# Attachment 13

## SHA Computer Architecture

## Standards for Information Technology

## Updated October 2012

# SHA Computer Architecture
## Standards for Information Technology

The State Highway Administration has adopted an "Open Architecture" as a basic Information Processing strategy. This Open Architecture, which makes use of international, national, DOT and industry standards, will ensure that mission critical enterprise information is available to the people who are authorized to receive it, regardless of the specifics of their computing platform. Following these standards is critical if our strategic information, both historical and real-time, is going to be available to serve the customers who need it.

The following sections describe our current computing environment. For the most part, these products have been adopted by SHA because they comply with the Open Architecture philosophy and are widely used throughout the computer industry. Evolutionary developments in the computing world create a continuing need to reexamine and modify our computing environment to ensure that SHA is in alignment with common industry practices. This on-going transition process is reflected in the following software section.

## 1. SOFTWARE

### 1.1. Operating Systems

The following are the commonly used operating systems within SHA for desktop, laptop and server computing devices:

#### 1.1.1. Desktop Devices

**Windows 7**

#### 1.1.2. Laptop Devices

**Windows 7**

#### 1.1.3. Server Devices

**Windows 2008 Enterprise Server –R2 x64**

#### 1.1.4. Utilities

For optimal performance in the Windows environment, the disk should be defragmented routinely. The standard utility for this is **Diskeeper 2010**

### 1.2. Database Management System (DBMS)

The following are the two categories of data within SHA, and the databases to be used for these categories:

#### 1.2.1. Level 1

**(Data to be accessed by individuals external to a particular office or enterprise applications.)**

Preferred DBMS Method – The currently used database for Level 1 **business systems** is **Oracle 11.2.0.3.0.** (Please also see 1.9.3 for database location reference standard.)

If possible, SHA would recommend developing databases as schema's in lieu of standalone database. Current development and production environment is supported by Oracle Real Application Clusters (RAC).

Other Supported DBMS Method – Microsoft SQL Server 2008 R2 can also be used for enterprise applications. SHA is in the process of upgrading to Microsoft SQL Server 2012 and should be completed with this upgrade by the end of the 2nd quarter FY 13.

**All Level 1 data must reside in industry standard Structured Query Language compliant format.**

### 1.2.2. Level 2

**(Data pertinent only to a specific office.)**

Level 2 Data is information that is required internally within an office, such as keeping track of employee records and internal documents. The databases for level 2 data are:

OIT Supported methods: **Oracle**

Other supported methods: **Microsoft SQL Server 2008 R2.** SHA is in the process of upgrading to Microsoft SQL Server 2012 and should be completed with this upgrade by the end of the 2nd quarter FY 13.

Please discuss with OIT before proceeding to determine which method is most acceptable.

**Not recommended for multi-user/office applications: MS Access 2007**

Desktop database products (such as Microsoft Access) are considered desktop productivity tools. They should not be used for multi-user or multi-office applications. (see discussion below re: Microsoft Office).

For data integration between systems, SHA has adopted **Talend** as its standard.

### 1.2.3. Data Classification

In an effort to better protect sensitive information and adhere to the DOIT Security policy, the SHA is now classifying information systems using the NIST FIPS 199 standards as a guideline. Currently the security level is established at the information system level; however, it is anticipated that the SHA will eventually classify each file and folder as well as the data within SharePoint.
These procedures provide a common framework that promotes effective management and oversight of information by determining that data which is viewed as Public and that data which is viewed as Confidential. Formulating and documenting the security level of an information system helps to determine the level of effort for security certification and accreditation. It should be noted that there is an increased cost for maintaining information systems that are classified as confidential. It should also be noted that incorrectly marking as system as public could expose the SHA to unnecessary and potential damaging effects. The balance between these two is key to an effective data governance strategy.

The Federal Information Security Management Act (FISMA) and FIPS 199 discuss three security objectives for information and information systems:

- **Confidentiality**
  - "Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information…" [44 U.S.C., Sec. 3542]
  - A loss of *confidentiality* is the unauthorized disclosure of information.
- **Integrity**
  - "Guarding against improper information modification or destruction, and includes ensuring information non-repudiation and authenticity…" [44 U.S.C., Sec. 3542]
  - A loss of *integrity* is the unauthorized modification or destruction of information.
- **Availability**
  - "Ensuring timely and reliable access to and use of information…" [44 U.S.C., SEC. 3542]
  - A loss of *availability* is the disruption of access to or use of information or an information system.

The SHA evaluates each information system through a series of questions to determine its confidentiality, integrity, and availability requirements. These requirements yield a classification of either public, internal, or confidential. Handling requirements exist for each classification level. Public is able to be placed in such a way that it is accessible to the general public, though care should be made to keep its integrity and availability may still be a demand. Internal, requires standard internal network security controls such as complex passwords, behind the MDOT firewall. Finally confidential requires all handling requirements mentioned in the DoIT security policy (such as encryption at rest and in transit).

## 1.3. Development Tools

The following tools are used for front-end development for the DBMS:

SHA supports CLOUD Computing via **SalesForce.com** with **Eclipse** as the supported development tool, Visual Force as the framework and **APEX** as the programming language. On any new development, CLOUD Computing is considered first before other development tools are considered.

**PowerBuilder 11**

**MS Visual Studio 2008 as IDE using Visual Basic.NET, ASP.NET and C#.NET as scripting language**
**SharePoint Designer for SharePoint pages**
**Visual Basic.Net**
**MS Access 2007** (see discussion below re: Microsoft Office)
**Microsoft's Team Foundation Server is currently being used for configuration management and source control**
**Flex 2.2**

The following tool should be used for the back-end report development for the DBMS: **SQL Reporting Services**, SHA is in the process of sun-setting the use of **Seagate Crystal Reports, version 11.x.**

For Business Intelligence, SHA currently supports **QlikView**.

For single sign on, SHA currently supports **Microsoft Windows Active Directory**.

## 1.4. Internet/Intranet Applications

The software for Internet browsing, on SHA computers, is **Microsoft Internet Explorer.** As Web pages are developed; they will be tested for compatibility with the most popular browsers used.

**Microsoft SharePoint** is used for both SHA's Internet and Intranet portals.

**SQL Server Reporting Services (SSRS)** will be used for server-based reporting

The graphics tool for Web development is **Adobe Photoshop.**

**Adobe Acrobat Writer** will be used to create PDF documents.

**Microsoft Internet Information Server 7**.

**Web Content Management** – Team Site by Interwoven and Microsoft Office SharePoint Services.

**Worldspace® by Deque Systems, Inc. is used for Section 508 compliance.**

**Google Analytics** – is used as SHA's web analysis tool.

## 1.5. Electronic Mail & Scheduling

The E-mail/Scheduling software package **Microsoft Outlook 2003 and Outlook 2007 clients connected to Microsoft Exchange Server 2007.**

## 1.6. Office Automation Products

SHA has adopted **Microsoft Office 2007 Professional** as its standard office automation product.

### 1.6.1. Word Processing

**Word 2007**

### 1.6.2. Spreadsheets

**Excel 2007**

#### 1.6.3. Business Graphics

**PowerPoint 2007**

### 1.7. Project Management

The project management packages are **Microsoft Project 2007, Microsoft Visio 2007, and SharePoint 2007 for documentation of project artifacts and collaboration, and Innotas (www.innotas.com) for tracking project & new requests.**

### 1.8. Computer Aided Design & Drafting (CADD)

Computer Aided Design & Drafting software is used to develop preliminary and final engineering contract documents and to perform engineering functions in the creation of the documents and map products. The following are the CADD software packages:

#### 1.8.1. Drafting

**Bentley MicroStation 2004 and MicroStation XM 2004 and MicroStation V8i Select Series 1**

#### 1.8.2. Design

**Bentley InRoads XM**
**Bentley GeoPak, version XM**

#### 1.8.3. Development Language

MicroStation has a complete development environment called **Micro-Station Development Language (MDL)**, which is a customized CADD development environment based on the C programming language. Additionally, **Visual Basic** may also be used to develop MicroStation applications.

#### 1.8.4. Engineering Plan Document Management

Bentley Project Wise V8i

### 1.9. Geographic Information Systems (GIS)

Geographic Information Systems software is used to relate geo-referenced data, located in a Relational Database Management System (RDBMS) with digital mapping files. The following preferred GIS software environment includes all associated products:

#### 1.9.1. Geographical Analysis & Route Development

**ESRI ArcGIS ArcInfo, ArcEditor and 10.0 or 10.1, and Adobe Flash 10 or higher are needed.**

**For any new GIS application (web or desktop) or data development the GIS team should be consulted to reduce any duplication of efforts and guidance.**
**GIS Team can be contacted at GIS@sha.state.md.us**

### 1.9.2. Geographical User Interface

**ESRI ArcGIS Desktop 10.0 or 10.1**

### 1.9.3. RDBMS

**Oracle 11g with ESRI ArcSDE for Spatial Data**

### 1.9.4 Map Server

ArcGIS Server Standard Enterprise

### 1.9.5 Linear Location Reference (Current) Standard

There has been general agreement by the members of the GIS TAC (Technical Advisory Committee) that all tabular databases from which point or linear features are to be designated on maps will conform to the HISD LRS (Location Reference Standard) by including the following field names and characteristics in those databases. (Note: The LRS fields are used by GIS software to locate point and linear features.)

| Name | Field Name | Type | Length | MS/Access Equivalent |
|---|---|---|---|---|
| County | county | small integer | 2 | integer |
| Municipal Sort Code | mun_sort | small integer | 3 | integer |
| Route Prefix | id_prefix | character | 2 | character |
| Route Number | id_rte_no | small integer | 4 | integer |
| Route Suffix | mp_suffix | character | 2 | character |
| Mile Point | id_mp | decimal | 4,2 | number, single |
| (and below for linear features) | | | | |
| Section Length or | section_length | decimal | 5,2 | number, single |
| Ending Mile Point | end_mp | decimal | 4,2 | number, single |
| Global Route ID | global_route_id | number | 32 max | integer |
| Subroute ID | sub_route_id | number | 32 max | integer |

Please include these fields and their content in the database to facilitate the loading of your data on the GIS server.

The Maryland State Highway Administration has implemented a new standard for the Route Identifier within the Highway Information Services Division (HISD). This new standard will be implemented for the remainder of the Administration as other systems require the new capabilities

ROUTE_ID (Route Identifier)

The RouteID is used by GIS software to locate points and line segments on the SHA road centerline. It is a concatenation of county, mun_sort, id_prefix, id_rte_no, and mp_suffix, mp_direction, cal_direction, assoc_id_prefix, exit_number and ramp_number or similarly named fields. The result is a thirty-two character field since each of the originating fields is converted

to character form as part of the concatenation. Further explanation of RouteID follows the table. The RouteID is comprised of the following fields:

| | | | |
|---|---|---|---|
| County | number | 1-2 | (see table below for values) |
| mun_sort | number | 3-5 | if id_prefix = MU, mun_sort value, else 000<br>(see table below for values) |
| id_prefix | Char(2) | 6-7 | (see table below for values) |
| id_rte_no | Char(5) | 8-12 | (00000 to 99999) |
| mp_suffix | Char(2) | 13-14 | SC= Scenic, BU = Business, or any other characters needed for coding -if no significant characters, must be blank, not null |
| mainline | number | 15-16 | Used to classify the road mileage of the inventoried road as follows: Mainline, Interchange Ramps, Service Roads, Couplet, etc. (see table below for values) |
| mp_direction | Char(1) | 17 | The direction in which the road was inventoried. IS, US, MD, and major MU and CO routes are inventoried either West to East or South to North. Minor county (CO) and municipal routes (MU) do not follow this pattern. |
| cal_direction | Char(1) | 18 | The direction of increasing mile points for single roadways. Dual roadways are calibrated in the direction of inventory on the inventory side of the route and in the opposite direction on the non-inventory side. Mile points increase in either direction. |
| Ramps have different coding needs and use the following additional fields. (id_prefix = “RP”) | | | |
| assoc_id_prefix | Char(2) | 19-20 | The id_prefix for the mainline route to which the ramp is associated. |
| exit_number | Char(10) | 21-30 | The mileage-based exit number of the mainline route. Left justified. |
| ramp_number | number | 31-32 | The ramp number follows the standard ramp numbering scheme as established in the SHA Standard Interchange Plan. |
| | | | |
| In addition to RouteID, milepoint fields indicate the location of the event. | | | |
| | | | |
| id_mp | Decimal(6,3) | | required number field with 6 digits left of decimal point and 3 to the right.<br>This field is used for point features (events). |
| end_mp | Decimal(6,3) | | optional number field with 6 digits left of decimal point and 3 to the right.<br>This field is necessary if the feature (event) is linear. |

RouteID

In order to support ramps and reverse lanes on divided highways in a manner consistent with the SHA HPMS database, additional attributes were added to the previously used NLF_ID. These are, MP_DIRECTION, CAL_DIRECTION, MAINLINE, ASSOC_ID_PREFIX,

EXIT_NUMBER, and RAMP_NUMBER. The addition of these fields resulted in a required length of 32 characters for the RouteID

Characters 1 – 14 follow the standard NLF_ID format.

Characters 15 – 16 contain the mainline code which is used to classify the roadway as to mainline, ramp, service road, couplet, etc.

Characters 17 – 18 house the two directional fields (inventory direction and calibration direction). For non-divided (single centerline) routes, the inventory direction and calibration are the same (NN for example). For divided highways with two centerlines, the "reverse" lane's calibration direction is opposite of the inventory direction (NS for the south-bound lane of a route inventoried south to north.

For ramps, characters 19 – 32 are used as follows: The associated id_prefix in spaces 19 and 20 is required (generally IS, US, MD). Characters 21 – 30 (10 characters) are reserved for exit number although generally only 3 or less are needed. Spaces (not nulls) are used as filler character for the exit number. Characters 31 and 32 are used for the ramp number. This numeric field is coded as numeric fields in the NLF_ID, "01", "02", "03", etc.

For any route other than ramps, characters 19 – 32 are coded with a series of asterisk (*).

Examples:

RouteID: 01041MU00760 01NN********** (note length is 32 characters)

This is municipal route 760 in mun_sort (municipality code) 41 (Cumberland) in county 1. The mun_sort is not used unless the id_prefix (route prefix/type) is "MU". If the id_prefix is not "MU", then the mun_sort is "000". There is no suffix (2 spaces), it is a mainline route, and we have assumed the inventory direction is North for this example, the calibration direction is also North.

RouteID: 01000MD00948AM01NN********** (note length is 32 characters)

This is MD route 948AM in county 1.

Ramp Examples:

RouteID: 13000RP00100 02EEMD4 08 (note length is 32 characters)

This route ID indicates a ramp (RP) on MD100 traveling E (Calibration direction is E). It is Exit number 4 and the ramp number is 8.

RouteID: 13000RP00100 02EWMD4A 01
13000RP00100 02EWMD4B 02

The ramp exit "number" often includes characters (A and B for example). The two examples above are for exits 4A and 4B on MD 100 in Howard County traveling in the westbound lane with ramp numbers of 1 and 2.

Global_Route_ID: This is a number that identifies routes, both sides of the routes having the same global route ID

Sub Route ID: Each side of the route has a sub_route_id which along with the global_route_id makes the record unique.

Example of Global_Route_ID and Sub_route_id

| Global_route_id | Sub_route_id | RouteID |
|---|---|---|
| 805 | 1 | 01000IS00068 01EE********** |
| 805 | 2 | 01000IS00068 01EW********** |

So in this case 805 is the global_route_id from route IS68 in county 1. Sub_route_id of 1 points to the inventory side of the route and sub_route_id of 2 points to the non_inventory side of the route.

Tables

| County field values | |
|---|---|
| 01 | ALLEGANY |
| 02 | ANNE ARUNDEL |
| 03 | BALTIMORE |
| 04 | CALVERT |
| 05 | CAROLINE |
| 06 | CARROLL |
| 07 | CECIL |
| 08 | CHARLES |
| 09 | DORCHESTER |
| 10 | FREDERICK |
| 11 | GARRETT |
| 12 | HARFORD |
| 13 | HOWARD |
| 14 | KENT |
| 15 | MONTGOMERY |
| 16 | PRINCE GEORGES |
| 17 | QUEEN ANNES |
| 18 | ST MARYS |
| 19 | SOMERSET |
| 20 | TALBOT |
| 21 | WASHINGTON |
| 22 | WICOMICO |
| 23 | WORCESTER |
| 24 | BALTIMORE CITY |

| mun_sort field values | | |
|---|---|---|
| Mun_sort | County | Incorporated Town |
| 1 | 12 | ABERDEEN |
| 2 | 11 | ACCIDENT |
| 3 | 2 | ANNAPOLIS |
| 4 | 17 | BARCLAY |
| 5 | 15 | BARNESVILLE |
| 6 | 1 | BARTON |
| 7 | 12 | BEL AIR |
| 8 | 23 | BERLIN |
| 9 | 16 | BERWYN HEIGHTS |
| 10 | 14 | BETTERTON |
| 11 | 16 | BLADENSBURG |
| 12 | 21 | BOONSBORO |
| 13 | 16 | BOWIE |
| 14 | 16 | BRENTWOOD |
| 15 | 15 | BROOKEVILLE |
| 16 | 9 | BROOKVIEW |
| 17 | 10 | BRUNSWICK |
| 18 | 10 | BURKITTSVILLE |
| 19 | 9 | CAMBRIDGE |
| 20 | 16 | CAPITOL HEIGHTS |
| 21 | 16 | NEW CARROLLTON |
| 22 | 7 | CECILTON |
| 23 | 17 | CENTREVILLE |
| 24 | 7 | CHARLESTOWN |
| 25 | 4 | CHESAPEAKE BEACH |
| 26 | 7 | CHESAPEAKE CITY |
| 27 | 14 | CHESTERTOWN |
| 28 | 16 | CHEVERLY |
| 29 | 15 | CHEVY CHASE SECTION III |
| 30 | 15 | TOWN OF CHEVY CHASE |
| 31 | 15 | CHEVY CHASE SECTION V |
| 32 | 15 | CHEVY CHASE VIEW |
| 33 | 15 | CHEVY CHASE VILLAGE |
| 34 | 9 | CHURCH CREEK |
| 35 | 17 | CHURCH HILL |
| 36 | 21 | CLEAR SPRING |
| 37 | 16 | COLLEGE PARK |
| 38 | 16 | COLMAR MANOR |
| 39 | 16 | COTTAGE CITY |
| 40 | 19 | CRISFIELD |
| 41 | 1 | CUMBERLAND |
| 42 | 11 | DEER PARK |

mun_sort field values

| Mun_sort | County | Incorporated Town |
|---|---|---|
| 43 | 22 | DELMAR |
| 44 | 5 | DENTON |
| 45 | 16 | DISTRICT HEIGHTS |
| 46 | 15 | DRUMMOND |
| 47 | 16 | EAGLE HARBOR |
| 48 | 9 | EAST NEW MARKET |
| 49 | 20 | EASTON |
| 50 | 16 | EDMONSTON |
| 51 | 9 | ELDORADO |
| 52 | 7 | ELKTON |
| 53 | 10 | EMMITSBURG |
| 54 | 16 | FAIRMOUNT HEIGHTS |
| 55 | 5 | FEDERALSBURG |
| 56 | 16 | FOREST HEIGHTS |
| 57 | 10 | FREDERICK |
| 58 | 15 | FRIENDSHIP HEIGHTS |
| 59 | 11 | FRIENDSVILLE |
| 60 | 1 | FROSTBURG |
| 61 | 22 | FRUITLAND |
| 62 | 21 | FUNKSTOWN |
| 63 | 15 | GAITHERSBURG |
| 64 | 14 | GALENA |
| 65 | 9 | GALESTOWN |
| 66 | 15 | GARRETT PARK |
| 67 | 16 | GLENARDEN |
| 68 | 15 | GLEN ECHO |
| 69 | 5 | GOLDSBORO |
| 70 | 11 | GRANTSVILLE |
| 71 | 16 | GREENBELT |
| 72 | 5 | GREENSBORO |
| 73 | 21 | HAGERSTOWN |
| 74 | 6 | HAMPSTEAD |
| 75 | 21 | HANCOCK |
| 76 | 12 | HAVRE DE GRACE |
| 77 | 22 | HEBRON |
| 78 | 5 | HENDERSON |
| 79 | 2 | HIGHLAND BEACH |
| 80 | 5 | HILLSBORO |
| 81 | 9 | HURLOCK |
| 82 | 16 | HYATTSVILLE |
| 83 | 8 | INDIAN HEAD |
| 84 | 21 | KEEDYSVILLE |
| 85 | 15 | KENSINGTON |
| 86 | 11 | KITZMILLER |
| 87 | 16 | LANDOVER HILLS |
| 88 | 8 | LA PLATA |
| 89 | 16 | LAUREL |

mun_sort field values

| Mun_sort | County | Incorporated Town |
|---|---|---|
| 90 | 15 | LAYTONSVILLE |
| 91 | 18 | LEONARDTOWN |
| 92 | 11 | LOCH LYNN HEIGHTS |
| 93 | 1 | LONACONING |
| 94 | 1 | LUKE |
| 95 | 6 | MANCHESTER |
| 96 | 22 | MARDELA SPRINGS |
| 97 | 15 | MARTINS ADDITION |
| 98 | 5 | MARYDEL |
| 99 | 10 | MIDDLETOWN |
| 100 | 1 | MIDLAND |
| 101 | 14 | MILLINGTON |
| 101 | 17 | MILLINGTON |
| 102 | 16 | MORNINGSIDE |
| 103 | 6 | MOUNT AIRY |
| 103 | 10 | MOUNT AIRY |
| 104 | 16 | MOUNT RAINIER |
| 105 | 11 | MOUNTAIN LAKE PARK |
| 106 | 10 | MYERSVILLE |
| 107 | 10 | NEW MARKET |
| 108 | 6 | NEW WINDSOR |
| 109 | 4 | NORTH BEACH |
| 110 | 16 | NORTH BRENTWOOD |
| 111 | 15 | NORTH CHEVY CHASE |
| 112 | 7 | NORTHEAST |
| 113 | 11 | OAKLAND |
| 114 | 15 | OAKMONT |
| 115 | 23 | OCEAN CITY |
| 116 | 20 | OXFORD |
| 117 | 7 | PERRYVILLE |
| 118 | 22 | PITTSVILLE |
| 119 | 23 | POCOMOKE CITY |
| 120 | 15 | POOLESVILLE |
| 121 | 7 | PORT DEPOSIT |
| 122 | 5 | PRESTON |
| 123 | 19 | PRINCESS ANNE |
| 124 | 17 | QUEEN ANNE |
| 124 | 20 | QUEEN ANNE |
| 125 | 17 | QUEENSTOWN |
| 126 | 5 | RIDGELY |
| 127 | 7 | RISING SUN |
| 128 | 16 | RIVERDALE |
| 129 | 14 | ROCK HALL |
| 130 | 15 | ROCKVILLE |
| 131 | 10 | ROSEMONT |
| 132 | 20 | ST MICHAELS |
| 133 | 22 | SALISBURY |

mun_sort field values

| Mun_sort | County | Incorporated Town |
|---|---|---|
| 134 | 16 | SEAT PLEASANT |
| 135 | 9 | SECRETARY |
| 136 | 21 | SHARPSBURG |
| 137 | 22 | SHARPTOWN |
| 138 | 21 | SMITHSBURG |
| 139 | 23 | SNOW HILL |
| 140 | 15 | SOMERSET |
| 141 | 17 | SUDLERSVILLE |
| 142 | 6 | SYKESVILLE |
| 143 | 15 | TAKOMA PARK |
| 143 | 16 | TAKOMA PARK |
| 144 | 6 | TANEYTOWN |
| 145 | 5 | TEMPLEVILLE |
| 145 | 17 | TEMPLEVILLE |
| 146 | 10 | THURMONT |
| 147 | 20 | TRAPPE |
| 148 | 6 | UNION BRIDGE |
| 149 | 16 | UNIVERSITY PARK |
| 150 | 16 | UPPER MARLBORO |
| 151 | 9 | VIENNA |
| 152 | 10 | WALKERSVILLE |
| 153 | 15 | WASHINGTON GROVE |
| 154 | 1 | WESTERNPORT |
| 155 | 6 | WESTMINSTER |
| 156 | 22 | WILLARDS |
| 157 | 21 | WILLIAMSPORT |
| 158 | 10 | WOODSBORO |
| 159 | 8 | PORT TOBACCO |
| 999 | 24 | BALTIMORE CITY |

id_prefix field values

| Id_prefix | Description |
|---|---|
| MD | Maryland Route |
| US | United States Route |
| IS | Interstate Route |
| CO | County Road |
| MU | Municipal Road |
| RP | Ramp |
| SR | State Road |
| GV | Government Road |
| OP | Other Public Road |

Mainline field values

| MAIN_LINE | DESCRIP | ABBREV |
|---|---|---|
| 1 | MAINLINE | MAIN |

| | | |
|---|---|---|
| 2 | INTERCHANGE RAMP | INT RAMP |
| 3 | SERVICE ROAD | SRV RD |
| 4 | SPURS | SPURS |
| 5 | CD | CD |
| 6 | OUT OF SIGHT LANE | OUT SITE |
| 8 | COUPLET NI DIR | COUPLET NI DIR |
| 7 | COUPLET INV DIR | COUPLET INV DIR |

# 2. NETWORK ENVIRONMENT

## 2.1. Network Protocols

The following are the network protocols used by SHA:

**TCP/IP**
**SSH**
**FTP**
**SMTP**
**HTTP**
**HTTPS**
**SFTP**
**SSL**
**Fiber Channel**
**iSCSI**

## 2.2. Network Topology

The following are the network topologies used by SHA:

**Switched Ethernet (100Base-T, 1000Base-T)**
**Fast Ethernet (100Base-T, 1000Base-T)**

## 2.3. Network Configuration

The SHA computer network extends to various offices, with the Headquarters complex serving as the hub. Cisco model 2500, 3000, 4000, and 7000 routers at the Headquarters with fiber connectivity to the SHA Operations Center at Connelley Drive, Hanover, and to most District offices with the remaining Districts having T-1 connectivity. Verizon Ethernet Everywhere (EE) service, Frame relay and T-1/ISDN allows the maintenance shops, of which there are an average of four per District, to connect into the District to reach file/print servers located at the District and/or at Headquarters. (Figure 1)

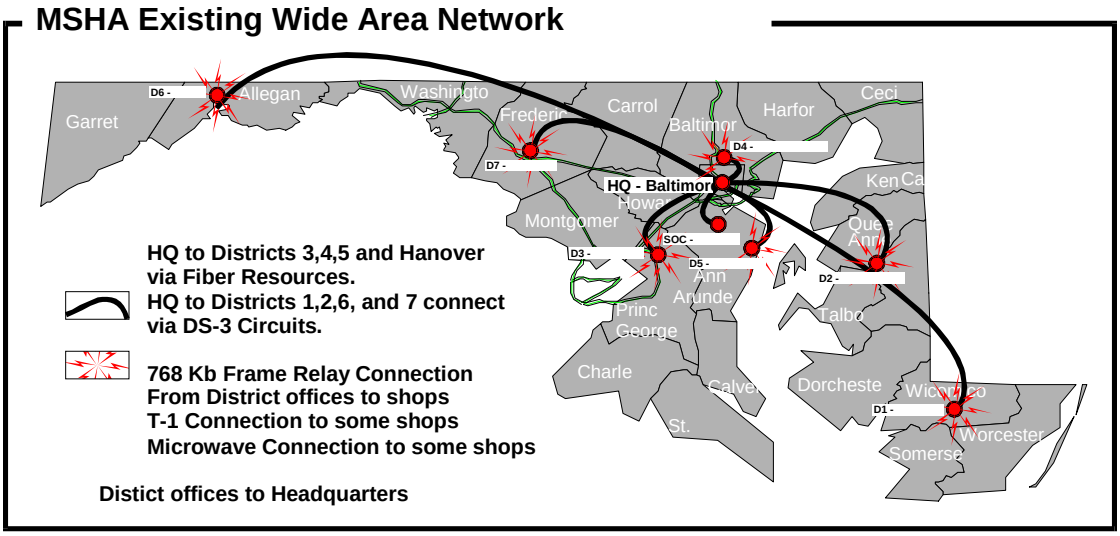



**Figure 1. Existing SHA WAN Connectivity**

Each of the District Offices contains a local LAN as shown in the drawing below:

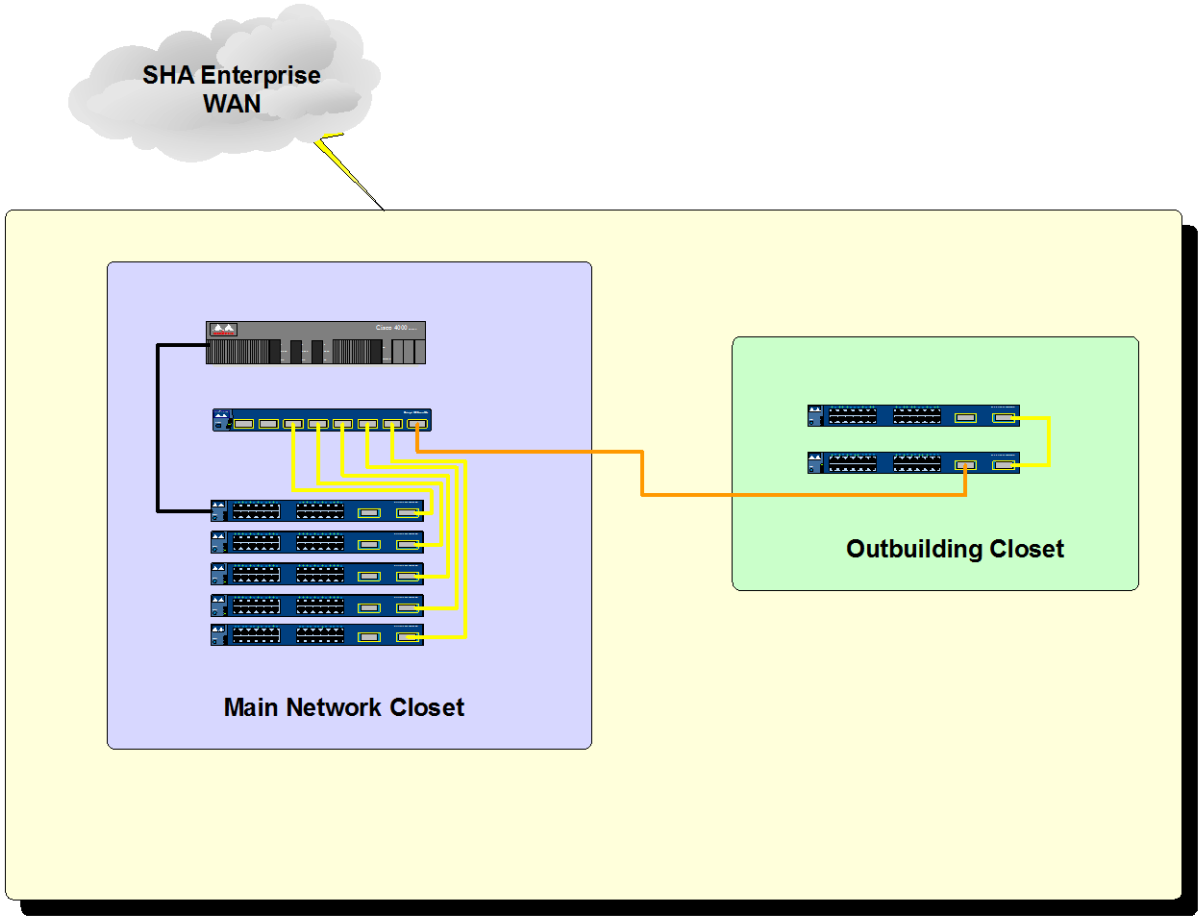



**Figure 3. Network configuration at SHA District office**

The Office of Traffic & Safety, at Connelley Drive, is running a 1000 Base-T Ethernet and is connected to the SHA Operations Center. The SHA Operations Center, including the Office of Maintenance, has installed a twisted pair Ethernet and fiber, and is connected to the rest of SHA via fiber.

## 2.4. Data Storage

SHA enterprise storage consists of two HP/3PAR v400 (one at HQ and one at HANOVER) for primary storage. Secondary storage consists of HP P4500 iSCSI and NetApp n6040 for disk to disk backups. Remaining data is stored on Direct Attached Storage. Both FC and iSCSI storage are being replicated using bi-directional synchronization between HQ and HANOVER Datacenters.
Districts 1, 2, and 7 are using DROBO B800i iSCSI SAN.

## 2.5. Back up Solution

SHA uses Syncsort Backup Express to backup its enterprise data (including SHA HQ and Districts 3,4,5 and 6) at Headquarters and Hanover locations to perform block level backups. Districts 1, 2, and 7 replicate local Windows-based file system data to SHA HQ

via Microsoft DFS and backup of this data occurs at SHA HQ. Backup data is replicated between HQ and Hanover.

### 2.6. VM Ware

SHA currently has multiple VMWare vSphere 5.0 server farms for development and production. VMware environments are connected to 3PAR v400 (primary) and P4500 (secondary) storage and backed up with Syncsort's Backup Express. Districts 1, 2, and 7 contain their own vSphere 5 clusters to house their local file, print, and authentication services. Their shared storage consists of a DROBO B800i SANs. Data from these District servers are replicated to HQ via Microsoft DFS and backed up using Syncsort's BackupExpress.

## 3. HARDWARE REQUIREMENTS

Although SHA has varying levels of hardware, any new hardware systems should meet the following minimum requirements.

### 3.1. Office Automation Workstations

These machines should have the following minimum configuration:

Intel Core i5-2400 CPU
4 Gb RAM
250.0 Gb hard drive
8X DVD+/-RW DVD-ROM
20" Ultra sharp Flat Panel color monitor,
10/100 PCI 32-bit Ethernet card
3 year NBD Onsite Support

### 3.2. CADD/GIS Development Workstations

These machines should have the following minimum configuration:

Intel Core i7-2600 3.4 8M 4C 95W GT1 CPU
4 Gb RAM
250GB 7200 RPM SATA 6G 1st HDD
16X SuperMulti DVDRW SATA 1st ODD
20" Ultra sharp Flat Panel color monitor
10/100 PCI 32-bit Ethernet card
3 year NBD Onsite Support

### 3.3. Laptops

These machines should have the following minimum configuration:

Intel® Core™ i5-2520M Processor
4 Gb RAM
250 GB 7200 rpm SATA hard drive
DVD±RW SuperMulti DL Drive
Wireless accessible
3 year NBD Onsite Support

### 3.4. ESX Server

Blade architecture consisting of the following minimum configuration:
Six Core Intel XEON 2.6 GHz

96Gb RAM
8 Network Interface Cards
Two(2) 68gb internal drives, mirrored as RAID 1
Storage Area Network SAN attached shared drives, striped as RAID 5

### 3.5. Database Servers – Windows 2008 R2 64 Bit Operating System

These machines should have the following minimum configuration:

Multi-processor (2) Dual-Core Intel® Xeon® Processor @ 3.00 GHz
32 Gb RAM
Two (2) 146 gb internal drives, mirrored as a RAID 1
Storage Area Network (SAN) attached shared drives, striped as RAID 5

## 4. Security Requirements

Systems developed for SHA must comply with ***"Department of Information Technology Information Security Policy"***, which can be found at the following URL: http://doit.maryland.gov/support/Pages/SecurityPolicies.aspx

In addition to following the State's IT Security Policy and Standards the following additional requirements must be met wherever applicable and practicable.

### 4.1. Log-on Accounts

1. All remote users (whether customers or contractor support) must notify SHA immediately when an employee resigns or his/her employment is terminated so that the log-on account including their VPN token and account (if applicable) can be disabled. (SHA's Employee Services and Employer-Employee Relations Divisions notify internally.) The log-on account will not be "inherited" by another employee. A new account must be established.

### 4.2. Passwords

1. All passwords will have a minimum length of eight (8) characters. It is recommended that the user not include known English words or the names of family members or pets, as these can more easily be "broken" by hackers.
    - Must have at least one uppercase letter
    - Must have lower case letters
    - Must have at least one number
    - Cannot have two of the same letters or numbers together
2. Passwords will be forced to be changed (i.e., expire) periodically. The expiration time varies, dependent upon the type of user:
    - SHA user, expiration = 45 days
    - External Web Application Users expiration = 45 days
    - Application administrator, expiration = 30 days
    - Remote user (i.e. non-SHA employee), expiration = 30 days

3. When passwords are changed, the application will request the password be keyed twice to confirm the new password.
4. Whenever a password is keyed, it will employ a hidden field.
5. Password history (i.e., number of unique passwords before reusing a password) = 20; this includes any default password.
6. All SHA passwords are considered sensitive information. Therefore, these actions will be undertaken:
   - The password table(s) will be encrypted.
   - If an application requires a remote user to send his/her password, it must be encrypted at that point.
7. With three (5) consecutive unsuccessful password attempts, the log-on account will be locked for 30 minutes.

## 4.3. Security for Remote Users

1. A remote application must establish a "captive account." i.e., The remote customer must connect directly into the application; he/she must not log onto a server and then have an option of whether or not he/she will run the application. This ensures that the remote user performs only the operations for which he/she is authorized.
2. When contractor support personnel are granted remote log-on privileges, trustee rights on the account will be set only to the specific directories necessary.
3. All applications which are not outside SHA's firewall must provide additional security by requiring the remote customer to dial in to SHA's authentication server, to provide auditing and authentication.

## 4.4. Virus Protection

Virus protection software **must** be utilized on all platforms – desktops, laptops and servers. The preferred tool for this purpose is McAfee **VirusScan Enterprise** for servers and clients.

# ATTACHMENT 17 – MMS MODULE 1 FRD

THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK

MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION

# MATERIALS MANAGEMENT SYSTEM PROJECT

# FUNCTIONAL REQUIREMENTS DOCUMENT

## Project I

**October 29, 2008**

**Version 1.0**

# Document Version Control

| Revision Date | Updated By | Requested By | Description of Revision |
|---|---|---|---|
| 9/23/2008 | Vendor | | Initial Draft |
| 9/26/08 | Vendor | | Addition of detailed requirements |
| 10/1/08 | Vendor | | Revised based on comments from Lee |
| 10/10/08 | Vendor | | Revised document based on team review and internal QA |
| 10/29/08 | Vendor | | Revised based on SHA formal review comments |

# Table of Contents

# 1 OVERVIEW

## 1.1 General

The Maryland State Highway Administration (SHA) and its Office of Materials Technology (OMT) have recognized a need to implement an electronic Materials Management System (MMS) to better track, record, evaluate, analyze, and review the quality of materials used on SHA construction projects. For the purposes of this document, the MMS will be defined as an integrated electronic system used as a tool to manage the materials testing, acceptance, and clearance process within SHA.

To address the need for an MMS, OMT initially chartered a team to develop the "Materials Management System Strategic Plan". This strategic plan was completed in early 2007. It provided a roadmap for the full implementation of an integrated MMS for SHA. The strategic plan outlined the high level user needs for the MMS and assessed various alternatives for implementing this system. This strategic plan recommended the development of a custom application and proposed implementation in a multi-phased approach over several years.

The MMS will serve as the single data repository for all materials testing and clearance activities, including materials tested in central and field laboratories, consultant laboratories, manufacturing sites, and project sites as needed. It will provide tools to managers in order to make decisions regarding the efficiency and effectiveness of the process and provide file storage, task tracking, and correspondence sharing. The MMS will also be capable of sharing data with SHA enterprise databases and other management systems such as AASHTO Trns•port ®, the Maryland Construction Management System (MCMS), the Financial Management Information System (FMIS), the Pavement Management System (PMS), and the Bridge Management System (BMS) among others.

## 1.2 Requirements Analysis Phase

The MMS has been determined to be a Major Information Technology Development Project (MITDP) and follows the State of Maryland's System Development Life Cycle Process (SDLC). The project is currently in the Requirements Analysis Phase of the project.

The Requirements Analysis Phase formally defines the detailed functional user requirements using the high-level requirements identified in the Initiation, System Concept Development, and Planning phases. It also delineates the requirements in terms of data, system performance, security, and maintainability requirements for the system. The requirements are defined in this phase to a level of detail sufficient for the issuance and evaluation of an RFP or for systems design to proceed. The requirements need to be measurable, testable, and relate to the business need or opportunity identified in the Initiation Phase. The requirements that will be used to determine acceptance of the system are captured in the Test and Evaluation Master Plan.

The objectives of the Requirements Analysis Phase include:

- Complete business process reengineering of the functions to be supported (i.e., verify what information drives the business process, what information is generated, who generates it, where does the information go, and who processes it).
- Develop detailed data and process models (system inputs, outputs, and the process flow).
- Further define and refine the functional and data requirements and document them in the Requirements Document.
- Develop the test and evaluation requirements that will be used to determine acceptable system performance.

- The primary deliverables of the requirements analysis phase are the (1) Functional Requirements Document and (2) the Test and Evaluation Master Plan.

### 1.2.1 Functional Requirements Document

The Functional Requirements Document (FRD) is a formal statement of an application's functional requirements. It serves the same purpose as a contract. The developers agree to provide the capabilities specified. The client agrees to find the product satisfactory if it provides the capabilities specified in the FRD.

Quality is defined as meeting the requirements of the system. For that reason, the FRD is the central document in system development. The primary uses of the FRD are as follows:

- Designing and developing the application system.
- Evaluating the product in all subsequent phases of the life cycle.
- Determining the success of the project.

The FRD has the following characteristics:

- It demonstrates that the application provides value to the State in terms of the business objectives and business processes in the 5-year plan.
- It contains a complete set of requirements for the application. It leaves no room for anyone to assume anything not stated in the FRD.
- It is solution independent. The FRD is a statement of what the application is to do—not of how it works.

A requirement is a condition that the application must meet for the customer to find the application satisfactory. A requirement has the following characteristics:

- It provides a benefit to the organization.
- It describes the capabilities the application must provide in business terms.
- It does not describe how the application provides that capability.
- It does not describe such design considerations as computer hardware, operating system, and database design.
- It is stated in unambiguous words. Its meaning is clear and understandable.
- It is verifiable.

## 1.3 Project Description

The goal of the Materials Management System (MMS) is to streamline all facets of the process including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This will in turn raise SHA's ability to perform design, construction, rehabilitation, and maintenance on the state highway system efficiently and effectively[a].

The MMS is intended to assist with source of supply acceptance, calculate pay factors, determine materials acceptability, generate sampling and testing schedules, and be used as a mechanism to determine when all materials clearance activities are complete.

---

[a] Materials Management System Strategic Plan (January 2007)

The project development strategy for the MMS project will be guided by the project plan defined in the System Boundary Document (SBD) for the MMS project that was completed in the System Concept Development Phase in May 2008.

The high level requirements for the MMS project were defined in the SBD and are grouped as follows:

**System Management** - System management refers to the overall technical management of the MMS.

**Project Management -** Project management refers to project management activities performed on a project. This includes activities like maintaining high level project information, storing project documentation, and tracking project tasks.

**Source of Supply -** Source of supply module consists of the functionality to review the sources of material supply that the contractors propose to use on the project. SHA approves or disapproves these sources for the project. The approval of the source does not indicate approval of material used on the project – merely approval of the source of the material. SHA also maintains a Qualified Products List (QPL), a list of products that have met prequalification requirements.

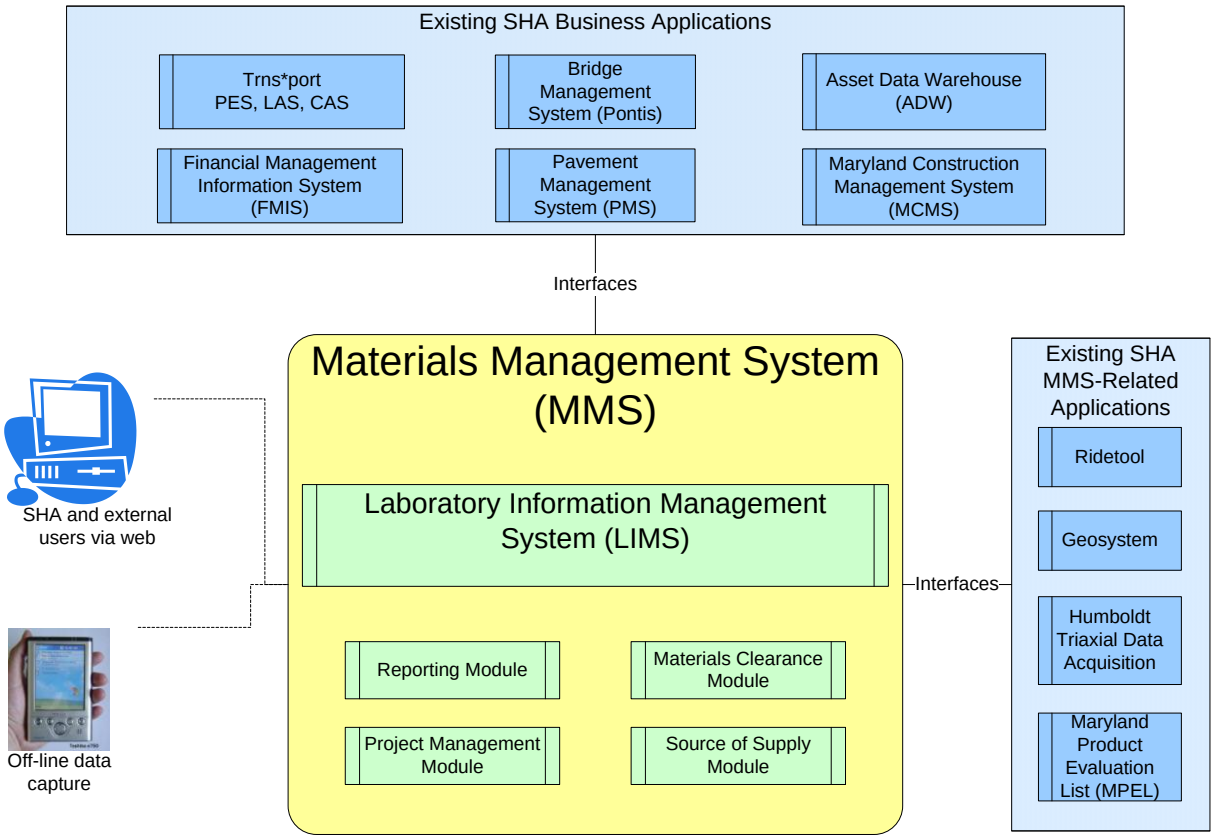
**Material Specification and Quality Assessment -** This requirements grouping consists of acceptance of materials on the project. Materials are accepted through on-site testing, laboratory testing, or a certification process. Samples are received and logged into the current systems; results of tests are recorded and then communicated to the project members. Due to the stand-alone nature of electronic systems, this process takes a long time and offers significant potential for improvement.

**Materials Clearance -** The materials clearance function consists of verification that the material sources are approved, documentations have been filed, quality assessment of materials has been performed, and there has been a review of placed quantities.

**Other/General -** This section presents other requirements for the MMS, including but not limited to historical data retrieval and data archival.

Exhibit 1 below provides a conceptual overview of the proposed MMS as defined in the System Boundary Document (SBD).

**Exhibit 1: Conceptual Overview of the Proposed MMS**




As shown in the exhibit above, the testing, data storage, and laboratory equipment capabilities will be a part of the Laboratory Information Management System (LIMS) which will be the largest component of the MMS.

The SBD for the MMS also defined a program of nine integrated projects to be implemented over a three year period to fully deploy the MMS solution.

The nine projects defined to be implemented include:

- Project I: System Management, Project Information, and Source of Supply
- Project II: Base Laboratory Information Management System
- Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs
- Project IV: Concrete/Chemical Lab
- Project V: Asphalt Lab
- Project VI: Structural Lab
- Project VII: Materials Clearance
- Project VIII: Management Reporting/Analysis
- Project IX: Infrastructure Upgrades

### 1.3.1 Background and History

The materials clearance process is a federally mandated program with which SHA and all state transportation agencies must comply. SHA is required to submit a materials certification for each construction project receiving federal funds. While this is only required for federally funded projects, SHA has extended this program to all construction projects regardless of the funding source.

Historically at SHA, the materials clearance process has been paper-based and utilized a series of stand-alone offline applications and log books to track samples and test results for each quality control sample taken on a project. Most, if not all, documentation for the process is originated in paper form, transmitted through mail or other in-house courier methods, and stored in filing cabinets.

A series of system specification documents were created throughout the early 1990s and this resulted in a well documented outline for an electronic Materials Management System. During this timeframe, the American Association of State Highway Transportation Officials (AASHTO) was also in the midst of developing a Construction Management System called SiteManager® as part of the Trns•port ® suite of products. SiteManager® provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization and includes a module for materials management. SHA decided to abandon the custom designed MMS and invested in the SiteManager® product. Over time, interest in the SiteManager® product waned as personnel realized that this system would not meet SHA's specific business environment and needs.

In the meantime, SHA OMT's divisions with responsibility for materials management activities created stand-alone systems to assist them in their particular mission. This included use of spreadsheets, databases, proprietary systems, and other electronic mediums to store and retrieve information. The systems developed by each party were, by necessity, developed within the business unit "silo" with differing data collection, processing, or reporting standards applied. In addition, paper was and remains the predominant form of communication and documentation within the materials management process. This ad hoc system of disparate computer tools meshed with paper reporting forms the backbone of the current materials clearance process within SHA.

During formulation of the OMT's Business Plan's goals in the 2002 and 2003 timeframe, a formalized MMS once again became a top priority for SHA. In response, a series of scoping meetings were held to determine how to approach this task. In 2006, funding was allocated to develop a strategic plan to formalize and outline the scope and implementation phases necessary. The MMS Strategic Plan was completed in early 2007. It has been utilized as a key input to guide the project team's understanding of the requirements for the MMS as well as in the creation of the System Boundary Document during the Concept Development phase of this project.

The MMS will support SHA's strategic objectives by supporting and enabling a number of key Office of Materials Technology (OMT) business drivers. These business drivers include the following:

- Streamline the materials clearance process throughout the life cycle of a construction project.
- Increase the efficiency and reduce the costs associated with materials clearance.
- Store and retrieve materials information more efficiently and effectively.
- Provide for improved sharing of materials information across various SHA Divisions and Offices.
- Link sources of materials and materials used during construction to a linear referencing system to facilitate access to materials information during on-going maintenance of the transportation assets.
- Measure and track long term material quality performance.
- Generate business plan progress reports easily.

### 1.3.2 Purpose

The goal of the MMS is to streamline all facets of the process, including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This increased efficiency will in turn raise SHA's

ability to efficiently and effectively perform design, construction, rehabilitation, and maintenance on the state highway system[b].

The implementation of a single electronic MMS has the following mission critical goals:

- Manage the materials clearance process throughout the construction project life cycle; this should include support for materials clearance activities in traditional design-bid-build construction contracts, as well as design-build and other innovative contracting methods.
- Allow information sharing and knowledge transfer among key SHA stakeholders.
- Allow one-stop data entry and status reporting on progress against materials clearance goals.
- Provide construction project managers with a notification of potential materials discrepancies as part of the preparation of construction contractor progress estimates.
- Provide documentation of materials clearance compliance for FHWA certification.
- Allow lab managers to track the status and costs of testing within a given Technical Material Division.
- Automate the allocation of testing costs to the various projects.
- Identify sources and materials used on projects through a referencing system to allow for easier access to materials information during ongoing maintenance of the asset.
- Support capturing of data from testing performed by construction contractors and facilitate the comparison of this test data with SHA quality assurance test results.
- Provide up to date information on selected items related to SHA business plan objectives.

### 1.3.3 Assumptions and Constraints

This section lists the assumptions and constraints associated with the Materials Management System Project. Assumptions are defined as future situations, beyond the control of the project, whose outcomes influence the success of the project.

**Resource Assumptions**

- Executive support and sponsorship will be available as planned and as needed.
- Long term management support and priority for this project.
- Project staff resources will be available as planned and as they are needed.
- The appropriate SHA resources will be available to review all deliverables as defined in the project schedule.
- The appropriate SHA resources will be available to attend training as defined in the project schedule and training plan.
- The appropriate SHA resources will be available to participate in User Acceptance Testing as defined in the project schedule.
- Required hardware resources will be available as planned and as they are needed.
- Required customer resources will be available as planned and as they are needed.
- Access to industry experts and specialized skills will occur as needed.

**Delivery Assumptions**

- The schedule reflects the Department of Information Technology's (DoIT) System Development Life Cycle (SDLC) methodology and deliverables.
- The System Development Life Cycle (SDLC) templates will be used as guidelines to produce all deliverables.
- The schedule assumes a phased implementation, based upon the high level functional requirements as defined in the System Boundary Document.
- The actual implementation schedule may change after the design phase is completed.

[b] Materials Management System Strategic Plan (January 2007)

- Deliverables will be subject to no more than a specific number of review cycles as specified in the Consulting And Technical Services (CATS) Task Order. The CATS Task Order is issued under the CATS Master Contract that provides the State with a flexible means of obtaining Information Technology (IT) resources quickly, efficiently and cost effectively by issuing Task Orders (TOs) specific to its needs.
- SHA will procure the required hardware and software necessary to support the solution within the thirty five business days reflected in the solution.

**Organizational Assumptions**

- Issues will be resolved in accordance with project plans in a timely manner.
- The project organization described in the project plan will be in place.

**Budgetary Assumptions**

- The statistics used in preparing the estimates are accurate within +/- 20% percent.
- Consulting Services will be limited to a specified number of days at a specified rate per day as specified in the associated CATS contract.
- Projected funding needs will be approved by the State Legislature on an annual basis in the year that the funds were budgeted.

**Functionality Assumptions**

- Formal Project Charter and scope change procedures will be followed.

### 1.3.4 Interfaces to External Systems

The proposed MMS may need to interface with the systems identified in Exhibit 2 below.

**Exhibit 2: External systems to interface with MMS**

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Trns*port suite of software: Proposal and Estimates System (PES)/Letting and Awards System (LAS), Construction Administration System (CAS) | The PES, LAS or CAS may need to interface with the MMS to provide MMS with initial materials estimates to generate a testing guide, based on estimated quantities and the frequency guide. The CAS may need to interface with MMS to obtain test results to generate pay estimates, or this information may be available in MCMS. | Unidirectional |
| Maryland Construction Management System (MCMS) | MCMS is the construction management system used by SHA, and the MMS may need to interface with MCMS to share data, including contractor payment data, and daily work reports. It is anticipated that MCMS Navigator will be the source of MCMS information. | Unidirectional |
| RIDETOOL | RIDETOOL is used to capture and access ride quality of new pavements and is used to calculate incentive payments based on ride quality. | Unidirectional |

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Financial Management Information System (FMIS) | The MMS and FMIS will need to interface with each other to obtain cost per test data, charge codes. Effort will be made to use interfaces that already exist and are being used for various purposes. It is anticipated that more than one existing interfaces will be used to meet MMS needs. | Unidirectional |
| Geosystem | Geosystem calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. | Unidirectional |
| Humboldt Triaxial Data Acquisition | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. | Unidirectional |
| Maryland Product Evaluation List (MPEL) | MPEL is a web based system used to determine eligibility of new products. | Unidirectional |
| Pavement Management System | This system maintains an inventory of pavement on Maryland roads and is currently under redevelopment. | Unidirectional |
| HISD Database | This database stores all the existing road location information (e.g. milepoints) and will provide this information to MMS. | Unidirectional |

An Asset Data Warehouse (ADW) system is in the planning and requirements analysis phase and is planned to allow storage and retrieval of all data related to SHA's transportation assets. The ADW is anticipated to interface with the MMS in the future. The details of the interface will have to be identified during later phases of both projects to account for the schedules.

Exhibit 3 below details the projects as a part of which the interfaces are planned to be designed.

**Exhibit 3: External Systems Interfaces by Project**

| Project | Interfaces |
|---|---|
| Project I: System Management, Project Information, and Source of Supply | Trns*port PES, LAS, or CAS as required<br>MPEL<br>FMIS |
| Project II: Base Laboratory Information Management System | MCMS or CAS as required |
| Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs | GeoSystem<br>Humboldt Triaxial Data Acquisition |
| Project IV: Concrete/Chemical Lab | |
| Project V: Asphalt Lab | RIDETOOL<br>Pavement Management System |
| Project VI: Structural Lab | |
| Project VII: Materials Clearance | MCMS |

## 1.4 Points of Contact

Exhibit 4 below identifies the key points of contact for the Materials Management System Project.[c]

**Exhibit 4: Points of Contact for MMS Implementation**

| Office | Project Role (Project Manager, Business Lead, Project Sponsor, etc.) | Contact Person and Information |
|---|---|---|
| Office of Materials & Technology (OMT) | Project Sponsor<br>Business Lead<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member | Tim Smith, SHA<br>Benjamin Gilardi, SHA<br>Woody Hood, SHA<br>Gregory Moore, SHA<br>Paul Finnerty, SHA<br>Jeff Withee, SHA<br>John Weisner, |
| Office of Information Technology (OIT) | Project Steering Committee Member<br>Task Order Manager, Project Coordination Team Member<br>Project Manager | Jim Yarsky, SHA<br>Glenn Donithan, SHA<br>Lee Youngblood, SHA |
| Vendor<br><br>Consultant:<br>Planning and Requirements Phase | Consultant Program Manager<br><br>Consultant Project Manager | |
| Office of Construction (OOC) | Project Steering Committee Member<br>Project Coordination Team Member | Mark Flack, SHA<br>Paul Gudelski, SHA |

[c] For a list of contacts specific to Project I, see appendix Exhibit A-1.

| Office | Project Role (Project Manager, Business Lead, Project Sponsor, etc.) | Contact Person and Information |
|---|---|---|
| Office of Finance (OOF) | Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member | Betty Conners, SHA<br><br>Janet Irvin, SHA<br><br>Bill Bertrand, SHA |
| District 5 | Project Steering Committee Member | Jamie Folden |

## 1.5 Document References

This section contains a bibliography of references used to produce this document. The key project references specific to this project are listed below:

- MMS Project Charter (January 2008)
- System Concept Proposal (January 2008)
- Materials Management System Strategic Plan (January 2007)
- Maryland's 2007-2012 Consolidated Transportation Program http://www.mdot.state.md.us/Planning/Plans%20Programs%20Reports/Programs/CTP%2007-12/Cover_ToC/Table%20of%20Contents
- Code of Federal Regulations, Title 23, Part 637, "Construction Inspection and Approval."
- MDOT Information Systems Security Plan http://www.e-mdot.com/Contract_Opportunities/Documents/MDOT%20IT%20Security%20Plan.doc
- Maryland Department of Information Technology Security Policy and Standards http://doit.maryland.gov/support/Pages/SecurityPolicies.aspx
- SHA Computer Architecture Standards for Information Technology
- Maryland Department of Transportation State Highway Administration Mission and Vision Statements and Values http://www.sha.state.md.us/aboutus/orgChart/OC/missionvision.asp
- SHA Materials Management System Project: System Boundary Document (May 2008)
- SHA Materials Management System Project: Risk Management Plan (May 2008)
- SHA Materials Management System Project Management Plan (September 2008)

# 2 PROCESS OVERVIEW

This section presents the process overview for Project I (Source of Supply, Project Information, and Project Management), and includes the current (as-is) process, improvement opportunities identified, and a future state (to-be) process.

## 2.1 Overview

The business requirements scope for Project I (Source of Supply, Project Information, Project Management) includes developing the basic framework for MMS and the source of supply process. This includes establishing standards for database design, sign-on, help screens, audit trails, logging user access, and data validation. It also includes developing the project information section of the MMS to store project information like project name, number, bid items, and project start and end dates. All project-related information will be imported from the Trns•port applications if available. This project will also involve interface with FMIS and will require involvement of preconstruction staff, OMT, and OIT. Finally, this project includes the source of supply functionality. This involves the designing of a module that will enable contractors to submit source of supply information to SHA over the Internet for review and allow SHA to approve/disapprove the sources electronically. This system will need to interface with the existing Maryland Product Evaluation List (MPEL) to obtain and maintain the Qualified Products List (QPL).

Source of Supply refers to the review of the sources of materials that the contractors propose to use on a project. The contractors are required to obtain SHA approval before any of the material can be used on a project. The approval of the source does not indicate approval of material used on the project – merely the source of the material to be used. The materials used on projects are tested per specifications as the project progresses. SHA maintains lists of qualified products and approved plants by different materials. These lists include: the aggregate bulletin for a list of approved sources for aggregates; List of Approved Plants (by different divisions); Approved Manufacturers List; and Qualified Products Lists (QPL) for Hot Mix Asphalt (HMA), Portland Cement Concrete (PCC), Graded Aggregate Base (GAB), Top Soil, and Geotextiles.

Project Management refers to project management activities performed on a project. This includes activities like maintaining high level project information, storing project documentation, and tracking project tasks. Project Management also includes defining workflow processes for review and approval of required project documentation.

System management refers to the overall technical requirements of the system. This includes activities relating to maintaining the system, managing documentation, etc.

## 2.2 “As-Is” and “Future-State” Processes

The As-Is and Future State process mapping files enable a comparison between the current business processes as they exist today (as-is), and the updated business processes after implementation of MMS that incorporates improvement opportunities identified during the review of the current process (future-state). The following as-is and future-state processes relate to the source of supply process.

### 2.2.1 As-Is Processes

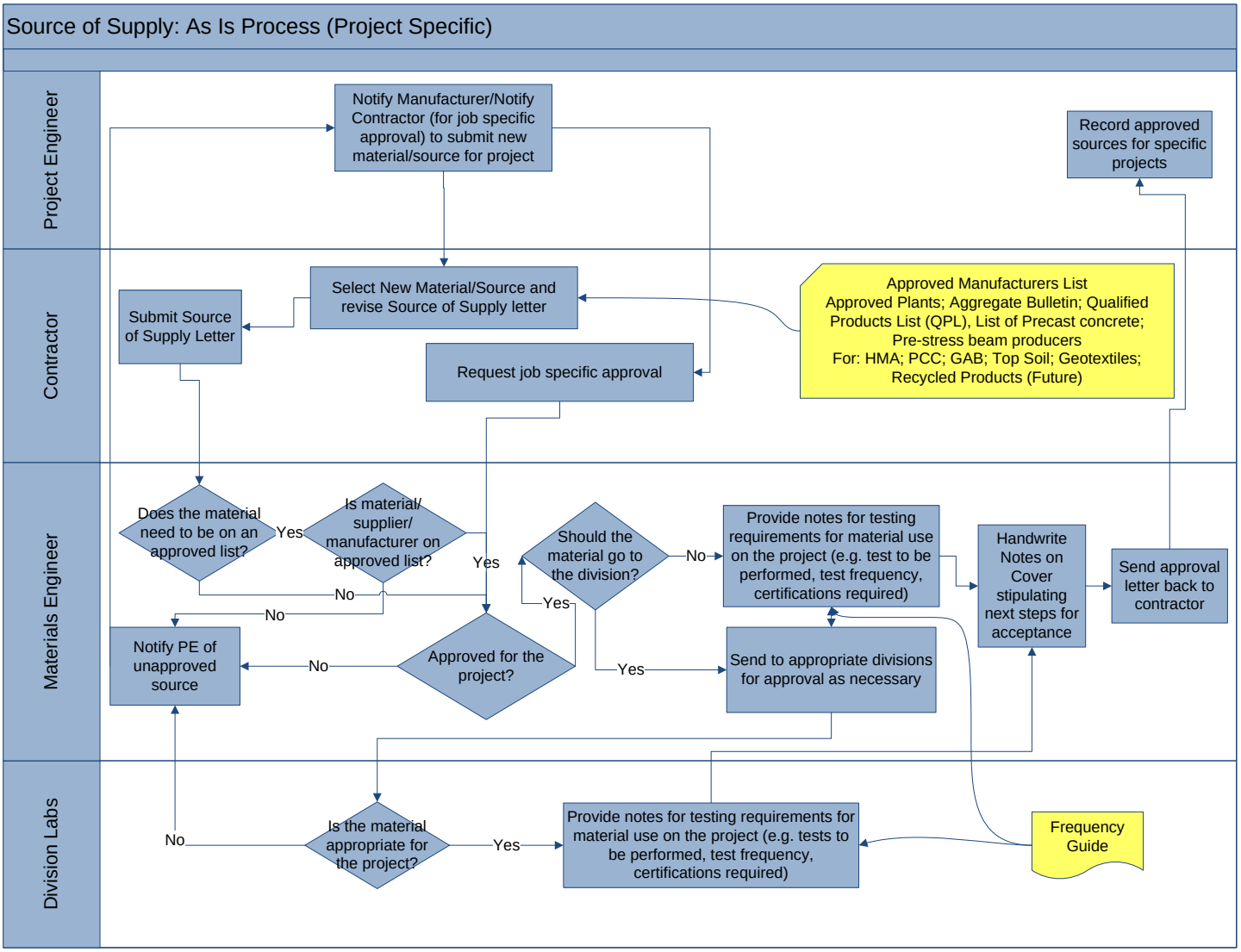
The as-is process for source of supply is largely paper based and uses stand alone offline applications and source of supply letters. Most, if not all, documentation originates in paper form or via email and is archived in filing cabinets manually.

The current as-is business process for Project I can be divided into *Project Specific* processes and processes associated with *New Products, Project Specific Materials, and New Sources of Approved Products*.

***Project Specific Sources***

**Error! Reference source not found.** below details the source of supply as-is process for project specific sources, and is followed by a description of the process.

**Exhibit 5: Source of Supply As Is Process (Project Specific)**



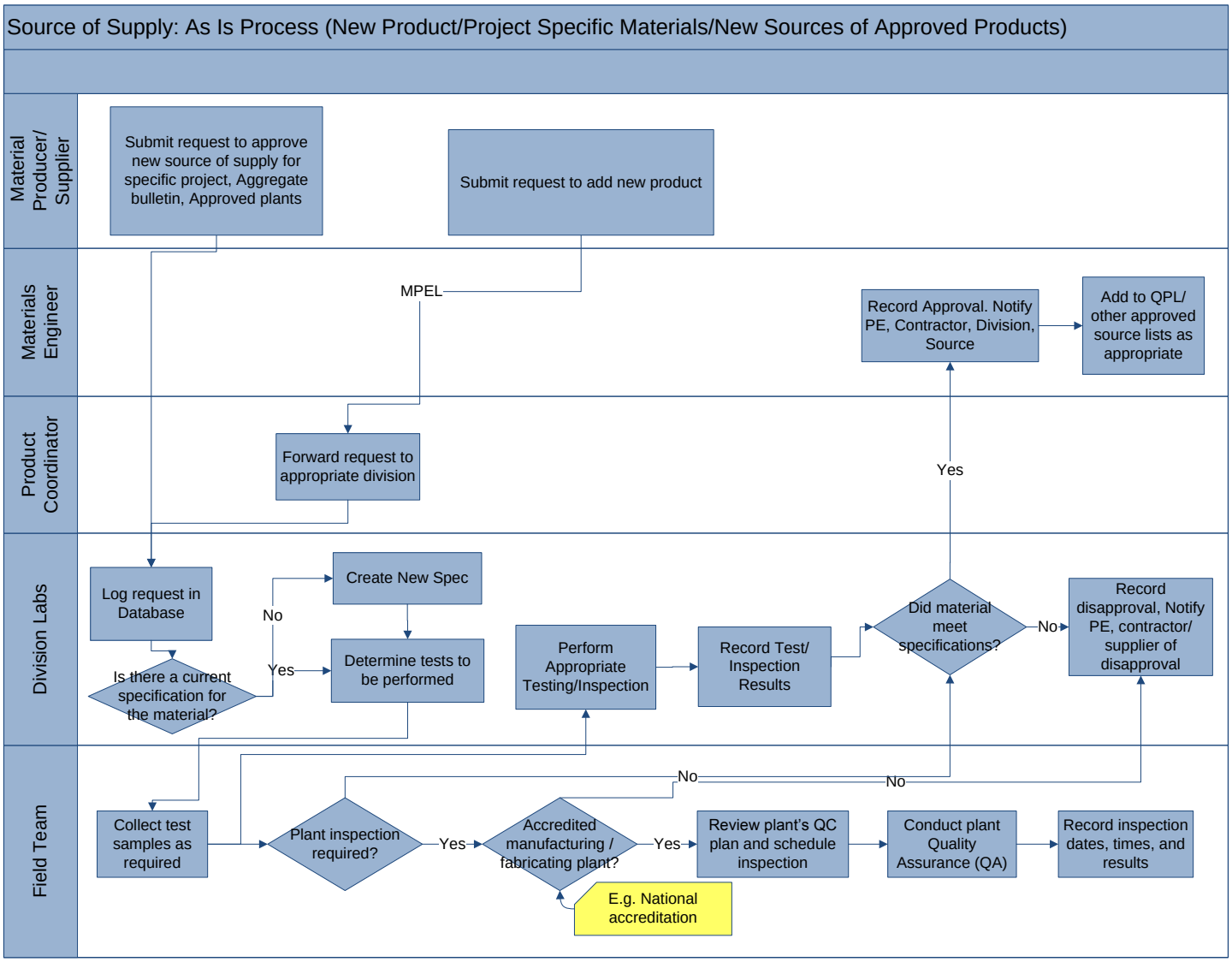

The as-is process, as it relates to *Project Specific* Source of Supply, includes the approval process for sources (material suppliers/manufacturers) which are already on an approved list. As previously

described, an approved supplier/manufacturer must be approved for specific projects even though they are already on a general approved list. The Materials Engineer acts as the first point of approval, and ensures that the material supplier/manufacturer is approved and that the material is appropriate for the specific project in question. The Materials Engineer sends the source of supply information to the appropriate divisions for approval when specialized knowledge of the division staff is required. The divisions review the submittal and approve/disapprove as appropriate, along with specific notes applicable to the submittal.

The “notes” are not arbitrary notes, but refer to a pre-existing list of descriptions that indicate how the material will be accepted on the project (specific tests to be performed or certifications required) or the reason for its rejection. The Materials Engineer collects notes from the Division Labs and sends a letter back to the contractor with the approval status. The contractor records the approved sources for specific projects and is expected to use only the approved sources for the project work.

The source of supply as-is process for New Products, Project Specific Materials, and New Sources of Approved Products is detailed in **Error! Reference source not found.** below. Approval requests for new products or new sources for approved products are not specific to the projects, while an approval request for project specific materials is for individual projects. In the case of the former, the source is added to an approved list (e..g QPL), while the source is not added to any list for project-specific materials, but is approved as a source only for the project. Project specific materials are usually those materials that are required for the project due to particular specifications for the projects, but may not be commonly required for other projects. These include specific brands of materials that might have been required in the specifications of a particular project.

**Exhibit 6: Source of Supply As Is Process (New Product, Project Specific Materials, New Sources of Approved Products)**




*New Products:*

This process begins when a Material Producer/ Supplier requests approval to be the source for a new product via MPEL. The project coordinator forwards the request to the appropriate division. The Division lab logs the request in the lab database and checks to see if there is an existing specification for the product to perform appropriate testing. If there is no existing specification, the division lab creates a new specification in order to determine the appropriate testing/inspection requirements. If current specifications for the product exist, the lab determines the appropriate testing necessary for approval. The field team then collects the required samples and determines whether a plant inspection is necessary.

If an inspection is necessary, the field team determines whether or not the plant is an accredited manufacturing/fabricating plant. If accredited, the field team reviews the Quality Control (QC) plan developed and provided by the plant, and if found acceptable, schedules an inspection. The field team then conducts the plant's Quality Assurance (QA) to ensure that the proper manufacturing processes are being met, and records the inspection dates, times, and results. If the facility is not accredited, the

division lab records disapproval, and notifies the project engineer, contractor, and supplier of disapproval.

In parallel to the field team conducting plant inspections, the division lab performs any necessary testing. The lab records the results and determines whether or not the results met specifications. If the test results did not meet specifications, the source is not approved and the appropriate parties are notified. If the lab test results met specifications, and the field inspections were satisfactory, the source is added to the QPL or other appropriate list as a qualified source for manufacturing/producing the new product in question.

*New Source of Approved Product/Material:*

This process begins when the material producer/supplier requests to be approved as a new source of supply for a project and to be added to the list of approved sources. The material/product is already on an approved list and if approved, the producer/supplier will be added to the list of approved sources to supply the material/product. The division lab logs the request in the lab database and checks to see if the plant/source has an active project to charge to for the testing and inspection work. If there is no active project, the divisions wait till they receive payment from the plant/source before performing any approval work. The division then checks the existing specification for the product/material. Since the product is already on an approved list, the division lab determines the testing necessary as per specification. The field team collects required samples, and determines whether a plant inspection is necessary.

If an inspection is necessary, the field team determines whether or not the plant is an accredited manufacturing/fabricating plant. If accredited, the field team reviews the Quality Control (QC) plan developed and provided by the plant, and if found acceptable, schedules an inspection. The field team then conducts the plant's Quality Assurance (QA) to ensure that the proper manufacturing processes are being met, and records the inspection dates, times, and results. If the facility is not accredited, the division lab records disapproval and notifies the project engineer, contractor, and supplier of disapproval.

If an inspection is not necessary, the division lab determines whether or not the source meets specifications for the product. If the source meets specifications, the materials engineer records approval and notifies the appropriate parties.

In parallel to the field team conducting plant inspections, the division lab performs the necessary testing. The lab records the results and determines whether or not the results met specifications. If the test results did not meet specifications, the source is not approved and the appropriate parties are notified. If the lab test results met specifications, and the field inspections were satisfactory, the source is added to the QPL or other appropriate list as a qualified source for manufacturing/producing the product in question.

*Project Specific Materials:*

The process for approving materials sources for specific projects is very similar to the approval process for new sources of approved products/materials – the primary differentiators being the requestor and the fact that the approved source does not get added to the QPL or other approved lists. The process of adding a new source of supply for a specific project begins when the prime contractor submits a request for approval. In some circumstances, the material will be approved on certification.

If the material needs to be tested or an inspection needs to be performed, the same process as mentioned above for new sources of approved products is followed. At the end of testing and/or inspection, the

appropriate parties are notified of approval or disapproval, but the product is not added to an approved list even if approved.

### 2.2.2 Process Improvements

During the review of the as-is process, the interview participants identified a number of improvement opportunities to be incorporated in the future state process. These improvement opportunities were discussed with the participants during the future state meetings and were defined in further detail. These opportunities are mentioned below.

