SYSTEM TECHNICAL DOCUMENT

DOT Scanning Project

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This document describes technical specifications of the DOT Scanning Project

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Overview

This document describes technical specifications for the highway plan scanning project sponsored by the WV Department of Transportation (DOT). The system utilizes ESRI ArcGIS Server and Microsoft SQL Server database software for collecting, storing and searching a digital collection of plans. A web application (http://www.mapwv.gov/dotplans) developed using the ArcGIS JavaScript API and PHP allows users to search the collection.

The digital images are produced by scanning hardcopy highway plan sheets provided by DOT into TIFF format. The images are then loaded into and ESRI format geodatabase that is used to provide spatial searches and web based access. A second database is used to record additional metadata related to the images along with a recording of the operational activity involved it the manual scanning process. A Microsoft Access application is used by the operations staff as the interface for entering this information.

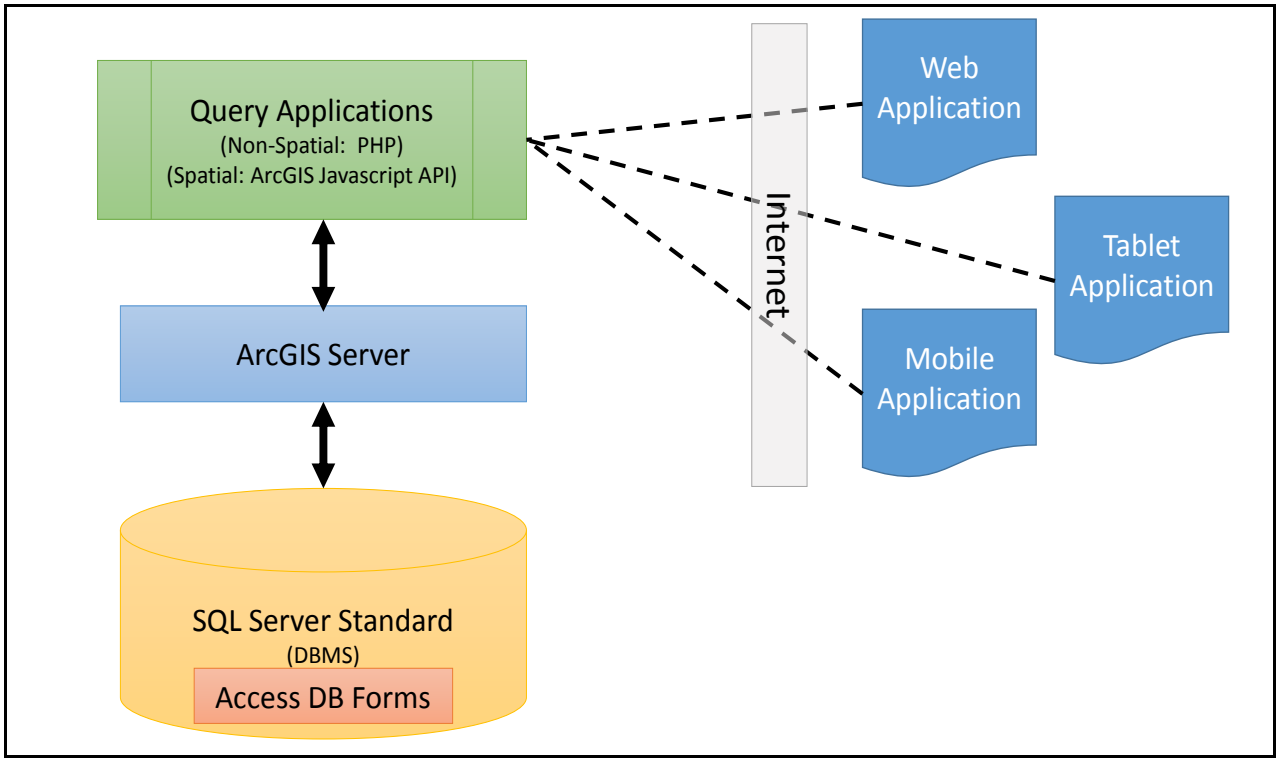


Figure 1: System Architecture

Server Hardware Configuration

The server is a virtual server that is housed on a physical servers located at the West Virginia GIS Technical Center on the campus of West Virginia University. The server uses Microsoft's Hyper-V virtualization environment, an industry standard virtualization environment. The physical server is connected via fiber channel to a Storage Area Network (SAN). The SAN provides RAID redundancy and speed using RAID level 10. RAID level 10 combines the speed benefits of striping of drives with the natural 100% redundancy of mirrored drives. In effect, the SAN at RAID 10 level provides a mirror of the stripes within the storage array. This provides a degree of redundancy that is highly resilient to any hardware failures within the SAN.

The physical machine itself runs Windows 2012 R2 Server with 4 CPUs each operating at 2.5 ghz (Figure 2). The virtual machine has 16 gigabytes of RAM memory for handling a large number of internal and external users. Data is stored in Microsoft's SQL Server 2012 Standard edition. The database itself is stored on a 6 TB data drive located on the SAN. SQL Server provides the ability to import and export the data to offsite data storage, such as external drives, which creates yet more resilience in the system.

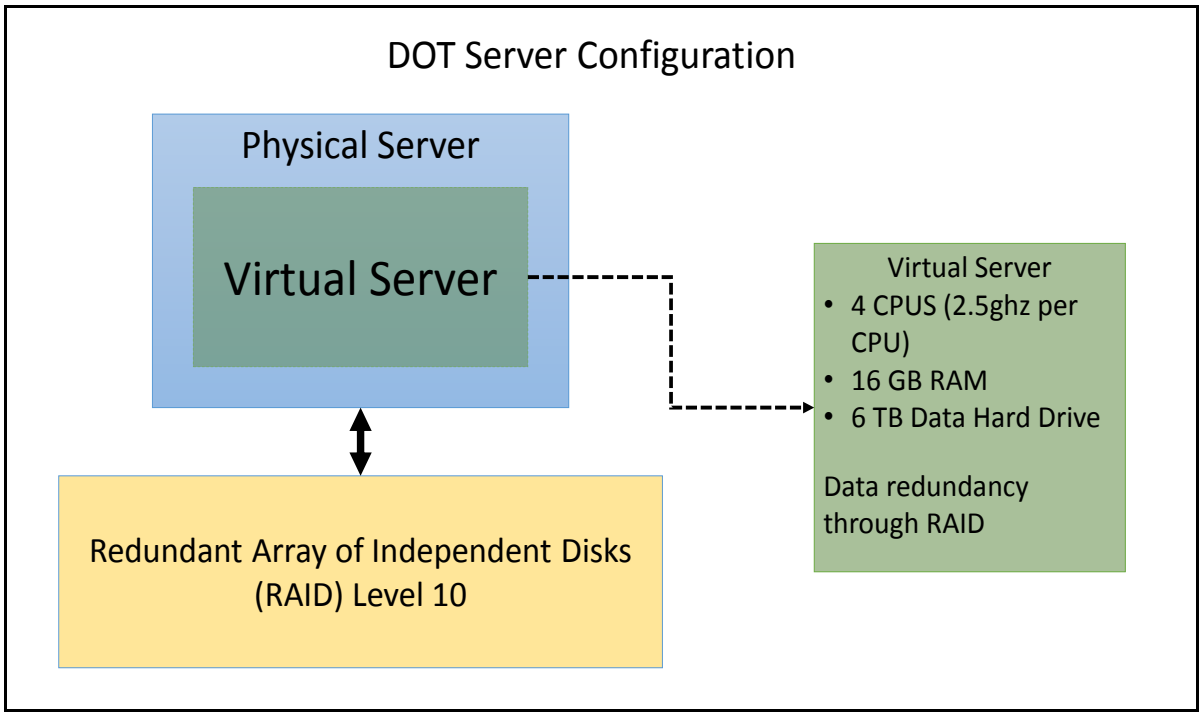


Figure 2: DOT Server Configuration

Note: The system runs on a virtual server house on a single physical server.

Microsoft SQL Server Database

Enterprise Database

The enterprise geodatabase is house in a Microsoft SQL Server 2012 Standard edition database. This database supports high performance data access, automation of various processes through the use of triggers, and an automated backup process.

