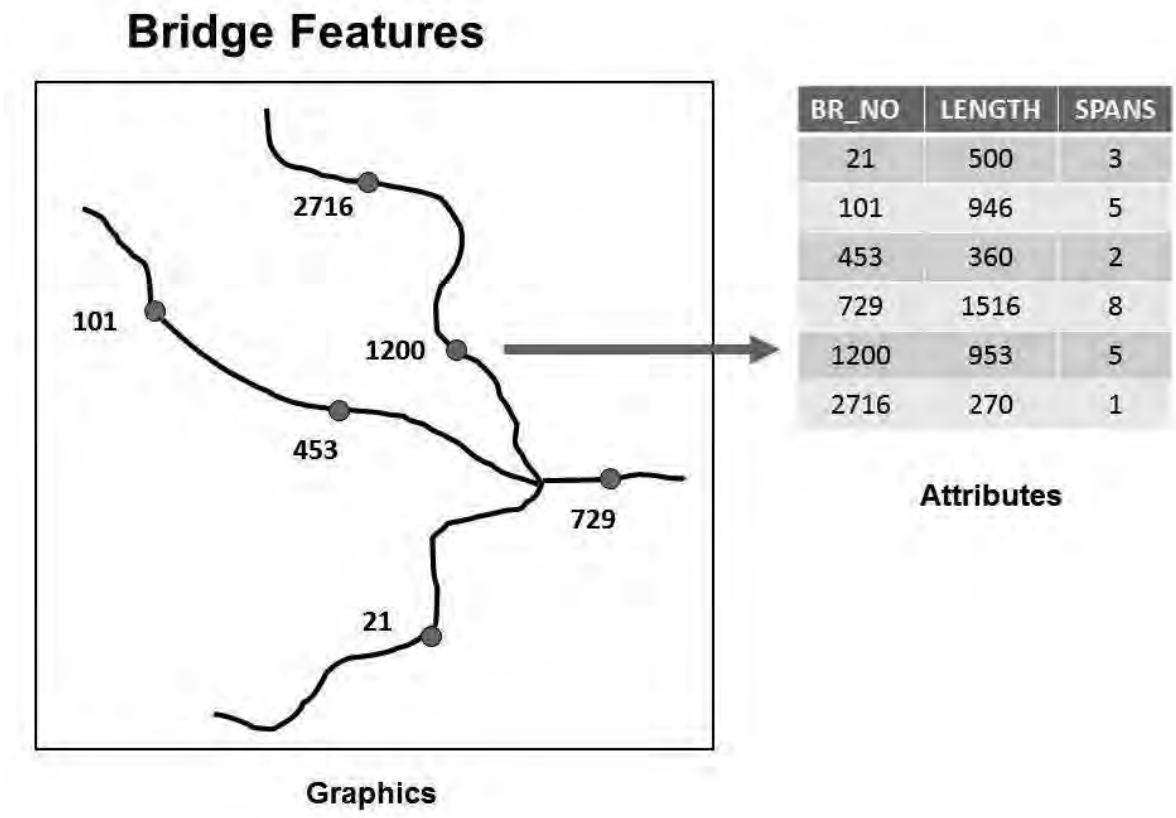

Figure 4: Indirect Reference Example

Table 2 lists some possible examples of indirect referencing location references for spatial data feature layers currently being used in MDOT, along with the agency responsible for maintenance (Data Custodian), the authoritative database location, and a description of content.

Table 2: Examples of Indirect Referencing Feature Layers

Feature Layer	Type	Custodian	Location	Content
Bridge Locations	Point	MDOT	MGF	MDOT bridge locations (mid-point)
MDOT Regions	Polygon	MDOT	MGF	MDOT regional boundary areas
MDOT Transportation Service Centers	Polygon	MDOT	MGF	MDOT TSC boundary areas
State House Districts	Polygon	DTMB	MGF	Michigan State House Districts

2.5 Location Referencing in Transportation Agencies

Linear Referencing Systems (LRS) have been commonly used in transportation agencies worldwide for many years. Prior to the widespread use of coordinate systems, the advent of GIS, and widespread use of digital mapping, LRS provided a convenient approach to locating road assets along transport agency networks based upon a logical network definition that utilized a one-dimensional coordinate system – offset measurement from a known point along a constrained linear path (the road centerline).

In the absence of coordinate based field survey location methods, LRS initially relied upon the establishment and maintenance of field Linear Reference Points that were defined by physical road features (for example: bridge abutments, road intersections), signs, and / or pavement markings. The locations of these LRPs were established using precisely calibrated Distance Measuring Instruments (DMIs) to measure the distance from the beginning of the road or from the previous RP.