- **Standardized templates and forms**. The participants indicated that standardized templates and forms should be utilized to ensure that collected data is consistent across projects and the reviewers can receive all data in a similar format. The participants indicated that the MMS should require that the submitters provide specific information, which will significantly reduce time spent gathering additional information that might not be properly submitted or neglected to be submitted in the current process.
- **Expandable item list**. The participants indicated that the bid item list should be able to be expanded so that all materials that are a part of the bid item can be linked to the bid item. This will allow the contractor as well as SHA to ensure that all the bid items and materials used on the project have approved sources of supply.
- **Audit trails**. Audit trails within the MMS will provide the ability to track information, to determine at what point information has changed, and who is responsible for the change. This information will include the date and time of last change, and the person who made the change.
- **Ability to store multiple versions of specifications**. Storing multiple versions of specifications within the MMS will provide the ability to track changes in specifications throughout the life cycle of a project. It is important to maintain an original list of specifications even after changes have been made to the originals since current projects will keep using the older specifications until their completion.
- **Interface with lists of approved sources, sampling plans, frequency guides and other documents and databases**. In the current process, the product coordinator and the division labs must manually look up whether or not a source or product is on an approved list and the appropriate inspections and testing as dictated in specifications. The field team must also manually review whether or not plants have proper accreditation in order. The MMS will interface with these documents and will automatically determine if a source is already approved, the testing and inspection requirements for new products, new sources, or new sources of approved products, and whether or not a plant has the proper certifications in order. The MMS will automatically generate a project specific frequency guide which provides a list of the minimum number of tests to be performed on a particular project.
- **Direct submission of source of supply information, and source of supply list database**. Storing source of supply information as a list (database/table) within the MMS will provide the ability for source of supply information to be readily accessible for review. This will allow the contractor as well as SHA to ensure that all materials used on a project have approved sources of supply. Source of supply can be submitted directly through templates and forms in MMS.
- **Automatic update to lists of approved sources**. When all testing and inspections are complete and the appropriate parties have reviewed and signed off on approvals, the MMS will automatically add the material in question to the appropriate list of approved sources.
- **Information on the availability of quarries to provide particular aggregates and/or soils**. Storing information on the stock available at quarries will enable contractors to select sources that will have material available during the time frame of a project.
- **Reciprocity agreements with other states**. Regional sources of supply provide products/materials for states other than Maryland. These states have their own QA/QC standards and inspection

requirements. Accepting these sources based on the approval of other states would save time and scarce financial resources.

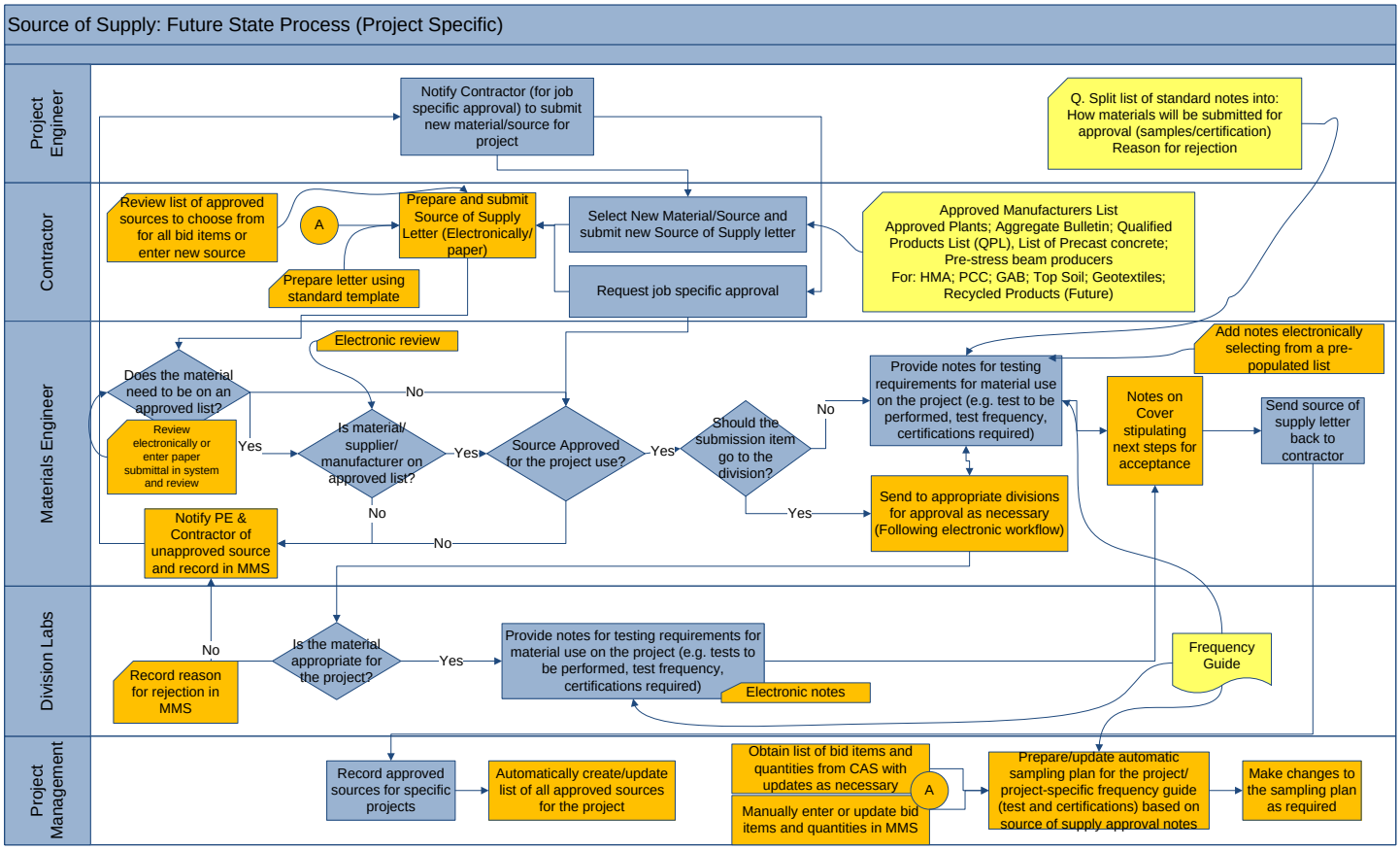
- **Increased Security**. The MMS will have the capability to restrict access to users as determined by project management within divisions. Each project will have specific and unique security needs which can be carefully controlled and monitored. Managers can control and manage who has access to MMS in general and specific areas within MMS in particular by restricting information as public/private/read-only/temporarily accessible or any other security designation. Users will be prompted to enter their login information when attempting to access restricted areas.
- **Electronic review and notification**. Completed steps in a workflow will automatically trigger MMS to notify the next in the chain of command that work is complete and is awaiting approval or review.

### 2.2.3 Future-State Processes

The future state process is what the as-is source of supply process will look like after MMS is implemented. In general, switching to an MMS from the current manual process will enable the automation and standardization of the entire Project I process.

**Error! Reference source not found.** below presents the future state process for project specific source of supply. Differences between the As-Is and Future-State processes can be easily distinguished by the orange colored boxes.

**Exhibit 7: Source of Supply Future State Process (Project Specific)**




In the future state process for project specific source of supply, contractors will be able to prepare and submit source of supply letters electronically through completing a pre-formatted template or will have

the option to submit these via hard copy as is the current process. To guide electronic submission, a list of approved sources will be available from which the contractor can select. This list will interface with the list of bid items and quantities stored in MMS. If the desired source is not on the approved list, the contractor will have the option to request approval of the source of supply with the required information. MMS will then notify the Materials Engineer that the contractor has submitted the appropriate information, marking whether the information is for an already approved source of supply or a new source of supply. The Materials Engineer determines whether or not the material needs to be on an approved list.

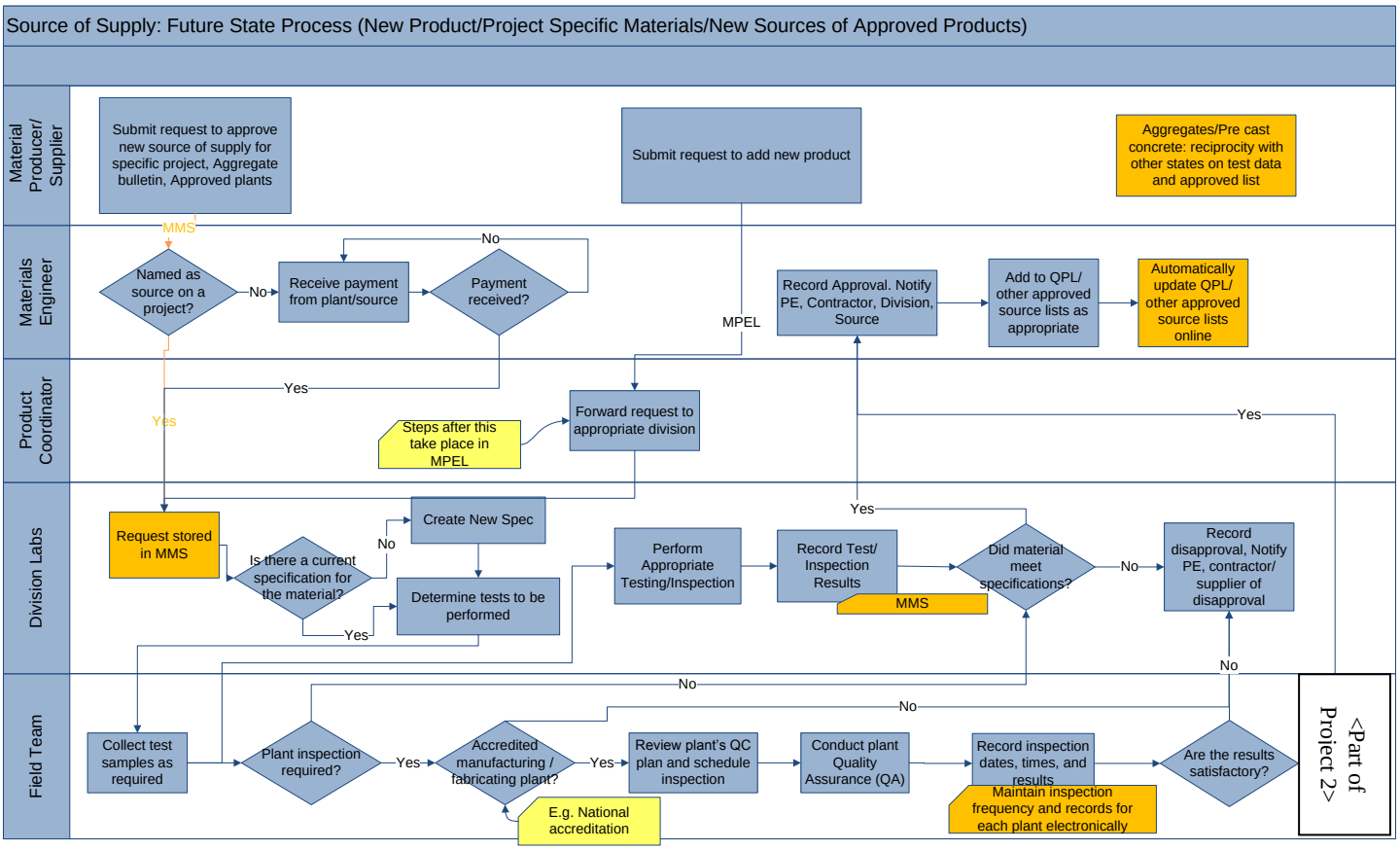
If the submitted item does not need to go on to the division, the Materials Engineer will provide notes for testing requirements for material use on the project. Notes detail the tests to be performed, the test frequency, and the required certifications. These notes can be selected electronically from a pre-populated list. The source of supply list, with attached notes, is sent back to the contractor. The contractor records the approved sources for specific projects. MMS will automatically create and update a list of approved sources for the project, and also include a list of all materials that do not have an approved source.

If the Materials Engineer determines that the submitted material needs approval from the Division Labs, the divisions are notified of the source information. The divisions then determine whether or not the material is appropriate for the particular project. If not appropriate, the division labs record in MMS the reason for disapproval. If appropriate, the labs provide notes for testing requirements such as the tests to be performed, the test frequency, and required certifications. These notes can be selected electronically from a pre-populated list.

If the material/supplier is not approved, the materials engineer notifies the project engineer and the contractor of an unapproved source. The project engineer then notifies the contractor to submit a new material or source for a project. The contractor can select a new source/material, or can request job specific approval. At this point, the electronic review process proceeds anew.

Functional Requirements below details the future state process for new products, project specific materials, and new sources of approved products.

**Exhibit 8: Source of Supply Future State Process (New Product, Project Specific Materials, New Sources of Approved Products)**




*New product*

If no category for a product exists in QPL, the approval process proceeds through MPEL. New products are, by definition, those products that are not yet on an approved list. New products will proceed through MPEL, outside of MMS. If the request comes through MMS, it follows the steps below.

*New Source of Approved Product/Material:*

The material producer/ supplier submits a request to be added as a source directly through MMS. The MMS will determine if this supplier/producer has been named as a source on an active project. If not named, the source is responsible for payment and no further action is taken until payment has been received. The MMS will flag the request as requiring payment at this point. The review process starts at this point if the source has been named on a project, or after the payment is received from the source.

The division labs determine whether or not there is a current specification for the material to be approved. If no specification exists, the division lab creates a new specification and contacts the field team to collect samples and perform inspections as appropriate. (As soon as payment is received for non-named sources, the division lab determines the appropriate testing to be performed on the new source of supply.)

If an inspection is necessary, the field team determines whether or not the plant is an accredited manufacturing/fabricating plant. Information on the qualifications of particular plants can be accessed

and updated via MMS. The manufacturing/fabricating plants can log in remotely and update information regarding their accreditation which can be accessed through MMS. If the appropriate accreditations are in order, the field team reviews the Quality Control (QC) plan developed and provided by the plant, and if found acceptable, schedules an inspection. This QC plan can be attached in the MMS by the plant for SHA review. The field team can enter the scheduled inspection date in MMS.
The field team then conducts the plant's Quality Assurance (QA) to ensure that the proper manufacturing processes are practiced, and records the inspection dates, times, and results in MMS. If the facility is not accredited, the division lab records disapproval. MMS notifies the project engineer, contractor, and supplier of disapproval. All inspection results are stored directly to MMS.

In parallel to the field team conducting plant inspections, the division lab performs any necessary testing. The lab records the results directly to MMS. When the lab has completed a task, MMS will automatically notify the next in the chain of command that the appropriate information is compiled and the next stage of testing can begin. All samples are tracked electronically through MMS. The lab determines whether test results met specifications. If the test results did not meet specifications, the source is not approved and the appropriate parties are notified (via MMS). If the lab test results met specifications, and the field inspections were satisfactory, the source is added to the QPL, or other appropriate list, as approved for producing the product in question. The capabilities mentioned above relating to sample tracking and checking against specifications will be developed as a part of projects II-VI.

In a future state, Aggregates/Pre Cast Concrete may have reciprocity with other states on test data and approved lists. This will enable the QA/QC plant inspection process to be significantly less time consuming or unnecessary altogether.

*Project Specific Material*

The process for approving materials sources for specific projects is very similar to the approval process for new sources of approved products/materials – the primary differentiators being the requestor and the fact that the approved source does not get added to the QPL or other approved lists. The process of adding a new source of supply for a specific project begins when the prime contractor submits a request for approval directly through MMS. In some circumstances, the material will be approved on certification.

If the material needs to be tested or an inspection needs to be performed, the same process as mentioned above for new sources of approved products is followed. At the end of testing and/or inspection, the appropriate parties are notified of approval or disapproval, but the product is not added to an approved list even if approved.

# 3 FUNCTIONAL REQUIREMENTS

The functional requirements describe the core functionality of the application. This section includes the data and functional process requirements and presents a high level logical data model for the source of supply process.

Exhibit 9 below presents the logical data model for the source of supply requirements, while Exhibit 11 presents the functional requirements.

**Exhibit 9: High Level Source of Supply Logical Data Model**

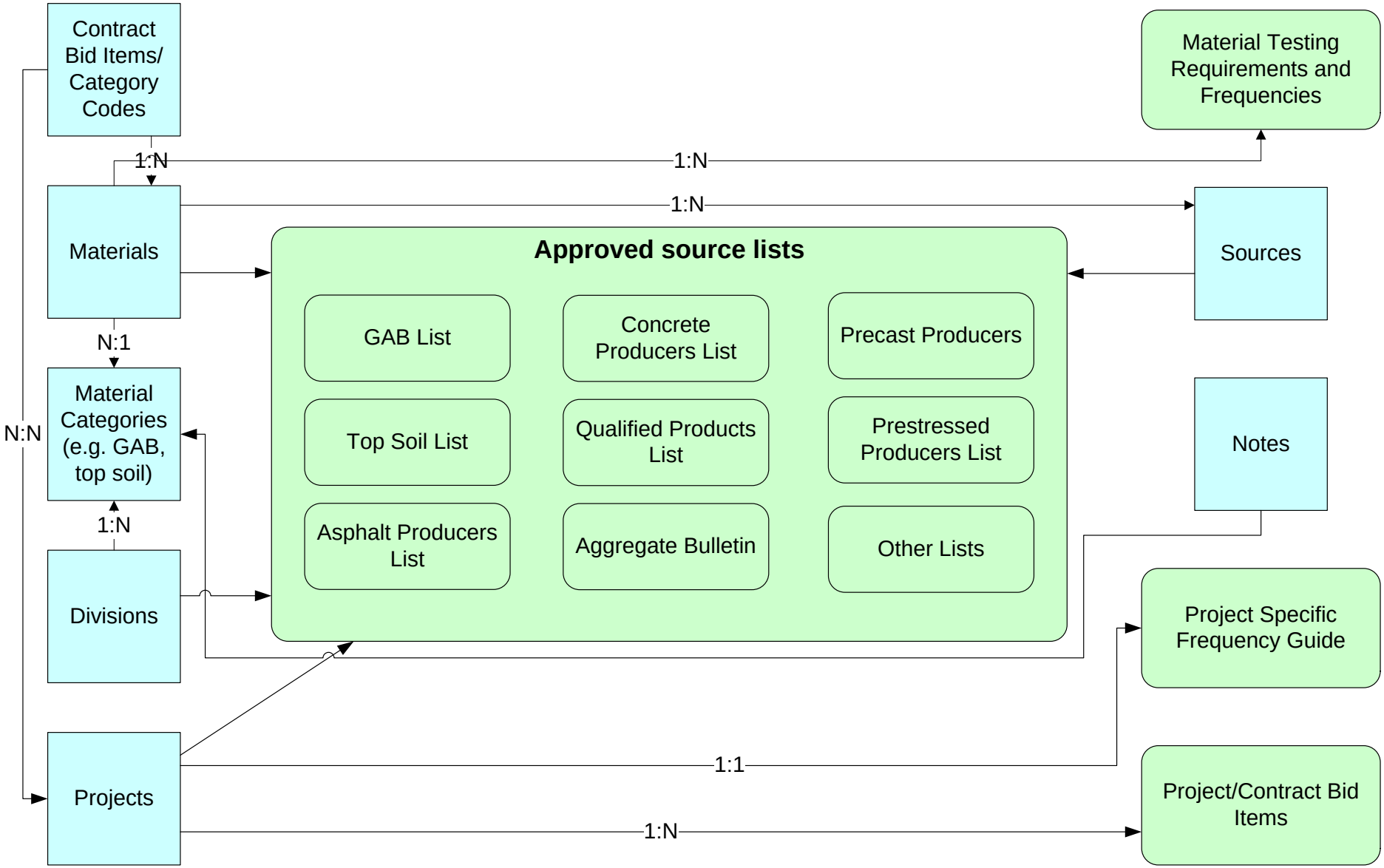


Exhibit 10 below presents the priority definitions used for the functional and operations requirements in this document.

**Exhibit 10: Priority Definitions**

| PR Rank | Definition |
|---|---|
| Mandatory | A priority of mandatory identifies a critical business need. The system must fulfill these needs. |
| Desirable | A priority of desirable identifies requirements that are important but are optional. A desirable ranking would mean "Like to Have" but not prevent selection of a chosen solution if that solution could not fulfill the requirement. |

The requirements below are primarily broken down into Project Management, Source of Supply, System Management, and MMS-Wide requirements. Source of Supply requirements apply specifically to Project I, while project management, system management, and MMS-wide requirements below refer to the MMS, and will apply to multiple projects from Project I through Project VIII, though all requirements may not apply to a specific project (including project 1).

**Exhibit 11: Functional Requirements**

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| **MMS-Wide*** (All these requirements may not apply to Project 1) | | | | | | |
| 001 | **MMS-Wide** | **Document Management** | MMS01 | Capability to record status of test results on materials associated with a project. The user shall be able to access a specific project, obtain a listing of materials being used and view the status and results of testing. Test results are logged manually today and no accessible electronic format is in place. | Mandatory | May not apply to project 1 |
| 002 | MMS-Wide | Document Management | MMS02 | Capability to export data to Microsoft Office product suite (Word, Excel, Access, etc.) for off-line data processing and availability. | Mandatory | |
| 003 | MMS-Wide | Document Management | MMS03 | Ability to enter field inspection data (Form 14) in MMS through a web based interface. For example, as addressed in other requirements, the field force needs access to MMS and the MMS database must store all forms associated with the approval process. | Mandatory | May not apply to project 1 |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 004 | MMS-Wide | Document Management | MMS04 | Capability to store standardized letter templates to display to internal and external users as needed and the ability to download templates. | Mandatory | |
| 005 | MMS-Wide | Document Management | MMS05 | Capability to attach supporting documentation (scanned images, reports letters, forms, notations or other documentation as PDF documents) to specific material test results. The attached documentation shall be viewed as part of the test results document and have the capability to be viewed, emailed or printed from MMS. For example, test results are recorded today and placed in a manual project folder. They are viewable in hard copy only. | Mandatory | |
| 006 | MMS-Wide | **Integration** | MMS06 | Capability to provide email integration functionality to allow MMS notifications to be sent via e-mail. For example, some documentation will need to be emailed from within MMS, specifically those people with no MMS access in the field. | Mandatory | |
| 007 | MMS-Wide | Integration | MMS07 | Capability to allow MMS to send Text (SMS) notifications to specified team members. This capability will be critical for team members on the field with no or sporadic internet connectivity. | Mandatory | |
| 008 | MMS-Wide | **Interface** | MMS08 | Ability to transfer charge allocation data from YB888 to appropriate contract numbers to FMIS electronically. The allocation data and other FMIS data is not currently available via interface. This includes the ability to flag third party billing, and how that is sent to FMIS. | Mandatory | May not apply to project 1 |
| 009 | MMS-Wide | Interface | MMS09 | Capability to migrate test data from current systems into MMS for current projects. This would be a post-operational activity conducted to provide support for existing projects at MMS system cutover. For example, projects will continue to be worked during the implementation of MMS. As implementation moves forward, projects still pending may be identified for migration to MMS. | Mandatory | May not apply to project 1 |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 010 | MMS-Wide | Interface | MMS10 | Capability to provide information to Pavement Management System. For example, the information associated with Hot Mix Asphalt is required by Pavement Management. This capability may be addressed via the overall system interface requirement. | Mandatory | May not apply to project 1 |
| 011 | MMS-Wide | Interface | MMS11 | Capability to import and export data to/from other systems. MMS shall, at a minimum, interface with Trns*port Suite (CAS/PES/LAS), MCMS, RIDETOOL, FMIS, Geosystem, Humboldt Triaxial Data Acquisition, MPEL/QPL and PMS. For example, financial data, construction information, pavement information and other data is not centralized in one place today, nor is it accessible via direct interface. | Mandatory | |
| 012 | MMS-Wide | **Location Tracking** | MMS12 | Capability to record test sample location in multiple coordinate systems and/or mileposts as required. This will require numerical fields with validation rules. Capability to utilize GPS locations at a later date shall be considered in meeting this requirement. For example, the sample location is noted manually today utilizing mileposts locations. | Mandatory | This may include recording location of source of supply, especially for borrow pits, etc. in Project 1. |
| 013 | MMS-Wide | **Test Information** | MMS13 | Capability for field personnel to check status of a test in real time through a web browser. The available results should be restricted based on the rights provided to the individual user. For example, field forces are dependent upon the specific divisional labs to provide them with testing and approval status. | Mandatory | May not apply to project 1 |
| 014 | MMS-Wide | Test Information | MMS14 | The provision of an MMS "Wizard" functionality to create or alter test entry screen to create a screen for new test entry. This should allow the user to enter formulas for fields that can be calculated automatically based on entered test results. | Mandatory | May not apply to project 1 |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 015 | MMS-Wide | Test Information | MMS15 | Ability to print final test document based on the data entered into the system. Also the capability to add notations to the document. For example, a hard copy version may be necessary for publication, a meeting or other reason. Having the option of creating a hard copy enables more flexibility. This document may need to be formatted differently than that used to enter the test data, and may require a "print" button that provides a specific print version of the form. | Mandatory | May not apply to project 1 |
| 016 | MMS-Wide | Test Information | MMS16 | Capability to process MMS reports via email, print, or to save (to file or to disk). This will allow SHA to use the right format based on capabilities available at the field locations. | Mandatory | May not apply to project 1 |
| 017 | MMS-Wide | **Test validation** | MMS17 | Capability to provide data validation for information being entered based on a reasonableness test, including warnings for missing fields and helpful error messages based on rules established in the system. Ability to correct typos. For example, if a user attempts to enter a letter into a field that only accepts numbers, they should be alerted with a pop-up, or other indication that it is not allowed. | Mandatory | May not apply to project 1 |
| 018 | MMS-Wide | Test validation | MMS18 | Capability to record serialized form numbers as unique identifiers for each sample and the ability to associate required forms for specific samples and tests and present them in a selectable menu. For example, various specific forms are used to record information associated with the samples that are collected on the field or at production facilities. | Mandatory | May not apply to project 1 |
| 019 | MMS-Wide | Test validation | MMS19 | Capability to allow authorized users in test labs to access project data regarding number of tests performed to date, materials used, etc. to assess adequate testing frequency as necessary. This is intended to help avoid any issues regarding inadequate testing at the end of the project during materials clearance. | Mandatory | May not apply to project 1 |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 020 | MMS-Wide | **User Support** | MMS20 | Provide an easy-to-use and easy to learn interface. The front-end user screens should mimic screens already in use on existing MMS pages/modules, to the extent possible. Pull-down menus, help screens, and input validation functionality shall be included in the user interface. For example, the user should be presented with an intuitive and familiar user interface. | Mandatory | |
| 021 | MMS-Wide | User Support | MMS21 | Capability to provide the system interface link in such a way that the user will only have to input data one time. For example, information entered regarding project schedules or other Daily Work Reports would automatically update the construction data base (MCMS). | Mandatory | |
| 022 | MMS-Wide | User Support | MMS22 | Capability to process batch entries from outside users. For example outsourced labs may batch their test results to send back to the SHA lab. | Mandatory | |
| 023 | MMS-Wide | User Support | MMS23 | Capability to provide daily confirmation on interactions via the system interface. For example, if a daily work report is transmitted from construction (MCMS), it would be documented and included in the confirmation report. | Mandatory | |
| 024 | MMS-Wide | User Support | MMS24 | Capability to support all SHA IT standards provided by SHA Department of Information Technology. For example the SHA SDLC and other standards must be adhered to for all projects. MMS may store standards documenting for reference. | Mandatory | |
| 025 | MMS-Wide | **Workflow** | MMS25 | Capability to report/display status of workflow (how many steps approved, who needs to review next, etc.) in a summary/dashboard format. For example, a team lead or other manager may need to review the overall process status. This may also be used for performance monitoring. | Mandatory | |
| **Project Management** | | | | | | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 026 | **Project Management** | **Frequency Guide** | PM01 | Capability to store frequency guide in the system as a database/tables that can be accessed for multiple uses. The frequency guide provides a list of materials, the frequency at which these materials need to be tested, and the tests that need to be performed on these materials. For example, all labs utilize the Frequency Guide for test reference. | Mandatory | |
| 027 | Project Management | Frequency Guide | PM02 | Capability to store multiple versions of frequency guide, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. | Mandatory | |
| 028 | Project Management | Frequency Guide | PM03 | Ability to manually link a particular version of the frequency guide to a project, even if it does not meet the date range validation. This may be required if a project has just started, a new frequency guide is released and the project members agree to using the new frequency guide. | Mandatory | |
| 029 | Project Management | **Project Contacts** | PM04 | Ability to maintain list of contacts on project, including external contacts. This should include full name, phone number, fax number, email address, physical address, company name, division, assigned role (e.g. project manager, project engineer, contractor) and others. | Mandatory | |
| 030 | Project Management | Project Contacts | PM05 | Ability to define and maintain multiple distribution lists of project participants. These distribution lists will include names, email addresses, and agency information (company name, division). These distribution lists will be specific for each project. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 031 | Project Management | **Project Information** | PM06 | Capability to import basic project information from Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, $ completion, other). This information will be important to understand project completion and help identify when the 30 day notice for materials clearance should be received and help with final clearance as well as monthly project clearance.<br>This information should be marked as "imported" to separate from manual entries. | Mandatory | |
| 032 | Project Management | Project Information | PM07 | Capability to enter basic project information for projects not entered in Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, cost and completion date.<br>This requirement is important since not all projects that require material testing are stored in Trns*port (e.g. local, county, some maintenance jobs). This information will likely be in the form of linked tables with multiple fields (e.g. bid item, materials, bid units, bid quantities) and can follow the same structure used in Trns*port for this information.<br>This information will be used to create a sampling plan as a start, but will also be used all the way through the project life cycle, including during the final clearance to compare materials used vs. materials that were planned to be used. | Mandatory | |
| 033 | Project Management | Project Information | PM08 | Capability to automatically update basic project information via an import from Trns*port. This capability will help keep the information in MMS up-to-date as project status or other information is updated in Trns*port. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 034 | Project Management | Project Information | PM09 | Capability to allow authorized users to update project information as changes occur for projects not in Trns*port. This capability will keep the information in MMS up-to-date for projects that are not in Trns*port. | Mandatory | |
| 035 | Project Management | Project Information | PM10 | Capability to link information for tests conducted before start of construction phase to information starting at the construction phase of the project. The primary difference between the tests performed is the phase of the project - for example, a soil sample may be collected and tested during pre-construction to determine/confirm soil properties, and other samples collected and tests conducted once the project is in construction. The ability to link all the test information will provide SHA with a better decision support and feedback tool than currently available. | Desirable | |
| 036 | Project Management | Project Information | PM11 | Capability to interface with FMIS to obtain information periodically (e.g. charge numbers). | Mandatory | Lee to discuss with Bill Bertrand |
| 037 | Project Management | Project Information | PM12 | Capability to store and retrieve supporting documentation from an enterprise level document management system to be developed by OIT. This capability will also include the ability to submit new documentation, such as specification changes, to the documentation system. For example, a user requiring specific documentation and/or procedures not stored in MMS, will have access to that documentation via the document management system. | Mandatory | If OIT document management system is not yet developed, then need further discussion. |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 038 | Project Management | Project Information | PM13 | Capability to link bid items to construction materials (one to many relationship) and expand a bid item into various materials that form the bid item. For example, a bid item of concrete on the project might consist of cement, aggregates, and admixtures. Each of these materials have different testing specifications and requirements (explained later). | Mandatory | The list of all bid items and material links was available in the mainframe system - need to try and find this list |
| 039 | Project Management | Project Information | PM14 | Capability to automatically generate letters to notify stakeholders and contractors of the status of material approvals; this could be done on a scheduled basis, or on-demand in response to a stakeholder query. For example, this reporting capability should allow a report to be generated for all materials involved on a project and their source approval status (approved, unapproved, submitted, not submitted, not required). | Mandatory | |
| 040 | Project Management | Project Information | PM15 | Capability to recognize and process various business rules based on different construction methods (i.e., Design Build vs. other methods). The MMS database, for example, must contain information tables on all construction methods used by SHA and be designed with the capability to process a project utilizing any of the defined methods. For example, the testing standards and frequency may vary based on the project construction method, but the final clearance requirements may be the same. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 041 | Project Management | **Project Sampling Plan/Project Specific Frequency Guide** | PM16 | Capability to automatically generate minimum number, types, and frequencies of tests required for the materials clearance process (project sampling plan) for each material to be used on the project based on frequency guide and material quantities for the project as obtained from Trns*port. This Project Sampling Plan will act as a guide for the overall testing requirements, and help ensure and track that all the testing requirements for the project are met.<br>For example, the sampling plan will specify that asphalt placed on the project should be tested at every x placements or every x tons, whichever comes first. | Mandatory | |
| 042 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | PM17 | Capability to show/present the project sampling plan/project-specific frequency guide in a web-based format to authorized users. This sampling plan should be formatted such that it is easy for the users to read and understand the report. For example, a user may print a copy of the Sampling Plan for reference throughout the project to track the requirements and ensure compliance. | Mandatory | |
| 043 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | PM18 | Capability to automatically make changes to the sampling plan based on quantity changes entered in the system due to change orders, or due to other unforeseen circumstances. This will require an interface with CAS or MCMS in which all quantity changes and change order information is recorded. The change may be manually input into MMS for projects that are not stored in CAS/MCMS (e.g. some maintenance projects).<br>For example, if a change order significantly increases the quantity of concrete to be used on the project, the number of tests required should automatically be increased in the sampling plan. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 044 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | PM19 | Capability to allow for manual changes to the sampling plan by authorized users - these changes should allow all parameters of the sampling plan to be changed, including addition and deletion of materials, tests to be performed, and frequency of the tests. This action could be prompted by project specific guidelines or any problems/issues being observed on the project. | Mandatory | |
| 045 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | PM20 | Capability to generate a sampling plan for projects not in Trns*port based on information manually entered in MMS. | Mandatory | |
| 046 | Project Management | **Project Workflow** | PM21 | Ability to define a workflow for establishing electronic review and approval of results. This workflow will provide the user a path to completing the source of supply and materials testing process. For example, the generated workflow shall define the steps, approvals, distribution list and other relevant process data for a given project. | Mandatory | |
| 047 | Project Management | Project Workflow | PM22 | Ability to assign a priority number to a workflow approval request at the individual level (1-low, 10-high) to allow resources to prioritize their work, and ensure that high priority projects (major projects, emergency projects) are completed first. A priority of 5 should be selected by default if a priority is not specified. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 048 | Project Management | Project Workflow | PM23 | Ability to add comments to the workflow at each approval step for internal use. These comments should propagate with the workflow to the next approver, and identify the person making the comment. This will allow the reviewers to put any questions/comments that will be relevant to the overall approval process as well as to the next approver in the workflow. | Mandatory | |
| 049 | Project Management | Project Workflow | PM24 | Ability to customize workflow for each project with varying workflow steps. The custom workflow shall be able to be created by a designated user in the SHA division. For example, divisions may follow different work flows, and the work flows may vary on different projects. Also, this will allow for changes that may occur in the approval process or test methodology on existing projects. | Mandatory | |
| 050 | Project Management | Project Workflow | PM25 | Capability to assign SHA team members or SHA team groups to a workflow individually for each project and for specific workflows. This capability provides resource flexibility within a division. For example, if designated team members are not available for participation in a specific project, alternates may be assigned on a project basis. | Mandatory | |
| 051 | Project Management | Project Workflow | PM26 | Capability to specify required approval timeframes in the system, and to notify users regarding the designated "approve by" date. This is a performance aid and provides information for overall performance management of the testing process. For example, management may review the "approve by" dates to assist in their resourcing decisions. | Mandatory | |
| 052 | Project Management | Project Workflow | PM27 | Capability to display elapsed time from start to end of a process. Also, the capability to display the time remaining to approve, or disapprove a given material. For example, for some divisions the approval time may start when a sample is taken in the field, while other start the clock when the sample is received in the lab. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 053 | Project Management | Project Workflow | PM28 | Capability to alert the process approver when an "approve by" date associated with the approval has passed or is within a certain time of completion. The method of alert shall include an email and a notification within the system. This will enable users to re-prioritize work and ensure that all projects stay on schedule. | Mandatory | |
| 054 | Project Management | Project Workflow | PM29 | Capability to automatically create a monthly management report of all missed dates and delayed approvals. This capability shall also allow for a specific delay time to be set for the system to create a missed-date alert. This report should have the ability to be filtered by project and by division. | Mandatory | |
| 055 | Project Management | Project Workflow | PM30 | Capability to allow specifying time of delay after which an automatic notification is displayed, and/or an email sent to management regarding samples with "approve by" dates that have passed. For example, managers may decide to have the alert on the "approve by" date, before the date, or one day after the date is missed. | Mandatory | |
| 056 | Project Management | Project Workflow | PM31 | Capability to modify reminder alert time (alert x days/hours before due) by authorized users and the capability to add, delete or change information on designated users to be notified, including email addresses. For example, the notification list for missed dates may change, so it is necessary for a designated user to have the authority to make the changes, as they occur. | Mandatory | |
| 057 | Project Management | Project Workflow | PM32 | Allow for electronic signatures to approve all project letters. This electronic signature should be based on the user's login information if applicable. For example, managers will be able to provide necessary approval signatures on-line and to designate certain users to have the same approval authority. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 058 | Project Management | Project Workflow | PM33 | Capability to print an approval letter with electronic signatures to send to external authorities that may require a paper copy. For example FHWA may require that SHA submit a paper copy of the final clearance letter, and may accept electronic signatures or require actual signatures in interim till the system is fully formalized and implemented. | Mandatory | |
| 059 | Project Management | **Material Specifications** | PM34 | Capability to store material specifications and standards in the system as a database/table, including factors such as:<br>• Test methods for various materials<br>• Pass/fail values for various tests<br>• Allowable % variations<br>These material specifications apply to all materials to be tested, and list the test methods that apply to each material, and the pass/fail values for each material's test. Any special provisions that might apply and allowable % variations are also mentioned in the test specifications. | Mandatory | May not apply to Project I |
| 060 | Project Management | Material Specifications | PM35 | Capability to store multiple versions of material specifications, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. For example, a project starting in year 2006 may use version x2 of the asphalt material specification for asphalt box samples, and have different allowable ranges and tests required, than a project starting in year 2006 that may use specification version x3 that have different allowable ranges of test values and different required tests. | Mandatory | May not apply to Project I |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 061 | Project Management | Material Specifications | PM36 | The system should have the ability to link to electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT). These specifications might be stored on an internal network drive, or could be a location on the internet. Generally, these specifications are not available on the internet for free, and require either a subscription or a download. These specifications guide the pass/fail result calculations for all the tests performed by OMT. | Desirable | May not apply to Project I |
| 062 | Project Management | Material Specifications | PM37 | The system should have the ability to store electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT) within MMS and to make them accessible to users, along with last update and validity dates. These specifications guide the pass/fail result calculations for all the tests performed by OMT.<br>Electronic storage of these potentially copyrighted standards will be consistent with licensing fees and agreements. | Desirable | May not apply to Project I |
| **Source of Supply** | | | | | | |
| 063 | Source of Supply | **Source database** | SoS01 | Capability to maintain a list of approved sources of supply in a database format, along with tracking active and inactive sources (sources not on the list anymore). This should include date the sources were approved, date the source will expire, date the source was made inactive, projects for which the sources are/were approved. This list should be accessible online to external users. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 064 | Source of Supply | Source database | SoS02 | Capability to maintain database of material plants, sources and suppliers and to make them retrievable to be viewed, printed or emailed via system pull-down menus. Based upon user permissions, field, Lab, Materials Management Division and other users will have direct access to review documentation on-line relevant to their needs. | Mandatory | |
| 065 | Source of Supply | Source database | SoS03 | Ability to store list of materials that are on an approved list (e.g. QPL, aggregate bulletin, etc.) and the materials that don't need to be on an approved list. | Mandatory | |
| 066 | Source of Supply | **Source list** | SoS04 | Capability to maintain approved sources list electronically (e.g. QPL, aggregate bulletin) that can be updated online and are accessible to the general public, or can be password protected. Specific Divisions will be granted access for updating specific approved source lists. For example, when a source is submitted by a contractor, the authorized MMS user will be able to check to see if it is preapproved or requires testing for approval. | Mandatory | |
| 067 | Source of Supply | Source list | SoS05 | Ability to look up and provide a report on the availability of quarries that provide designated aggregates and/or soils. Pull-down selection menus shall be utilized to view and/or print quarry information. For example this will aid the Soils & Aggregates Technology Division in their decision making regarding their quarry resources. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 068 | Source of Supply | **Source request** | SoS06 | Capability to record and require source of supply's contact person, phone number and email address and mandate that this information be provided by the contractor for the source to be submitted to SHA. An accurate and easy access to the contact person for the source of supply letter/list is necessary to enable early contact to resolve any obvious issues and to jump-start the approval process. | Mandatory | |
| 069 | Source of Supply | Source request | SoS07 | Capability for contractors to submit requested materials sources (sources of supply) online through a web interface. The interface should allow the contractor to pick a bid item and specific materials to request sources of supply for each material. | Mandatory | |
| 070 | Source of Supply | Source request | SoS08 | Capability to allow external users (contractors) to pick sources of supply to request from a pull-down menu that includes all sources on the current approved list for each material used on the project. The pull-down menu should also include the option to add a new source with an accompanying text box that contractors can fill in if they would like to propose a source of supply that is not on the list of approved sources | Mandatory | |
| 071 | Source of Supply | Source request | SoS09 | Ability for user to request approval for sources of supply that are not on an approved list and send this request directly to the appropriate division. | Mandatory | |
| 072 | Source of Supply | Source request | SoS10 | Capability to allow contractors to submit multiple sources of supply for each bid item/material. Contractors often have multiple sources of supply for each bid item on large projects. MMS must be capable to accommodate more than one source of supply per project and contractor. This capability should be allowed to be turned on or off for each material. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 073 | Source of Supply | **Source review** | SoS11 | Provide capability to link to manufacturer's product installation information on the web from approved products function. This capability entails the ability to link to the internet from within the MMS screens for various purposes. For example, a user may be viewing a project within MMS and notice a questionable entry regarding material installation. Given a link to the manufacture's product installation information will save time and possibly avert project delay. | Mandatory | |
| 074 | Source of Supply | Source review | SoS12 | Capability to automatically trigger workflow based on predefined rules for source of supply approval once a request is received from the contractor. This will require compliance with all workflow requirements listed in Project Management requirements | Mandatory | |
| 075 | Source of Supply | Source review | SoS13 | Capability to review and distribute Source of Supply letter/list electronically after the review is complete. For example, much of the processing of source of supply lists and letters are processed via hard copy, this capability will enable electronic versions to be distributed electronically within MMS. | Mandatory | |
| 076 | Source of Supply | Source review | SoS14 | Capability to approve sources of supply for specific material for specific project, along with notes and assign validity dates for the source of supply. For example, if a GAB source goes out of business and is not being used anymore, the source information should still be available for the project, clearly marking the date range for which the source of supply was valid. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 077 | Source of Supply | Source review | SoS15 | Ability to distribute project documentation to appropriate divisions, as required. Each Division recipient of project information shall be selectable via a pull-down menu or other reliable means. By selecting the appropriate recipient, a transport medium shall be presented for transmittal of the information (email, fax or within MMS). For example, the distribution list presented must also contain the means by which the document will be sent for various recipients. The MMS user shall be able to select recipients from the menu provided. | Mandatory | |
| 078 | Source of Supply | Source review | SoS16 | Capability to automatically assign review "notes" to submitted sources of supply based on source material category using a predefined table/database of the source material and "notes" relationship. | Mandatory | |
| 079 | Source of Supply | Source review | SoS17 | Capability to manually edit the review "notes" automatically assigned to the sources. | Mandatory | |
| 080 | Source of Supply | Source review | SoS18 | Capability to maintain list of review "notes" that are tied to source rejection electronically in a database and provide as a drop down menu on review page. | Mandatory | |
| 081 | Source of Supply | Source review | SoS19 | Capability to assign multiple review "notes" to source of supply items as the same source may require multiple notes. For example, the materials engineer might review an item and add "notes", and forward to a division for further input, and the division might add more comments to the source of supply. | Mandatory | |
| 082 | Source of Supply | Source review | SoS20 | Capability to add comments at the material level for internal use. This field will allow the approver to enter any questions/comments they have before sending to the appropriate division. | Mandatory | |
| 083 | Source of Supply | Source review | SoS21 | Capability to add comments at the material level intended for display to external users. A clear alert should also be provided next to this field informing the reviewer that this comment will be visible to the contractor. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 084 | Source of Supply | Source review | SoS22 | Capability to interface with Maryland Product Evaluation List (MPEL) to import approved new products that are new additions to QPL (Qualified Products List). | Desirable | |
| 085 | Source of Supply | Source review | SoS23 | Capability to flag source approval inspection requests as those for active projects or no projects to determine where the funds for testing will come from (project, or directly from source). If the payment is expected to be received directly from the source, the MMS should allow the capability to mark status as "awaiting payment" or "payment received" and flag all work as such with an alert when awaiting payment. | Mandatory | |
| 086 | Source of Supply | Source review | SoS24 | Capability to retrieve and print reports relating to production facilities. The report should also provide the option to include or exclude all inactive sources (sources not currently approved for use) and the ability to mark them clearly as such. Examples of these lists of approved sources are the Qualified Product List (QPL) and aggregate bulletin. | Mandatory | |
| 087 | Source of Supply | Source review | SoS25 | Capability to retrieve and print a report of all the projects a particular source is providing material to. | Mandatory | |
| 088 | Source of Supply | Source review | SoS26 | Capability to print a formatted report and convert to an easily transferable format (e.g. pdf). This capability shall allow for notations/comments to be added to the formatted report. For example, some stakeholders may only be capable of receiving hard copy reports, by converting the MMS reports to pdf or other format, those stakeholders can be accommodated. | Mandatory | This cannot be achieved right now, but will need to be added before the completion of all 9 projects |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 089 | Source of Supply | Source review | SoS27 | Capability to mark sources as approved based on reciprocity with other states. A database of preapproved sources, based upon reciprocity, shall be maintained for reference and the user shall have the ability to electronically mark a source as approved, based on that database. An MMS user will have direct knowledge of other state reciprocal approvals, if applicable. | Mandatory | |
| 090 | Source of Supply | Source review | SoS28 | Capability to add sources to approved list and mark sources as "tentatively approved". Sources that have a national certification, and have not been inspected by OMT, or sources that have been inspected but are waiting for necessary certifications are tentatively approved for project work. | Mandatory | |
| 091 | Source of Supply | Source review | SoS29 | Capability to send source approval or disapproval information back to contractor/provider electronically in the form of an email. This email should be triggered by the appropriate OMT team member. For example, when it is determined that a product/source has been approved or disapproved for use on a project, it is necessary to notify the contractor as well as the SHA stakeholders. | Mandatory | |
| 092 | Source of Supply | Source review | SoS30 | Capability to approve sources of supply for specific projects only. These sources should be clearly marked as approved for specific projects only, and not added to the approved sources list. | Mandatory | |
| 093 | Source of Supply | Source review | SoS31 | Ability to automatically add sources to approved lists once the sources are approved. The ability to override the automatic addition should also be provided for unforeseen situations. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 094 | Source of Supply | Source review | SoS32 | Ability to notify materials engineer when x number of sources submitted by the contractor are approved, or when x days have passed since the submittal request. The number of sources and the number of days should be user modifiable. This will allow SHA to send the contractors information routinely, and help the materials engineer with the approval process. | Mandatory | |
| 095 | Source of Supply | Source review | SoS33 | Ability to record acceptance of material source based on certified test results as received by OMT. This includes the ability to approve material source for multiple projects based on one certified result, as well as the ability to approve material source for individual projects. For example, the geotextile manufacturers are approved based on certified NTPEP test results and manufacturer submitted results. | Mandatory | |
| 096 | Source of Supply | Source review | SoS34 | Ability to provide a list of all bid items and materials to be used on the project, along with their source approval status (approved, unapproved, submitted, not submitted, not required) | Mandatory | |
| 097 | Source of Supply | Source review | SoS35 | Ability to notify the new source submitter of approval status once the source has been reviewed. The approval status might indicate approved for project, approved and added to approved list, or disapproved with comments regarding the disapproval. | Mandatory | |
| 098 | Source of Supply | Source review | SoS36 | Ability to store a list of reasons for source disapproval/rejection in the form of a table, and present the information in the form of a drop down menu for selection on the approval page. This menu should also include "Other" and provide a comment box that is available and tied to the reason for disapproval/rejection. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 099 | Source of Supply | Source review | SoS37 | Ability to generate an alert when an existing approved source is no longer valid and send to source representative, SHA representatives & contractor representatives of all projects on which the source is noted as an approved source. | Mandatory | |
| 100 | Source of Supply | Source review | SoS38 | Ability to generate a report displaying all the sources rejected (overall, and by project) along with the reason for rejection, and the comment entered. | Mandatory | |
| 101 | Source of Supply | Source review | SoS39 | Capability to manually release items for distribution once the items are approved or disapproved. | Mandatory | |
| 102 | Source of Supply | Source review | SoS40 | Capability to manually distribute approved and released items to appropriate parties in the form of a consolidated email. For example, if 5 sources are approved/disapproved for a project, a consolidated email will be sent with all 5 sources approval status. | Mandatory | |
| 103 | Source of Supply | Source review | SoS41 | Capability to automatically distribute approved and released items to appropriate parties in the form of a consolidated email based on business-specifiable rules regarding time for release. For example, the time specified could be one day, or five days as specified by the document. | Mandatory | |
| **System Management** | | | | | | |
| 104 | **System Management** | **System Maintenance** | SyMg01 | Capability to provide the users with the back-end to make changes to basic tasks. For example, this capability should provide the administrators the capability to create new distribution lists, maintain cost tables, etc. In other words, this capability should allow the users to make changes to data tables on the back-end using a simple to use interface. | Desirable | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 105 | System Management | System Maintenance | SyMg02 | Capability to maintain an organizational structure (table) of Office of Materials Technology with the added capability to assign tasks to individuals or organizations. For example, organizations change and the individual stakeholders within the organizations often change. Maintaining an updated organization chart on line ensures that forwarded documentation is going to the correct contact. | Mandatory | |
| 106 | System Management | System Maintenance | SyMg03 | Ability to provide user definable tables, fields, indexes and forms. This function may be enabled through the application of a Wizard functionality. For example, an administrator may want to design a form for reporting daily or weekly activity in report format. | Mandatory | |
| 107 | System Management | System Maintenance | SyMg04 | Capability to provide online "Help Screens" that can be populated from an administration back-end by authorized users. The help screens shall "pop-up" to aid input, or be selectable by user to obtain specific help information on a functionality. For example, a user may require assistance to add notation to a source of supply letter or where to find test results. | Mandatory | |
| 108 | System Management | System Maintenance | SyMg05 | Capability to maintain a list of SHA users with various levels of access rights. A system administrator will have access to maintain the user capability designations. For example, it is necessary to ascertain who has what access capability from the division heads. Each division will have specific access requirements and all will have some general access requirements. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 109 | System Management | System Maintenance | SyMg06 | Capability to provide role-based security so that system users have limited/restricted access to the system. The access level of the user will depend on their division and the projects they are working on. The control of outside users shall be limited to the responsible division and specific fields. Several outside groups (contractors, suppliers, outsourced labs) will require limited, defined access to MMS besides the SHA users. | Mandatory | |
| 110 | System Management | System Maintenance | SyMg07 | Capability to maintain a security log (audit trail) of user access to the system with date & time of access and user name of person accessing the system. For example, a user may inadvertently or purposely destroy information while using the system, It is necessary to have an audit trail to determine who did what. | Mandatory | |
| 111 | System Management | System Maintenance | SyMg08 | Capability to require approval, per access, on input from external groups with limited/restricted access. Also, the capability to deny access to an outside user and log access attempt and flag repeated attempts. For example, Users in the restricted outside user group will change and may attempt unauthorized access. | Mandatory | |

# 4 OPERATIONAL REQUIREMENTS

Exhibit 12 below presents the operational requirements for the MMS. These requirements describe the non-business characteristics of the MMS, and apply to all eight projects.

The operational requirements are divided into the following functions:

- Security: These requirements describe the need to control access, and include controlling who may view and alter application data.
- Audit trail: These requirements indicate the activities that will be recorded in the application's audit trail.
- Data currency: These requirements mention how recent the data in MMS will be, and how recent the information will be when the MMS is queried for information.
- Reliability: These requirements list the acceptable level of reliability
- Recoverability: These requirements deal with the ability to restore function and data in the event of a failure.
- System availability: These requirements relate to the time during which the system is available, and lists when the usage is expected to be at its peak.
- Fault tolerance: These requirements detail the ability of the system to remain partially operational during a failure.
- Performance: These requirements mention the required response time for queries and updates, throughput, etc.
- Capacity: These requirements list the required capabilities and expected volumes of data in business terms.
- Data retention: These requirements list the requirements relating to retaining data that is entered in the system and being stored within the system.

## Exhibit 12: Operational Requirements

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 001 | Audit Trail | Monitor | Aud01 | Capability to provide a report of the date & time, any changes, adds or deletes made and the logon ID of the user accessing monitored data files. For example, in the event of data corruption, erasure, or other contamination, a report shall be available to detail user recent activity. | Mandatory | |
| 002 | Audit Trail | Monitor | Aud02 | Capability to segment users by division and configure audit capabilities only to users with access to the defined databases. For example, if a user only has rights to access the forms and reports data segment, that user will be audited based on the access to those segments only. | Mandatory | |
| 003 | Audit Trail | Monitor | Aud03 | Capability to monitor access to Source of Supply Letters/Lists, test results, contractor information, project notes, SHA forms and other designated databases. For example, each time a user access a monitored data file, a record will be posited of the activity. | Mandatory | |
| 004 | Capacity | Database | Cap01 | Capability to handle high volumes of data that may occur on a "peak" basis. For example, end of month final clearances, monthly reporting and ad-hoc queries for completion status will generate a high volume of data while routine project work during the month may range from low to high. | Mandatory | |
| 005 | Capacity | Database | Cap02 | Capability to process transactions from an estimated 400-500 total users on a daily basis. In addition to the SHA users, transactions will be created by contractors, suppliers and outsourced labs. For example, transactions will include, at a minimum, Source of Supply Letters/Lists from contractors, the transfer of sample information between lab and field forces, the submission and retrieval of project test results, access of information for reports, ad-hoc user queries. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 006 | Data Currency | Backup | DC01 | Capability to provide data in near real-time in response to requests for data access. For example, resource allocation and deployment decisions for field and lab work are based on project dates. The dates reflected in MMS must be as recent as possible. | Mandatory | |
| 007 | Data Currency | Backup | DC02 | Capability to maintain a current back-up of the system database to be utilized for restoration in the event of catastrophic failure and loss of data. For example, a fire or other event could destroy the server causing total loss of data and system configurations. | Mandatory | |
| 008 | Data Currency | Backup | DC03 | Capability to maintain a current backup of all system configurations to be utilized in case of catastrophic loss to the server. | Mandatory | |
| 009 | Data Retention | Cleanup | DaR01 | Ability for the administrator to delete old records as required. It is anticipated that the records will be archived most of the time and not deleted, but a deletion may be required in case of duplicate entries or other unforeseen circumstances. | Mandatory | |
| 010 | Data Retention | Storage | DaR02 | Capability to store project related data for an indefinite period of time. For example, project related data may be retained for the life of the asset associated with the project. For example, there will be varying degrees of retention requirements throughout the system database, from "none" to indefinite. | Mandatory | |
| 011 | Data Retention | Storage | DaR03 | Ability to save data in a common or easily accessible format. This may include .pdf, WORD or other common format. For example, there will be specific users (TBD) who may have limited or no access to MMS. This ability will enhance the function of emailing and/or printing. | Mandatory | |
| 012 | Fault Tolerance | Configuration Management | FT01 | Capability to provide additional back-up and protection for specified system applications during planned or unplanned outages. For example, applications supporting the source of supply test and approval process are critical while email (from within MMS) and field access to the system may be less critical. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 013 | Fault Tolerance | Configuration Management | FT02 | Capability to react to a single board or data drive failure through a fault tolerant architecture. For example, if a circuit board or other piece of hardware fails, the system shall be capable of continuing functionality through redundant hardware/software configuration architecture. | Mandatory | |
| 014 | Performance | Measurements | Perf01 | Capability to provide system performance analysis and reports. For example, a log of system bugs and or actual interruptions shall be kept and statistically analyzed to address current issues and to predict possible future issues. | Mandatory | |
| 015 | Performance | Measurements | Perf02 | Capability to provide performance measurement details based upon the number of tests and test completion data (e.g. time required to complete a specific test or all tests on a particular sample). For example, The "Approve By" date and other performance measurement opportunities may be accessed via MMS. | Mandatory | |
| 016 | Performance | Measurements | Perf03 | Capability to provide Statistical analysis and/or ability to extract to a statistical analysis package to review mix designs and other designated analytical functions. For example, an analysis of missed project completion dates and their causes may be analyzed and reports provided. | Mandatory | |
| 017 | Performance | Process Support | Perf04 | Capability to provide response to user queries in three seconds or less. For example when an icon or menu item is selected, the user should notice no delay in viewing the requested screen or data list. | Mandatory | |
| 018 | Performance | User Support | Perf05 | Capability to provide user multi-tasking with system screens. For example, a user may have multiple MMS screens open and active while also using other application screens. | Mandatory | |
| 019 | Performance | User Support | Perf06 | Capability to provide system user documentation that is comprehensive, clear and easy to use. For example, system user documentation shall provide quick answers to questions regarding the navigation of the system screens. | Mandatory | |
| 020 | Recoverability | Configuration Management | Rcvr01 | Capability to provide data redundancy to protect against loss of data due to system failure For example, in the event of a total failure of MMS, the database shall be recoverable and be restored to the image that existed at the time of failure. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 021 | Recoverability | Configuration Management | Rcvr02 | Capability to recover from, or not be impacted by a commercial power failure. A given power failure may be just from a moment to many hours. It is expected that all functionality and data access would remain intact. For example an alternate source of power shall be available and the MMS wired to that source of power. | Mandatory | |
| 022 | Recoverability | Configuration Management | Rcvr03 | Capability to restore full functionality and data integrity within thirty minutes of detecting the failure. For example, critical hardware spares and recent system & data backups shall be available on site. | Mandatory | |
| 023 | Reliability | System Measurements | Rel01 | Capability to meet a Monthly Mean Time to Repair (MTTR) performance of five minutes. MTTR is figured by dividing total system down time by the number of outage occurrences for the month. | Mandatory | |
| 024 | Reliability | System Measurements | Rel02 | Ability to provide same-day replacement for failed hardware parts causing system outage (down-time) and twenty-four hour turn-around time for repair and/or replacement of defective parts. For example, a failure may occur that requires a hardware item that is not at the site. | Mandatory | |
| 025 | Reliability | System Measurements | Rel03 | Capability to perform system backups that are transparent to the users. For example, information for reports and project scheduling must be as current as possible which necessitates frequent backups. | Mandatory | |
| 026 | Retrieve Data | User Support | RD01 | Ad-hoc query capability to retrieve test results by non-project characteristics (mix design, location, contractor, materials supplier, etc.). This capability requires that a user can obtain project data based upon various data point starting points. For example, retrieve a materials supplier, and view all of the projects that that supplier is currently involved in (or has been involved in). | Mandatory | |
| 027 | Security | Data | Sec01 | Capability to protect Application Data from contamination and/or erasure by users. For example, the loss or contamination of vital project information, such as Source of Supply Letter, test results or project notes could jeopardize project schedules. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 028 | Security | Data | Sec02 | Capability to protect sensitive SHA and contractor data from casual access. For example a supplier's specific materials mix submitted for testing or SHA project costing information. | Mandatory | |
| 029 | Security | Environment | Sec03 | Access to the IT facility housing the MMS servers shall be controlled and monitored. For example, key card entry shall be utilized to track users' access to the server area. | Mandatory | |
| 030 | Security | User Configuration | Sec04 | Capability to provide a user logon interface that is designed to allow access to specific data by designated users within SHA Divisions. For example, users in the Asphalt Technology Division may not need access to projects associated with Soils and Aggregates Division. Also, some users need an access for a specific purpose such as preparing reports, while another user may need full administrative access. | Mandatory | |
| 031 | Security | User Configuration | Sec05 | Capability to limit access to designated non-SHA users, such as contractors and consultants. However, this access must be restricted and recorded within the system. For example, contractors may require access to submit sources for approval and to check on project status. | Mandatory | |
| 032 | Security | User Configuration | Sec06 | Capability to provide reports detailing outside user access. For example, a monthly report of outside user access may be provided to check against contractor project activity. | Mandatory | |
| 033 | Security | User Configuration | Sec07 | Capability to restrict access to a limited number of individuals with permission to alter data tables, applications and other database configurations. For example, in order to protect the integrity of the MMS data, only designated members of the Office of Materials Technology (OMT) shall have these permissions. | Mandatory | |
| 034 | Security | User Configuration | Sec08 | Capability to limit some users to "View Only" MMS access on specified projects or materials. For example some users may only need to check on completion dates or other key project information with no need to input or retrieve data. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 035 | Security | User Configuration | Sec09 | Capability to monitor and restrict SHA field access by project. The field will however have input access related to plant inspections and certifications. For example, field staff may only access data relevant to a current project at their site location but be given permission to access the plant certification data base to update inspection information. | Mandatory | |
| 036 | Security | User Configuration | Sec10 | Capability to monitor and control access to MMS interfacing systems, by restricting other system access by an additional layer of password security or other means. | Mandatory | |
| 037 | Security | User Configuration | Sec11 | Capability to provide a robust authentication procedure to be employed for all logins. For example, VPN remote access may be allowed with authentication. | Mandatory | |
| 038 | Security | User Configuration | Sec12 | Capability to require passwords to be changed on a regular basis. For example, the system should prompt the user every three months to request a change in password. | Mandatory | |
| 039 | Security | User Configuration | Sec13 | Allow users to request password reset requests from the web interface. Users should be assigned temporary passwords and required to change at first login. For example, users often forget their logon information and require a method to have it reset. | Mandatory | |
| 040 | Security | User Configuration | Sec14 | Allow users to choose from multiple roles if the user is assigned more than one role (e.g. Project Manager, administrator). For example, a division head may require a logon that has access to the entire division. | Desirable | |
| 041 | Security | User Configuration | Sec15 | Capability to restrict the display to only the options and icon selections to which the user has rights. For example a user's logon would define the functionality required and present only that capability. This has the added benefit of simplifying the screen for the user. | Mandatory | |
| 042 | Security | User Configuration | Sec16 | Facilitate Single Sign-on to use enterprise login information for OMT staff and allow use of VPN or request login credentials for web-based modules. For example, the Office of Materials Technology has responsibility for MMS and the processes it supports. VPN may be used with authentication. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 043 | System Availability | Failure Management | SyAv01 | Capability to provide 24/7 system uptime. For example, data transfers with interfacing systems and other automated system routines must be accommodated. Peak system usage is expected to be from 6:30 a.m. to 5:30 p.m. This time period is the least optimal time to schedule planned maintenance outages. | Mandatory | |
| 044 | System Availability | Failure Management | SyAv02 | Capability to provide simultaneous access to all MMS screens by all concurrent users. There shall be no degradation of service or extended screen wait time. For example, all users may have a need for information on a specific project, at the same time. It is estimated that initially the system will have 400-500 total users. | Mandatory | |
| 045 | System Availability | Failure Management | SyAv03 | Capability to provide system availability at 99.999%. This equates to a total of five minutes of unplanned outage for a year. | Mandatory | |
| 046 | System Availability | Failure Management | SyAv04 | Ability to conduct scheduled maintenance during hours designated as the "Maintenance Window". For example, the Maintenance Window may be designated from midnight to two a.m. It is possible that the Maintenance Window could be expanded dependent upon the estimated time to perform the scheduled maintenance. This "window" applies to work performed by SHA as well as work performed by the vendor. | Mandatory | |

# 5 REQUIREMENTS TRACEABILITY MATRIX

The Requirements Traceability Matrix (RTM) provides a method for tracking the functional requirements and their implementation through the development process. Each requirement is included in the matrix along with its associated section number. As the project progresses, the RTM will be updated to reflect each requirement's status. When the product is ready for system testing, the matrix will list each requirement, what product component addresses it, and what test verifies that it is correctly implemented.

The RTM is presented in Appendix B of this document, and will be further populated with the tests that will verify the requirements before the end of the requirements analysis phase.

# 6 GLOSSARY

The following is a list of business terms relevant to the Materials Management System and implementation process.

**Exhibit 13: Glossary of Terms**

| Reference or Acronym | Definition |
|---|---|
| **AASHTO** | American Association of State Highway Transit Officials |
| **ADW** | Asset Data Warehouse will provide an inventory of all SHA linear highway assets and track their condition. |
| **CAS** | Construction Administration System |
| **CATS** | Consulting and Technical Services |
| **COTS** | Commercial-Off-the-Shelf Software Package |
| **FHWA** | Federal Highway Administration |
| **FMIS** | Financial Management Information System |
| **FRD** | Functional Requirements Document |
| **GAB** | Graded Aggregate Base |
| **Geosystem** | Calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. |
| **Humboldt Triaxial Data Acquisition** | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. |
| **HMA** | Hot Mix Asphalt |
| **Intangible benefits** | Any benefits that cannot be assigned a specific dollar value are expressed as intangible benefits. These benefits are expressed in terms of improved mission performance, improved decisions making, or more reliable or usable information. Many public goods and services are difficult to quantify reliably and precisely in dollar units. However, intangible benefits are vital to understanding the total outcome of implementing a particular IT system. |
| **LAS** | Letting and Awards System |
| **LIMS** | Laboratory Information Management System |
| **Maryland Product Evaluation List (MPEL)** | A web based system used to determine eligibility for the Qualified Products List. |
| **Marylandware System** | Records and calculates Density and Mix test results from QA and QC sources. Allows electronic exchange of data through emailing of text based data files. |
| **Material specification and quality assessment** | This phase consists of acceptance of materials on the project. |
| **Materials clearance process** | A systematic method to assess and approve the quality of different constituent materials that are used as part of the construction process. |
| **MCMS** | Maryland Construction Management System |

| Reference or Acronym | Definition |
|---|---|
| **MMS** | Materials Management System is an integrated electronic system used as a tool to manage the materials testing, acceptance, and clearance process within SHA. |
| **OBD** | SHA Office of Bridge Development |
| **OIT** | SHA Office of Information Technology |
| **OMT** | SHA Office of Materials Technology |
| **OOF** | SHA Office of Finance |
| **Oracle** | An industry-strength database system. |
| **PES** | Proposal and Estimates System |
| **PCC** | Portland Cement Concrete |
| **PMS** | Pavement Management System - Maintains an inventory of pavement on Maryland roads. |
| **Pontis BMS** | Pontis® is a Bridge Management System that assists transportation agencies to make decisions about maintenance, rehabilitation, and replacement of structures. Pontis stores complete bridge inventory and inspection data, including detailed element conditions. |
| **Project management** | Refers to project management activities performed on a project. This includes activities like maintaining high level project information, store project documentation, and track project tasks. |
| **QPL** | Qualified Products List |
| **RFP** | Request for Proposal |
| **RIDETOOL** | Used to capture and access ride quality of new pavements and is used to calculate incentive payments based on ride quality. |
| **SBD** | System Boundary Document used to document the scope of an SHA development project. |
| **SDLC** | System Development Life Cycle is the process utilized by SHA to design and implement new systems. |
| **SiteManager®** | Provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization and includes a module for materials management. |
| **Source of Supply** | This phase refers to the review of the sources of material supply that the contractors propose to use on the project. |
| **System management** | Refers to the overall technical management of the MMS |
| **Tangible benefits** | Any benefits that can be quantified are expressed as tangible benefits. These benefits are expressed in dollars or in units in this document. The result of tangible benefits may be: increased revenue, streamlined production, or saved time and money. |
| **Trns*Port** | TRNS*PORT is a trade name for a series of construction management products. Maryland SHA is currently utilizing four of the available products: PES – Proposal and Estimates System; LAS – Letting and Awards System; CAS – Construction Administration System, and DSS – Decision Support System. |

# 7 APPENDIX A

Exhibit A-1 below lists points of contact associated with Project 1.

**Exhibit A-1: Points of Contact for MMS Implementation specific to Project 1**

| First Name | Last Name | Division | Contact Information |
|---|---|---|---|
| Bennie | Thomas | Structural Materials, Area Materials Engineer | bthomas@sha.state.md.us |
| Bob | Kochen | Soils/Aggregates Division | bkochen@sha.state.md.us |
| Bonnie | Johnson | Asphalt | bjohnson@sha.state.md.us |
| Bruce | Abernathy | Materials Division (Metals) | babernathy@sha.state.md.us |
| Bruce | Nelson | Coatings | bnelson@sha.state.md.us |
| Christopher | Gale | Concrete Technology Division | cgale@sha.state.md.us |
| David | Oswald | Metals/Structural Materials | doswald@sha.state.md.us |
| Doc | Tisdale | Pavement Markings | dtisdale@sha.state.md.us |
| Donald | Provine | Asphalt Technology Division | dprovine@sha.state.md.us |
| Dusty | Brady | Concrete/Chemical | dbrady@sha.state.md.us |
| Edwin | McNeal | Asphalt Technology Division | emcneal@sha.state.md.us |
| Elangovan | Subramaniam | OIT | esubramaniam@sha.state.md.us |
| Finnerty | Paul | Concrete Technology Division | pfinnerty@sha.state.md.us |
| Frederick | Bennett | Asphalt | fbennett@sha.state.md.us |
| Gary | Spencer | OOTS-IT | gspencer@sha.state.md.us |
| Geoff | Hall | Pavement and Geotech Division (Chief) | ghall@sha.state.md.us |
| Gil | Rushton | Structural Materials and Coatings Division | grushton@sha.state.md.us |
| Gregory | Moore | Asphalt Technology Division (Chief) | gmoore@sha.state.md.us |
| Jack | Zies | Materials Clearance | jzies@sha.state.md.us |
| James | Faulkner | Asphalt | jfaulkner@sha.state.md.us |
| Jeffrey | Withee | Soils and Aggregate Technology Division | jwithee@sha.state.md.us |
| Jim | Wineke | Concrete Technology Division | jwineke@sha.state.md.us |
| John | Weisner | Structural Materials and Coatings Division (Chief) | jweisner@sha.state.md.us |
| Keilyn | Perez | Asphalt | kperez@sha.state.md.us |
| Kiran | Kanipakam | OOTS-IT | kkanipakam@sha.state.md.us |
| Lou | Wagner | Aggregates | lwagner@sha.state.md.us |
| Loui | Stratakos | OOTS-IT | lstratakos@sha.state.md.us |
| Mark | Chapman | Pavement Management | mchapman@sha.state.md.us |
| Mark | Weil | OOTS-IT | mweil@sha.state.md.us |
| Mesgana | Ayele | MMD | mayele@sha.state.md.us |
| Michael | Ryan | Pre-Cast | mryan@sha.state.md.us |
| Paulo | DeSousa | Geo Tech and Design | pdesousa@sha.md.us |
| Rama | Alamanda | OOTS-IT | ralamanda@sha.state.md.us |
| Rebeccah | Smith | Asphalt Technology Division | rsmith@sha.state.md.us |

| First Name | Last Name | Division | Contact Information |
|---|---|---|---|
| Robert | Voelkel | Asphalt Technology Division | rvoelkel@sha.state.md.us |
| Rodney | Wynn | Product Evaluation List | rwynn@sha.state.md.us |
| Ronald | Ergott | Materials Management Division | rergott@sha.state.md.us |
| Ronald | Haste | Soils and Aggregate Technology Division | rhaste@sha.state.md.us |
| Ronald | Toloczko | Asphalt Technology Division | rtoloczko@sha.state.md.us |
| Sanjay | Sharma | OOTS-IT | ssharma@sha.state.md.us |
| Stu | Jones | Materials Clearance, QPL | sjones@sha.state.md.us |
| Stuart | Sommers | Soils and Aggregate Technology Division | ssommers@sha.state.md.us |
| Tim | Avara | OOTS-IT | tavara@sha.state.md.us |
| Timothy | Ramsey | Concrete/Redi-Mix | tramsey@sha.state.md.us |
| Vicki | Stewart | Chemical/Concrete Lab | vstewart@sha.state.md.us |
| Vincent | Mise | OOTS-IT | vmise@sha.state.md.us |
| William | Wells | Asphalt Technology Division | wwells@sha.state.md.us |
| Weixian | Xiong | Pavement Management | xweixian@sha.state.md.us |

# 8 APPENDIX B

Appendix B below presents the Requirements Traceability Matrix (RTM) for all requirements (functional and operational) mentioned in this document.