Backup and Recovery

Full database backups are performed weekly and incremental backups are performed daily. These are performed using scheduled SQL Server Agent jobs that run database maintenance plans. The schedules and plans are authored and managed using Microsoft SQL Server Management Studio. This allows the data to be restored to its end-of-day state for any selected date. All backups are maintained for one year. Restores to previous versions of the data are performed using built-in SQL Server capabilities. This processing and other database administration is normally performed using the *Microsoft SQL Server Management Studio* application. Database access permissions are based on the use of Windows Authentication; that is Windows network domain logins.

ArcGIS Server Configuration

ArcGIS Server and ArcSDE

ESRI's ArcGIS Server 10.3.1 and Microsoft's SQL Server 2012 are currently configured on a development server machine and is in the process of being migrated to a production server. Also, ArcGIS Desktop is installed for GIS resource composing. In the DOT Scanning system, a Microsoft SQL Server-powered geodatabase stores all the data. While ArcGIS Desktop, i.e., ArcMap, can save data to the geodatabase server directly, ArcGIS Desktop is also used to compose DOT related image services. ArcGIS Server publishes the resources, primarily maps and data, which are from ArcGIS Desktop, as RESTful web map service and/or feature service. The DOT web interface supports querying and displaying of georeferenced project plans using ArcGIS feature services. The communications between different components can be seen at Figure 3.

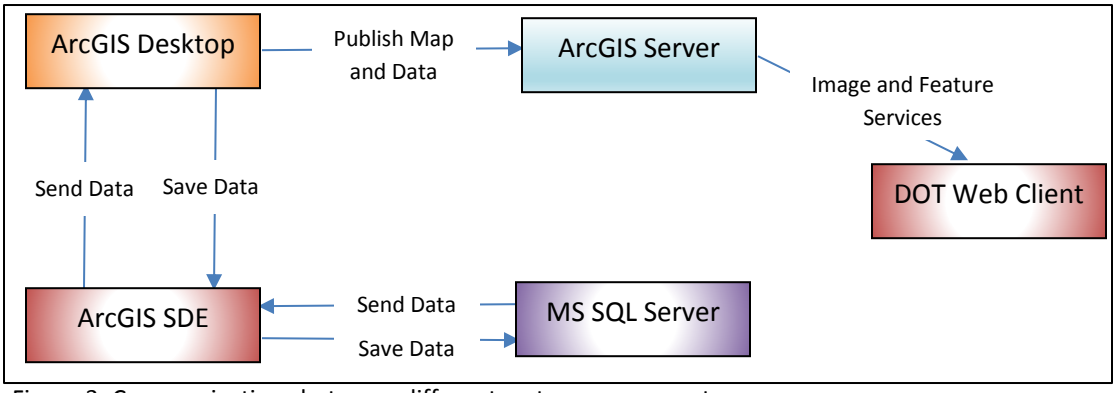


Figure 3: Communications between different system components.

Types of Services

Image Services. The Image Service makes scanned images of DOT Project Plan data available to the Web interface. It includes a viewing only DOT image layer and an outline footprint layers.

Feature Services (aka: Feature Access Capability). Feature Access capability is embedded on a map service, and it provides accesses to vector data that are served by an enterprise-level relational database management system (RDMS). To implement this capability, an enterprise level of RDMS-based ArcSDE is required. The Feature Access capability not only allows users to edit features by using thin clients, such as the application developed by using ArcGIS JavaScript API, but also allows users to edit features by using fat clients, such as ArcMap Desktop. The following figure illustrates the general idea of feature editing behind of Feature Access capability.

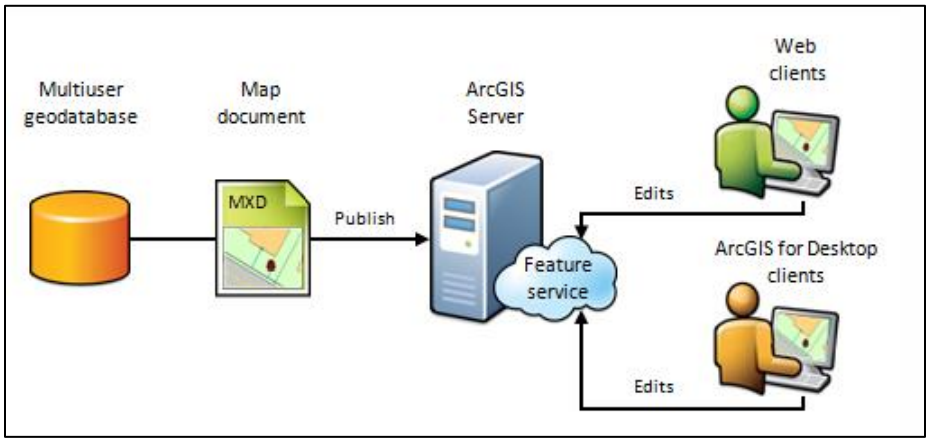


Figure 4: Feature service architecture

Spatial Reference

The map layers in the SQL Server Database are projected to UTM Zone 17. The map projection of the map services of the application is reprojected to Web Mercator (Auxiliary Sphere) EPSG: 3857. Length and area calculations are performed in UTM Zone 17 for positional accuracy reasons.

DOT Plan Viewer Web Application

The DOT Plan Viewer Web application allows users to query the database for plan sets based on a variety of metadata attributes. The query interface can be access at http://mapwv.gov/dotplans.html. The query results are presented in tabular form with links that allow the user to view additional metadata details access related PDF documents and GeoTIFF images. The interface also allows the user to view plan images overlaid on a map background. Searching can be performed using either a free-form text search capability that searches for matching information across all metadata or by searching for matching information in specific fields. The search options are shown in Figure 6. The web application was developed using the ArcGIS JavaScript API and PHP. The PHP, a server-side HTML embedded scripting language, allows access to the non-spatial scanning data while the ArcGIS JavaScript provides access to spatial information.

User Interface

The interface also allows the user to view plan images overlaid on a map background. Searching can be performed using either a free-form text search capability that searches for matching information across all metadata or by searching for matching information in specific fields. The search interface options are shown in Figure 5.

Figure 5: Web Search Interface

Query results are presented in tabular form with hyperlinks that allow the user to access additional metadata and plan imagery. Figure 6 shows an example of the query results. The icons on the left of the tabular results provide access to related PDF documents, GeoTIFFs, and georeferenced imagery. The Project Key column provides a hyperlink to additional details related to the selected Project Plan. The Query URL value presented at the top of the results table can be shared with other users as a means of quickly invoking the same query that produced the results.

Query URL: //mapwv.gov/dotplans/index.php?county=Boone&signSystem=County Route&limitResults=on

20 matches out of 1819 published scans

ID	Project Key	Project Title	Federal Project	State Project	County	Sign System	Year	Route	Mile	Bridge
3	B_03_4_0003_10_000_1994_S00003	Keith Bridge	BRO_0310(009)E	S303-3/10-0.02	Boone	County	1994	3	0	---
184	B_03_4_0001_00_008_2007_S00184	Ashford Truss Bridge	BR-0001(112)E	S303-1-8.28 00	Boone	County	2007	1	8	---
514	P_03_4_0005_00_000_1974_S00514	Coal River Bridge at Seth		B00-5-18-5074	Boone	County	1974	5	0	2973
583	B_03_4_0085_05_000_1986_S00583	Danville Temporary Bridge	BRO-0858(003)5C-1	S303-85/8-0.37(0.2)	Boone	County	1986	85	0	3707
599	B_03_4_0020_00_005_1984_S00599	Boone County Route 20	BRS-0020(45)5	S303-20-4.64	Boone	County	1984	20	5	3372
609	B_03_4_0017_00_000_1985_S00609	Spruce Fork Bridge	BRS-0017(018)	S703-17-8.80	Boone	County	1985	17	0	3432
697	B_03_4_0017_00_001_1979_S00697	State Route 17 over Spruce Fork	BRS-0017(002)	5303-17-0.53	Boone	County	1979	17	1	3247
882	B_03_4_0119_20_000_1982_S00882	Madison Bridge Replacement	BRO-1192(001)	S303-119/20-0.20	Boone	County	1982	119	0	4326
897	B_03_4_0010_00_006_1979_S00897	Route 10 over Mud River		S703-10-6.61	Boone	County	1979	10	6	3251
902	B_03_4_0009_00_000_1979_S00902	Jeffrey Bridge over Spruce Fork	BRS-0009(004)	S303-9-0.01	Boone	County	1979	9	0	3254
905	B_03_4_0119_20_000_1982_S00905	Madison Bridge Replacement	BRO-1192(001)	S303-119/20-0.20	Boone	County	1982	119	0	3258
1059	B_03_4_0000_00_000_1982_S01059	East Madison Bridge			Boone	County	1982	0	0	B105

Figure 6: Web query results example

Clicking on the Project Key hyperlink displays a page containing additional details related to the selected project (Figure 7). The ProjectWise link at the bottom of the form allows DOT staff to directly access additional details stored in the ProjectWise information management system. This feature is only available to users who are currently logged in to the DOT internal network.