In a LRS framework that must support field data collection using DMIs, the density of LRPs depends upon the desired accuracy of asset location. As the requirement for accuracy increases, so does the corresponding density of Reference Points. As an example, the New Zealand Transport Agency (NZTA) LRS Standard SM051 was established to provide an accuracy of +/- 10 meters in asset location at any point along the State Highway network. To support this requirement, NZTA has established precisely located LRPs (known as Reference Stations, or RS) at a maximum spacing of 16 kilometers along each road included in the State Highway system. In addition to this, the following additional LRPs are also provided:

- Intermediate Reference Points (known as Extended Reference Points, or ERP) at intervals of 3 kilometers or less between RS – these locations are precisely measured from the prior RS;
- Kilometer Posts (KP) at approximately each kilometer along the road – these are not as precisely measured and are classified as secondary RPs not to be utilized as a starting point for precise linear measurement.

Other transportation agencies have historically adopted similar approaches, although most LRS have not been implemented with Linear Reference Points as extensive as defined in SM051. The tradeoff in these instances has been reduced asset location accuracy for a decreased level of field LRPs. This has implications for road asset management practice.

2.6 LRS Support for Road Asset Management

Irrespective of the capabilities of modern GIS software to directly analyze road network data using spatial overlay techniques, LRS continues to provide essential support for road asset management as LRS locations serve as the key to integrate data across multiple asset management applications. This has been recognized for many years in transportation agencies that have been early adapters of life cycle road asset management frameworks. These frameworks require supporting asset management systems applications that incorporate extensive data mining to develop optimal intervention strategies. Accurate and consistent location measurement is needed to support these analyses.

With the increasing use of Global Positioning Systems (GPS) in recent years, GPS based data collection systems now offer an alternate approach for locating assets and works projects in the field. This is further discussed below. However, irrespective of the location method taken for field data collection, it is accepted as current best practice that LRS is still required to support asset management systems data storage, integration, reporting and analysis. Additionally, experienced asset management practitioners can easily relate to a LRM location as it references business data relative to a position along a roadway.

2.7 LRS Current Practice

The following trends have been identified through prior international experience and are summarized here for the benefit of MDOT staff.

2.7.1 GPS as Primary Field Asset Location Method

Many transportation agencies have indicated that GPS has now replaced, or will replace in the next few years, DMI as the primary field asset location method. They also feel that these technologies will provide superior location accuracies.

2.7.2 Road Centerline Databases

Road centerline databases are the most commonly used method for locating transportation agency assets. Ramps, interchanges, roundabouts, and bridges are also typically included in these databases. In general, these databases are being collected to an accuracy of +/- 10 meters or better. In some countries, national specifications for road network databases are being developed that are sufficiently accurate for use in road asset management applications.

Increasingly and as the accuracy of digital mapping improves, the road network lengths as derived from the GIS spatial data are being utilized to establish the linear distance between Linear Reference Points as an alternative to measuring these distances in the field using DMIs. Recent studies undertaken by transportation agencies and others in the US and Canada have confirmed that the differences between ground measured DMI distances and those derived from the road centerline spatial data are insignificant, even when the spatial data is planimetric (elevations not included). Furthermore, errors in position are evenly distributed across the network whereas with DMI measurements positional errors increase as the distance from the LRP increases.

Roadway realignments require the adjustment of all subsequent roadway segments which creates challenging data updates and historical data management.

2.7.3 Linear Referencing

Irrespective of the move toward GPS based asset location, linear referencing will continue to be required in transportation agencies. LRS provides necessary support to legacy applications and facilitates database inquiry and reporting. In other words, there is a continuing requirement to translate between GPS coordinates and various agency LRMs.

Agencies seeking new application solutions for asset location management should include LRM – LRM and LRM - coordinate translation in their functional requirements.

2.7.4 Multiple Linear Referencing Methods

Many agencies have now developed LRS (and broader location referencing) standards in an attempt to encourage consistent practice in asset location collection and reporting. However, it is likely that LRS application management solutions will continue to require support for multiple LRMs in order to address both legacy databases / applications and to best support field data collection, analysis and reporting business processes.

2.7.5 Integrated Network History Management

Modern asset management systems incorporating GIS technologies have recognized a requirement to maintain referential integrity between the logical road network data model and its GIS spatial representation. Specifically, as network changes occur the logical and spatial models must be synchronized, and changes in network length must be propagated across all associated LRMs. These changes must also be reflected in LRM based locations in business application databases.