**Functional Requirements RTM**

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| **MMS-Wide*** (All these requirements may not apply to Project 1) | | | | | | | | |
| MMS01 | **MMS-Wide** | **Document Management** | Capability to record status of test results on materials associated with a project. The user shall be able to access a specific project, obtain a listing of materials being used and view the status and results of testing. Test results are logged manually today and no accessible electronic format is in place. | | | | | |
| MMS02 | MMS-Wide | Document Management | Capability to export data to Microsoft Office product suite (Word, Excel, Access, etc.) for off-line data processing and availability. | | | | | |
| MMS03 | MMS-Wide | Document Management | Ability to enter field inspection data (Form 14) in MMS through a web based interface. For example, as addressed in other requirements, the field force needs access to MMS and the MMS database must store all forms associated with the approval process. | | | | | |
| MMS04 | MMS-Wide | Document Management | Capability to store standardized letter templates to display to internal and external users as needed and the ability to download templates. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS05 | MMS-Wide | Document Management | Capability to attach supporting documentation (scanned images, reports letters, forms, notations or other documentation as PDF documents) to specific material test results. The attached documentation shall be viewed as part of the test results document and have the capability to be viewed, emailed or printed from MMS. For example, test results are recorded today and placed in a manual project folder. They are viewable in hard copy only. | | | | | |
| MMS06 | MMS-Wide | **Integration** | Capability to provide email integration functionality to allow MMS notifications to be sent via e-mail. For example, some documentation will need to be emailed from within MMS, specifically those people with no MMS access in the field. | | | | | |
| MMS07 | MMS-Wide | Integration | Capability to allow MMS to send Text (SMS) notifications to specified team members. This capability will be critical for team members on the field with no or sporadic internet connectivity. | | | | | |
| MMS08 | MMS-Wide | **Interface** | Ability to transfer charge allocation data from YB888 to appropriate contract numbers to FMIS electronically. The allocation data and other FMIS data is not currently available via interface. This includes the ability to flag third party billing, and how that is sent to FMIS. | | | | | |
| MMS09 | MMS-Wide | Interface | Capability to migrate test data from current systems into MMS for current projects. This would be a post-operational activity conducted to provide support for existing projects at MMS system cutover. For example, projects will continue to be worked during the implementation of MMS. As implementation moves forward, projects still pending may be identified for migration to MMS. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS10 | MMS-Wide | Interface | Capability to provide information to Pavement Management System. For example, the information associated with Hot Mix Asphalt is required by Pavement Management. This capability may be addressed via the overall system interface requirement. | | | | | |
| MMS11 | MMS-Wide | Interface | Capability to import and export data to/from other systems. MMS shall, at a minimum, interface with Trns*port Suite (CAS/PES/LAS), MCMS, RIDETOOL, FMIS, Geosystem, Humboldt Triaxial Data Acquisition, MPEL/QPL and PMS. For example, financial data, construction information, pavement information and other data is not centralized in one place today, nor is it accessible via direct interface. | | | | | |
| MMS12 | MMS-Wide | **Location Tracking** | Capability to record test sample location in multiple coordinate systems and/or mileposts as required. This will require numerical fields with validation rules. Capability to utilize GPS locations at a later date shall be considered in meeting this requirement. For example, the sample location is noted manually today utilizing mileposts locations. | | | | | |
| MMS13 | MMS-Wide | **Test Information** | Capability for field personnel to check status of a test in real time through a web browser. The available results should be restricted based on the rights provided to the individual user. For example, field forces are dependent upon the specific divisional labs to provide them with testing and approval status. | | | | | |
| MMS14 | MMS-Wide | Test Information | The provision of an MMS "Wizard" functionality to create or alter test entry screen to create a screen for new test entry. This should allow the user to enter formulas for fields that can be calculated automatically based on entered test results. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS15 | MMS-Wide | Test Information | Ability to print final test document based on the data entered into the system. Also the capability to add notations to the document. For example, a hard copy version may be necessary for publication, a meeting or other reason. Having the option of creating a hard copy enables more flexibility. This document may need to be formatted differently than that used to enter the test data, and may require a "print" button that provides a specific print version of the form. | | | | | |
| MMS16 | MMS-Wide | Test Information | Capability to process MMS reports via email, print, or to save (to file or to disk). This will allow SHA to use the right format based on capabilities available at the field locations. | | | | | |
| MMS17 | MMS-Wide | **Test validation** | Capability to provide data validation for information being entered based on a reasonableness test, including warnings for missing fields and helpful error messages based on rules established in the system. Ability to correct typos. For example, if a user attempts to enter a letter into a field that only accepts numbers, they should be alerted with a pop-up, or other indication that it is not allowed. | | | | | |
| MMS18 | MMS-Wide | Test validation | Capability to record serialized form numbers as unique identifiers for each sample and the ability to associate required forms for specific samples and tests and present them in a selectable menu. For example, various specific forms are used to record information associated with the samples that are collected on the field or at production facilities. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS19 | MMS-Wide | Test validation | Capability to allow authorized users in test labs to access project data regarding number of tests performed to date, materials used, etc. to assess adequate testing frequency as necessary. This is intended to help avoid any issues regarding inadequate testing at the end of the project during materials clearance. | | | | | |
| MMS20 | MMS-Wide | **User Support** | Provide an easy-to-use and easy to learn interface. The front-end user screens should mimic screens already in use on existing MMS pages/modules, to the extent possible. Pull-down menus, help screens, and input validation functionality shall be included in the user interface. For example, the user should be presented with an intuitive and familiar user interface. | | | | | |
| MMS21 | MMS-Wide | User Support | Capability to provide the system interface link in such a way that the user will only have to input data one time. For example, information entered regarding project schedules or other Daily Work Reports would automatically update the construction data base (MCMS). | | | | | |
| MMS22 | MMS-Wide | User Support | Capability to process batch entries from outside users. For example outsourced labs may batch their test results to send back to the SHA lab. | | | | | |
| MMS23 | MMS-Wide | User Support | Capability to provide daily confirmation on interactions via the system interface. For example, if a daily work report is transmitted from construction (MCMS), it would be documented and included in the confirmation report. | | | | | |
| MMS24 | MMS-Wide | User Support | Capability to support all SHA IT standards provided by SHA Department of Information Technology. For example the SHA SDLC and other standards must be adhered to for all projects. MMS may store standards documenting for reference. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS25 | MMS-Wide | **Workflow** | Capability to report/display status of workflow (how many steps approved, who needs to review next, etc.) in a summary/dashboard format. For example, a team lead or other manager may need to review the overall process status. This may also be used for performance monitoring. | | | | | |
| **Project Management** | | | | | | | | |
| PM01 | **Project Management** | **Frequency Guide** | Capability to store frequency guide in the system as a database/tables that can be accessed for multiple uses. The frequency guide provides a list of materials, the frequency at which these materials need to be tested, and the tests that need to be performed on these materials. For example, all labs utilize the Frequency Guide for test reference. | | | | | |
| PM02 | Project Management | Frequency Guide | Capability to store multiple versions of frequency guide, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. | | | | | |
| PM03 | Project Management | Frequency Guide | Ability to manually link a particular version of the frequency guide to a project, even if it does not meet the date range validation. This may be required if a project has just started, a new frequency guide is released and the project members agree to using the new frequency guide. | | | | | |
| PM04 | Project Management | **Project Contacts** | Ability to maintain list of contacts on project, including external contacts. This should include full name, phone number, fax number, email address, physical address, company name, division, assigned role (e.g. project manager, project engineer, contractor) and others. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM05 | Project Management | Project Contacts | Ability to define and maintain multiple distribution lists of project participants. These distribution lists will include names, email addresses, and agency information (company name, division). These distribution lists will be specific for each project. | | | | | |
| PM06 | Project Management | **Project Information** | Capability to import basic project information from Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, $ completion, other). This information will be important to understand project completion and help identify when the 30 day notice for materials clearance should be received and help with final clearance as well as monthly project clearance.<br>This information should be marked as “imported” to separate from manual entries. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM07 | Project Management | Project Information | Capability to enter basic project information for projects not entered in Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, cost and completion date.<br>This requirement is important since not all projects that require material testing are stored in Trns*port (e.g. local, county, some maintenance jobs). This information will likely be in the form of linked tables with multiple fields (e.g. bid item, materials, bid units, bid quantities) and can follow the same structure used in Trns*port for this information.<br>This information will be used to create a sampling plan as a start, but will also be used all the way through the project life cycle, including during the final clearance to compare materials used vs. materials that were planned to be used. | | | | | |
| PM08 | Project Management | Project Information | Capability to automatically update basic project information via an import from Trns*port. This capability will help keep the information in MMS up-to-date as project status or other information is updated in Trns*port. | | | | | |
| PM09 | Project Management | Project Information | Capability to allow authorized users to update project information as changes occur for projects not in Trns*port. This capability will keep the information in MMS up-to-date for projects that are not in Trns*port. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM10 | Project Management | Project Information | Capability to link information for tests conducted before start of construction phase to information starting at the construction phase of the project. The primary difference between the tests performed is the phase of the project - for example, a soil sample may be collected and tested during pre-construction to determine/confirm soil properties, and other samples collected and tests conducted once the project is in construction. The ability to link all the test information will provide SHA with a better decision support and feedback tool than currently available. | | | | | |
| PM11 | Project Management | Project Information | Capability to interface with FMIS to obtain information periodically (e.g. charge numbers). | | | | | |
| PM12 | Project Management | Project Information | Capability to store and retrieve supporting documentation from an enterprise level document management system to be developed by OIT. This capability will also include the ability to submit new documentation, such as specification changes, to the documentation system. For example, a user requiring specific documentation and/or procedures not stored in MMS, will have access to that documentation via the document management system. | | | | | |
| PM13 | Project Management | Project Information | Capability to link bid items to construction materials (one to many relationship) and expand a bid item into various materials that form the bid item. For example, a bid item of concrete on the project might consist of cement, aggregates, and admixtures. Each of these materials have different testing specifications and requirements (explained later). | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM14 | Project Management | Project Information | Capability to automatically generate letters to notify stakeholders and contractors of the status of material approvals; this could be done on a scheduled basis, or on-demand in response to a stakeholder query. For example, this reporting capability should allow a report to be generated for all materials involved on a project and their source approval status (approved, unapproved, submitted, not submitted, not required). | | | | | |
| PM15 | Project Management | Project Information | Capability to recognize and process various business rules based on different construction methods (i.e., Design Build vs. other methods). The MMS database, for example, must contain information tables on all construction methods used by SHA and be designed with the capability to process a project utilizing any of the defined methods. For example, the testing standards and frequency may vary based on the project construction method, but the final clearance requirements may be the same. | | | | | |
| PM16 | Project Management | **Project Sampling Plan/Project Specific Frequency Guide** | Capability to automatically generate minimum number, types, and frequencies of tests required for the materials clearance process (project sampling plan) for each material to be used on the project based on frequency guide and material quantities for the project as obtained from Trns*port. This Project Sampling Plan will act as a guide for the overall testing requirements, and help ensure and track that all the testing requirements for the project are met.<br>For example, the sampling plan will specify that asphalt placed on the project should be tested at every x placements or every x tons, whichever comes first. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM17 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to show/present the project sampling plan/project-specific frequency guide in a web-based format to authorized users. This sampling plan should be formatted such that it is easy for the users to read and understand the report.<br>For example, a user may print a copy of the Sampling Plan for reference throughout the project to track the requirements and ensure compliance. | | | | | |
| PM18 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to automatically make changes to the sampling plan based on quantity changes entered in the system due to change orders, or due to other unforeseen circumstances. This will require an interface with CAS or MCMS in which all quantity changes and change order information is recorded. The change may be manually input into MMS for projects that are not stored in CAS/MCMS (e.g. some maintenance projects).<br>For example, if a change order significantly increases the quantity of concrete to be used on the project, the number of tests required should automatically be increased in the sampling plan. | | | | | |
| PM19 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to allow for manual changes to the sampling plan by authorized users - these changes should allow all parameters of the sampling plan to be changed, including addition and deletion of materials, tests to be performed, and frequency of the tests. This action could be prompted by project specific guidelines or any problems/issues being observed on the project. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM20 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to generate a sampling plan for projects not in Trns*port based on information manually entered in MMS. | | | | | |
| PM21 | Project Management | **Project Workflow** | Ability to define a workflow for establishing electronic review and approval of results. This workflow will provide the user a path to completing the source of supply and materials testing process. For example, the generated workflow shall define the steps, approvals, distribution list and other relevant process data for a given project. | | | | | |
| PM22 | Project Management | Project Workflow | Ability to assign a priority number to a workflow approval request at the individual level (1-low, 10-high) to allow resources to prioritize their work, and ensure that high priority projects (major projects, emergency projects) are completed first. A priority of 5 should be selected by default if a priority is not specified. | | | | | |
| PM23 | Project Management | Project Workflow | Ability to add comments to the workflow at each approval step for internal use. These comments should propagate with the workflow to the next approver, and identify the person making the comment. This will allow the reviewers to put any questions/comments that will be relevant to the overall approval process as well as to the next approver in the workflow. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM24 | Project Management | Project Workflow | Ability to customize workflow for each project with varying workflow steps. The custom workflow shall be able to be created by a designated user in the SHA division. For example, divisions may follow different work flows, and the work flows may vary on different projects. Also, this will allow for changes that may occur in the approval process or test methodology on existing projects. | | | | | |
| PM25 | Project Management | Project Workflow | Capability to assign SHA team members or SHA team groups to a workflow individually for each project and for specific workflows. This capability provides resource flexibility within a division. For example, if designated team members are not available for participation in a specific project, alternates may be assigned on a project basis. | | | | | |
| PM26 | Project Management | Project Workflow | Capability to specify required approval timeframes in the system, and to notify users regarding the designated "approve by" date. This is a performance aid and provides information for overall performance management of the testing process. For example, management may review the "approve by" dates to assist in their resourcing decisions. | | | | | |
| PM27 | Project Management | Project Workflow | Capability to display elapsed time from start to end of a process. Also, the capability to display the time remaining to approve, or disapprove a given material. For example, for some divisions the approval time may start when a sample is taken in the field, while other start the clock when the sample is received in the lab. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM28 | Project Management | Project Workflow | Capability to alert the process approver when an "approve by" date associated with the approval has passed or is within a certain time of completion. The method of alert shall include an email and a notification within the system. This will enable users to re-prioritize work and ensure that all projects stay on schedule. | | | | | |
| PM29 | Project Management | Project Workflow | Capability to automatically create a monthly management report of all missed dates and delayed approvals. This capability shall also allow for a specific delay time to be set for the system to create a missed-date alert. This report should have the ability to be filtered by project and by division. | | | | | |
| PM30 | Project Management | Project Workflow | Capability to allow specifying time of delay after which an automatic notification is displayed, and/or an email sent to management regarding samples with "approve by" dates that have passed. For example, managers may decide to have the alert on the "approve by" date, before the date, or one day after the date is missed. | | | | | |
| PM31 | Project Management | Project Workflow | Capability to modify reminder alert time (alert x days/hours before due) by authorized users and the capability to add, delete or change information on designated users to be notified, including email addresses. For example, the notification list for missed dates may change, so it is necessary for a designated user to have the authority to make the changes, as they occur. | | | | | |
| PM32 | Project Management | Project Workflow | Allow for electronic signatures to approve all project letters. This electronic signature should be based on the user's login information if applicable. For example, managers will be able to provide necessary approval signatures on-line and to designate certain users to have the same approval authority. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM33 | Project Management | Project Workflow | Capability to print an approval letter with electronic signatures to send to external authorities that may require a paper copy. For example FHWA may require that SHA submit a paper copy of the final clearance letter, and may accept electronic signatures or require actual signatures in interim till the system is fully formalized and implemented. | | | | | |
| PM34 | Project Management | **Material Specifications** | Capability to store material specifications and standards in the system as a database/table, including factors such as:<br>• Test methods for various materials<br>• Pass/fail values for various tests<br>• Allowable % variations<br>These material specifications apply to all materials to be tested, and list the test methods that apply to each material, and the pass/fail values for each material's test. Any special provisions that might apply and allowable % variations are also mentioned in the test specifications. | | | | | |
| PM35 | Project Management | Material Specifications | Capability to store multiple versions of material specifications, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. For example, a project starting in year 2006 may use version x2 of the asphalt material specification for asphalt box samples, and have different allowable ranges and tests required, than a project starting in year 2006 that may use specification version x3 that have different allowable ranges of test values and different required tests. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| PM36 | Project Management | Material Specifications | The system should have the ability to link to electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT). These specifications might be stored on an internal network drive, or could be a location on the internet. Generally, these specifications are not available on the internet for free, and require either a subscription or a download. These specifications guide the pass/fail result calculations for all the tests performed by OMT. | | | | | |
| PM37 | Project Management | Material Specifications | The system should have the ability to store electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT) within MMS and to make them accessible to users, along with last update and validity dates. These specifications guide the pass/fail result calculations for all the tests performed by OMT.<br>Electronic storage of these potentially copyrighted standards will be consistent with licensing fees and agreements. | | | | | |
| **Source of Supply** | | | | | | | | |
| SoS01 | **Source of Supply** | **Source database** | Capability to maintain a list of approved sources of supply in a database format, along with tracking active and inactive sources (sources not on the list anymore). This should include date the sources were approved, date the source will expire, date the source was made inactive, projects for which the sources are/were approved. This list should be accessible online to external users. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS02 | Source of Supply | Source database | Capability to maintain database of material plants, sources and suppliers and to make them retrievable to be viewed, printed or emailed via system pull-down menus. Based upon user permissions, field, Lab, Materials Management Division and other users will have direct access to review documentation on-line relevant to their needs. | | | | | |
| SoS03 | Source of Supply | Source database | Ability to store list of materials that are on an approved list (e.g. QPL, aggregate bulletin, etc.) and the materials that don't need to be on an approved list. | | | | | |
| SoS04 | Source of Supply | **Source list** | Capability to maintain approved sources list electronically (e.g. QPL, aggregate bulletin) that can be updated online and are accessible to the general public, or can be password protected. Specific Divisions will be granted access for updating specific approved source lists. For example, when a source is submitted by a contractor, the authorized MMS user will be able to check to see if it is preapproved or requires testing for approval. | | | | | |
| SoS05 | Source of Supply | Source list | Ability to look up and provide a report on the availability of quarries that provide designated aggregates and/or soils. Pull-down selection menus shall be utilized to view and/or print quarry information. For example this will aid the Soils & Aggregates Technology Division in their decision making regarding their quarry resources. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS06 | Source of Supply | **Source request** | Capability to record and require source of supply's contact person, phone number and email address and mandate that this information be provided by the contractor for the source to be submitted to SHA. An accurate and easy access to the contact person for the source of supply letter/list is necessary to enable early contact to resolve any obvious issues and to jump-start the approval process. | | | | | |
| SoS07 | Source of Supply | Source request | Capability for contractors to submit requested materials sources (sources of supply) online through a web interface. The interface should allow the contractor to pick a bid item and specific materials to request sources of supply for each material. | | | | | |
| SoS08 | Source of Supply | Source request | Capability to allow external users (contractors) to pick sources of supply to request from a pull-down menu that includes all sources on the current approved list for each material used on the project. The pull-down menu should also include the option to add a new source with an accompanying text box that contractors can fill in if they would like to propose a source of supply that is not on the list of approved sources | | | | | |
| SoS09 | Source of Supply | Source request | Ability for user to request approval for sources of supply that are not on an approved list and send this request directly to the appropriate division. | | | | | |
| SoS10 | Source of Supply | Source request | Capability to allow contractors to submit multiple sources of supply for each bid item/material. Contractors often have multiple sources of supply for each bid item on large projects. MMS must be capable to accommodate more than one source of supply per project and contractor. This capability should be allowed to be turned on or off for each material. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS11 | Source of Supply | **Source review** | Provide capability to link to manufacturer's product installation information on the web from approved products function. This capability entails the ability to link to the internet from within the MMS screens for various purposes. For example, a user may be viewing a project within MMS and notice a questionable entry regarding material installation. Given a link to the manufacture's product installation information will save time and possibly avert project delay. | | | | | |
| SoS12 | Source of Supply | Source review | Capability to automatically trigger workflow based on predefined rules for source of supply approval once a request is received from the contractor. This will require compliance with all workflow requirements listed in Project Management requirements | | | | | |
| SoS13 | Source of Supply | Source review | Capability to review and distribute Source of Supply letter/list electronically after the review is complete. For example, much of the processing of source of supply lists and letters are processed via hard copy, this capability will enable electronic versions to be distributed electronically within MMS. | | | | | |
| SoS14 | Source of Supply | Source review | Capability to approve sources of supply for specific material for specific project, along with notes and assign validity dates for the source of supply. For example, if a GAB source goes out of business and is not being used anymore, the source information should still be available for the project, clearly marking the date range for which the source of supply was valid. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS15 | Source of Supply | Source review | Ability to distribute project documentation to appropriate divisions, as required. Each Division recipient of project information shall be selectable via a pull-down menu or other reliable means. By selecting the appropriate recipient, a transport medium shall be presented for transmittal of the information (email, fax or within MMS). For example, the distribution list presented must also contain the means by which the document will be sent for various recipients. The MMS user shall be able to select recipients from the menu provided. | | | | | |
| SoS16 | Source of Supply | Source review | Capability to automatically assign review "notes" to submitted sources of supply based on source material category using a predefined table/database of the source material and "notes" relationship. | | | | | |
| SoS17 | Source of Supply | Source review | Capability to manually edit the review "notes" automatically assigned to the sources. | | | | | |
| SoS18 | Source of Supply | Source review | Capability to maintain list of review "notes" that are tied to source rejection electronically in a database and provide as a drop down menu on review page. | | | | | |
| SoS19 | Source of Supply | Source review | Capability to assign multiple review "notes" to source of supply items as the same source may require multiple notes. For example, the materials engineer might review an item and add "notes", and forward to a division for further input, and the division might add more comments to the source of supply. | | | | | |
| SoS20 | Source of Supply | Source review | Capability to add comments at the material level for internal use. This field will allow the approver to enter any questions/comments they have before sending to the appropriate division. | | | | | |
| SoS21 | Source of Supply | Source review | Capability to add comments at the material level intended for display to external users. A clear alert should also be provided next to this field informing the reviewer that this comment will be visible to the contractor. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS22 | Source of Supply | Source review | Capability to interface with Maryland Product Evaluation List (MPEL) to import approved new products that are new additions to QPL (Qualified Products List). | | | | | |
| SoS23 | Source of Supply | Source review | Capability to flag source approval inspection requests as those for active projects or no projects to determine where the funds for testing will come from (project, or directly from source). If the payment is expected to be received directly from the source, the MMS should allow the capability to mark status as "awaiting payment" or "payment received" and flag all work as such with an alert when awaiting payment. | | | | | |
| SoS24 | Source of Supply | Source review | Capability to retrieve and print reports relating to production facilities. The report should also provide the option to include or exclude all inactive sources (sources not currently approved for use) and the ability to mark them clearly as such. Examples of these lists of approved sources are the Qualified Product List (QPL) and aggregate bulletin. | | | | | |
| SoS25 | Source of Supply | Source review | Capability to retrieve and print a report of all the projects a particular source is providing material to. | | | | | |
| SoS26 | Source of Supply | Source review | Capability to print a formatted report and convert to an easily transferable format (e.g. pdf). This capability shall allow for notations/comments to be added to the formatted report. For example, some stakeholders may only be capable of receiving hard copy reports, by converting the MMS reports to pdf or other format, those stakeholders can be accommodated. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS27 | Source of Supply | Source review | Capability to mark sources as approved based on reciprocity with other states. A database of preapproved sources, based upon reciprocity, shall be maintained for reference and the user shall have the ability to electronically mark a source as approved, based on that database. An MMS user will have direct knowledge of other state reciprocal approvals, if applicable. | | | | | |
| SoS28 | Source of Supply | Source review | Capability to add sources to approved list and mark sources as "tentatively approved". Sources that have a national certification, and have not been inspected by OMT, or sources that have been inspected but are waiting for necessary certifications are tentatively approved for project work. | | | | | |
| SoS29 | Source of Supply | Source review | Capability to send source approval or disapproval information back to contractor/provider electronically in the form of an email. This email should be triggered by the appropriate OMT team member. For example, when it is determined that a product/source has been approved or disapproved for use on a project, it is necessary to notify the contractor as well as the SHA stakeholders. | | | | | |
| SoS30 | Source of Supply | Source review | Capability to approve sources of supply for specific projects only. These sources should be clearly marked as approved for specific projects only, and not added to the approved sources list. | | | | | |
| SoS31 | Source of Supply | Source review | Ability to automatically add sources to approved lists once the sources are approved. The ability to override the automatic addition should also be provided for unforeseen situations. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS32 | Source of Supply | Source review | Ability to notify materials engineer when x number of sources submitted by the contractor are approved, or when x days have passed since the submittal request. The number of sources and the number of days should be user modifiable. This will allow SHA to send the contractors information routinely, and help the materials engineer with the approval process. | | | | | |
| SoS33 | Source of Supply | Source review | Ability to record acceptance of material source based on certified test results as received by OMT. This includes the ability to approve material source for multiple projects based on one certified result, as well as the ability to approve material source for individual projects. For example, the geotextile manufacturers are approved based on certified NTPEP test results and manufacturer submitted results. | | | | | |
| SoS34 | Source of Supply | Source review | Ability to provide a list of all bid items and materials to be used on the project, along with their source approval status (approved, unapproved, submitted, not submitted, not required) | | | | | |
| SoS35 | Source of Supply | Source review | Ability to notify the new source submitter of approval status once the source has been reviewed. The approval status might indicate approved for project, approved and added to approved list, or disapproved with comments regarding the disapproval. | | | | | |
| SoS36 | Source of Supply | Source review | Ability to store a list of reasons for source disapproval/rejection in the form of a table, and present the information in the form of a drop down menu for selection on the approval page. This menu should also include "Other" and provide a comment box that is available and tied to the reason for disapproval/rejection. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SoS37 | Source of Supply | Source review | Ability to generate an alert when an existing approved source is no longer valid and send to source representative, SHA representatives & contractor representatives of all projects on which the source is noted as an approved source. | | | | | |
| SoS38 | Source of Supply | Source review | Ability to generate a report displaying all the sources rejected (overall, and by project) along with the reason for rejection, and the comment entered. | | | | | |
| SoS39 | Source of Supply | Source review | Capability to manually release items for distribution once the items are approved or disapproved. | | | | | |
| SoS40 | Source of Supply | Source review | Capability to manually distribute approved and released items to appropriate parties in the form of a consolidated email. For example, if 5 sources are approved/disapproved for a project, a consolidated email will be sent with all 5 sources approval status. | | | | | |
| SoS41 | Source of Supply | Source review | Capability to automatically distribute approved and released items to appropriate parties in the form of a consolidated email based on business-specifiable rules regarding time for release. For example, the time specified could be one day, or five days as specified by the document. | | | | | |
| **System Management** | | | | | | | | |
| SyMg01 | **System Management** | **System Maintenance** | Capability to provide the users with the back-end to make changes to basic tasks. For example, this capability should provide the administrators the capability to create new distribution lists, maintain cost tables, etc. In other words, this capability should allow the users to make changes to data tables on the back-end using a simple to use interface. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SyMg02 | System Management | System Maintenance | Capability to maintain an organizational structure (table) of Office of Materials Technology with the added capability to assign tasks to individuals or organizations. For example, organizations change and the individual stakeholders within the organizations often change. Maintaining an updated organization chart on line ensures that forwarded documentation is going to the correct contact. | | | | | |
| SyMg03 | System Management | System Maintenance | Ability to provide user definable tables, fields, indexes and forms. This function may be enabled through the application of a Wizard functionality. For example, an administrator may want to design a form for reporting daily or weekly activity in report format. | | | | | |
| SyMg04 | System Management | System Maintenance | Capability to provide online "Help Screens" that can be populated from an administration back-end by authorized users. The help screens shall "pop-up" to aid input, or be selectable by user to obtain specific help information on a functionality. For example, a user may require assistance to add notation to a source of supply letter or where to find test results. | | | | | |
| SyMg05 | System Management | System Maintenance | Capability to maintain a list of SHA users with various levels of access rights. A system administrator will have access to maintain the user capability designations. For example, it is necessary to ascertain who has what access capability from the division heads. Each division will have specific access requirements and all will have some general access requirements. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SyMg06 | System Management | System Maintenance | Capability to provide role-based security so that system users have limited/restricted access to the system. The access level of the user will depend on their division and the projects they are working on. The control of outside users shall be limited to the responsible division and specific fields. Several outside groups (contractors, suppliers, outsourced labs) will require limited, defined access to MMS besides the SHA users. | | | | | |
| SyMg07 | System Management | System Maintenance | Capability to maintain a security log (audit trail) of user access to the system with date & time of access and user name of person accessing the system. For example, a user may inadvertently or purposely destroy information while using the system, It is necessary to have an audit trail to determine who did what. | | | | | |
| SyMg08 | System Management | System Maintenance | Capability to require approval, per access, on input from external groups with limited/restricted access. Also, the capability to deny access to an outside user and log access attempt and flag repeated attempts. For example, Users in the restricted outside user group will change and may attempt unauthorized access. | | | | | |

**Operational Requirements RTM**

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Aud01 | Audit Trail | Monitor | Capability to provide a report of the date & time, any changes, adds or deletes made and the logon ID of the user accessing monitored data files. For example, in the event of data corruption, erasure, or other contamination, a report shall be available to detail user recent activity. | | | | | |
| Aud02 | Audit Trail | Monitor | Capability to segment users by division and configure audit capabilities only to users with access to the defined databases. For example, if a user only has rights to access the forms and reports data segment, that user will be audited based on the access to those segments only. | | | | | |
| Aud03 | Audit Trail | Monitor | Capability to monitor access to Source of Supply Letters/Lists, test results, contractor information, project notes, SHA forms and other designated databases. For example, each time a user access a monitored data file, a record will be posited of the activity. | | | | | |
| Cap01 | Capacity | Database | Capability to handle high volumes of data that may occur on a "peak" basis. For example, end of month final clearances, monthly reporting and ad-hoc queries for completion status will generate a high volume of data while routine project work during the month may range from low to high. | | | | | |
| Cap02 | Capacity | Database | Capability to process transactions from an estimated 400-500 total users on a daily basis. In addition to the SHA users, transactions will be created by contractors, suppliers and outsourced labs. For example, transactions will include, at a minimum, Source of Supply Letters/Lists from contractors, the transfer of sample information between lab and field forces, the submission and retrieval of project test results, access of information for reports, ad-hoc user queries. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| DC01 | Data Currency | Backup | Capability to provide data in near real-time in response to requests for data access. For example, resource allocation and deployment decisions for field and lab work are based on project dates. The dates reflected in MMS must be as recent as possible. | | | | | |
| DC02 | Data Currency | Backup | Capability to maintain a current back-up of the system database to be utilized for restoration in the event of catastrophic failure and loss of data. For example, a fire or other event could destroy the server causing total loss of data and system configurations. | | | | | |
| DC03 | Data Currency | Backup | Capability to maintain a current backup of all system configurations to be utilized in case of catastrophic loss to the server. | | | | | |
| DaR01 | Data Retention | Cleanup | Ability for the administrator to delete old records as required. It is anticipated that the records will be archived most of the time and not deleted, but a deletion may be required in case of duplicate entries or other unforeseen circumstances. | | | | | |
| DaR02 | Data Retention | Storage | Capability to store project related data for an indefinite period of time. For example, project related data may be retained for the life of the asset associated with the project. For example, there will be varying degrees of retention requirements throughout the system database, from "none" to indefinite. | | | | | |
| DaR03 | Data Retention | Storage | Ability to save data in a common or easily accessible format. This may include .pdf, WORD or other common format. For example, there will be specific users (TBD) who may have limited or no access to MMS. This ability will enhance the function of emailing and/or printing. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| FT01 | Fault Tolerance | Configuration Management | Capability to provide additional back-up and protection for specified system applications during planned or unplanned outages. For example, applications supporting the source of supply test and approval process are critical while email (from within MMS) and field access to the system may be less critical. | | | | | |
| FT02 | Fault Tolerance | Configuration Management | Capability to react to a single board or data drive failure through a fault tolerant architecture. For example, if a circuit board or other piece of hardware fails, the system shall be capable of continuing functionality through redundant hardware/software configuration architecture. | | | | | |
| Perf01 | Performance | Measurements | Capability to provide system performance analysis and reports. For example, a log of system bugs and or actual interruptions shall be kept and statistically analyzed to address current issues and to predict possible future issues. | | | | | |
| Perf02 | Performance | Measurements | Capability to provide performance measurement details based upon the number of tests and test completion data (e.g. time required to complete a specific test or all tests on a particular sample). For example, The "Approve By" date and other performance measurement opportunities may be accessed via MMS. | | | | | |
| Perf03 | Performance | Measurements | Capability to provide Statistical analysis and/or ability to extract to a statistical analysis package to review mix designs and other designated analytical functions. For example, an analysis of missed project completion dates and their causes may be analyzed and reports provided. | | | | | |
| Perf04 | Performance | Process Support | Capability to provide response to user queries in three seconds or less. For example when an icon or menu item is selected, the user should notice no delay in viewing the requested screen or data list. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Perf05 | Performance | User Support | Capability to provide user multi-tasking with system screens. For example, a user may have multiple MMS screens open and active while also using other application screens. | | | | | |
| Perf06 | Performance | User Support | Capability to provide system user documentation that is comprehensive, clear and easy to use. For example, system user documentation shall provide quick answers to questions regarding the navigation of the system screens. | | | | | |
| Rcvr01 | Recoverability | Configuration Management | Capability to provide data redundancy to protect against loss of data due to system failure For example, in the event of a total failure of MMS, the database shall be recoverable and be restored to the image that existed at the time of failure. | | | | | |
| Rcvr02 | Recoverability | Configuration Management | Capability to recover from, or not be impacted by a commercial power failure. A given power failure may be just from a moment to many hours. It is expected that all functionality and data access would remain intact. For example an alternate source of power shall be available and the MMS wired to that source of power. | | | | | |
| Rcvr03 | Recoverability | Configuration Management | Capability to restore full functionality and data integrity within thirty minutes of detecting the failure. For example, critical hardware spares and recent system & data backups shall be available on site. | | | | | |
| Rel01 | Reliability | System Measurements | Capability to meet a Monthly Mean Time to Repair (MTTR) performance of five minutes. MTTR is figured by dividing total system down time by the number of outage occurrences for the month. | | | | | |
| Rel02 | Reliability | System Measurements | Ability to provide same-day replacement for failed hardware parts causing system outage (down-time) and twenty-four hour turn-around time for repair and/or replacement of defective parts. For example, a failure may occur that requires a hardware item that is not at the site. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Rel03 | Reliability | System Measurements | Capability to perform system backups that are transparent to the users. For example, information for reports and project scheduling must be as current as possible which necessitates frequent backups. | | | | | |
| RD01 | Retrieve Data | User Support | Ad-hoc query capability to retrieve test results by non-project characteristics (mix design, location, contractor, materials supplier, etc.). This capability requires that a user can obtain project data based upon various data point starting points. For example, retrieve a materials supplier, and view all of the projects that that supplier is currently involved in (or has been involved in). | | | | | |
| Sec01 | Security | Data | Capability to protect Application Data from contamination and/or erasure by users. For example, the loss or contamination of vital project information, such as Source of Supply Letter, test results or project notes could jeopardize project schedules. | | | | | |
| Sec02 | Security | Data | Capability to protect sensitive SHA and contractor data from casual access. For example a supplier's specific materials mix submitted for testing or SHA project costing information. | | | | | |
| Sec03 | Security | Environment | Access to the IT facility housing the MMS servers shall be controlled and monitored. For example, key card entry shall be utilized to track users' access to the server area. | | | | | |
| Sec04 | Security | User Configuration | Capability to provide a user logon interface that is designed to allow access to specific data by designated users within SHA Divisions. For example, users in the Asphalt Technology Division may not need access to projects associated with Soils and Aggregates Division. Also, some users need an access for a specific purpose such as preparing reports, while another user may need full administrative access. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Sec05 | Security | User Configuration | Capability to limit access to designated non-SHA users, such as contractors and consultants. However, this access must be restricted and recorded within the system. For example, contractors may require access to submit sources for approval and to check on project status. | | | | | |
| Sec06 | Security | User Configuration | Capability to provide reports detailing outside user access. For example, a monthly report of outside user access may be provided to check against contractor project activity. | | | | | |
| Sec07 | Security | User Configuration | Capability to restrict access to a limited number of individuals with permission to alter data tables, applications and other database configurations. For example, in order to protect the integrity of the MMS data, only designated members of the Office of Materials Technology (OMT) shall have these permissions. | | | | | |
| Sec08 | Security | User Configuration | Capability to limit some users to "View Only" MMS access on specified projects or materials. For example some users may only need to check on completion dates or other key project information with no need to input or retrieve data. | | | | | |
| Sec09 | Security | User Configuration | Capability to monitor and restrict SHA field access by project. The field will however have input access related to plant inspections and certifications. For example, field staff may only access data relevant to a current project at their site location but be given permission to access the plant certification data base to update inspection information. | | | | | |
| Sec10 | Security | User Configuration | Capability to monitor and control access to MMS interfacing systems, by restricting other system access by an additional layer of password security or other means. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Sec11 | Security | User Configuration | Capability to provide a robust authentication procedure to be employed for all logins. For example, VPN remote access may be allowed with authentication. | | | | | |
| Sec12 | Security | User Configuration | Capability to require passwords to be changed on a regular basis. For example, the system should prompt the user every three months to request a change in password. | | | | | |
| Sec13 | Security | User Configuration | Allow users to request password reset requests from the web interface. Users should be assigned temporary passwords and required to change at first login. For example, users often forget their logon information and require a method to have it reset. | | | | | |
| Sec14 | Security | User Configuration | Allow users to choose from multiple roles if the user is assigned more than one role (e.g. Project Manager, administrator). For example, a division head may require a logon that has access to the entire division. | | | | | |
| Sec15 | Security | User Configuration | Capability to restrict the display to only the options and icon selections to which the user has rights. For example a user's logon would define the functionality required and present only that capability. This has the added benefit of simplifying the screen for the user. | | | | | |
| Sec16 | Security | User Configuration | Facilitate Single Sign-on to use enterprise login information for OMT staff and allow use of VPN or request login credentials for web-based modules. For example, the Office of Materials Technology has responsibility for MMS and the processes it supports. VPN may be used with authentication. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SyAv01 | System Availability | Failure Management | Capability to provide 24/7 system uptime. For example, data transfers with interfacing systems and other automated system routines must be accommodated. Peak system usage is expected to be from 6:30 a.m. to 5:30 p.m. This time period is the least optimal time to schedule planned maintenance outages. | | | | | |
| SyAv02 | System Availability | Failure Management | Capability to provide simultaneous access to all MMS screens by all concurrent users. There shall be no degradation of service or extended screen wait time. For example, all users may have a need for information on a specific project, at the same time. It is estimated that initially the system will have 400-500 total users. | | | | | |
| SyAv03 | System Availability | Failure Management | Capability to provide system availability at 99.999%. This equates to a total of five minutes of unplanned outage for a year. | | | | | |
| SyAv04 | System Availability | Failure Management | Ability to conduct scheduled maintenance during hours designated as the "Maintenance Window". For example, the Maintenance Window may be designated from midnight to two a.m. It is possible that the Maintenance Window could be expanded dependent upon the estimated time to perform the scheduled maintenance. This "window" applies to work performed by SHA as well as work performed by the vendor. | | | | | |

# ATTACHMENT 18 – MMS TMP

THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

# MATERIALS MANAGEMENT SYSTEM PROJECT
# TEST AND EVALUATION MASTER PLAN
## Volume I (Test Plan)

**April 8, 2009**
**Version 1.0**

# Document Version Control

| Revision Date | Updated By | Requested By | Description of Revision |
|---|---|---|---|
| 04/08/2009 | Vendor | | Discussion Draft |
| 04/22/2009 | Vendor | | Final version based on SHA comments |
| | | | |

## TABLE OF CONTENTS

**STATE HIGHWAY ADMINISTRATION**
Test and Evaluation Master Plan
MATERIALS MANAGEMENT SYSTEM

# 1 INTRODUCTION

## 1.1 Overview

The Maryland State Highway Administration (SHA) and its Office of Materials Technology (OMT) have recognized a need to implement an electronic Materials Management System (MMS) to better track, record, evaluate, analyze, and review the quality of materials used on SHA construction projects. For the purposes of this document, the MMS will be defined as an integrated electronic system used as a tool to manage the materials testing, acceptance, and clearance process within SHA.

To address the need for an MMS, OMT initially chartered a team to develop the "Materials Management System Strategic Plan." This strategic plan was completed in early 2007. It provided a roadmap for the full implementation of an integrated MMS for SHA. The strategic plan outlined the high level user needs for the MMS and assessed various alternatives for implementing this system. This strategic plan recommended the development of a custom application and proposed implementation in a multi-phased approach over several years.

The Materials Management System Strategic Plan was used as the starting point for the Initiation Phase which was completed in early 2008 and the System Concept Development Phase of the MMS project which was completed in May 2008. The current phase of work on the MMS, the Requirements Planning and Analysis Phase, was then launched in July 2008. The Requirements Analysis Phase formally defines the detailed functional user requirements using the high-level requirements identified in the System Concept Development phase. It also delineates the requirements in terms of data, system performance, security, and maintainability requirements for the system. The requirements are defined in this phase to a level of detail sufficient for the issuance and evaluation of an RFP or for systems design to proceed. These requirements are captured in a deliverable known as the Functional Requirements Document (FRD).

The requirements documented in the FRD need to be measurable, testable, and relate to the business need or opportunity identified in the Initiation and Concept Development Phases. The requirements that will be used to determine acceptance of the system are then captured in this deliverable, known as the Test and Evaluation Master Plan.

The proposed MMS will serve as the single data repository for all materials testing and clearance activities, including materials tested in central and field laboratories, consultant laboratories, manufacturing sites, and project sites as needed. It will provide tools to managers in order to make decisions regarding the efficiency and effectiveness of the process and provide file storage, task tracking, and correspondence sharing. The MMS will also be capable of sharing data with SHA enterprise databases and other management systems such as AASHTO Trns•port ®, the Maryland Construction Management System (MCMS), the Financial Management Information System (FMIS), the Pavement Management System (PMS), and the Bridge Management System (BMS) among others.

The goal of the MMS is to streamline all facets of the process, including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This increased efficiency will in turn raise SHA's ability to efficiently and effectively perform design, construction, rehabilitation, and maintenance on the state highway system[a].

The implementation of a single electronic MMS has the following mission critical goals:

- Manage the materials clearance process throughout the construction project life cycle; this should include support for materials clearance activities in traditional design-bid-build construction contracts, as well as design-build and other innovative contracting methods.
- Allow information sharing and knowledge transfer among key SHA stakeholders.
- Allow one-stop data entry and status reporting on progress against materials clearance goals.
- Provide construction Project Managers with a notification of potential materials discrepancies as part of the preparation of construction contractor progress estimates.
- Provide documentation of materials clearance compliance for FHWA certification.
- Allow lab managers to track the status and costs of testing within a given Technical Material Division.
- Automate the allocation of testing costs to the various projects.
- Identify sources and materials used on projects through a referencing system to allow for easier access to materials information during ongoing maintenance of the asset.
- Support capturing of data from testing performed by construction contractors and facilitate the comparison of this test data with SHA quality assurance test results.
- Provide up to date information on selected items related to SHA business plan objectives.

MMS is envisioned to be implemented as a program of nine related projects. This includes eight software development projects and a ninth project which consists of the necessary infrastructure upgrades to support MMS throughout the life of the entire program. This Test and Evaluation Master Plan outlines the testing program which will be utilized for the implementation of all eight software projects. These projects are as follows:

- Project I: System Management, Project Information, and Source of Supply
- Project II: Base Laboratory Information Management System
- Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs
- Project IV: Concrete/Chemical Lab
- Project V: Asphalt Lab

[a] Materials Management System Strategic Plan (January 2007)

- Project VI: Structural Lab
- Project VII: Materials Clearance
- Project VIII: Management Reporting/Analysis

Project I is being developed internally by SHA by developers and a database administrator who are part of the Office of Traffic Safety (OOTS) information technology staff. This OOTS IT development team will have responsibility for development and unit test of Project I and making required program fixes to Project I program modules identified during system test, user acceptance test and security test for Project I. The SHA MMS Business Lead and the SHA MMS Test Lead will manage and coordinate all testing for Project I other than unit testing.

It is SHA's current intention to obtain through a Request for Proposal (RFP) process the services of a system integrator, hereafter called the MMS system integrator, to develop and lead the implementation of Projects II through VIII. This RFP will provide the system integrators submitting a proposal in response to this RFP with the option of proposing either a commercially available off the shelf (COTS) software solution with any custom extensions needed to meet SHA requirements or a custom solution tailored to SHA's needs. SHA will then select the system integrator who based on SHA's evaluation criteria has proposed a total solution which provides the best value to OMT in terms of providing an MMS solution which both meets the defined business needs of SHA and provides flexibility for future expansion with an appropriate cost to develop and long term cost of ownership.

## 1.2 Purpose

The Test and Evaluation Master Plan (TEMP) provides a basis for planning, performing, managing, monitoring, and measuring testing activities during the development and implementation of all the projects planned for the MMS program. Specifically, this plan documents the following:

- References that will be used as the basis for test management, planning, development, and documentation
- Organizations responsible for planning, management, and test execution
- Management of a testing strategy that addresses the evolution of the design, incremental delivery, testing efficiency, and testing coverage as well as the system's known areas of risk
- General testing process including the testing phases and processes for evaluating test adequacy
- Test facility, test equipment, test configuration and environment, and test support requirements
- Approach for documenting, tracking, and resolving issues found during testing

- Measurement and reporting of test work products and test results
- Approach for developing acceptance criteria

The TEMP is a program level document and is applicable to all MMS testing activities in the system acquisition and development lifecycle phases for all of the planned MMS projects. This TEMP focuses on the overall test management strategy to ensure a high quality system that meets user acceptance criteria.

MMS testing will address the full system (i.e., commercial off the shelf and custom developed application components, interfaces and supporting system services). In the Requirements Analysis phase, the MMS Program Sponsor, MMS Business Lead, SHA Office of Information Technology (OIT) Project Manager, and SHA OIT Task Order Manager will conduct a functional review to ensure that the business requirements have been accurately linked to functional and data requirements.

During Project I, the OOTS IT development team will conduct unit test activities related to Project I. The MMS testing team will plan and execute system integration, system test user, acceptance test and security test activities leading to the initial implementation of Project I into the SHA production environment.

During subsequent development efforts leading to implementation of Projects II-VIII of the MMS in the SHA production environment, the MMS testing team will be responsible for overseeing and monitoring the MMS system integrator's test efforts, overseeing and monitoring the test efforts of SHA OIT and SHA OOTS IT staff responsible for making any required changes to MMS Project I components or for other systems with which the MMS application will integrate, and for ensuring the product is tested against the requirements, and ensuring the deliverables comply with the documented requirements. The MMS testing team will also have responsibilities for planning and executing the user acceptance process at the end of the development phase for Projects II-VIII. This includes user acceptance test, security test and any regression testing required to ensure that neither the introduction of new application software from Project II-VIII or any changes to the Project I components made to support the new project had any unintended impact on existing MMS production operations. Additional MMS testing team duties, activities, and responsibilities will be discussed later in this document.

The foundation for the testing of the MMS application defined in this TEMP is a complete set of functional requirements against which the system will be measured. While much of the testing effort documented in the TEMP is technical in nature, the overall goal of the testing process is to ensure the developed/implemented system is a high quality product, and meets all of the mutually agreed upon functional requirements. As the project moves into design phase, the TEMP will be updated to ensure the system meets detailed specifications, ultimately leading to a high quality product.

Provided within this planning document are the details necessary to perform the management of the testing activities, including organization planning and roles and responsibilities for each structured testing project component. The end users assist in the development of the TEMP document. This involvement ensures an organizational commitment to the successful

implementation of the new system by providing a foundation for verification and validation of the testing results. Included in this process is the validation of the functional requirements for which the system was developed. A test analysis report is developed at each level of testing to record the results of the test and certify the system's readiness for the next level of testing or for implementation into a production environment.

Problems, deficiencies, modifications, and refinements identified during testing or implementation will be tracked through configuration control and tested using the same test procedures described in this document. Specific tests may need to be added to the plan at that time, and other documentation may need updating upon implementation. Notification of implemented changes to the initiator of the change request/problem report and to the users of the system is also handled as part of this configuration control process.

The methodology found in this TEMP is based on guidance from the Maryland Department of Information Technology's (DOIT) *Systems Development Life Cycle* documentation. The TEMP has been tailored to fit the MMS Functional Requirements and include industry "best practices" for testing large systems.

This TEMP document identifies the tasks and activities required to be performed during testing so that all components of the MMS application are adequately tested and to validate that the system can be successfully implemented into a production environment. The TEMP documents the scope, content, methodology, sequence, management of, and responsibilities for all test activities associated with the following individually structured project test components:

- Unit Test
- Subsystem Integration Test
- System Test
- User Acceptance Test
- Regression Test
- Security Test

All test components will be performed for each of the eight identified projects in the MMS program, with the exception of regression testing will be required only for Projects II-VIII. In addition, the specific scope of regression testing will vary among Projects II-VIII based on the extent to which any Project I or later project elements were changed or determined to be impacted by the software being added to the MMS production environment by the new project.

Each of these components is described briefly below.

### 1.2.1 Unit Test

Unit test for the MMS application is considered a white box test, and allows for the use of internal knowledge of the software and system to guide the selection of test data. Unit test is a

developer function, and includes verification of all custom program units, any Extract Transform and Load process (ETL), data mapping, stored procedures and scheduled jobs, and ensures that any reports created by the system launch and populate data as designed. In Project I, unit testing will be performed by SHA OOTS IT staff or contractors under the direction of the SHA OOTS IT unit manager. In Projects II-VII, unit test will be performed primarily by the MMS system integrator's developers. SHA OIT staff and SHA OOTS IT staff will be responsible for unit testing any changes to Project I software and any components of interfaces with other SHA systems which they are responsible for developing.

### 1.2.2 Subsystem Integration Test

A successful unit test forms the foundation of the subsystem integration test phase. This phase involves testing the functionality of related groupings of system functionality and how these logical groupings or subsystems perform their intended functions including required interactions with other systems. For the MMS application, we will perform subsystem integration testing at the business function or sub-function grouping within the scope of each of the eight projects.

Subsystem integration testing for Project I will be the responsibility of SHA MMS testing staff. Planning and execution of subsystem integration testing for Project II-VIII will be the responsibility of the MMS system integrator. This will require close coordination with SHA OIT and SHA OOTS IT staff in order to test any components of Project II-VIII which these teams are responsible for developing and/or for testing any required changes to Project I components to fully implement the requirements of Projects II-VIII.

### 1.2.3 System Test

System test involves end-to-end testing of the MMS application in a production-like environment. System testing is designed around the primary business functions or processes the MMS or the specific project within the MMS is intended to support and the business cycles in which these activities are performed. Unlike subsystem integration testing, system test cases are not focused on a specific grouping of system functionality (i.e. driven by the design of the application) but instead are focused on the various system components (potentially across one or more subsystems within a project or possibly one or more MMS projects) required to complete a particular business function.

System test cases or cycles, for example, might include activities that are performed at system initiation or on a periodic basis such as when a new material type is added to the system and information about the associated contract line items is imported from Trns•port ® or when new materials specifications are added or when a new project is added to MMS for tracking of test results and data about that project is imported from CAS or MCMS. It would also include various daily business cycles such as when a contractor requests OMT review of a new source of material; when samples are logged into the lab and assigned for testing and when various tests are performed on the sample, the results compared against specifications and the test results reported to project stakeholders. It will also include periodic reporting cycles and analytical reporting test cycles for the various management reports, which draw data from across the functionality included in several of the MMS projects.

System testing for Project I will be the responsibility of SHA MMS testing staff. Planning and execution of system testing for Project II-VIII will be the responsibility of the MMS system integrator. This will require close coordination with SHA OIT and SHA MMS testing staff in order to test any components of Project II-VIII which these teams are responsible for developing and/or for testing any required changes to Project I components to fully implement the requirements of Projects II-VIII.

### 1.2.4 User Acceptance Test

User acceptance test marks the final phase of the testing process for each of the MMS projects. In this phase, the MMS application is tested by the user community on a smaller scale than the expected production user base. The MMS application is tested with full functionality and, to the users, represents how the application will function upon go-live. User acceptance is often modeled after or is designed to be similar to system testing in its scope with the testing performed by the user community instead of the MMS system integrator or the SHA MMS testing staff in the case of Project I, both of whom whose role during user acceptance test is limited to supporting test execution by the user team and making any required program fixes identified during the testing.

User acceptance testing should also validate user training and available user procedures. The user acceptance team should go through the training being planned for the user community and assess how this training did or did not prepare them to use the application. Any user manual or user procedures should also be available during user testing for use and validation by the user testing team.

The foundation for the testing of the MMS application defined in this TEMP is a complete set of functional requirements against which the system will be measured. While much of the testing effort documented in the TEMP is technical in nature, the overall goal of the testing process is to ensure the implemented system meets all of the mutually agreed upon functional requirements.

Provided within this planning document are the details necessary to perform the management of the testing activities, including organization planning and roles and responsibilities for each structured testing project component. The end users assist in the development of the TEMP document. This involvement ensures an organizational commitment to the successful implementation of the new system by providing a foundation for verification and validation of the testing results. Included in this process is the validation of the functional requirements for which the system was developed. A test analysis report is developed at each level of testing to record the results of the test and certify the system's readiness for the next level of testing or for implementation into a production environment.

Problems, deficiencies, modifications, and refinements identified during testing or implementation will be tracked through configuration control and tested using the same test procedures described in this document. Specific tests may need to be added to the plan at that time, and other documentation may need updating upon implementation. Notification of implemented changes to the initiator of the change request/problem report and to the users of the system is also handled as part of this configuration control process.

The methodology found in this TEMP is based on guidance from the Maryland Department of Information Technology's (DOIT) *Systems Development Life Cycle* documentation. The TEMP has been tailored to fit the MMS Functional Requirements and include industry "best practices" for testing large systems.

### 1.2.5 Security Test

Security test is intended to ensure that adequate security and controls is in place for the new system. The security test ensures that unauthorized users will not have access to system features or functions that they are not authorized to. It will also ensure that users will not have the ability to change or modify data that they may be authorized to view but are not authorized to change.

Security testing for all projects within the MMS program is the responsibility of the SHA OIT Security Lead designated for this program, with support and assistance from the SHA MMS Business Lead, SHA OIT Project Manager, other SHA OIT staff as appropriate, SHA OOTS IT staff assigned to the MMS program and the MMS system integrator.

### 1.2.6 Regression Test

Regression test is intended to ensure that the introduction of new system components to the MMS production environment in Projects II-VIII or any changes which may be required to Project I components to support implementation of Projects II-VIII do not inadvertently impact current MMS production operations. Given the incremental nature of the implementation approach for the MMS program and the extent to which Projects III-VIII rely on building block components being implemented in Projects I and II, regression testing will be a critical element of the MMS testing program,

Planning and execution of a formal, structured regression test is the responsibility of the MMS test team in coordination with SHA OIT staff, the OOTS IT staff/MMS testing staff assigned to the MMS program and the MMS system integrator. While the MMS test team has formal responsibility for regression test, it is envisioned, however, that regression testing to the extent it is required would likely be a test case or test cycle in subsystem integration test and system test activities performed by the MMS system integrator for Projects II-VIII.

## 1.3 Mission Description and Measures of Success

The testing management methodology and activities depicted in this TEMP will ensure that the MMS application meets SHA's strategic goals with focus and emphasis being placed on those business objectives that relate back to the SHA business plan, as well as Managing for Results (MFR) initiatives.

The mission for the Materials Management System is to streamline all facets of the materials clearance process so that information can be tracked and SHA personnel can manage the entire process more effectively and efficiently. With improved management of the materials clearance process, SHA will be better positioned to assure the quality of materials utilized in the construction of transportation infrastructure[a]. SHA will be able to facilitate the long term management of the transportation assets by more easily identifying where and what materials were utilized during the construction of different parts of the state's transportation infrastructure.

This enhanced access to information about materials used in the construction of state highways will help to achieve SHA's mission to: "Efficiently provide mobility for our customers through a safe, well-maintained, and attractive highway system that enhances Maryland's communities, economy, and environment."[b]

SHA has the following six strategic business objectives:

1. Highway safety
2. Mobility and congestion relief
3. System preservation and maintenance
4. Organizational effectiveness
5. Environmental stewardship
6. Customer communications, service, and satisfaction

The proposed MMS supports several of SHA's strategic business objectives. Examples of these linkages include:

- The proposed MMS supports highway safety through helping to assure the use of materials which meet specifications during highway construction. The MMS will also improve the measuring and tracking of material quality, thereby improving overall highway safety.
- The MMS assists and supports system preservation and maintenance by providing enhanced access to information about what materials from what sources and supplies were used in the construction of assets in the transportation network.
- The MMS supports organizational effectiveness by helping to streamline both the delivery of construction projects through more efficient processes and the ongoing stewardship of managing SHA's transportation assets.
- The MMS supports these SHA strategic objectives by supporting and enabling a number of key Office of Materials Technology (OMT) business drivers. These business drivers include the following:
    - Streamline the materials clearance process throughout the life cycle of a construction project.
    - Increase the efficiency and reduce the costs associated with materials clearance.
    - Store and retrieve materials information more efficiently and effectively.
    - Provide for improved sharing of materials information across various SHA Divisions and Offices.
    - Link sources of materials and materials used during construction to a linear referencing system to facilitate access to materials information during on-going maintenance of the transportation assets.
    - Measure and track long term material quality performance.
    - Generate business plan progress reports easily.

[b] http://www.sha.state.md.us/aboutus/orgChart/OC/missionvision.asp

The objectives of MMS and the relationship of these objectives to SHA's strategic business objectives and OMT's business drivers are outlined in Exhibit 1-1 below. This exhibit also outlines several anticipated benefits opportunities for each MMS objective and the probable timeframe for achieving these benefits in terms of time following implementation of each individual MMS project component.

**Exhibit 1-1: Mapping of MMS System Objectives to OMT Business Drivers and SHA Strategic Business Objectives**

| OMT Business Drivers | MMS System Objectives | SHA Strategic Business Objectives Supported | Anticipated Benefits and Target Timeframe |
|---|---|---|---|
| ▪ Manage the materials clearance process throughout the construction project life cycle. | ▪ Streamline materials clearance process.<br>▪ Increase efficiency and reduce costs associated with materials clearance.<br>▪ Store and retrieve materials information more efficiently and effectively. | ▪ Highway safety.<br>▪ System preservation and maintenance.<br>▪ Organizational effectiveness. | ▪ Time taken to complete the materials clearance process.<br>▪ Reduction in contractor claims for late payment.<br>**Time frame:** One year from implementation of project VII (Materials Clearance). |
| ▪ Allow information sharing and knowledge transfer among key SHA stakeholders. | ▪ Provide for improved sharing of materials information across various SHA Divisions and Offices.<br>▪ Generate business plan progress reports easily. | ▪ System preservation and maintenance.<br>▪ Organizational effectiveness. | ▪ Time taken to process test samples [from receiving samples to releasing results to project manager].<br>**Time frame:** One year from implementation of project VII (Materials Clearance). |
| ▪ Allow one-stop data entry and status reporting on progress against materials clearance goals. | ▪ Store and retrieve materials information more efficiently and effectively.<br>▪ Provide for improved sharing of materials information across various SHA Divisions and Offices. | ▪ Organizational effectiveness. | ▪ Time (# of days) for new materials source approval [source of supply letter to source approval/rejection].<br>**Time frame:** One year from implementation of project VII (Materials Clearance). |

| OMT Business Drivers | MMS System Objectives | SHA Strategic Business Objectives Supported | Anticipated Benefits and Target Timeframe |
|---|---|---|---|
| ▪ Provide construction project managers with a notification of potential materials discrepancies as part of the preparation of construction contractor progress estimates. | ▪ Provide for improved sharing of materials information across various SHA Divisions and Offices. | ▪ Highway safety.<br>▪ Organizational effectiveness. | ▪ Reduction in contractor claims for late payment.<br>**Time frame:** One year from implementation of project VII (Materials Clearance). |
| ▪ Provide documentation of materials clearance compliance for FHWA certification. | ▪ Store and retrieve data more efficiently and effectively. | ▪ Organizational effectiveness. | ▪ Time taken to complete the materials clearance process.<br>**Time frame:** One year from implementation of project VII (Materials Clearance). |
| ▪ Allow lab managers to track the status and costs of testing within a given technical material division. | ▪ Track long term material quality performance. | ▪ Organizational effectiveness. | ▪ Cost associated with most frequent tests.<br>**Time frame:** One year from implementation of applicable project for each lab (Projects III, IV, V and VI). |

| OMT Business Drivers | MMS System Objectives | SHA Strategic Business Objectives Supported | Anticipated Benefits and Target Timeframe |
|---|---|---|---|
| ▪ Automate the allocation of testing costs to the various projects. | ▪ Increase the efficiency and reduce the costs associated with materials clearance.<br>▪ Store and retrieve materials information more efficiently and effectively.<br>▪ Provide for improved sharing of materials information across various SHA Divisions and Offices. | ▪ Organizational effectiveness. | ▪ Cost associated with most frequent tests.<br>**Time frame:** One year from implementation of applicable project for each lab (Projects III, IV, V and VI). |
| ▪ Identify sources and materials used on projects through a referencing system to allow for easier access to materials information during ongoing maintenance of the asset. | ▪ Link sources of materials and materials used during construction to a linear referencing system to facilitate access to materials information during ongoing maintenance of the transportation assets. | ▪ System preservation and maintenance. | ▪ <New capability><br>**Time frame:** Two years after implementation of MMS and Asset Data Warehouse. |
| ▪ Support capture of data from testing performed by construction contractors and facilitate the comparison of this test data with SHA quality assurance test results. | ▪ Store and retrieve materials information more efficiently and effectively. | ▪ Organizational effectiveness. | ▪ <New capability><br>**Time frame:** One year from implementation of project VII (Materials Clearance). |

| OMT Business Drivers | MMS System Objectives | SHA Strategic Business Objectives Supported | Anticipated Benefits and Target Timeframe |
|---|---|---|---|
| ▪ Provide up to date information on selected items related to SHA business plan objectives. | ▪ Generate business plan progress reports easily. | ▪ Organizational effectiveness. | ▪ Time (# of hours) to create monthly materials status report.<br>**Time frame:** One year from implementation of project VIII (Management Reporting/Analysis). |

## 1.4 System Description

The goal of the MMS is to streamline all facets of the process including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This will in turn raise SHA's ability to perform design, construction, rehabilitation, and maintenance on the state highway system efficiently and effectively[c].

The MMS is intended to assist with source of supply acceptance, calculate pay factors, determine materials acceptability, generate sampling and testing schedules, final materials clearance letters, and be used as a mechanism to determine when all materials clearance activities are complete.

The project development strategy for the MMS project will be guided by the project plan defined in the System Boundary Document (SBD) for the MMS project that was completed in the System Concept Development Phase in May 2008.

The high level requirements for the MMS project were defined in the SBD and are grouped as follows:

**System Management** - System management refers to the overall technical management of the MMS.

**Project Management -** Project management refers to project management activities performed on a project. This includes activities like maintaining high level project information, storing project documentation, and tracking project tasks.

**Source of Supply -** Source of supply module consists of the functionality to review the sources of material supply that the contractors propose to use on the project. SHA approves or disapproves these sources for the project. The approval of the source does not indicate approval of material used on the project – merely approval of the source of the material. SHA also maintains a Qualified Products List (QPL), a list of products that have met prequalification requirements.

**Material Specification and Quality Assessment -** This requirements grouping consists of acceptance of materials on the project. Materials are accepted through on-site testing, laboratory testing, or a certification process. Samples are received and logged into the current systems; results of tests are recorded and then communicated to the project members. Due to the stand-alone nature of electronic systems, this process takes a long time and offers significant potential for improvement.

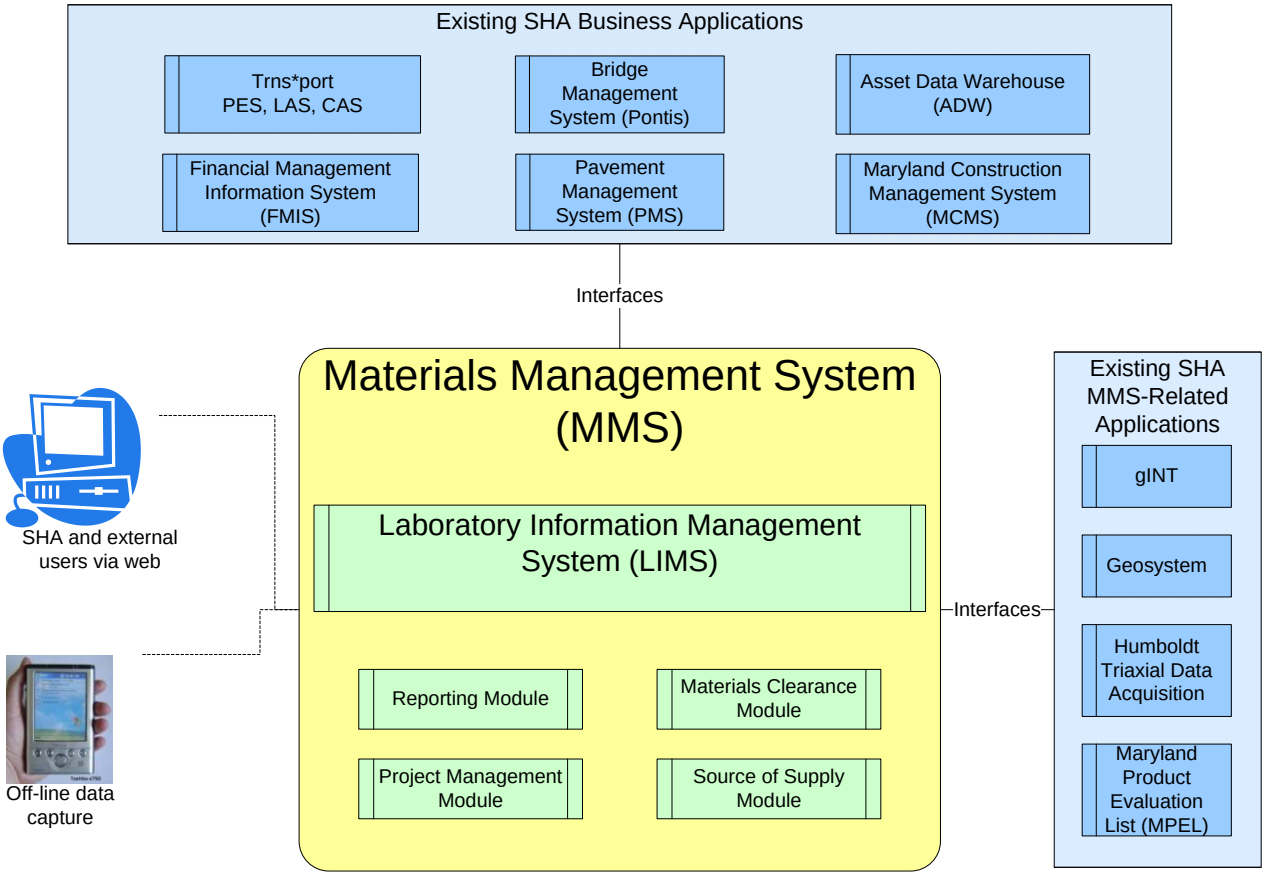
**Materials Clearance -** The materials clearance function consists of verification that the material sources are approved, documentations have been filed, quality assessment of materials has been performed, and there has been a review of placed quantities.

**Other/General -** This section presents other requirements for the MMS, including but not limited to historical data retrieval and data archival.

[c] Materials Management System Strategic Plan (January 2007)

Exhibit 1-2 below provides a conceptual overview of the proposed MMS as initially defined in the System Boundary Document (SBD).

**Exhibit 1-2: Conceptual Overview of the Proposed MMS**




### 1.4.1 System Interfaces

There is the potential for a number of interfaces between MMS and existing or planned SHA management systems. Exhibit 1-3 below provides a list of potential interfaces and the anticipated direction of data flow between the systems. Exhibit 1-4 outlines the specific MMS software development project under which it is anticipated that the interface will be developed.

**Exhibit 1-3: Potential Interfaces between MMS and Other Systems**

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Trns•port ® suite of software: Proposal and Estimates System (PES)/Letting and Awards System (LAS), Construction Administration System (CAS) | The PES, LAS or CAS modules may need to interface with the MMS to provide MMS with initial materials estimates to generate a testing guide, based on estimated quantities and the frequency guide. The CAS may need to interface with MMS to obtain test results to generate pay estimates, or this information may be available in MCMS. | Unidirectional |
| Maryland Construction Management System (MCMS) | MCMS is the construction management system used by SHA, and the MMS may need to interface with MCMS to share data, including contractor payment data, and daily work reports. It is anticipated that MCMS Navigator will be the source of MCMS information. | Unidirectional |
| Ride smoothness profiler | Ride smoothness profiler equipment is used to capture and access ride quality of new pavements. This information is then used to calculate incentive payments based on ride quality. | Unidirectional |
| Financial Management Information System (FMIS) | The MMS and FMIS will need to interface with each other to obtain cost per test data, charge codes. Effort will be made to use interfaces that already exist and are being used for various purposes. It is anticipated that more than one existing interfaces will be used to meet MMS needs. | Unidirectional |
| Geosystem | Geosystem calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. | Unidirectional |

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Humboldt Triaxial Data Acquisition | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. | Unidirectional |
| Maryland Product Evaluation List (MPEL) | MPEL is a web based system used to determine eligibility of new products. | Unidirectional |
| Pavement Management System | This system maintains an inventory of pavement on Maryland roads and is currently under redevelopment. | Unidirectional |
| HISD Database | This database stores all the existing road location information (e.g. milepoints) and will provide this information to MMS. | Unidirectional |
| GeoComp Resilient Modulus Software | This software stores the test results for the resilient modulus test performed in the soils division. | Unidirectional |

**Exhibit 1-4: External Systems Interfaces by MMS Project**

| MMS Project | Interfaces |
|---|---|
| Project I: System Management, Project Information, and Source of Supply | Trns•port ®PES, LAS, or CAS as required<br>MPEL<br>FMIS |
| Project II: Base Laboratory Information Management System | MCMS or CAS as required |
| Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs | GeoSystem<br>Humboldt Triaxial Data Acquisition<br>gINT<br>GeoComp resilient modulus software |
| Project IV: Concrete/Chemical Lab | |
| Project V: Asphalt Lab | Ride smoothness profiler<br>Brookfield apparatus<br>DSR Rheoplus V3.10 apparatus<br>Bending beam apparatus<br>Gyratory compaction equipment |

| MMS Project | Interfaces |
|---|---|
| Project VI: Structural Lab | Low cap T.O<br>Medium Universal Testing Machine 120 K<br>Universal Testing Machine 400 K |
| Project VII: Materials Clearance | MCMS |

## 1.5 System Acceptance Criteria

The functional requirements documented in the MMS Functional Requirements Document (FRD) will be allocated into testable system requirements using the business, capacity, and performance requirements as quantified in the FRD as well as the Request for Proposal (RFP), the Statement of Work (SOW), and the resulting contract for the MMS system integrator.

The allocation will be performed by the MMS system integrator in conjunction with the design phase and approved by the MMS Project Sponsor, MMS Business Lead, the SHA OIT Project Manager and the SHA OIT Contract Manager. The resulting system requirements will be included in an update to the Requirements Traceability Matrix (RTM) included in Volume III of this plan.

The MMS testing team will ensure that the MMS application meets the system acceptance criteria for all MMS projects within the program as incorporated into the system requirements baselines that are developed.

## 1.6 Security Assessment

Early in the development lifecycle, threats to the MMS application will be minimal. As development of Project I is completed and then later subsequent MMS projects are developed and completed, the MMS will mature from the Initial Operational Capability (IOC) state to the Full Operational Capability (FOC) state. At that point, threats to MMS application may increase. The vast amount of information stored about the materials being utilized on SHA's construction projects and the quality of these materials that will be available from the MMS application could make it a likely target of diverse threats, compromise of data, disruption of service, or loss of information. Testing of the MMS will be performed to establish a high degree of confidence in the security of the MMS and minimize system threats. SHA OIT, through its designated SHA OIT Security Lead for the program, will review all security requirements, tests, and test results.

The SHA OIT Security lead for the MMS program will determine the security levels required for the MMS application, internal MMS users, external MMS users, the MMS system integrator, SHA OIT staff and SHA OOTS IT staff assigned to work on the program, the MMS testing team, test environments, test facilities, and any SHA proprietary components such as interfaces with existing SHA systems.

The *MMS Security Risk Assessment (SRA)* to be developed during Project I and expanded during the Design phase for Projects II-VIII will provide more detail on the anticipated MMS security posture. The Security Risk assessment will be performed by SHA OIT after completing user

acceptance testing and prior to installing the initial release of MMS resulting from Project I and any subsequent releases of MMS from Projects II-VIII in SHA's production software environment. The MMS SRA will refer to the Requirements Analysis phase and Design phase for more information on security considerations. It will adhere to the guidelines and template outlined in the State Certification and Accreditation Guide.

## 1.7 Organization of TEMP Document

The Test and Evaluation Master Plan for the MMS program consists of three volumes. This is Volume I. The remainder of this document provides an outline of the testing strategy for the MMS program; identifies the various components required to manage, implement and execute this testing program and provides an overview of the various tests included in the testing program.

Volume II presents the recommended test cases for testing Projects I-VIII. This includes identification of test cases for subsystem test, system test, user acceptance test and security test. It also includes identification of test cases in one MMS project recommended for inclusion in regression testing conducted as part of implementation of later MMS project components.

Volume III presents the Requirements Traceability Matrix (RTM) for the MMS program, organized by project, which maps the system requirements identified in the Functional Requirements Document (FRD) to specific recommended test cases within the subsystem test, system test, and security test for Projects I-VIII.

# 2 GLOSSARY

Exhibit 2-1 below presents a list of business terms and testing terms relevant to the MMS project and the working definitions of these terms in the context of the MMS TEMP.