West Virginia
Department of Transportation

Project: B_17_2_0019_00_026_2012_S00142

Scan ID:	142
Project Title:	Shinnston Bridge
Federal Project:	BR-0019(197)D
State Project:	S317-19-26.19
County:	Harrison
District:	4
Plan Type:	Bridge
Sign System:	U.S. Highway
Route:	19
Mile:	26
Special ID:	N/A
Bridges:	
Fiscal Year:	2012
Supplemental Code:	(20) Construction
Project Status:	Final Design
Book Location:	DOT
Scanning:	Scanned 06/18/2014, 152 Sheets, 152 Scans
PDF:	PDF
GeoTIFF:	GeoTIFF
Map:	Show on Map
Comments:	Sheet #0146 has a different federal project number. Sheets #0143-0145 have no sheet number.
ProjectWise:	pw://DOTB6PWHQ.executive.stateofwv.gov:PW-Primary/Documents/P{09b3cd20-1541-40e5-a71c-3c06dec50c4d}/

Query URL: //mapwv.gov/dotplans/Index.php?scanID=142

Figure 7: Project Plan detail form

DOT Project Tracking Data Specifications

Data Model

The model used to manage DOT scanning data was custom designed to handle all of the custom attributes required by DOT as well as to enforce data integrity and consistency. The Project Database was created which incorporates fields (field names uppercase) from the original DOT database. The new Project Database has 36 fields and auto generates the *Project Key* from select data fields. Some of the data fields are auto-generated from other fields. Select fields are used by the Web map index.

Figures 8 and 9 show high-level data model diagrams of the DOT database. Figure 8 shows the tables used to record and manage the project book scanning metadata. Figure 9 shows the tables used to record and monitory the operational activity related to the scanning process. The individual tables and fields are defined below in Tables 1 through 15.

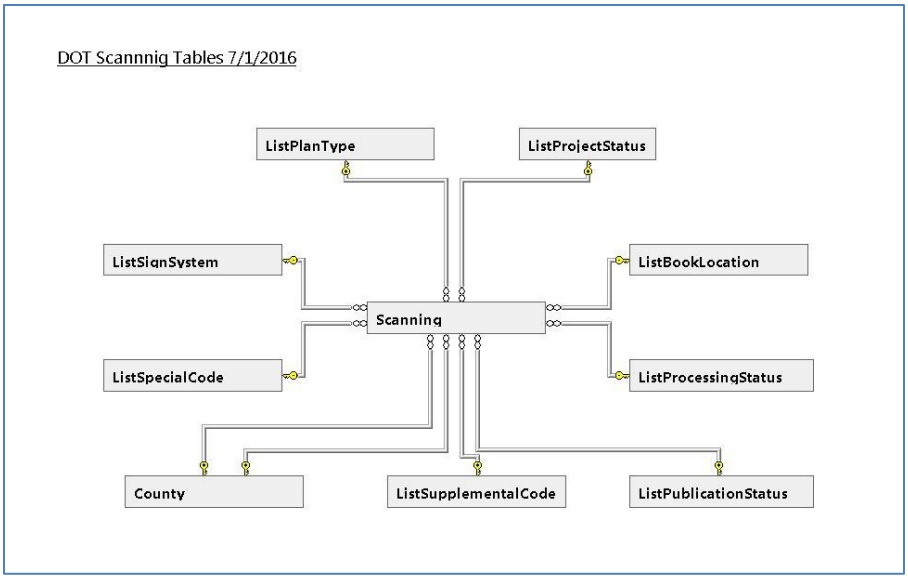


Figure 8: DOT Database tables used for storing Project Book metadata.

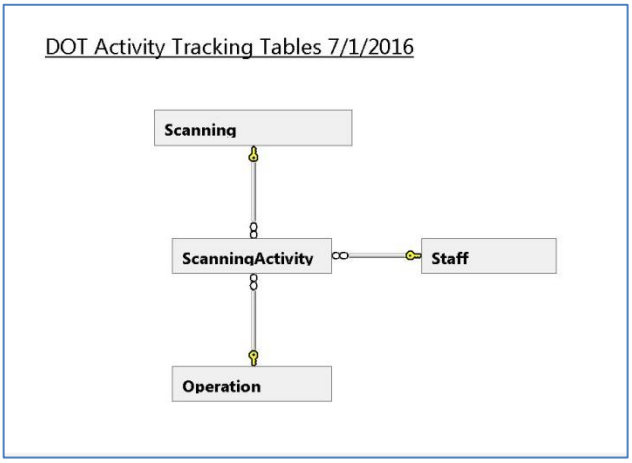


Figure 9: DOT Database tables used for tracking operational scanning activity.

DOT Data Dictionary

County Table of West Virginia Counties							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	The name of the County	--	--	varchar	50	--	--
Code	Two digit numerical identifier for the County provided by CAMA data source	--	--	varchar	2	Yes	--
FIPSCode	Five digit combination of State and County FIPS codes	--	--	int	4	Yes	--

Table 1: County table definition

ListBookLocation Lookup table containing a list of possible locations for hardcopy DOT project books							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	Name of the location	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 2: ListBookLocation table definition

ListDirection Lookup table containing the list of possible road directions along with corresponding coded values							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	Name of the road direction	--	--	varchar	50	--	--
Abbreviation	Abbreviation of the road direction	--	--	varchar	5	--	--
Notes	Note describing the record	--	--	varchar	500	Yes	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	((1))

Table 3: ListDirection table definition

ListPlanType Lookup table containing the list of possible plan types along with corresponding coded values							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Code	Code for the Plan Type	--	--	varchar	1	--	--
Name	The name of the Plan Type	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 4: ListPlanType table definition

ListProcessingStatus Lookup table containing possible operational status values for in-process project books							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	The name of the Processing status	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	((1))

Table 5: ListProcessingStatus table definition

ListProjectStatus Lookup table containing the list of possible DOT defined project book statuses							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	The name of the Project Status	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 6: ListProjectStatus table definition

ListPublicationStatus Lookup table containing list of possible publication statuses that control whether individual projects books are listed and displayed in the on-line interface							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	The name of the Publication Status - Indicates the visibility of of the Project Book data	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	((1))

Table 7: ListPublicationStatus table definition

ListSignSystem Lookup table containing DOT defined Sign System values along with corresponding coded values							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Code	Code for the Sign System	--	--	varchar	1	Yes	--
Name	Name of the Sign System	--	--	varchar	50	--	--
ShortName	Shorter version of the name - Used for compact display and reporting	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 8: ListSignSystem table definition

ListSpecialCode Lookup table containing DOT defined 'Special' codes used to distinguish project types							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Code	Code for the Special Code	--	--	varchar	2	Yes	--
Name	Name of the Special Code	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 9: ListSpecialCode table definition

ListSupplementalCode Lookup table containing DOT defined Supplemental Codes							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	Name of the Supplemental Code	--	--	varchar	50	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	--

Table 10: ListSupplementalCode table definition

Operation List of individual operations tasks involved in scanning and loading DOT project books							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
Name	Name of a specific processing operation	--	--	varchar	50	--	--
SupervisorOperation	Boolean flag indicating if the operation can only be performed by a supervisor	--	--	bit	1	--	--
SortOrder	Value used for sorting on reports and UI	--	--	int	4	--	((1))