Furthermore, network changes must be time stamped so that these changes can be tracked and data related to the network at any point in time. The complexity of managing these changes has led to the development of commercial LRS management software solutions that support history management, maintain network integrity, and support multiple LRMs.

3. Coordinate Referencing Standards

This section describes the coordinate location referencing standards that are recommended for use in MDOT in support of EAMS and other applications. In general, these are based upon existing State standards.

3.1 Data Fields and Coding Conventions

This section and others in this document contain coding standards for location referencing database elements in tabular form. The table columns and associated coding conventions are as follows:

- *Field Name* – contains the recommended database field name for the database element. These names are compliant with the DTMD approved standards[2] and abbreviations[3] for field names in IT applications
- *Type* – the type of data field:
  - *N* – Numeric field, used for numbers containing a decimal point
  - *I* – Integer field
  - *C* – Character (text) field
  - *D* – Date field
- *Size* – the size of the field:
  - For Numeric fields, specified as *n*,*d*, where
    - *n* is the maximum number of digits contained in the field including the decimal point
    - *d* is the number of digits to the right of the decimal point

    Example: 8,3 indicates a maximum number of 9999.999
  - For Integer fields, specified as *n*, where *n* is the maximum number of digits contained in the field. Example: 5 indicates a maximum number of 99999
  - For Character fields, specified as *n*, where *n* is the maximum number of characters contained in the field. Example: 5 indicates a maximum of 5 characters
  - For Date fields, size is not specified. The format for entering dates is yyyy-mm-dd. Example: 2013-04-09

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[2] Michigan Department of Information Technology at Michigan Department of Transportation, *Data Standards*, 08/04/2009.
[3] Michigan Department of Information Technology at Michigan Department of Transportation, internal document **AbbrFinal_11232009.pdf**.

- *Coding Rules* – contains specific instructions for entering data into the field
- *Code Table* – provides a reference to a code table in Appendix A that specifies the domain of valid values for this field, **if applicable**. If this column is blank for a specific field name entry, there is no associated code table.

3.2 Digital Basemap Coordinate Framework

Digital map standards for EAMS use should be consistent with those being employed or considered by MDOT for use in other enterprise GIS applications, or as recommended by CSS in order to ensure ongoing compatibility with the Michigan Geographic Framework. The currently recommended GIS coordinate framework is the Michigan GeoRef standard. It is based upon a custom projection for Michigan, as follows:

Horizontal Datum:	North American Datum of 1983 (NAD83)
Vertical Datum:	North American Vertical Datum of 1988 (NAVD 88)
Ellipsoid:	Geodetic Reference System1980 (GRS80)
Projection:	Hotine Oblique Mercator
Units:	Meters

Further information concerning the Michigan GeoRef standard is contained in Appendix B.

3.3 Projected Coordinate Standards

A known limitation of the GeoRef projection is that coordinate accuracy may be reduced to 3 meters at the state boundaries. MDOT supports other coordinate projections for use where higher accuracy is required to meet business needs. These are described below.

3.3.1 Other Supported Projections

MDOT currently supports the Michigan State Plane Coordinate System for use in field survey, CAD and other business requirements where higher accuracy is needed. It is based upon a 3 zone Lambert projection for Michigan, as follows:

Horizontal Datum:	NAD83
Vertical Datum:	NAVD 88
Ellipsoid:	GRS80
Projection:	Lambert Conformal Conic
Units:	Meters
Zones:	North, Central, South

Further information concerning the Michigan State Plane Coordinate System standard is contained in Appendix B.

Information regarding both the Michigan GeoRef and the state plane coordinate system is available at:

http://www.michigan.gov/documents/DNR_Map_Proj_and_MI_Georef_Info_20889_7.pdf

Coordinate locations stored in other supported projections must be translated into GeoRef for use within MDOT GIS database applications. Coordinate translation is discussed in Section 3.7 below.

3.3.2 Database Projected Coordinate Coding Standards

When projected coordinates are maintained in database tables associated with MDOT applications, the following field layout and coding standards are to be used as described in Table 3 below.

Location metadata fields associated with projected coordinate positions are shaded in light green.