**Exhibit 2-1: Glossary of MMS Project Terms**

| Reference or Acronym | Definition |
|---|---|
| **AASHTO** | American Association of State Highway Transit Officials |
| **Acceptance Criteria** | The criteria that a system or component must satisfy in order to be accepted by a user, customer, or other authorized entity |
| **Acceptance Testing** | (1) Formal testing conducted to determine whether a system satisfies its acceptance criteria and enables the customer to determine whether to accept the system. (2) Formal testing conducted to enable a user, customer, or other authorized entity to determine whether to accept a system or component |
| **CAS** | Construction Administration System which is part of the American Association of State Highway Transportation Officials Trns•port ® software suite and is used by SHA to support some construction administration activities. |
| **CATS** | The State of Maryland's Consulting and Technical Services contract vehicle administered by the Department of Budget and Management and used by SHA for project planning, requirements definition and project management services through various contract task order vehicles. This TEMP was developed through the CATS contract vehicle. |
| **COTS** | Commercial-Off-the-Shelf Software Package |
| **Configuration Management** | The discipline of identifying the configuration of a hardware/software system at each life cycle phase for the purpose of controlling changes to the configuration and maintaining the integrity and Traceability of the configuration through the entire life |
| **Configuration Item** | An aggregation of hardware, software, or both, that is designated for configuration management and treated as a single entity in the configuration management process |
| **Configuration Software Item** | An aggregation of software that is designated for configuration management and treated as a single entity in the configuration management process |
| **Cutover Plan** | Planning document which specifies the tasks and steps which will need to be performed in order to migrate the MMS software solution into production status |
| **Development Testing** | Formal or informal testing conducted during the development of a system or component, usually in the development environment by the developer |
| **FHWA** | Federal Highway Administration |

| Reference or Acronym | Definition |
|---|---|
| **FMIS** | Financial Information Management System |
| **FRD** | Functional Requirements Document |
| **Functional Review** | The Functional and Data Requirements Review is conducted in the Requirements Analysis Phase. This is where the functional requirements identified in the FRD are reviewed to see if they are sufficiently detailed and can be allocated to testable requirements. It also provides the project management with the opportunity to ensure a complete understanding of the requirements and that the documented requirements can support a detailed design of the proposed system |
| **Functional Testing** | Testing that ignores the internal mechanism of a system or component and focuses solely on the outputs generated in response to selected inputs and execution conditions. (2) Testing conducted to evaluate the compliance of a system or component with specified functional requirements |
| **GAB** | Graded Aggregate Base |
| **Geosystem** | Calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. |
| **GIS** | Geographic Information Systems |
| **Hardware Configuration Item** | Hardware items that include disks, disk drives, display screens, keyboards, printers, boards, and chips |
| **HMA** | Hot Mix Asphalt |
| **Humboldt Triaxial Data Acquisition** | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. |
| **Installation and Check-out Phase** | The period of time in the software life cycle during which a software product is integrated into its production environment and tested in this environment to ensure that it performs as required |
| **Intangible Benefits** | Any benefits that cannot be assigned a specific dollar value are expressed as intangible benefits. These benefits are expressed in terms of improved mission performance, improved decisions making, or more reliable or usable information. Many public goods and services are difficult to reliably and precisely quantify in dollar units. However, intangible benefits are vital to understanding the total outcome of implementing a particular IT system. |
| **Integration Testing** | Testing in which software components, hardware components, or both are combined and tested to evaluate the interaction between them |
| **IV&V** | Independent verification and validation reviews conducted by another consulting firm under contract to the State to review the status of the project from an outside, objective perspective at pre-determined project milestones |

| Reference or Acronym | Definition |
|---|---|
| **LAS** | Letting and Awards System |
| **LIMS** | Laboratory Information Management System |
| **LOD** | Landscape Operations Division |
| **Load Testing** | Testing that studies the behavior of the program when it is working at its limits. See also: ***Stress Testing*** |
| **Maryland Product Evaluation List (MPEL)** | A web based system used to determine eligibility for the Qualified Products List |
| **Marylandware System** | Records and calculates Density and Mix test results from QA and QC sources. Allows electronic exchange of data through emailing of text based data files |
| **Material specification and quality assessment** | This phase consists of acceptance of materials on the project |
| **Materials clearance process** | A systematic method to assess and approve the quality of different constituent materials that are used as part of the construction process |
| **MCMS** | Maryland Construction Management System |
| **OIT** | SHA Office of Information Technology |
| **OMT** | SHA Office of Materials Technology |
| **OOC** | SHA Office of Construction |
| **OOTS** | SHA Office of Traffic Services |
| **Operational Testing** | Testing conducted to evaluate a system or component in its operational environment |
| **Oracle** | An industry-strength database system, which is used as the database management system for a number of SHA systems |
| **PCC** | Portland Cement Concrete |
| **PES** | Proposal and Estimates System |
| **PMS** | Pavement Management System - Maintains an inventory of pavement on Maryland roads. |
| **Path Testing** | Testing that is designed to execute all or selected paths through a computer program |
| **Pass/Fail Criteria** | Decision rules used to determine whether a software item or software feature passes or fails a test |
| **Performance Testing** | Testing conducted to evaluate the compliance of a system or component with specified performance requirements |
| **Project Management** | Refers to project management activities performed on a project. This includes activities like maintaining high level project information, store project documentation, and track project tasks. |
| **QPL** | Qualified Products List |
| **Quality Control (QC)** | (1) The process of monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance. (2) The organizational unit that is assigned responsibility for quality control |
| **RFP** | Request for Proposal |

| Reference or Acronym | Definition |
|---|---|
| **Regression Testing** | Selective retesting of a system or component to verify that modifications have not caused unintended effects and that the system or component still complies with its specified requirements |
| **RIDETOOL** | Used to capture and access ride quality of new pavements and is used to calculate incentive payments based on ride quality. |
| **SATD** | Soils and Aggregates Technology Division |
| **SBD** | System Boundary Document used to document the scope of an SHA development project. |
| **SDLC** | System Development Life Cycle is the Maryland Department of Information Technology process utilized by SHA to design and implement new systems. |
| **Scenario** | Selective retesting of a system or component to verify that modifications have not caused unintended effects and that the system or component still complies with its specified requirements |
| **Security Testing** | Security testing is intended to ensure that adequate security and controls is in place for the new system. The security test ensures that unauthorized users will not have access to system features or functions which they are not authorized to. It will also ensure that users will not have the ability to change or modify data that they may be authorized to view but are not authorized to change |
| **SiteManager®** | Module of the American Association of State Highway Transportation Officals Trns•port ® suite which provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization and includes a module for materials management. |
| **Source of Supply** | This phase refers to the review of the sources of material supply that the contractors propose to use on the project. |
| **Stress Testing** | Testing conducted to evaluate a system or component at or beyond the limits of its specified requirements. See also: ***Load testing*** |
| **Structural Testing** | Testing that takes into account the internal mechanism of a system or component. Types include branch testing, path testing, statement testing |
| **Subsystem Integration Testing** | Testing the functionality of related groupings of system functionality and how these logical groupings or subsystems perform their intended functions including required interactions with other systems |
| **System Management** | Refers to the overall technical management of the MMS |
| **System Testing** | Testing conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements |

| Reference or Acronym | Definition |
|---|---|
| **Tangible benefits** | Any benefits that can be quantified are expressed as tangible benefits. These benefits are expressed in dollars or in units in this document. The result of tangible benefits may be: increased revenue, streamlined production, or saved time and money. |
| **Test** | An activity in which a system or component is executed under specified conditions, the results are observed or recorded, and an evaluation is made of some aspect of the system or component |
| **Test Case Specification** | A document specifying inputs, predicted results, and a set of execution conditions for a test item |
| **Test Configuration and Environment** | All software, hardware and databases used for testing. The model and version numbers, as well as how they are configured is documented |
| **Test Design and Specification** | Documentation specifying the details of the test approach for a software feature or combination of software features and identifying the associated tests |
| **Test Incident Report (TIR)** | A document reporting on any event that occurs during the testing process that requires investigation |
| **Test Item** | A software item that is an object of testing |
| **Test Log** | A chronological record of relevant details about the execution tests |
| **Test Phase** | The period of time in the life cycle during which components of a system are integrated, and the product is evaluated to determine whether or not requirements have been satisfied |
| **Test Plan** | A document describing the scope, approach, resources, and schedule of intended testing activities. It identifies test items, the features to be tested, the testing tasks, who will do each task, and any risks requiring contingency planning |
| **Test Procedure** | (1) Detailed instructions for the set-up, execution, and evaluation of results for a given test case. (2) A document containing a set of associated instructions as in (1). (3) Documentation specifying a sequence of actions for the execution of a test |
| **Test Readiness Review (TRR)** | A review conducted to evaluate preliminary test results for one or more configuration items and verify that the test procedures for each configuration item are complete, comply with test plans and descriptions, and satisfy test requirements. This will also verify that a project is prepared to proceed to formal testing of the configuration item |
| **Test Summary Report** | A document summarizing testing activities and results. It also contains an evaluation of the corresponding test items |

| Reference or Acronym | Definition |
|---|---|
| **Testability** | (1) The degree to which a system or component facilitates the establishment of test criteria and the performance of tests to determine whether those criteria have been met. (2) The degree to which a requirement is stated in terms that permit establishment of test criteria and performance of tests to determine whether those criteria have been met |
| **Testing** | (1) The process of operating, observing or recording the results, and making an evaluation of some aspect of the system or component a under specified conditions. (2)The process of analyzing and evaluating the features of a software item to detect the differences between existing and required conditions (i.e., bugs) |
| **Trns•port ®** | Trade name for a suite of preconstruction and construction management products marketed by the American Association of State Highway Transportation Officials. SHA is currently utilizing four of the available products: PES – Proposal and Estimates System; LAS – Letting and Awards System; CAS – Construction Administration System, and DSS – Decision Support System. |
| **Unit Testing** | The testing of individual hardware or software units or groups of related units (i.e., component, modules) |
| **User Acceptance Testing** | User acceptance testing marks the final phase of the testing process prior to initiating production operations. In this phase, the system is tested by the user community in a way which models anticipated production operations, but on a smaller scale than the expected production user base |

# 3 REFERENCES

This section contains a bibliography of references used to produce this document. The key project references specific to this project are listed below:


- MMS Project Charter (January 2008)
- System Concept Proposal (January 2008)
- Materials Management System Strategic Plan (January 2007)
- Maryland's 2007-2012 Consolidated Transportation Program http://www.mdot.state.md.us/Planning/Plans%20Programs%20Reports/Programs/CTP%2007-12/Cover_ToC/Table%20of%20Contents
- Code of Federal Regulations, Title 23, Part 637, "Construction Inspection and Approval"
- MDOT Information Systems Security Plan http://www.e-mdot.com/Contract_Opportunities/Documents/MDOT%20IT%20Security%20Plan.doc
- Maryland Department of Information Technology Security Policy and Standards http://doit.maryland.gov/support/Pages/SecurityPolicies.aspx
- SHA Computer Architecture Standards for Information Technology
- Maryland Department of Transportation State Highway Administration Mission and Vision Statements and Values http://www.sha.state.md.us/aboutus/orgChart/OC/missionvision.asp
- SHA Materials Management System Project: System Boundary Document (May 2008)
- SHA Materials Management System Project: Risk Management Plan (May 2008)
- SHA Materials Management System Project Management Plan (September 2008)
- The Test Analysis Report Template included in the Maryland Department of Information Technology's System Development Lifecycle (SDLC) Manual
- A sample Test and Evaluation Master Plan deliverable previously prepared for SHA for another project for use as a template in developing this document to ensure consistency across SHA projects

# 4 MMS TEST TEAM

The MMS test team consists of representatives on the SHA MMS project team from OMT, OIT and OOTS IT and the MMS system integrator. These individuals will perform each of the following roles required to support the MMS testing program (some personnel may execute multiple roles):

- MMS Project Sponsor
- MMS Business Lead
- SHA OIT MMS Project Manager
- MMS Test Team Leader
- Test Engineer
- Reviewer
- Resident Expert
- Configuration Management (CM) Specialist
- Quality Control (QC) Specialist
- Risk Officer
- MMS System Integrator Lead
- MMS System Integrator Testing Team
- MMS System Integrator Development Team
- SHA OOTS IT Development Team
- SHA OIT Development Team
- SHA OMT Business Team
- SHA OIT Security Lead

## 4.1 Roles and Responsibilities

Exhibit 4-1 below outlines the primary responsibilities of each role.

**Exhibit 4-1 MMS Testing Team Roles and Responsibilities**

| Roles | Required Responsibilities |
|---|---|
| **MMS Project Sponsor** | • Ensure the appropriate number and type of user resources are available to lead user acceptance testing and support the entire testing process<br>• Meet with the MMS Business Lead periodically to review the status of testing and the production readiness of the application<br>• Review the status of testing throughout the testing process with the MMS Business Lead<br>• Sign-off on the decision to move the application into production (or any decision to delay system go-live) based on the recommendations of the MMS Business Lead |
| **MMS Business Lead** | • Ensure user resources are available to assist in defining user acceptance test cases and participating in user acceptance testing<br>• Lead preparation of system test cases and user acceptance test cases for Project I<br>• Coordinate with MMS Test Lead planning and execution of system test and user acceptance test for Project I<br>• Review system test cases being prepared by the MMS system integrator for Projects II-VIII to ensure these test cases are addressing key business requirements<br>• Periodically review test results to ensure the software satisfies its requirements<br>• Recommend to MMS Project Sponsor whether to advance the system into production based on user acceptance testing |
| **SHA OIT MMS Project Manager (PM)** | • Responsible for the successful management of the work, including:<br>• Identifying, tracking managing and resolving project-level testing issues<br>• Proactively disseminating project testing information to all stakeholders<br>• Identifying, managing and mitigating test project risk<br>• Ensuring that the solution is of acceptable quality<br>• Proactively managing scope to ensure that only what was agreed to is delivered, unless changes are approved through scope management<br>• Defining and collecting metrics to give a sense for how the project is progressing and whether the deliverables produced are acceptable<br>• Managing the overall schedule to ensure work is assigned and completed on time and within budget |

| Roles | Required Responsibilities |
|---|---|
| **MMS Test Team Leader** | • Responsible for identifying any formal testing standards, then ensuring that those standards are being followed<br>• Ensure that system acquisition activities relative to the test effort adhere to relevant standards, best practices, and conventions<br>• Identify what to test and determine when testing resources are needed to ensure adequate test preparation<br>• Determine and acquire needed test environment and support, including tools such as:<br>  • RTM and Test tracking tool<br>  • Problems and Issues tracking tool<br>• Monitor and control test work products and test results<br>• Oversee overall testing effort<br>• Prepare system test plan for Project I in conjunction with MMS Business Lead<br>• Develop user acceptance test plan for Projects I-VIII and revise the plan, as needed<br>• Lead system testing for Project I and user acceptance testing for Projects II-VIII<br>• Review test work products to ensure that they are complete and are developed according to plan<br>• Review test scripts and scenarios to ensure they satisfy acceptance criteria<br>• Review and validate test plans, procedures, scripts, and scenarios<br>• Review test analysis report templates<br>• Review test results to determine whether software satisfies its requirements<br>• Administer RTM and Test Tracking tool<br>• Administer Problems and Issue Tracking tool<br>• Manage the RTM and tests tracking, issues tracking, test problem tracking , system software and hardware configuration items (HWCIs) tracking, and database loading/refresh scheduling<br>• Attend test related peer reviews<br>• Attend Test Readiness Reviews (TRRs) |

| Roles | Required Responsibilities |
|---|---|
| **Test Engineer** | • Review test scripts and scenarios to ensure they satisfy acceptance criteria<br>• Review test results<br>• Ensure testing is conducted per the test plan or procedures<br>• Conduct QC audits of testing process<br>• Perform QC inspections<br>• Coordinate set-up of required testing environments (hardware and software)<br>• Resolve technical issues as they arise |
| **Reviewers (OMT)** | • OMT staff typically at the manager or supervisor level with subject matter expertise in various functional areas<br>• Witness test execution during development testing<br>• Execute and validate tests during acceptance testing<br>• Participate in testing activities at a level of involvement needed to have an overall awareness of system functionality and be prepared to confirm/validate their units readiness to implement the various projects within the MMS program<br>• Recommend to SHA MMS Business Lead whether to move application into production based on the results of user acceptance testing |
| **Resident Experts (OMT)** | • OMT staff with subject matter expertise in various functional areas<br>• Witness test execution during development testing<br>• Execute and validate tests during acceptance testing<br>• Participate in testing activities at a level of involvement needed to be prepared to assist with training and act as a first line of support of the system during production operations as the various projects are implemented<br>• Provide input to Reviewers and SHA MMS Business Lead whether to move application into production based on the results of user acceptance testing |
| **CM Specialist** | • Schedule and conduct software builds (or installs)<br>• Ensure test environment configuration is controlled<br>• Conduct configuration management (CM) audits |

| Roles | Required Responsibilities |
|---|---|
| **QC Specialist** | • Responsible for conducting or ensuring conduct of periodic reviews of source code for adherence to SHA and State standards<br>• Responsible for performing or ensuring performance of periodic audits of testing process throughout the MMS testing program to ensure adherence to SHA and State standards and adherence to the overall testing strategy as defined in the TEMP<br>• Responsible for ensuring the overall quality of the MMS testing program and that the testing program is meeting its objective of evaluating the effectiveness of the resulting MMS application to meet the business requirements as defined |
| **Risk Officer** | • Uncover and assess technical risks during testing phases<br>• Assist in developing risk mitigation plans<br>• Track and report risk information to the MMS Project Sponsor, MMS Business Lead and SHA OIT Project Manager for tracking of risks and identification and execution of risk response strategies |
| **MMS System Integrator Lead** | • Ensure program development documentation maps to the project documentation<br>• Review and validate all development test plans, test design specifications, procedures, scenarios, cases, and scripts for Projects II-VIII |
| **MMS System Integrator Testing Team** | • Develop and execute test design specifications, procedures, scenarios, cases, and scripts for Projects II-VIII<br>• Execute test plan(s) for subsystem test and system test for Projects II-VIII<br>• Assist and support SHA execution of user acceptance testing for Projects II-VIII<br>• Attend peer reviews of requirements and software to ensure in depth knowledge of the functionality of the software<br>• Peer review test plan(s), procedures, test cases, test scripts, and scenarios for Projects II-VIII<br>• Analyze each requirement to verify it can be tested<br>• Document and monitor test issues and track to closure<br>• Perform tool administration<br>• Participate in test related peer reviews<br>• Participate in TRRs |

| Roles | Required Responsibilities |
|---|---|
| **MMS System Integrator Development Team** | • Perform unit testing and subsystem integration testing for all components developed by the MMS system integrator for Projects II-VIII<br>• Make necessary program fixes during subsystem test, system test, user acceptance test, security test and regression test for Projects II-VIII for all components developed by the MMS system integrator |
| **SHA OOTS IT Development Team** | • Perform unit testing for all components developed by the team for Project I<br>• Make necessary program fixes during subsystem test, system test, user acceptance test and security test for Project I<br>• Make necessary program fixes during subsystem test, system test, user acceptance test, security test and regression test for Projects II-VIII for any Project I components requiring modification to support Projects II-VIII |
| **SHA OIT Development Team** | • Perform unit testing and subsystem integration testing for all components developed by OIT staff (components of interfaces to other systems, etc.) for Projects I-VIII<br>• Support system test and user acceptance test execution of any interface or other components developed by SHA OIT for Projects I-VIII<br>• Make necessary program fixes during system test, user acceptance test and security test for all components developed by OIT |
| **Other SHA Business Team Members (OMT, OOF, OOC)** | • Develop user acceptance test cases and test scripts<br>• Conduct user acceptance testing<br>• Document and monitor test issues identified during user acceptance testing<br>• Recommend to SHA Senior Business Lead and Business Lead whether to move application into production based on the results of user acceptance testing |
| **SHA OIT Security Lead** | • Responsible for developing detailed test cases for security testing and executing the security tests for Projects I-VIII<br>• Documents whether the application is compliant with State, MDOT and SHA security standards and guidelines and any specific MMS application security requirements<br>• Recommends configuration changes if required to meet State, MDOT and SHA security standards and guidelines or MMS specific security requirements |

## 4.2 Staffing

Specific staff assignments for the MMS testing team will be identified in each project phase maintained as part of the *MMS Program Management Plan* (PMP).

## 4.3 Status Reports

Testing activities will be reported on a regular basis. For Project I, during the unit testing activities, the SHA OOTS IT Development Team will provide testing activity status reports to the SHA OIT MMS Project Manager and the MMS Business Lead. Status reports on subsystem testing, system testing, user acceptance testing and security testing for Project I will be prepared by the MMS Test Team Lead, with support from the MMS Business Lead and the SHA OIT MMS Project Manager.

For Projects II-VIII, the MMS system integrator will provide testing activity status reports to the SHA OIT MMS Project Manager, the MMS testing team, and any other affected groups on a regular basis for development testing activities. During user acceptance testing activities, the MMS testing team will provide testing activity status reports to the MMS Business Lead and MMS Project Sponsor.

The frequency and process for posting these reports will be consistent with the MMS Communication Plan as defined in the *MMS PMP*.

## 4.4 Management and Quality Control (QC) Reviews

All testing activities including development testing and user acceptance testing will be reviewed in regularly scheduled project status meetings and Steering Committee meetings. In addition, the testing process will be subject to quality control reviews and audits as described in Section 7.0 of this document.

## 4.5 Test Readiness Reviews (TRRs)

TRRs are technical in nature and will be conducted by members of the MMS system integrator team (e.g., development engineers, testing engineers, QC specialists, CM specialists) with SHA MMS testing team representatives in attendance. The goal of the review is to ensure that all related test items and materials have been completed and are ready for turnover to the next test phase. Additionally, the TRR provides SHA management with the assurance that the software has undergone a thorough test process. This review will be held at the completion of all subsystem integration testing activities and at the completion of system testing.

# 5 TEST AND EVALUATION (T&E)

The MMS testing program consists of development tests, user acceptance tests, security tests and regressions tests. Within development test, there are three test levels: unit test, subsystem integration test and system test.

For Project I, unit test will be responsibility of the SHA OOTS IT development team. Subsystem test and system test will be the responsibility of the MMS testing team. This includes coordinating with SHA OIT staff who support Trns*port, MCMS, CAS or other systems which integrate with Project I and whose interfaces will require testing. User acceptance test and security test for Project I will be the responsibility of the MMS testing team.

For Projects II-VIII, the MMS system integrator will prepare a Contractor's Test Plan that identifies all of the elements of development test. The MMS test team will prepare the user acceptance test plan for Project II-VIII, with guidance, assistance and support from the MMS system integrator. The user acceptance plan outlines the scope of the user acceptance test that will be performed by the SHA end-users. The designated SHA OIT Security Lead will prepare the security test plan.

The Contractor's Test Plan will identify all tests that will be conducted to demonstrate that the technical and performance requirements specified in the contract have been met. This Contractor's Test Plan should also define development tests that need to be performed by other parties such as SHA OOTS IT or SHA OIT who either support MMS Project I components or other SHA systems that will integrate with MMS.

The Contractor's Test Plan describes the *test activities* of the subsystem integration test and the system test in progressively higher levels of detail as the system is developed; the *actual or subordinate tests* to be performed are documented using Test and Evaluation (T&E) Test Plans. The Contractor's Test Plan will be developed in accordance with the guidance described in Appendix A that provides the format for the Contractor's Test Plan and Appendix B that provides a high level outline for a T&E Test Plan**.**

The SHA MMS test team's user acceptance test plan will describe the activities to be performed during the user acceptance test, with the actual tests documented using T&E Test Plans as defined in Appendix B. The security test plan will describe in detail the activities to be performed during the security test.

Unit tests are documented during the development phase using the Software Development Document.

Taken together, the Contractor's Test Plan and the MMS test team's user acceptance test plan and security test plan is structured to:

- Provide essential information to support decision-making
- Provide essential information for assessing technical risk

- Determine the technical performance parameters of the design and architecture
- Verify the attainment of technical performance specifications and objectives
- Verify that systems are operationally effective and suitable for their intended use

The MMS testing team will monitor test items, features, methods, processes, and documentation for compliance with standards and testing adequacy. To improve the testing process, the MMS testing team will capture metrics. The team will use metric reports to analyze and report on the status of testing. Please refer to the discussion of metrics in Section 5.8 for a comprehensive description of metric activities.

Development testing and acceptance testing will be oriented toward demonstrating system performance as required by the *MMS FRD*. SHA OIT staff or MMS system integrator staff assigned to perform the quality control (QC) and configuration management roles will conduct assessments during the development testing effort in order to determine programmatic risk, to support TRRs, and the subsequent acceptance testing. The user acceptance testing effort will collect data to support overall test objectives that will demonstrate that each MMS project within the program meets the requirements for that specific project. The SHA Business Lead and the SHA OIT Project Manager will conduct TRRs to ensure that the software, hardware, test environments, test facilities, and test engineers are ready to begin testing.

The MMS testing team will establish the necessary discipline, rigor, and structure to achieve the objectives of test and evaluation by implementing and managing the testing strategy, assigning resources, witnessing testing, and monitoring results.

Additional processes that precede testing are outlined in Section 8, Test and Evaluation Resource Summary.

## 5.1 Limitations

There are no identified test limitations at this time, since the same equipment (or type of equipment) is planned to be used for both the production and the testing environments (please refer to Section 5.4, User Acceptance Test Overview and Section 8.2, Test Environment and Facilities).

## 5.2 Traceability (Functional Requirements Traceability Matrix)

Volume III of this MMS Test and Evaluation Master Plan contains the initial MMS Requirements Traceability Matrix (RTM). This matrix version is based on the functional and operational requirements described in the *MMS Functional Requirements Document*. It will be expanded during the design phase for Projects II-VIII to include other requirements deemed appropriate for the testing program including any additional requirements specified in the RFP, the SOW, the contract and other subordinate documents (all such requirements are referred to in this document as system requirements). The MMS RTM clearly identifies the specific test case(s) within each type of testing appropriate for that requirement which can be used to verify that the particular requirement has been addressed within the MMS application. Each system requirement will be assigned to at least one defined test category and one test case within that

category; however, in actual practice, most requirements will be tested in subsystem integration test, system test and user acceptance test. Requirements that specify a level of security or authorization to perform a function are also tested during the security test. Requirements in one MMS project may also be recommended for inclusion regression testing to be performed prior to implementing subsequent MMS projects in order to ensure that the development and implementation of later projects have not in some way impacted the ability of the MMS application to fully meet the requirement. The RTM will be maintained as a separate document throughout the design phase and the implementation test phases for all MMS projects. It will be maintained using Microsoft Excel or another automated tool recommended by the MMS system integrator.

## 5.3 Development Test

The objectives of development tests are to verify the status of development, verify that design risks have been minimized, demonstrate that all technical and performance requirements specified in the contract are met, and certify readiness for user acceptance testing. Development testing is structural in nature and will consist of unit, subsystem integration, and system testing.

For Project I, unit test will be responsibility of the SHA OOTS IT development team. Subsystem test and system test will be the responsibility of the MMS testing team

For Projects II-VIII, all aspects of development testing will be coordinated by the MMS system integrator. It will be performed as appropriate by the MMS system integrator and the SHA OIT OOTS development team and/or SHA OIT for any development components developed by these organizations. Development testing can be witnessed by OIT staff performing a quality control or configuration management function, the MMS testing team, and any other designated representatives.

The development test will be conducted in the development environment established by SHA for this purpose and/or for Projects II-VIII a development environment provided by the MMS system integrator (depending on specific project approach of the selected MMS system integrator). The MMS system integrator will prepare test analysis reports during testing at the subsystem integration test level and higher. Please refer to Section 6.0, Test Reporting for details.

Although the specific development test events have yet to be determined, it is important to note that development testing must occur for every release (i.e., preliminary, production) of all eight planned MMS projects. All development test activities will be performed and associated documentation (e.g., test plans, test case specifications, and test logs) will be generated for each release. Currently, only one production release per project is planned for the initial implementation of each of the eight distinct MMS projects. No preliminary or pilot releases, for example, are planned for any of the projects.

### 5.3.1 Unit Test

This phase of testing is considered the basic level of testing that focuses on the smaller building blocks of a program (e.g., components, modules) or system separately. Unit testing is the earliest phase of testing and is the most cost-effective phase in removing

defects. Unit testing permits the testing and debugging of small units, thereby providing a better way to manage the integration of the units into larger units. The detailed unit design is used as a basis to compare how and what the unit is able to perform. Unit testing will be conducted by the following parties:

- The MMS system integrator for any development component in Projects II-VIII which it created including extract programs from MMS, load programs into MMS and any transformation programs

- The SHA OOTS IT and SHA OIT developers for any development component that these staff create including Project I components requiring modification, extracts from other SHA systems and/or load programs into another SHA system or the GIS environment

- Any third party system integrators under contract to SHA to support a management system for any development component that these integrators create including extracts from or loads into other management systems that part of an MMS interface program unit

The party performing the unit testing activity will be responsible not only for conducting the unit tests, but will also be required to document all testing performed along with the results. Unit testing will be generated and prepared according to the required format for software development documents, which are subject to review by the configuration management and quality control functions and the MMS testing team.

Unit testing can be witnessed on a spot basis by SHA OIT staff assigned to perform the quality control and configuration management functions.

### 5.3.2 Subsystem Integration Test

Following unit testing and prior to the beginning of system testing, groups of related units are fully tested together. This process is known as the subsystem integration test. This is also sometimes called software qualification testing.

During subsystem integration testing, program units are systematically added one or more units at a time to the core of already integrated modules. The goals of subsystem integration testing are to verify that program units interact correctly and that any hardware configuration items (HWCIs) and computer software configuration items (CSCIs) are integrated adequately.

For Project I, subsystem integration testing will be managed and coordinated by the MMS Business Lead and the MMS Test Lead. For Projects II-VIII, subsystem integration testing will be managed and coordinated by the MMS system integrator to demonstrate accurate operation of the integrated units. However, all parties responsible for developing program units will need to participate in subsystem integration testing including SHA OIT OOTS and SHA OIT development staff that developed custom

program modules, extracts or load routines which are part of the MMS application architecture.

Subsystem integration testing can be witnessed by the designated SHA quality control function and the MMS testing team. Subsystem integration test plans will be generated and prepared according to the T&E Test Plans specification provided in Appendix B. The subsystem integration test plan is subject to review by SHA's assigned configuration management and quality control staff and by the MMS testing team.

### 5.3.3 System Test

System test, which is sometimes also known as system qualification testing, involves an end-to-end verification of the entire system from a business process perspective. The purpose of system test is to check the system as a whole for functionality and fitness for use based on the system test plan. The goals of system test are to verify that functions are carried out correctly and that certain nonfunctional characteristics are present (e.g., usability testing, performance testing, and stress testing).

System test for Project I will be managed, coordinated and conducted by the MMS Business Lead and MMS Test Team Lead and executed by the members of the MMS test team. Program fixes for Project I will be made as required by the SHA OOTS development team.

System test will be managed, coordinated, and conducted by the MMS system integrator. However, all parties who performed development activities will need to be available to support the system test and to make any required program fixes to program units they developed.

System testing can be witnessed by the assigned SHA quality control function and the MMS testing team. System test plans will be prepared according to the T&E Test Plans specification in Appendix B. The system test plan is subject to review by SHA's assigned configuration management and quality control functions and the MMS testing team.

### 5.3.4 Development Test Entrance and Exit Criteria

The development test entrance criterion includes baseline requirements, and completed and approved T&E Test Plans (including approved test cases and test procedures) for development tests. Exit criteria or successful completion of development test requires that:

- All the test documentation has been approved (e.g., test plans and test procedures)
- All test scripts have been executed and trouble reports are generated for each failure or anomaly
- All trouble reports have been resolved (i.e., trouble reports have been fixed or deferred to a later release with approval)

- All changes made as a result of trouble reports have been tested
- The test analysis report has been reviewed and approved, and
- All documentation associated with the specific project within the MMS program or the particular functions of the MMS application included in the scope of the project effort has been updated to reflect changes made during testing

The MMS test team (for Project I) and the MMS system integrator (for Project II-VIII) is responsible for managing the completion of the documentation associated with development test activities. This involves either completing the documentation or ensuring that the party that performed the development activities completes the necessary documentation.

It will be the responsibility of the MMS Business Lead, in conjunction with the SHA OIT Project Manager, to determine whether the project is ready to move between phases of the development test, that is from unit test to subsystem integration test to system test. The MMS Business Lead will have the responsibility for making a recommendation to the MMS Project Sponsor that development test is complete and that the project is ready to move from development test to user acceptance test.

## 5.4 User Acceptance Test

User acceptance testing involves the execution of structured test cases by OMT and other SHA business and technical staff to verify that the MMS application supports SHA's business operations per the documented system requirements without any identified significant defects and without any material work arounds being required.

For Project II through Project VIII, the user acceptance test is also a contractual decision point where the MMS application components and documentation associated with the MMS is handed from the MMS system integrator to the MMS testing team for T&E from a user's perspective. User acceptance testing is primarily functional in nature though it will also include system usability testing and performance testing.

User acceptance testing also includes verification of any planned user training, any user manuals and the on-line help function of the system. This is accomplished by putting the users who will be performing testing through the end-user training prior to the start of testing and by providing them with the system manuals and other job aids for use during testing. All MMS documentation (e.g., user manuals, online help, online tutorial) will also be tested (i.e., compare documentation and system keystroke by keystroke) and evaluated for technical accuracy, conformance, and usability.

Likewise, user acceptance testing will also include two configuration management and quality control audits, known as the Physical Configuration Audit (PCA) and the Functional Configuration Audit (FCA). These audits will verify that the configuration identification for a configured item is accurate, complete, and meets specified program needs. Guidance for

conducting audits is found in the *MMS Configuration Management Plan (CMP)*. The CMP will be developed by SHA at the beginning of the MMS Development Phase for Projects II-VIII.

The objectives during user acceptance test are to demonstrate that the MMS is operationally effective and operationally suitable for use by trained users in a representative production environment, and to determine that SHA's infrastructure is ready to accept the system in a realistic environment before deployment. During user acceptance test, the involvement of key users across OMT known as reviewers and resident experts and other SHA staff as appropriate will be encouraged by the MMS testing team to ensure that production system issues are identified early.

A frequent perception of testing is that the principal goal is program verification; however, several other goals exist. The main user acceptance test goals are to:

- Ensure the software satisfies the user requirements and expectations
- Stress the software at all levels by identifying discrepancies, discovering deficiencies, determining limitations, and verifying interfaces
- Demonstrate and integrate capabilities by proving the software's ability to handle a wide spectrum of data values, recognize data dependency on the expected environment, and demonstrate requirements satisfaction
- Illustrate system usefulness by demonstrating operational capabilities, proving adequacy of documentation, and gaining user acceptance

User acceptance testing certifies that the system, including software, satisfies all the requirements. A user acceptance test will not be performed until the software has successfully completed development testing. User acceptance testing will involve trained users exercising production representative MMS configurations in a realistic manner to determine the degree to which the system satisfies the stated operational requirements in the *MMS FRD*.

User acceptance testing will be performed on a test bed to be established in an SHA controlled environment. Much of the data in this test bed will be populated by executing test cases in the user acceptance test to perform the initial data loads required for the MMS application. This test bed will be hosted in an environment resembling production. This could be accomplished for Project I by utilizing the equipment to be used for the production environment for user acceptance testing. A separate user acceptance test environment will then need to be established to support Projects II-VIII. In addition, a user acceptance test environment will be required for systems which integrate with MMS such as MCMS, CAS and FMIS.

Throughout user acceptance testing, various assessment techniques such as stress, performance, and load/volume tests will be used. User acceptance testing activities will be carried out in accordance with this TEMP, the CMP and the MMS user acceptance test plan for each individual project.

The user acceptance test plan and test scripts for user acceptance test will be developed by the SHA MMS test team. For Projects II-VIII, the SHA MMS team will be guided and assisted in this activity as required from the MMS system integrator.

The test plan and the associated test scripts for user acceptance test is usually similar to that used for system test, with the exception that some test cases may be omitted for various reasons and potentially different data values or data volumes utilized. Appendix B illustrates the format for the T&E Test Plan for user acceptance test.

User acceptance test results form the basis of the MMS testing team's recommendation to the MMS Business Lead regarding acceptance and deployment readiness of each of the eight individual projects within the MMS program. This recommendation will then be presented to the MMS Project Sponsor for final sign-off.

### 5.4.1 User Acceptance Test Entrance and Exit Criteria

The user acceptance test entrance criteria for each individual MMS project include:

- Successful completion of all development test phases
- Baseline configuration management controlled documentation, software, and hardware
- Completed and approved T&E Test Plans (including approved test cases and test procedures) for user acceptance test

Upon the completion of user acceptance test, a user acceptance test report will be prepared using the Test Analysis Report and the Test Analysis Approval Determination form discussed in Section 6.0, Test Reporting.

In order to sign-off on user acceptance test and by extension the readiness of each individual MMS project or MMS system component to be deployed into production, the following conditions must hold:

- Any material issues classified as a high priority impacting business operations must be resolved
- Any issues classified as a medium priority where the system does not work per the system requirements but there is an acceptable work around must have an agreed to resolution date, generally within thirty days of the target Go-Live date
- Any minor issues classified as a low priority are inventoried and identified for future maintenance releases and any requests for future enhancements identified during user acceptance test are logged
- The users are prepared to use the system as demonstrated by the user acceptance test process

- The end-user training and user manuals have been verified by the MMS testing team and deemed acceptable to prepare end-users for production operations and to support them during production

- The required technical infrastructure for the MMS production environment is in place

- Security test and regression test (see Sections 5.5 and 5.6 below) has been successfully completed with no material or high priority issues remaining open

## 5.5 Security Test

A security test will be conducted for those security requirements identified within the *MMS FRD*, and to ensure compliance with DoIT security standards. The tests will be planned, performed, reported, and otherwise processed as specified by this document.

Security testing is intended to ensure that adequate security and controls is in place for the MMS application. The security test ensures that unauthorized users will not have access to system features or functions which they are not authorized to. It will also ensure that users will not have the ability to change or modify data that they may be authorized to view but are not authorized to change.

Security testing for the MMS application is the responsibility of the SHA OIT staff member assigned as the SHA Security Lead for this application, with support and assistance from the SHA MMS Business Lead, SHA OIT Project Manager, and the MMS system integrator.

## 5.6 Regression Test

Regression test will be implemented prior to the production deployment of Projects II-VIII. Regression test is intended to ensure that the introduction of new system components to the MMS production environment in Projects II-VIII or any changes which may be required to Project I components to support implementation of Projects II-VIII do not inadvertently impact current MMS production operations. Given the incremental nature of the implementation approach for the MMS program and the extent to which Projects III-VIII rely on building block components being implemented in Projects I and II, regression testing will be a critical element of the MMS testing program.

Planning and execution of a formal, structured regression test is the responsibility of the MMS test team with support, guidance and assistance from the MMS system integrator. SHA OOTS IT staff and SHA OIT staff will also assist with regression testing and perform any identified program fixes for which they are responsible as required.

## 5.7 Installation, Testing and Control

Installation, testing, and control are all integral elements of the testing environment. All three elements need to work in an effectively cohesive manner so that the MMS testing effort can accurately locate, correct, and track requirements, defects, and enhancements. Since the test environments will emulate a normal production facility, the procedures for the test environment

operation and management are similar. Installation and inspection of the testing environment occurs at the test facilities prior to the start of software testing. The MMS Test Lead is responsible for the management, control, scheduling, and maintenance of the testing environment.

The MMS system integrator, the SHA OOTS development team, SHA OIT developers and other parties performing development for the MMS project will be required to use a configuration management tool established by SHA for checking-in and checking-out such things as source code files, installation scripts, test scripts, and documentation so that revision history information can be monitored and tracked. For detailed procedures on this task, refer to the *MMS CMP*. Migration checklists, developed as part of the MMS Implementation Plan, and/or test procedures, will be used to assist in the compilation of components for testing. The checklists detail the execution of migration procedures in sequence throughout the testing levels and provide useful information in the TRR.

The incorporation of application software and test elements into the test environments is highlighted as follows:

- Execute the migration checklist form throughout the migration process. This checklist ensures all elements in the migration from unit test to system test take place. SHA's assigned configuration management and quality control staff and the MMS testing team are responsible for this task

- Create/modify the needed test database files and tables (including data from the source management systems); the SHA OOTS development team (for Project I), the MMS system integrator (for Projects II-VIII) and the MMS Test Lead jointly coordinate this task

- Identify and assemble the elements of the application software for testing; the assigned SHA configuration management resources initiate this task

- Review and identify any new procedure(s) used for installing the test software; the designated SHA staff will perform a quality control review on new procedure(s) before the staff assigned configuration management responsibilities performs its review

- Conduct a TRR- this step is performed prior to moving from one testing level to another; the configuration management, quality control, MMS Test Lead, and the MMS testing team are responsible for this task; the SHA MMS Business Lead chairs the review

- Check the testing environment- this step ensures that the migration is successfully executed in the test environment and everything is ready for system testing; the designated SHA OIT staff responsible for configuration management confirms proper operation of the application software; the MMS Test Lead checks or ensures appropriate technical staff check the database operations

All policies and procedures specified in the *MMS CMP* will be adhered to in all test-related artifacts and documentation. Please refer to the *MMS CMP* for information on configuration management change requests.

Please note that once Project I of the MMS is deployed as a production system, it will be necessary to have a maintenance test environment or staging area where production problems can be replicated and resolved without impact on the production or development environments. These changes will then need to be migrated down to the project environments: user acceptance test, system test, subsystem integration test and development/unit test as appropriate to ensure that these test environments as closely as possible resemble the current snapshot of the production environment. This reduces the risk of issues occurring in the production environment when a project is deployed because the project was system tested and acceptance tested in an environment with material differences from the production environment.

## 5.8 Metrics

Metrics can be used to track test development, execution, requirements verified, unit-under-test defect status, and other unit-under-test quality metrics to update estimates of project progress.

The following metrics will be utilized during testing of the MMS application for all eight projects:

- For each identified subsystem integration test, system test, or user acceptance test case, record the date of the test and its pass or fail status; report regularly during each level of testing on the number of test cases out of the total number of test cases that have signed-off

- Using the Requirements Traceability Matrix to trace the requirements to identified development test and acceptance test, record the dates each requirement is tested and its pass or fail status; report regularly on the number of requirements that have been verified out of the total number of requirements or the total number within a section of the system requirements during each level of testing

# 6 TEST REPORTING

Issues and results will be documented in testing logs and the MMS Issue Tracking database. Ideally, the MMS Issue Tracking database will be maintained using an automated tool such as Microsoft Excel, Microsoft Access or through the List functionality in Microsoft SharePoint. All test plans, test procedures, and test cases or other test work products will not be considered complete until the work products undergo peer reviews. Peer review approval is documented on the T&E Test Plan in Appendix B.

Test Analysis Reports and Test Problem Reports are required. Test Problem Reports will be used during testing at the integration level and higher to document discovered anomalies, deficiencies, or discrepancies. Ideally the Test Problem Report also referred to as the issue or bug report, captures how to reproduce the problem and an analysis of the error. Test Problem Reports are attached to Test Analysis Reports. The disposition of problems found will be tracked and reported under configuration control.

Minimally, the Test Problem Report will include:

- Tester (name of tester)
- Problem report number (unique identifier assigned to the problem)
- Severity (indicate seriousness of the problem on a scale, e.g., low to high)
- Problem summary/description (briefly describe the problem)
- Steps to reproduce the problem (describe steps, symptoms, and error messages) and
- Module/program/functional area where error occurred (identify where the problem exists)

Test Analysis Reports will be used to document the results of a test and will recommend a course of action based on those results. Test Analysis Reports will be produced for each phase of development test, user acceptance test, and security test. The Test Analysis Report describes the testing performed and evaluates the results.

The Test Analysis Report will contain one copy of the Test Analysis Approval Determination form. This form briefly summarizes the perceived readiness for migration of the software as follows:

- **Full acceptance.** The Test Analysis Report describes any problems encountered, which are now corrected.
- **Full implementation with modifications implemented in a future release.** The Test Analysis Report describes the outstanding discrepancies and the potential impact of these items to the end user.

- **Partial implementation.** The Test Analysis Report details the recommended implementation limitations, and describes the impact and expected results of this alternative.

- **Rejection.** The Test Analysis Report describes the reasons.

In the case of user acceptance test, the Test Analysis Approval Determination form serves as the user's recommendation for migration to production.

The Maryland DOIT SDLC Manual specifies the format of the Test Analysis Report and the Test Analysis Approval Determination form.

A sample layout of a Test Problem Report is provided in Appendix C.

Minimally, the test analysis report will include:

- Test analysis report identifier (unique identifier assigned to the report)

- Summary of tests (summarize the evaluation of test items)

- Variances (report any inconsistencies of test items from their design specifications)

- Comprehensiveness assessment (evaluate comprehensiveness of the testing process)

- Summary of results (summarize the results of testing)

- Evaluation (provide an overall evaluation of each test item, e.g., impact of any deviation from goals)

- Summary of activities (summarize major testing activities and events)

- Approvals (specify names and titles of persons who must approve the report)

# 7 QUALITY CONTROL REVIEWS AND AUDITS

The MMS testing team will perform certain quality control (QC) reviews and audits throughout the MMS testing process. QC reviews determine whether development products of a given activity conform to the requirements of that activity, and whether the software satisfies its intended use and user needs. The MMS testing team may analyze, evaluate, review, inspect, assess, and test software products and processes.

The various reviews to be performed by the SHA OIT staff assigned to perform the QC function for the MMS testing team are described in the subsections below.

Note: Many of these reviews are multi-day meetings conducted by the MMS system integrator to demonstrate compliance to requirements and other standards; principally by presentations of the software configuration, test analysis reports and other work products to the MMS testing team, followed by question and answer sessions.

Examples of the different test related project deliverables by major phase are outlined in Appendix D. Many of these deliverables form the basis for the walkthroughs and discussions in these review sessions.

## 7.1 Functional and Data Requirements Review

The Functional and Data Requirements Review is conducted in the Requirements Analysis Phase by the Task Order Manager or his designee and the MMS Business Lead to ensure that the business requirements have been accurately linked to functional and data requirements.

## 7.2 Preliminary Design Review

This is an ongoing interim review of the system design as it evolves through the Design Phase from the initial loading and configuration of the MMS COTS components through the design of custom extensions and interface components or the development of the system design for a custom MMS solution. Detailed objective system functions, performance requirements, security requirements, and system platform characteristics will be reviewed.

This review will include a detailed review of the system requirements as allocated from the Functional Requirement Document via the Requirements Traceability Matrix (RTM).

The review criteria include the following points of evaluation:

- All software requirements completed
- The requirements exhibit a clear distinction between functions and data
- The requirements define all the information that is to be displayed to the user
- The requirements address system and user response to error conditions

- Each requirement stated clearly, concisely, and unambiguously
- Each requirement testable
- A preliminary version of the user acceptance test plan, including an updated RTM
- No ambiguous or implied requirements
- No conflicting requirements
- Performance requirements (such as response time and data storage requirements) stated
- The requirements involving complex decision chains are expressed in a form that facilitates comprehension (decision tables, decision trees, etc.)
- Requirements for performing software upgrades specified
- Real-time constraints specified in sufficient detail
- Precision and accuracy of calculations specified
- Possible to develop a thorough set of tests based on the information contained in the System Design Document
- Assumptions and dependencies clearly stated
- The document contains all the information called out in the System Design Document outline

## 7.3 Security Risk Assessment

During the design phase, the assigned SHA OIT Security Lead for the project will conduct a security risk assessment by addressing the following components: assets, threats, vulnerabilities, likelihood, consequences and safeguards. The risk assessment evaluates compliance with baseline security requirements, identifies threats and vulnerabilities, and assesses alternatives for mitigating or accepting residual risks.

## 7.4 Final Design Review

The SHA OIT Project Manager manages and jointly conducts the final design review with the MMS Business Lead. This review is conducted at the end of the Design Phase and confirms that modifications prompted by earlier reviews are incorporated. The MMS Business Lead and the SHA OIT Project Manager are responsible for jointly recommending sign off to the SHA Contract Manager for the MMS system integrator's contract and the MMS Project Sponsor.

## 7.5 QC Audits During Subsystem Integration Testing

Periodic QC audits may be conducted during subsystem integration testing by the SHA OIT staff member assigned the QC role on the project. Goals of audits during the subsystem integration test could include ensuring that:

- As-coded software products (such as software item) reflect the design documentation
- The acceptance review and testing requirements prescribed by the documentation are adequate for the acceptance of the software products
- Test data comply with the specification
- Software products were successfully tested and meet their specifications
- Test reports are correct and discrepancies between actual and expected results have been resolved
- User documentation complies with standards as specified
- Activities have been conducted according to applicable requirements, plans and contract
- The costs and schedules adhere to the established plans

The results of these audits will be documented. If both hardware and software are under development or integration, the audits may be postponed until the system test.

Upon successful completion of the audits, if conducted, the assigned SHA OIT QC resource will update and prepare the deliverable software product for system testing. The assigned QC resource will also establish a baseline for the design and code of the software item.

## 7.6 QC Audits During System Testing

The assigned SHA OIT QC resource may conduct audits during system testing to help to ensure that the implementation of each system requirement is tested for compliance and that the system is ready for delivery. These QC audits could have the following objectives:

- Test coverage of system requirements
- Ensure conformance of test results to the expected results
- Assess the feasibility of system operation and maintenance

The results of any audits performed will be documented. Upon successful completion of the audits, if conducted, the assigned SHA OIT QC resource will update and prepare the deliverable software product for Software Installation and Software Acceptance Support. The assigned QC resource will also establish a baseline for the design and code of each software configuration item.

# 8 TEST AND EVALUATION RESOURCE SUMMARY

This section describes test and evaluation resources that will be used during the course of the MMS testing processes and the related preliminary processes that will occur prior to testing.

## 8.1 Test Items

All testable items that comprise the MMS application will be tested. The versions to be tested will be placed in the appropriate libraries by the SHA OIT staff member assigned configuration management responsibilities. The configuration management specialist will also control changes to the versions under test, perform system builds, and notify the MMS testing team when new versions are available.

Whether the MMS program will be primarily a COTS solution with significant custom components or an entirely custom application has not yet been finalized as the program is initiating the solicitation process for Projects II-VIII and the specific components of MMS will be specified after contract award. Hardware configurations are expected to leverage to the extent possible equipment which is already in use. Hardware configurations will consist of these minimum configuration areas:

- Workstation hardware
- Workstation software
- Communications hardware
- Communications software
- Application server for the new MMS application
- Database server hardware
- Database server software
- Peripherals

Specific items (e.g., hardware and software) and associated details within these configuration areas will be addressed in an updated version of this document following the selection of the MMS system integrator and solution.

## 8.2 Test Environments and Facilities

Test environments (i.e., staging areas or regions—physical or virtual) will be established to perform test preparation and support execution of unit test, subsystem integration test, system test, user acceptance test, regression test (as required) and security test prior to deploying each project within the MMS program.

Unit test will take place in the development environment. Subsystem test may take place in the development environment or in a separate subsystem test environment. System test will take place in a separate environment within the development area. System test, while managed and led by the MMS system integrator will be under configuration management and structured promotion and demotion as required of items will need to take place between the system test environment and the development environment. With the exception of the unit test environment, these test environments will be separate from the development environment and as identical to the operational or production environment as possible. Subsystem test environment

User acceptance test, security test and regression test will be led by the MMS testing team and will take place in the user acceptance test environment or another environment separate from the development environment and as identical to the operational or production environment as possible. The environment(s) used for user acceptance test, security test and regression test will be managed by the MMS testing team and will be placed under configuration management control.

Specific test facilities will be determined during the Design Phase. Test environment and facilities support resources will be coordinated through the SHA OIT MMS Project Manager and the MMS Business Lead.

To establish the operational test environment, the following steps will be taken.

- **Review and expand technical environment** -The purpose of this step is to ensure that adequate computer hardware and the appropriate system software has been installed and is available through the testing phase.

- **Inspect the test environment** -The purpose of this step is to ensure that an effective test environment has been established for the testing phase. The MMS Test Engineer and the assigned SHA OIT configuration management resource will review the test environments to make certain that HWCIs needed to support the testing are available and operating properly.

- **Prepare system software to support testing** -The purpose of this step is to ensure that the system software in the test environment is ready for the testing effort. The MMS Test Engineer will confirm proper operation of the following types of system software: operating systems, utilities, network software, network management software, LAN utilities, testing tools, and legacy software by physically observing every HWCI in the test environment.

Note: Testing environments will be required not only for the MMS application itself but for any system with which MMS will interface such as MCMS, CAS or FMIS.

## 8.3 Test Support Equipment

The selection of the MMS system integrator and the determination of whether Projects II-VIII will be a COTS solution with custom components or a primarily a custom solution is in its early stages and any test support equipment that may be required will be specified after contract

award. Specific equipment or tools and associated details will be addressed in an updated version of this document. Various test support equipment may be used during each of the testing phases. Testing tools will be used to generate and load test data, to conduct stress testing, and to perform regression testing when applicable.

## 8.4 Test Beds

Specific requirements for test data beds will require further evaluation and be presented in a future update to this document.

## 8.5 Special Requirements

Federal Acquisition Regulations (FARs) require that the MMS comply with Section 508 of the Rehabilitation Act of 1973. The need for special testing tools and resources to test Section 508 compliance will require further evaluation and be presented in a future update to this document.

## 8.6 Test Locations

It is anticipated that the execution of user acceptance test will be performed primarily at the OMT facilities at SHA's Hanover complex.

The physical location of staff performing unit test and system test may vary based on the MMS system integrator selected, whether the solution is COTS or custom and the specific project approach of the selected MMS integrator. However, it is anticipated that all development test activities will take place in technical environments that will be accessible via the SHA network or the Internet to all MMS test team members.

## 8.7 Organizations Participating in MMS Testing

Exhibit 8-1 outlines the various organizations expected to participate in the MMS testing process and the expected role of each of these organizations.

**Exhibit 8-1: Roles of Various Organizational Units in MMS Testing**

| Organization | Role in Testing |
|---|---|
| Office of Materials Technology (OMT) | OMT will be the primary user of the new MMS application and is providing overall business leadership for the project. OMT will provide the project sponsor and the business lead for the project. OMT will also provide most of the business side staff who will participate on the MMS testing team.<br><br>The MMS Project Sponsor will provide overall leadership and direction to testing activities and will sign-off on completion of subsystem testing, system testing, user acceptance testing, any required regression testing and the initiation of production operations. The MMS Project Sponsor will also be responsible for ensuring sufficient SHA user resources are available as required to support testing activities.<br><br>The MMS Business Lead will periodically review the status and quality of development testing activities. The MMS Business Lead will be responsible for guiding and directing user acceptance testing activities including planning for and executing the testing. The MMS Business Lead will also recommend to the MMS Project Sponsor the approval (or other appropriate action) for all test levels upon completion of testing activities. For Project I, the MMS Business Lead will plan and manage subsystem and system test activities.<br><br>Other OMT staff from across all of the business areas in OMT will participate in user acceptance test planning and execution. |

| Organization | Role in Testing |
|---|---|
| Office of Information Technology (OIT) | OIT staff will participate in testing activities in a variety of ways.<br><br>The designated SHA OIT contract manager will be responsible for managing the contract with the selected MMS system integrator. This includes ensuring the contractor meets all testing requirements for the project.<br><br>The SHA OIT Project Manager will be responsible for managing execution of testing activities across all project phases. This includes coordinating as required between the MMS system integrator, SHA OIT staff and SHA OOTS IT staff.<br><br>SHA OIT developers responsible for any source systems which feed MMS such as CAS and/or MCMS will be responsible for developing and unit testing exports from these applications/data sets and for assisting in subsystem integration testing and system testing of these data loads. OIT developers will make program fixes as required during subsystem integration testing, system testing and user acceptance testing to address issues identified in program units it developed.<br><br>SHA OIT Database Administrators will support the development, system test and user acceptance test environments in conjunction with HISD staff as required. SHA OIT management staff will participate in Quality Control and Configuration Management activities. |

| Organization | Role in Testing |
|---|---|
| Office of Traffic Safety (OOTS) Information Technology Staff | OOTS IT staff will be responsible for the design and development of the Project I software and the unit test of this software. OOTS IT staff will also make any necessary fixes to programs identified during OMT led subsystem testing, system testing and user acceptance testing for Phase I.<br><br>A Database Administrator assigned to this team will support development and testing activities throughout Project I.<br><br>OOTS IT staff will coordinate with the selected MMS system integrator as required to support development and testing activities for Projects II-VIII. This will include making any required program changes to Project I programs as needed to meet the requirements of Projects II-VIII and participating in subsystem test and system test activities related to these program changes.<br><br>OOTS IT staff will also make any program changes or fixes required to Project I program units identified during user acceptance test, regression test or security test activities during testing for Projects II-VIII. |
| SHA Districts | Staff from SHA districts may participate in planning and executing user acceptance activities on an as needed basis. It is anticipated that SHA field staff from the districts will specifically be involved in testing those MMS components which will be utilized by field personnel. |
| Office of Construction (OOC) | OOF users may participate in planning and executing user acceptance activities on an as needed basis. |
| Office of Finance (OOF) | OOF users may participate in planning and executing user acceptance activities on an as needed basis. |

| Organization | Role in Testing |
|---|---|
| MMS System Integrator | If the MMS application is primarily a COTS solution with custom extensions, the MMS system integrator will be responsible for unit testing all custom extensions to the MMS COTS solution and unit testing all transformation and load program modules for importing data into MMS and the extract module for data being transferred from MMS to other applications.<br><br>If the MMS application is primarily a custom solution, the MMS system integrator will be responsible for unit testing all custom components of the MMS solution. Likewise, the MMS system integrator will also be responsible for unit testing all transformation and load program modules for importing data into MMS and the extract module for data being transferred from MMS to other applications.<br><br>The MMS system integrator will be responsible for planning and coordinating subsystem integration test and for executing the MMS solution components of this testing including the MMS application and any extracts, transformation and load program modules developed by the MMS system integrator. The MMS system integrator will coordinate with SHA OIT and SHA OOTS IT staff as required to ensure testing of any MMS components developed by these organizations. The MMS system integrator will make program fixes as required during subsystem integration testing to address issues identified in program units it developed.<br><br>The MMS system integrator will be responsible for planning, coordinating and executing system test (or managing execution by other SHA OIT or SHA OOTS IT developers at the appropriate time in the test plan). The MMS system integrator will make program fixes as required during system testing to address issues identified in program units it developed.<br><br>The MMS system integrator will provide guidance to the MMS test team in the preparation of the user acceptance test plan and test scripts and will provide hands-on guidance and support during test execution. The MMS system integrator will make program fixes as required during user acceptance testing to address issues identified in program units it developed. |

## 8.8 Staff Training

All end user staff who will be participating in the MMS user acceptance test phase for Projects I-VIII will participate in the MMS end user training program prior to initiating user acceptance test. This will provide users with training on how to use the system to assist with performing testing. It will also allow for verification of the effectiveness of the MMS training program in preparing users to utilize the MMS application.

In addition, training will be given to all test personnel on how to conduct user acceptance test to ensure familiarity with any special requirements, forms, and reporting methods.

As the MMS continues to mature in its development, the test resource requirements will be reassessed and refined and subsequent TEMP updates will reflect any change to system concepts or resource requirements.

# 9 RISKS AND CONTINGENCIES

A system with the magnitude of the MMS application will not be void of risk and associated mitigations. Similarly, there will be risks that the MMS testing team will encounter. A solid test management strategy; the active involvement of OMT staff; the involvement of SHA OIT staff with designated responsibility for configuration management and quality control; various reviews throughout the MMS testing process; and regular status reporting on the progress of testing will prove beneficial to the MMS testing team and may help lessen risks. When risks and contingencies arise, they will be handled using formal risk management as is discussed in the *MMS Risk Management Plan (RMP)*.

# 10 MMS TEST DESCRIPTION

The MMS Test program is divided into eight distinct components representing each of the eight separate projects, known as Projects I-VIII which will be developed and implemented as part of the overall MMS program. The test program for each of the eight projects will contain the following levels of testing: subsystem test, system test, user acceptance test, security test and regression test (for Projects II-VIII).

Volume II of the MMS Test and Evaluation Master Plan outlines the scope of the various levels of testing to be performed for each of the eight MMS projects. For each test type, the objectives of the test are identified and the test cases recommended for that testing phase are identified and described at the level of detail commensurate with the requirements phase of the project. These test cases will be further enhanced and developed during and following the Design phase of Project I and the Design Phase for Projects II-VIII. Detailed test scripts will then be prepared for each test case during the Implementation phase of each project in preparation for execution of each type of testing.

Each test case identified Volume II has been cross-referenced to one or more system requirements in the Requirements Traceability Matrix contained in Volume III of the MMS Test and Evaluation Master Plan. This cross-referencing suggests which test cases will be utilized to verify that a specific MMS system requirement has been met during implementation.

# 11 PLAN MAINTENANCE

The MMS Test Lead is responsible for the ongoing update and maintenance of this plan. As a part of process improvement (e.g., lessons learned, quality control assessments), the TEMP and the overall testing management approach will continue to be adapted for use in later testing phases of both the first and then subsequent releases of the MMS. The plan will be updated as needed to maintain current and sufficient testing management activities. The MMS testing team will place the plan under configuration management control following its initial approval. The Configuration Control Board (CCB) as defined in the *MMS CMP* will control its update.

## APPENDIX A – CONTENT AND FORMAT OF THE CONTRACTOR'S TEST PLAN

Appendix A provides an overview of the expected content and format of the Contractor's Test Plan to be prepared by the MMS system integrator.

Title Page: The title page contains the name of the program and the words "Contractor's Test Plan." The title page also contains the document version (e.g., draft, final), version number, date of delivery, contract number and delivery order number.

Signature Page: The signature page is signed by everyone listed, before the test plan is submitted for review.

Document Change Control Sheet: The Document Change Control Sheet allows the author to record the document's history.

Table of Contents: The table of contents contains paragraph titles and page numbers. It lists each test description. Illustrations, tables, and figures are listed separately.

1.0 Introduction: This section is divided into the following paragraphs.

1.1 Purpose: The following statement will be included in the introduction: "The purpose of this test plan is to validate requirements for the Materials Management System. This Contractor's Test Plan documents _____ *(enter contractor's company name)* test program strategy in order to meet the requirements of the contract."

1.2 Scope: This paragraph describes the amount and type of testing to be performed, any limitations imposed, and the amount of test data from prior testing that is proposed for use in verifying requirements.

2.0 Reference Documents: This section contains all reference documents used in the development of the test plan, including all documents listed or referenced in the FRD, the RFP, the SOW and contract.

3.0 System Description: This section will be divided into the following paragraphs.

3.1 System: This paragraph describes the system(s) to be tested, and included the major functions of subsystems. The contractor also provides a functional block diagram of the system and subsystems.

3.2 Interfaces: This paragraph contains a simplified system block diagram with a functional description of each interface. This includes any interface required to validate the system requirements (e.g., facility interfaces, remote maintenance monitoring interface, voice communications interface, operator interface, etc.).

Test Program Description: This section will be divided into the following paragraphs.

4.1 Management: This paragraph describes the contractor's management responsibilities for the test program. This includes an organizational chart with names of individuals responsible for each department and/or subcontractor(s) participating in the test program.

4.2 Test Identification: This paragraph will list all tests to be accomplished in the contractor's test program, both contract required and any other contractor tests. Tests will be labeled with a unique identifier for ease and consistency of reference throughout the test program.

4.3 Subordinate Test Plans: This paragraph identifies all the appropriate test plan(s) that will further detail each test referenced in paragraph 4.2 (above). All critical functionalities and test criteria required to complete each test are itemized. The contractors identify all subordinate test plans required in order to meet the requirements of the contract. This includes unit/module level software and hardware test plans, inspection plans (e.g., sub-First Article), subordinate reliability plans (e.g., for screenings, failure analysis, etc., if required by contract).

4.4 Integrated Schedule. This paragraph contains the test program integrated schedule. The integrated schedule contains major contract milestones and test program milestones that show how the contractor intends to meet the contract schedule.

4.5 Configuration Management (CM) on Unit Under Test: This paragraph describes how the software and hardware configurations of each unit under test will be controlled in the context of each system requirement and related tests. The contractor will also describe the methods and personnel to be employed for the production, certification, and control of test software that is planned for these tests. (The Contractor's CM Plan may be referenced if applicable.)

4.6 Problem Reporting and Resolution: This paragraph describes the failure/problem identification, reporting, and resolution process. It also identifies the documentation to be used in this process. This paragraph also describes the role of the Quality organization and CM in the resolution process. (The Contractor's Performance Work Statement (PWS), similar to a Statement of Work (SOW) and/or Contractor's CM Plan may be referenced if applicable.)

5.0 Functional Requirements Traceability Matrix (RTM): A single matrix will be maintained which addresses the broad test methods to be employed for each contract requirement. The contractor will build on the RTM developed during the Requirements Phase. The matrix is initially based on requirements described in the Functional Requirements document, and it will be expanded during the Design phase to include other requirements deemed appropriate for the testing program; including such requirements as specified in the RFP, the SOW, the contract and other subordinate documents (all such requirements are referred to in this document as system requirements). The matrix will:

- Clearly itemize the method of test (e.g., Inspection, Analysis, Documentation, or Test) for each system requirement, and,

- Clearly identify the test to which each system requirement will be allocated for testing and which subordinate T&E Test Plan documents the verification of the particular requirement. Each system requirement will be allocated to at least one defined test category. Upon approval, the matrix will be changed only with the approval of the MMS Testing team.

6.0 Metrics: Metrics will be recorded and reported as required by the MMS Test and Evaluation Plan.

## APPENDIX B – GENERAL FORMAT FOR TEST AND EVALUATION (T&E) TEST PLANS

The general format for development test, user acceptance test, and security test T&E Test Plans is outlined below. Each plan should include the following items:

- Test plan identifier
- Introduction
- Test items
- Features to be tested
- Features not to be tested
- Approach (including test cases)
- Item pass/fail criteria
- Suspension criteria and resumption
- Test deliverables
- Testing tasks (procedures)
- Environmental needs
- Responsibilities
- Staffing and training needs
- Schedule
- Risks and contingencies
- Approvals (Peer Reviewed)

Development Test, user acceptance test, and security test T&E Test Plans will be prepared in accordance with IEEE 829 Std-1998, Standard for Software Test Documentation. Please refer to this standard as appropriate for more specific content requirements.

## APPENDIX C - TEST PROBLEM REPORT

A sample format for a Test Problem Report is provided in Exhibit C-1 below.

**Exhibit C-1: Sample Test Problem Report**

| | | | | |
|---|---|---|---|---|
| **Test Case:** | **Module:** | **Tested By:** | **Test Date:** | **Test Time:** |
| | | | | |
| ***Problem Description:*** | | | | |
| | | | | |

| **Expected Results/Outputs** | **Actual Results**: |
|---|---|
| | |

| **Disposition of Problem** | |
|---|---|
| **Action Taken to Correct Problem** | **Date Corrected** |
| | |
| **Risk Impact if Problem Not Corrected** | |
| | |
| Changes Required for Existing Documentation | |
| | |

**SIGNATURES**

| | |
|---|---|
| _____ | _____ |
| Project Manager | System Developer |
| _____ | _____ |
| Date | Date |

## APPENDIX D – TESTING RELATED PROJECT DELIVERABLES

This appendix provides a summary of testing related project deliverables by project phase.

Exhibit D-1 lists the deliverable documents related to the testing process to be created in each major phase of the software development lifecycle for the eight separate projects which make-up the MMS program. Additional testing specific deliverables may also be developed as needed during each phase.

**Exhibit D-1: Testing Related Project Deliverables**

| Requirements Analysis Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| Requirements Document | PM, PM Team as appropriate | Project Sponsor, SHA Task Order Manager |
| Test and Evaluation Master Plan | PM, PM Team as appropriate | Project Sponsor, SHA Task Order Manager |

| Design Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| System Design Document | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Security Risk Assessment | PM, PM Team as appropriate | Project Sponsor, Task Order Manager |
| Contingency Plan | PM, PM Team as appropriate | Project Sponsor, Task Order Manager |

| Development Phase Deliverables | Reviewed and Comment | Approved By |
|---|---|---|
| Configuration Management Plan | PM, PM Team as appropriate | Project Sponsor, Task Order Manager |
| Software Development Document | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| System Software | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Test Files/Data | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Integration Document | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Test Analysis Report | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Conversion Plan | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Implementation Plan | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |

| Development Phase Deliverables | Reviewed and Comment | Approved By |
|---|---|---|
| Operations and Maintenance Manuals | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| System Administration Manual | PM, PM Team as appropriate | SHA Operations Manager, SHA Contract Manager |
| Training Plan | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| User Manual | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |

| Integration and Test Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| Test Analysis Approval Determination | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Test Problem Reports | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| Remediation Plan | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |
| IT Systems Security Certification & Accreditation | PM, PM Team as appropriate | Project Sponsor, SHA OIT Security Lead, SHA Contract Manager |

| Implementation Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| Delivered System Documentation | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager, SHA Operations/Support Manager |
| Version Description Document | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager, SHA Operations/Support Manager |
| Post-implementation Review Report | PM, PM Team as appropriate | Project Sponsor, SHA Contract Manager |

| Operations and Maintenance Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| Program Trouble Reports | PM, PM Team as appropriate | System Manager, SHA Contract Manager, SHA Operations/Support Manager |
| In-Process Review | PM, PM Team as appropriate | System Manager, SHA Contract Manager |

| Operations and Maintenance Phase Deliverables | Review and Comment | Approved By |
|---|---|---|
| **User Satisfaction Review** | PM, PM Team as appropriate | Project Sponsor, SHA Operations/Support Manager, Contract Manager,<br>SHA Contract Manager |

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

# MATERIALS MANAGEMENT SYSTEM PROJECT
# TEST AND EVALUATION MASTER PLAN
# Volume II (Test Cases)

**April 8, 2009**
**Version 1.0**

# Document Version Control

| Revision Date | Updated By | Requested By | Description of Revision |
|---|---|---|---|
| 04/08/2009 | Vendor | | Discussion Draft |
| 04/22/2009 | Vendor | | Updated based on SHA comments |
| 4/30/2009 | Vendor | | Final version based on formal SHA comments |

# Table of Contents

# MMS Test Plan (Test Cases)

This document presents the test plan for MMS to review and confirm that all requirements mentioned in FRD are incorporated in the system.

The test cases are broken down by each project, and business functions under each project. All test cases mentioned below assume that tests will be performed as a user authorized to access the functionality, unless noted otherwise.