Table 11: Operation table definition

Scanning Primary table used to store Project Book metadata							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	Yes	--	int	4	--	--
ProcessingStatusID	The ID of the corresponding Processing Status	--	Yes	int	4	--	((1))
PublicationStatusID	The ID of the corresponding Publication Status	--	Yes	int	4	--	((1))
ProjectTitle	The DOT project title	--	--	varchar	100	Yes	--
FederalProject	DOT supplied Federal Project Title	--	--	varchar	50	Yes	--
StateProject	DOT provided State Project Title	--	--	varchar	50	Yes	--
CountyID	The ID of the corresponding County record	--	Yes	int	4	Yes	--
County2ID	The ID of a secondary County related to the project	--	Yes	int	4	Yes	--
District	DOT supplied District name	--	--	int	4	Yes	--
SignSystemID	ID of the corresponding Sign System	--	Yes	int	4	Yes	--
RouteNumber	DOT supplied Route Number	--	--	int	4	Yes	--
SubRoute	DOT supplied Sub-Route Number	--	--	int	4	Yes	--
ProjectLength	Length in miles of the section of road affected by the project	--	--	varchar	255	Yes	--
ProjectDate	DOT Supplied date of the project	--	--	Date time	8	Yes	--
FiscalYear	Fiscal year that the project was budgeted to	--	--	int	4	Yes	--

Scanning Primary table used to store Project Book metadata							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
SheetCount	Number of scheets in the project book	--	--	int	4	Yes	--
ScanCount	Number of sheets actually scanned	--	--	int	4	Yes	--
PlanTypeID	ID of the corresponding Plan Type	--	Yes	int	4	Yes	--
ScanDate	The date that the scanning of the project book was completed	--	--	Datetime	8	Yes	--
BookLocationID	ID of the corresponding Book Location	--	Yes	int	4	Yes	--
Comments	General comments regarding the scanning activity for the project	--	--	varchar	255	Yes	--
SupplementalCodeID	ID of the correspoinding Supplemental Code	--	Yes	int	4	Yes	--
DirectionID	ID of the corresponding Direction record	--	--	int	4	Yes	--
BeginMile	The beginning mile marker for the project	--	--	int	4	Yes	--
ProjectStatusID	ID of the corresponding Project Status record	--	Yes	int	4	Yes	--
SpecialCodeID	ID of the corresponding Special Code record	--	Yes	int	4	Yes	--
SpecialID	Not Used	--	--	varchar	5	Yes	--
BridgeNumbers	Comma delimited list of DOT supplied bridge numbers related to the project	--	--	varchar	100	Yes	--
OldProjectKey	Not used	--	--	varchar	50	Yes	--
OldDOTKey	Not used	--	--	varchar	20	Yes	--
GeoTIFFSheet	The number of the sheet that the GeoTIFF was created from	--	--	varchar	3	Yes	--
XMax	Bounding rectangle Maximum X coordinate	--	--	numeric	9	Yes	--
XMin	Bounding rectangle Minimum X coordinate	--	--	numeric	9	Yes	--
YMax	Bounding rectangle Maximum Y coordinate	--	--	numeric	9	Yes	--
YMin	Bounding rectangle Mimimun Y coordinate	--	--	numeric	9	Yes	--
URN	DOT internal pathname to the ProjectWise record for the project	--	--	varchar	500	Yes	--

Table 12: Scanning table definition

ScanningActivity Table used to record the work involved in scanning and loading DOT project books							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Primary Key - Unique Identifier	1	--	int	4	--	--
StaffID	ID of the Staff member associated with the activity record	--	Yes	int	4	--	--
ScanningID	ID of the Scanning record that this activity is related to	--	Yes	int	4	--	--
OperationID	ID of the corresponding Operation type	--	Yes	int	4	--	--
ActivityDate	The date and time that the activity completed	--	--	date	3	Yes	GetDate
Minutes	The number of minutes that the activity took	--	--	int	4	Yes	((0))
Quantity	The number of items processed	--	--	int	4	Yes	((0))
Notes	Note related to the activity	--	--	varchar	1000	Yes	

Table 13: ScanningActivity table definition

ScanningCountyUsage Used to link Counties to DOT Projects - CURRENTLY NOT USED							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Unique identifier - Primary key value	1	--	int	4	--	--
ScanningID	Foreign key to the related Scanning record	--	Yes	int	4	--	--
CountyID	Foreign key to the related County record	--	Yes	int	4	--	--
IsPrimary	Boolean flag indicating if the referenced County is the primary county related to the project	--	--	bit	1	--	--

Table 14: ScanningCountyUsage table definition

Staff Table containing a list of WV GIS Tech Center workers involved in the project book scanning project							
Column Name	**Description**	**Primary Key**	**Foreign Key**	**Data Type**	**Length**	**Allow Nulls**	**Default Value**
ID	Value used for sorting on reports and UI	1	--	int	4	--	--
FirstName	The persons first name	--	--	varchar	20	--	--
LastName	The persons last name	--	--	varchar	20	--	--
IsActive	Boolean flag indicating if the person is an active employee. Only active employees can perform processing operations.	--	--	bit	1	--	((1))
Notes	General notes related to the person	--	--	varchar	500	Yes	

Table 15: Staff table definition

WV DOT File Name Conventions and Codes

Scanning File Name Convention

The following table illustrates the file naming convention, a fixed-length alpha-numeric name of 28 digits that describes the project being named. The first 13 digits follow the WV DOT County Route ID naming convention. Folder structures and scanned files will adopt this convention for file organization. All the files will be complete to include leading zeroes and null values so that all Project Key Numbers have the same fixed length format. Fields are separated by underscores within the file name for readability.

PRIMARY FIELDS: Plan Type, County Code, Sign System Code, Route, Sub-Route, Begin Mile Marker, Scan Order Number, Fiscal Year, ScanID, and Sheet Number where appropriate

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	S	–	–	–	–	–	–	–	–	–	–
Type	County ID		Sign System	Route Number				Sub Route		Begin Milepost			Fiscal Year				Unique Scan ID						Sheet Number			Suffix	

PROJECT KEY NUMBER: The unique ID number generated for each project book. The first 8 fields are concatenated and separated with underscores to create this Project Key Number which is also the file folder name. The last two fields are for the sheet names of the individual scanned TIFF files; total file name characters of Project Key Number (23 characters) and Sheet Number and Suffix (5 characters) sums to 28 possible characters.

EXAMPLE FILE NAMES: Boldfaced text represents Project Key Number; regular text represents sheet number and suffix.

1 2 3 4 5 6
12345678901234567890123456789012345678901234567890123456789012

B_06_1_0064_00_011_2012_S00149	(Folder name)
B_02_3_0081_08_000_2008_S00150.pdf	(PDF highway plan set)
B_52_4_0036_00_002_2010_S00151_0010A1.tif	(TIF file of individual scanned sheet)
P_47_2_0048_00_073_2005_S00152_0002.tif	(TIF file of individual scanned sheet)
B_23_3_0010_00_013_2012_S00153_0157B.tif	(TIF file of individual scanned sheet)
R_17_1_0079_00_132_1971_S00156_0001_UTM17N83.tif.zip	(Compressed Geo-Referenced Tiff)

PRIMARY FIELDS: Data elements that are part of Scanned File Name

- **Type:** Must be a letter.
  Currently permitted values:
  R = Right of Way, P = Construction Plan, B = Bridge, S = Shop Drawings,
  H = Half Size, A = As Built

- **County Code:** Denotes a numeric code associated with each county. This reflects the county of origin of the project. This code is the numeric equivalent of the alphabetized county name list.

- **Sign System:** Denotes sign system. Code specified by WV DOT.
  Example: 1 = Interstate, 2 = US Route, 3 = State, 4 = County

- **Route Number:** Denotes the project primary route number.

- **Sub Route Number:** Denotes the primary sub-route number.

- **Begin Milepost:** Denotes the project's beginning milepost, as stated on the project cover/index sheet. If the beginning milepost is unknown, the value 000 shall be entered.

- **Fiscal Year:** Denotes the fiscal year, as stated on the project cover/index sheet.

- **Scan ID:** Unique scan order number.

- **Sheet Number:** Denotes a 3-digit sheet number as stated on the page/sheet scanned. Folder names shall not include these characters.

- **Suffix:** Multi-use, alpha-numerical characters of two digits or more to ensure scanned sheet file names are in the proper sequential order. Can denote: alpha-characters that appear after the page number as seen on the scanned sheet, as in page 5**A**, 5**B**, etc.; the reverse side of a sheet; sheets that have no page number; deleted sheets. Additional uses added as discovered. Folder names shall not include these characters. Can be left blank.