Table 3: Projected Coordinate System Data Coding Standards

Field Name	Type	Size	Coding Rules	Code Table
X_COORD	N	10,2	The X coordinate in meters to the nearest 0.01 meter.	
Y_COORD	N	10,2	The Y coordinate in meters to the nearest 0.01 meter	
ELEVATION	N	6,1	The elevation in meters to the nearest 0.1 meter. **Note: use of the ELEVATION field is optional. However, elevation data should be included as part of coordinate location references wherever possible.**	
PROJECTION_CD	C	3	The coordinate projection, from the code table.	Table A-1
The following location metadata fields are included with each location reference. See Section 6 of this document for a description of these fields.				
HORZ_POS_ACUR	I	3	An integer number that represents the estimated horizontal positional accuracy of the location, in meters.	
VERT_POS_ACUR	I	3	An integer number that represents the estimated vertical positional accuracy of the location, in meters. **Note: use of this field is required only if the ELEVATION field is used.**	
SRC_POS	I	2	Source Position. The referencing method used to digitize/capture the feature position, from the code table.	Table A-2
DT_POS_SRC	DATE		The date when the feature was collected in accordance with the Source Position specified above.	
DT_FE_ADD	DATE		This field will be updated with the current date when a new feature is added to the database.	

Field Name	Type	Size	Coding Rules	Code Table
DT_POS_ED	DATE		This field will be updated with the current date when the position associated with an existing database feature is edited.	
DT_POS_RET	DATE		The date when the feature was retired.	
POS_COLL_AGN	I	2	The organization responsible for the collection of the feature, to be recorded for new or modified geometry. Select a code from the code table. Select "01" (MDOT) if the data was collected by MDOT staff.	Table A-3
COLL_AGN_NAME	C	50	The name of the organization responsible for the collection of the feature position, to be recorded for new or modified geometry. The agency name is a free format text field. **Note: use of this field is optional.**	

Notes:

1. Horizontal datum is NAD83.
2. Vertical datum is NAVD 88.

3.4 Geographic Coordinate (Latitude / Longitude) Standards

When coordinate values are stored as geographic (latitude / longitude) coordinates, they must adhere to CSS horizontal and vertical datum standards. These are as follows:

Horizontal Datum: North American Datum of 1983 (NAD83)

Vertical Datum: North American Vertical Datum of 1988 (NAVD 88)

Ellipsoid: GRS 1980

Locations that are captured as geographic coordinates using GPS will need to be transformed into the recommended coordinate framework as per the standards described in Section 3.2 above in order to be integrated into MDOT GIS data layers. In these cases, it is recommended that the original geographic coordinate values should also be retained as feature attributes for possible future use (in the event that the coordinate framework changes at some later date).

Geographic coordinates that are not related to the above datum must be converted using coordinate transformation software. See Section 3.5 below for information regarding coordinate transformation software standards.

When geographic coordinates are maintained in data base tables associated with MDOT applications, the following field layout and coding standards are to be used as described in Table 4 below.

Table 4: Geographic Coordinate System Data Coding Standards

Field Name	Type	Size	Coding Rules	Code Table
LATITUDE	F	11,8	The geographic North latitude coordinate in decimal degrees to the nearest 0.00000001 degree.	
LONGITUDE	F	12,8	The geographic West longitude coordinate in decimal degrees to the nearest 0.00000001 degree.	
ELEVATION	F	6,1	The elevation in meters to the nearest 0.1 meter. **Note: use of the ELEVATION field is optional. However, elevation data should be included as part of coordinate location references wherever possible.**	
The following location metadata fields are included with each location reference. See Section 6 of this document for a description of these fields.				
HORZ_POS_ACUR	I	3	An integer number that represents the estimated horizontal positional accuracy of the location, in meters.	
VERT_POS_ACUR	I	3	An integer number that represents the estimated vertical positional accuracy of the location, in meters. **Note: use of this field is required only if the ELEVATION field is used. However, elevation data should be included as part of coordinate location references wherever possible.**	
SRC_POS	I	2	The referencing method used to digitize/capture the feature position, from the code table.	Table A-2
DT_POS_SRC	DATE		The date when the feature was collected in accordance with the Source Position specified above.	
DT_FE_ADD	DATE		This field will be updated with the current date when a new feature is added to the database.	
DT_POS_ED	DATE		This field will be updated with the current date when the position associated with an existing database feature is edited.	
DT_POS_RET	DATE		The date when the feature was retired.	
POS_COLL_AGN	I	2	The organization responsible for the collection of the feature, to be recorded for new or modified geometry. Select a code from the code table. Select “01” (MDOT) if the data was collected by MDOT staff.	Table A-3

Field Name	Type	Size	Coding Rules	Code Table
COLL_AGN_NAME	C	50	The name of the organization responsible for the collection of the feature position, to be recorded for new or modified geometry. The agency name is a free format text field. **Note: use of this field is optional.**	
Notes: 1. Horizontal datum is NAD83. 2. Vertical datum is NAVD 88.				