## MMS-WIDE BUSINESS SPECIFIC TEST CASES

### Test Specification: Document Management (MMS.1)

Test that all requirements relating to document management are incorporated in MMS. These include exporting data, attaching documentation, etc. All test cases assume that tests will be performed as a user authorized to access the functionality.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.1.01 | Test that data from MMS can be exported to MS Office product suite | • Project data | Open administration screen and export data to applicable application (MS Word, Excel, etc.) | Data can be exported successfully out of MMS and imported in desired application | Pass/Fail | Yes | System; User acceptance |
| MMS.1.02 | Test that status of tests conducted and test results for any project can be obtained from MMS | • Project name | Select specific project and request status of all tests conducted, including test results | List of tests and results can be obtained as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.1.03 | Test that MMS data can be exported to MS Office product suite as required | • Project data | Select data to export, and view data in applicable MS Office program (Excel, Word, etc.) | Data can be exported successfully out of MMS and imported in desired application | Pass/Fail | No | Subsystem |
| MMS.1.04 | Test that MMS can be accessed using web interface to enter inspection data | • Project name<br>• Project inspection data | Access MMS inspection data entry screen using web interface. Enter and save inspection data | MMS can be successfully accessed. Inspection data can be saved successfully | Pass/Fail | No | Subsystem |
| MMS.1.05 | Test that standard letter templates can be stored in MMS and downloaded as required | • Letter template | Open administration screen and upload new letter template. Close, re-enter and download another pre-existing letter template | Letter templates can be saved and downloaded as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.1.06 | Test that project supporting documentation (scanned images, reports, letters, etc.) can be attached in MMS as required, and can be viewed, emailed or printed as required | • Project name<br>• Project documentation | Open specific project, and attach project documentation. Close and open documentation to email and print | Documentation can be saved, emailed and printed as required | Pass/Fail | No | Subsystem |
| MMS.1.07 | Test that project documentation can be deleted from MMS as required | • Project name<br>• Project documentation | Open project and select project documentation. Select and delete a project document | The project document can be deleted as required | Pass/Fail | Yes | System; User acceptance |
| MMS.1.08 | Test that files generated in MMS are attached automatically | • Project name<br>• Project file | Generate project file (e.g. letter) in MMS. Check if file is saved automatically | The file is saved automatically in MMS | Pass/Fail | No | Subsystem |
| MMS.1.09 | Test that projects can be classified based on funding type in MMS | • Project name<br>• Project classification | Open new project in MMS. Assign a classification to project | Projects can be classified in MMS as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.1.10 | Test that project classification can be modified in MMS if required | • Project name<br>• Project classification | Open existing project in MMS. Change project classification | Project classification can be changed in MMS as required | Pass/Fail | Yes | System; User acceptance |
| MMS.1.11 | Test that quantity of material approved on certification and quantity of material used on project can be stored in MMS | • Project name<br>• Material quantities | Open project in MMS, and screen to enter material quantities. Enter and save material quantities approved on certification as well as material quantity used on project | Material quantities can be successfully saved as required | Pass/Fail | No | Subsystem |
| MMS.1.12 | Test that a report showing the quantity of material approved on certification vs. quantity used on project can be generated as required | • Project name | Generate report showing quantity of material based on certification vs. quantity used on project | An accurate report can be generated as required | Pass/Fail | No | Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: Integration (MMS.2)

Test that all requirements relating to integrating email and text messaging capabilities are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.2.01 | Test that an email with documentation can be sent via MMS | • Project name<br>• Project document to email | Open project and select document to email. Send email to intended recipients | Project email can be sent as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.2.02 | Test that text notification can be sent via MMS | • Project name<br>• Notification | Open project and send text notification | Text message can be sent as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: Interface (MMS.3)

Test that all requirements relating to integrating email and text messaging capabilities are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.3.01 | Test that MMS can receive charge allocation data from FMIS | • FMIS data | Initiate import in MMS from FMIS | Data can be imported as requested | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.3.02 | Test that project charge data (time charged to project, time charged to YB-888, etc.) can be sent to FMIS from MMS | • Project charge data to be exported to FMIS | • Initiate export from MMS to create FMIS import file<br>• Initiate import in FMIS and select FMIS import file generated from MMS | Data can be exported from MMS and imported into FMIS (using existing FMIS import file structure) | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.3.03 | Test that active project data can be migrated from current systems (to be retired) to MMS | • Test data in systems to be retired | Initiate import in MMS of test data from systems to be retired | Data can be imported in MMS as requested | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.3.04 | Test that information can be exported from MMS to Pavement Management System (PMS) | • Project data | Initiate export from MMS. Initiate import in PMS | Data can be exported from MMS, and imported in PMS successfully | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.3.05 | Test that data can be imported/exported to/from MMS from other systems | • Project data | Initiate import in MMS from required systems, and export from required system | Data can be imported/exported successfully | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

***MMS-Wide Business Specific Test Cases***

## Test Specification: Location Tracking (MMS.4)

Test that all requirements relating to location tracking are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.4.01 | Test that test sample location can be recorded in multiple coordinate systems and/or mileposts as required | • Test sample location | Record test sample location in multiple coordinate systems | Test sample location can be recorded in multiple coordinate systems as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

***MMS-Wide Business Specific Test Cases***

## Test Specification: Test Information (MMS.5)

Test that all requirements relating to test information are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.5.01 | Test that test status can be checked in real time through a web browser | • Project name | Select project using web interface to check test status | Test status can be checked using web interface successfully | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.5.02 | Test that MMS "wizard" functionality can be used to create test entry screens | • Test screen | Open MMS test wizard and create new test entry screen | New test entry screen can be created successfully | Pass/Fail | No | Subsystem |
| MMS.5.03 | Test that MMS "wizard" functionality can be used to edit test entry screens | • Test screen | Open existing MMS test screen using wizard. Edit screen as required | Test screen can be edited using MMS wizard as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.5.04 | Test that a final test document can be printed from MMS | • Project name<br>• Test document | Open project and print final test document | Project document can be printed as required | Pass/Fail | No | Subsystem |
| MMS.5.05 | Test that MMS reports can be printed, emailed, or saved to file as required | • Project name<br>• Test document | Open project and print, email and save document to file as required | Project document can be printed, emailed, saved to file as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: Test Validation (MMS.6)

Test that all requirements relating to test validation are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.6.01 | Test that data validation can be provided in MMS based on reasonableness test, including warnings for missing fields and helpful error messages | • Data entry screen | Open data entry screen. Enter invalid data (e.g., future date, pH value outside 0 to 14) | Invalid data generates a warning and/or helpful error message | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.6.02 | Test that serialized form numbers are used as unique identifiers in MMS | • Test sample | Enter new sample in MMS and assign serial number | A unique serial number is assigned to sample | Pass/Fail | No | Subsystem |
| MMS.6.03 | Test that project data regarding number of tests performed, etc. can be accessed as required | • Project name<br>• Project data | Open a project. Access project data | Project data can be accessed as required by authorized users | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: User Support (MMS.7)

Test that all requirements relating to user support are incorporated in MMS. This includes, but is not limited to providing an easy to use interface, provide daily confirmations, etc.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.7.01 | Test that the MMS provides an easy-to-use and easy-to-learn interface | | Open multiple MMS screens and access usability | MMS screens are easy to use and easy to learn/understand | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.7.02 | Test that data entry does not need to be duplicated, and data is transferred to other MMS areas/ modules or OMT systems automatically | • Daily work reports | Enter daily work report information in MCMS, and check if information is accurately updated in MMS | Information entered in MCMS is automatically updated in MMS | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.7.03 | Test that batch entries can be processed in MMS | • Test data | Request import of test data into MMS using batch entry | Batch entries are processed accurately by MMS | Pass/Fail | Yes | Subsystem |
| MMS.7.04 | Test that daily confirmation on MMS interactions with other systems can be provided in MMS | • MMS data | Run report to view daily confirmations on MMS interactions with other systems | Daily confirmations on MMS interactions can be provided accurately in MMS | Pass/Fail | Yes | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.7.05 | Test that all SHA IT standards provided by SHA DoIT are supported by MMS | | Test that MMS meets all security standards using security scripts | MMS meets all SHA IT standards | Pass/Fail | Yes | System<br>Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: Workflow (MMS.8)

Test that all requirements relating to overall MMS workflow are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.8.01 | Test that the status of workflow can be presented in a summary/ dashboard format in MMS | • Project name | Open project. Request workflow status in summary/ dashboard format | Workflow status can be presented in summary/ dashboard format | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MMS.8.02 | Test that an alert is triggered in MMS when approved quantity of material is used and a new certification is required | • Project name<br>• Project workflow | Open a project and update material quantity used to equal approved quantity | An alert is triggered when approved quantity has been used on the project | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

### *MMS-Wide Business Specific Test Cases*

## Test Specification: Internet Calendar (MMS.9)

Test that the requirements relating to internet calendar are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MMS.9.01 | Test that MMS calendars can be published in an internet publishable format | • Project name<br>• Project calendar | Open project and view project calendar and publish to internet | MMS calendars can be published in internet calendar format | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

## PROJECT 1 (PROJECT MANAGEMENT, SOURCE OF SUPPLY, SYSTEM MANAGEMENT)

### Business Function: Project Management

Test Specification: Frequency Guide (PM.1)

Test that all requirements for providing frequency guide functionality are incorporated in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.1.01 | Test that an earlier version of frequency guide can be assigned to a project | • Project<br>• Specification version | Retrieve project number and description, assigned specification. Change assigned specification to different version of specification | The assigned specification can be changed for a project | Pass/Fail | Yes | System; User acceptance |
| PM.1.02 | Test that frequency guide can be successfully stored as a database/tables | • Material type<br>• Testing frequency<br>• Inspection frequency | Enter material type, related testing and/or inspection frequency and retrieve information | New information can be successfully stored in the database/tables | Pass/Fail | Yes | Subsystem |
| PM.1.03 | Test that multiple versions of frequency guide can be stored and retrieved from the system | • Version number<br>• Version activation date<br>• Version deactivation date | Enter version number, version activation date and deactivation date for a record | Version information can successfully be entered and stored in the database/tables | Pass/Fail | Yes | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.1.04 | Test that frequency guide versions can be automatically assigned to projects based on creation date | • Project information<br>• Project creation date | Create a new project in system and review if the correct (currently active) frequency guide is assigned | The currently active frequency guide is automatically assigned to the project | Pass/Fail | Yes | Subsystem |
| PM.1.05 | Test that frequency guide versions can be manually assigned to projects, overriding the automatically assigned guide | • Frequency guide version | Retrieve a project and attached frequency guide. Change frequency guide version assigned to the project | The frequency guide version can be successfully changed | Pass/Fail | Yes | Subsystem |

***Project 1***

***Business Function: Project Management***

## Test Specification: Project Contacts (PM.2)

Test that all requirements relating to storing and maintaining a list of contacts for all projects in system, as well as related distribution lists are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.2.01 | Test that an existing contact can be added to an existing distribution list | • Project contact<br>• Distribution list | Retrieve distribution list, add contact to distribution list from existing contact list | A contact can be added to an existing distribution list | Pass/Fail | Yes | System; User acceptance |
| PM.2.02 | Test that an existing contact can be deleted from an existing distribution list without deleting the contact from the system or the project | • Project contact<br>• Distribution list | Retrieve distribution list, remove contact from distribution list | A contact can be deleted from existing distribution list, but is retained as a contact on the project and in the system | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.2.03 | Test that a distribution list can be deleted without deleting any contacts | • Project contact<br>• Distribution list | Retrieve and delete distribution list. Check that no contacts from the distribution list are deleted | A distribution list can be deleted without affecting the contacts list | Pass/Fail | Yes | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.2.04 | Test that a new contact can be added to an existing contact list | • Project contact<br>• Distribution list | Enter a new contact to the contact list along with full name, phone number, and other properties. Retrieve contact to confirm the contact is stored successfully | The contact is successfully stored in the system | Pass/Fail | No | Subsystem |
| PM.2.05 | Test that an existing contact can be deleted from a contact list for a project without affecting the system-level contact list | • Project contact | Delete a contact from the contact list for a project. Retrieve all system contacts and ensure the contact is not deleted | The contact is removed from the project contact list, but not from system contacts | Pass/Fail | No | Subsystem |
| PM.2.06 | Test that a new distribution list can be created using existing contacts and without affecting existing distribution lists | • Project contacts | Create a new distribution list. Add contacts to the distribution list | A new distribution list is created | Pass/Fail | No | Subsystem |

***Project 1***

***Business Function: Project Management***

Test Specification: Project Information (PM.3)

Test that all requirements relating to importing, manually entering, and updating project information are incorporated in the system. This includes Trns*port project information, FMIS information, and information in document management system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.01 | Test that information can be successfully imported from Trns*port for specific projects and marked as "imported" | • Trns*port project information (project name, project boundaries, project start date, etc.) | Initiate import in MMS from Trns*port and verify correct information is received without any errors | Project information is correctly and successfully imported from Trns*port | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.3.02 | Test that information can be successfully updated from Trns*port for specific projects | • Trns*port project information (project name, project boundaries, project start date, etc.)<br>• Project information in MMS | Initiate update in MMS from Trns*port and verify correct information is received without any errors | Project information is correctly and successfully updated in MMS from Trns*port | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.03 | Test that project information can be manually updated in MMS for specific projects | • Project information<br>• Update date | Retrieve project information for a specific project. Update project information and save. Confirm information has been saved | Updated project information is successfully saved in the MMS. | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.3.04 | Test that project information can be manually entered and stored in MMS | • Project information | Create a new project in MMS, and enter basic project information. Save project, and retrieve project information | Project information can successfully be retrieved in MMS | Pass/Fail | Yes | Subsystem |
| PM.3.05 | Test that project information can be manually deleted in MMS | • Project name<br>• Project information | Retrieve project information in MMS. Select project dates and delete. Save project, and retrieve project information | Deleted project information should no longer be present in MMS | Pass/Fail | Yes | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.06 | Test that test information for pre-construction can be linked to construction test information | • Project number (control number, contract number) | • Enter and save a control number and contract number for a pre-construction project<br>• Enter and save a control number and contract number for a construction project that has pre-construction test information. The control number here will be the same as one for pre-construction project | Test information for both pre-construction and construction can be linked using project control and contract numbers (project contract numbers are linked to control numbers) | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.3.07 | Test that required information can be imported from FMIS | • Project financial information from FMIS | Initiate import in MMS from FMIS and verify correct information is received without any errors and is imported in correct fields | Project information is correctly and successfully imported from FMIS | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.08 | Test that supporting documentation can be retrieved from MMS | • Project name<br>• Document name | Retrieve document for specific project that was stored in document management system earlier | Requested documentation can be retrieved successfully from within MMS | Pass/Fail | No | System; User acceptance<br>Subsystem |
| PM.3.09 | Test that information can be stored in document management system from MMS | • Project name<br>• Project documentation | Open project and attached project documentation. Save attachments and retrieve attached documentation | The attached documentation can be successfully retrieved from MMS | Pass/Fail | No | Subsystem |
| PM.3.10 | Test that a construction material can be un-linked from a bid item without deleting the material from the system | • Bid item<br>• Construction material | Retrieve bid item with construction materials linked, unlink existing material to bid item | Material can be successfully unlinked from bid item without deleting material from MMS | Pass/Fail | No | System; User acceptance |
| PM.3.11 | Test that a construction material can be added to a bid item | • Bid item<br>• Construction material | Retrieve bid item with construction materials linked, link new material to bid item | Material can be successfully linked to bid item | Pass/Fail | No | Subsystem |
| PM.3.12 | Test that stakeholder notification letters can be generated as required | • Project name<br>• Project stakeholders | Generate project letter for selected stakeholders for a specific project | Required letters are generated as requested | Pass/Fail | No | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.13 | Test that stakeholder notification letters contain all required project information | • Project name<br>• Project stakeholders | Generate project letter and cross-check letter details with details in MMS | Generated letter displays all requested information with correct labels | Pass/Fail | No | Subsystem |
| PM.3.14 | Test that business rules applied to a project change when the project construction method is changed | • Project name<br>• Construction method | Create a dummy project for testing purposes.<br>Select project and change construction method from existing method to different method | The business rules that are automatically applied to the project (e.g. testing required, etc.) change automatically | Pass/Fail | Yes | System; User acceptance |
| PM.3.15 | Test that applicable business rules are applied correctly according to type of construction method | • Project name<br>• Construction method | Create new projects and assign different construction methods to projects. The number of projects created should equal the number of construction methods supported by MMS | Correct business rules are applied to construction projects | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.3.16 | Test that materials in MMS can be flagged/marked as experimental materials as required | • Experimental materials | Open MMS administration screen to review materials in MMS. Mark specific material as experimental material and save | Materials can be marked as experimental materials as required | Pass/Fail | No | System<br>Subsystem |

***Project 1***

***Business Function: Project Management***

Test Specification: Project Sampling Plan/Project Specific Frequency Guide (PM.4)

Test that all requirements relating to generating and updating a project sampling plan (project-specific frequency guide) are satisfactorily met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.4.01 | Test that a sampling plan can be printed from MMS along with a version history | • Project name | Select project, sampling plan, and print sampling plan along with version history | Project sampling plan is printed successfully with version history | Pass/Fail | Yes | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.4.02 | Test that a sampling plan can be automatically generated based on material quantities in MMS (This information could have been imported from Trns*port or manually entered in MMS) | • Project name | Initiate process to generate project sampling plan. Verify that project sampling plan is created and contains all eligible bid items | Project sampling plan is accurately generated | Pass/Fail | Yes | Subsystem |
| PM.4.03 | Test that the sampling plan is properly presented in a web-based format and can be printed as required | • Project name | Initiate request in MMS to present sampling plan for a specific project. Review sampling plan and print | The sampling plan is presented in the right/required format | Pass/Fail | Yes | Subsystem |
| PM.4.04 | Test that the sampling plan is updated automatically when material quantities for a project are updated in MMS and the old version is archived | • Project name<br>• Updated material quantities | Update material quantity in MMS. Initiate update to sampling plan. Review changes to sampling plan | The sampling plan includes updated test requirements based on changes to the material quantities | Pass/Fail | No | System; User acceptance<br>Subsystem |
| PM.4.05 | Test that the sampling plan can be changed manually, including additions and deletions | • Project name<br>• Project sampling plan | Open project sampling plan. Change tests required and frequency for more than one material | The changes to sampling plan are accepted and the sampling plan is updated accordingly | Pass/Fail | No | Subsystem |

***Project 1***

***Business Function: Project Management***

Test Specification: Project Workflow (PM.5)

Test that all requirements relating to project workflow are satisfactorily met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.5.01 | Test that comments can be added at approval steps to an existing workflow and edited as required | • Project name<br>• Sample/test information | Select project and appropriate sample to view workflow. Add comment to an approval step. Exit the workflow and reopen to edit the comment | The comment can be stored and edited for each approval step of the workflow, and only authorized users can edit the comment | Pass/Fail | Yes | System; User acceptance |
| PM.5.02 | Test that a workflow can be defined/ established for source of supply approval or material testing process (source of supply, material test, etc.) | • Project name<br>• Project workflow | Open project information. Initiate creation of new workflow. Create workflow with approval steps and save | Project workflow can be saved successfully | Pass/Fail | No | Subsystem |
| PM.5.03 | Test that a priority number can be assigned to a workflow approval request at each approval step (individual level) | • Project name<br>• Project workflow | Open existing workflow in a project. Assign priority number to the approval request | A priority number can be successfully assigned to a workflow step's approval request | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.5.04 | Test that comments can be added and edited for each approval step of the workflow | • Project name<br>• Project workflow | Select project and appropriate sample to view workflow. Add comment to an approval step. Exit the workflow and reopen to edit the comment | The comment can be stored and edited for each approval step of the workflow, and only authorized users can edit the comment | Pass/Fail | Yes | Subsystem |
| PM.5.05 | Test that workflows can be customized for any project with varying workflow steps | • Project name<br>• Project workflow | Select an existing workflow on a project. Edit workflow steps | The workflow can be edited as required | Pass/Fail | No | Subsystem |
| PM.5.06 | Test that SHA existing team members or groups can be removed and new team members/groups can be assigned to a workflow or all workflows on a project as required | • Project workflow | Open an existing workflow on a project. Remove either a team member or a group from a workflow step. Close and reopen workflow. Add a new member or group to the workflow and save | Users can be added and removed from workflow steps as required | Pass/Fail | Yes | System; User acceptance |
| PM.5.07 | Test that SHA team members or groups can be assigned to workflow steps. | • Project name<br>• Project workflow | Open an existing project. Open existing workflow on the project. Assign a user group to a workflow step. Close workflow | The user group can be successfully assigned to the workflow step | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.5.08 | Test that approval timeframes for workflow steps can be specified in MMS and displayed to approvers on approval screen | • Project name<br>• Project workflow | Open an existing project workflow. Enter approval timeframes (e.g., days) as required. Save and close screen. Open screen as approver to check whether "approve by" date is displayed | Approval timeframes can be successfully saved, and "approve by" date is automatically calculated and displayed on the approver screen | Pass/Fail | No | Subsystem |
| PM.5.09 | Test that elapsed time on a workflow, along with remaining time, can be displayed in MMS | • Project name<br>• Project workflow | Open an existing workflow. Open timeframe view/ screen and record elapsed and remaining time for review at each workflow step | Timeframes are accurately displayed | Pass/Fail | No | Subsystem |
| PM.5.10 | Test that system alerts can be generated when workflow steps with pending reviews are within specified days of completion date | • Project name<br>• Project workflow | Open an existing workflow and review alert timelines. Open a workflow with steps that are within specified timelines, or modify allowed time for a workflow step to be within the alert timeline | Alerts are generated successfully for items that are within the alert timeline | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.5.11 | Test that system alert (both email and system notification) threshold can be changed as required, and alerts are triggered automatically when thresholds are reached | • Project name | Open an existing workflow on a project and increase alert threshold days (increase, so that alerts are generated earlier) | Alerts (emails and system notifications) are generated successfully for items that are within the alert timeline | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.5.12 | Test that a management report with delayed reviews and missed dates can be generated successfully | • Project name | Request report for specific project | The management report for specific project is generated successfully | Pass/Fail | Yes | Subsystem |
| PM.5.13 | Test that timeframe for automatic notification regarding sample review delays can be specified/modified in MMS | • Project name | Retrieve project information. Review timeframes for automatic notification and modify as required | Automatic notification timeframes can be modified as required | Pass/Fail | No | Subsystem |
| PM.5.14 | Test that reminder alert times and designated team members can be modified in MMS | • Project name | Retrieve project information. Modify alert times and team members who will receive alerts | Information can be modified as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.5.15 | Test that project documents (letters) can be approved electronically | • Project name<br>• Project workflow<br>• Project document | Retrieve project document (letter) for a specific project. Approve using an electronic signature | The letter can be approved successfully using an electronic signature | Pass/Fail | No | Subsystem |
| PM.5.16 | Test that letters can be printed from MMS with electronic signatures | • Project name<br>• Project document | Retrieve specific project document (letter) and print | The letter can be printed successfully with electronic signatures where appropriate | Pass/Fail | No | System; User acceptance<br>Subsystem |

***Project 1***

***Business Function: Project Management***

Test Specification: Material Specifications (PM.6)

Test that all requirements relating to material specifications are satisfactorily met. These include storing multiple versions of specifications and linking to and storing AASHTO and other specifications in MMS.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.6.01 | Test that multiple versions of material specifications can be successfully stored in MMS. Each specification version will have an associated effective date range. Any projects created in the range will automatically connect to the material specification version active at the time of project creation | • Material specifications | Create a copy of an existing specification and modify certain specifications. Assign effective date range for the new specification | A new version of specification can be successfully created and new projects automatically link to new material specification | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| PM.6.02 | Test that material specification and standards can be successfully stored in MMS | • Material specifications | Enter material specifications and standards in MMS and save | The standards and specifications can be successfully stored in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| PM.6.03 | Test that specifications stored or linked in MMS can be retrieved as required | • Material specifications | Retrieve AASHTO or other material specifications stored or linked in MMS | The specifications can be retrieved successfully | Pass/Fail | Yes | System; User acceptance |
| PM.6.04 | Test that electronic versions of specifications can be linked from MMS | • Material specification links | Enter specification link in MMS. Close and re-enter MMS and retrieve specification | The specification can be retrieved successfully | Pass/Fail | No | Subsystem |
| PM.6.05 | Test that electronic version of AASHTO and other specifications can be stored in MMS | • Material specifications | Store AASHTO/ other specifications in MMS. Save, exit, and re-enter MMS and retrieve specification | The specification can be retrieved successfully | Pass/Fail | No | Subsystem |

***Project 1***

***Business Function: Source of Supply***

Test Specification: Source Database (SoS.1)

Test that all requirements relating to maintaining and storing source of supply information are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.1.01 | Test that the database of material sources can be maintained in MMS | • Material sources | Open a material source, modify the source expiration date and save | The material source can be modified as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| SoS.1.02 | Test that a list of approved sources can be maintained in a database format | • Material source | Enter a new material source in database and save | The material source(s) can be successfully saved in database format | Pass/Fail | No | Subsystem |
| SoS.1.03 | Test that list of materials can be stored, with distinction of whether the material needs to be on an approved list or not | • Material lists | Open a list of material sources and mark as not requiring to be on an approved list | The list can be marked as being on an approved list or not as required | Pass/Fail | No | Subsystem |

***Project 1***

***Business Function: Source of Supply***

Test Specification: Source List (SoS.2)

Test that all requirements relating to storing and maintaining list of approved sources are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.2.01 | Test that the list of approved sources can be maintained electronically and is available as required | • List of approved sources | Open a list of approved sources for a material. Change the expiry date for a source. Password protect the list | The expiry date can be changed, and the list can be password protected as required | Pass/Fail | No | Subsystem |
| SoS.2.02 | Test that a report showing which approved materials (aggregate sizes/soils) can be produced by a quarry can be generated in MMS as required | • List of quarries | Generate report showing availability of quarries | The report can be generated as required | Pass/Fail | No | Subsystem |

***Project 1***

***Business Function: Source of Supply***

Test Specification: Source Request (SoS.3)

Test that all requirements relating to requesting review/approval of a new material source are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.3.01 | Test that source of supply requestor can submit contact person, phone number and other information along with the source | • Project name<br>• Bid item/ material | Request approval of source for a project. Enter contact information, etc. | Information can be submitted successfully if all contact information is entered, and an error is presented if all contact information is not provided | Pass/Fail | No | Subsystem |
| SoS.3.02 | Test that material sources can be submitted online via a web interface. This includes the ability to pick bid items and specific materials to request | • Project name<br>• Bid item/ material<br>• Material sources | Request approval of material source for a specific project using web interface | Approval request can be submitted successfully online using web interface | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.3.03 | Test that submitters (contractors) can select source of supply to request from a current approved list. The screen should also provide the option to add a new source using a text box | • Project name<br>• Bid item/ material<br>• Material sources | Select an existing source of supply from approved list for approval on a project. Enter a new source for approval using text box | The source of supply can be successfully requested using both existing approved list and the text box | Pass/Fail | No | Subsystem |
| SoS.3.04 | Test that sources of supply not on an approved list are automatically forwarded to the appropriate division for approval | • Project name<br>• Bid item/ material<br>• Material source | Enter a new source for approval using provided text box | The source of supply is received by the appropriate division for review and approval | Pass/Fail | No | Subsystem |
| SoS.3.05 | Test that multiple sources of supply can be submitted with each bid item/ material as required if allowed for the material | • Project name<br>• Bid item/ material<br>• Sources of supply | Select a bid item/material. Enter two sources of supply for the bid item and submit | The sources of supply can be submitted successfully only if allowed for the material | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

***Project 1***

***Business Function: Source of Supply***

Test Specification: Source Review (SoS.4)

Test that all requirements relating to review of new material sources are incorporated in the system. This includes review of new sources, forwarding to appropriate division, and communicating review results to submitter.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.01 | Test that links can be provided from approved products function | • Approved products list<br>• Product link | Select an approved product. Insert link for product information | Product link can be added as required | Pass/Fail | No | Subsystem |
| SoS.4.02 | Test that a workflow can be triggered automatically based on pre-defined rules of source of supply approval process | • Source of supply | Request approval of source in MMS and review workflow status | Workflow is triggered automatically | Pass/Fail | No | Subsystem |
| SoS.4.03 | Test that source of supply letter/list can be distributed electronically after review is complete | • Source of supply letter/list | Complete review source of supply letter/list. Distribute letter/list to team members | The letter/list can be distributed successfully as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.04 | Test that a source of supply can be reviewed/ approved, and assigned notes and validity dates | • Source of supply | Select and open an existing source of supply. Change review comments and validity dates | The changes are saved successfully in MMS | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| SoS.4.05 | Test that project documentation can be distributed as required via an email, fax, or within MMS as required | • Project name<br>• Project documentation | Select project, open project documentation. Select a recipient, and send project documentation as email, fax and within MMS | Project documentation can be sent to the required recipient via all transport media | Pass/Fail | No | Subsystem |
| SoS.4.06 | Test that review "notes" can be automatically assigned to submitted sources of supply. These "notes" would be assigned from a pre-defined table/database | • Source of supply<br>• Source material category | Open and approve a source of supply. Close and reopen source of supply window to check review "notes" | Review "notes" are automatically assigned upon approval | Pass/Fail | No | Subsystem |
| SoS.4.07 | Test that review "notes" can be manually edited | • Source of supply | Open a source of supply approval request. Edit existing review "note" and save | Review "notes" can be edited as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.08 | Test that list of review "notes" tied to source rejection can be stored in database and provided on review page | • Source of supply<br>• Rejection "notes" | Open page to enter rejection "notes" and save. Open review page and retrieve review "notes" for rejection | Rejection "notes" can be successfully saved in database and are provided on the review page as required | Pass/Fail | No | Subsystem |
| SoS.4.09 | Test that multiple review "notes" can be assigned to source of supply items as required | • Source of supply | Open an existing source of supply under review, manually add review "note," and save | New review "note" is added and the old "notes" stay intact | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| SoS.4.10 | Test that comments can be added to each level of material approval for internal and external users | • Source of supply material approval | Open an existing source approval workflow. Add comments for both internal and external members | Multiple comments can be added at each level of material approval for both internal and external users | Pass/Fail | No | System; User acceptance<br>Subsystem |
| SoS.4.11 | Test that MMS can interface with MPEL | • Requested and approved new products | Initiate import in MMS from MPEL. Cross-check information in MPEL with information in MMS to verify all information has been imported accurately in the correct fields | Required information is correctly imported in MMS | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.12 | Test that source approval inspection requests can be flagged as those for active projects or no projects. If the approval is for no specific project, the MMS should allow to mark status as "awaiting payment" or "payment received" | • Source approval request | Open source approval request and flag as for active project | The approval request can be flagged successfully | Pass/Fail | No | Subsystem |
| SoS.4.13 | Test that reports relating to production facilities can be retrieved and printed as required | • Production facilities | Open report generation screen and request reports related to production facilities | Requested report(s) can be generated successfully | Pass/Fail | No | User acceptance<br>Subsystem |
| SoS.4.14 | Test that a report can be retrieved and printed for all projects to which particular source is providing material | • Source of supply | Generate report to show the projects to which a source of supply provides material | The report can be generated successfully | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.15 | Test that a formatted report can be printed and converted to an easily transferable format | • Source of supply | Generate report for source of supply | A formatted report can be generated successfully and can be converted into an easily transferable format | Pass/Fail | No | Subsystem |
| SoS.4.16 | Test that an approved source's status can be changed to not approved | • Source of supply | Open a source of supply and change status to either "under review" or "unapproved" | The source of supply status can be changed as required | Pass/Fail | Yes | System; User acceptance |
| SoS.4.17 | Test that sources can be marked as approved based on reciprocity with other states | • Sources of supply | Open a source of supply under review, and mark as approved based on reciprocity. Enter reciprocal state and save | The source of supply can be approved as required | Pass/Fail | No | Subsystem |
| SoS.4.18 | Test that sources can be marked as tentatively approved for project work | • Source of supply<br>• Project name | Open a source of supply under review. Mark as tentatively approved, and enter project it is tentatively approved for | Source of supply can be successfully approved tentatively for a specific project | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.19 | Test that an approved source addition to approved source list can be overridden manually | • Source of supply<br>• Approved source list | Open source list. Remove approved source from source list | Approved source can be removed from source list as required | Pass/Fail | Yes | System; User acceptance |
| SoS.4.20 | Test that source approval/disapproval information can be provided electronically via email to requestors | • Source approval/disapproval result<br>• Requestor information | Open source approval/disapproval decision. Email approval/disapproval decision | Email can be sent successfully | Pass/Fail | No | Subsystem |
| SoS.4.21 | Test that source of supply can be approved only for specific projects | • Source of supply<br>• Project name | Select source of supply approval, and select approved for a specific project. Select project for which source is approved | Source of supply is approved, but only for specific project | Pass/Fail | No | Subsystem |
| SoS.4.22 | Test that source of supply is added automatically to appropriate approved list upon approval | • Source of supply<br>• Material category | Select source of supply and approve. Review appropriate approved source list | Source of supply is added automatically to the approved source list | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.23 | Test that source of supply can be manually removed from approved source list, while keeping it approved for specific projects | • Source of supply<br>• Project name<br>• Material category | Select source of supply that is approved for specific project. Remove from approved list | Source of supply can be removed from approved list leaving source approved for specific projects | Pass/Fail | No | Subsystem |
| SoS.4.24 | Test that a list of all bid items and materials to be used on a project can be presented along with the source of supply approval status | • Project name<br>• Project bid items<br>• Sources of supply | Select existing project. Retrieve list of bid items and sources of supply approval status | All bid items and source approval status is presented accurately | Pass/Fail | Yes | System; User acceptance |
| SoS.4.25 | Test that materials engineer can be notified when user-specified number of submitted sources are approved, or when user-specified number of days have passed since submittal request | • Project name<br>• Source of supply | Change number of days after submittal request is submitted for when material engineer is notified to one day. Review if alerts are generated | Alerts are successfully generated | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.26 | Test that material sources can be accepted and marked as approved based on certified test results submitted to OMT | • Source of supply<br>• Associated certified test results<br>• Project name | Open source of supply submitted for approval. Approve and mark as approved based on certified test results. If approved for specific projects only, mark projects the results are approved for | Source of supply can be approved for specific projects as required based on certified test results | Pass/Fail | No | Subsystem |
| SoS.4.27 | Test that list of reasons for source disapproval/rejection can be stored in table/database and provided on review page as a drop-down menu, along with “other” as an option on the drop-down menu and a comment box | • Source of supply<br>• Rejection reasons | Open page to enter rejection reason and save. Open review page and retrieve review reason for rejection. Open page to review source, enter “other” as rejection reason and enter comment in text box | Rejection reason can be successfully saved in table/ database, and are provided on the review page as required. Reason entered in comment box can be saved successfully | Pass/Fail | No | Subsystem |
| SoS.4.28 | Test that an alert is generated when existing approved source is no longer valid and sent to relevant parties | • Source of supply | Open existing approved source and change status to “expired”/ ”unapproved” | An alert is generated and sent to contact members for all projects the source is approved for | Pass/Fail | Yes | System; User acceptance; Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SoS.4.29 | Test that a report displaying all sources that are rejected can be generated as required | • Sources of supply | Open screen to generate report. Request report showing all sources rejected | Report showing all sources that are rejected, along with reason for rejection and comment entered can be generated successfully | Pass/Fail | No | Subsystem |
| SoS.4.30 | Test that items can be manually released for distribution after review completion | • Source of supply | Open screen to release results for approved sources. Select sources to release results, and release results | Source review results can be successfully released as required | Pass/Fail | No | User acceptance<br>Subsystem |
| SoS.4.31 | Test that items released for distribution can be distributed manually through MMS in the form of a consolidated email | • Source of supply | Open screen to distribute results, and release a set of results | Released results are emailed to relevant parties in the form of a consolidated email | Pass/Fail | No | User acceptance<br>Subsystem |
| SoS.4.32 | Test that items released for distribution can be automatically released based on business-specific rules listed in MMS | • Source of supply | Change rule to automatically release results every day, and check if new results are released | New results are emailed as appropriate | Pass/Fail | No | User acceptance<br>Subsystem |

***Project 1***

***Business Function: System Management***

Test Specification: System Maintenance (SyMg.1)

Test that all requirements related to maintaining MMS are successfully met. This includes granting access to users and maintaining security log (audit trail) of user access to MMS

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SyMg.1.01 | Test that "help screens" can be edited in MMS using administration back-end | • Help data<br>• MMS screen to display help data | Open help screen using administration back-end and modify (add/ remove data) as required | Help data can be successfully modified and updated data is displayed on applicable data entry screen | Pass/Fail | Yes | System; User acceptance |
| SyMg.1.02 | Test that user back-end can be successfully used to accomplish administration tasks | • Distribution list | Open administration back-end to modify existing distribution list. Make changes to distribution list and save | Changes to distribution list can be saved successfully | Pass/Fail | No | Subsystem |
| SyMg.1.03 | Test that OMT organization structure can be maintained in MMS, and tasks can be assigned at individual or organizational level | • OMT organization structure<br>• Tasks to be assigned | Open OMT organization structure. Assign task to individual, and organization | Tasks can be assigned as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SyMg.1.04 | Test that user-definable tables, fields, indexes, and forms can be provided in MMS | • User data | Open back-end or applicable wizard. Specify new table and save | New table can be saved successfully | Pass/Fail | No | Subsystem |
| SyMg.1.05 | Test that online "help screens" can be populated in MMS using administration back-end | • Help data<br>• MMS screen to display help data | Open help screen using administration back-end and add help data. Link help data to applicable MMS screen | Help data can be added successfully, linked to right MMS screen, and displayed as required on MMS screen | Pass/Fail | No | Subsystem |
| SyMg.1.06 | Test that a list of MMS users can be edited in MMS | • Users | Open list of MMS users. Remove a user and save. Add user back in MMS | User can be removed and added as required | Pass/Fail | Yes | System; User acceptance |
| SyMg.1.07 | Test that a list of MMS users and access rights can be maintained in MMS | • Users<br>• Access levels | Open list of MMS users. Add new user and specify access rights | New users can be added and access rights can be specified in MMS | Pass/Fail | No | Subsystem |
| SyMg.1.08 | Test that users with insufficient security rights are denied access to parts of MMS | • User<br>• Access levels | Review user's access rights. Try to access screens that user does and does not have access to | User can access screens where access has been granted, and access is denied where not granted | Pass/Fail | Yes | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SyMg.1.09 | Test that role-based security can be provided in MMS to grant and restrict access as required | • User | Use administration back-end to assign role to new role, and review access rights | User access rights are modified according to the new specified role | Pass/Fail | Yes | Subsystem |
| SyMg.1.10 | Test that a security log with user access details is maintained in MMS | • User data | Open administration back-end to generate security log for all users | A user log can be successfully generated showing appropriate access data | Pass/Fail | Yes | Subsystem |
| SyMg.1.11 | Test that external (non-SHA) users can be granted access to MMS screens on a case-by-case basis if required | • User<br>• Access screen/level | Open administration back-end and grant user access to additional screen | User can access additional screen, but cannot access any other parts of the MMS as specified in security access | Pass/Fail | Yes | Subsystem |

***Project 1***

***Business Function: Other***

Test Specification: Other (Othr.1)

Test that all other requirements are successfully met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Othr.1.01 | Test that project placed quantities can be stored separately as reported by project site and as reported by manufacturing plant | • Project name<br>• Placed quantity | Enter project placed quantity and mark are either reported by project site or manufacturing plant | Project data can be saved successfully, and marked as reported by project site or manufacturing plant (but not as both). If one of the two options are not selected, an error is presented | Pass/Fail | Yes | System; User acceptance; Subsystem |

## PROJECT 2 (GENERIC LIMS)

### Business Function: Material Testing

Test Specification: Sample Login (MT.1)

Test that all requirements related to logging a sample in MMS are incorporated in the system. This includes, but is not limited to assigning a serial number, recording source of material for the sample, mark status of sample, etc.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.01 | Test that a serial number is automatically assigned to a sample when a sample is logged into MMS | • Project name | Open screen to log new sample in MMS. Enter sample information and save. Review sample number | A serial number is automatically assigned to the sample successfully | Pass/Fail | Yes | Subsystem |
| MT.1.02 | Test that a serial number can be automatically assigned to a specimen upon logging specimen into MMS | • Project name<br>• Sample serial number | Open screen to log new specimen in MMS. Enter sample it is connected to. Review specimen number | A serial number is automatically assigned to the specimen successfully | Pass/Fail | No | Subsystem |
| MT.1.03 | Test that sample properties like project number, project name, appropriate division, mix design #, etc. can be entered and stored in MMS | • Project name | Open screen to log new sample in MMS. Enter sample information/properties and save | Sample properties can be saved successfully in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.04 | Test that specimen properties are automatically populated based on sample properties | • Project name<br>• Sample number | Open screen to log new specimen in MMS. Enter the sample number the specimen is connected to. Review if specimen properties are automatically populated | Specimen properties are automatically populated based on sample properties | Pass/Fail | Yes | Subsystem |
| MT.1.05 | Test that parameters other than sample and specimen properties (e.g., sample condition, test type, test values, etc.) can be assigned to samples and specimens | • Project name<br>• Sample number<br>• Specimen number | • Open screen to view sample information in MMS. Add sample condition, test type, etc. for sample and save<br>• Open screen to view specimen information in MMS. Add specimen condition, test type, etc. for specimen and save | • Sample parameters can be successfully saved in MMS<br>• Specimen parameters can be successfully saved in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.06 | Test that the source of material for each sample can be recorded in MMS | • Project name<br>• Sample number<br>• Source of supply | Open screen to view sample information in MMS. Enter source of supply information, either pulling from a list of approved sources, or in a comment box as appropriate | Source of supply information for sample can be entered and stored as required | Pass/Fail | No | Subsystem |
| MT.1.07 | Test that source of material for a sample can be modified in MMS | • Project name<br>• Sample number<br>• Source of supply | Open screen to view sample information in MMS. Review existing source of material for sample, modify to another approved source, and save | Source of supply information for sample can be modified as required | Pass/Fail | Yes | System; User acceptance |
| MT.1.08 | Test that sample information entered can be validated, and the sample can be flagged when required information is not provided | • Project name<br>• Sample number<br>• Sample information | Open screen to view sample information in MMS. Leave required sample information field blank and save | MMS saves sample information, but the sample is flagged automatically as having incomplete information | Pass/Fail | No | User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.09 | Test that sample information can be updated for an existing sample | • Project name<br>• Sample number<br>• Sample information | • Open screen to view sample information in MMS for an existing sample that is flagged as having incomplete information. Enter information in missing fields and save<br>• Flag sample manually as unfit for testing | • Entered information can be saved as required, and sample flag of incomplete information is automatically removed<br>• The manual flag for the sample is retained | Pass/Fail | Yes | System; User acceptance |
| MT.1.10 | Test that an alert is automatically generated when a sample is flagged as not fit for testing, and an email is sent to applicable distribution list | • Project name<br>• Sample number | Open an existing sample in MMS. Flag sample as not fit for testing and save | The sample is flagged as not fit, and an alert is automatically generated and emailed | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.11 | Test that automatic reminders can be sent when sample information is missing (sample flagged with missing information) at user specified intervals | • Project name<br>• Sample number | Open an existing sample and flag as unfit for testing with incomplete information. Open administration screen to change user-specified interval for reminders to one day. Review if reminder is automatically sent | A reminder is automatically sent for the sample | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MT.1.12 | Test that sample information can be marked as received without sample as required | • Project name<br>• Sample number | Open existing sample information received. Mark as "received without sample" | Sample status can be successfully marked as received without sample as required | Pass/Fail | No | Subsystem |
| MT.1.13 | Test that sample status (e.g., recorded at field, shipped to lab, received by lab, etc.) can be marked in the system as required | • Project name<br>• Sample number | Open existing sample for a specific project. Mark sample status as "received by lab" and save | Sample status can be marked as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.14 | Test that status of a sample recorded in the system can be modified as required | • Project name<br>• Sample number | Open existing sample. Change sample status and save | Sample status can be changed successfully as required | Pass/Fail | Yes | System; User acceptance |
| MT.1.15 | Test that shipment date for sample can be recorded in MMS | • Project name<br>• Sample number | Open existing project in MMS and enter new sample information. Enter shipment date for sample and save | Sample information, including shipment date for sample, can be saved successfully | Pass/Fail | No | Subsystem |
| MT.1.16 | Test that a sample can be logged offline, and the information can be imported back into MMS when connected to internet/intranet | • Project name<br>• Sample number<br>• Sample information | • Open offline data capture tool, enter sample information and save<br>• Connect to MMS and import information from off-line data capture tool | • Sample information can be successfully logged using offline data capture tool and an offline serial number is assigned to the sample<br>• Information is correctly imported in MMS from off-line data capture tool, and an MMS serial number is now assigned to the sample | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.17 | Test that a sample serial number can be printed from MMS as required. This will help attach a serial number to a sample that is logged offline | • Project name<br>• Sample number (serial number) | Open existing project, and an existing sample on project. Request a sample serial number (label) be printed | The sample serial number can be printed successfully | Pass/Fail | No | Subsystem |
| MT.1.18 | Test that a barcode containing sample serial number can be printed from MMS to attach to a sample | • Project name<br>• Sample number (serial number) | Open existing sample information in MMS, and request that a barcode be printed | A barcode containing sample serial number can be printed successfully as required | Pass/Fail | No | Subsystem |
| MT.1.19 | Test that sample information can be retrieved in MMS by entering sample serial number | • Sample number (serial number) | Open MMS screen to enter serial number, and enter the serial number for an existing sample (may use serial number printed in test case MT.1.17) | Sample information can be retrieved successfully | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.20 | Test that data from barcode readers can be recorded in MMS and sample information can be retrieved based on barcode reading | • Sample barcode containing sample serial number | Open MMS screen to read sample barcode. Scan barcode using barcode reader | Sample information is successfully retrieved using barcode reading | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MT.1.21 | Test that offline test results/ information can be imported in MMS as an email, scan file, etc. | • Project name<br>• Sample number | Open MMS screen to import information, or screen to attach information. Import email or scan containing offline test results/attach to existing sample information | Offline test results/information can be successfully imported in MMS or attached to existing test results as electronic files as appropriate | Pass/Fail | No | Subsystem |
| MT.1.22 | Test that a material placement location can be stored in MMS in multiple coordinate systems | • Project name<br>• Material placement location | Open MMS screen to record material placement location. Enter location in multiple coordinate systems (latitude/ longitude, etc.) | Material placement location can be successfully stored in MMS in multiple coordinate systems | Pass/Fail | No | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.23 | Test that a project engineer can trigger a particular workflow manually once project information is received | • Project name<br>• Project information | Open MMS as an authorized user (project engineer) to view project information. Initiate workflow based on project information | Workflow can be initiated/ triggered by authorized user as required | Pass/Fail | No | System; User acceptance<br>Subsystem |
| MT.1.24 | Test that QC data can be requested and stored in MMS | • Project name<br>• Project QC data | • Open MMS screen to request QC data from particular users via email<br>• Initiate import of QC data in MMS | • QC data can be successfully requested<br>• QC data can be successfully imported in MMS | Pass/Fail | Yes | System<br>Subsystem |
| MT.1.25 | Test that a note can be added to a sample regarding the purpose of the sample (e.g., QA, plant acceptance, etc.) | • Project name<br>• Sample number | Open MMS screen to view sample information. Enter note (plant acceptance) in purpose field to indicate sample purpose | A note indicating sample purpose can be successfully added to a sample | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.1.26 | Test that RFID tags can be used to record sample information in MMS | • Project name<br>• Sample data | Open MMS screen to view sample information. Select option to transmit/ write sample information to RFID tag | Sample information can be successfully written to an RFID tag | Pass/Fail | No | Subsystem |
| MT.1.27 | Test that sample information from RFID tags can be read in MMS | • Project name<br>• Sample information in RFID tag | Initiate read of RFID tag in MMS and retrieve relevant sample information | Relevant sample information can be retrieved by reading RFID tag in MMS | Pass/Fail | No | System; User acceptance<br>Subsystem |
| MT.1.28 | Test that RFID records and code information can be stored in MMS | • Project name<br>• RFID tag information | Open MMS screen to view sample information. Transmit/ write sample information to RFID tag | Sample information can be written to RFID tag and stored in MMS for retrieval | Pass/Fail | No | Subsystem |

***Project 2***

***Business Function: Material Testing***

## Test Specification: Prepare Specimen (MT.2)

Test that all requirements related to preparing a specimen from a sample in MMS are incorporated in the system. A sample is generally broken down into multiple samples for testing.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.2.01 | Test that samples can be split into multiple specimens and properties can be assigned to specimens | • Sample number | • Create new specimen, and select existing sample as originating sample. Create another specimen and select same sample in step 1 as originating sample<br>• Assign properties to each specimen created and save | • Multiple specimens can be attached to a sample, thereby splitting the sample into multiple specimens<br>• Properties for each specimen can be saved as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.2.02 | Test that tests can be assigned to samples and specimens as required | • Project name<br>• Sample number<br>• Specimen number<br>• Required tests | Open MMS manager screen and view sample. Assign test to sample. Open specimen, and assign test to specimen | Tests can be assigned to specimens and samples as required. If a sample has multiple specimens associated, the information is provided to confirm whether same test should be assigned to all specimens | Pass/Fail | No | Subsystem |
| MT.2.03 | Test that task options (e.g. complete by, test on, etc.) can be assigned to specimens | • Project name<br>• Specimen number | Open existing specimen in MMS. Assign task options to specimen and save | Task options can be successfully assigned and saved | Pass/Fail | No | Subsystem |
| MT.2.04 | Test that comments can be assigned such that they are visible only to testers | • Project name<br>• Specimen number | Open existing specimen in MMS. Add comments to specimen as required and save. Review comment as tester. Exit and login as contractor and attempt to view comment | Comments can be successfully saved in MMS. The saved comments are viewable to testers only, and contractors are denied access to MMS | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.2.05 | Test that a tester or a group of testers can be assigned to each specimen | • Specimen number<br>• Tests/ tester group | Open existing specimen in MMS. Open screen to assign tester/group of testers to specimen. Assign tester/group and save | Tester or group of testers can be successfully assigned to specimen as required | Pass/Fail | No | Subsystem |
| MT.2.06 | Test that a priority rating between 1 and 5 can be assigned to samples/ specimens as required | • Specimen/ sample number | Open MMS screen to assign priority rating. Open existing specimen. Assign a rating of 5 to specimen and save | The priority rating for specimen is saved successfully | Pass/Fail | No | Subsystem |
| MT.2.07 | Test that samples/specimens can be flagged as active or inactive | • Sample number | Open MMS screen to flag sample. Flag sample as inactive | Sample can be flagged as required | Pass/Fail | No | Subsystem |
| MT.2.08 | Test that the location of sample storage (physical location) can be stored in MMS | • Sample number | Open MMS screen to enter sample information. Enter physical storage location of sample and save | Physical storage location of sample can be saved as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.2.09 | Test that location of sample storage (physical location) can be modified as required | • Sample number<br>• Sample information | Open MMS screen to view and edit sample information. Modify sample physical storage location | The physical storage location of sample can be modified as required | Pass/Fail | Yes | System; User acceptance |

***Project 2***

***Business Function: Material Testing***

## Test Specification: Record Test Results (MT.3)

Test that all requirements related to recording test results in MMS are incorporated in the system. These include, but are not limited to logging test results, compiling specimen results, etc.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.01 | Test that each test performed for each sample/specimen can be logged in MMS | • Project name<br>• Sample/ specimen number<br>• Sample test | • Open MMS test entry screen and enter test result for specimen/sample<br>• Open MMS screen to view list of tests for a specific project | • Test results can be saved in MMS as required<br>• A test log for each project is saved in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.02 | Test that sample or specimen test results can be retrieved as required | • Project name<br>• Sample/ specimen list | Open existing project in MMS. View list of samples and open sample to view list of tests performed on sample. Open test performed and add test information to sample/ specimen | Test results can be retrieved as required and additional information can be added as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| MT.3.03 | Test that outsourced labs can be allowed restricted access to MMS to enter test results | • Project name<br>• Tests | Login to MMS as an outsourced lab. Enter data on project that access has been provided for and enter data. Attempt to access project that access has not been provided for | Outsourced labs are provided restricted access to MMS – access is denied to projects for which access has not been provided | Pass/Fail | No | Subsystem |
| MT.3.04 | Test that lab results can be entered in MMS using batch entry | • Project name<br>• Test results | Open MMS screen to batch import test results from outsourced lab. Initiate and complete batch import | Outsourced lab results are successfully imported in MMS using batch entry | Pass/Fail | Yes | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.05 | Test that sample/specimen test results can be entered in MMS through a web-based interface | • Project name<br>• Sample number<br>• Sample information | Open web-based MMS screen for specific project.<br>• Enter test results for a new sample<br>• Enter test results for an existing sample | Test results for both new sample and existing sample can be entered in MMS successfully | Pass/Fail | No | System; User acceptance<br>Subsystem |
| MT.3.06 | Test that contractor's/plant's QC results can be stored in the system, and marked as such | • Project name<br>• Test results | Open MMS screen to enter test results. Enter test results and mark as QC results | Test results can be stored in MMS and marked as QC results | Pass/Fail | No | Subsystem |
| MT.3.07 | Test that specimen results can be compiled into one sample result | • Project name<br>• Specimen test results | Open MMS screen to consolidate results. Select specimens to compile results, and initiate result compilation | Specimen test results can be compiled into sample results successfully | Pass/Fail | No | Subsystem |
| MT.3.08 | Test that comments relevant to testing process can be stored at specimen level as internal and external comments | • Project name<br>• Specimen number | Open MMS screen to view test information. Enter test comments to specimen for internal use and external use | Comments for both internal and external use are saved successfully | Pass/Fail | No | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.09 | Test that the lab tester's information and data and time the test result is entered is automatically recorded in MMS | • Sample information<br>• Tester information | Open MMS to enter sample test data. Close and view administration panel/ screen to view sample tester's information | Sample tester's information is automatically saved in MMS | Pass/Fail | No | Subsystem |
| MT.3.10 | Test that a lab test can be flagged as being charged to YB-888 | • Project name<br>• Project test<br>• Charge information | Open MMS screen to enter test information. Flag test as being charged to YB-888 | Individual tests can be flagged as being charged to YB-888 | Pass/Fail | No | Subsystem |
| MT.3.11 | Test that it can be noted in MMS that a particular test is generally charged to YB-888 | • Test name | Open administration screen, and note test as generally charging to YB-888 | Tests can be noted as generally charging test time and cost to YB-888 | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.12 | Test that MMS automatically marks a test as going to be charged to YB-888 if listed as such | • Test name<br>• Tester | • Open test screen that is generally charged to YB-888 as SHA user to review if the test is marked as being charged to YB-888<br>• Open test screen that is generally not charged to YB-888 as SHA user<br>• Open test screen that is generally charged to YB-888 as consultant technician | • Test is marked as being charged to YB-888 as required<br>• Test is not marked as being charged to YB-888<br>• Test is not marked as being charged to YB-888 | Pass/Fail | No | System; User acceptance<br>Subsystem |
| MT.3.13 | Test that specific field can be entered on MMS screens as required | • Test screen | Open test screen for a particular test, enter cost per test and material specification used, and save | Specific fields can be entered and saved on MMS screens as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.3.14 | Test that a material specification and applicable specification version for a test can be entered for MMS tests | • Test screen<br>• Material specification | Open MMS test screen and enter test results. Select applicable material specification from drop-down menu, select applicable version of specification, and save | Material specification and version can be saved to test results as required | Pass/Fail | No | Subsystem |
| MT.3.15 | Test that a material specification and version applied to a test sample can be modified as required | • Sample number<br>• Test screen<br>• Material specification | Open test screen to view existing sample results. Modify applicable material specification, select applicable version, and save | Material specification and version can be modified for the sample | Pass/Fail | Yes | System; User acceptance |
| MT.3.16 | Test that sample tests can be rescheduled electronically if required (e.g., in case of failure of first sample) | • Sample number<br>• Testing schedule | Open MMS test schedule. Edit test date for particular sample and save | Tests can be rescheduled in MMS as required | Pass/Fail | No | Subsystem |

***Project 2***

***Business Function: Material Testing***

## Test Specification: Review/Approve Results (MT.4)

Test that all requirements related to reviewing and approving test results in MMS are incorporated in the system. These include, but are not limited to comparing data from different sources, approving results, etc.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.4.01 | Test that the approvers can approve test results by material division | • Test results | • Open MMS screen as an authorized user, and approve test results<br>• Open MMS screen as a user not authorized to approve test results | • Test results can be approved as required<br>• An error message is presented, mentioning that only authorized users can approve test results | Pass/Fail | No | Subsystem |
| MT.4.02 | Test that sample test results can be approved if tests results have minor deviation compared to material specifications | • Test results | Open MMS screen to review test results. Manually approve test results for a sample that has minor deviation from applicable specifications | Test results can be manually approved as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.4.03 | Test that material testing data from construction contractors/material producers can be compared to SHA QA test results | • Contractor/ producer test results<br>• SHA QA test results | Open MMS screen to compare contractor/ producer and QA test results | Test results can be compared successfully as required | Pass/Fail | No | Subsystem |
| MT.4.04 | Test that all specimen testing, approval and distribution data is tracked and recorded in MMS | • Test data | Open MMS screen to review specimen testing, approval, and distribution data | Testing, approval and distribution data is accurately tracked and recorded in MMS | Pass/Fail | No | System<br>Subsystem |
| MT.4.05 | Test that facility/ product/material accepted lists are updated automatically upon meeting requirements for approval and upon completion of QA/AC checklist | • Material list<br>• Test results | Approve test results for facility and review if facility is automatically added to approved list | Facility/ product/material accepted list is updated automatically upon approval of test results | Pass/Fail | No | Subsystem |

***Project 2***

***Business Function: Material Testing***

Test Specification: Sample Management (MT.5)

Test that all requirements related to sample management are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.5.01 | Test that approved test results can be manually distributed to recipients | • Test results | Open MMS screen to distribute approved results. select results to distribute and email | A consolidated email for all approved results marked for distribution on a project is sent | Pass/Fail | No | Subsystem |
| MT.5.02 | Test that tasks to be performed on tests can be sorted by work group, technician, work backlog, etc. | • Sample number | Open MMS screen to review tasks to be performed on samples and sort by work group | Tasks can be sorted as requested | Pass/Fail | No | Subsystem |
| MT.5.03 | Test that a backlog of tests can be viewed, sorted by multiple criteria (e.g., division lab, aging of samples) as required | • Tests to be performed | Open MMS screen to view backlog of tests to be performed. Sort test backlog by aging of samples | The test backlog can be displayed accurately and can be sorted as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.5.04 | Test that number of samples collected (logged) for a project can be compared to the number in the project sampling plan | • Project name | Select project and open screen to view comparison of number of sample collected vs. number mentioned in project sampling plan | Comparison of number of samples collected vs. number in project sampling plan can be generated successfully | Pass/Fail | No | Subsystem |
| MT.5.05 | Test that the status of sample test progress can be viewed within a division | • Sample number | Select sample, and request status of sample test progress within division | Sample test progress can be viewed successfully in MMS | Pass/Fail | No | Subsystem |
| MT.5.06 | Test that alerts can be generated when samples can be discarded. The alert will be based on division-specific business rules | • Sample number | Open administration screen and modify business rule for alert generation, reducing number of days to hold sample to one day. Review if alerts are generated | Alerts are generated and emailed as required | Pass/Fail | No | Subsystem |
| MT.5.07 | Test that the business rules for sample discard can be manually overridden for samples as required | • Sample number | Open administration screen. Override sample discard rule for specific sample and save | Sample discard rules can be overridden as required | Pass/Fail | Yes | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| MT.5.08 | Test that sample and test information can be viewed by contractors through a web-based interface | • Project name<br>• Sample information | Login as contractor and request to view sample and test information for project | Sample and test information can be viewed as requested | Pass/Fail | No | Subsystem |

***Project 2***

***Business Function: Certification Based Approval***

Test Specification: Certifications (Cert.1)

Test that all requirements related to approving materials based on certification are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.01 | Test that electronic certifications/certified test results can be stored in MMS as PDF files and indexed with test attributes | • Test name<br>• Test results | Open MMS and save certified test results as PDF. Add attributes to file as required (e.g., project, manufacturer/ plant) | Certifications/ certified test results can be stored in MMS as PDF files and indexed as required | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.02 | Test that electronic certifications/certified test results (PDFs and test attributes) stored in MMS can be modified | • Test results | Open MMS and view certified test results. Edit attached attributes to add a project that the material is approved for. Update test result PDF file with new version and save | Certifications/ certified test results can be modified in MMS by authorized users as required | Pass/Fail | Yes | System; User acceptance |
| Cert.1.03 | Test that certification approval and recertification requests can be submitted electronically | • Certification approval request<br>• Certified test results | Open MMS to request certification approval. Enter required fields, attach certified test results as PDF, and submit request | Certification/ recertification request is submitted correctly and received in MMS as required | Pass/Fail | No | Subsystem |
| Cert.1.04 | Test that documents can be attached with certification approval requests | • Certification approval request<br>• Certified test results | Open MMS to request certification approval. Enter required fields, attach certified test results as PDF, and submit request | Documents can be correctly attached to certification/ recertification requests | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.05 | Test that certification test results can be reviewed in MMS, comments entered, and results can be approved or disapproved as appropriate | • Certification approval request<br>• Certified test results | Open MMS to review certification request and to review test results. Enter comments to certification request and save. Approve certification request as appropriate | Test results can be reviewed as required, request reviewed, and approved or disapproved as appropriate | Pass/Fail | No | Subsystem |
| Cert.1.06 | Test that certification request approval/ disapproval can be reviewed and the results can be marked as released and ready for distribution to involved parties | • Certification request | Open certification request review screen and mark approved/ disapproved requests as released and ready for distribution | The status of certification requests is updated to indicate they are released for distribution | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.07 | Test that released results can be distributed to requestor and other interested parties via email | • Certification request | Open certification request release screen and select certifications to release. Review distribution list presented for each request, and edit to add another email address. Distribute certification results | The results are distributed via email as required. Requestors with more than one request receive only one email that includes all requests submitted and distributed | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| Cert.1.08 | Test that all certification expiration dates can be presented in a calendar format | • Approved certifications | • Request a view of all certification expiration dates in MMS in a calendar format.<br>• Filter results by any three material sources | • Certification expiration dates are presented in a calendar format<br>• The calendar results are filtered to show only the three material sources requested | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.09 | Test that an automatic notification can be generated and email sent out when certificates are within x days of expiration | • Certifications about to expire<br>• Distribution lists | Open administration screen to review number of days remaining for expiration when an alert (email) is sent. Review that each certification has an attached distribution list. Modify number of days remaining to 90 days and save | Alerts (emails) are sent out to appropriate distribution lists for all certifications set to expire in the next 90 days | Pass/Fail | No | Subsystem |
| Cert.1.10 | Test that a certification approval request can be printed with an electronic signature | • Certification approval request | Open certification review screen and select approved certification. Request print of the certification | The certification is printed as requested, and an electronic signature of the approver(s) is/are printed on certification review | Pass/Fail | No | System; User acceptance<br>Subsystem |
| Cert.1.11 | Test that certification test results can be captured in a retrievable and reportable format | • Certification approval<br>• Certified test results | Open screen to enter test results in MMS and mark as certified test results. Save test results and exit | Certification test results can be stored similar to sample test results (for tests conducted by SHA) | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cert.1.12 | Test that certifications and certified test results can be stored at plant level and linked to projects as required | • Certification approval<br>• Requesting plant<br>• Project for which plant can submit material | Open submitted certification approval request and review requesting plant. Approve certification request. Review that the approved results show requesting plant information. Enter existing project as one that can accept material from the plant and save | The certification approval and test results are stored at the plan level as required, and projects for which material will be provided from the plant are entered and linked to the plant/ certification approval and test results | Pass/Fail | No | Subsystem |

***Project 2***

***Business Function: Plant Review***

Test Specification: New Plant Approval (Plnt.1)

Test that all requirements related to approving new plants are incorporated in the system. This includes receiving request to add new plant to approved list

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.1.01 | Test that plants can request addition to approved list and inspection of plant electronically | • Plant name | Request addition of plant to approved list and plant inspection using MMS screen. | Request to add plant and conduct plant inspection are successfully submitted by requestor and received in MMS | Pass/Fail | No | System; User acceptance<br>Subsystem |
| Plnt.1.02 | Test that documents can be attached electronically to plant approval/ inspection request | • Plant name<br>• Electronic document (QC plan) | Open screen to request addition of plant or plant inspection. Attach latest QC plan as electronic PDF file and submit | The QC plan can be submitted successfully and is saved in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.1.03 | Test that inspection/audit checklists can be stored and maintained in MMS | • Inspection/ audit checklist | • Create new checklist in MMS using appropriate screen<br>• Open existing checklist and remove item. Add a new item and save | • New checklist can be created successfully in MMS<br>• Checklist can be edited and saved as required | Pass/Fail | No | Subsystem |
| Plnt.1.04 | Test that inspection schedule information can be stored in MMS and can be presented in a calendar format and can be printed | • Plant name<br>• Inspection schedule | • Open screen to enter inspections that have been scheduled. Enter inspection details like contact information, technician scheduled, etc.<br>• Review inspections that have been scheduled in MMS in calendar view and print | • Inspections can be scheduled in MMS as required<br>• Scheduled inspection can be viewed in a calendar format and can be viewed if required | Pass/Fail | No | User acceptance<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.1.05 | Test that a plant request can be approved or disapproved in MMS based on inspection, and other relevant information can be entered as required | • Plant name<br>• Plant approval request | Open plant approval request and add inspection details. Add whether the plant is approved, tentatively approved, or disapproved. Add whether any issues need to be resolved before final approval | All information regarding plant inspection can be attached to plant approval request, including plant approval status | Pass/Fail | No | Subsystem |
| Plnt.1.06 | Test that plant can be automatically added to list of approved plants/sources once the plant is approved | • Plant approval request<br>• Plant approval status | Approve a plant approval request in MMS. Review whether plant has been added to appropriate approved list | The newly approved plant is automatically added to appropriate approved list | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| Plnt.1.07 | Test that a plant approval update can be distributed to involved parties via email | • Plant name<br>• Plant approval information | Open MMS screen to view plant approval status. Select option to email approval information, and select intended recipients | Approval update can be emailed to requestors as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

***Project 2***

***Business Function: Plant Review***

Test Specification: Plant QA Visits (Plnt.2)

Test that all requirements related to conducting plant Quality Assurance (QA) visits are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.2.01 | Test that planned production values and actual production values of plants can be entered in MMS | • Plant name<br>• Planned production values<br>• Actual production values | Open MMS screen to enter production values. Enter value and mark as either planned production or actual production value and save | Production values can be marked as required and can be saved in MMS successfully | Pass/Fail | No | Subsystem |
| Plnt.2.02 | Test that divisions can be notified to schedule plant inspection based on plant's production values | • Plant name<br>• Plant production | Open MMS screen to view required plant inspections | MMS-generated notifications can be viewed, along with plant's current production values | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.2.03 | Test that plant QA checklists can be maintained in MMS and can be updated as required | • QA checklists | • Open MMS screen to create new plant QA checklist. Specify division, plant, checklist information and save<br>• Open existing plant QA checklist in MMS. Edit checklist items and save | • New plant QA checklist can be created as required<br>• Existing QA checklist can be edited as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |
| Plnt.2.04 | Test that a QA visit schedule can be generated based on inspection frequency | • Plants<br>• QA visit schedule | Open MMS to view automatically generated QA visit schedule | The QA visit schedule is presented as required, along with last inspection dates | Pass/Fail | No | Subsystem |
| Plnt.2.05 | Test that plant visits can be recorded in MMS along with appropriate checklist | • Plant name<br>• Plant visit information | Open MMS screen to record results of plant visit. Select applicable checklist to fill. Complete checklist and add any comments. Save and close screen | Plant visit information is successfully recorded in MMS along with notes and other information | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.2.06 | Test that status of a plant on approved list can be updated based on conducted inspection | • Plant name<br>• Plant visit information | Open MMS screen to enter plant information. Change plant status to temporary removal pending issue resolution and close. Review approved plant list | The status of plant changes to pending issue resolution, and is removed from the approved list | Pass/Fail | No | System; User acceptance<br>Subsystem |
| Plnt.2.07 | Test that dispute resolution process for plant review can be stored in MMS | • Plant name | Open MMS screen to enter plant issues and disputes. Enter dispute information (including plant response) and save | Dispute resolution process information can be saved as required | Pass/Fail | No | Subsystem |
| Plnt.2.08 | Test that dispute resolution process for plant review can be maintained in MMS | • Plant name | Select project and open issues and disputes screen. Update dispute information and save | Dispute resolution information can be successfully saved as required | Pass/Fail | Yes | System; User acceptance |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.2.09 | Test that the difference/ discrepancy between material shipped to a project (from MMS) vs. quantities received (from MCMS) can be presented in MMS | • Project name | Open MMS screen to view quantity of material shipped to a project as reported by MMS, and quantity of material received, as reported by PE in MCMS and imported in MMS | The difference/ discrepancy in material quantities can be displayed accurately in MMS | Pass/Fail | No | Subsystem |
| Plnt.2.10 | Test that an alert can be generated when a plant's annual inspection is due based on the approval date, and that an email is triggered upon alert generation | • Plant name | Open MMS administration screen to view time threshold when an alert is triggered regarding plant's annual inspection. Increase time to 90 days and save. Review if new alerts are generated and email sent out to distribution list | An alert is generated successfully in MMS and an email is sent out to attached distribution list | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Plnt.2.11 | Test that upcoming production schedule information can be saved in MMS by plants | • Plant name | Login to MMS as authorized plant user and enter upcoming production schedule on applicable screen | Upcoming production schedule information can be saved successfully | Pass/Fail | No | Subsystem |
| Plnt.2.12 | Test that automatic notification of upcoming production schedules is triggered | • Plant name | Repeat Plnt.2.11 and review whether automatic notification is triggered | Automatic notification of upcoming production schedule is successfully triggered in MMS | Pass/Fail | Yes | System; User acceptance |

***Project 2***

***Business Function: Other***

Test Specification: Equipment Calibration (Othr.2)

Test that all requirements related to storing equipment calibration data are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Othr.2.01 | Test that an inventory of all lab equipment, along with appropriate attributes, can be provided in MMS | • Lab equipment | Open screen to enter lab equipment information. Enter lab equipment information along with division, age of equipment, and any comments. Save data | Lab equipment information can be saved in MMS successfully, thus providing an inventory of all lab equipment | Pass/Fail | No | System; User acceptance<br>Subsystem |
| Othr.2.02 | Test that calibration history for all lab equipment can be stored in MMS | • Lab equipment<br>• Calibration date | Open screen to view inventory of lab equipment. Select equipment and add last calibration date and any applicable comments | Calibration data (date, comments) can be stored successfully, keeping old information in MMS | Pass/Fail | No | System; User acceptance<br>Subsystem |

***Project 2***

***Business Function: Other***

Test Specification: Other (Othr.3)

Test that all other requirements related to MMS

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Othr.3.01 | Test that audio and video files can be attached to samples in MMS | • Sample number | Open sample information in MMS. Attach audio and video files and save | Audio and video files can be attached to samples in MMS | Pass/Fail | No | Subsystem |
| Othr.3.02 | Test that files attached to samples in MMS can be modified as required | • Sample number | Open sample information in MMS. Remove attached audio file, attach new video file, and save | Attached files can be updated as required | Pass/Fail | Yes | System; User acceptance |
| Othr.3.03 | Test that the maximum size of attachments that users can store can be specified in MMS | • Attachment size | Open administration screen, enter maximum size of attachments, and save. Close and reopen administration screen, and change maximum size specified | The maximum attachment size can be saved and modified in MMS as required | Pass/Fail | Yes | System; User acceptance<br>Subsystem |

***Project 2***

***Business Function: Reporting***

## Test Specification: Reporting (Rprt.1)

Test that all requirements related to reporting are incorporated in the system. This test case will be repeated for all reporting requirements (Rprt01 to Rprt11)

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Rprt.1.01 | Test that the specified reports can be generated as required | • Required reports | Open MMS screen to generate required report. Select parameters for filtering report and request report generation | Requested report can be generated accurately as required | Pass/Fail | No | System; User acceptance<br>Subsystem |

***Project 2***

***Business Function: Cost per Test***

Test Specification: Cost per Test (CPT.1)

Test that all requirements related to storing cost per test data are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| CPT.1.01 | Test that cost per test data for all SHA tests can be stored in MMS | • Test name<br>• Cost per test | Open MMS screen, select test and enter cost for test separately for SHA employee, and by SHA contractor working in SHA lab | Cost per test data can be stored for all tests in MMS | Pass/Fail | No | System<br>Subsystem |
| CPT.1.02 | Test that all parameters used to generate cost per test can be stored for each test | • Test name<br>• Cost per test parameters | Open MMS screen to enter parameters (time taken to run test, employee class performing test) for cost per test for each test. Save | All parameters used to generate cost per test for each test can be stored in MMS | Pass/Fail | No | System<br>Subsystem |
| CPT.1.03 | Test that multiple versions of parameters used to generate cost per time can be stored in MMS | • Test name<br>• Cost per test parameters | Open MMS screen and enter parameters for each test. Save as new version of parameter | Multiple versions of cost per test parameters can be stored in MMS | Pass/Fail | No | Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| CPT.1.04 | Test that cost per test charged by outsourced consulting labs can be stored in MMS, by user-defined factors | • Test name<br>• Outsourced consulting lab | Open MMS screen to enter cost per test. Enter outsourced consulting lab name, test, cost per test, project, and other parameters. Save information in MMS | Cost per test charge by outsourced consulting labs can be stored in MMS as required | Pass/Fail | No | Subsystem |
| CPT.1.05 | Test that project costs can be tracked by either a contract number or a control number | • Test name<br>• Contract number<br>• Control number | Open MMS screen to view project costs. View contract numbers and control numbers assigned to project and view cost by contract and control numbers | Project costs can be successfully tracked by contract or control numbers | Pass/Fail | No | Subsystem |

## OPERATIONAL REQUIREMENTS (MMS-WIDE)

The test cases presented below address operational requirements for MMS. Each test specification relates to a specific function in MMS. These functions are listed below:

- Audit trail
- Capacity
- Data currency
- Data retention
- Fault tolerance
- Performance
- Recoverability
- Reliability
- Security
- System availability

Since the MMS is anticipated to be hosted in-house by SHA, fault tolerance, performance, recoverability, reliability, and system availability requirements will need to be tested and met by SHA staff. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

For example, if the code includes a batch file running at night that may lock out users for three hours, it will prevent the system availability requirement(s) from being met.

***Operational Requirements (MMS-Wide)***

Test specification: Audit Trail (Aud.1)

Test that requirements related to providing audit trail functionality are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Aud.1.01 | Test that all activity in MMS is logged, and a report of the date & time, changes, additions and deletions by login ID can be provided | • User login<br>• User activity | • Attempt to login to MMS with wrong password<br>• Login to MMS as administrator. View administration screen and user log | • Access to MMS is prevented and access attempt is logged<br>• Administration log provides report of date & time, changes, and other information recorded by login ID | Pass/Fail | No | System<br>Subsystem |
| Aud.1.02 | Test that audit capabilities can be configured at different levels for different users, providing higher level of audit for some users (each login, logoff, etc.) and lower level for others (only when files are modified) | • User activity | Open administration screen to modify user audit level. Increase audit level for one user and reduce for another user | Audit capabilities for users can be configured as required | Pass/Fail | No | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Aud.1.03 | Test that access to certain files/databases can be monitored in MMS | • MMS files | Open MMS administration screen and select files or databases to be monitored. Select contacts (administrators) who will be emailed when the files/databases are modified | File or database monitoring can be successfully configured, and email alerts are successfully sent out | Pass/Fail | Yes | System<br>Subsystem |

### *Operational Requirements (MMS-Wide)*

Test specification: Capacity (Cap.1)

Test that requirements related to MMS capacity are incorporated in system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Cap.1.01 | Test that high volumes of data can be handled in MMS without deteriorating system performance | • Large batch transaction<br>• Ongoing MMS user data access | • Execute a series of large batch loads such as interfaces from source management systems<br>• View data online, request predefined reports and request ad-hoc queries<br>• Monitor system performance during this time using performance testing tools | System performance should not be materially impacted by large volumes of data | Pass/Fail | No | Subsystem |
| Cap.1.02 | Test that transactions from up to 500 simultaneous users can be processed in MMS without deteriorating system performance | • Ongoing simultaneous user data access | Perform a set of MMS system functions and monitor performance using performance testing tools | 500 simultaneous users can access MMS simultaneously, still meeting MMS performance requirements | Pass/Fail | No | System<br>Subsystem |

***Operational Requirements (MMS-Wide)***

## Test specification: Data Currency (DC.1)

Test that requirements related to data currency are incorporated in the system. It should be noted that test case DC.1.02 will need to be tested by SHA, since MMS will be hosted by SHA.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| DC.1.01 | Test that data can be provided in near real-time in response to data requests | • Data request | • Open MMS to request reports<br>• Monitor system performance using performance testing tools | Data can be provided in near real-time in response to data requests | Pass/Fail | No | System<br>Subsystem |
| DC.1.02 | Test that a current backup of system database and system configurations can be maintained and utilized for restore purposes | • Backup request<br>• Restore | • Create full system backup including system data and system configuration using SHA backup software<br>• Attempt to restore data and configuration on a new server | • A full system backup can be created successfully<br>• System information and configuration can be restored successfully with no loss of data | Pass/Fail | No | System<br>Subsystem |

***Operational Requirements (MMS-Wide)***

Test specification: Data Retention (DaR.1)

Test that requirements related to data retention are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| DaR.1.01 | Test that old records can be deleted from MMS as required | • Data to be deleted | • Open administration screen and select data to be deleted<br>• Approve that data will be permanently deleted from MMS | • Data can be marked for deletion<br>• A prompt is provided to verify that data needs to be permanently from MMS<br>• Data is successfully deleted permanently from MMS | Pass/Fail | No | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| DaR.1.02 | Test that project data can be stored in MMS for an indefinite period of time and the data saved can be in any format (e.g. PDF, word) | • Project data | • Verify that data can be saved in the system and no triggers exist for automatic data deletion<br>• Verify that enough storage space has been provided for MMS<br>• Verify that data archival mechanisms are available and set correctly | • Data can be saved correctly and no triggers in MMS automatically delete data<br>• Data archival mechanisms are available and work as expected | Pass/Fail | No | System<br>Subsystem |

### *Operational Requirements (MMS-Wide)*

Test specification: Fault Tolerance (FT.1)

Test that requirements related to fault tolerance are incorporated in the system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| FT.1.01 | Test that additional back-up and protection is provided for critical applications | • | • Review backup provisions and compare to best practices | • Backup and data protection is provided as required | Pass/Fail | No | System<br>Subsystem |
| FT.1.02 | Test that the MMS hardware features a fault tolerant architecture (e.g. hard drives in RAID 4 configuration) | • | • Review hardware architecture to measure fault tolerant measures | • MMS hardware features a reasonable fault-tolerant architecture that complies to all SHA standards | Pass/Fail | No | System<br>Subsystem |

### *Operational Requirements (MMS-Wide)*

Test specification: Performance (Perf.1)

Test that requirements related to performance are incorporated in the system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Perf.1.01 | Test that performance measurement details, performance analysis and reports can be provided for MMS | • Performance testing tools | Review use and configuration of performance measurement and performance testing tools | Performance measurement, analysis, and reports can be generated as required | Pass/Fail | No | System<br>Subsystem |
| Perf.1.02 | Test that a response to user query is provided within three seconds or less | • Performance testing tools | • Request access to various MMS screens<br>• Measure performance using performance testing tools | • Response to user queries is provided in three seconds or less | Pass/Fail | No | System<br>Subsystem |
| Perf.1.03 | Test that opening multiple screens in MMS does not deteriorate performance below acceptable levels | • Performance testing tools | • Open multiple screens in MMS<br>• Measure system performance using performance testing tools | • Opening multiple screens does not affect MMS performance | Pass/Fail | No | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Perf.1.04 | Test that proper user documentation is prepared for MMS that is easy to understand and comprehensive | • MMS user documentation | Review MMS documentation prepared by either the vendor, or SHA staff as specified in contract | MMS documentation is comprehensive and easy to use | Pass/Fail | No | System; User acceptance |

### *Operational Requirements (MMS-Wide)*

Test specification: Recoverability (Rcvr.1)

Test that requirements related to data recoverability are incorporated in the system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Rcvr.1.01 | Test that data redundancy will prevent loss of data, and data can be recovered after data loss within SHA acceptable time frame | • MMS application<br>• Back-up site | • Implement replication of data and system back-up at second site per SHA policy and standard set in terms of timing for replication/back-up for MMS<br>• Execute back-up routine/data replication<br>• Confirm back-up copy mirrors production<br>• Execute system restore process<br>• Confirm original MMS environment successfully restored | System should be restored within SHA acceptance time frames with no loss of data as specified in MMS requirements | Pass/Fail | No | System<br>Subsystem |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Rcvr.1.02 | Test that the Monthly Mean Time to Repair (MTTR) is less than five minutes | • MMS application<br>• Performance testing tool | Measure total system down time and number of outage occurrences using performance testing tools | Monthly MTTR is less than five minutes | Pass/Fail | No | System<br>Subsystem |
| Rcvr.1.03 | Test that same day hardware repair and/or replacement can be provided for all MMS hardware | • Hardware vendor agreements | Review SHA hardware agreements to ensure that same day hardware repair/replacement is contractually agreed upon | Same day hardware repair and/or replacement is contractually agreed with hardware vendor | Pass/Fail | No | System<br>Subsystem |
| Rcvr.1.04 | Test that system backups are performed transparently i.e. there are no user interruptions during backups | • MMS backup<br>• Performance testing tools | Initiate data backup in MMS and measure system performance | System performance is not affected while backups are in progress | Pass/Fail | No | System<br>Subsystem |

### *Operational Requirements (MMS-Wide)*

Test specification: Reliability (Rel.1)

Test that requirements related to data reliability are incorporated in the system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Rel.1.01 | Test that the Monthly Mean Time to Repair (MTTR) is less than five minutes | • MMS application<br>• Performance testing tool | Measure total system down time and number of outage occurrences using performance testing tools | Monthly MTTR is less than five minutes | Pass/Fail | No | System<br>Subsystem |
| Rel.1.02 | Test that same day hardware repair and/or replacement can be provided for all MMS hardware | • Hardware vendor agreements | Review SHA hardware agreements to ensure that same day hardware repair/replacement is contractually agreed upon | Same day hardware repair and/or replacement is contractually agreed with hardware vendor | Pass/Fail | No | System<br>Subsystem |
| Rel.1.03 | Test that system backups are performed transparently i.e. there are no user interruptions during backups | • MMS backup<br>• Performance testing tools | Initiate data backup in MMS and measure system performance | System performance is not affected while backups are in progress | Pass/Fail | No | System<br>Subsystem |

### *Operational Requirements (MMS-Wide)*

Test specification: Security (Sec.1)

Test that requirements related to security are incorporated in the system.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Sec.1.01 | Test that application data can be protected from accidental access or deletion | • MMS data access request | • Login to MMS and attempt to access data that user is not authorized to view<br>• Login to MMS and attempt to delete the data that user is not authorized to delete | MMS data is successfully protected from accidental access or deletion | Pass/Fail | No | Security |
| Sec.1.02 | Test that access to MMS servers is properly controlled and monitored, meeting all SHA standards | | Review hardware storage location and security provisions | Access to MMS servers is properly controlled and monitored meeting all SHA standards | Pass/Fail | No | Security |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Sec.1.03 | Test that user logins can be restricted to certain parts of MMS as required, preventing access to certain projects, tests, etc. | • User IDs | • Open MMS administration screen to review and modify user role and access<br>• Modify user access as required, and save<br>• Login to MMS as user with modified access rights, and review whether all areas/screens with allowed access can be opened<br>• Login to MMS as user with modified access rights and review whether all areas/screens with no access cannot be opened | • User access rights can be assigned and modified as required<br>• User access can be restricted as required | Pass/Fail | Yes | Security |
| Sec.1.04 | Test that access to MMS by non SHA users can be limited as required | • User IDs | • Review access rights for non SHA users<br>• Attempt to access projects that non SHA user is not allowed access | • Non SHA users are restricted access as required<br>• Non SHA users cannot access restricted areas | Pass/Fail | No | Security |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Sec.1.05 | Test that reports can be generated to view access by non SHA users | • Report request | Request generation of report presenting access details/log by non SHA users | Report detailing non SHA user access can be provided in MMS | Pass/Fail | No | Security |
| Sec.1.06 | Test that MMS access from locations outside SHA network can be restricted to only adding data to MMS (no deletions) if required | • User IDs<br>• User login location | • Assign user rights to existing user such that field access is restricted to data input only<br>• Login to MMS from outside SHA network | • User rights can be assessed as required<br>• MMS login from outside SHA network can be restricted to only adding data if required | Pass/Fail | No | Security |
| Sec.1.07 | Test that access to MMS interfaces is restricted to certain users using login IDs | • MMS interface<br>• User ID | • Assign existing user full access to existing MMS interface<br>• Initiate MMS interface and review results | • User access to interfaces can be configured as required<br>• MMS interface can be initiated by authorized users | Pass/Fail | No | Security |

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| Sec.1.08 | Test that password rights and mechanisms meet SHA and industry standards | • User password policies | Review existing password policies to review:<br>• Authentication procedure<br>• Password change policies<br>• Password reset functionality | All existing policies and mechanisms meet SHA and industry standards | Pass/Fail | No | Security |
| Sec.1.09 | Test that users can choose from multiple roles assigned upon login | • User name | Login as existing user with multiple assigned roles. Choose one role | User can choose from multiple assigned roles | Pass/Fail | No | Security |
| Sec1.10 | Test that the only options a user has access to are displayed on the screen | • User name | Login as existing user and review available options on screen | The options that a user has access to are presented on screen | Pass/Fail | No | Security |
| Sec.1.11 | Test that all functionality can be accessed using a single sign-on | • User name | Access all MMS functions a user is authorized | Users should be able to access all MMS functions for which they have authorization without having to sign-on again | Pass/Fail | No | Security |

### *Operational Requirements (MMS-Wide)*

Test specification: System Availability (SyAv.1)

Test that requirements related to system availability are incorporated in the system. The test cases presented below will need to be performed by SHA, not the developer/tester since MMS will be hosted within SHA. The MMS vendor(s) will need to contractually agree that there will be no mechanisms in code that will specifically prevent the requirements to be met.

| Test Case # | Test Case | Inputs | Test Procedure | Expected Result | Test Case Result | Regression Testing Required? | Test Category |
|---|---|---|---|---|---|---|---|
| SyAv.1.01 | Test that system is available for SHA specified percentage (e.g. 99.99%) around the clock (24/7) | • Performance testing tool | Review system performance using performance testing tool | System is available for SHA-required percentage | Pass/Fail | No | System<br>Subsystem |
| SyAv.1.02 | Test that maintenance can be scheduled on MMS as required | | Open MMS administration screen and review that maintenance on MMS can be scheduled for particular time frames as required | MMS maintenance can be scheduled as required | Pass/Fail | No | System<br>Subsystem |

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

# MATERIALS MANAGEMENT SYSTEM PROJECT
# TEST AND EVALUATION MASTER PLAN
# Volume III (Requirements Traceability Matrix)

**April 13, 2009**
**Version 1.0**

# Document Version Control

| Revision Date | Updated By | Requested By | Description of Revision |
|---|---|---|---|
| 04/08/2009 | Vendor | | Discussion Draft |
| 04/30/09 | Vendor | | Final version based on SHA formal comments |
| | | | |
| | | | |

# Table of Contents

# REQUIREMENTS TRACEABILITY MATRIX

The Requirements Traceability Matrix (RTM) provides a method for tracking the functional requirements and their implementation through the development process. Each requirement is included in the matrix along with its associated section number. As the project progresses, the RTM will be updated to reflect each requirement's status. When the product is ready for system testing, the matrix will list each requirement, what product component addresses it, and what test verifies that it is correctly implemented.