SUPPLEMENTARY FIELDS: Data elements that can be added to the Project Tracking Database and subsequently displayed or queried using the Highway Plan Locator tool.

- **Direction:** Denotes the directional heading of the roads depicted on the map. NB, SB, EB, WB for dual geometry; 00 for bidirectional, single geometry road systems.

- **Supplemental Code**: Denotes a supplementary code identifier which refers to a key provided by WVDOT. (See below for all values)

- **Status ID:** Denotes Project book Status ID. Code to be specified by WV DOT: 1 = initial design, 2 = preliminary design, 3 = final design

- **Special ID:** Denotes a special code. This code is intended to differentiate between multiple contracts or projects that fall within the same route and milepost. Code to be specified by WV DOT.
  Example: 01 = contract 1, AA = archived set. (See WVDOT table for all values)

- **Bridge/Structure Number:** If there are multiple bridge design or structure identifiers, then list in order from lowest to highest.

Project Key Domain And Default Values:

FIELD NAME	WIDTH	DOMAIN VALUES	DEFAULT VALUES
Plan Type	1	R = Right of Way, P = Construction Plan, B = Bridge, S = Shop Drawings, H = Half Size, A = As Built	Required
County Code	2	County Number 01 (Barbour) through 55 (Wyoming); 99 for statewide continuous features	Required
Sign System	1	Sign system of route: 1 = Interstate, 2 = US Route, 3 = State, 4 = County (See WVDOT table for all values)	Required
Route Number	4	Project Route Number	Required
Sub Route	2	Sub-Route Number	00
Begin Milepost	3	Starting Milepost Number	000
Fiscal Year	4	Project fiscal year as it appears on the cover sheet	Required
Scan ID	6	Letter "S" plus unique 5-digit scan order number for scans done by Main Office or WVGIST. *In the future a letter "D" may be added for scans done at the District Offices*	Required
Sheet Number	3	Sheet Number	Blank
Suffix	2	Sheet Number Suffix	Blank

Codes / Data Domain Values:

COUNTY LIST		
01 Barbour	20 Kanawha	39 Preston
02 Berkeley	21 Lewis	40 Putnum
03 Boone	22 Lincoln	41 Raleigh
04 Braxton	23 Logan	42 Randolph
05 Brooke	24 McDowell	43 Ritchie
06 Cabell	25 Marion	44 Roane
07 Calhoun	26 Marshall	45 Summers
08 Clay	27 Mason	46 Taylor
09 Doddridge	28 Mercer	47 Tucker
10 Fayette	29 Mineral	48 Tyler
11 Gilmer	30 Mingo	49 Upshur
12 Grant	31 Monongalia	50 Wayne
13 Greenbrier	32 Monroe	51 Webster
14 Hampshire	33 Morgan	52 Wetzel
15 Hancock	34 Nicholas	53 Wirt
16 Hardy	35 Ohio	54 Wood
17 Harrison	36 Pendleton	55 Wyoming
18 Jackson	37 Pleasants	**99 Reserved for Other Statewide Continuous features**
19 Jefferson	38 Pocahontas	

Sign System Code	Long Name	Short Name
0	Municipal Non-State	MNS
1	Interstate	Interstate
2	U.S. Highways	U.S.
3	WV State Routes	State
4	County Routes	County
5	N/A	
6	State Parks and Forest	State Parks and Forest
7	FANS	FANS
8	HARP	HARP
U	US Forest Road	US Forest
R	WV State Rail Authority	Railroads
T	Trails	Trails
9	Other	Other

Supplemental Code	Name
0	Not Applicable
1	Alternate
2	Wye
3	Spur
4	North
5	South
6	East
7	West
8	business
9	North Bound (Business)
10	South Bound (Business)
11	East Bound (Business)
12	West Bound (Business)
13	Truck Route
14	Bypass
15	Loop
16	Toll
17	Ramp
18	Other
19	City Streets Non-State
20	Construction
21	Footbridges
22	Historical Bridges
23	Connector
24	New/Proposed
25	Crossover (btwn dual geometry)
26	Emergency Crossover
27	Left Turn Lane
28	Right Turn Lane
51	Rail Trail
99	Abandoned

Special Code	
AA	Archived Set
C(#)	Contract 1 (C1), Contract 2 (C2), Contract 6 (C6), etc.
P(#)	Phase 3 (P3), Phase 4 (P4), Phase 5 (P5), etc.
R(#)	R1,R2,R3,R4 (Right of way submissions 1-4)
S(#)	Submission 1 (S1), Submission 2 (S2), etc

Status ID	
1	Initial Design
2	Preliminary Design
3	Final Design

Plan Type	
R	Right of Way
P	Construction
B	Bridge
S	Shop Drawing
H	Half Size
A	As Built

Scanning and Import Process

Acquisition and Scanning

Project plans to be scanned are delivered to the WV GIS Tech Center by DOT personnel. The frequency of delivery varies and is based upon operational backlog. All activity related to the scanning process at the GISTC is recorded and timestamped for audit and performance tracking purposes. Detailed descriptions of the operational activity, procedures, and operator interface can be found in separate procedural document.

The high-level tasks involved in the operational process are:

1) Project plan delivery
2) Manual logging of newly delivered Project Plans
3) Scanning of Project Plan Sheets and recording of operations activity
4) Production of GeoTIFF reference images for each Project Book
5) Importing of GeoTIFF images into the DOT Geodatabase
6) Web publication of newly scanned project book metadata and imagery

A detailed breakdown of the scanning tasks can be found in the Procedural Manual.

APPENDIX A – Estimated Sizes of Scanned Products

File type preferences are based on preferences of image quality, file size, and display performances.

Files Size Estimates for Each File Format

Product	DPI	Unit	Est. Size	X 100,000	Notes
ORIGINAL SCANS					
(1) Original TIFF 8-bit indexed color; not gray-scale because files need to be homogeneous (all color or gray-scale) for web raster mosaic.	300	Sheet	75 MB Zip Compressed 37.5 MB	7.5 TB 3.75 TB	Best format for archival purposes and image quality. Zip compression results in 2 to 1 compression ratio or file size reduction by 50%.
PDF PLAN BOOK					
(2) PDF Sheet Saved as "Reduced Sized PDF"	300	Sheet	1 MB 55 MB avg. project book size	0.1 TB	75 to 1 compression ratio or about 1 MB per page; allows for OCR recognition. Combines all pages of plan into single file. Some image quality lost due to compression but readable.
GEO-REFERENCED					
(3) GeoRef TIFFs 8-bit indexed color (UTM projection)	300	Sheet	70 MB Zip 25 MB	7 TB 2.5 TB	Varies by crop size. Assume only index map needs to be geo-referenced. Zip compression typically 3 to 1 compression ratio.
COMPRESSED					
(4) ZIP Lossless Compression of TIFFs or GeoTIFFs	300	Sheet	37.5 MB (TIFFS) 25 MB (GeoTIFFs)	3.75 TB 2.5 TB	2 to 1 compression of **TIFFs** 3 to 1 compression of **GeoTIFFs**

Product	DPI	Unit	Est. Size	X 100,000	Notes
(5) JPG Lossy Compression of TIFFs 24-bit RGB color	300	Sheet	37.5 MB	3.75 TB	2 to 1 compression of **TIFFs** and a more common format for viewing online with web browsers
(6) MrSIDs Lossy Compression of GeoTIFFS 8-bit RGB color	300	Sheet	10 MB 5 MB	1 TB 500 GB	20: 1 MrSID compression setting results in a 7 to 1 to compression of **GeoTIFFs** 40: 1 MrSID compression setting results in a 14 to 1 to compression of **GeoTIFFs**
WEB RASTER MOSAIC (for web index application)					
(7) Raster Mosaic for Web Map Index (Web Mercator Projection; GeoTIFF or MrSID format)	300	Mosaic	Files stored on server	500 GB to 7 TB	MrSID significantly reduced file sizes but slower drawing performance. An extra processing step using Photoshp is also required to remove color value artifacts (Appendix G)

Yellow Highlight: File types at a minimum that must be created for project.