3.5 Other Related Coordinate Standards

No other coordinate standards are recommended for MDOT use at this time.

3.6 Field Survey Procedures

This document is not intended to be a field survey procedures manual. Refer to the MDOT Design Survey Manual[4] for procedures and specifications to be used for field surveys. Additional field survey reference documents that are available for use in the State of Michigan are:

1. *Survey Feature Codes* – a list of the valid feature codes for use in field data collection and in MDOT CAD files.

Further information pertaining to MDOT design survey and CAD standards may be obtained online through the MDOT Design Services Resources webpage[5] or by contacting:

Design Survey Manual and Standards

John P. Lobbestael, P.S.
Phone: 517-335-5550
lobbestaelj@michigan.gov

CAD Standards

Rachelle Van Deventer, P.E.
Phone: 517-335-1927
vandeventerr@michigan.gov

[4] Michigan Department of Transportation, Design Survey Manual, available online at: http://mdotcf.state.mi.us/public/design/surveymanual/
[5] Michigan Department of Transportation, Design Services Resources, Manuals & Guides: http://mi.gov/mdot/0,1607,7-151-9625_21540_36037---,00.html

3.7 Coordinate Transformation Software

Software tools for coordinate system transformations exist in the ESRI ArcGIS software used at MDOT. Coordinate data transformations have a pervasive impact on the LRS and as such must be done with care and understanding. Staff involved with analyzing and implementing coordinate transformations must be trained accordingly.

3.7.1 GIS Support

MDOT staff that have a need to transform coordinates in order to conform to MDOT data standards for GIS use as described above are advised to contact DTMB:

Laura Blastic
Geo-Framework Services Manager
Department of Technology, Management & Budget
Michigan Center for Shared Solutions
Phone: (517) 373-7910
Email: blasticl@michigan.gov

3.7.2 Design – Survey Support

MDOT staff that have a need to transform coordinates for use in field survey and design applications are advised to contact:

John P. Lobbestael, P.S.
Phone: 517-335-5550
lobbestaelj@michigan.gov

4. Linear Referencing Standards

This section describes the linear location referencing standards that are to be used in MDOT for EAMS related GIS / IT applications and databases. Terminology used in this section is consistent both with the NCHRP-20-27-2 report[1] and the International Standards Organization (ISO) LRS standards[6].

The contents in this section are organized as follows:

- *Section 4.1 MDOT Network Scope* defines the extent of the MDOT network;
- *Section 4.2 Spatial Network Datum* defines the spatial road network datum for the LRS standards;
- *Section 4.3 MDOT Linear Referencing System (MLRS)* defines the entities comprising the MLRS and specifies the rules for coding the entity identifiers;
- *Section 4.4 PR Segment – Mile Point (PR-MP) LRM* defines the primary LRM used for linear referencing in MDOT IT applications and specifies the rules for coding LRM location fields;
- *Section 4.5 Secondary Linear Referencing Methods* defines secondary MDOT business LRMs used for linear referencing in MDOT IT applications and specifies the rules for coding LRM location fields. These secondary LRMs are:
    - Control Section – Mile Point (CS-MP)
    - Route – Mile Point (Route-MP)
- *Section 4.6 Special Situations* contains business rules for handling special situations in the MLRS and its associated LRMs.

4.1 MDOT Network Scope

The linear referencing standards described in this chapter are intended for use by MDOT staff to locate features on the portion of the MGF road network that may need to be analyzed or reported on by agency staff. The scope of this network includes:

- *Trunkline Roads*: roads or portions of roads that are owned by MDOT; and
- *Federal Aid Roads*: include additional roads or portions or roads that are not owned by MDOT but required to be reported upon as part of the US Department of Transportation (USDOT) Federal Highway Administration (FHWA) Highway Performance Monitoring System (HPMS).

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[6] International Organization for Standardization, *Geographic information — Location based services — Linear referencing system*, International Standard ISO/DIS 19148, ICS 35.240.70, 2012-02-20.

4.2 Spatial Network Datum

The GIS database that is used as the spatial road network datum for the MDOT LRS and associated LRMs is the Michigan Geographic Framework database[7] that is maintained by the Department of Technology, Management, and Budget, Center for Shared Solutions and Technology Partnerships (DTMB/CSSTP) through CSS. A new version of this database is released annually.

In addition to road centerline data, the MGF contains other features such as rivers, lakes, streams, railroads, political jurisdiction boundaries, and other miscellaneous features. There are currently 21 feature classes in the dataset, including bridges and railroad crossings which are stored as point features. MDOT administrative boundaries are maintained as polygon features in the MGF. This facilitates spatial inquiry, analysis and reporting to meet MDOT business needs.