## 1.1 Requirements Traceability Matrix – Operational Requirements (MMS-Wide)

Exhibit 1 below presents the Requirements Traceability Matrix (RTM) for all requirements mentioned in *Section 2: Operational Requirements* of the Functional Requirements Document (FRD).

## Exhibit 1: Operational Requirements RTM

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Aud01 | Audit Trail | Monitor | Capability to provide a report of the date & time, any changes, adds or deletes made and the logon ID of the user accessing monitored data files. For example, in the event of data corruption, erasure, or other contamination, a report shall be available to detail user recent activity. | Aud.1.01 | Aud.1.01 | | |
| Aud02 | Audit Trail | Monitor | Capability to segment users by division and configure audit capabilities only to users with access to the defined databases. For example, if a user only has rights to access the forms and reports data segment, that user will be audited based on the access to those segments only. | Aud.1.02 | Aud.1.02 | | |
| Aud03 | Audit Trail | Monitor | Capability to monitor access to Source of Supply Letters/Lists, test results, contractor information, project notes, SHA forms and other designated databases. For example, each time a user access a monitored data file, a record will be posited of the activity. | Aud.1.03 | Aud.1.03 | | |
| Cap01 | Capacity | Database | Capability to handle high volumes of data that may occur on a "peak" basis. For example, end of month final clearances, monthly reporting and ad-hoc queries for completion status will generate a high volume of data while routine project work during the month may range from low to high. | Cap.1.01 | Cap.1.01 | | |
| Cap02 | Capacity | Database | Capability to process transactions from an estimated 400-500 total users on a daily basis. In addition to the SHA users, transactions will be created by contractors, suppliers and outsourced labs. For example, transactions will include, at a minimum, Source of Supply Letters/Lists from contractors, the transfer of sample information between lab and field forces, the | Cap.1.02 | Cap.1.02 | | |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| | | | submission and retrieval of project test results, access of information for reports, ad-hoc user queries. | | | | |
| DC01 | Data Currency | Backup | Capability to provide data in near real-time in response to requests for data access. For example, resource allocation and deployment decisions for field and lab work are based on project dates. The dates reflected in MMS must be as recent as possible. | DC.1.01 | DC.1.01 | | |
| DC02 | Data Currency | Backup | Capability to maintain a current back-up of the system database to be utilized for restoration in the event of catastrophic failure and loss of data. For example, a fire or other event could destroy the server causing total loss of data and system configurations. | DC.1.02 | DC.1.02 | | |
| DC03 | Data Currency | Backup | Capability to maintain a current backup of all system configurations to be utilized in case of catastrophic loss to the server. | DC.1.02 | DC.1.02 | | |
| DaR01 | Data Retention | Cleanup | Ability for the administrator to delete old records as required. It is anticipated that the records will be archived most of the time and not deleted, but a deletion may be required in case of duplicate entries or other unforeseen circumstances. | DaR.1.01 | DaR.1.01 | | Sec.1.01 |
| DaR02 | Data Retention | Storage | Capability to store project related data for an indefinite period of time. For example, project related data may be retained for the life of the asset associated with the project. For example, there will be varying degrees of retention requirements throughout the system database, from "none" to indefinite. | DaR.1.02 | DaR.1.02 | | |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| DaR03 | Data Retention | Storage | Ability to save data in a common or easily accessible format. This may include .pdf, WORD or other common format. For example, there will be specific users (TBD) who may have limited or no access to MMS. This ability will enhance the function of emailing and/or printing. | DaR.1.02 | DaR.1.02 | | |
| FT01 | Fault Tolerance | Configuration Management | Capability to provide additional back-up and protection for specified system applications during planned or unplanned outages. For example, applications supporting the source of supply test and approval process are critical while email (from within MMS) and field access to the system may be less critical. | FT.1.01 | FT.1.01 | | |
| FT02 | Fault Tolerance | Configuration Management | Capability to react to a single board or data drive failure through a fault tolerant architecture. For example, if a circuit board or other piece of hardware fails, the system shall be capable of continuing functionality through redundant hardware/software configuration architecture. | FT.1.02 | FT.1.02 | | |
| Perf01 | Performance | Measurements | Capability to provide system performance analysis and reports. For example, a log of system bugs and or actual interruptions shall be kept and statistically analyzed to address current issues and to predict possible future issues. | Perf.1.01 | Perf.1.01 | | |
| Perf02 | Performance | Measurements | Capability to provide performance measurement details based upon the number of tests and test completion data (e.g. time required to complete a specific test or all tests on a particular sample). For example, The "Approve By" date and other performance measurement opportunities may be accessed via MMS. | Perf.1.01 | Perf.1.01 | | |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Perf03 | Performance | Measurements | Capability to provide Statistical analysis and/or ability to extract to a statistical analysis package to review mix designs and other designated analytical functions. For example, an analysis of missed project completion dates and their causes may be analyzed and reports provided. | MRA.1.04<br>MRA.1.05 | MRA.1.04<br>MRA.1.05 | | |
| Perf04 | Performance | Process Support | Capability to provide response to user queries in three seconds or less. For example when an icon or menu item is selected, the user should notice no delay in viewing the requested screen or data list. | Perf.1.02 | Perf.1.02 | | |
| Perf05 | Performance | User Support | Capability to provide user multi-tasking with system screens. For example, a user may have multiple MMS screens open and active while also using other application screens. | Perf.1.03 | Perf.1.03 | | |
| Perf06 | Performance | User Support | Capability to provide system user documentation that is comprehensive, clear and easy to use. For example, system user documentation shall provide quick answers to questions regarding the navigation of the system screens. | Perf.1.04 | | Perf.1.04 | |
| Rcvr01 | Recoverability | Configuration Management | Capability to provide data redundancy to protect against loss of data due to system failure For example, in the event of a total failure of MMS, the database shall be recoverable and be restored to the image that existed at the time of failure. | Rcvr.1.01 | Rcvr.1.01 | | |
| Rcvr02 | Recoverability | Configuration Management | Capability to recover from, or not be impacted by a commercial power failure. A given power failure may be just from a moment to many hours. It is expected that all functionality and data access would remain intact. For example an alternate source of power shall be available and the MMS wired to that source of power. | Rcvr.1.01 | Rcvr.1.01 | | |
| Rcvr03 | Recoverability | Configuration Management | Capability to restore full functionality and data integrity within thirty minutes of detecting the failure. For example, critical hardware spares and recent system & data backups shall be available on site. | Rcvr.1.01 | Rcvr.1.01 | | |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Rel01 | Reliability | System Measurements | Capability to meet a Monthly Mean Time to Repair (MTTR) performance of five minutes. MTTR is figured by dividing total system down time by the number of outage occurrences for the month. | Rel.1.01 | Rel.1.01 | | |
| Rel02 | Reliability | System Measurements | Ability to provide same-day replacement for failed hardware parts causing system outage (down-time) and twenty-four hour turn-around time for repair and/or replacement of defective parts. For example, a failure may occur that requires a hardware item that is not at the site. | Rel.1.02 | Rel.1.02 | | |
| Rel03 | Reliability | System Measurements | Capability to perform system backups that are transparent to the users. For example, information for reports and project scheduling must be as current as possible which necessitates frequent backups. | Rel.1.03 | Rel.1.03 | | |
| RD01 | Retrieve Data | User Support | Ad-hoc query capability to retrieve test results by non-project characteristics (mix design, location, contractor, materials supplier, etc.). This capability requires that a user can obtain project data based upon various data point starting points. For example, retrieve a materials supplier, and view all of the projects that that supplier is currently involved in (or has been involved in). | MRA.2.05 | MRA.2.05 | | |
| Sec01 | Security | Data | Capability to protect Application Data from contamination and/or erasure by users. For example, the loss or contamination of vital project information, such as Source of Supply Letter, test results or project notes could jeopardize project schedules. | | | | Sec.1.01 |
| Sec02 | Security | Data | Capability to protect sensitive SHA and contractor data from casual access. For example a supplier's specific materials mix submitted for testing or SHA project costing information. | | | | Sec.1.01 |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Sec03 | Security | Environment | Access to the IT facility housing the MMS servers shall be controlled and monitored. For example, key card entry shall be utilized to track users' access to the server area. | | | | Sec.1.02 |
| Sec04 | Security | User Configuration | Capability to provide a user logon interface that is designed to allow access to specific data by designated users within SHA Divisions. For example, users in the Asphalt Technology Division may not need access to projects associated with Soils and Aggregates Division. Also, some users need an access for a specific purpose such as preparing reports, while another user may need full administrative access. | | | | Sec.1.03 |
| Sec05 | Security | User Configuration | Capability to limit access to designated non-SHA users, such as contractors and consultants. However, this access must be restricted and recorded within the system. For example, contractors may require access to submit sources for approval and to check on project status. | | | | Sec.1.04 |
| Sec06 | Security | User Configuration | Capability to provide reports detailing outside user access. For example, a monthly report of outside user access may be provided to check against contractor project activity. | | | | Sec.1.05 |
| Sec07 | Security | User Configuration | Capability to restrict access to a limited number of individuals with permission to alter data tables, applications and other database configurations. For example, in order to protect the integrity of the MMS data, only designated members of the Office of Materials Technology (OMT) shall have these permissions. | | | | Sec.1.03 |
| Sec08 | Security | User Configuration | Capability to limit some users to "View Only" MMS access on specified projects or materials. For example some users may only need to check on completion dates or other key project information with no need to input or retrieve data. | | | | Sec.1.03 |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Sec09 | Security | User Configuration | Capability to monitor and restrict SHA field access by project. The field will however have input access related to plant inspections and certifications. For example, field staff may only access data relevant to a current project at their site location but be given permission to access the plant certification data base to update inspection information. | | | | Sec.1.06 |
| Sec10 | Security | User Configuration | Capability to monitor and control access to MMS interfacing systems, by restricting other system access by an additional layer of password security or other means. | | | | Sec.1.07 |
| Sec11 | Security | User Configuration | Capability to provide a robust authentication procedure to be employed for all logins. For example, VPN remote access may be allowed with authentication. | | | | Sec.1.08 |
| Sec12 | Security | User Configuration | Capability to require passwords to be changed on a regular basis. For example, the system should prompt the user every three months to request a change in password. | | | | Sec.1.08 |
| Sec13 | Security | User Configuration | Allow users to request password reset requests from the web interface. Users should be assigned temporary passwords and required to change at first login. For example, users often forget their logon information and require a method to have it reset. | | | | Sec.1.08 |
| Sec14 | Security | User Configuration | Allow users to choose from multiple roles if the user is assigned more than one role (e.g. Project Manager, administrator). For example, a division head may require a logon that has access to the entire division. | | | | Sec.1.09 |
| Sec15 | Security | User Configuration | Capability to restrict the display to only the options and icon selections to which the user has rights. For example a user's logon would define the functionality required and present only that capability. This has the added benefit of simplifying the screen for the user. | | | | Sec.1.10 |

| Req # | Function | Sub Function | Operational Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Sec16 | Security | User Configuration | Facilitate Single Sign-on to use enterprise login information for OMT staff and allow use of VPN or request login credentials for web-based modules. For example, the Office of Materials Technology has responsibility for MMS and the processes it supports. VPN may be used with authentication. | | | | Sec.1.11 |
| SyAv01 | System Availability | Failure Management | Capability to provide 24/7 system uptime. For example, data transfers with interfacing systems and other automated system routines must be accommodated. Peak system usage is expected to be from 6:30 a.m. to 5:30 p.m. This time period is the least optimal time to schedule planned maintenance outages. | SyAv.1.01 | SyAv.1.01 | | |
| SyAv02 | System Availability | Failure Management | Capability to provide simultaneous access to all MMS screens by all concurrent users. There shall be no degradation of service or extended screen wait time. For example, all users may have a need for information on a specific project, at the same time. It is estimated that initially the system will have 400-500 total users. | Cap.1.02<br>SyAv.1.01 | Cap.1.02<br>SyAv.1.01 | | |
| SyAv03 | System Availability | Failure Management | Capability to provide system availability at 99.999%. This equates to a total of five minutes of unplanned outage for a year. | SyAv.1.01 | SyAv.1.01 | | |
| SyAv04 | System Availability | Failure Management | Ability to conduct scheduled maintenance during hours designated as the "Maintenance Window". For example, the Maintenance Window may be designated from midnight to two a.m. It is possible that the Maintenance Window could be expanded dependent upon the estimated time to perform the scheduled maintenance. This "window" applies to work performed by SHA as well as work performed by the vendor. | SyAv.1.02 | SyAv.1.02 | | |

## 1.2 Requirements Traceability Matrix – MMS Wide (Business Specific)

Exhibit 3 below presents the Requirements Traceability Matrix (RTM) for all requirements that are MMS wide and mentioned in Project 1 of the FRD.

## Exhibit 2: Requirements Traceability Matrix – MMS Wide

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS01 | **MMS-Wide** | **Document Management** | Capability to record status of test results on materials associated with a project. The user shall be able to access a specific project, obtain a listing of materials being used and view the status and results of testing. Test results are logged manually today and no accessible electronic format is in place. | | MMS.1.02 | | Sec.1.03 |
| MMS02 | MMS-Wide | Document Management | Capability to export data to Microsoft Office product suite (Word, Excel, Access, etc.) for off-line data processing and availability. | MMS.1.01 | MMS.1.03 | MMS.1.01 | |
| MMS03 | MMS-Wide | Document Management | Ability to enter field inspection data (Form 14) in MMS through a web based interface. For example, as addressed in other requirements, the field force needs access to MMS and the MMS database must store all forms associated with the approval process. | | MMS.1.04 | | Sec.1.06 |
| MMS04 | MMS-Wide | Document Management | Capability to store standardized letter templates to display to internal and external users as needed and the ability to download templates. | | MMS.1.05 | | |
| MMS05 | MMS-Wide | Document Management | Capability to attach supporting documentation (scanned images, reports letters, forms, notations or other documentation as PDF documents) to specific material test results. The attached documentation shall be viewed as part of the test results document and have the capability to be viewed, emailed or printed from MMS. For example, test results are recorded today and placed in a manual project folder. They are viewable in hard copy only. | MMS.1.07 | MMS.1.06 | MMS.1.07 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS06 | MMS-Wide | Document Management | Ability to automatically attach files in the system. These files will include letters generated for distribution to contractors/PEs. | | MMS.1.08 | | |
| MMS07 | MMS-Wide | Document Management | Ability to classify projects based on funding type of the project (e.g. Federal aid, exempt; Federal aid, non-exempt) | MMS.1.10 | MMS.1.09 | MMS.1.10 | Sec.1.03 |
| MMS08 | MMS-Wide | Document Management | Ability to record and report the quantity of a material approved on certification vs. quantity used on the project. | | MMS.1.11<br>MMS.1.12 | | |
| MMS09 | MMS-Wide | **Integration** | Capability to provide email integration functionality to allow MMS notifications to be sent via e-mail. For example, some documentation will need to be emailed from within MMS, specifically those people with no MMS access in the field. | MMS.2.01 | MMS.2.01 | MMS.2.01 | |
| MMS10 | MMS-Wide | Integration | Capability to allow MMS to send Text (SMS) notifications to specified team members. This capability will be critical for team members in the field with no or sporadic internet connectivity. | MMS.2.02 | MMS.2.02 | MMS.2.02 | |
| MMS11 | MMS-Wide | **Interface** | Ability to transfer charge allocation data from YB888 to appropriate contract numbers to FMIS electronically. The allocation data and other FMIS data is not currently available via interface. This includes the ability to flag third party billing, and how that is sent to FMIS. | MMS.3.01<br>MMS.3.02 | MMS.3.01<br>MMS.3.02 | MMS.3.01<br>MMS.3.02 | Sec.1.07 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS12 | MMS-Wide | Interface | Capability to migrate test data from current systems into MMS for current projects. This would be a post-operational activity conducted to provide support for existing projects at MMS system cutover. For example, projects will continue to be worked during the implementation of MMS. As implementation moves forward, projects still pending may be identified for migration to MMS. | MMS.3.03 | MMS.3.03 | MMS.3.03 | Sec.1.07 |
| MMS13 | MMS-Wide | Interface | Capability to provide information to Pavement Management System. For example, the information associated with Hot Mix Asphalt is required by Pavement Management. This capability may be addressed via the overall system interface requirement. | MMS.3.04 | MMS.3.04 | MMS.3.04 | Sec.1.07 |
| MMS14 | MMS-Wide | Interface | Capability to import and export data to/from other systems. MMS shall, at a minimum, interface with Trns*port Suite (CAS/PES/LAS), MCMS, RIDETOOL, FMIS, Geosystem, Humboldt Triaxial Data Acquisition, MPEL/QPL and PMS. For example, financial data, construction information, pavement information and other data is not centralized in one place today, nor is it accessible via direct interface. | MMS.3.05 | MMS.3.05 | MMS.3.05 | Sec.1.07 |
| MMS15 | MMS-Wide | **Location Tracking** | Capability to record test sample location in multiple coordinate systems and/or mileposts as required. This will require numerical fields with validation rules. Capability to utilize GPS locations at a later date shall be considered in meeting this requirement. For example, the sample location is noted manually today utilizing mileposts locations. | MMS.4.01 | MMS.4.01 | MMS.4.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS16 | MMS-Wide | **Test Information** | Capability for field personnel to check status of a test in real time through a web browser. The available results should be restricted based on the rights provided to the individual user. For example, field forces are dependent upon the specific divisional labs to provide them with testing and approval status. | MMS.5.01 | MMS.5.01 | MMS.5.01 | Sec.1.06 |
| MMS17 | MMS-Wide | Test Information | The provision of an MMS "Wizard" functionality to create or alter test entry screen to create a screen for new test entry. This should allow the user to enter formulas for fields that can be calculated automatically based on entered test results. | MMS.5.03 | MMS.5.02 | MMS.5.03 | |
| MMS18 | MMS-Wide | Test Information | Ability to print final test document based on the data entered into the system. Also the capability to add notations to the document. For example, a hard copy version may be necessary for publication, a meeting or other reason. Having the option of creating a hard copy enables more flexibility. This document may need to be formatted differently than that used to enter the test data, and may require a "print" button that provides a specific print version of the form. | | MMS.5.04 | | |
| MMS19 | MMS-Wide | Test Information | Capability to process MMS reports via email, print, or to save (to file or to disk). This will allow SHA to use the right format based on capabilities available at the field locations. | MMS.5.05 | MMS.5.05 | MMS.5.05 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS20 | MMS-Wide | **Test validation** | Capability to provide data validation for information being entered based on a reasonableness test, including warnings for missing fields and helpful error messages based on rules established in the system. Ability to correct typos. For example, if a user attempts to enter a letter into a field that only accepts numbers, they should be alerted with a pop-up, or other indication that it is not allowed. | MMS.6.01 | MMS.6.01 | MMS.6.01 | |
| MMS21 | MMS-Wide | Test validation | Capability to record serialized form numbers as unique identifiers for each sample and the ability to associate required forms for specific samples and tests and present them in a selectable menu. For example, various specific forms are used to record information associated with the samples that are collected in the field or at production facilities. | | MMS.6.02 | | |
| MMS22 | MMS-Wide | Test validation | Capability to allow authorized users in test labs to access project data regarding number of tests performed to date, materials used, etc. to assess adequate testing frequency as necessary. This is intended to help avoid any issues regarding inadequate testing at the end of the project during materials clearance. | MMS.6.03 | MMS.6.03 | MMS.6.03 | Sec.1.06 |
| MMS23 | MMS-Wide | **User Support** | Provide an easy-to-use and easy to learn interface. The front-end user screens should mimic screens already in use on existing MMS pages/modules, to the extent possible. Pull-down menus, help screens, and input validation functionality shall be included in the user interface. For example, the user should be presented with an intuitive and familiar user interface. | MMS.7.01 | MMS.7.01 | MMS.7.01 | Perf.1.04 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS24 | MMS-Wide | User Support | Capability to provide the system interface link in such a way that the user will only have to input data one time. For example, information entered regarding project schedules or other Daily Work Reports would automatically update the construction data base (MCMS). | MMS.7.02 | MMS.7.02 | MMS.7.02 | |
| MMS25 | MMS-Wide | User Support | Capability to process batch entries from outside users. For example outsourced labs may batch their test results to send back to the SHA lab. | | MMS.7.03 | | Sec.1.01<br>Sec.1.07 |
| MMS26 | MMS-Wide | User Support | Capability to provide daily confirmation on interactions via the system interface. For example, if a daily work report is transmitted from construction (MCMS), it would be documented and included in the confirmation report. | MMS.7.04 | MMS.7.04 | | |
| MMS27 | MMS-Wide | User Support | Capability to support all SHA IT standards provided by SHA Department of Information Technology. For example the SHA SDLC and other standards must be adhered to for all projects. MMS may store standards documenting for reference. | MMS.7.05 | MMS.7.05 | | |
| MMS28 | MMS-Wide | **Workflow** | Capability to report/display status of workflow (how many steps approved, who needs to review next, etc.) in a summary/dashboard format. For example, a team lead or other manager may need to review the overall process status. This may also be used for performance monitoring. | MMS.8.01 | MMS.8.01 | MMS.8.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MMS29 | MMS-Wide | Workflow | Ability to trigger an alert when the approved quantity of a material (accepted on certification) has been used on a project and a new certification is now required. For example, a large volume of a material may be received at a job site with the proper certifications and the material may not be used all at once. An alert is necessary to assure that the relevant system users are aware that additional certification must be sought. | MMS.8.02 | MMS.8.02 | MMS.8.02 | |
| MMS30 | MMS-Wide | **Internet Calendar** | Ability to generate project calendars in an internet publishable format (icalendar, vcalendar) | MMS.9.01 | MMS.9.01 | MMS.9.01 | |

## 1.3 Requirements Traceability Matrix – Project 1

Exhibit 3 below presents the Requirements Traceability Matrix (RTM) for all requirements mentioned in Project 1 of the FRD.

**Exhibit 3: Requirements Traceability Matrix - Project 1**

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM01 | **Project Management** | **Frequency Guide** | Capability to store frequency guide in the system as a database/tables that can be accessed for multiple uses. The frequency guide provides a list of materials, the frequency at which these materials need to be tested, and the tests that need to be performed on these materials. For example, all labs utilize the Frequency Guide for test reference. | PM.1.01 | PM.1.02 | PM.1.01 | |
| PM02 | Project Management | Frequency Guide | Capability to store multiple versions of frequency guide, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. | PM.1.01 | PM.1.03<br>PM.1.04 | PM.1.01 | |
| PM03 | Project Management | Frequency Guide | Ability to manually link a particular version of the frequency guide to a project, even if it does not meet the date range validation. This may be required if a project has just started, a new frequency guide is released and the project members agree to using the new frequency guide. | | PM.1.05 | | Sec.1.03 |
| PM04 | Project Management | **Project Contacts** | Ability to maintain list of contacts on project, including external contacts. This should include full name, phone number, fax number, email address, physical address, company name, division, assigned role (e.g. Project Manager, Project Engineer, contractor) and others. | PM.2.01<br>PM.2.02 | PM.2.02<br>PM.2.05 | PM.2.01<br>PM.2.02 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM05 | Project Management | Project Contacts | Ability to define and maintain multiple distribution lists of project participants. These distribution lists will include names, email addresses, and agency information (company name, division). These distribution lists will be specific for each project. | PM.2.03<br>PM.2.04<br>PM.2.06 | | PM.2.03<br>PM.2.04<br>PM.2.06 | |
| PM06 | Project Management | **Project Information** | Capability to import basic project information from Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, $ completion, other). This information will be important to understand project completion and help identify when the 30 day notice for materials clearance should be received and help with final clearance as well as monthly project clearance.<br>This information should be marked as “imported” to separate from manual entries. | PM.3.01 | PM.3.01 | PM.3.01 | Sec.1.07 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM07 | Project Management | Project Information | Capability to enter basic project information for projects not entered in Trns*port (e.g. project name, project boundaries, project current phase, project start date (anticipated/actual), project finish date (anticipated/actual), % project complete (physical completion, cost and completion date.<br>This requirement is important since not all projects that require material testing are stored in Trns*port (e.g. local, county, some maintenance jobs). This information will likely be in the form of linked tables with multiple fields (e.g. bid item, materials, bid units, bid quantities) and can follow the same structure used in Trns*port for this information.<br>This information will be used to create a sampling plan as a start, but will also be used all the way through the project life cycle, including during the final clearance to compare materials used vs. materials that were planned to be used. | | PM.3.04 | | |
| PM08 | Project Management | Project Information | Capability to automatically update basic project information via an import from Trns*port. This capability will help keep the information in MMS up-to-date as project status or other information is updated in Trns*port. | PM.3.02 | PM.3.02 | PM.3.02 | |
| PM09 | Project Management | Project Information | Capability to allow authorized users to update project information as changes occur for projects not in Trns*port. This capability will keep the information in MMS up-to-date for projects that are not in Trns*port. | PM.3.03 | PM.3.03<br>PM.3.05 | PM.3.03 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM10 | Project Management | Project Information | Capability to link information for tests conducted before start of construction phase to information starting at the construction phase of the project. The primary difference between the tests performed is the phase of the project - for example, a soil sample may be collected and tested during pre-construction to determine/confirm soil properties, and other samples collected and tests conducted once the project is in construction. The ability to link all the test information will provide SHA with a better decision support and feedback tool than currently available. | PM.3.06 | PM.3.06 | PM.3.06 | |
| PM11 | Project Management | Project Information | Capability to interface with FMIS to obtain information periodically (e.g. charge numbers). | PM.3.07 | PM.3.07 | PM.3.07 | |
| PM12 | Project Management | Project Information | Capability to store and retrieve supporting documentation from an enterprise level document management system to be developed by OIT. This capability will also include the ability to submit new documentation, such as specification changes, to the documentation system. For example, a user requiring specific documentation and/or procedures not stored in MMS, will have access to that documentation via the document management system. | PM.3.08 | PM.3.08<br>PM.3.09 | PM.3.08 | |
| PM13 | Project Management | Project Information | Capability to link bid items to construction materials (one to many relationship) and expand a bid item into various materials that form the bid item. For example, a bid item of concrete on the project might consist of cement, aggregates, and admixtures. Each of these materials have different testing specifications and requirements (explained later). | PM.3.10 | PM.3.10<br>PM.3.11 | PM.3.10 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM14 | Project Management | Project Information | Capability to automatically generate letters to notify stakeholders and contractors of the status of material approvals; this could be done on a scheduled basis, or on-demand in response to a stakeholder query. For example, this reporting capability should allow a report to be generated for all materials involved on a project and their source approval status (approved, unapproved, submitted, not submitted, not required). | PM.3.12 | PM.3.13 | PM.3.12 | |
| PM15 | Project Management | Project Information | Capability to recognize and process various business rules based on different construction methods (i.e., Design Build vs. other methods). The MMS database, for example, must contain information tables on all construction methods used by SHA and be designed with the capability to process a project utilizing any of the defined methods. For example, the testing standards and frequency may vary based on the project construction method, but the final clearance requirements may be the same. | PM.3.14 | PM.3.15 | PM.3.14 | |
| PM16 | Project Management | Project Information | Ability to link contract numbers to control numbers. Contract numbers are the numbers assigned to contracts, while control numbers are/will be used to track projects that may be composed of multiple contracts. This will allow linking project phases (design and construction), and allow SHA to monitor project that may have been split of combined during the project phases. For example, a project in design phase may be let as different projects in construction phase. Vice versa, two projects in design phase may be let as one construction project. | PM.3.06 | PM.3.06 | PM.3.06 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM17 | Project Management | Project Information | Ability to track costs using either a contract number, or a "control number". These control numbers can be defined by system administrators/authorized users. | | CPT.1.05 | | |
| PM18 | Project Management | Project Information | Capability to flag materials as experimental materials in the system. This will allow SHA to track the use of experimental materials on projects. | PM.3.16 | PM.3.16 | | |
| PM19 | Project Management | **Project Sampling Plan/Project Specific Frequency Guide** | Capability to automatically generate minimum number, types, and frequencies of tests required for the materials clearance process (project sampling plan) for each material to be used on the project based on frequency guide and material quantities for the project as obtained from Trns*port. This Project Sampling Plan will act as a guide for the overall testing requirements, and help ensure and track that all the testing requirements for the project are met. For example, the sampling plan will specify that asphalt placed on the project should be tested at every x placements or every x tons, whichever comes first. | PM.4.01 | PM.4.02 | PM.4.01 | |
| PM20 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to show/present the project sampling plan/project-specific frequency guide in a web-based format to authorized users. This sampling plan should be formatted such that it is easy for the users to read and understand the report. For example, a user may print a copy of the Sampling Plan for reference throughout the project to track the requirements and ensure compliance. | PM.4.01 | PM.4.03 | PM.4.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM21 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to automatically make changes to the sampling plan based on quantity changes entered in the system due to change orders, or due to other unforeseen circumstances. This will require an interface with CAS or MCMS in which all quantity changes and change order information is recorded. The change may be manually input into MMS for projects that are not stored in CAS/MCMS (e.g. some maintenance projects). For example, if a change order significantly increases the quantity of concrete to be used on the project, the number of tests required should automatically be increased in the sampling plan. | PM.4.04 | PM.4.04 | PM.4.04 | |
| PM22 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to allow for manual changes to the sampling plan by authorized users - these changes should allow all parameters of the sampling plan to be changed, including addition and deletion of materials, tests to be performed, and frequency of the tests. This action could be prompted by project specific guidelines or any problems/issues being observed on the project. | | PM.4.05 | | |
| PM23 | Project Management | Project Sampling Plan/Project Specific Frequency Guide | Capability to generate a sampling plan for projects not in Trns*port based on information manually entered in MMS. | | PM.4.02 | | |
| PM24 | Project Management | **Project Workflow** | Ability to define a workflow for establishing electronic review and approval of results. This workflow will provide the user a path to completing the source of supply and materials testing process. For example, the generated workflow shall define the steps, approvals, distribution list and other relevant process data for a given project. | PM.5.01 | PM.5.02 | PM.5.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM25 | Project Management | Project Workflow | Ability to assign a priority number to a workflow approval request at the individual level (1-low, 10-high) to allow resources to prioritize their work, and ensure that high priority projects (major projects, emergency projects) are completed first. A priority of 5 should be selected by default if a priority is not specified. | | PM.5.03 | | |
| PM26 | Project Management | Project Workflow | Ability to add comments to the workflow at each approval step for internal use. These comments should propagate with the workflow to the next approver, and identify the person making the comment. This will allow the reviewers to put any questions/comments that will be relevant to the overall approval process as well as to the next approver in the workflow. | PM.5.01 | PM.5.04 | PM.5.01 | |
| PM27 | Project Management | Project Workflow | Ability to customize workflow for each project with varying workflow steps. The custom workflow shall be able to be created by a designated user in the SHA division. For example, divisions may follow different work flows, and the work flows may vary on different projects. Also, this will allow for changes that may occur in the approval process or test methodology on existing projects. | | PM.5.05 | | |
| PM28 | Project Management | Project Workflow | Capability to assign SHA team members or SHA team groups to a workflow individually for each project and for specific workflows. This capability provides resource flexibility within a division. For example, if designated team members are not available for participation in a specific project, alternates may be assigned on a project basis. | PM.5.06 | PM.5.07 | PM.5.06 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM29 | Project Management | Project Workflow | Capability to specify required approval timeframes in the system, and to notify users regarding the designated "approve by" date. This is a performance aid and provides information for overall performance management of the testing process. For example, management may review the "approve by" dates to assist in their resourcing decisions. | | PM.5.08 | | |
| PM30 | Project Management | Project Workflow | Capability to display elapsed time from start to end of a process. Also, the capability to display the time remaining to approve, or disapprove a given material. For example, for some divisions the approval time may start when a sample is taken in the field, while other start the clock when the sample is received in the lab. | | PM.5.09 | | |
| PM31 | Project Management | Project Workflow | Capability to alert the process approver when an "approve by" date associated with the approval has passed or is within a certain time of completion. The method of alert shall include an email and a notification within the system. This will enable users to re-prioritize work and ensure that all projects stay on schedule. | PM.5.11 | PM.5.10 | PM.5.11 | |
| PM32 | Project Management | Project Workflow | Capability to automatically create a monthly management report of all missed dates and delayed approvals. This capability shall also allow for a specific delay time to be set for the system to create a missed-date alert. This report should have the ability to be filtered by project and by division. | | PM.5.12 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM33 | Project Management | Project Workflow | Capability to allow specifying time of delay after which an automatic notification is displayed, and/or an email sent to management regarding samples with "approve by" dates that have passed. For example, managers may decide to have the alert on the "approve by" date, before the date, or one day after the date is missed. | | PM.5.13 | | |
| PM34 | Project Management | Project Workflow | Capability to modify reminder alert time (alert x days/hours before due) by authorized users and the capability to add, delete or change information on designated users to be notified, including email addresses. For example, the notification list for missed dates may change, so it is necessary for a designated user to have the authority to make the changes, as they occur. | PM.5.14 | PM.5.14 | PM.5.14 | |
| PM35 | Project Management | Project Workflow | Allow for electronic signatures to approve all project letters. This electronic signature should be based on the user's login information if applicable. For example, managers will be able to provide necessary approval signatures on-line and to designate certain users to have the same approval authority. | | PM.5.15 | | |
| PM36 | Project Management | Project Workflow | Capability to print an approval letter with electronic signatures to send to external authorities that may require a paper copy. For example FHWA may require that SHA submit a paper copy of the final clearance letter, and may accept electronic signatures or require actual signatures in interim till the system is fully formalized and implemented. | PM.5.16 | PM.5.16 | PM.5.16 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM37 | Project Management | **Material Specifications** | Capability to store material specifications and standards in the system as a database/table, including factors such as:<br>• Test methods for various materials<br>• Pass/fail values for various tests<br>• Allowable % variations<br>These material specifications apply to all materials to be tested, and list the test methods that apply to each material, and the pass/fail values for each material's test. Any special provisions that might apply and allowable % variations are also mentioned in the test specifications. | PM.6.01 | PM.6.02 | PM.6.01 | Sec.1.03 |
| PM38 | Project Management | Material Specifications | Capability to store multiple versions of material specifications, along with an effective date range indicating which version of the specification is valid for the projects depending on project start and anticipated finish dates as applicable. For example, a project starting in year 2006 may use version x2 of the asphalt material specification for asphalt box samples, and have different allowable ranges and tests required, than a project starting in year 2006 that may use specification version x3 that have different allowable ranges of test values and different required tests. | PM.6.01<br>PM.6.03 | PM.6.01 | PM.6.01<br>PM.6.03 | Sec.1.03 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| PM39 | Project Management | Material Specifications | The system should have the ability to link to electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT). These specifications might be stored on an internal network drive, or could be a location on the internet. Generally, these specifications are not available on the internet for free, and require either a subscription or a download. These specifications guide the pass/fail result calculations for all the tests performed by OMT. | | PM.6.04 | | |
| PM40 | Project Management | Material Specifications | The system should have the ability to store electronic versions of American Association of State Highway and Transportation Officials (AASHTO) specifications, American Society of Testing and Materials (ASTM) and Maryland Standard Method of Tests (MSMT) within MMS and to make them accessible to users, along with last update and validity dates. These specifications guide the pass/fail result calculations for all the tests performed by OMT.<br>Electronic storage of these potentially copyrighted standards will be consistent with licensing fees and agreements. | | PM.6.05 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS01 | Source of Supply | **Source database** | Capability to maintain a list of approved sources of supply in a database format, along with tracking active and inactive sources (sources not on the list anymore). This should include date the sources were approved, date the source will expire, date the source was made inactive, projects for which the sources are/were approved. This list should be accessible online to external users. | SoS.1.01 | SoS.1.01 | SoS.1.01 | Sec.1.03<br>Sec.1.06 |
| SoS02 | Source of Supply | Source database | Capability to maintain database of material plants, sources and suppliers and to make them retrievable to be viewed, printed or emailed via system pull-down menus. Based upon user permissions, field, Lab, Materials Management Division and other users will have direct access to review documentation on-line relevant to their needs. | SoS.1.01<br>SoS.1.02 | SoS.1.01<br>SoS.1.02 | SoS.1.01<br>SoS.1.02 | Sec.1.03<br>Sec.1.06 |
| SoS03 | Source of Supply | Source database | Ability to store list of materials that are on an approved list (e.g. QPL, aggregate bulletin, etc.) and the materials that don't need to be on an approved list. | | SoS.1.03 | | |
| SoS04 | Source of Supply | **Source list** | Capability to maintain approved sources list electronically (e.g. QPL, aggregate bulletin) that can be updated online and are accessible to the general public, or can be password protected. Specific Divisions will be granted access for updating specific approved source lists. For example, when a source is submitted by a contractor, the authorized MMS user will be able to check to see if it is preapproved or requires testing for approval. | | SoS.2.01 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS05 | Source of Supply | Source list | Ability to look up and provide a report on the availability of quarries that provide designated aggregates and/or soils. Pull-down selection menus shall be utilized to view and/or print quarry information. For example this will aid the Soils & Aggregates Technology Division in their decision making regarding their quarry resources. | | SoS.2.02 | | |
| SoS06 | Source of Supply | **Source request** | Capability to record and require source of supply's contact person, phone number and email address and mandate that this information be provided by the contractor for the source to be submitted to SHA. An accurate and easy access to the contact person for the source of supply letter/list is necessary to enable early contact to resolve any obvious issues and to jump-start the approval process. | | SoS.3.01 | | Sec.1.01<br>Sec.1.03 |
| SoS07 | Source of Supply | Source request | Capability for contractors to submit requested materials sources (sources of supply) online through a web interface. The interface should allow the contractor to pick a bid item and specific materials to request sources of supply for each material. | | SoS.3.02 | | Sec.1.01<br>Sec.1.03 |
| SoS08 | Source of Supply | Source request | Capability to allow external users (contractors) to pick sources of supply to request from a pull-down menu that includes all sources on the current approved list for each material used on the project. The pull-down menu should also include the option to add a new source with an accompanying text box that contractors can fill in if they would like to propose a source of supply that is not on the list of approved sources | | SoS.3.03 | | Sec.1.01<br>Sec.1.03 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS09 | Source of Supply | Source request | Ability for user to request approval for sources of supply that are not on an approved list and send this request directly to the appropriate division. | | SoS.3.04 | | Sec.1.01<br>Sec.1.03 |
| SoS10 | Source of Supply | Source request | Capability to allow contractors to submit multiple sources of supply for each bid item/material. Contractors often have multiple sources of supply for each bid item on large projects. MMS must be capable to accommodate more than one source of supply per project and contractor. This capability should be allowed to be turned on or off for each material. | SoS.3.05 | SoS.3.05 | SoS.3.05 | Sec.1.01<br>Sec.1.03 |
| SoS11 | Source of Supply | **Source review** | Provide capability to link to manufacturer's product installation information on the web from approved products function. This capability entails the ability to link to the internet from within the MMS screens for various purposes. For example, a user may be viewing a project within MMS and notice a questionable entry regarding material installation. Given a link to the manufacture's product installation information will save time and possibly avert project delay. | | SoS.4.01 | | |
| SoS12 | Source of Supply | Source review | Capability to automatically trigger workflow based on predefined rules for source of supply approval once a request is received from the contractor. This will require compliance with all workflow requirements listed in Project Management requirements | | SoS.4.02 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS13 | Source of Supply | Source review | Capability to review and distribute Source of Supply letter/list electronically after the review is complete. For example, much of the processing of source of supply lists and letters are processed via hard copy, this capability will enable electronic versions to be distributed electronically within MMS. | | SoS.4.03 | | |
| SoS14 | Source of Supply | Source review | Capability to approve sources of supply for specific material for specific project, along with notes and assign validity dates for the source of supply. For example, if a GAB source goes out of business and is not being used anymore, the source information should still be available for the project, clearly marking the date range for which the source of supply was valid. | SoS.4.04 | SoS.4.04 | SoS.4.04 | |
| SoS15 | Source of Supply | Source review | Ability to distribute project documentation to appropriate divisions, as required. Each Division recipient of project information shall be selectable via a pull-down menu or other reliable means. By selecting the appropriate recipient, a transport medium shall be presented for transmittal of the information (email, fax or within MMS). For example, the distribution list presented must also contain the means by which the document will be sent for various recipients. The MMS user shall be able to select recipients from the menu provided. | | SoS.4.05 | | |
| SoS16 | Source of Supply | Source review | Capability to automatically assign review "notes" to submitted sources of supply based on source material category using a predefined table/database of the source material and "notes" relationship. | | SoS.4.06 | | |
| SoS17 | Source of Supply | Source review | Capability to manually edit the review "notes" automatically assigned to the sources. | | SoS.4.07 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS18 | Source of Supply | Source review | Capability to maintain list of review "notes" that are tied to source rejection electronically in a database and provide as a drop down menu on review page. | | SoS.4.08 | | |
| SoS19 | Source of Supply | Source review | Capability to assign multiple review "notes" to source of supply items as the same source may require multiple notes. For example, the Materials Engineer might review an item and add "notes", and forward to a division for further input, and the division might add more comments to the source of supply. | | SoS.4.09 | | |
| SoS20 | Source of Supply | Source review | Capability to add comments at the material level for internal use. This field will allow the approver to enter any questions/comments they have before sending to the appropriate division. | SoS.4.10 | SoS.4.10 | SoS.4.10 | |
| SoS21 | Source of Supply | Source review | Capability to add comments at the material level intended for display to external users. A clear alert should also be provided next to this field informing the reviewer that this comment will be visible to the contractor. | SoS.4.10 | SoS.4.10 | SoS.4.10 | |
| SoS22 | Source of Supply | Source review | Capability to interface with Maryland Product Evaluation List (MPEL) to import approved new products that are new additions to QPL (Qualified Products List). | SoS.4.11 | SoS.4.11 | SoS.4.11 | |
| SoS23 | Source of Supply | Source review | Capability to flag source approval inspection requests as those for active projects or no projects to determine where the funds for testing will come from (project, or directly from source). If the payment is expected to be received directly from the source, the MMS should allow the capability to mark status as "awaiting payment" or "payment received" and flag all work as such with an alert when awaiting payment. | | SoS.4.12 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS24 | Source of Supply | Source review | Capability to retrieve and print reports relating to production facilities. The report should also provide the option to include or exclude all inactive sources (sources not currently approved for use) and the ability to mark them clearly as such. Examples of these lists of approved sources are the Qualified Product List (QPL) and aggregate bulletin. | | SoS.4.13 | SoS.4.13 | |
| SoS25 | Source of Supply | Source review | Capability to retrieve and print a report of all the projects a particular source is providing material to. | SoS.4.14 | SoS.4.14 | SoS.4.14 | |
| SoS26 | Source of Supply | Source review | Capability to print a formatted report and convert to an easily transferable format (e.g. pdf). This capability shall allow for notations/comments to be added to the formatted report. For example, some stakeholders may only be capable of receiving hard copy reports, by converting the MMS reports to pdf or other format, those stakeholders can be accommodated. | | SoS.4.15 | | |
| SoS27 | Source of Supply | Source review | Capability to mark sources as approved based on reciprocity with other states. A database of preapproved sources, based upon reciprocity, shall be maintained for reference and the user shall have the ability to electronically mark a source as approved, based on that database. An MMS user will have direct knowledge of other state reciprocal approvals, if applicable. | SoS.4.16 | SoS.4.17 | SoS.4.16 | |
| SoS28 | Source of Supply | Source review | Capability to add sources to approved list and mark sources as "tentatively approved". Sources that have a national certification, and have not been inspected by OMT, or sources that have been inspected but are waiting for necessary certifications are tentatively approved for project work. | SoS.4.19 | SoS.4.18 | SoS.4.19 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS29 | Source of Supply | Source review | Capability to send source approval or disapproval information back to contractor/provider electronically in the form of an email. This email should be triggered by the appropriate OMT team member. For example, when it is determined that a product/source has been approved or disapproved for use on a project, it is necessary to notify the contractor as well as the SHA stakeholders. | | SoS.4.20 | | |
| SoS30 | Source of Supply | Source review | Capability to approve sources of supply for specific projects only. These sources should be clearly marked as approved for specific projects only, and not added to the approved sources list. | SoS.4.19 | SoS.4.21 | SoS.4.19 | |
| SoS31 | Source of Supply | Source review | Ability to automatically add sources to approved lists once the sources are approved. The ability to override the automatic addition should also be provided for unforeseen situations. | | SoS.4.22<br>SoS.4.23 | | |
| SoS32 | Source of Supply | Source review | Ability to notify Materials Engineer when x number of sources submitted by the contractor are approved, or when x days have passed since the submittal request. The number of sources and the number of days should be user modifiable. This will allow SHA to send the contractors information routinely, and help the Materials Engineer with the approval process. | | SoS.4.25 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS33 | Source of Supply | Source review | Ability to record acceptance of material source based on certified test results as received by OMT. This includes the ability to approve material source for multiple projects based on one certified result, as well as the ability to approve material source for individual projects. For example, the geotextile manufacturers are approved based on certified NTPEP test results and manufacturer submitted results. | | SoS.4.26 | | |
| SoS34 | Source of Supply | Source review | Ability to provide a list of all bid items and materials to be used on the project, along with their source approval status (approved, unapproved, submitted, not submitted, not required) | SoS.3.05 | SoS.3.05 | SoS.3.05 | Sec.1.01<br>Sec.1.03 |
| SoS35 | Source of Supply | Source review | Ability to notify the new source submitter of approval status once the source has been reviewed. The approval status might indicate approved for project, approved and added to approved list, or disapproved with comments regarding the disapproval. | | SoS.4.20 | | |
| SoS36 | Source of Supply | Source review | Ability to store a list of reasons for source disapproval/rejection in the form of a table, and present the information in the form of a drop down menu for selection on the approval page. This menu should also include "Other" and provide a comment box that is available and tied to the reason for disapproval/rejection. | | SoS.4.27 | | |
| SoS37 | Source of Supply | Source review | Ability to generate an alert when an existing approved source is no longer valid and send to source representative, SHA representatives & contractor representatives of all projects on which the source is noted as an approved source. | SoS.4.28 | SoS.4.28 | SoS.4.28 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SoS38 | Source of Supply | Source review | Ability to generate a report displaying all the sources rejected (overall, and by project) along with the reason for rejection, and the comment entered. | SoS.4.29 | SoS.4.29 | SoS.4.29 | |
| SoS39 | Source of Supply | Source review | Capability to manually release items for distribution once the items are approved or disapproved. | | SoS.4.30 | SoS.4.30 | Sec.1.03 |
| SoS40 | Source of Supply | Source review | Capability to manually distribute approved and released items to appropriate parties in the form of a consolidated email. For example, if 5 sources are approved/disapproved for a project, a consolidated email will be sent with all 5 sources approval status. | | SoS.4.31 | SoS.4.31 | |
| SoS41 | Source of Supply | Source review | Capability to automatically distribute approved and released items to appropriate parties in the form of a consolidated email based on business-specifiable rules regarding time for release. For example, the time specified could be one day, or five days as specified by the document. | | SoS.4.32 | SoS.4.32 | |
| SyMg01 | **System Management** | **System Maintenance** | Capability to provide the users with the back-end to make changes to basic tasks. For example, this capability should provide the administrators the capability to create new distribution lists, maintain cost tables, etc. In other words, this capability should allow the users to make changes to data tables on the back-end using a simple to use interface. | SyMg.1.01 | SyMg.1.02 | SyMg.1.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SyMg02 | System Management | System Maintenance | Capability to maintain an organizational structure (table) of Office of Materials Technology with the added capability to assign tasks to individuals or organizations. For example, organizations change and the individual stakeholders within the organizations often change. Maintaining an updated organization chart on line ensures that forwarded documentation is going to the correct contact. | | SyMg.1.03 | | |
| SyMg03 | System Management | System Maintenance | Ability to provide user definable tables, fields, indexes and forms. This function may be enabled through the application of a Wizard functionality. For example, an administrator may want to design a form for reporting daily or weekly activity in report format. | | SyMg.1.04 | | |
| SyMg04 | System Management | System Maintenance | Capability to provide online "Help Screens" that can be populated from an administration back-end by authorized users. The help screens shall "pop-up" to aid input, or be selectable by user to obtain specific help information on a functionality. For example, a user may require assistance to add notation to a source of supply letter or where to find test results. | | SyMg.1.05 | | |
| SyMg05 | System Management | System Maintenance | Capability to maintain a list of SHA users with various levels of access rights. A system administrator will have access to maintain the user capability designations. For example, it is necessary to ascertain who has what access capability from the division heads. Each division will have specific access requirements and all will have some general access requirements. | SyMg.1.06 | SyMg.1.07 | SyMg.1.06 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| SyMg06 | System Management | System Maintenance | Capability to provide role-based security so that system users have limited/restricted access to the system. The access level of the user will depend on their division and the projects they are working on. The control of outside users shall be limited to the responsible division and specific fields. Several outside groups (contractors, suppliers, outsourced labs) will require limited, defined access to MMS besides the SHA users. | SyMg.1.08 | SyMg.1.09 | SyMg.1.08 | Sec.1.03<br>Sec.1.04 |
| SyMg07 | System Management | System Maintenance | Capability to maintain a security log (audit trail) of user access to the system with date & time of access and user name of person accessing the system. For example, a user may inadvertently or purposely destroy information while using the system, It is necessary to have an audit trail to determine who did what. | | SyMg.1.10 | | Aud.1.01<br>Aud.1.02<br>Aud.1.03 |
| SyMg08 | System Management | System Maintenance | Capability to require approval, per access, on input from external groups with limited/restricted access. Also, the capability to deny access to an outside user and log access attempt and flag repeated attempts. For example, Users in the restricted outside user group will change and may attempt unauthorized access. | | SyMg.1.11 | | Sec.1.04<br>Sec.1.05 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Othr01 | Other | Other | Ability to store placed quantities as reported by project site and quantities as reported by manufacturing plant separately in the system. These quantities will be reported by different team members (plants, PEs, others). These quantities may be different due to batches rejected on-site or other reasons, and it is important to know both the quantities for different reasons (plant inspection frequency is related to plant production, while actual pay amounts and material test frequency is related to actual quantities placed). | Othr.1.01 | Othr.1.01 | Othr.1.01 | Sec.1.04<br>Sec.1.05 |

## 1.4 Requirements Traceability Matrix – Project 2

Exhibit 4 below presents the Requirements Traceability Matrix (RTM) for all requirements mentioned in Project 2 of FRD.

**Exhibit 4: Requirements Traceability Matrix - Project 2**

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| **Material Testing** | | | | | | | |
| MT01 | **Material Testing** | **1. Sample Login** | Ability to automatically assign a serial number to the sample when a sample is logged in to the system. The serial number assigned should be such that the OMT division can be identified by looking at the serial number. For example, all asphalt samples may end with an A, or start with a "4." | | MT.1.01 | | |
| MT02 | Material Testing | 1. Sample Login | Ability to automatically assign a serial number to the specimen when a specimen is logged in to the system. The specimen number will be tied to a unique serial number, and multiple specimen number can be tied to one serial (sample) number. For example, a concrete "sample" may consist of two or more "specimens" (cylinders) for testing. | | MT.1.02 | | |
| MT03 | Material Testing | 1. Sample Login | Ability to enter and store project number, project name, appropriate division, mix design #, etc. to each sample when entered in the system. All this information should be automatically populated for all specimens based on the samples they are linked to. | | MT.1.03<br>MT.1.04 | | Sec.1.06 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT04 | Material Testing | 1. Sample Login | Ability to enter other parameters to sample and specimen information like sample condition, test type, test values, test result (pass/fail/other), charge code, ship date, etc. either at first sample login or later on during the process. | MT.1.07 | MT.1.05 | MT.1.07 | |
| MT05 | Material Testing | 1. Sample Login | Ability to record the sources of the material that is being sampled for each sample collected. Some of the materials may have more than one source approved for the project. For example, the sample login screen will provide a drop down menu with approved sources for the project from which the applicable source can be selected, but also have a text box to record the source if the source is not yet an approved source. | MT.1.07 | MT.1.06 | MT.1.07 | |
| MT06 | Material Testing | 1. Sample Login | Ability to validate sample information and flag when required information is not provided. The system will need to flag the sample as "incomplete" in such a case. The system should also allow the user to enter the type of information that is missing - this information should be available as a drop down menu (from a pre-populated table) but also allow the user to enter another value. | MT.1.09 | MT.1.08 | MT.1.08<br>MT.1.09 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT07 | Material Testing | 1. Sample Login | Capability to generate alert when a sample is flagged as not fit for testing (e.g. having incomplete information, incorrect size), along with additional notes (e.g. information that is missing (paperwork, improper sampling, etc.)). This alert should be in the form of an email that can be sent out to a distribution list including the contractor and the PE as applicable. | | MT.1.10 | | |
| MT08 | Material Testing | 1. Sample Login | Ability to send automatic reminders when sample information is missing at user-specified intervals. The intervals should be separately specified for each division. | MT.1.11 | MT.1.11 | MT.1.11 | |
| MT09 | Material Testing | 1. Sample Login | Capability to mark when sample information received for inter-lab tests is not accompanied by a sample. This is to prevent situations when a sample is tested by one lab, and the information is transferred but the actual sample is not transferred in a reasonable time frame (for multiple tests to be performed on the same sample/item). | | MT.1.12 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT10 | Material Testing | 1. Sample Login | Ability to mark the status of the sample in the system. The status would include "recorded at field," "shipped to lab," "received by lab," "test complete," "results approved," "results received" and others as determined by the divisions. The sample should automatically have a time stamp associated with it when the status of the sample is updated in the system. | MT.1.14 | MT.1.13 | MT.1.14 | Sec.1.03 |
| MT11 | Material Testing | 1. Sample Login | Capability to record shipment date for samples that are collected at remote locations and shipped to OMT lab. This will allow the labs to note how long it took to receive the sample. | | MT.1.15 | | |
| MT12 | Material Testing | 1. Sample Login | Ability to login a sample offline and import the information in to MMS when connected to the internet/intranet. This will be very important for remote locations or sample collected at the plants where no internet connectivity is available. The offline data entry tool could be a module of the MMS or a complex spreadsheet whose import will be supported by the MMS. This will also require the MMS to set aside a number of serial ids/numbers for offline use that will be tracked as such. | MT.1.16 | MT.1.16 | MT.1.16 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT13 | Material Testing | 1. Sample Login | Capability to print a serial number that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, enter the serial number, and will be able to pull up all relevant sample information. | | MT.1.17 | | |
| MT14 | Material Testing | 1. Sample Login | Capability to print a barcode that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, scan the barcode, and will be able to pull up all relevant sample information. | | MT.1.18 | | |
| MT15 | Material Testing | 1. Sample Login | Ability to retrieve sample information based on serial numbers attached to samples. This will allow the labs to retrieve information and not reenter information that has already been gathered in the field. | MT.1.19 | MT.1.19 | MT.1.19 | |
| MT16 | Material Testing | 1. Sample Login | Ability to record data from barcode readers and retrieve sample information based on the barcode attached to samples. This will help prevent the same duplication mentioned above, with the additional benefit of not needing to enter the serial number. | MT.1.20 | MT.1.20 | MT.1.20 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT17 | Material Testing | 1. Sample Login | Capability for the tester or inspector to capture test and inspection results offline for instances where worksheets/forms and other manual media are used to document the test/inspection results and export them back to MMS via an email, scan, or other method. It is necessary to accommodate field input to MMS in a robust way. All plant test and inspection work is done by field forces. | | MT.1.21 | | |
| MT18 | Material Testing | 1. Sample Login | Ability to record material placement location for test samples in multiple coordinate systems. This will require the use of multiple fields with information stored in a table that will be accessed by an Asset Data Warehouse (ADW) or a GIS system in the future. This feature will allow SHA to back track the test results for a particular location in case of any issues. | MT.1.22 | MT.1.22 | MT.1.22 | |
| MT19 | Material Testing | 1. Sample Login | Ability to allow the Project Engineer to trigger a particular workflow once project information is received. For example, the Project Engineer may receive notification of completion of placement from the contractor and may need to trigger the inspection workflow. | MT.1.23 | MT.1.23 | MT.1.23 | |
| MT20 | Material Testing | 1. Sample Login | Ability to request QC data from the contractor or PE and store the information in the system. | MT.1.24 | MT.1.24 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT21 | Material Testing | 1. Sample Login | Ability to note the purpose of the sample. For example, the sample might be for QA, or for plant acceptance, or for informational purposes. This will also determine where the sample's cost to test will be charged. | | MT.1.25 | | |
| MT22 | Material Testing | 1. Sample Login | Ability to use RFID tags to record sample information. This will allow one more way to record sample information in MMS. | | MT.1.26 | | |
| MT23 | Material Testing | 1. Sample Login | Ability to read sample information from embedded/attached RFID tags in samples. | MT.1.27 | MT.1.27 | MT.1.27 | |
| MT24 | Material Testing | 1. Sample Login | Ability to store RFID records and code in MMS | | MT.1.28 | | |
| MT25 | Material Testing | **2. Prepare Specimen** | Ability to split samples into multiple specimens and assign properties to the specimens (tests to be performed, etc.) For example, a concrete "sample" received will consist of two or more cylinders, where each cylinder is equivalent to one "specimen." | | MT.2.01 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT26 | Material Testing | 2. Prepare Specimen | Capability for managers to assign tests to specimens and samples. Managers will have the ability to assign tests from a pre-defined list of tests.<br>Managers should be able to assign tests from different divisions for inter-lab samples (e.g. chemical samples). Such assignment should automatically trigger an alert in the form of an email to the recipient division. | | MT.2.02 | | |
| MT27 | Material Testing | 2. Prepare Specimen | Ability to assign task options to samples or specimens. These options may include "complete by," "test on," etc.<br>A "test-on-date" refers to a schedule of tests to be performed on samples. For example, concrete samples received by the lab are assigned a "test-on-date" based on 3-day, 7-day or 28-day strength testing to be performed. | | MT.2.03 | | Sec.1.03 |
| MT28 | Material Testing | 2. Prepare Specimen | Ability to assign comments to each sample/specimen at test assignment that are visible to the testers (including specific instructions for specimen/sample storage). These notes may provide specific instructions relevant to the sample/specimen like test using a particular equipment, etc. These comments should be printed in a bigger font/different color to make it clearly visible. | MT.2.04 | MT.2.04 | MT.2.04 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT29 | Material Testing | 2. Prepare Specimen | Ability to assign testers or groups of testers to each sample/specimen from a drop down list. This assignment should automatically trigger a notification to the tester or the test group as appropriate. | | MT.2.05 | | Sec.1.03 |
| MT30 | Material Testing | 2. Prepare Specimen | Ability to assign a priority rating between 1 (Very Low) and 5 (Very High) to samples. This will allow testers to prioritize testing within their backlog and result in efficient communication within the labs. | | MT.2.06 | | |
| MT31 | Material Testing | 2. Prepare Specimen | Ability to flag sample status as active or inactive. | | MT.2.07 | | |
| MT32 | Material Testing | 2. Prepare Specimen | Ability to enter sample storage location (physical location) in MMS. | MT.2.09 | MT.2.08 | MT.2.09 | |
| MT33 | Material Testing | **3. Record Test Results** | Ability to log test performed for each sample in the system. The test login screen should provide a drop down with all tests, so the right test can be selected from the menu. The test fields should allow the testers to enter the field names for the recorded parameters, and the recorded values. The screen should also allow the tester to record the pass or fail result for the test if applicable. | | MT.3.01 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT34 | Material Testing | 3. Record Test Results | Ability to retrieve test results for a particular sample or specimen to add more test information to the sample/specimen if applicable. For example, a tester may perform some tests on the specimen one day and other tests on the other day, and may want to record them at the time of testing. | MT.3.02 | MT.3.02 | MT.3.02 | |
| MT35 | Material Testing | 3. Record Test Results | Ability to allow outsourced labs restricted access to the system to enter test results. The outsourced labs will be allowed to only enter test results for tests and projects assigned, and not be able to view any other information in the system. This should be accomplished through a web based interface to the MMS. | | MT.3.03 | | Sec.1.04<br>Sec.1.06 |
| MT36 | Material Testing | 3. Record Test Results | Ability for batch entry of lab results from outsourced labs. For example, some lab work is outsourced to provide specialty testing. Providing an automated entry portal for the outsourced contractor would speed up that process. The outsourced labs shall have restricted access. | MT.3.04 | MT.3.04 | | Sec.1.04 |
| MT37 | Material Testing | 3. Record Test Results | Ability to enter test results through a web based interface outside SHA intranet. This capability is critical for field staff and outsourced labs to record test results for tests performed in the field. | MT.3.05 | MT.3.05 | MT.3.05 | Sec.1.06 |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT38 | Material Testing | 3. Record Test Results | Capability to store contractor's/plant's QC results in the system and clearly mark them as QC results. This will enable SHA to review the QC results easily as required and compare the QA and QC results. | | MT.3.06 | | Sec.1.06 |
| MT39 | Material Testing | 3. Record Test Results | Capability to compile specimen results into one sample result. This requires a separate screen that consolidates all specimen information. Pass/fail is based on tester's judgment based on specimen's pass/fail. For example, for a concrete cylinder sample, the pass/fail will depend on the average value of more than one specimen. Thus, a particular specimen might have failed, but the average will result in a passing value for the sample. This is also necessary since the approval/disapproval sent to contractor is at the sample level. | | MT.3.07 | | |
| MT40 | Material Testing | 3. Record Test Results | Ability for testers to add comments relevant to the testing process or results at the specimen level. For example, the tester may want to note certain conditions that led to the failure of the specimen. The system should provide two comment fields: one for internal use only, and one that will be accessible to the contractor. The external comment field should provide clear indication that anything entered in the field will be visible to external (Non-SHA) team members. | MT.3.08 | MT.3.08 | MT.3.08 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT41 | Material Testing | 3. Record Test Results | Ability to automatically record the tester's information and date and time the test result is entered in the system. The tester's information will allow SHA to differentiate between outsourced lab/tester, in-house test performed by consultant, or in-house test performed by SHA employee. | | MT.3.09 | | |
| MT42 | Material Testing | 3. Record Test Results | Ability to flag if the test time and cost are being charged to Y-B888. | | MT.3.10 | | |
| MT43 | Material Testing | 3. Record Test Results | Ability to store whether a particular test is generally charged to Y-B888. | | MT.3.11 | | |
| MT44 | Material Testing | 3. Record Test Results | The system will put in a default check mark if the test is generally charged to Y-B888, and will account for whether the project is a third party project (that does not get charged to Y-B888) and consultant technicians (do not charge to Y-B888) | MT.3.12 | MT.3.12 | MT.3.12 | |
| MT45 | Material Testing | 3. Record Test Results | Ability to add specific fields that can be entered on each screen (e.g. cost per test, material specification used) | | MT.3.13 | | |
| MT46 | Material Testing | 3. Record Test Results | Ability to enter the material specification and version that is applicable for a test that is performed from a drop down menu. (e.g. ASTM 392, etc.) | MT.3.15 | MT.3.14 | MT.3.15 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT47 | Material Testing | 3. Record Test Results | Ability to reschedule tests electronically. When a test fails, the system should provide the ability for the supervisor to reschedule additional testing or request another sample from whoever provided the original sample (vendor/manufacturer/supplier/source). The original sample/specimen information should be made available to the tester on a screen based on information already present in the system. | | MT.3.16 | | |
| MT48 | Material Testing | **4. Review/Approve Results** | Capability for test approver (technician's superior) to approve results - this approval will be by material division. | | MT.4.01 | | |
| MT49 | Material Testing | 4. Review/Approve Results | Capability to approve test results if the sample does not meet material specifications, but has minor deviations. Any such approvals should be specifically noted as such in the system, along with an explanation. This approval is specifically for the test results, and indicates a recommendation for approval for the material. This should include the ability to record the approver in the system. | MT.4.02 | MT.4.02 | MT.4.02 | Sec.1.03 |
| MT50 | Material Testing | 4. Review/Approve Results | Capability to compare data from testing performed by construction contractors/material producers with SHA quality assurance test results. | | MT.4.03 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT51 | Material Testing | 4. Review/Approve Results | Capability to track and record all dates on which the specimens were tested, approved & released for distribution, and actually distributed to the involved parties. | MT.4.04 | MT.4.04 | | |
| MT52 | Material Testing | 4. Review/Approve Results | Automatically update facility/product/material accepted lists upon meeting requirements for approval and upon completion of QA/QC checklist. | | MT.4.05 | | |
| MT53 | Material Testing | **5. Sample Management** | Ability to manually distribute approved test results. For example, if 3 test results are approved, for a project, the distribution trigger should send out a consolidated email with all 3 test results. | | MT.5.01 | | |
| MT54 | Material Testing | 5. Sample Management | Ability to sort tasks based on criteria such as work group, technician, work backlog, equipment/test, priority etc. This function will enable managers/supervisors to prioritize work assignments. | | MT.5.02 | | |
| MT55 | Material Testing | 5. Sample Management | Capability to view backlog of tests to be performed by multiple criteria (e.g. Division lab, aging of samples, tests to be performed, projects for which testing is to be performed), The viewing criteria shall be made available to users via pull-down menu selections. This function will allow for better performance measures within the divisions and provide data to aid in planning of the testing process. | MT.5.03 | MT.5.03 | MT.5.03 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT56 | Material Testing | 5. Sample Management | Ability to compare the number of samples collected (logged) for each material against the number mentioned in the project sampling plan. This will enable the teams to adjust the sampling frequency to collect more or less samples as required. | | MT.5.04 | | |
| MT57 | Material Testing | 5. Sample Management | Capability to view status of sample test progress within a division. The purpose of this function is to highlight bottlenecks or backlogs. A manager will be able to see where a sample is in a workflow process and how long it has taken for the sample to flow between tasks. | | MT.5.05 | | |
| MT58 | Material Testing | 5. Sample Management | Generate alerts that the samples can now be discarded. This will be based on user-definable business rules that will vary by each division, lab, or sample type. Managers will have the ability to override alerts or to specify destruction/retention criteria manually. | MT.5.07 | MT.5.06 | MT.5.07 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| MT59 | Material Testing | 5. Sample Management | Capability for contractors to view sample and test information in MMS through a web-based interface or via another designated/restricted remote login to MMS. Contractors have a need to view status information and to input specific data for SHA action; a contractor who wants to know whether or not a product is approved can log on and see whether the sample has been logged in, if tests are pending, or if the product has been approved or disapproved. Management defines the extent of information visible to outside parties. | | MT.5.08 | | |
| **Certification Based Approval** | | | | | | | |
| Cert01 | **Certification Based Approval** | **6. Certifications** | Ability to store and index all certifications/certified test results received by OMT in the system. These certifications will be stored in the MMS as electronic files (e.g. PDFs), and indexed with the various attributes (e.g. Project, manufacturer/plant, relevant division, certificate expiration date, valid quantities, etc.) | Cert.1.02 | Cert.1.01 | Cert.1.02 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Cert02 | Certification Based Approval | 6. Certifications | Ability for contractors/suppliers/manufacturers to request certification approval and recertification electronically through the system. The outside parties must be able to submit a certification approval request that is then reviewed by SHA. The certification approval is envisioned to be a web-based form with drop down menus and fields that the requestor can use to enter appropriate information (e.g. contact information, project number, etc.). | | Cert.1.03 | | |
| Cert03 | Certification Based Approval | 6. Certifications | Ability for certification requestors to attach documents along with the certification approval request. Most of the certification approval requests will include certified test results. This information could be submitted by the Project Engineer, contractor or material source representative. | | Cert.1.04 | | |
| Cert04 | Certification Based Approval | 6. Certifications | Ability for SHA to review certification test results and enter comments in the system regarding approval (e.g. deviations, what needs to be addressed before they can be certified, etc.) and approve/disapprove the certification request in the system. | | Cert.1.05 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Cert05 | Certification Based Approval | 6. Certifications | Ability for SHA to review the approval/disapproval and mark the results as released and ready for distribution to the requestor and other involved parties. This activity will generally be performed by the first approver's supervisor. | | Cert.1.06 | | |
| Cert06 | Certification Based Approval | 6. Certifications | Ability to distribute released results to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the certification approval request. All requested and released certification requests should be sent out in one consolidated email. | Cert.1.07 | Cert.1.07 | Cert.1.07 | |
| Cert07 | Certification Based Approval | 6. Certifications | Ability to generate, in calendar form, a list of certification expiration dates. The system should provide options to narrow selection from a drop-down menu and may include producer/material/source. For example, the lab may want to display only the certifications for concrete producers that expire within the next six months. | | Cert.1.08 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Cert08 | Certification Based Approval | 6. Certifications | Ability to provide automatic notification to SHA members and plants/suppliers of expiring certificates for plants/suppliers based on expiration dates in the system. This will help both the plants/suppliers and SHA being proactive in ensuring that the plants/suppliers stay properly certified. The automatic notification should be in the form of an email and include a link to the page where the plant/supplier/manufacturer can apply for recertification. | | Cert.1.09 | | |
| Cert09 | Certification Based Approval | 6. Certifications | Ability to print certification approval requests with an electronic signature to send to interested parties or for project records. | Cert.1.10 | Cert.1.10 | Cert.1.10 | |
| Cert10 | Certification Based Approval | 6. Certifications | Ability to capture certification test results in a retrievable and reportable format. This will require test entry screen with list of items accepted based on certification, and entry fields for all test results. This functionality is similar to a test entry screen for materials that are tested by OMT. | | Cert.1.11 | | |
| Cert11 | Certification Based Approval | 6. Certifications | Ability to capture and store certifications and certification test results at the plant level (for each plant) and link the certifications to projects for which the certification is applicable. This should also allow the capability to search certifications by projects as well as plants. | | Cert.1.12 | | |
| **Plant Review** | | | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Plnt01 | **Plant Review** | **7. New plant approval** | Ability for plants to request addition of plant to approved list and request inspection for the plant. | Plnt.1.01 | Plnt.1.01 | Plnt.1.01 | |
| Plnt02 | Plant Review | 7. New plant approval | Ability to electronically attach the Quality Control (QC) plan so SHA members can download and review before plant visit. This will allow the plant to provide the plan and updates faster and more efficiently. | | Plnt.1.02 | | |
| Plnt03 | Plant Review | 7. New plant approval | Capability to maintain inspection/audit checklists in MMS that can be updated as required. The checklists may include checks for basic equipment operations, contact information, technician certifications, etc. | | Plnt.1.03 | | |
| Plnt04 | Plant Review | 7. New plant approval | Ability to schedule plant inspections including date, anticipated time, inspector, plant contact, etc.; and display all scheduled inspections and information on a calendar that can be printed for offline use. | | Plnt.1.04 | Plnt.1.04 | |
| Plnt05 | Plant Review | 7. New plant approval | Ability to approve or disapprove a plant approval request based on inspection, tentatively approve a plan, along with the reason for action taken, and any issues to be resolved before final approval if applicable. | | Plnt.1.05 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Plnt06 | Plant Review | 7. New plant approval | Ability to automatically add plant to list of approved plants/sources once the plant is approved. This will require tight integration between table/database of requests received and table/database of approved plants. | Plnt.1.06 | Plnt.1.06 | Plnt.1.06 | |
| Plnt07 | Plant Review | 7. New plant approval | Ability to distribute approval update to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the plant approval request. | Plnt.1.07 | Plnt.1.07 | Plnt.1.07 | |
| Plnt08 | Plant Review | **8. Plant QA visits** | Ability for plants to enter planned production values as well as actual production values directly in the system. This will allow SHA to track and review the information easily and allow easier scheduling of plant QA visits. | | Plnt.2.01 | | |
| Plnt09 | Plant Review | 8. Plant QA visits | Capability to notify division to schedule plant inspections based on plant's production values (e.g. Hot Mix Asphalt, Portland Cement Concrete). This provides an automated means to monitor specific plant output for SHA projects and to plan schedule inspections accordingly (based on tons of material delivered). For example, by reviewing the plant production amounts, MMS may alert the associated division, by email or otherwise, that a plant inspection is due or is coming due. | | Plnt.2.02 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Plnt10 | Plant Review | 8. Plant QA visits | Capability to maintain QA checklists in MMS that can be updated as required. The checklists may vary based on the type of plant being inspected. The checklists should have place to rate each element to be checked on a scale of 1 to 5. The checklist should also allow entry of QC plan review comments, open issues to be resolved, etc. | Plnt.2.03 | Plnt.2.03 | Plnt.2.03 | |
| Plnt11 | Plant Review | 8. Plant QA visits | Ability to generate a QA visit schedule based on inspection frequency. This schedule should be modifiable to list specific dates or week ranges for the inspection. This will allow SHA to adhere to the minimum inspection frequency. | | Plnt.2.04 | | |
| Plnt12 | Plant Review | 8. Plant QA visits | Capability to record plant visits in the system along with the appropriate checklist. The plant visit record should include inspector information, date visited, checklist details, issues to be resolved, any actions taken, and any other relevant information. | | Plnt.2.05 | | |
| Plnt13 | Plant Review | 8. Plant QA visits | Ability to update plant status on approved list based on conducted inspection. This update may involve changing the plant status to temporary removal from list pending issue resolution, permanent removal, other status updates as defined by business users. | Plnt.2.06 | Plnt.2.06 | Plnt.2.06 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Plnt14 | Plant Review | 8. Plant QA visits | Ability to maintain and store dispute resolution procedure for plant approval. This will require multiple screens with details on the issues, and resolution steps followed for resolution of the issues. The users will be able to create new issues/disputes tied to plants, and update the status as in progress, or resolved. The system should also have the ability to generate a report with the dispute resolution steps followed. | Plnt.2.08 | Plnt.2.07 | Plnt.2.08 | |
| Plnt15 | Plant Review | 8. Plant QA visits | Capability to identify discrepancies in materials quantities shipped vs. quantities received through a report and/or on-line notification. This auditing is essential for proper accounting. By providing an opportunity, to determine electronically, quantities shipped vs. quantities received, discrepancies may be addressed early in the project. | | Plnt.2.09 | | |
| Plnt16 | Plant Review | 8. Plant QA visits | Ability to generate an alert when a plant's annual inspection is due. This alert should trigger an email to members that are a part of the distribution list, and will include the plant and SHA members. This will allow the plant and SHA to be more proactive in ensuring proper and continuous approval of the plants. | | Plnt.2.10 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Plnt17 | Plant Review | 8. Plant QA visits | Capability to provide automatic notification of upcoming production schedules for plants/suppliers. Knowing the production schedule for plants/suppliers provides a heads-up notification of testing pending activity and provides for better planning. For example an SHA manager has the responsibility to schedule his/her resources to meet field and lab workloads. This capability will provide the manager with the information necessary to meet project demands. | Plnt.2.12 | Plnt.2.11 | Plnt.2.12 | |
| Othr01 | **Other** | **9. Equipment Calibration** | Ability to provide an inventory of all lab equipment with appropriate attributes (e.g. Division, age, comments). The system should allow authorized users to add, remove or update the inventory information. | Othr.2.01 | Othr.2.01 | Othr.2.01 | |
| Othr02 | Other | 9. Equipment Calibration | Ability to record and store calibration history for all lab equipment. The calibration history will consist of all dates the equipment was calibrated on, and a comment field for each date. The system should also allow the storage of next required calibration date for each equipment. This will provide SHA an easy means to track calibration history and determine if any equipment is due for calibration. | Othr.2.02 | Othr.2.02 | Othr.2.02 | |
| Othr03 | Other | 9. Equipment Calibration | Ability to attach audio and video files to samples in MMS. | Othr.3.02 | Othr.3.01 | Othr.3.02 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Othr04 | Other | 9. Equipment Calibration | Ability for authorized users (administrators) to specify maximum size of attachments that users can store in MMS. | Othr.3.03 | Othr.3.03 | Othr.3.03 | |
| **Reporting** | | | | | | | |
| Rprt01 | **Reporting** | **11. Reporting** | Ability to generate reports based on sample information as follows: (These reports should be retrievable for each division, specific project, or for all labs as required)<br>- Average response time to test a sample in days<br>- Number of samples logged in the system<br>- Number of samples logged out of the system<br>- Percentage of samples tested based on number logged in and logged out<br>- Number and percentage of samples that passed<br>- Number and percentage of samples that failed | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt02 | Reporting | 11. Reporting | Ability to generate a report to indicate all samples collected for a specific project, along with the status of each sample (pass, fail, pending, other). This should also include the total number of samples logged in, logged out, passed, and failed for the project. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Rprt03 | Reporting | 11. Reporting | Ability to generate a report to present the number of tests that have been currently scheduled, and the number of tests that have been completed in a given time frame. The user should be able to specify parameters such as the time frame, division, and project. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt04 | Reporting | 11. Reporting | Ability to generate report indicating number of tests performed or inspections conducted by employee and division. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt05 | Reporting | 11. Reporting | Ability to generate report indicating how many samples were received with incomplete information. The user should be able to specify parameters like type of missing information, division, and project. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt06 | Reporting | 11. Reporting | Ability to generate report for each plant regarding number of batches shipped, projects shipped to, number of inspections at the plant, production days, and projects serviced by the plant. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt07 | Reporting | 11. Reporting | Ability to generate a summary of the total number of ship days for each plant and across all plants. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt08 | Reporting | 11. Reporting | Ability to generate a summary report of all plant inspections conducted and issues discovered at the plants. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt09 | Reporting | 11. Reporting | Ability to generate a report of all SHA equipment, along with their calibration information. The user should have the capability to specify parameters for the report like division, etc. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| Rprt10 | Reporting | 11. Reporting | Ability to generate report on the total cost of all tests within a particular time frame. This report should have the capability to filter by the test performed or division. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| Rprt11 | Reporting | 11. Reporting | Ability to generate a report showing number of samples approved with minor deviations. The user should have the capability to specify parameters for the report like division, project, etc. | Rprt.1.01 | Rprt.1.01 | Rprt.1.01 | |
| **Cost Per Test** | | | | | | | |
| CPT01 | Cost per Test | Cost per Test | Ability for the system to store cost per test for all SHA tests, including cost when tests are conducted by full time SHA employees, and by SHA contractors (working in SHA labs) | CPT.1.01 | CPT.1.01 | | |
| CPT02 | Cost per Test | Cost per Test | Ability for the system to store all parameters used to generate a cost per test for each test (from time and motion study). These parameters may include, but are not limited to time taken to run each test, employee class performing test, year last updated, escalation factors, technician hourly rate, payroll burden, overhead, etc. This will include some fields that will be calculated using multiplication, division, or other simple calculations. | CPT.1.02 | CPT.1.02 | | |
| CPT03 | Cost per Test | Cost per Test | Ability to store multiple versions of parameters used to generate cost per test from multiple time and motion studies. | | CPT.1.03 | | |

| Req # | Business Function | Sub Function | Functional Requirements | System Integration Test Case # | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|
| CPT04 | Cost per Test | Cost per Test | Ability to store cost per test charged by outsourced consulting labs (third party labs) for each consulting lab, by project, county, and other user-defined factors. | | CPT.1.04 | | |
| CPT05 | Cost per Test | Cost per Test | Ability to track costs using either a contract number, or a "control number". These control numbers can be defined by system administrators/authorized users. | | CPT.1.05 | | |

# ATTACHMENT 19 – MMS MODULE 2 FRD

THE REMAINDER OF THIS PAGE IS INTENTIONALLY LEFT BLANK

MARYLAND DEPARTMENT OF TRANSPORTATION STATE HIGHWAY ADMINISTRATION

# MATERIALS MANAGEMENT SYSTEM PROJECT

# FUNCTIONAL REQUIREMENTS DOCUMENT

## Project II

**December 1, 2008**

**Version 1.0**

# Document Version Control

| Revision Date | Updated By | Requested By | Description of Revision |
|---|---|---|---|
| 10/13/2008 | Vendor | | Initial Draft |
| 11/11/2008 | Vendor | | Draft edits |
| 11/17/08 | Vendor | | Revisions based on stakeholder review, release for formal review |
| 12/1/08 | Vendor | | Revisions based on formal review comments |
| | | | |

# Table of Contents

# 1 OVERVIEW

## 1.1 General

The Maryland State Highway Administration (SHA) and its Office of Materials Technology (OMT) have recognized a need to implement an electronic Materials Management System (MMS) to better track, record, evaluate, analyze, and review the quality of materials used on SHA construction projects. For the purposes of this document, the MMS will be defined as an integrated electronic system used as a tool to manage the materials testing, acceptance, and clearance process within SHA.