Total Estimates for 100,000 Scanned Images

File Type	X 100,000 scans
TIFFs/GeoTIFFS	7.5 TB
Zipped TIFFs/GeoTIFFS	3.8 TB
JPEGs	3.8 TB
PDF Individual Sheets	0.1 TB
GeoRef MrSIDS (40:1 setting)	.25 TB

Zip File Compression Ratios of Different File Types

File Name	File Type	.zip compression ratio	Original Size (KB)	.zip Size (KB)
00003_1	TIFF	1.9 to 1	71,744	37,089
00003_2	TIFF	2 to 1	75,493	38,255
00003_3	TIFF	2.1 to 1	71,357	34,155
00003_1_wmA84.tif	GeoTIFF	2.8 to 1	17,019	6,085
00003_4_wmA84.tif	GeoTIFF	2.8 to 1	17,966	6,394
00003_1	JPG	1 to 1	27,922	27,702
00003_2	JPG	1 to 1	28,419	27,158
00003.pdf	PDF	1.1 to 1	16,156	15,139
00003_1_wmA84.sid	MrSID	1 to 1	9,638	9,574

MrSID compression ratios from GeoTIFF to MrSID

File Name	GeoTIFF size (KB)	MrSID size (20 to 1)	Ratio to one	MrSID size (40 to 1)	Ratio to one
00001_1_wmA84	67,179	14,035	4.79	7,023	9.57
00006_1_wmA84	65,353	7,937	8.23	3,972	16.45
00007_1_wmA84	68,215	8,757	7.79	4,383	15.56
00008_1_wmA84	77,747	9,477	8.20	4,743	16.39
00009_1_wmA84	65,952	8,348	7.90	4,179	15.78
00011_1_wmA84	72,682	9,371	7.76	4,689	15.50
average	*69,521*	*9,654*	*7.45*	*4,832*	*14.88*

File Type Recommendations

- Sheets will be originally scanned at 300 dpi as TIFFs and compressed to Zip files. Sheets that are geo-referenced will be in a GeoTIFF format, zip compressed, and in a UTM 17N map projection.
- The PDF book format is recommended because it combines all map sheets of a particular construction plan set into a highly compressed single file for viewing purposes.
- The JPG and MrSID compression formats are optional and can be implemented any time later during the project using batch processes. MrSID is only recommended if a large number of sheets are being geo-referenced.
- The raster mosaic of spatially referenced sheets is required for the web map index application and will reference either GeoTIFF or MrSID compression formats in a Web Mercator Auxiliary projection.

APPENDIX B – Advantages and Disadvantages of File Types

TIFF

TIFF (Tagged Image File Format) is recognized by the extensions .tif or .tiff. It is recommended especially for text and black and white images. Though it is not widely supported by web browsers, it remains the standard format for printing, scanned documents and Optical Character Recognition, since it doesn't have any of the JPG artifacts.

Purpose: Best format for original scans.

GeoTIFF

GeoTIFF is a public domain metadata standard which allows georeferencing information to be embedded within a TIFF file. The potential additional information includes map projection, coordinate systems, ellipsoids, datums, and everything else necessary to establish the exact spatial reference for the file. The GeoTIFF format is fully compliant with TIFF 6.0, so software incapable of reading and interpreting the specialized metadata will still be able to open a GeoTIFF format file.

Purpose: Best format for spatially referenced maps using Esri GIS software.

Adobe PDF

Invented by Adobe Systems and perfected over 20 years, Portable Document Format (PDF) is now an open standard for electronic document exchange maintained by the International Organization for Standardization (ISO). Scanned text can be converted using optical character recognition (OCR) technology to make text searchable. Files are read using free Adobe Reader software.

Purpose: Best format for viewing an entire set of project sheets at a very high reduced file size or compression ratio.

Compressed files are worth evaluating because of the significant file size reduction; however, the image quality of the original images may be affected.

JPG compressed

JPEG is probably the most commonly used image format. Its name derives from the name of the people who developed the JPEG compression technique: the Joint Photographic Experts Group. Common file extensions associated with this format are .jpg, .jpeg. Jpeg is a good format for photographs because it offers a reasonable compromise between picture size and picture quality. However, images can lose their quality when repeatedly edited and saved in this format. It is not recommended for scanned documents or text that's going to be used with OCR software because of the digital artifacts (unpleasant visual defects in an image).

Purpose: Best format for viewing compressed TIFF scans.

Zip compressed

ZIP is an archive file format that supports lossless data compression. A ZIP file may contain one or more files or folders that may have been compressed. Lossless data compression is a class of data compression algorithms that allows the original data to be perfectly reconstructed from the compressed data.

Purpose: A suitable compression format to compress TIFFs and GeoTIFFs as well as to combine multiple files like geo-referenced TIFFs (TIFF & TIFW) into a single file name which allows for easier download.

Mr SID compressed

MrSID (pronounced Mister Sid) is an acronym that stands for multiresolution seamless image database. It is a file format (filename extension .sid) developed and patented by LizardTech for encoding of georeferenced raster graphics, such as orthophotos. MrSID technology uses lossless wavelet compression to create an initial image.

LizardTech offers a software package called GeoExpress to read and write MrSID files. They also provide a free web browser plug-in for the Microsoft Windows operating system. Most commercial GIS software packages can read MrSID files including those from GE Smallworld, ESRI, Intergraph, Bentley Systems, MapInfo, Safe Software, Autodesk, with ERDAS IMAGINE being able to both read and write MrSID files.

Display Viewing Performance

Raster layers that do not use wavelet compression result in improved drawing performance because the data does not have to be uncompressed at display time.

Wavelet compression, used by raster formats such as MrSID, JPEG 2000, and ER Mapper's ECW, takes time to decompress before drawing. These formats are good at storage efficiency but result in slower drawing because of the amount of computation required to unpack the wavelet-compressed data prior to display. Other compression options often require more storage but can uncompress and draw faster in ArcGIS.

Esri recommends that you use a compression other than wavelet to get better drawing performance. For example, formats such as TIFF and JPEG provide much better drawing performance, but they typically require more storage space than wavelet-based compression.

Caching could improve display performance but would increase file storage required.

Purpose: For compressing spatially referenced GeoTIFFs, the format is good for storage efficiency but results in slower drawing because of the amount of computation required to unpack the wavelet-compressed data prior to display. More processing steps using Photoshop are also required before creating GeoTIFFs to to remove color value artifacts during the MrSID conversion process (See Appendix G). Lastly, there is a conversion cost involved with MrSID software. It is recommended that MrSID only be considered if there are a large number of files being geo-referenced.

APPENDIX C – MrSID Conversion Process

MrSID Conversion Process Summary

In order to successfully convert GeoTIFFs into MrSID format while maintaining compatibility with the raster mosaic and the ArcGIS online utility, some image processing steps must be performed.

When GeoTIFFs are converted to compressed MrSIDs, the background "No Data" pixels of the GeoTIFF are forced into have a color value as part of the compression process, which causes those pixels to be opaque. It is possible to set a single color value in a MrSID image to be transparent in ArcGIS, but the MrSID compression process causes speckling in those background pixels which results in a "halo" of discoloration around the image border. Additionally, images must contain some color information to avoid be converted to Grayscale mode by the MrSID conversion process.

The above issues can be avoided by following the steps outlined below before and during georeferencing. These steps only need to be performed on the TIFFs that will be georeferenced, and all steps performed in Adobe Photoshop can be automated and run as a batch process.

Steps for MrSID conversion

In Photoshop (all steps here can be automated in a batch process):

- Brighten the image (raise Output Levels by 10)
- Convert to RGB mode
- Convert back to Indexed Color Mode, creating a custom Color index where swatch 0 is the color R:0 G:0 B:0 (pure black)
- Adjust Color Levels to add color data to the TIFF if there is not any

In ArcGIS:

- Georeference the image
- Rectify, set "No Data" to 0

In GeoExpress 9:

- Run the Despeckle tool
- Convert to MrSID

Conversion Procedure

In Adobe Photoshop, a newly scanned image is brightened slightly to ensure that there are no visible pixels in the image with an RGB value lower than R:10 G:10 B:10. This is done by raising the Output Levels in the levels adjuster by 10. By this process, darker pixels are brightened more than lighter pixels (black pixels will be brightened by 10, whereas nearly white pixels might be raised by 2 or 3), which minimizes the brightening of the image, resulting in little noticeable change from the original.

Again in Adobe Photoshop, the image is converted to RGB Color mode, then back to Indexed Color mode. This step optimizes and rearranges the color index and allows for a custom color index to be generated.

During the conversion back to Indexed Color mode, the new custom color index will be configured to contain the color R:0 G:0 B:0 (pure black), and this color will be assigned to the index value 0.