The MGF road network linear datum is based upon Physical Road (PR) Segments. The MDOT standards document for PR Segment definition[8] contains comprehensive business rules governing the creation and modification of these datum sections. The primary characteristics of PR Segments are briefly summarized as follows:

- PR Segments are continuous with no gaps or overlaps. Unconnected segments cannot have the same PR Segment identifier.
- PR Segments have one beginning and one end. The beginning is assigned the zero mile point. PR Segments have only one direction.
- PR Segments have no branches or loops. PR Segments never extend from a point or converge on a point along more than two paths.
- Each PR Segment refers to a unique link of the transportation system, and no link has more than one PR Segment.
- In general, PR Segments begin and end at road intersections although on MDOT trunkline roads PR Segments are broken at County boundaries. Additional special cases exist in the MGF although these are relatively few in number.
- PR Segments are defined at the individual road centerline (carriageway) level. Divided highways are represented by individual PR Segments for each direction of travel.
- Ramps and Roundabouts are included as PR Segments.
- If a PR Segment is retired, its number cannot be reused. This is done to ensure that an audit trail of network history is properly maintained.

[7] Department of Technology, Management and Budget, Center for Shared Solutions and Technology Partnerships, *The Michigan Geographic Framework Program and Product Prospectus*, MGF Version 12, May 25, 2012.
[8] Michigan Department of Transportation, *Standards for Establishing & Modifying Physical Road Numbers, Mile Points & Point Identifiers in the Michigan Geographic Framework Transportation Referencing System*, document produced in cooperation with the Michigan Center for Geographic Information, November 14, 2005.

In addition to the above, special case business rules exist for dealing with divided / undivided trunkline highway sections[9] and Roundabouts[10].

PR Segment beginning and end points are coincident with underlying road network spatial nodes. This is further described in Section 4.3.1 below.

MDOT and MGF attributes that are defined as LRS event features are stored against the network using a Link – Offset Linear Referencing Method (LRM). This is known as the PR Segment – Mile Point (PR-MP) LRM and is the current MDOT standard for linear referencing of business data in IT application databases. Further information concerning this LRM is provided in Section 4.4 below.

4.3 MDOT Linear Referencing System (MLRS)

MDOT has enterprise standards for LRS use in IT applications. These standards also apply to EAMS. These standards are collectively referred to as the MDOT Linear Referencing System (MLRS) and are described below.

4.3.1 MLRS Overview

The MLRS is based upon a statewide standard Link - Offset LRM that is used on all roads contained in the MGF. The MDOT trunkline roads are a subset of the MGF network. The MLRS logical network data model consists of the following entities:

- MLRS Anchor Point (MAP)
- MLRS PR Segment
- MLRS Route Branch
- MLRS Control Section Branch
- MDOT Control Section
- MDOT Highway
- MDOT Network
- MLRS Reference Point (MRP)
- MLRS Intersection / Interchange
- MLRS Ramp
- MLRS Event

The naming conventions used for the logical data model are as follows:

[9] Michigan Department of Transportation, *Framework Standards for Representing Divided Roads*, internal undated document.
[10] CSS, *PR Referencing Standards for Roundabouts*, online standards document available at: http://www.michigan.gov/cgi/0,4548,7-158-52927_53037_12759_14194---,00.html

- Where MLRS is used as part of the name, the entity is directly associated with or is a component part of a linear reference; and
- Where MDOT is used as part of the name, the entity is a level of aggregation for network inventory reporting purposes.

For example, MLRS Control Section Branches are used to locate business data against the CS-MP LRM, whereas MDOT Control Sections are used to aggregate business data across all associated Control Section Branches.

Figure 5 presents the conceptual data model for the MLRS and illustrates the relationship between the logical network model and the corresponding MGF spatial database that comprises the linear datum. The model includes the following secondary LRMs that are used for business purposes in MDOT:

- Control Section – Mile Point (CS-MP) LRM; and
- Route – MP LRM.