To address the need for an MMS, OMT initially chartered a team to develop the "Materials Management System Strategic Plan." This strategic plan was completed in early 2007. It provided a roadmap for the full implementation of an integrated MMS for SHA. The strategic plan outlined the high level user needs for the MMS and assessed various alternatives for implementing this system. This strategic plan recommended the development of a custom application and proposed implementation in a multi-phased approach over several years.

The MMS will serve as the single data repository for all materials testing and clearance activities, including materials tested in central and field laboratories, consultant laboratories, manufacturing sites, and project sites as needed. It will provide tools to managers in order to make decisions regarding the efficiency and effectiveness of the process and provide file storage, task tracking, and correspondence sharing. The MMS will also be capable of sharing data with SHA enterprise databases and other management systems such as AASHTO Trns•port ®, the Maryland Construction Management System (MCMS), the Financial Management Information System (FMIS), the Pavement Management System (PMS), and the Bridge Management System (BMS) among others.

## 1.2 Requirements Analysis Phase

The MMS has been determined to be a Major Information Technology Development Project (MITDP) and follows the State of Maryland's System Development Life Cycle Process (SDLC). The project is currently in the Requirements Analysis Phase of the project.

The Requirements Analysis Phase formally defines the detailed functional user requirements using the high-level requirements identified in the Initiation, System Concept Development, and Planning phases. It also delineates the requirements in terms of data, system performance, security, and maintainability requirements for the system. The requirements are defined in this phase to a level of detail sufficient for the issuance and evaluation of an RFP or for systems design to proceed. The requirements need to be measurable, testable, and relate to the business need or opportunity identified in the Initiation Phase. The requirements that will be used to determine acceptance of the system are captured in the Test and Evaluation Master Plan.

The objectives of the Requirements Analysis Phase include:

- Complete business process reengineering of the functions to be supported (i.e., verify what information drives the business process, what information is generated, who generates it, where does the information go, and who processes it).

- Develop detailed data and process models (system inputs, outputs, and the process flow).

- Further define and refine the functional and data requirements and document them in the Requirements Document.

- Develop the test and evaluation requirements that will be used to determine acceptable system performance.

- The primary deliverables of the requirements analysis phase are the (1) Functional Requirements Document and (2) the Test and Evaluation Master Plan.

### 1.2.1 Functional Requirements Document

The Functional Requirements Document (FRD) is a formal statement of an application's functional requirements. It serves the same purpose as a contract. The developers agree to provide the capabilities specified. The client agrees to find the product satisfactory if it provides the capabilities specified in the FRD.

Quality is defined as meeting the requirements of the system. For that reason, the FRD is the central document in system development. The primary uses of the FRD are as follows:

- Designing and developing the application system.

- Evaluating the product in all subsequent phases of the life cycle.

- Determining the success of the project.

The FRD has the following characteristics:

- It demonstrates that the application provides value to the State in terms of the business objectives and business processes in the 5-year plan.

- It contains a complete set of requirements for the application. It leaves no room for anyone to assume anything not stated in the FRD.

- It is solution independent. The FRD is a statement of what the application is to do—not of how it works.

A requirement is a condition that the application must meet for the customer to find the application satisfactory. A requirement has the following characteristics:

- It provides a benefit to the organization.

- It describes the capabilities the application must provide in business terms.

- It does not describe how the application provides that capability.

- It does not describe such design considerations as computer hardware, operating system, and database design.

- It is stated in unambiguous words. Its meaning is clear and understandable.

- It is verifiable.

## 1.3 Project Description

The goal of the Materials Management System (MMS) is to streamline all facets of the process including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This will in turn raise

SHA's ability to perform design, construction, rehabilitation, and maintenance on the state highway system efficiently and effectively[a].

The MMS is intended to assist with source of supply acceptance, calculate pay factors, determine materials acceptability, generate sampling and testing schedules, and be used as a mechanism to determine when all materials clearance activities are complete.

The project development strategy for the MMS project will be guided by the project plan defined in the System Boundary Document (SBD) for the MMS project that was completed in the System Concept Development Phase in May 2008.

The high level requirements for the MMS project were defined in the SBD and are grouped as follows:

**System Management** - System management refers to the overall technical management of the MMS.

**Project Management -** Project management refers to project management activities performed on a project. This includes activities like maintaining high level project information, storing project documentation, and tracking project tasks.

**Source of Supply -** Source of supply module consists of the functionality to review the sources of material supply that the contractors propose to use on the project. SHA approves or disapproves these sources for the project. The approval of the source does not indicate approval of material used on the project – merely approval of the source of the material. SHA also maintains a Qualified Products List (QPL), a list of products that have met prequalification requirements.

**Material Specification and Quality Assessment -** This requirements grouping consists of acceptance of materials on the project. Materials are accepted through on-site testing, laboratory testing, or a certification process. Samples are received and logged into the current systems; results of tests are recorded and then communicated to the project members. Due to the stand-alone nature of electronic systems, this process takes a long time and offers significant potential for improvement.

**Materials Clearance -** The materials clearance function consists of verification that the material sources are approved, documentations have been filed, quality assessment of materials has been performed, and there has been a review of placed quantities.

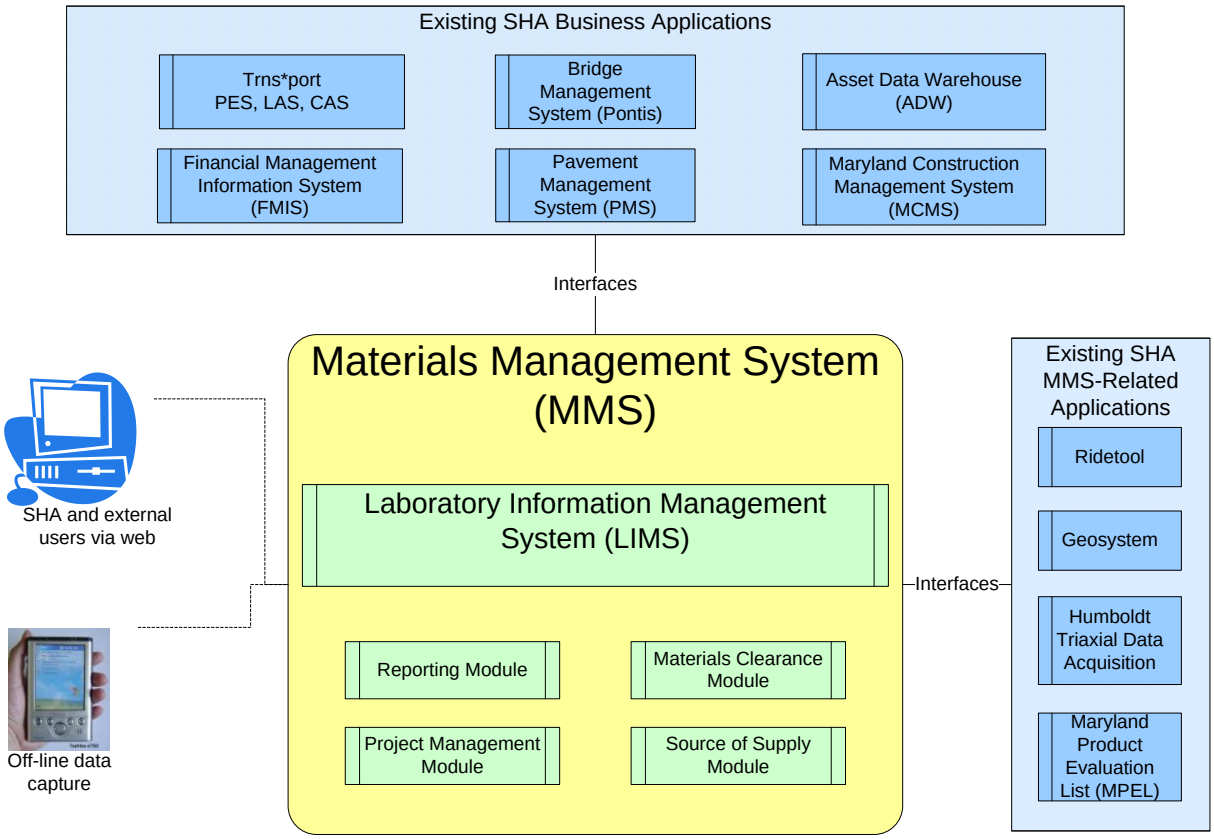
**Other/General -** This section presents other requirements for the MMS, including but not limited to historical data retrieval and data archival.

Exhibit 1 below provides a conceptual overview of the proposed MMS as defined in the System Boundary Document (SBD).

---

[a] Materials Management System Strategic Plan (January 2007)

**Exhibit 1: Conceptual Overview of the Proposed MMS**




As shown in the exhibit above, the testing, data storage, and laboratory equipment capabilities will be a part of the Laboratory Information Management System (LIMS) which will be the largest component of the MMS.

The SBD for the MMS also defined a program of nine integrated projects to be implemented over a three year period to fully deploy the MMS solution.

The nine projects defined to be implemented include:

- Project I: System Management, Project Information, and Source of Supply
- Project II: Base Laboratory Information Management System
- Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs
- Project IV: Concrete/Chemical Lab
- Project V: Asphalt Lab
- Project VI: Structural Lab
- Project VII: Materials Clearance
- Project VIII: Management Reporting/Analysis
- Project IX: Infrastructure Upgrades

### 1.3.1 Background and History

The materials clearance process is a federally mandated program with which SHA and all state transportation agencies must comply. SHA is required to submit a materials certification for each construction project receiving federal funds. While this is only required for federally funded projects, SHA has extended this program to all construction projects regardless of the funding source.

Historically at SHA, the materials clearance process has been paper-based and utilized a series of stand-alone offline applications and log books to track samples and test results for each quality control sample taken on a project. Most, if not all, documentation for the process is originated in paper form, transmitted through mail or other in-house courier methods, and stored in filing cabinets.

A series of system specification documents were created throughout the early 1990s and this resulted in a well documented outline for an electronic Materials Management System. During this timeframe, the American Association of State Highway Transportation Officials (AASHTO) was also in the midst of developing a Construction Management System called SiteManager® as part of the Trns•port ® suite of products. SiteManager® provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization and includes a module for materials management. SHA decided to abandon the custom designed MMS and invested in the SiteManager® product. Over time, interest in the SiteManager® product waned as personnel realized that this system would not meet SHA's specific business environment and needs.

In the meantime, SHA OMT's divisions with responsibility for materials management activities created stand-alone systems to assist them in their particular mission. This included use of spreadsheets, databases, proprietary systems, and other electronic mediums to store and retrieve information. The systems developed by each party were, by necessity, developed within the business unit "silo" with differing data collection, processing, or reporting standards applied. In addition, paper was and remains the predominant form of communication and documentation within the materials management process. This ad hoc system of disparate computer tools meshed with paper reporting forms the backbone of the current materials clearance process within SHA.

During formulation of the OMT's Business Plan's goals in the 2002 and 2003 timeframe, a formalized MMS once again became a top priority for SHA. In response, a series of scoping meetings were held to determine how to approach this task. In 2006, funding was allocated to develop a strategic plan to formalize and outline the scope and implementation phases necessary. The MMS Strategic Plan was completed in early 2007. It has been utilized as a key input to guide the project team's understanding of the requirements for the MMS as well as in the creation of the System Boundary Document during the Concept Development phase of this project.

The MMS will support SHA's strategic objectives by supporting and enabling a number of key Office of Materials Technology (OMT) business drivers. These business drivers include the following:

- Streamline the materials clearance process throughout the life cycle of a construction project.
- Increase the efficiency and reduce the costs associated with materials clearance.
- Store and retrieve materials information more efficiently and effectively.
- Provide for improved sharing of materials information across various SHA Divisions and Offices.
- Link sources of materials and materials used during construction to a linear referencing system to facilitate access to materials information during on-going maintenance of the transportation assets.

- Measure and track long term material quality performance.
- Generate business plan progress reports easily.

### 1.3.2 Purpose

The goal of the MMS is to streamline all facets of the process, including testing, acceptance, and clearance so that information can be tracked and SHA personnel can manage the entire materials clearance process more effectively and efficiently. This increased efficiency will in turn raise SHA's ability to efficiently and effectively perform design, construction, rehabilitation, and maintenance on the state highway system[b].

The implementation of a single electronic MMS has the following mission critical goals:

- Manage the materials clearance process throughout the construction project life cycle; this should include support for materials clearance activities in traditional design-bid-build construction contracts, as well as design-build and other innovative contracting methods.
- Allow information sharing and knowledge transfer among key SHA stakeholders.
- Allow one-stop data entry and status reporting on progress against materials clearance goals.
- Provide construction project managers with a notification of potential materials discrepancies as part of the preparation of construction contractor progress estimates.
- Provide documentation of materials clearance compliance for FHWA certification.
- Allow lab managers to track the status and costs of testing within a given Technical Material Division.
- Automate the allocation of testing costs to the various projects.
- Identify sources and materials used on projects through a referencing system to allow for easier access to materials information during ongoing maintenance of the asset.
- Support capturing of data from testing performed by construction contractors and facilitate the comparison of this test data with SHA quality assurance test results.
- Provide up to date information on selected items related to SHA business plan objectives.

### 1.3.3 Assumptions and Constraints

This section lists the assumptions and constraints associated with the Materials Management System Project. Assumptions are defined as future situations, beyond the control of the project, whose outcomes influence the success of the project.

**Resource Assumptions**

- Executive support and sponsorship will be available as planned and as needed.
- Long term management support and priority for this project.

[b] Materials Management System Strategic Plan (January 2007)

- Project staff resources will be available as planned and as they are needed.
- The appropriate SHA resources will be available to review all deliverables as defined in the project schedule.
- The appropriate SHA resources will be available to attend training as defined in the project schedule and training plan.
- The appropriate SHA resources will be available to participate in User Acceptance Testing as defined in the project schedule.
- Required hardware resources will be available as planned and as they are needed.
- Required customer resources will be available as planned and as they are needed.
- Access to industry experts and specialized skills will occur as needed.

**Delivery Assumptions**

- The schedule reflects the Department of Information Technology's (DoIT) System Development Life Cycle (SDLC) methodology and deliverables.
- The System Development Life Cycle (SDLC) templates will be used as guidelines to produce all deliverables.
- The schedule assumes a phased implementation, based upon the high level functional requirements as defined in the System Boundary Document.
- The actual implementation schedule may change after the design phase is completed.
- Deliverables will be subject to no more than a specific number of review cycles as specified in the Consulting And Technical Services (CATS) Task Order. The CATS Task Order is issued under the CATS Master Contract that provides the State with a flexible means of obtaining Information Technology (IT) resources quickly, efficiently and cost effectively by issuing Task Orders (TOs) specific to its needs.
- SHA will procure the required hardware and software necessary to support the solution within the thirty five business days reflected in the solution.

**Organizational Assumptions**

- Issues will be resolved in accordance with project plans in a timely manner.
- The project organization described in the project plan will be in place.

**Budgetary Assumptions**

- The statistics used in preparing the estimates are accurate within +/- 20% percent.
- Consulting Services will be limited to a specified number of days at a specified rate per day as specified in the associated CATS contract.
- Projected funding needs will be approved by the State Legislature on an annual basis in the year that the funds were budgeted.

**Functionality Assumptions**

- Formal Project Charter and scope change procedures will be followed.

### 1.3.4 Interfaces to External Systems

The proposed MMS may need to interface with the systems identified in Exhibit 2 below.

**Exhibit 2: External systems to interface with MMS**

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Trns*port suite of software: Proposal and Estimates System (PES)/Letting and Awards System (LAS), Construction Administration System (CAS) | The PES, LAS or CAS may need to interface with the MMS to provide MMS with initial materials estimates to generate a testing guide, based on estimated quantities and the frequency guide. The CAS may need to interface with MMS to obtain test results to generate pay estimates, or this information may be available in MCMS. | Unidirectional |
| Maryland Construction Management System (MCMS) | MCMS is the construction management system used by SHA, and the MMS may need to interface with MCMS to share data, including contractor payment data, and daily work reports. It is anticipated that MCMS Navigator will be the source of MCMS information. | Unidirectional |
| RIDETOOL | RIDETOOL is used to capture and access ride quality of new pavements and is used to calculate incentive payments based on ride quality. | Unidirectional |

| Existing Systems | Purpose/Requirement | Data Flow |
|---|---|---|
| Financial Management Information System (FMIS) | The MMS and FMIS will need to interface with each other to obtain cost per test data, charge codes. Effort will be made to use interfaces that already exist and are being used for various purposes. It is anticipated that more than one existing interfaces will be used to meet MMS needs. | Unidirectional |
| Geosystem | Geosystem calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. | Unidirectional |
| Humboldt Triaxial Data Acquisition | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. | Unidirectional |
| Maryland Product Evaluation List (MPEL) | MPEL is a web based system used to determine eligibility of new products. | Unidirectional |
| Pavement Management System | This system maintains an inventory of pavement on Maryland roads and is currently under redevelopment. | Unidirectional |
| HISD Database | This database stores all the existing road location information (e.g. milepoints) and will provide this information to MMS. | Unidirectional |
| gINT | This system records soil data, including soil borings data. | Unidirectional |
| Asphalt Test Systems (TBD) | The asphalt test systems record test data for asphalt tests. | Unidirectional |

An Asset Data Warehouse (ADW) system is in the planning and requirements analysis phase and is planned to allow storage and retrieval of all data related to SHA's transportation assets. The ADW is anticipated to interface with the MMS in the future. The details of the interface will have to be identified during later phases of both projects to account for the schedules.

Exhibit 3 below details the projects as a part of which the interfaces are planned to be designed.

**Exhibit 3: External Systems Interfaces by Project**

| Project | Interfaces |
|---|---|
| Project I: System Management, Project Information, and Source of Supply | Trns*port PES, LAS, or CAS as required<br>MPEL<br>FMIS |
| Project II: Base Laboratory Information Management System | MCMS or CAS as required |
| Project III: Aggregates/Soils, Pavement, Geotech, Field Exploration Labs | GeoSystem<br>Humboldt Triaxial Data Acquisition<br>gINT |
| Project IV: Concrete/Chemical Lab | |
| Project V: Asphalt Lab | RIDETOOL |
| Project VI: Structural Lab | |
| Project VII: Materials Clearance | MCMS |

## 1.4 Points of Contact

Exhibit 4 below identifies the key points of contact for the Materials Management System Project.[c]

**Exhibit 4: Points of Contact for MMS Implementation**

| Office | Project Role<br>(Project Manager, Business Lead, Project Sponsor, etc.) | Contact Person and Information |
|---|---|---|
| Office of Materials & Technology (OMT) | Project Sponsor<br>Business Lead<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member | Tim Smith, SHA<br>Benjamin Gilardi, SHA<br>Woody Hood, SHA<br>Gregory Moore, SHA<br>Paul Finnerty, SHA<br>Jeff Withee, SHA<br>John Weisner, |
| Office of Information Technology (OIT) | Project Steering Committee Member<br>Task Order Manager, Project Coordination Team Member<br>Project Manager | Jim Yarsky, SHA<br>Glenn Donithan, SHA<br>Lee Youngblood, SHA |
| Vendor<br><br>Consultant:<br>Planning and Requirements Phase | Consultant Program Manager<br><br>Consultant Project Manager | |

[c] For a list of contacts specific to Project II, see appendix Exhibit A-1.

| Office | Project Role (Project Manager, Business Lead, Project Sponsor, etc.) | Contact Person and Information |
|---|---|---|
| Office of Construction (OOC) | Project Steering Committee Member<br>Project Coordination Team Member | Mark Flack, SHA<br><br>Paul Gudelski, SHA |
| Office of Finance (OOF) | Project Coordination Team Member<br>Project Coordination Team Member<br>Project Coordination Team Member | Betty Conners, SHA<br><br>Janet Irvin, SHA<br><br>Bill Bertrand, SHA |
| District 5 | Project Steering Committee Member | Jamie Folden |

## 1.5 Document References

This section contains a bibliography of references used to produce this document. The key project references specific to this project are listed below:

- MMS Project Charter (January 2008)
- System Concept Proposal (January 2008)
- Materials Management System Strategic Plan (January 2007)
- Maryland's 2007-2012 Consolidated Transportation Program http://www.mdot.state.md.us/Planning/Plans%20Programs%20Reports/Programs/CTP%2007-12/Cover_ToC/Table%20of%20Contents
- Code of Federal Regulations, Title 23, Part 637, "Construction Inspection and Approval."
- MDOT Information Systems Security Plan http://www.e-mdot.com/Contract_Opportunities/Documents/MDOT%20IT%20Security%20Plan.doc
- Maryland Department of Information Technology Security Policy and Standards http://doit.maryland.gov/support/Pages/SecurityPolicies.aspx
- SHA Computer Architecture Standards for Information Technology
- Maryland Department of Transportation State Highway Administration Mission and Vision Statements and Values http://www.sha.state.md.us/aboutus/orgChart/OC/missionvision.asp
- SHA Materials Management System Project: System Boundary Document (May 2008)
- SHA Materials Management System Project: Risk Management Plan (May 2008)
- SHA Materials Management System Project Management Plan (September 2008)

# 2 PROCESS OVERVIEW

## 2.1 Overview

This section presents the process overview for Project II (Base Laboratory Information Management System). The scope for Project II includes creating a base Laboratory Information Management System (LIMS) for all OMT labs. This base LIMS will support logging the sample, identifying specimens, assigning tests and staff, reviewing test backlog, creating a generic test screen to record test results, recording test equipment's calibration log, and recording cost per test. Detailed test data entry screens along with incentive/disincentive calculations for each lab will then be created as a part of lab specific projects. Since there is not one system that is used by all SHA division laboratories to log and monitor samples, there is no "as-is" state for a base LIMS. The future state, described in section 2.2 below details the base LIMS process for all OMT divisions.

## 2.2 Base LIMS Process

As mentioned in section 2.1 above, there is currently no shared LIMS at SHA OMT and consequently, no "current system" exists. Each laboratory has a series of stand-alone and offline processes, databases, and systems that incorporate similar components but are unique to each laboratory. In the current system, each lab has separate means to providing similar laboratory functions. These common functions will comprise the future state base LIMS which will be adopted and shared among the SHA laboratories and accessed through MMS. Specific requirements unique to individual labs will be addressed as part of projects 3-6.

The Future State process maps in section 2.2.2 provide an overview of what the LIMS business process will look like after implementation of MMS.

### 2.2.1 Process Improvements

During the review of the as-is process, the interview participants identified a number of improvement opportunities to be incorporated in the future state process. These improvement opportunities were discussed with the participants during the future state meetings and were defined in further detail. These opportunities are mentioned below.

- **Unique identifier for samples.** Having a unique identifier tied to each sample, either as a bar code, a serial number, or both, will help reduce double entry of sample and project data (once in field, and once in the lab). This unique identifier will be assigned to the sample at the first login to the MMS, either at the field or in the lab. As the sample moves through its testing workflow, more information can be added to the sample that can all be retrieved using the unique identifier/serial number. This will help identify the sample and will avoid re-entering information when the sample is received at the lab from the field or sent to another lab for testing.

- **Flag samples with incomplete information.** The ability to flag samples that have incomplete information, record the type of information missing, and inform the relevant parties automatically will help resolve such issues proactively and reduce sample testing turnaround time.

- **Assign properties to samples.** The ability to assign tests, testers/testing groups, priority, and other properties to the samples will make it easier for the technicians to know the work associated with each sample and prioritize their work load. This information, combined with reports, will enable managers to view the backlog of tests and to re-prioritize if necessary.

- **Results distribution.** The ability to release results to the relevant parties upon completion of testing via an email distribution list will allow the faster and more accurate distribution of results.

- **Real time/near real time access to data.** The large volume of phone calls to OMT requesting information on sample status will be reduced if the PEs, contractors, and suppliers can access this information online in real time or near-real time. The information available to non-OMT employees will be restricted to high level sample status categories such as “received,” “in progress,” “tested” etc. The participants also indicated that the functionality to provide comments for the outside parties should be provided to present additional information as needed.

- **Request QC data from contractors for ride smoothness.** Participants indicated that obtaining QC data related to ride smoothness can be obtained directly from the contractor rather than from the PE, thus reducing some of the burden on the PE, and allow the OMT testers to interface directly with the contractors. It will be important in such a case to keep the PE informed, and OMT may need to interface with the PE if the contractor does not respond in a timely fashion.

- **Plant inspection schedule/calendar.** The incorporation of an inspection schedule/calendar in MMS will allow OMT to determine the next inspection required for the plant based on both production quantities and time elapsed since last inspection.

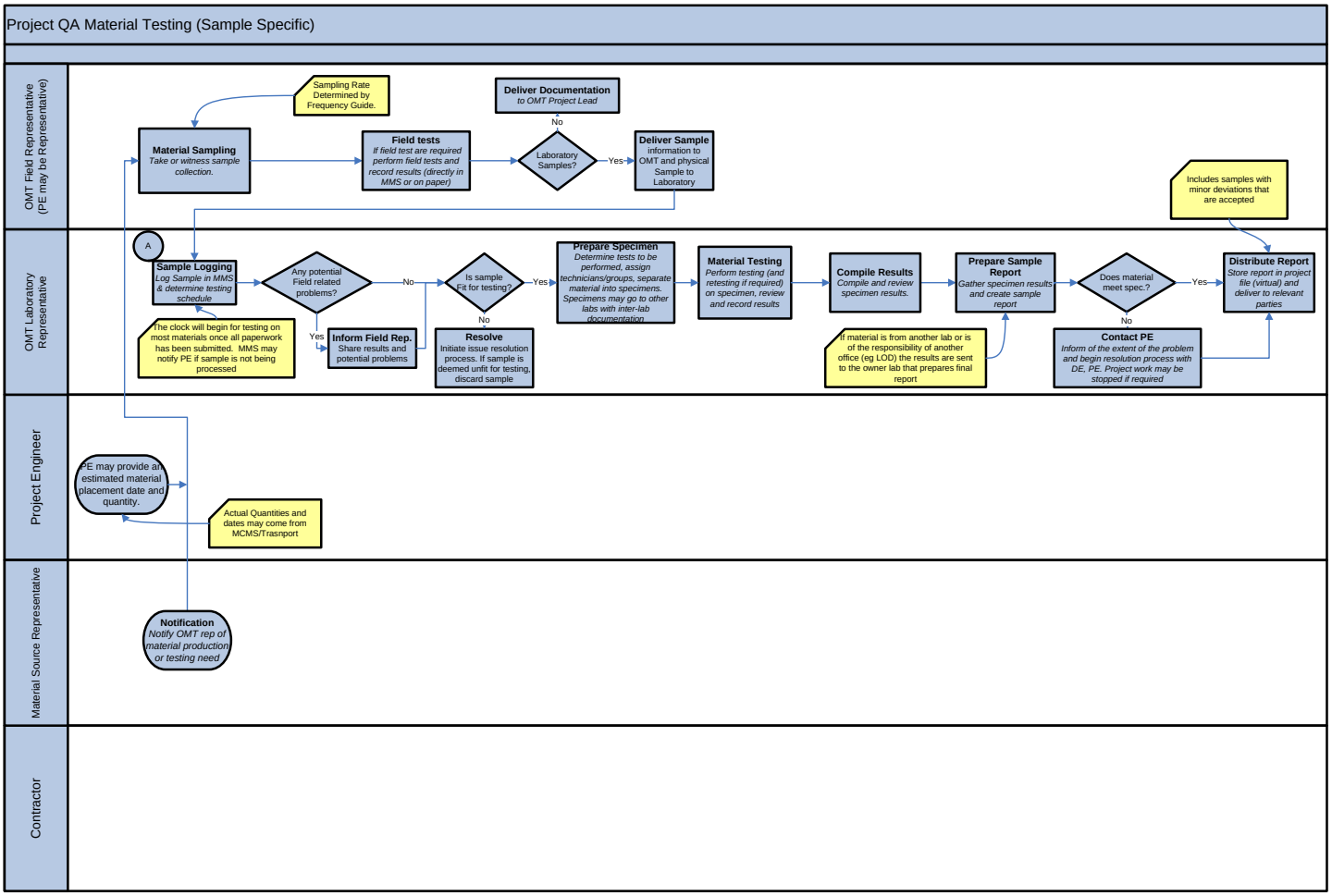
### 2.2.2 Future-State Processes

The future-state processes for the LIMS are detailed below.

**Project QA Material Testing (Sample Specific)**

Exhibit 5 below details the process for project QA material testing of sample specific projects. The majority of testing at OMT follows this process.

## Exhibit 5: Project QA Material Testing (Sample Specific)




The project QA material testing process begins when a material source representative notifies the OMT field representative/ Project Engineer of production or testing needed. Notification can be sent to the OMT representative directly through MMS. The PE may provide an estimated material placement date and quantity (input directly to MMS) to determine when the field representative will need to be on the field to collect the sample or witness sample collection. The OMT Field Representative takes or witnesses sampling as appropriate. The sampling rate for the material is determined by the project specific frequency guide (Project sampling guide). The sampling guides for all projects as well as all versions of frequency guides are stored in and are accessible via MMS.

If the material requires field testing, the tests are performed at this point. Test results at this point can be recorded directly to MMS, recorded in an offline MMS module, or on paper to be input into MMS at a later time. The mode of recording results will depend on internet connectivity and hardware available at the project site. If laboratory samples are taken at site, the OMT Field Representative is responsible for delivering the physical samples and sample information to the laboratory. If laboratory samples are not required, the documentation is delivered to the OMT Project Lead. The project lead is normally the Area Materials Engineer (AME) on construction projects, or the design engineer for preliminary engineering projects.

When samples are received at the OMT laboratory, they are immediately logged into MMS as received.

The OMT timeline for testing materials begins when all paperwork has been submitted to OMT. MMS will generate an alert if the sample is received but not in the test pipeline due to incomplete documentation. If there are any field related problems associated with the sample, the field

representative will be notified by OMT staff. If the sample is not fit for testing in any other way, a resolution process is initiated and the sample is discarded if it is not fit for testing.

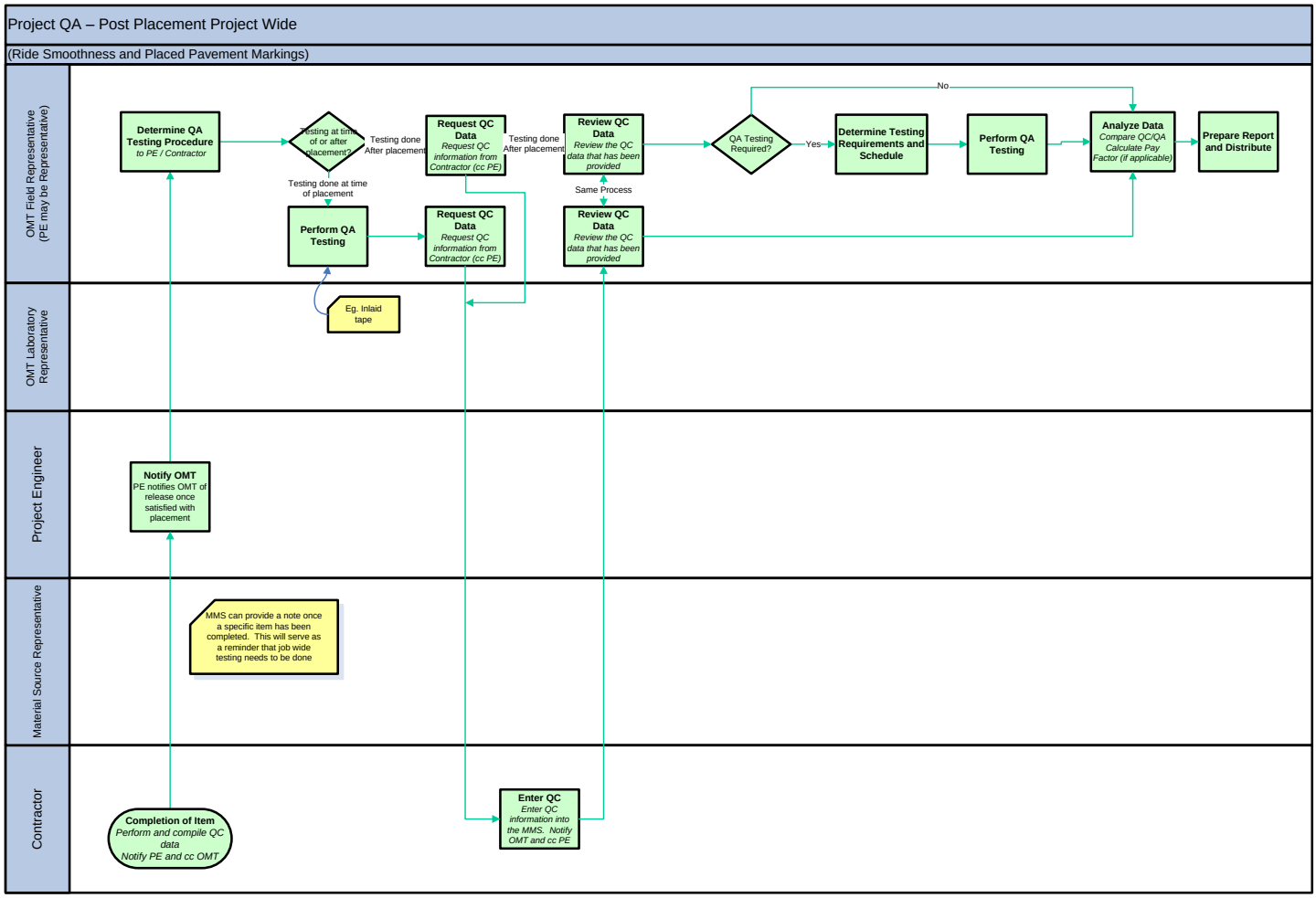
If the sample is fit for testing, the sample is split into specimens as necessary. The OMT lab determines the appropriate tests to be performed, technician assignments, and the priority for each specimen. The specimen may go to another lab than the one receiving and logging the sample depending on the tests required. The technician then performs the material testing (and retesting if necessary). The technician records the results directly to MMS at this point. OMT representative then compiles specimen results, calculates the pass/fail result for the sample, and generate a sample test report. If the material sample is tested by an outsourced laboratory, or another OMT division, it is the responsibility of the other lab/division to ensure that results are sent to the OMT lab representative and are input into the MMS.

If the material meets specifications, the report is released and distributed to the appropriate parties. The report and information can be distributed directly through MMS. If the material does not meet specifications, the PE is contacted (via MMS) and informed of the problem. A resolution process begins and work on the project may have to be stopped depending on the severity of the failing results.

**Project QA- Project Wide (Post Placement Activities)**

Exhibit 6 below details the process for Project QA for project wide post placement activities. This process represents activities for reviewing and accepting pavement ride smoothness and placed pavement markings (typically after asphalt or concrete have been placed on project). These activities include recording and checking pavement smoothness and calculating pay factors as well as ensuring the proper reflectivity of pavement markings and associated pay factor calculation.

## Exhibit 6: Project QA- Post Placement Project Wide




The process begins when the contractor notifies the OMT Field Representative/PE when pavement placement is completed. The contractor is additionally responsible for compiling any QC data and providing the data to the OMT representative. The PE reviews completion of the item and notifies the OMT of satisfactory completion if appropriate. The OMT Field Rep then determines if QA testing is required, and if the testing is required at the time of placement or after placement.

For items where testing is done after placement, the OMT reviews the QC data provided by the contractor directly through MMS. If additional QC data is needed, it is requested at this point. The OMT representative then determines if QA testing is required. If QA testing is required, the OMT representative determines testing requirements and scheduling. The appropriate tests are performed, and results are entered directly to MMS. The OMT Representative analyzes the data and compares the QA data with QC data from the contractor. At this point, the OMT Representative will calculate pay factors as applicable. A report detailing all of this information will be prepared directly through MMS and distributed to the appropriate parties via MMS. If QA testing is not required (based on contractor's results history or other reasons), the OMT Representative reviews the data provided by the contractor and distributes pay factors and reports to appropriate parties via MMS.

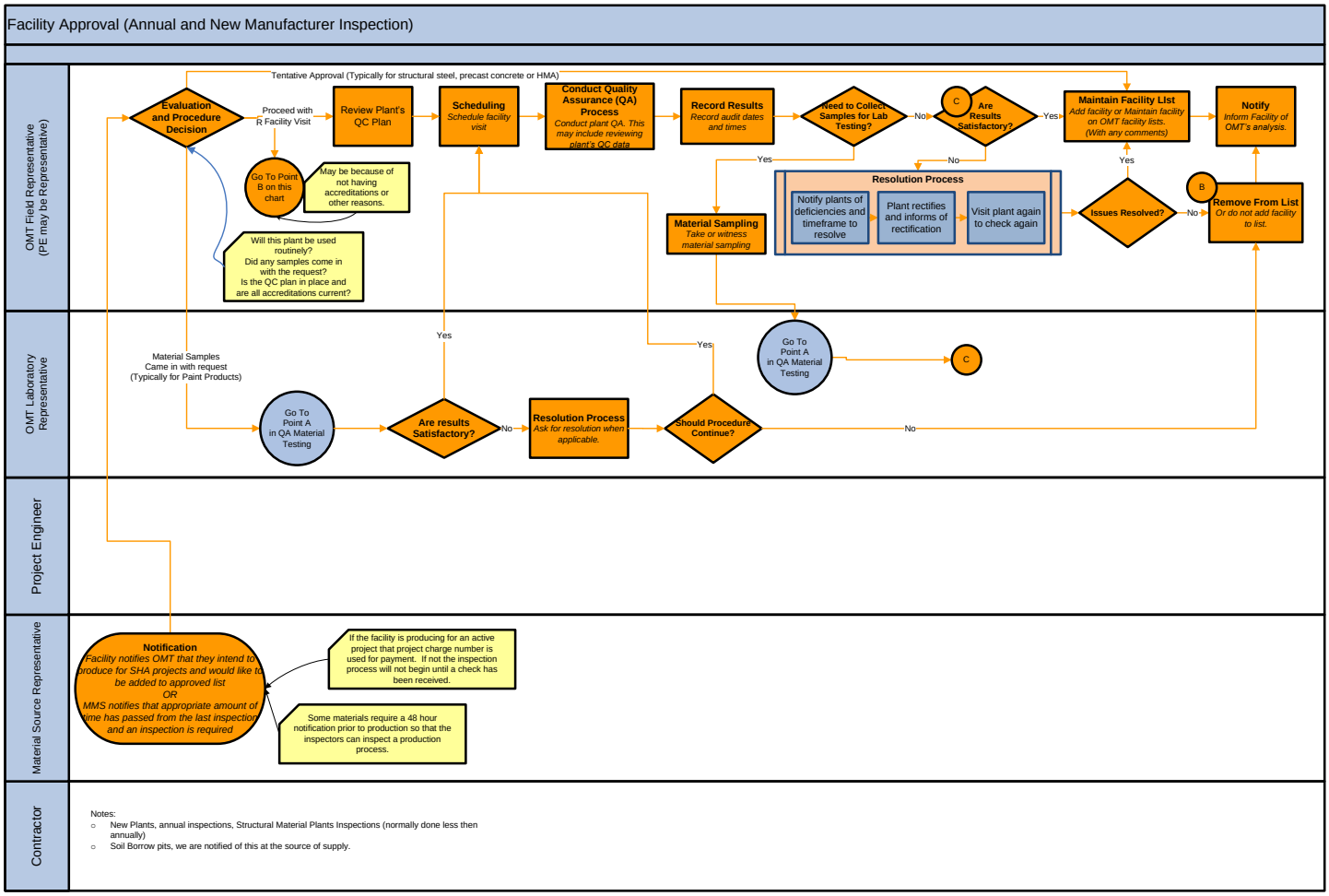
For items where testing is done at the time of placement (such as inlaid tape), QA testing is performed simultaneously with completion of the item. The OMT Representative requests QC information from the contractor and CCs the PE. The contractor enters the QC information directly to the MMS which triggers notification to the PE and OMT Representative. The OMT Representative reviews the submitted material to ensure that all information has been submitted. At this point, the OMT Representative analyzes the data and compares the contractor QC data with the OMT's QA results. The OMT

representative calculates pay factors if applicable. A report detailing all of this information is prepared, directly through MMS, and distributed to the appropriate parties via MMS. If QA testing is not required, the OMT Representative reviews the data provided by the contractor and calculates and distributes pay factors and reports to appropriate parties via MMS.

## Facility Approval (Annual and New Manufacturer Inspection)

Exhibit 7 below details the process for Facility Approval (Annual and New Manufacturer Inspection)[d]. This is the process to follow for a plant to be added to the approved list for the first time, or for annual approval of the facility to remain on the approved list.

**Exhibit 7: Facility Approval (Annual and New Manufacturer Inspection)**




This process begins when the Materials Source Representative notifies the OMT Field Representative/PE that they would like to be added to SHA's approved list of plant to either produce for an active project, or for future projects (planned or unplanned). The process can also begin when it is determined that the required amount of time has passed since the last inspection for a facility[e]. If the facility is producing for an active project, SHA time is charged to the active project. If the facility is not producing for an active project, the plant sends in payment for the inspection, and the inspection process will not begin until the payment has been received.

---

[d] New plants, annual inspections, structural material plants inspections are all normally performed less than annually. Soil Borrow pits request facility approval at the source of supply.

[e] Some materials require a 48 hour notification prior to production so that the inspectors can inspect a production process.

Once the payment for inspection is received, OMT field representative evaluates the request to determine if the plant will require a tentative approval, plant visit, visit with sample testing, or rejection based on information submitted. The tentative approval is typically granted when either the plant will be producing for only one project and there are no plans for future work, or when the plant is waiting for a certification of accreditation or other documentation needed for final approval. If tentative approval is granted, the facility is notified that they may proceed with production.

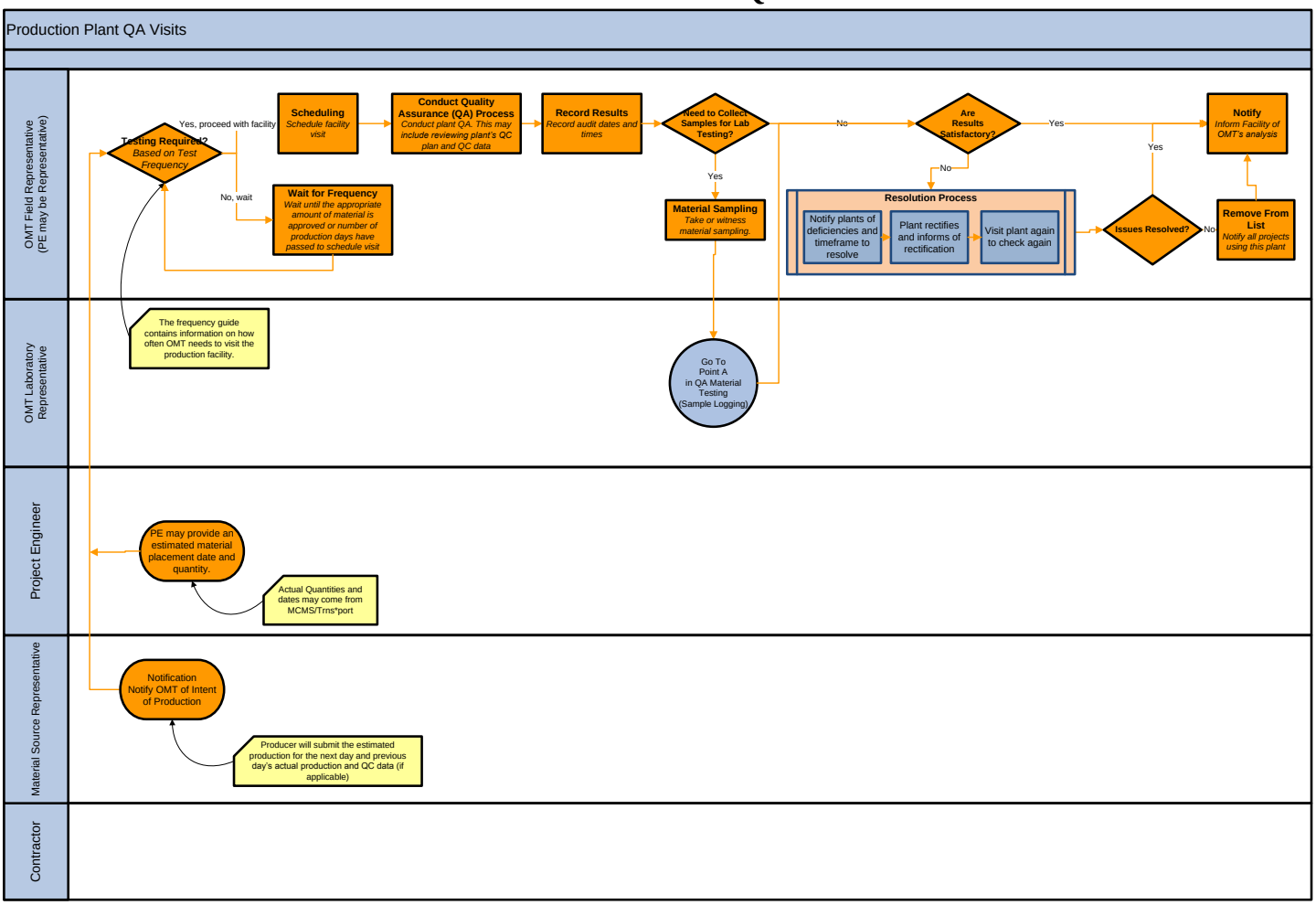
If the facility requires a visit, OMT first reviews the plant's QC plan. Once the QC plan is reviewed and is found acceptable, a plant visit is scheduled. If the QC plan is not found acceptable, revisions are requested before scheduling a visit. At the facility visit, the representative conducts plant QA process that may include reviewing plant's QC reports. Once the plant visit is completed, all the visit results will be stored in the MMS with the audit date and times. If laboratory testing is required, the representative takes or witnesses sampling and sends the samples to appropriate division lab for testing. From this point on, the process follows Point A in QA Material Testing (Exhibit 5). Once the sample results (if applicable) are received, the OMT representative determines if the sample results as well as the audit visit results are acceptable. If either of the result is found to be unacceptable, a resolution process is started with the plants to resolve the issues if possible. This process involves the plant being notified of the deficiencies, the plants rectifying the issues, and OMT reviewing the changes (may require another plant visit). If the issues are successfully resolved, the plant is added to the approved list or updated on the approved list as applicable. If the issues cannot be successfully resolved, the plant is either not added or removed from the approved list as applicable. The OMT will have the option in MMS to add comments/notes at any point in review. These comments are stored in the files associated with the facility.

If Material Samples came in with request (typically for paint products), the process immediately proceeds to Point A in QA Material Testing (Exhibit 5). Once this process is complete, the OMT lab representative reviews the results to ensure they are satisfactory. If the results are satisfactory, the OMT field representative schedules facility visit and the process picks up from there. If the results are not satisfactory, the resolution process begins (if applicable). If the process is resolved, scheduling facility visits proceeds. If issues are unresolved, the facility is moved from the approved list.

**Production QA Visit Process**

Exhibit 8 details the Production QA Visit process. This process refers to the regular visits to manufacturing and production plants to conduct Quality Assurance activities. These activities include reviewing the QC plan, QC results, and completing a checklist of activities and inspections to ensure plants are properly producing. Any noted problems must be resolved before the plant can be approved/reapproved.

## Exhibit 8: Production QA Visit



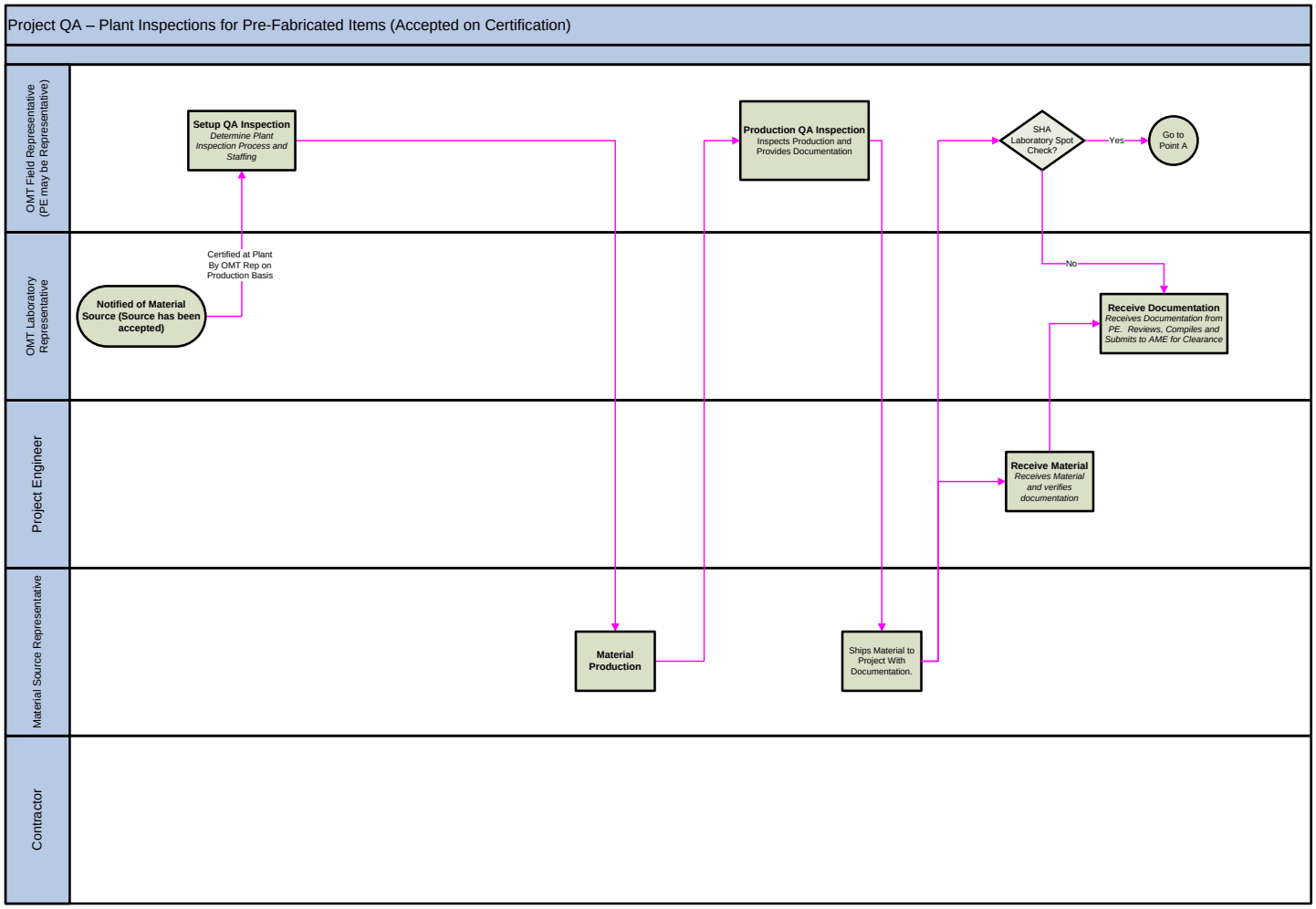

This process begins when the Material Source Representative notifies (via MMS) OMT of the Intent of Production. The producer will submit the estimated production for the next day and previous day's actual production as well as QC data directly to MMS, if applicable. The OMT Field Representative, who may be the PE, determines whether or not testing is required. This is determined by consulting the frequency guide, access to which is available through MMS. If the frequency of production has not been met, the OMT waits until the appropriate amount of material is approved or until the appropriate number of production days have elapsed. If the frequency has been met, the OMT Field Representative proceeds with scheduling the facility visit.

The representative conducts the appropriate QA process, which follows the same process steps as for approving a new plant.

### <u>Project QA- Plant Inspections for Pre-Fabricated Items (Accepted on Certification)</u>

Exhibit 9 details the process for Project QA for pre-fabricated items. This process is to be followed in situation when inspectors are present at the plant during production of pre-fabricated materials. The inspectors then certify the manufactured items which are now considered approved for use on specific projects. Typical certified materials include concrete structures such as noise walls or other structural materials such as prefabricated beams.

## Exhibit 9: Project QA- Certified Materials (Plant Inspection Required)




This process begins when the OMT Laboratory representative notifies the OMT Field Representative that the material source has been approved for use on the project. The material has to be certified at the plant by an OMT representative at the time of production. The OMT field representative determines the plant inspection process and staffing and schedules QA inspection based on production schedule provided by the source. The production QA inspection occurs when the material is produced. The inspector reviews the QA checklist, reviews the QC results as appropriate, and documents all production information in MMS (or on paper to enter later in MMS). If all the results and procedures are found satisfactory, the OMT representative certifies the material. This material is then shipped to the project site with a copy of the certification.

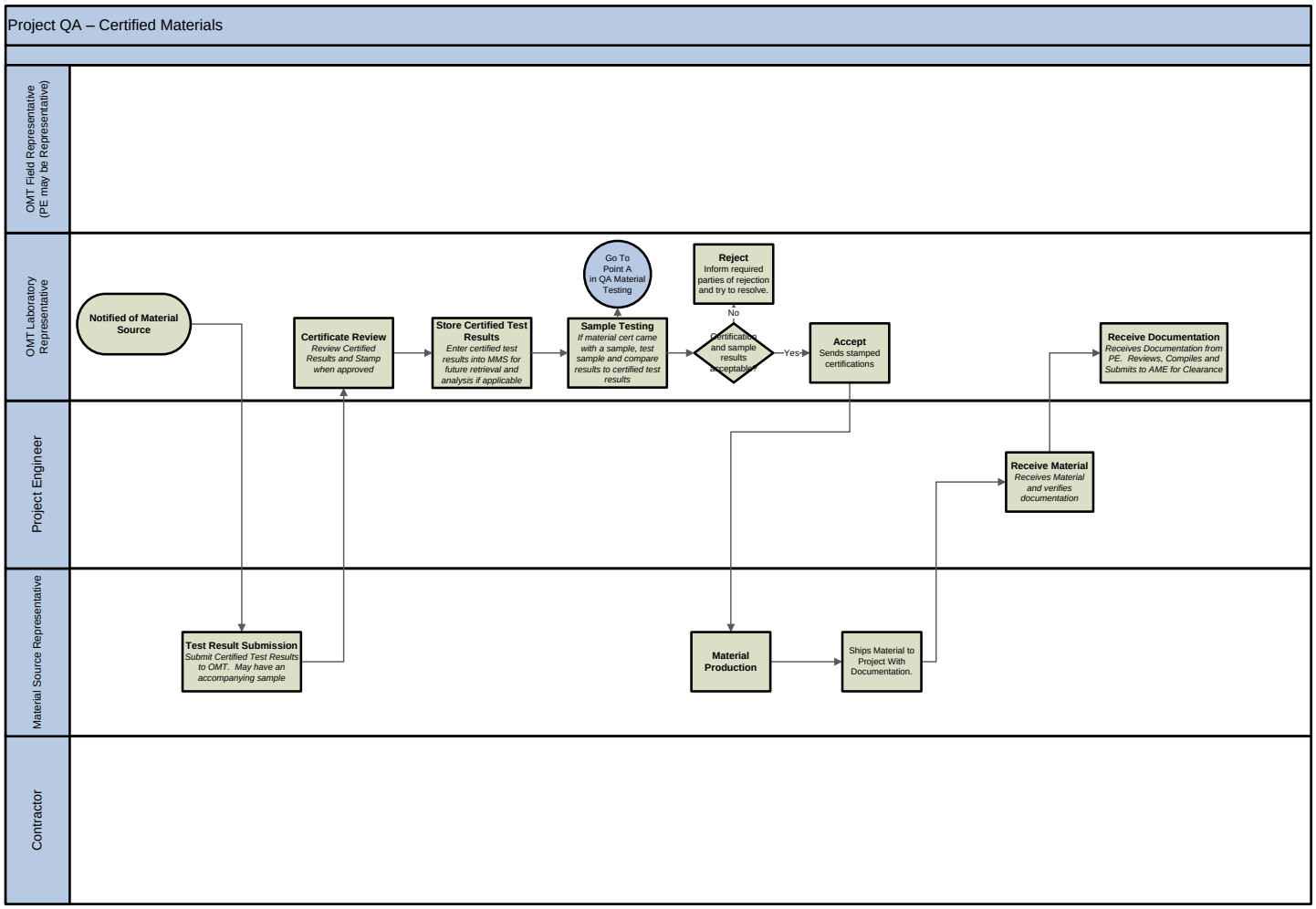
At this point, OMT may perform a laboratory spot check if required. If a spot check is to be conducted, the process proceeds at Point A on the Project QA Material Testing Process- Sample Specific (Exhibit 5).

The project engineer at the project site receives the material and verifies the accompanying certification/documentation. The OMT lab representative receives documentation from the PE, reviews the documentation and prepares reports as necessary. The OMT lab representative may release this information to the AME for clearance. The information can be released via MMS.

## Project QA- Certified Materials

Exhibit 10 details the process for Project QA- Certified Materials. This process is followed for materials that are accepted on certification only and do not require an OMT representative present at the plant during production, such as paint.

**Exhibit 10: Project QA- Certified Materials**




This process begins when the OMT laboratory is notified of material source. The material source representative submits certified test results to OMT. These results may be accompanied by a sample. The OMT laboratory representative reviews the certified results and approves/disapproves the certifications. These results are stored to MMS for future retrieval and analysis.

If material certification came with a sample, the sample will be tested and results compared to the test results on certificate. This process follows Point A in QA Material Testing (Exhibit 5). If the certification does not meet approval, the material is rejected and a resolution process may begin. If the certification meets approval, the material is accepted. The OMT lab representative sends the stamped certifications (these may be electronically approved) to the material source representative. Once the project source is approved through the steps mentioned earlier, the plant can begin production. The material is shipped after production with the appropriate certification and certified test results. The Project Engineer receives the material and verifies the documentation. The OMT Laboratory Representative receives this documentation from the PE. The OMT laboratory representative reviews, compiles, generates reports, and submits this information to the AME for clearance.

# 3 FUNCTIONAL REQUIREMENTS

The functional requirements describe the core functionality of the application. This section includes the data and functional process requirements and presents a high level logical data model for generic LIMS. This data model includes elements of Project 1 high level data model that will be integrated with Project 2.

Exhibit 11 below presents the logical data model for Project 2, while Exhibit 13 presents the functional requirements.

**Exhibit 11: High Level Logical Data Model**

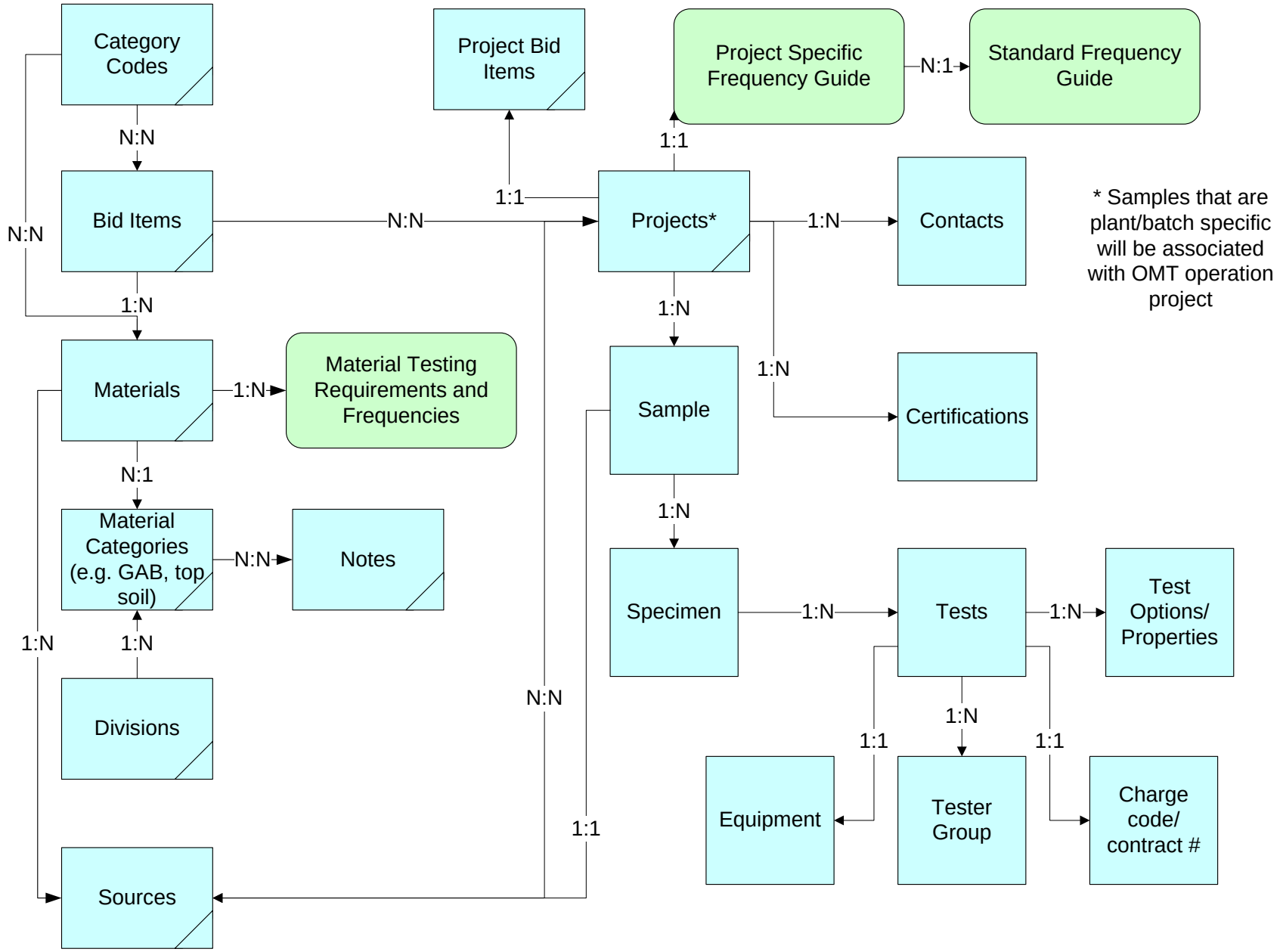


Exhibit 12 below presents the priority definitions used for the functional and operations requirements in this document.

**Exhibit 12: Priority Definitions**

| PR Rank | Definition |
|---|---|
| Mandatory | A priority of mandatory identifies a critical business need. The system must fulfill these needs. |
| Desirable | A priority of desirable identifies requirements that are important but are optional. A desirable ranking would mean "Like to Have" but not prevent selection of a chosen solution if that solution could not fulfill the requirement. |

The requirements below are primarily broken down into Material Testing, Certification based Approval, Plant Review, Reporting, Other, and MMS-Wide requirements. All requirements below except MMS-Wide requirements apply specifically to Project 2, while the MMS-wide requirements will apply to multiple projects from Project I through Project VIII, though all requirements may not apply to a specific project (including project 2).