If there are no color pixels in the image (all pixels are some shade of gray), a small amount of color must be added, which can be easily done by adjusting the color levels. This is because the MrSID conversion process will detect if all the pixels are gray and then automatically convert the image to Grayscale mode, rendering it incompatible with the raster mosaic. This step prevents that.

The image can now be georeferenced. When rectifying the georeferenced image, the "No Data" value is set to the image's color index value 0, which is pure black.

The image is then compressed into MrSID format, which forces the image out of Indexed Color mode and into RGB mode as part of the compression process. During this process, the despeckling tool is utilized to avoid any discoloration created in the black background. This tool works by causing all pixels below a specified brightness threshold, in this case R:10 G:10 B:10, to be set to R:0 G:0 B:0. This should be only those pixels that comprise the black background. The resulting image can be added to a map in ArcGIS, and all pixels with the RGB value R:0 G:0 B:0 can be set to transparent, which will remove only the black background.

GeoTIFF versus MrSID Web Display Performance Comparison

In 2014 an ArcGIS Online demo containing a TIFF and two SIDs was conducted at different compression settings. The demo compared the performance quality of the different image formats but in the same map projection.

From viewing the online web demo, first, the SIDs have a speckled black halo around them which may be difficult to remove. Secondly, the viewing display time of the MrSIDs (zoom in on GeoTIFF and MrSID formats at larger scales) is faster for the GeoTIFFs than the MrSID files. The same applies to when displaying both formats in the same projection using ArcGIS desktop software.

APPENDIX D – Web Map Index Application

Example screen shots of web map index, a geographic locator for viewing and downloading project plans.

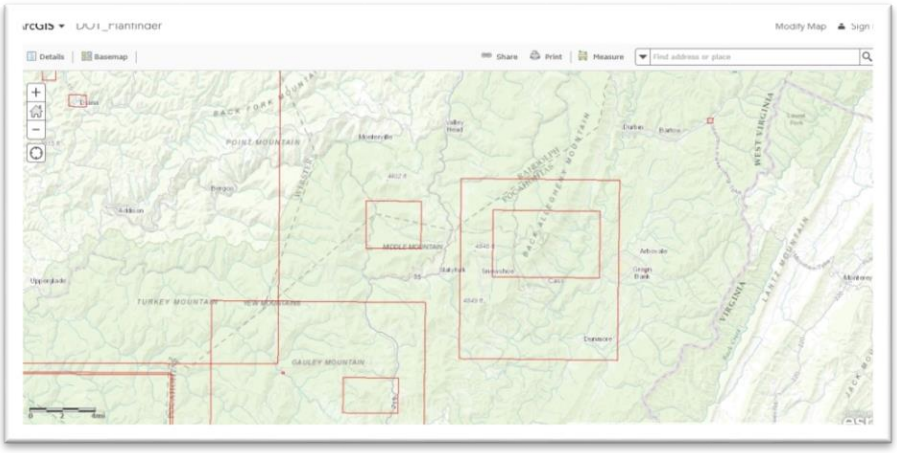


Figure 10: Sheet map boundaries (red boxes) of Project Plan

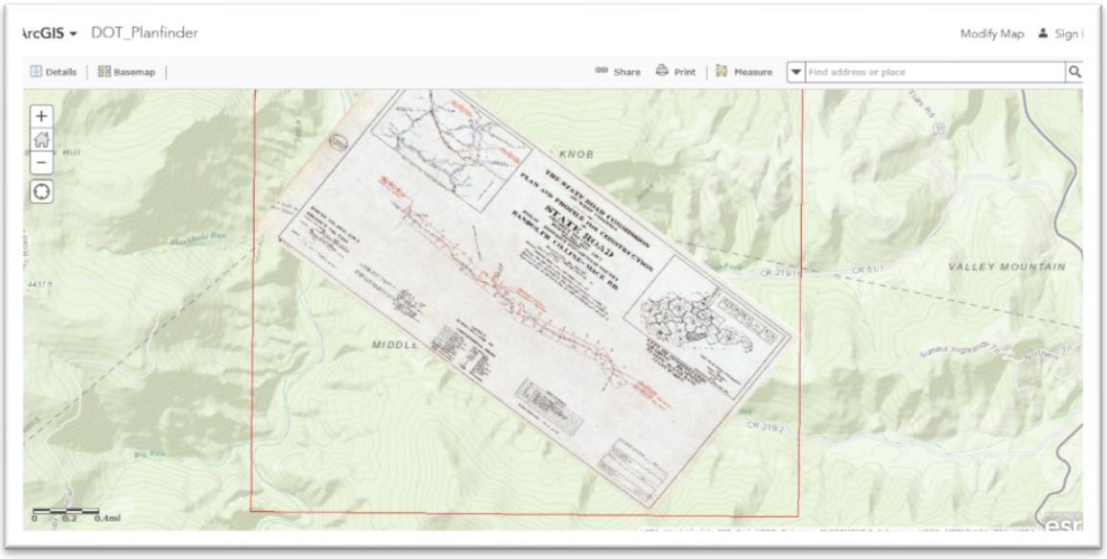


Figure 11: Example of online viewing and download of individual TIFF digital image

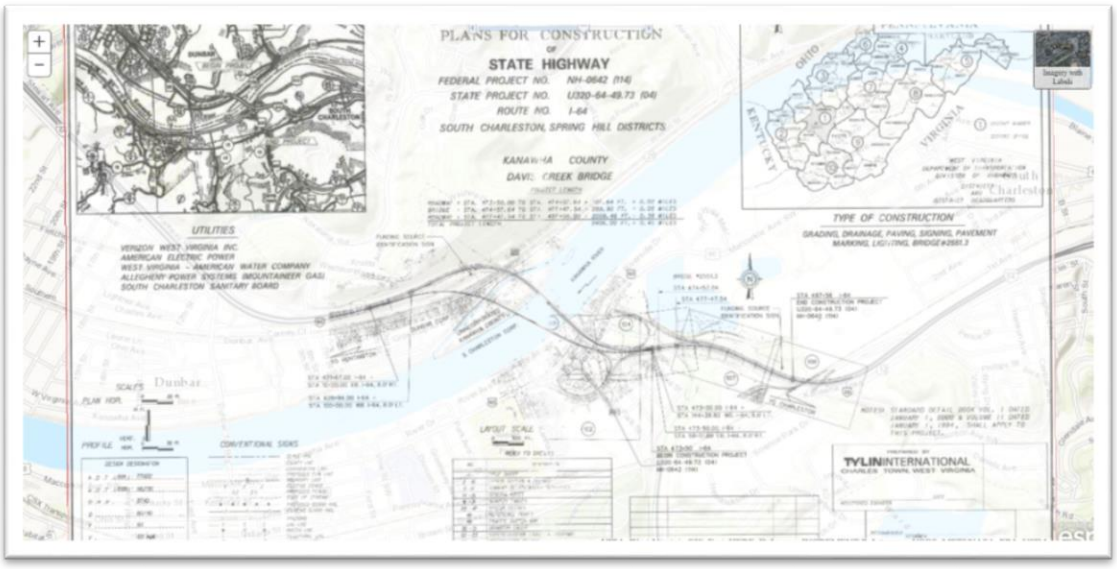


Figure 12: Example of online viewing and download of PDF plan book

Customized Web Map Application

A customized web map index could be similar to the online Pennsylvania Mine Map Atlas application (http://www.minemaps.psu.edu/) hosted by the Pennsylvania Spatial Data Access (PASDA). The map index application can customized to user requirements set forth by the WV Division of Highways. Map functions could include:

- Customized user interface
- View spatially referenced scans (GeoTiffs or compressed MrSIDs)
- Map Results Box which could include Download, Highlight, View Map, and Zoom to Map functions. Could have viewable and downloadable links for (1) individual sheets as TIFFs or compressed JPGs, (2) PDF booklet of all sheets, and access to (3) project plan file folders that contains all files (TIFF, JPG, PDF, GeoTIFF, MrSID) as well as project notes.
- Zoom to County, Street Address, Geographic Coordinates
- Search by Highway Number, Project Name, or Project Key
- Base map and other reference overlay layers with no map scale zoom-in limitations
- Other functions: Transparency Slider for highway maps, print map, measure tool, Link to FTP folder of all scanned and processed files