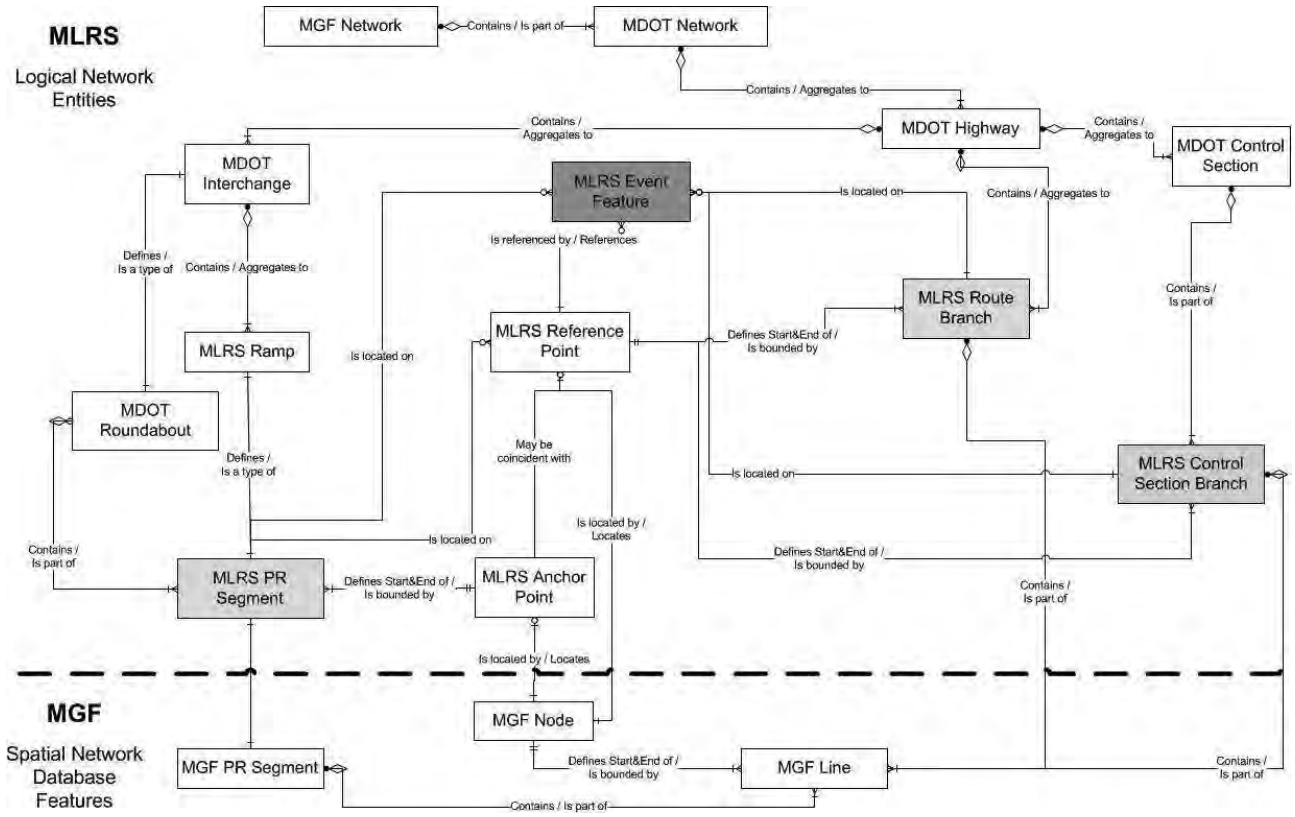

Figure 5: MLRS Conceptual Data Model

In the above diagram, the following color coding conventions are used:

- Entities colored in light green are associated with the PR-MP LRM;
- Entities colored in pink are associated with secondary LRMs; and
- Entities colored in blue are associated with business data that is referenced to a MLRS LRM.

Table 5 includes a summary definition for each of the above entities and also relates them to the NCHRP 20-27-2 data model terminology.

Table 5: MLRS Entity Definitions

Entity	Definition	20-27-2 Term
MLRS Anchor Point (MAP)	A point that defines the start or end of a MDOT PR Segment. The spatial location of each MAP is represented by a MGF Node. The complete set of MDOT Anchor Points is defined by those bounding all PR Segments included in the MDOT Network.	Anchor Point
MLRS PR Segment (PR)	A road network segment that is defined by the spatial location of a MGF PR Segment. The complete set of MLRS PR Segments is defined by those included as part of the MDOT Network. Since the PR-MP LRM is the standard for linear referencing in MDOT IT applications, MLRS PR Segments are both Anchor Sections and Traversals.	Anchor Section, Traversal
MLRS Reference Point (MRP)	A point on a MLRS PR Segment that is used as a starting point for linear measurement along the roadway centerline. MLRS Anchor Points are a subset of MRPs.	Traversal Reference Point
MLRS Ramp	A special case of a MLRS PR Segment that permits traffic to flow between two MDOT Highways, or between a MDOT Highway and another road.	Traversal
MDOT Interchange	A collection of MLRS Ramps at a location where two or more MDOT Highways intersect, or where a MDOT Highway intersects with another MGF road. In the MLRS, an Interchange is used as a means of aggregation for reporting purposes.	Network
MDOT Roundabout	A collection of MLRS PR Segments comprising a Roundabout at a location where two or more MDOT Highways meet, or where a MDOT Highway meets with another MGF road. In the MLRS, a Roundabout is used as a means of aggregation for reporting purposes.	
MDOT Control Section	The collection of Control Section Branches. MDOT Control Sections are used as a means of aggregation for reporting purposes.	
MLRS Control Section Branch	A contiguous carriageway section of a MLRS Control Section that is used as a basis for linear location referencing against the Control Section – Mile Point (CS-MP) LRM. A MLRS Control Section Branch encompasses one or more MGF Lines and begins / ends at either a MLRS Anchor Point or a MLRS Reference Point.	Traversal