**Exhibit 13: Functional Requirements**

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| **Material Testing** | | | | | | |
| 001 | **Material Testing** | **1. Sample Login** | MT01 | Ability to automatically assign a serial number to the sample when a sample is logged in to the system. The serial number assigned should be such that the OMT division can be identified by looking at the serial number. For example, all asphalt samples may end with an A, or start with a "4." | Mandatory | |
| 002 | Material Testing | 1. Sample Login | MT02 | Ability to automatically assign a serial number to the specimen when a specimen is logged in to the system. The specimen number will be tied to a unique serial number, and multiple specimen number can be tied to one serial (sample) number. For example, a concrete "sample" may consist of two or more "specimens" (cylinders) for testing. | Mandatory | |
| 003 | Material Testing | 1. Sample Login | MT03 | Ability to enter and store project number, project name, appropriate division, mix design #, etc. to each sample when entered in the system. All this information should be automatically populated for all specimens based on the samples they are linked to. | Mandatory | |
| 004 | Material Testing | 1. Sample Login | MT04 | Ability to enter other parameters to sample and specimen information like sample condition, test type, test values, test result (pass/fail/other), charge code, ship date, etc. either at first sample login or later on during the process. | Mandatory | |
| 005 | Material Testing | 1. Sample Login | MT05 | Ability to record the sources of the material that is being sampled for each sample collected. Some of the materials may have more than one source approved for the project. For example, the sample login screen will provide a drop down menu with approved sources for the project from which the applicable source can be selected, but also have a text box to record the source if the source is not yet an approved source. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 006 | Material Testing | 1. Sample Login | MT06 | Ability to validate sample information and flag when required information is not provided. The system will need to flag the sample as "incomplete" in such a case. The system should also allow the user to enter the type of information that is missing - this information should be available as a drop down menu (from a pre-populated table) but also allow the user to enter another value. | Mandatory | |
| 007 | Material Testing | 1. Sample Login | MT07 | Capability to generate alert when a sample is flagged as not fit for testing (e.g. having incomplete information, incorrect size), along with additional notes (e.g. information that is missing (paperwork, improper sampling, etc.)). This alert should be in the form of an email that can be sent out to a distribution list including the contractor and the PE as applicable. | Mandatory | |
| 008 | Material Testing | 1. Sample Login | MT08 | Ability to send automatic reminders when sample information is missing at user-specified intervals. The intervals should be separately specified for each division. | Mandatory | |
| 009 | Material Testing | 1. Sample Login | MT09 | Capability to mark when sample information received for inter-lab tests is not accompanied by a sample. This is to prevent situations when a sample is tested by one lab, and the information is transferred but the actual sample is not transferred in a reasonable time frame (for multiple tests to be performed on the same sample/item). | Mandatory | |
| 010 | Material Testing | 1. Sample Login | MT10 | Ability to mark the status of the sample in the system. The status would include "recorded at field," "shipped to lab," "received by lab," "test complete," "results approved," "results received" and others as determined by the divisions. The sample should automatically have a time stamp associated with it when the status of the sample is updated in the system. | Mandatory | |
| 011 | Material Testing | 1. Sample Login | MT11 | Capability to record shipment date for samples that are collected at remote locations and shipped to OMT lab. This will allow the labs to note how long it took to receive the sample. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 012 | Material Testing | 1. Sample Login | MT12 | Ability to login a sample offline and import the information in to MMS when connected to the internet/intranet. This will be very important for remote locations or sample collected at the plants where no internet connectivity is available. The offline data entry tool could be a module of the MMS or a complex spreadsheet whose import will be supported by the MMS.<br>This will also require the MMS to set aside a number of serial ids/numbers for offline use that will be tracked as such. | Mandatory | It is envisioned that samples collected and recorded offline will have an "offline" serial number, and will be assigned an MMS serial number when the sample information is uploaded to MMS. |
| 013 | Material Testing | 1. Sample Login | MT13 | Capability to print a serial number that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, enter the serial number, and will be able to pull up all relevant sample information. | Mandatory | |
| 014 | Material Testing | 1. Sample Login | MT14 | Capability to print a barcode that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, scan the barcode, and will be able to pull up all relevant sample information. | Desirable | |
| 015 | Material Testing | 1. Sample Login | MT15 | Ability to retrieve sample information based on serial numbers attached to samples. This will allow the labs to retrieve information and not reenter information that has already been gathered on the field. | Mandatory | |
| 016 | Material Testing | 1. Sample Login | MT16 | Ability to record data from barcode readers and retrieve sample information based on the barcode attached to samples. This will help prevent the same duplication mentioned above, with the additional benefit of not needing to enter the serial number. | Desirable | |
| 017 | Material Testing | 1. Sample Login | MT17 | Capability for the tester or inspector to capture test and inspection results offline for instances where worksheets/forms and other manual media are used to document the test/inspection results and export them back to MMS via an email, scan, or other method. It is necessary to accommodate field input to MMS in a robust way. All plant test and inspection work is done by field forces. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 018 | Material Testing | 1. Sample Login | MT18 | Ability to record material placement location for test samples in multiple coordinate systems. This will require the use of multiple fields with information stored in a table that will be accessed by an Asset Data Warehouse (ADW) or a GIS system in the future. This feature will allow SHA to back track the test results for a particular location in case of any issues. | Mandatory | |
| 019 | Material Testing | 1. Sample Login | MT19 | Ability to allow the Project Engineer to trigger a particular workflow once project information is received. For example, the Project Engineer may receive notification of completion of placement from the contractor and may need to trigger the inspection workflow. | Mandatory | |
| 020 | Material Testing | 1. Sample Login | MT20 | Ability to request QC data from the contractor or PE and store the information in the system. | Mandatory | |
| 021 | Material Testing | 1. Sample Login | MT21 | Ability to note the purpose of the sample. For example, the sample might be for QA, or for plant acceptance, or for informational purposes. This will also determine where the sample's cost to test will be charged. | Mandatory | |
| 022 | Material Testing | **2. Prepare Specimen** | MT22 | Ability to split samples into multiple specimens and assign properties to the specimens (tests to be performed, etc.) For example, a concrete "sample" received will consist of two or more cylinders, where each cylinder is equivalent to one "specimen." | Mandatory | |
| 023 | Material Testing | 2. Prepare Specimen | MT23 | Capability for managers to assign tests to specimens and samples. Managers will have the ability to assign tests from a pre-defined list of tests. Managers should be able to assign tests from different divisions for inter-lab samples (e.g. chemical samples). Such assignment should automatically trigger an alert in the form of an email to the recipient division. | Mandatory | |
| 024 | Material Testing | 2. Prepare Specimen | MT24 | Ability to assign task options to samples or specimens. These options may include "complete by," "test on," etc.<br>A "test-on-date" refers to a schedule of tests to be performed on samples. For example, concrete samples received by the lab are assigned a "test-on-date" based on 3-day, 7-day or 28-day strength testing to be performed. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 025 | Material Testing | 2. Prepare Specimen | MT25 | Ability to assign comments to each sample/specimen at test assignment that are visible to the testers (including specific instructions for specimen/sample storage). These notes may provide specific instructions relevant to the sample/specimen like test using a particular equipment, etc. These comments should be printed in a bigger font/different color to make it clearly visible. | Mandatory | |
| 026 | Material Testing | 2. Prepare Specimen | MT26 | Ability to assign testers or groups of testers to each sample/specimen from a drop down list. This assignment should automatically trigger a notification to the tester or the test group as appropriate. | Mandatory | |
| 027 | Material Testing | 2. Prepare Specimen | MT27 | Ability to assign a priority rating between 1 (Very Low) and 5 (Very High) to samples. This will allow testers to prioritize testing within their backlog and result in efficient communication within the labs. | Mandatory | |
| 028 | Material Testing | **3. Record Test Results** | MT28 | Ability to log test performed for each sample in the system. The test login screen should provide a drop down with all tests, so the right test can be selected from the menu. The test fields should allow the testers to enter the field names for the recorded parameters, and the recorded values. The screen should also allow the tester to record the pass or fail result for the test if applicable. | Mandatory | |
| 029 | Material Testing | 3. Record Test Results | MT29 | Ability to retrieve test results for a particular sample or specimen to add more test information to the sample/specimen if applicable. For example, a tester may perform some tests on the specimen one day and other tests on the other day, and may want to record them at the time of testing. | Mandatory | |
| 030 | Material Testing | 3. Record Test Results | MT30 | Ability to allow outsourced labs restricted access to the system to enter test results. The outsourced labs will be allowed to only enter test results for tests and projects assigned, and not be able to view any other information in the system. This should be accomplished through a web based interface to the MMS. | Mandatory | |
| 031 | Material Testing | 3. Record Test Results | MT31 | Ability for batch entry of lab results from outsourced labs. For example, some lab work is outsourced to provide specialty testing. Providing an automated entry portal for the outsourced contractor would speed up that process. The outsourced labs shall have restricted access. | Mandatory | This capability is more critical at the labs level. For Project 2, the information to be imported will be high level test information |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 032 | Material Testing | 3. Record Test Results | MT32 | Ability to enter test results through a web based interface outside SHA intranet. This capability is critical for field staff and outsourced labs to record test results for tests performed on the field. | Mandatory | |
| 033 | Material Testing | 3. Record Test Results | MT33 | Capability to store contractor's/plant's QC results in the system and clearly mark them as QC results. This will enable SHA to review the QC results easily as required and compare the QA and QC results. | Mandatory | This capability is more critical at the labs level. For Project 2, the information to be imported will be high level test information |
| 034 | Material Testing | 3. Record Test Results | MT34 | Capability to compile specimen results into one sample result. This requires a separate screen that consolidates all specimen information. Pass/fail is based on tester's judgment based on specimen's pass/fail. For example, for a concrete cylinder sample, the pass/fail will depend on the average value of more than one specimen. Thus, a particular specimen might have failed, but the average will result in a passing value for the sample. This is also necessary since the approval/disapproval sent to contractor is at the sample level. | Mandatory | |
| 035 | Material Testing | 3. Record Test Results | MT35 | Ability for testers to add comments relevant to the testing process or results at the specimen level. For example, the tester may want to note certain conditions that led to the failure of the specimen. The system should provide two comment fields: one for internal use only, and one that will be accessible to the contractor. The external comment field should provide clear indication that anything entered in the field will be visible to external (Non-SHA) team members. | Mandatory | |
| 036 | Material Testing | 3. Record Test Results | MT36 | Ability to automatically record the tester's information and date and time the test result is entered in the system. The tester's information will allow SHA to differentiate between outsourced lab/tester, in-house test performed by consultant, or in-house test performed by SHA employee. | Mandatory | |
| 037 | Material Testing | 3. Record Test Results | MT37 | Ability to flag if the test time and cost are being charged to Y-B888. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 038 | Material Testing | 3. Record Test Results | MT38 | Ability to store whether a particular test is generally charged to Y-B888. | Mandatory | This capability is more critical at the labs level. The information will be populated when projects 3 - 6 are developed. |
| 039 | Material Testing | 3. Record Test Results | MT39 | The system will put in a default check mark if the test is generally charged to Y-B888, and will account for whether the project is a third party project (that does not get charged to Y-B888) and consultant technicians (do not charge to Y-B888) | Mandatory | |
| 040 | Material Testing | 3. Record Test Results | MT40 | Ability to add specific fields that can be entered on each screen (e.g. cost per test, material specification used) | Mandatory | |
| 041 | Material Testing | 3. Record Test Results | MT41 | Ability to enter the material specification and version that is applicable for a test that is performed from a drop down menu. (e.g. ASTM 392, etc.) | Desirable | |
| 042 | Material Testing | 3. Record Test Results | MT42 | Ability to reschedule tests electronically. When a test fails, the system should provide the ability for the supervisor to reschedule additional testing or request another sample from whoever provided the original sample (vendor/manufacturer/supplier/source). The original sample/specimen information should be made available to the tester on a screen based on information already present in the system. | Mandatory | |
| 043 | Material Testing | **4. Review/Approve Results** | MT43 | Capability for test approver (technician's superior) to approve results - this approval will be by material division. | Mandatory | |
| 044 | Material Testing | 4. Review/Approve Results | MT44 | Capability to approve test results if the sample does not meet material specifications, but has minor deviations. Any such approvals should be specifically noted as such in the system, along with an explanation. This approval is specifically for the test results, and indicates a recommendation for approval for the material. This should include the ability to record the approver in the system. | Mandatory | |
| 045 | Material Testing | 4. Review/Approve Results | MT45 | Capability to compare data from testing performed by construction contractors/material producers with SHA quality assurance test results. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 046 | Material Testing | 4. Review/Approve Results | MT46 | Capability to track and record all dates on which the specimens were tested, approved & released for distribution, and actually distributed to the involved parties. | Mandatory | |
| 047 | Material Testing | 4. Review/Approve Results | MT47 | Automatically update facility/product/material accepted lists upon meeting requirements for approval and upon completion of QA/QC checklist. | Mandatory | |
| 048 | Material Testing | **5. Sample Management** | MT48 | Ability to manually distribute approved test results. For example, if 3 test results are approved, for a project, the distribution trigger should send out a consolidated email with all 3 test results. | Mandatory | |
| 049 | Material Testing | 5. Sample Management | MT49 | Ability to sort tasks based on criteria such as work group, technician, work backlog, equipment/test, priority etc. This function will enable managers/supervisors to prioritize work assignments. | Mandatory | |
| 050 | Material Testing | 5. Sample Management | MT50 | Capability to view backlog of tests to be performed by multiple criteria (e.g. Division lab, aging of samples, tests to be performed, projects for which testing is to be performed), The viewing criteria shall be made available to users via pull-down menu selections. This function will allow for better performance measures within the divisions and provide data to aid in planning of the testing process. | Mandatory | |
| 051 | Material Testing | 5. Sample Management | MT51 | Ability to compare the number of samples collected (logged) for each material against the number mentioned in the project sampling plan. This will enable the teams to adjust the sampling frequency to collect more or less samples as required. | Mandatory | |
| 052 | Material Testing | 5. Sample Management | MT52 | Capability to view status of sample test progress within a division. The purpose of this function is to highlight bottlenecks or backlogs. A manager will be able to see where a sample is in a workflow process and how long it has taken for the sample to flow between tasks. | Mandatory | |
| 053 | Material Testing | 5. Sample Management | MT53 | Generate alerts that the samples can now be discarded. This will be based on user-definable business rules that will vary by each division, lab, or sample type. Managers will have the ability to override alerts or to specify destruction/retention criteria manually. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 054 | Material Testing | 5. Sample Management | MT54 | Capability for contractors to view sample and test information in MMS through a web-based interface or via another designated/restricted remote login to MMS. Contractors have a need to view status information and to input specific data for SHA action; a contractor who wants to know whether or not a product is approved can log on and see whether the sample has been logged in, if tests are pending, or if the product has been approved or disapproved. Management defines the extent of information visible to outside parties. | Mandatory | |
| **Certification Based Approval** | | | | | | |
| 055 | **Certification Based Approval** | **6. Certifications** | Cert01 | Ability to store and index all certifications/certified test results received by OMT in the system. These certifications will be stored in the MMS as electronic files (e.g. PDFs), and indexed with the various attributes (e.g. Project, manufacturer/plant, relevant division, certificate expiration date, valid quantities, etc.) | Mandatory | |
| 056 | Certification Based Approval | 6. Certifications | Cert02 | Ability for contractors/suppliers/manufacturers to request certification approval and recertification electronically through the system. The outside parties must be able to submit a certification approval request that is then reviewed by SHA. The certification approval is envisioned to be a web-based form with drop down menus and fields that the requestor can use to enter appropriate information (e.g. contact information, project number, etc.). | Mandatory | |
| 057 | Certification Based Approval | 6. Certifications | Cert03 | Ability for certification requestors to attach documents along with the certification approval request. Most of the certification approval requests will include certified test results. This information could be submitted by the Project Engineer, contractor or material source representative. | Mandatory | |
| 058 | Certification Based Approval | 6. Certifications | Cert04 | Ability for SHA to review certification test results and enter comments in the system regarding approval (e.g. deviations, what needs to be addressed before they can be certified, etc.) and approve/disapprove the certification request in the system. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 059 | Certification Based Approval | 6. Certifications | Cert05 | Ability for SHA to review the approval/disapproval and mark the results as released and ready for distribution to the requestor and other involved parties. This activity will generally be performed by the first approver's supervisor. | Mandatory | |
| 060 | Certification Based Approval | 6. Certifications | Cert06 | Ability to distribute released results to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the certification approval request. All requested and released certification requests should be sent out in one consolidated email. | Mandatory | |
| 061 | Certification Based Approval | 6. Certifications | Cert07 | Ability to generate, in calendar form, a list of certification expiration dates. The system should provide options to narrow selection from a drop-down menu and may include producer/material/source. For example, the lab may want to display only the certifications for concrete producers that expire within the next six months. | Mandatory | |
| 062 | Certification Based Approval | 6. Certifications | Cert08 | Ability to provide automatic notification to SHA members and plants/suppliers of expiring certificates for plants/suppliers based on expiration dates in the system. This will help both the plants/suppliers and SHA being proactive in ensuring that the plants/suppliers stay properly certified. The automatic notification should be in the form of an email and include a link to the page where the plant/supplier/manufacturer can apply for recertification. | Mandatory | |
| 063 | Certification Based Approval | 6. Certifications | Cert09 | Ability to print certification approval requests with an electronic signature to send to interested parties or for project records. | Mandatory | |
| 064 | Certification Based Approval | 6. Certifications | Cert10 | Ability to capture certification test results in a retrievable and reportable format. This will require test entry screen with list of items accepted based on certification, and entry fields for all test results. This functionality is similar to a test entry screen for materials that are tested by OMT. | Mandatory | Sos24 applies here (check payment status for plant) |
| 065 | Certification Based Approval | 6. Certifications | Cert11 | Ability to capture and store certifications and certification test results at the plant level (for each plant) and link the certifications to projects for which the certification is applicable. This should also allow the capability to search certifications by projects as well as plants. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| **Plant Review** | | | | | | |
| 066 | **Plant Review** | **7. New plant approval** | Plnt01 | Ability for plants to request addition of plant to approved list and request inspection for the plant. | Mandatory | |
| 067 | Plant Review | 7. New plant approval | Plnt02 | Ability to electronically attach the Quality Control (QC) plan so SHA members can download and review before plant visit. This will allow the plant to provide the plan and updates faster and more efficiently. | Mandatory | |
| 068 | Plant Review | 7. New plant approval | Plnt03 | Capability to maintain inspection/audit checklists in MMS that can be updated as required. The checklists may include checks for basic equipment operations, contact information, technician certifications, etc. | Mandatory | |
| 069 | Plant Review | 7. New plant approval | Plnt04 | Ability to schedule plant inspections including date, anticipated time, inspector, plant contact, etc.; and display all scheduled inspections and information on a calendar that can be printed for offline use. | Mandatory | |
| 070 | Plant Review | 7. New plant approval | Plnt05 | Ability to approve or disapprove a plant approval request based on inspection, tentatively approve a plan, along with the reason for action taken, and any issues to be resolved before final approval if applicable. | Mandatory | |
| 071 | Plant Review | 7. New plant approval | Plnt06 | Ability to automatically add plant to list of approved plants/sources once the plant is approved. This will require tight integration between table/database of requests received and table/database of approved plants. | Mandatory | Also applies to QA visits |
| 072 | Plant Review | 7. New plant approval | Plnt07 | Ability to distribute approval update to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the plant approval request. | Mandatory | |
| 073 | Plant Review | **8. Plant QA visits** | Plnt08 | Ability for plants to enter planned production values as well as actual production values directly in the system. This will allow SHA to track and review the information easily and allow easier scheduling of plant QA visits. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 074 | Plant Review | 8. Plant QA visits | Plnt09 | Capability to notify division to schedule plant inspections based on plant's production values (e.g. Hot Mix Asphalt, Portland Cement Concrete). This provides an automated means to monitor specific plant output for SHA projects and to plan schedule inspections accordingly (based on tons of material delivered). For example, by reviewing the plant production amounts, MMS may alert the associated division, by email or otherwise, that a plant inspection is due or is coming due. | Mandatory | |
| 075 | Plant Review | 8. Plant QA visits | Plnt10 | Capability to maintain QA checklists in MMS that can be updated as required. The checklists may vary based on the type of plant being inspected. The checklists should have place to rate each element to be checked on a scale of 1 to 5. The checklist should also allow entry of QC plan review comments, open issues to be resolved, etc. | Mandatory | |
| 076 | Plant Review | 8. Plant QA visits | Plnt11 | Ability to generate a QA visit schedule based on inspection frequency. This schedule should be modifiable to list specific dates or week ranges for the inspection. This will allow SHA to adhere to the minimum inspection frequency. | Mandatory | |
| 077 | Plant Review | 8. Plant QA visits | Plnt12 | Capability to record plant visits in the system along with the appropriate checklist. The plant visit record should include inspector information, date visited, checklist details, issues to be resolved, any actions taken, and any other relevant information. | Mandatory | |
| 078 | Plant Review | 8. Plant QA visits | Plnt13 | Ability to update plant status on approved list based on conducted inspection. This update may involve changing the plant status to temporary removal from list pending issue resolution, permanent removal, other status updates as defined by business users. | Mandatory | |
| 079 | Plant Review | 8. Plant QA visits | Plnt14 | Ability to maintain and store dispute resolution procedure for plant approval. This will require multiple screens with details on the issues, and resolution steps followed for resolution of the issues. The users will be able to create new issues/disputes tied to plants, and update the status as in progress, or resolved. The system should also have the ability to generate a report with the dispute resolution steps followed. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 080 | Plant Review | 8. Plant QA visits | Plnt15 | Capability to identify discrepancies in materials quantities shipped vs. quantities received through a report and/or on-line notification. This auditing is essential for proper accounting. By providing an opportunity, to determine electronically, quantities shipped vs. quantities received, discrepancies may be addressed early in the project. | Mandatory | |
| 081 | Plant Review | 8. Plant QA visits | Plnt16 | Ability to generate an alert when a plant's annual inspection is due. This alert should trigger an email to members that are a part of the distribution list, and will include the plant and SHA members. This will allow the plant and SHA to be more proactive in ensuring proper and continuous approval of the plants. | Mandatory | |
| 082 | Plant Review | 8. Plant QA visits | Plnt17 | Capability to provide automatic notification of upcoming production schedules for plants/suppliers. Knowing the production schedule for plants/suppliers provides a heads-up notification of testing pending activity and provides for better planning. For example an SHA manager has the responsibility to schedule his/her resources to meet field and lab workloads. This capability will provide the manager with the information necessary to meet project demands. | Mandatory | |
| **Other** | | | | | | |
| 083 | **Other** | **9. Equipment Calibration** | Othr01 | Ability to provide an inventory of all lab equipment with appropriate attributes (e.g. Division, age, comments). The system should allow authorized users to add, remove or update the inventory information. | Mandatory | |
| 084 | Other | 9. Equipment Calibration | Othr02 | Ability to record and store calibration history for all lab equipment. The calibration history will consist of all dates the equipment was calibrated on, and a comment field for each date. The system should also allow the storage of next required calibration date for each equipment. This will provide SHA an easy means to track calibration history and determine if any equipment is due for calibration. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 085 | Other | Other | Othr03 | Ability to store placed quantities as reported by project site and quantities as reported by manufacturing plant separately in the system. These quantities will be reported by different team members (plants, PEs, others). These quantities may be different due to batches rejected on-site or other reasons, and it is important to know both the quantities for different reasons (plant inspection frequency is related to plant production, while actual pay amounts and material test frequency is related to actual quantities placed). | Mandatory | |
| **Reporting** | | | | | | |
| 086 | **Reporting** | **10. Reporting** | Rprt01 | Ability to generate reports based on sample information as follows: (These reports should be retrievable for each division, specific project, or for all labs as required)<br>- Average response time to test a sample in days<br>- Number of samples logged in the system<br>- Number of samples logged out of the system<br>- Percentage of samples tested based on number logged in and logged out<br>- Number and percentage of samples that passed<br>- Number and percentage of samples that failed | Mandatory | |
| 087 | Reporting | 10. Reporting | Rprt02 | Ability to generate a report to indicate all samples collected for a specific project, along with the status of each sample (pass, fail, pending, other). This should also include the total number of samples logged in, logged out, passed, and failed for the project. | Mandatory | |
| 088 | Reporting | 10. Reporting | Rprt03 | Ability to generate a report to present the number of tests that have been currently scheduled, and the number of tests that have been completed in a given time frame. The user should be able to specify parameters such as the time frame, division, and project. | Mandatory | |
| 089 | Reporting | 10. Reporting | Rprt04 | Ability to generate report indicating number of tests performed or inspections conducted by employee and division. | Mandatory | |
| 090 | Reporting | 10. Reporting | Rprt05 | Ability to generate report indicating how many samples were received with incomplete information. The user should be able to specify parameters like type of missing information, division, and project. | Mandatory | |

| Line # | Business Function | Sub Function | Req # | Functional Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 091 | Reporting | 10. Reporting | Rprt06 | Ability to generate report for each plant regarding number of batches shipped, projects shipped to, number of inspections at the plant, production days, and projects serviced by the plant. | Mandatory | |
| 092 | Reporting | 10. Reporting | Rprt07 | Ability to generate a summary of the total number of ship days for each plant and across all plants. | Mandatory | |
| 093 | Reporting | 10. Reporting | Rprt08 | Ability to generate a summary report of all plant inspections conducted and issues discovered at the plants. | Mandatory | |
| 094 | Reporting | 10. Reporting | Rprt09 | Ability to generate a report of all SHA equipment, along with their calibration information. The user should have the capability to specify parameters for the report like division, etc. | Mandatory | |
| 095 | Reporting | 10. Reporting | Rprt10 | Ability to generate a report showing number of samples approved with minor deviations. The user should have the capability to specify parameters for the report like division, project, etc. | Mandatory | |
| **MMS-Wide** | | | | | | |
| 096 | MMS-Wide | **Internet Calendar** | | Ability to generate project calendars in an internet publishable format (icalendar, vcalendar) | Desirable | |
| 097 | MMS-Wide | | | Ability to automatically attach files in the system. These files will include letters generated for distribution to contractors/PEs. | Mandatory | Part of Project 1 |
| 098 | MMS-Wide | | | Ability to classify projects based on funding type of the project (e.g. Federal aid, exempt; Federal aid, non-exempt) | Mandatory | |
| 099 | MMS-Wide | | | Ability to record and report the quantity of a material approved on certification vs. quantity used on the project. | Mandatory | |
| 100 | MMS-Wide | | | Ability to trigger an alert when the approved quantity of a material (accepted on certification) has been used on a project and a new certification is now required. For example, a large volume of a material may be received at a job site with the proper certifications and the material may not be used all at once. An alert is necessary to assure that the relevant system users are aware that additional certification must be sought. | Mandatory | |

# 4 OPERATIONAL REQUIREMENTS

Exhibit 14 below presents the operational requirements for the MMS. These requirements describe the non-business characteristics of the MMS, and apply to all eight projects.

The operational requirements are divided into the following functions:

- Security: These requirements describe the need to control access, and include controlling who may view and alter application data.
- Audit trail: These requirements indicate the activities that will be recorded in the application's audit trail.
- Data currency: These requirements mention how recent the data in MMS will be, and how recent the information will be when the MMS is queried for information.
- Reliability: These requirements list the acceptable level of reliability
- Recoverability: These requirements deal with the ability to restore function and data in the event of a failure.
- System availability: These requirements relate to the time during which the system is available, and lists when the usage is expected to be at its peak.
- Fault tolerance: These requirements detail the ability of the system to remain partially operational during a failure.
- Performance: These requirements mention the required response time for queries and updates, throughput, etc.
- Capacity: These requirements list the required capabilities and expected volumes of data in business terms.
- Data retention: These requirements list the requirements relating to retaining data that is entered in the system and being stored within the system.

## Exhibit 14: Operational Requirements

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 001 | Audit Trail | Monitor | Aud01 | Capability to provide a report of the date & time, any changes, adds or deletes made and the logon ID of the user accessing monitored data files. For example, in the event of data corruption, erasure, or other contamination, a report shall be available to detail user recent activity. | Mandatory | |
| 002 | Audit Trail | Monitor | Aud02 | Capability to segment users by division and configure audit capabilities only to users with access to the defined databases. For example, if a user only has rights to access the forms and reports data segment, that user will be audited based on the access to those segments only. | Mandatory | |
| 003 | Audit Trail | Monitor | Aud03 | Capability to monitor access to Source of Supply Letters/Lists, test results, contractor information, project notes, SHA forms and other designated databases. For example, each time a user access a monitored data file, a record will be posited of the activity. | Mandatory | |
| 004 | Capacity | Database | Cap01 | Capability to handle high volumes of data that may occur on a "peak" basis. For example, end of month final clearances, monthly reporting and ad-hoc queries for completion status will generate a high volume of data while routine project work during the month may range from low to high. | Mandatory | |
| 005 | Capacity | Database | Cap02 | Capability to process transactions from estimated 400-500 total users on a daily basis. In addition to the SHA users, transactions will be created by contractors, suppliers and outsourced labs. For example, transactions will include, at a minimum, Source of Supply Letters/Lists from contractors, the transfer of sample information between lab and field forces, the submission and retrieval of project test results, access of information for reports, ad-hoc user queries. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 006 | Data Currency | Backup | DC01 | Capability to provide data in near real-time in response to requests for data access. For example, resource allocation and deployment decisions for field and lab work are based on project dates. The dates reflected in MMS must be as recent as possible. | Mandatory | |
| 007 | Data Currency | Backup | DC02 | Capability to maintain a current back-up of the system database to be utilized for restoration in the event of catastrophic failure and loss of data. For example, a fire or other event could destroy the server causing total loss of data and system configurations. | Mandatory | |
| 008 | Data Currency | Backup | DC03 | Capability to maintain a current backup of all system configurations to be utilized in case of catastrophic loss to the server. | Mandatory | |
| 009 | Data Retention | Cleanup | DaR01 | Ability for the administrator to delete old records as required. It is anticipated that the records will be archived most of the time and not deleted, but a deletion may be required in case of duplicate entries or other unforeseen circumstances. | Mandatory | |
| 010 | Data Retention | Storage | DaR02 | Capability to store project related data for an indefinite period of time. For example, project related data may be retained for the life of the asset associated with the project. For example, there will be varying degrees of retention requirements throughout the system database, from "none" to indefinite. | Mandatory | |
| 011 | Data Retention | Storage | DaR03 | Ability to save data in a common or easily accessible format. This may include .pdf, WORD or other common format. For example, there will be specific users (TBD) who may have limited or no access to MMS. This ability will enhance the function of emailing and/or printing. | Mandatory | |
| 012 | Fault Tolerance | Configuration Management | FT01 | Capability to provide additional back-up and protection for specified system applications during planned or unplanned outages. For example, applications supporting the source of supply test and approval process are critical while email (from within MMS) and field access to the system may be less critical. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 013 | Fault Tolerance | Configuration Management | FT02 | Capability to react to a single board or data drive failure through a fault tolerant architecture. For example, if a circuit board or other piece of hardware fails, the system shall be capable of continuing functionality through redundant hardware/software configuration architecture. | Mandatory | |
| 014 | Performance | Measurements | Perf01 | Capability to provide system performance analysis and reports. For example, a log of system bugs and or actual interruptions shall be kept and statistically analyzed to address current issues and to predict possible future issues. | Mandatory | |
| 015 | Performance | Measurements | Perf02 | Capability to provide performance measurement details based upon the number of tests and test completion data (e.g. time required to complete a specific test or all tests on a particular sample). For example, The "Approve By" date and other performance measurement opportunities may be accessed via MMS. | Mandatory | |
| 016 | Performance | Measurements | Perf03 | Capability to provide Statistical analysis and/or ability to extract to a statistical analysis package to review mix designs and other designated analytical functions. For example, an analysis of missed project completion dates and their causes may be analyzed and reports provided. | Mandatory | |
| 017 | Performance | Process Support | Perf04 | Capability to provide response to user queries in three seconds or less. For example when an icon or menu item is selected, the user should notice no delay in viewing the requested screen or data list. | Mandatory | |
| 018 | Performance | User Support | Perf05 | Capability to provide user multi-tasking with system screens. For example, a user may have multiple MMS screens open and active while also using other application screens. | Mandatory | |
| 019 | Performance | User Support | Perf06 | Capability to provide system user documentation that is comprehensive, clear and easy to use. For example, system user documentation shall provide quick answers to questions regarding the navigation of the system screens. | Mandatory | |
| 020 | Recoverability | Configuration Management | Rcvr01 | Capability to provide data redundancy to protect against loss of data due to system failure For example, in the event of a total failure of MMS, the database shall be recoverable and be restored to the image that existed at the time of failure. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 021 | Recoverability | Configuration Management | Rcvr02 | Capability to recover from, or not be impacted by a commercial power failure. A given power failure may be just from a moment to many hours. It is expected that all functionality and data access would remain intact. For example an alternate source of power shall be available and the MMS wired to that source of power. | Mandatory | |
| 022 | Recoverability | Configuration Management | Rcvr03 | Capability to restore full functionality and data integrity within thirty minutes of detecting the failure. For example, critical hardware spares and recent system & data backups shall be available on site. | Mandatory | |
| 023 | Reliability | System Measurements | Rel01 | Capability to meet a Monthly Mean Time to Repair (MTTR) performance of five minutes. MTTR is figured by dividing total system down time by the number of outage occurrences for the month. | Mandatory | |
| 024 | Reliability | System Measurements | Rel02 | Ability to provide same-day replacement for failed hardware parts causing system outage (down-time) and twenty-four hour turn-around time for repair and/or replacement of defective parts. For example, a failure may occur that requires a hardware item that is not at the site. | Mandatory | |
| 025 | Reliability | System Measurements | Rel03 | Capability to perform system backups that are transparent to the users. For example, information for reports and project scheduling must be as current as possible which necessitates frequent backups. | Mandatory | |
| 026 | Retrieve Data | User Support | RD01 | Ad-hoc query capability to retrieve test results by non-project characteristics (mix design, location, contractor, materials supplier, etc.). This capability requires that a user can obtain project data based upon various data point starting points. For example, retrieve a materials supplier, and view all of the projects that that supplier is currently involved in (or has been involved in). | Mandatory | |
| 027 | Security | Data | Sec01 | Capability to protect Application Data from contamination and/or erasure by users. For example, the loss or contamination of vital project information, such as Source of Supply Letter, test results or project notes could jeopardize project schedules. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 028 | Security | Data | Sec02 | Capability to protect sensitive SHA and contractor data from casual access. For example a supplier's specific materials mix submitted for testing or SHA project costing information. | Mandatory | |
| 029 | Security | Environment | Sec03 | Access to the IT facility housing the MMS servers shall be controlled and monitored. For example, key card entry shall be utilized to track users' access to the server area. | Mandatory | |
| 030 | Security | User Configuration | Sec04 | Capability to provide a user logon interface that is designed to allow access to specific data by designated users within SHA Divisions. For example, users in the Asphalt Technology Division may not need access to projects associated with Soils and Aggregates Division. Also, some users need an access for a specific purpose such as preparing reports, while another user may need full administrative access. | Mandatory | |
| 031 | Security | User Configuration | Sec05 | Capability to limit access to designated non-SHA users, such as contractors and consultants. However, this access must be restricted and recorded within the system. For example, contractors may require access to submit sources for approval and to check on project status. | Mandatory | |
| 032 | Security | User Configuration | Sec06 | Capability to provide reports detailing outside user access. For example, a monthly report of outside user access may be provided to check against contractor project activity. | Mandatory | |
| 033 | Security | User Configuration | Sec07 | Capability to restrict access to a limited number of individuals with permission to alter data tables, applications and other database configurations. For example, in order to protect the integrity of the MMS data, only designated members of the Office of Materials Technology (OMT) shall have these permissions. | Mandatory | |
| 034 | Security | User Configuration | Sec08 | Capability to limit some users to "View Only" MMS access on specified projects or materials. For example some users may only need to check on completion dates or other key project information with no need to input or retrieve data. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 035 | Security | User Configuration | Sec09 | Capability to monitor and restrict SHA field access by project. The field will however have input access related to plant inspections and certifications. For example, field staff may only access data relevant to a current project at their site location but be given permission to access the plant certification data base to update inspection information. | Mandatory | |
| 036 | Security | User Configuration | Sec10 | Capability to monitor and control access to MMS interfacing systems, by restricting other system access by an additional layer of password security or other means. | Mandatory | |
| 037 | Security | User Configuration | Sec11 | Capability to provide a robust authentication procedure to be employed for all logins. For example, VPN remote access may be allowed with authentication. | Mandatory | |
| 038 | Security | User Configuration | Sec12 | Capability to require passwords to be changed on a regular basis. For example, the system should prompt the user every three months to request a change in password. | Mandatory | |
| 039 | Security | User Configuration | Sec13 | Allow users to request password reset requests from the web interface. Users should be assigned temporary passwords and required to change at first login. For example, users often forget their logon information and require a method to have it reset. | Mandatory | |
| 040 | Security | User Configuration | Sec14 | Allow users to choose from multiple roles if the user is assigned more than one role (e.g. Project Manager, administrator). For example, a division head may require a logon that has access to the entire division. | Desirable | |
| 041 | Security | User Configuration | Sec15 | Capability to restrict the display to only the options and icon selections to which the user has rights. For example a user's logon would define the functionality required and present only that capability. This has the added benefit of simplifying the screen for the user. | Mandatory | |
| 042 | Security | User Configuration | Sec16 | Facilitate Single Sign-on to use enterprise login information for OMT staff and allow use of VPN or request login credentials for web-based modules. For example, the Office of Materials Technology has responsibility for MMS and the processes it supports. VPN may be used with authentication. | Mandatory | |

| Line # | Function | Sub Function | Req # | Operational Requirements | Priority | Comments |
|---|---|---|---|---|---|---|
| 043 | System Availability | Failure Management | SyAv01 | Capability to provide 24/7 system uptime. For example, data transfers with interfacing systems and other automated system routines must be accommodated. Peak system usage is expected to be from 6:30 a.m. to 5:30 p.m. This time period is the least optimal time to schedule planned maintenance outages. | Mandatory | |
| 044 | System Availability | Failure Management | SyAv02 | Capability to provide simultaneous access to all MMS screens by all concurrent users. There shall be no degradation of service or extended screen wait time. For example, all users may have a need for information on a specific project, at the same time. It is estimated that initially the system will have 400-500 total users. | Mandatory | |
| 045 | System Availability | Failure Management | SyAv03 | Capability to provide system availability at 99.999%. This equates to a total of five minutes of unplanned outage for a year. | Mandatory | |
| 046 | System Availability | Failure Management | SyAv04 | Ability to conduct scheduled maintenance during hours designated as the "Maintenance Window." For example, the Maintenance Window may be designated from midnight to two a.m. It is possible that the Maintenance Window could be expanded dependent upon the estimated time to perform the scheduled maintenance. This "window" applies to work performed by SHA as well as work performed by the vendor. | Mandatory | |

# 5 REQUIREMENTS TRACEABILITY MATRIX

The Requirements Traceability Matrix (RTM) provides a method for tracking the functional requirements and their implementation through the development process. Each requirement is included in the matrix along with its associated section number. As the project progresses, the RTM will be updated to reflect each requirement's status. When the product is ready for system testing, the matrix will list each requirement, what product component addresses it, and what test verifies that it is correctly implemented.

The RTM is presented in Appendix B of this document, and will be further populated with the tests that will verify the requirements before the end of the requirements analysis phase.

# 6 GLOSSARY

Exhibit 15 below presents a list of business terms relevant to the Materials Management System and implementation process.

**Exhibit 15: Glossary of Terms**

| Reference or Acronym | Definition |
|---|---|
| **AASHTO** | American Association of State Highway Transit Officials |
| **ADW** | Asset Data Warehouse will provide an inventory of all SHA linear highway assets and track their condition. |
| **CAS** | Construction Administration System |
| **CATS** | Consulting and Technical Services |
| **COTS** | Commercial-Off-the-Shelf Software Package |
| **FHWA** | Federal Highway Administration |
| **FMIS** | Financial Management Information System |
| **FRD** | Functional Requirements Document |
| **GAB** | Graded Aggregate Base |
| **Geosystem** | Calculates and classifies raw data and maintains records (database) by contract number. It is used during preliminary engineering and on active construction projects. |
| **Humboldt Triaxial Data Acquisition** | This system records and calculates raw data acquisition and provides final analysis of Triaxial and Consolidation testing for both preliminary and active construction projects. |
| **HMA** | Hot Mix Asphalt |
| **Intangible benefits** | Any benefits that cannot be assigned a specific dollar value are expressed as intangible benefits. These benefits are expressed in terms of improved mission performance, improved decisions making, or more reliable or usable information. Many public goods and services are difficult to quantify reliably and precisely in dollar units. However, intangible benefits are vital to understanding the total outcome of implementing a particular IT system. |
| **LAS** | Letting and Awards System |
| **LIMS** | Laboratory Information Management System |
| **Maryland Product Evaluation List (MPEL)** | A web based system used to determine eligibility for the Qualified Products List. |
| **Marylandware System** | Records and calculates Density and Mix test results from QA and QC sources. Allows electronic exchange of data through emailing of text based data files. |
| **Material specification and quality assessment** | This phase consists of acceptance of materials on the project. |
| **Materials clearance process** | A systematic method to assess and approve the quality of different constituent materials that are used as part of the construction process. |
| **MCMS** | Maryland Construction Management System |

| Reference or Acronym | Definition |
|---|---|
| **MMS** | Materials Management System is an integrated electronic system used as a tool to manage the materials testing, acceptance, and clearance process within SHA. |
| **OBD** | SHA Office of Bridge Development |
| **OIT** | SHA Office of Information Technology |
| **OMT** | SHA Office of Materials Technology |
| **OOF** | SHA Office of Finance |
| **Oracle** | An industry-strength database system. |
| **PES** | Proposal and Estimates System |
| **PCC** | Portland Cement Concrete |
| **PMS** | Pavement Management System - Maintains an inventory of pavement on Maryland roads. |
| **Pontis BMS** | Pontis® is a Bridge Management System that assists transportation agencies to make decisions about maintenance, rehabilitation, and replacement of structures. Pontis stores complete bridge inventory and inspection data, including detailed element conditions. |
| **Project management** | Refers to project management activities performed on a project. This includes activities like maintaining high level project information, store project documentation, and track project tasks. |
| **QPL** | Qualified Products List |
| **RFP** | Request for Proposal |
| **RIDETOOL** | Used to capture and access ride quality of new pavements and is used to calculate incentive payments based on ride quality. |
| **SBD** | System Boundary Document used to document the scope of an SHA development project. |
| **SDLC** | System Development Life Cycle is the process utilized by SHA to design and implement new systems. |
| **SiteManager®** | Provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization and includes a module for materials management. |
| **Source of Supply** | This phase refers to the review of the sources of material supply that the contractors propose to use on the project. |
| **System management** | Refers to the overall technical management of the MMS |
| **Tangible benefits** | Any benefits that can be quantified are expressed as tangible benefits. These benefits are expressed in dollars or in units in this document. The result of tangible benefits may be: increased revenue, streamlined production, or saved time and money. |
| **Trns*Port** | TRNS*PORT is a trade name for a series of construction management products. Maryland SHA is currently utilizing four of the available products: PES – Proposal and Estimates System; LAS – Letting and Awards System; CAS – Construction Administration System, and DSS – Decision Support System. |

# 7 APPENDIX A

Exhibit A-1 below lists points of contact associated with Project II.

**Exhibit A-1: Points of Contact for MMS Implementation specific to Project II**

| First Name | Last Name | Division | Contact Information |
|---|---|---|---|
| Bruce | Abernathy | Materials Division (Metals) | babernathy@sha.state.md.us |
| Christopher | Gale | Concrete Technology Division | cgale@sha.state.md.us |
| Dusty | Brady | Concrete/Chemical | dbrady@sha.state.md.us |
| Gregory | Moore | Asphalt Technology Division Chief | gmoore@sha.state.md.us |
| Jeffrey | Withee | Deputy Director, Material Quality | jwithee@sha.state.md.us |
| John | Weisner | Structural Materials and Coatings Division Chief | jweisner@sha.state.md.us |
| Lou | Wagner | Aggregates | lwagner@sha.state.md.us |
| Paul | Finnerty | Concrete Technology Division Chief | pfinnerty@sha.state.md.us |
| Vicki | Stewart | Chemical/Concrete Lab | vstewart@sha.state.md.us |
| George | Hall | Soils and Aggregates Division | GHall@sha.state.md.us |
| Bob | Kochen | Soils and Aggregates Division | BKochen@sha.state.md.us |
| Gil | Rushton | Structural Materials and Coatings Division | GRushton@sha.state.md.us |

# 8 APPENDIX B

Appendix B below presents the Requirements Traceability Matrix (RTM) for all requirements (functional and operational) mentioned in this document.

## Functional Requirements RTM

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| **Material Testing** | | | | | | | | |
| MT01 | **Material Testing** | **1. Sample Login** | Ability to automatically assign a serial number to the sample when a sample is logged in to the system. The serial number assigned should be such that the OMT division can be identified by looking at the serial number. For example, all asphalt samples may end with an A, or start with a "4." | | | | | |
| MT02 | Material Testing | 1. Sample Login | Ability to automatically assign a serial number to the specimen when a specimen is logged in to the system. The specimen number will be tied to a unique serial number, and multiple specimen number can be tied to one serial (sample) number. For example, a concrete "sample" may consist of two or more "specimens" (cylinders) for testing. | | | | | |
| MT03 | Material Testing | 1. Sample Login | Ability to enter and store project number, project name, appropriate division, mix design #, etc. to each sample when entered in the system. All this information should be automatically populated for all specimens based on the samples they are linked to. | | | | | |
| MT04 | Material Testing | 1. Sample Login | Ability to enter other parameters to sample and specimen information like sample condition, test type, test values, test result (pass/fail/other), charge code, ship date, etc. either at first sample login or later on during the process. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT05 | Material Testing | 1. Sample Login | Ability to record the sources of the material that is being sampled for each sample collected. Some of the materials may have more than one source approved for the project. For example, the sample login screen will provide a drop down menu with approved sources for the project from which the applicable source can be selected, but also have a text box to record the source if the source is not yet an approved source. | | | | | |
| MT06 | Material Testing | 1. Sample Login | Ability to validate sample information and flag when required information is not provided. The system will need to flag the sample as "incomplete" in such a case. The system should also allow the user to enter the type of information that is missing - this information should be available as a drop down menu (from a pre-populated table) but also allow the user to enter another value. | | | | | |
| MT07 | Material Testing | 1. Sample Login | Capability to generate alert when a sample is flagged as not fit for testing (e.g. having incomplete information, incorrect size), along with additional notes (e.g. information that is missing (paperwork, improper sampling, etc.)). This alert should be in the form of an email that can be sent out to a distribution list including the contractor and the PE as applicable. | | | | | |
| MT08 | Material Testing | 1. Sample Login | Ability to send automatic reminders when sample information is missing at user-specified intervals. The intervals should be separately specified for each division. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT09 | Material Testing | 1. Sample Login | Capability to mark when sample information received for inter-lab tests is not accompanied by a sample. This is to prevent situations when a sample is tested by one lab, and the information is transferred but the actual sample is not transferred in a reasonable time frame (for multiple tests to be performed on the same sample/item). | | | | | |
| MT10 | Material Testing | 1. Sample Login | Ability to mark the status of the sample in the system. The status would include "recorded at field," "shipped to lab," "received by lab," "test complete," "results approved," "results received" and others as determined by the divisions. The sample should automatically have a time stamp associated with it when the status of the sample is updated in the system. | | | | | |
| MT11 | Material Testing | 1. Sample Login | Capability to record shipment date for samples that are collected at remote locations and shipped to OMT lab. This will allow the labs to note how long it took to receive the sample. | | | | | |
| MT12 | Material Testing | 1. Sample Login | Ability to login a sample offline and import the information in to MMS when connected to the internet/intranet. This will be very important for remote locations or sample collected at the plants where no internet connectivity is available. The offline data entry tool could be a module of the MMS or a complex spreadsheet whose import will be supported by the MMS. This will also require the MMS to set aside a number of serial ids/numbers for offline use that will be tracked as such. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT13 | Material Testing | 1. Sample Login | Capability to print a serial number that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, enter the serial number, and will be able to pull up all relevant sample information. | | | | | |
| MT14 | Material Testing | 1. Sample Login | Capability to print a barcode that can be attached to the sample. This will ensure that all data does not have to be reentered when the sample is received at the lab. The lab user will be able to login to MMS, scan the barcode, and will be able to pull up all relevant sample information. | | | | | |
| MT15 | Material Testing | 1. Sample Login | Ability to retrieve sample information based on serial numbers attached to samples. This will allow the labs to retrieve information and not reenter information that has already been gathered on the field. | | | | | |
| MT16 | Material Testing | 1. Sample Login | Ability to record data from barcode readers and retrieve sample information based on the barcode attached to samples. This will help prevent the same duplication mentioned above, with the additional benefit of not needing to enter the serial number. | | | | | |
| MT17 | Material Testing | 1. Sample Login | Capability for the tester or inspector to capture test and inspection results offline for instances where worksheets/forms and other manual media are used to document the test/inspection results and export them back to MMS via an email, scan, or other method. It is necessary to accommodate field input to MMS in a robust way. All plant test and inspection work is done by field forces. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT18 | Material Testing | 1. Sample Login | Ability to record material placement location for test samples in multiple coordinate systems. This will require the use of multiple fields with information stored in a table that will be accessed by an Asset Data Warehouse (ADW) or a GIS system in the future. This feature will allow SHA to back track the test results for a particular location in case of any issues. | | | | | |
| MT19 | Material Testing | 1. Sample Login | Ability to allow the Project Engineer to trigger a particular workflow once project information is received. For example, the Project Engineer may receive notification of completion of placement from the contractor and may need to trigger the inspection workflow. | | | | | |
| MT20 | Material Testing | 1. Sample Login | Ability to request QC data from the contractor or PE and store the information in the system. | | | | | |
| MT21 | Material Testing | 1. Sample Login | Ability to note the purpose of the sample. For example, the sample might be for QA, or for plant acceptance, or for informational purposes. This will also determine where the sample's cost to test will be charged. | | | | | |
| MT22 | Material Testing | **2. Prepare Specimen** | Ability to split samples into multiple specimens and assign properties to the specimens (tests to be performed, etc.) For example, a concrete "sample" received will consist of two or more cylinders, where each cylinder is equivalent to one "specimen." | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT23 | Material Testing | 2. Prepare Specimen | Capability for managers to assign tests to specimens and samples. Managers will have the ability to assign tests from a drop-down menu of tests. Managers should be able to assign tests from different divisions for inter-lab samples (e.g. chemical samples). Such assignment should automatically trigger an alert in the form of an email to the recipient division. | | | | | |
| MT24 | Material Testing | 2. Prepare Specimen | Ability to assign task options to samples or specimens. These options may include "complete by," "test on," etc.<br>A "test-on-date" refers to a schedule of tests to be performed on samples. For example, concrete samples received by the lab are assigned a "test-on-date" based on 3-day, 7-day or 28-day strength testing to be performed. | | | | | |
| MT25 | Material Testing | 2. Prepare Specimen | Ability to assign comments to each sample/specimen at test assignment that are visible to the testers (including specific instructions for specimen/sample storage). These notes may provide specific instructions relevant to the sample/specimen like test using a particular equipment, etc. These comments should be printed in a bigger font/different color to make it clearly visible. | | | | | |
| MT26 | Material Testing | **3. Record Test Results** | Ability to assign testers or groups of testers to each sample/specimen from a drop down list. This assignment should automatically trigger a notification to the tester or the test group as appropriate. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT27 | Material Testing | 3. Record Test Results | Ability to assign a priority rating between 1 (Very Low) and 5 (Very High) to samples. This will allow testers to prioritize testing within their backlog and result in efficient communication within the labs. | | | | | |
| MT28 | Material Testing | 3. Record Test Results | Ability to log test performed for each sample in the system. The test login screen should provide a drop down with all tests, so the right test can be selected from the menu. The test fields should allow the testers to enter the field names for the recorded parameters, and the recorded values. The screen should also allow the tester to record the pass or fail result for the test if applicable. | | | | | |
| MT29 | Material Testing | 3. Record Test Results | Ability to retrieve test results for a particular sample or specimen to add more test information to the sample/specimen if applicable. For example, a tester may perform some tests on the specimen one day and other tests on the other day, and may want to record them at the time of testing. | | | | | |
| MT30 | Material Testing | 3. Record Test Results | Ability to allow outsourced labs restricted access to the system to enter test results. The outsourced labs will be allowed to only enter test results for tests and projects assigned, and not be able to view any other information in the system. This should be accomplished through a web based interface to the MMS. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT31 | Material Testing | 3. Record Test Results | Ability for batch entry of lab results from outsourced labs. For example, some lab work is outsourced to provide specialty testing. Providing an automated entry portal for the outsourced contractor would speed up that process. The outsourced labs shall have restricted access. | | | | | |
| MT32 | Material Testing | 3. Record Test Results | Ability to enter test results through a web based interface outside SHA intranet. This capability is critical for field staff and outsourced labs to record test results for tests performed on the field. | | | | | |
| MT33 | Material Testing | 3. Record Test Results | Capability to store contractor's/plant's QC results in the system and clearly mark them as QC results. This will enable SHA to review the QC results easily as required and compare the QA and QC results. | | | | | |
| MT34 | Material Testing | 3. Record Test Results | Capability to compile specimen results into one sample result. This requires a separate screen that consolidates all specimen information. Pass/fail is based on tester's judgment based on specimen's pass/fail. For example, for a concrete cylinder sample, the pass/fail will depend on the average value of more than one specimen. Thus, a particular specimen might have failed, but the average will result in a passing value for the sample. This is also necessary since the approval/disapproval sent to contractor is at the sample level. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT35 | Material Testing | 3. Record Test Results | Ability for testers to add comments relevant to the testing process or results at the specimen level. For example, the tester may want to note certain conditions that led to the failure of the specimen. The system should provide two comment fields: one for internal use only, and one that will be accessible to the contractor. The external comment field should provide clear indication that anything entered in the field will be visible to external (Non-SHA) team members. | | | | | |
| MT36 | Material Testing | 3. Record Test Results | Ability to automatically record the tester's information and date and time the test result is entered in the system. The tester's information will allow SHA to differentiate between outsourced lab/tester, in-house test performed by consultant, or in-house test performed by SHA employee. | | | | | |
| MT37 | Material Testing | 3. Record Test Results | Ability to flag if the test time and cost are being charged to Y-B888. | | | | | |
| MT38 | Material Testing | 3. Record Test Results | Ability to store whether a particular test is generally charged to Y-B888. | | | | | |
| MT39 | Material Testing | 3. Record Test Results | The system will put in a default check mark if the test is generally charged to Y-B888, and will account for whether the project is a third party project (that does not get charged to Y-B888) and consultant technicians (do not charge to Y-B888) | | | | | |
| MT40 | Material Testing | 3. Record Test Results | Ability to add specific fields that can be entered on each screen (e.g. cost per test, material specification used) | | | | | |
| MT41 | Material Testing | **4. Review/Approve Results** | Ability to enter the material specification and version that is applicable for a test that is performed from a drop down menu. (e.g. ASTM 392, etc.) | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT42 | Material Testing | 4. Review/Approve Results | Ability to reschedule tests electronically. When a test fails, the system should provide the ability for the supervisor to reschedule additional testing or request another sample from whoever provided the original sample (vendor/manufacturer/supplier/source). The original sample/specimen information should be made available to the tester on a screen based on information already present in the system. | | | | | |
| MT43 | Material Testing | 4. Review/Approve Results | Capability for test approver (technician's superior) to approve results - this approval will be by material division. | | | | | |
| MT44 | Material Testing | 4. Review/Approve Results | Capability to approve test results if the sample does not meet material specifications, but has minor deviations. Any such approvals should be specifically noted as such in the system, along with an explanation. This approval is specifically for the test results, and indicates a recommendation for approval for the material. This should include the ability to record the approver in the system. | | | | | |
| MT45 | Material Testing | 4. Review/Approve Results | Capability to compare data from testing performed by construction contractors/material producers with SHA quality assurance test results. | | | | | |
| MT46 | Material Testing | **5. Sample Management** | Capability to track and record all dates on which the specimens were tested, approved & released for distribution, and actually distributed to the involved parties. | | | | | |
| MT47 | Material Testing | 5. Sample Management | Automatically update facility/product/material accepted lists upon meeting requirements for approval and upon completion of QA/QC checklist. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT48 | Material Testing | 5. Sample Management | Ability to manually distribute approved test results. For example, if 3 test results are approved, for a project, the distribution trigger should send out a consolidated email with all 3 test results. | | | | | |
| MT49 | Material Testing | 5. Sample Management | Ability to sort tasks based on criteria such as work group, technician, work backlog, equipment/test, priority etc. This function will enable managers/supervisors to prioritize work assignments. | | | | | |
| MT50 | Material Testing | 5. Sample Management | Capability to view backlog of tests to be performed by multiple criteria (e.g. Division lab, aging of samples, tests to be performed, projects for which testing is to be performed), The viewing criteria shall be made available to users via pull-down menu selections. This function will allow for better performance measures within the divisions and provide data to aid in planning of the testing process. | | | | | |
| MT51 | Material Testing | 5. Sample Management | Ability to compare the number of samples collected (logged) for each material against the number mentioned in the project sampling plan. This will enable the teams to adjust the sampling frequency to collect more or less samples as required. | | | | | |
| MT52 | Material Testing | 5. Sample Management | Capability to view status of sample test progress within a division. The purpose of this function is to highlight bottlenecks or backlogs. A manager will be able to see where a sample is in a workflow process and how long it has taken for the sample to flow between tasks. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MT53 | Material Testing | 5. Sample Management | Generate alerts that the samples can now be discarded. This will be based on user-definable business rules that will vary by each division, lab, or sample type. Managers will have the ability to override alerts or to specify destruction/retention criteria manually. | | | | | |
| MT54 | Material Testing | 5. Sample Management | Capability for contractors to view sample and test information in MMS through a web-based interface or via another designated/restricted remote login to MMS. Contractors have a need to view status information and to input specific data for SHA action; a contractor who wants to know whether or not a product is approved can log on and see whether the sample has been logged in, if tests are pending, or if the product has been approved or disapproved. Management defines the extent of information visible to outside parties. | | | | | |
| **Certification Based Approval** | | | | | | | | |
| Cert01 | **Certification Based Approval** | **6. Certifications** | Ability to store and index all certifications/certified test results received by OMT in the system. These certifications will be stored in the MMS as electronic files (e.g. PDFs), and indexed with the various attributes (e.g. Project, manufacturer/plant, relevant division, certificate expiration date, valid quantities, etc.) | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Cert02 | Certification Based Approval | 6. Certifications | Ability for contractors/suppliers/manufacturers to request certification approval and recertification electronically through the system. The outside parties must be able to submit a certification approval request that is then reviewed by SHA. The certification approval is envisioned to be a web-based form with drop down menus and fields that the requestor can use to enter appropriate information (e.g. contact information, project number, etc.). | | | | | |
| Cert03 | Certification Based Approval | 6. Certifications | Ability for certification requestors to attach documents along with the certification approval request. Most of the certification approval requests will include certified test results. This information could be submitted by the Project Engineer, contractor or material source representative. | | | | | |
| Cert04 | Certification Based Approval | 6. Certifications | Ability for SHA to review certification test results and enter comments in the system regarding approval (e.g. deviations, what needs to be addressed before they can be certified, etc.) and approve/disapprove the certification request in the system. | | | | | |
| Cert05 | Certification Based Approval | 6. Certifications | Ability for SHA to review the approval/disapproval and mark the results as released and ready for distribution to the requestor and other involved parties. This activity will generally be performed by the first approver's supervisor. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Cert06 | Certification Based Approval | 6. Certifications | Ability to distribute released results to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the certification approval request. All requested and released certification requests should be sent out in one consolidated email. | | | | | |
| Cert07 | Certification Based Approval | 6. Certifications | Ability to generate, in calendar form, a list of certification expiration dates. The system should provide options to narrow selection from a drop-down menu and may include producer/material/source. For example, the lab may want to display only the certifications for concrete producers that expire within the next six months. | | | | | |
| Cert08 | Certification Based Approval | 6. Certifications | Ability to provide automatic notification to SHA members and plants/suppliers of expiring certificates for plants/suppliers based on expiration dates in the system. This will help both the plants/suppliers and SHA being proactive in ensuring that the plants/suppliers stay properly certified. The automatic notification should be in the form of an email and include a link to the page where the plant/supplier/manufacturer can apply for recertification. | | | | | |
| Cert09 | Certification Based Approval | 6. Certifications | Ability to print certification approval requests with an electronic signature to send to interested parties or for project records. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Cert10 | Certification Based Approval | 6. Certifications | Ability to capture certification test results in a retrievable and reportable format. This will require test entry screen with list of items accepted based on certification, and entry fields for all test results. This functionality is similar to a test entry screen for materials that are tested by OMT. | | | | | |
| Cert11 | Certification Based Approval | 6. Certifications | Ability to capture and store certifications and certification test results at the plant level (for each plant) and link the certifications to projects for which the certification is applicable. This should also allow the capability to search certifications by projects as well as plants. | | | | | |
| **Plant Review** | | | | | | | | |
| Plnt01 | **Plant Review** | **7. New plant approval** | Ability for plants to request addition of plant to approved list and request inspection for the plant. | | | | | |
| Plnt02 | Plant Review | 7. New plant approval | Ability to electronically attach the Quality Control (QC) plan so SHA members can download and review before plant visit. This will allow the plant to provide the plan and updates faster and more efficiently. | | | | | |
| Plnt03 | Plant Review | 7. New plant approval | Capability to maintain inspection/audit checklists in MMS that can be updated as required. The checklists may include checks for basic equipment operations, contact information, technician certifications, etc. | | | | | |
| Plnt04 | Plant Review | 7. New plant approval | Ability to schedule plant inspections including date, anticipated time, inspector, plant contact, etc.; and display all scheduled inspections and information on a calendar that can be printed for offline use. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Plnt05 | Plant Review | 7. New plant approval | Ability to approve or disapprove a plant approval request based on inspection, tentatively approve a plan, along with the reason for action taken, and any issues to be resolved before final approval if applicable. | | | | | |
| Plnt06 | Plant Review | 7. New plant approval | Ability to automatically add plant to list of approved plants/sources once the plant is approved. This will require tight integration between table/database of requests received and table/database of approved plants. | | | | | |
| Plnt07 | Plant Review | 7. New plant approval | Ability to distribute approval update to the requestor and other involved parties via email. The other involved parties can be added by email address or attaching a distribution list to the plant approval request. | | | | | |
| Plnt08 | Plant Review | **8. Plant QA visits** | Ability for plants to enter planned production values as well as actual production values directly in the system. This will allow SHA to track and review the information easily and allow easier scheduling of plant QA visits. | | | | | |
| Plnt09 | Plant Review | 8. Plant QA visits | Capability to notify division to schedule plant inspections based on plant's production values (e.g. Hot Mix Asphalt, Portland Cement Concrete). This provides an automated means to monitor specific plant output for SHA projects and to plan schedule inspections accordingly (based on tons of material delivered). For example, by reviewing the plant production amounts, MMS may alert the associated division, by email or otherwise, that a plant inspection is due or is coming due. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Plnt10 | Plant Review | 8. Plant QA visits | Capability to maintain QA checklists in MMS that can be updated as required. The checklists may vary based on the type of plant being inspected. The checklists should have place to rate each element to be checked on a scale of 1 to 5. The checklist should also allow entry of QC plan review comments, open issues to be resolved, etc. | | | | | |
| Plnt11 | Plant Review | 8. Plant QA visits | Ability to generate a QA visit schedule based on inspection frequency. This schedule should be modifiable to list specific dates or week ranges for the inspection. This will allow SHA to adhere to the minimum inspection frequency. | | | | | |
| Plnt12 | Plant Review | 8. Plant QA visits | Capability to record plant visits in the system along with the appropriate checklist. The plant visit record should include inspector information, date visited, checklist details, issues to be resolved, any actions taken, and any other relevant information. | | | | | |
| Plnt13 | Plant Review | 8. Plant QA visits | Ability to update plant status on approved list based on conducted inspection. This update may involve changing the plant status to temporary removal from list pending issue resolution, permanent removal, other status updates as defined by business users. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Plnt14 | Plant Review | 8. Plant QA visits | Ability to maintain and store dispute resolution procedure for plant approval. This will require multiple screens with details on the issues, and resolution steps followed for resolution of the issues. The users will be able to create new issues/disputes tied to plants, and update the status as in progress, or resolved. The system should also have the ability to generate a report with the dispute resolution steps followed. | | | | | |
| Plnt15 | Plant Review | 8. Plant QA visits | Capability to identify discrepancies in materials quantities shipped vs. quantities received through a report and/or on-line notification. This auditing is essential for proper accounting. By providing an opportunity, to determine electronically, quantities shipped vs. quantities received, discrepancies may be addressed early in the project. | | | | | |
| Plnt16 | Plant Review | 8. Plant QA visits | Ability to generate an alert when a plant's annual inspection is due. This alert should trigger an email to members that are a part of the distribution list, and will include the plant and SHA members. This will allow the plant and SHA to be more proactive in ensuring proper and continuous approval of the plants. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Plnt17 | Plant Review | 8. Plant QA visits | Capability to provide automatic notification of upcoming production schedules for plants/suppliers. Knowing the production schedule for plants/suppliers provides a heads-up notification of testing pending activity and provides for better planning. For example an SHA manager has the responsibility to schedule his/her resources to meet field and lab workloads. This capability will provide the manager with the information necessary to meet project demands. | | | | | |
| **Other** | | | | | | | | |
| Othr01 | **Other** | **9. Equipment Calibration** | Ability to provide an inventory of all lab equipment with appropriate attributes (e.g. Division, age, comments). The system should allow authorized users to add, remove or update the inventory information. | | | | | |
| Othr02 | Other | 9. Equipment Calibration | Ability to record and store calibration history for all lab equipment. The calibration history will consist of all dates the equipment was calibrated on, and a comment field for each date. The system should also allow the storage of next required calibration date for each equipment. This will provide SHA an easy means to track calibration history and determine if any equipment is due for calibration. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Othr03 | Other | Other | Ability to store placed quantities as reported by project site and quantities as reported by manufacturing plant separately in the system. These quantities will be reported by different team members (plants, PEs, others). These quantities may be different due to batches rejected on-site or other reasons, and it is important to know both the quantities for different reasons (plant inspection frequency is related to plant production, while actual pay amounts and material test frequency is related to actual quantities placed). | | | | | |
| **Reporting** | | | | | | | | |
| Rprt01 | **Reporting** | **10. Reporting** | Ability to generate reports based on sample information as follows: (These reports should be retrievable for each division, specific project, or for all labs as required)<br>- Average response time to test a sample in days<br>- Number of samples logged in the system<br>- Number of samples logged out of the system<br>- Percentage of samples tested based on number logged in and logged out<br>- Number and percentage of samples that passed<br>- Number and percentage of samples that failed | | | | | |
| Rprt02 | Reporting | 10. Reporting | Ability to generate a report to indicate all samples collected for a specific project, along with the status of each sample (pass, fail, pending, other). This should also include the total number of samples logged in, logged out, passed, and failed for the project. | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Rprt03 | Reporting | 10. Reporting | Ability to generate a report to present the number of tests that have been currently scheduled, and the number of tests that have been completed in a given time frame. The user should be able to specify parameters such as the time frame, division, and project. | | | | | |
| Rprt04 | Reporting | 10. Reporting | Ability to generate report indicating number of tests performed or inspections conducted by employee and division. | | | | | |
| Rprt05 | Reporting | 10. Reporting | Ability to generate report indicating how many samples were received with incomplete information. The user should be able to specify parameters like type of missing information, division, and project. | | | | | |
| Rprt06 | Reporting | 10. Reporting | Ability to generate report for each plant regarding number of batches shipped, projects shipped to, number of inspections at the plant, production days, and projects serviced by the plant. | | | | | |
| Rprt07 | Reporting | 10. Reporting | Ability to generate a summary of the total number of ship days for each plant and across all plants. | | | | | |
| Rprt08 | Reporting | 10. Reporting | Ability to generate a summary report of all plant inspections conducted and issues discovered at the plants. | | | | | |
| Rprt09 | Reporting | 10. Reporting | Ability to generate a report of all SHA equipment, along with their calibration information. The user should have the capability to specify parameters for the report like division, etc. | | | | | |
| Rprt10 | Reporting | 10. Reporting | Ability to generate a report showing number of samples approved with minor deviations. The user should have the capability to specify parameters for the report like division, project, etc. | | | | | |
| **MMS-Wide** | | | | | | | | |

| Req # | Business Function | Sub Function | Functional Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| MMS26 | MMS-Wide | **Internet Calendar** | Ability to generate project calendars in an internet publishable format (icalendar, vcalendar) | | | | | |
| MMS27 | MMS-Wide | | Ability to automatically attach files in the system. These files will include letters generated for distribution to contractors/PEs. | | | | | |
| MMS28 | MMS-Wide | | Ability to classify projects based on funding type of the project (e.g. Federal aid, exempt; Federal aid, non-exempt) | | | | | |
| MMS29 | MMS-Wide | | Ability to record and report the quantity of a material approved on certification vs. quantity used on the project. | | | | | |
| MMS30 | MMS-Wide | | Ability to trigger an alert when the approved quantity of a material (accepted on certification) has been used on a project and a new certification is now required. For example, a large volume of a material may be received at a job site with the proper certifications and the material may not be used all at once. An alert is necessary to assure that the relevant system users are aware that additional certification must be sought. | | | | | |

## Operational Requirements RTM

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Aud01 | Audit Trail | Monitor | Capability to provide a report of the date & time, any changes, adds or deletes made and the logon ID of the user accessing monitored data files. For example, in the event of data corruption, erasure, or other contamination, a report shall be available to detail user recent activity. | | | | | |
| Aud02 | Audit Trail | Monitor | Capability to segment users by division and configure audit capabilities only to users with access to the defined databases. For example, if a user only has rights to access the forms and reports data segment, that user will be audited based on the access to those segments only. | | | | | |
| Aud03 | Audit Trail | Monitor | Capability to monitor access to Source of Supply Letters/Lists, test results, contractor information, project notes, SHA forms and other designated databases. For example, each time a user access a monitored data file, a record will be posited of the activity. | | | | | |
| Cap01 | Capacity | Database | Capability to handle high volumes of data that may occur on a "peak" basis. For example, end of month final clearances, monthly reporting and ad-hoc queries for completion status will generate a high volume of data while routine project work during the month may range from low to high. | | | | | |
| Cap02 | Capacity | Database | Capability to process transactions from estimated 400-500 total users on a daily basis. In addition to the SHA users, transactions will be created by contractors, suppliers and outsourced labs. For example, transactions will include, at a minimum, Source of Supply Letters/Lists from contractors, the transfer of sample information between lab and field forces, the submission and retrieval of project test results, access of information for reports, ad-hoc user queries. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| DC01 | Data Currency | Backup | Capability to provide data in near real-time in response to requests for data access. For example, resource allocation and deployment decisions for field and lab work are based on project dates. The dates reflected in MMS must be as recent as possible. | | | | | |
| DC02 | Data Currency | Backup | Capability to maintain a current back-up of the system database to be utilized for restoration in the event of catastrophic failure and loss of data. For example, a fire or other event could destroy the server causing total loss of data and system configurations. | | | | | |
| DC03 | Data Currency | Backup | Capability to maintain a current backup of all system configurations to be utilized in case of catastrophic loss to the server. | | | | | |
| DaR01 | Data Retention | Cleanup | Ability for the administrator to delete old records as required. It is anticipated that the records will be archived most of the time and not deleted, but a deletion may be required in case of duplicate entries or other unforeseen circumstances. | | | | | |
| DaR02 | Data Retention | Storage | Capability to store project related data for an indefinite period of time. For example, project related data may be retained for the life of the asset associated with the project. For example, there will be varying degrees of retention requirements throughout the system database, from "none" to indefinite. | | | | | |
| DaR03 | Data Retention | Storage | Ability to save data in a common or easily accessible format. This may include .pdf, WORD or other common format. For example, there will be specific users (TBD) who may have limited or no access to MMS. This ability will enhance the function of emailing and/or printing. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| FT01 | Fault Tolerance | Configuration Management | Capability to provide additional back-up and protection for specified system applications during planned or unplanned outages. For example, applications supporting the source of supply test and approval process are critical while email (from within MMS) and field access to the system may be less critical. | | | | | |
| FT02 | Fault Tolerance | Configuration Management | Capability to react to a single board or data drive failure through a fault tolerant architecture. For example, if a circuit board or other piece of hardware fails, the system shall be capable of continuing functionality through redundant hardware/software configuration architecture. | | | | | |
| Perf01 | Performance | Measurements | Capability to provide system performance analysis and reports. For example, a log of system bugs and or actual interruptions shall be kept and statistically analyzed to address current issues and to predict possible future issues. | | | | | |
| Perf02 | Performance | Measurements | Capability to provide performance measurement details based upon the number of tests and test completion data (e.g. time required to complete a specific test or all tests on a particular sample). For example, The "Approve By" date and other performance measurement opportunities may be accessed via MMS. | | | | | |
| Perf03 | Performance | Measurements | Capability to provide Statistical analysis and/or ability to extract to a statistical analysis package to review mix designs and other designated analytical functions. For example, an analysis of missed project completion dates and their causes may be analyzed and reports provided. | | | | | |
| Perf04 | Performance | Process Support | Capability to provide response to user queries in three seconds or less. For example when an icon or menu item is selected, the user should notice no delay in viewing the requested screen or data list. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Perf05 | Performance | User Support | Capability to provide user multi-tasking with system screens. For example, a user may have multiple MMS screens open and active while also using other application screens. | | | | | |
| Perf06 | Performance | User Support | Capability to provide system user documentation that is comprehensive, clear and easy to use. For example, system user documentation shall provide quick answers to questions regarding the navigation of the system screens. | | | | | |
| Rcvr01 | Recoverability | Configuration Management | Capability to provide data redundancy to protect against loss of data due to system failure For example, in the event of a total failure of MMS, the database shall be recoverable and be restored to the image that existed at the time of failure. | | | | | |
| Rcvr02 | Recoverability | Configuration Management | Capability to recover from, or not be impacted by a commercial power failure. A given power failure may be just from a moment to many hours. It is expected that all functionality and data access would remain intact. For example an alternate source of power shall be available and the MMS wired to that source of power. | | | | | |
| Rcvr03 | Recoverability | Configuration Management | Capability to restore full functionality and data integrity within thirty minutes of detecting the failure. For example, critical hardware spares and recent system & data backups shall be available on site. | | | | | |
| Rel01 | Reliability | System Measurements | Capability to meet a Monthly Mean Time to Repair (MTTR) performance of five minutes. MTTR is figured by dividing total system down time by the number of outage occurrences for the month. | | | | | |
| Rel02 | Reliability | System Measurements | Ability to provide same-day replacement for failed hardware parts causing system outage (down-time) and twenty-four hour turn-around time for repair and/or replacement of defective parts. For example, a failure may occur that requires a hardware item that is not at the site. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Rel03 | Reliability | System Measurements | Capability to perform system backups that are transparent to the users. For example, information for reports and project scheduling must be as current as possible which necessitates frequent backups. | | | | | |
| RD01 | Retrieve Data | User Support | Ad-hoc query capability to retrieve test results by non-project characteristics (mix design, location, contractor, materials supplier, etc.). This capability requires that a user can obtain project data based upon various data point starting points. For example, retrieve a materials supplier, and view all of the projects that that supplier is currently involved in (or has been involved in). | | | | | |
| Sec01 | Security | Data | Capability to protect Application Data from contamination and/or erasure by users. For example, the loss or contamination of vital project information, such as Source of Supply Letter, test results or project notes could jeopardize project schedules. | | | | | |
| Sec02 | Security | Data | Capability to protect sensitive SHA and contractor data from casual access. For example a supplier's specific materials mix submitted for testing or SHA project costing information. | | | | | |
| Sec03 | Security | Environment | Access to the IT facility housing the MMS servers shall be controlled and monitored. For example, key card entry shall be utilized to track users' access to the server area. | | | | | |
| Sec04 | Security | User Configuration | Capability to provide a user logon interface that is designed to allow access to specific data by designated users within SHA Divisions. For example, users in the Asphalt Technology Division may not need access to projects associated with Soils and Aggregates Division. Also, some users need an access for a specific purpose such as preparing reports, while another user may need full administrative access. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Sec05 | Security | User Configuration | Capability to limit access to designated non-SHA users, such as contractors and consultants. However, this access must be restricted and recorded within the system. For example, contractors may require access to submit sources for approval and to check on project status. | | | | | |
| Sec06 | Security | User Configuration | Capability to provide reports detailing outside user access. For example, a monthly report of outside user access may be provided to check against contractor project activity. | | | | | |
| Sec07 | Security | User Configuration | Capability to restrict access to a limited number of individuals with permission to alter data tables, applications and other database configurations. For example, in order to protect the integrity of the MMS data, only designated members of the Office of Materials Technology (OMT) shall have these permissions. | | | | | |
| Sec08 | Security | User Configuration | Capability to limit some users to "View Only" MMS access on specified projects or materials. For example some users may only need to check on completion dates or other key project information with no need to input or retrieve data. | | | | | |
| Sec09 | Security | User Configuration | Capability to monitor and restrict SHA field access by project. The field will however have input access related to plant inspections and certifications. For example, field staff may only access data relevant to a current project at their site location but be given permission to access the plant certification data base to update inspection information. | | | | | |
| Sec10 | Security | User Configuration | Capability to monitor and control access to MMS interfacing systems, by restricting other system access by an additional layer of password security or other means. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| Sec11 | Security | User Configuration | Capability to provide a robust authentication procedure to be employed for all logins. For example, VPN remote access may be allowed with authentication. | | | | | |
| Sec12 | Security | User Configuration | Capability to require passwords to be changed on a regular basis. For example, the system should prompt the user every three months to request a change in password. | | | | | |
| Sec13 | Security | User Configuration | Allow users to request password reset requests from the web interface. Users should be assigned temporary passwords and required to change at first login. For example, users often forget their logon information and require a method to have it reset. | | | | | |
| Sec14 | Security | User Configuration | Allow users to choose from multiple roles if the user is assigned more than one role (e.g. Project Manager, administrator). For example, a division head may require a logon that has access to the entire division. | | | | | |
| Sec15 | Security | User Configuration | Capability to restrict the display to only the options and icon selections to which the user has rights. For example a user's logon would define the functionality required and present only that capability. This has the added benefit of simplifying the screen for the user. | | | | | |
| Sec16 | Security | User Configuration | Facilitate Single Sign-on to use enterprise login information for OMT staff and allow use of VPN or request login credentials for web-based modules. For example, the Office of Materials Technology has responsibility for MMS and the processes it supports. VPN may be used with authentication. | | | | | |

| Req # | Business Function | Sub Function | Operational Requirements | Software Module | Test Spec | Subsystem Integration Test Case # | User Acceptance Test Case # | Security Test Case # |
|---|---|---|---|---|---|---|---|---|
| SyAv01 | System Availability | Failure Management | Capability to provide 24/7 system uptime. For example, data transfers with interfacing systems and other automated system routines must be accommodated. Peak system usage is expected to be from 6:30 a.m. to 5:30 p.m. This time period is the least optimal time to schedule planned maintenance outages. | | | | | |
| SyAv02 | System Availability | Failure Management | Capability to provide simultaneous access to all MMS screens by all concurrent users. There shall be no degradation of service or extended screen wait time. For example, all users may have a need for information on a specific project, at the same time. It is estimated that initially the system will have 400-500 total users. | | | | | |
| SyAv03 | System Availability | Failure Management | Capability to provide system availability at 99.999%. This equates to a total of five minutes of unplanned outage for a year. | | | | | |
| SyAv04 | System Availability | Failure Management | Ability to conduct scheduled maintenance during hours designated as the "Maintenance Window." For example, the Maintenance Window may be designated from midnight to two a.m. It is possible that the Maintenance Window could be expanded dependent upon the estimated time to perform the scheduled maintenance. This "window" applies to work performed by SHA as well as work performed by the vendor. | | | | | |