Entity	Definition	20-27-2 Term
MLRS Route Branch	A contiguous carriageway section of a MLRS Route that is used as a basis for linear location referencing against the Route - MP LRM. A MLRS Route Branch encompasses one or more MGF Lines and begins / ends at a MLRS Anchor Point or a MLRS Reference Point.	Traversal
MDOT Highway	The collection of MLRS Route Branches, Interchange / Intersections and Roundabouts in the scope of an MDOT Highway. MDOT Highways are used as a means of aggregation for reporting purposes. MDOT Control Sections also aggregate to an MDOT Highway.	
MDOT Network	The collection of MDOT Highways that define the extent of the MDOT trunkline road network.	Network
MLRS Event	A physical feature, incident or highway characteristic that is located in the MLRS based upon a distance measurement along a MLRS PR Segment, Control Section Branch or Route Branch from a MLRS Reference Point. There are two subclasses of MLRS Event: • A MLRS Point Event exists at a distinct point and is located using a single distance measurement • A MLRS Linear Event exists at a contiguous section of road and is located using two distance measurements that define its start and end	Event Point Event Linear Event
MGF Node	A spatial node that defines the start or end of a MGF Line in the MGF database. Most MGF Nodes occur at topological intersection points although some may also be placed at County boundaries and other special case locations. MLRS Anchor Points are a subset of MGF nodes.	
MGF Line	A linear spatial feature that is bounded by two MGF Nodes.	
MGF PR Segment	A composite spatial linear feature in the MGF that is comprised of one or more MGF Lines.	Anchor Section

MLRS PR Segments are components of carriageway level road centerlines in an overall MDOT trunkline route that meet the following criteria:

1. Each MLRS PR Segment begins and ends at a MLRS Anchor Point (MAP) that has the following characteristics:
    a. It is physically and uniquely identifiable in the field.
    b. It is precisely located and reconciled with a MGF Node in the MGF digital mapping base.
    c. Most MAPs will be located at road intersections. However, in the MDOT trunkline network County boundaries are also used as MAPs. It is also noted that other special situations

may exist to deal with crash reporting requirements (for example: right angle curves along roads where the road name changes).

2. Where divided highway situations occur, individual PR Segments are defined for each carriageway in each travel direction.
3. MLRS PR Segments terminate at state boundaries.

4.3.2 MLRS Entity Identifiers

Each of the MLRS data entities has descriptive attributes and a standard identifier. Table 6 summarizes the standard identifier format used for each of these entities.

Table 6: MLRS Entity Identifier Coding Rules

Entity	ID Format	Components	Examples
MLRS Anchor Point (MAP) MLRS Reference Point (MRP)	*cc nnnnnn*	MAP and MRP identifiers are internally generated in MGF and are County based: *cc* is the MDOT 2 digit County number *nnnnnn* is a 6 digit number in the County	33123456
MLRS PR Segment (PR)	*nnnnnnn*	PR identifiers are internally generated in MGF and consist of a 7 digit number	525201, 14409
MLRS Control Section Branch	*cc sss bb*	Control Section Branch identifiers are County based: *cc* is the 2 digit MDOT County number *sss* is a 3 digit Control Section number *bb* is the 2 digit Control Section Branch code which is used to identify individual carriageways– the primary codes are: 01 = Forward CS mainline 11 – 20 = Reverse CS mainline 61/62 = Forward/reverse service drives 63/64 = Forward/reverse service drives 65/66 = Forward/reverse collector-distributors For a complete list of Branch codes, see Appendix A, Table A-5	390221, 390222 540223, 540224
MLRS Control Section	*cc sss*	*cc* is the 2 digit MDOT County number *sss* is a 3 digit Control Section number	39022, 54022