Project Book Links

Users can share online links to specific Project Books. Some examples are listed below:

(1) Keith Bridge:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=B_03_4_0003_10_000_1994_S00003_001_UTM17N83

(2) Trus Joist MacMillan Access Road:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_49_4_0013_00_001_1995_S00002_001_UTM17N83

(3) Elk Two Mile Watershed:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_20_4_0046_05_000_1995_S00004_001_UTM17N83

(4) St Albans Nitro Bridge:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=R_20_3_0025_00_000_1977_S00010_001_UTM17N83

(5&6) McMechen Slide Corrections 1 & 2: (two projects overlap)
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_26_3_0002_00_000_1979_S00005_001_UTM17N83
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_26_3_0002_00_000_1983_S00006_001_UTM17N83

(7) Grantsville Bridge:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_07_3_0016_00_000_1959_S00001_001_UTM17N83

(8) Guyandot and Gideon District:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=R_06_1_0064_00_010_1959_S00011_001_UTM17N83

(9) Washington and Scott Districts and Danville Corporation:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=R_03_2_0119_00_000_1970_S00007_001_UTM17N83

(10) Logan Relocation:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=P_23_2_0119_00_000_1950_S00008_001_UTM17N83

(11) Oak Hill Expressway Contract No. 6:
http://mapwv.gov/DOTPlans/ImageViewer.html?Name=R_10_2_0021_00_000_1961_S00009_001_UTM17N83

Full Extent:
http://www.arcgis.com/home/webmap/viewer.html?webmap=8cb52a4578cd47e3bb2189b3207a27a1&extent=-84.367,36.7083,-76.2536,40.3803

Automatically Update Web Index

Another objective of the web application could be the ability to automatically generate a new web map index and corresponding file links when additional map scans are ready to be viewed online. Automatic programming scripts have been developed to expedite updating functions in the application which will decrease costs and minimize human errors during the file updating procedures.

APPENDIX E – Project Tracking Database

Excerpt of Project Database as of 12/30/2014

#	Project Title	Federal Project Number	State Project Number	Total Sheets	Date Scanned
1	Grantsville Bridge and Approaches	S-119(6)		43	1/1/2014
2	Trus Joist MacMillan Access Road		U349-13-0.85	20	1/1/2014
3	Keith Bridge	BRO_0310(009)E	S303-3/10-0.02	26	1/1/2014
4	Elk Two Mile Watershed Dam Site #4		U320-SCS/14-1	12	1/1/2014
5	McMechen Slide Correction 1		E426-MECH-1, C-2	28	1/1/2014
6	McMechen Slide Correction 2		426-MECH-1, C-3	17	1/1/2014
7	Washington & Scott Districts & Danville Corporation	APD-323(22)		30	1/1/2014
8	Logan Relocation	U-296(5)		21	1/1/2014
9	Oak Hill Expressway Contract No. 6	F-173(28)		26	1/1/2014
10	St. Albans-Nitro Bridge Modification		320-SP25-0.00	2	1/1/2014
11	Guyandot & Gideon District	I-64-1(12)10		40	1/1/2014
12	Neds Branch Bridge		S330-52/4-0.01	26	2/21/2014
13	Jesse Run Girder	TBCG-0084(047)E	S321-8/4-0.00	18	2/21/2014
14	Given Bridge (Rock Castle)	BR-0015(033)E	S318-15-5.64	23	2/21/2014
15	Glico Access Bridge and Approaches		X324-52/32-0.00	22	2/24/2014
16	Poverty Run Arch Bridge	NFA-0005-(0.56)	S309-5-5.34	17	2/24/2014
17	Moorefield Middle School		U316-55/7-0.00	16	2/24/2014
18	Lost River Dam Site#4		S316-SCS/4-1.00	42	2/24/2014
19	Upper Buffalo Creek Dam Site 33A		S325-ScS/33-1.00	30	2/25/2014
20	Browning Fork Bridge	BR-0052(115)	S330-52-50.34	59	2/25/2014
21	WV 55 to Clifford Hollow Bridge	APD-0484 (123)C	X316-H-101.92 04	109	2/26/2014
22	Kanawha County Building Demolition	NFA-0642(126)	U320-64-49.73 (12)	10	3/6/2014
23	Spring Valley I-64 Connector		X250-7/47-0.00	59	3/7/2014
24	Culloden Interchange		X306-64-31.65 00	140	3/7/2014
25	Dunbar I/C to Westmoreland Bridge	NH-0642 (116)	U320-64-49.73 (03)	144	3/8/2014
26	Davis Creek Bridge	NH-0642 (114)	U320-64-49.73 (04)	238	3/11/2014
27	Institute I/C to Dunbar I/C	NH-0642 (110)	U320-64-49.73 (05)	163	3/12/2014
28	Institute I/C to Dunbar I/C	NH-0642 (110)	U320-64-49.73 (05)	178	3/13/2014
29	I-64, Darnell Road Overpass	IM-0641 (253)	S306-64-14.12	214	3/14/2014
30	Interstate 64 Bridge Over Edgewood Drive	IM-0641 (116)	S350-64-5.20	123	3/15/2014
31	Interstate 64	IR-64-2 (43) 53	S320-64-53.27	14	3/17/2014
32	Dunbar I/C to Westmoreland Bridge	NH-0642 (116)	U320-64-49.73 (03)	186	3/18/2014
33	Kanawha River Bridge West Abutment and Wall	NH-0642 (115)	U320-64-49.73 (06)	132	3/19/2014
34	Interstate Highway 64	I-64-1 (32)10		58	3/21/2014
35	Interstate Highway 64	I-64-1 (32)10, C-2		18	3/21/2014
36	Interstate Highway 64	I-64-1 (32)10, C-3	F-57 (5)	26	3/21/2014
37	Interstate Highway 64	I-64-1 (32)10, C-3	F-57 (5)	20	3/22/2014
38	Huntington Mall Road	NH-0641 (245)	U306-64-19.72 00	40	3/23/2014
39	ALT. D, Parallel Road (Huntington Mall Road)	NH-0641 (245)	U306-64-19.72 00	4	3/23/2014
40	Interstate 64 Over Big Sandy River	IM-0641(164)	S350-64-0.02	3	3/27/2014
41	Twelvepole Creek Bridge	BR-0641(220)	S350-64-2.02 02	15	3/28/2014
42	Crossroads Overpass Bridge	NFA 0641(279)	S306-64-11.98	2	3/28/2014
43	16th St Ent/Exit Ramp	IM-0641(339)D	S306-64-10.91 00	22	3/29/2014

#	Project Title	Federal Project Number	State Project Number	Total Sheets	Date Scanned
44	19th Street Overpass	IM-0641(268)	S306-64-6.28 00	5	3/29/2014
45	Interstate Route NO.64 Expressway (Union District)	I-64-2(13)53, S-1		19	3/29/2014
46	Interstate 64 (Loudon Charleston District)	I-64-2-2(15)57	PM96-1-KANA-26	58	3/29/2014
47	Interstate 64 (West Charleston District)	I-64-2(16)59		43	4/2/2014
48	Interstate 64 (Union District, Slide Corrections)	I-64-2(25)47		6	4/2/2014
49	Interstate Route NO. 64 (Union District)	I-64-2(13)53, S-2		11	4/2/2014
50	Merrick Creek Connector Interchange	NH-0019(180)	U306-19-0.00 00	66	4/3/2014
51	Interstate Route NO. 64 (Pocatalico Union District)	I-64-2(3)46, S-1		52	4/3/2014
52	Interstate NO. 64 (Pocatalico District)	I-64-1(25)43	S-71(7)	29	4/3/2014
53	Interstate Route NO. 64 (Union District)	I-64-2(13)53, S-3		70	4/4/2014
54	Cross Lanes Interchange - WV Route 622	IM-0642(096)	U320-64-47.42	22	4/4/2014
55	Institute - South Charleston Road		U320-64-49.73 (00)	45	4/4/2014
56	Interstate Route NO. 64 (Union District)	I-64-2(6)51, C-2		5	4/5/2014
57	Interstate Route NO. 64 (Union District)	I-64-2(3)46, S-3		76	4/5/2014
58	Interstate 64	I-64-2(14)55		90	4/8/2014
59	Interstate 64 (Teays Valley & Scott Districts)	I-64-1(20)35		57	4/9/2014
60	I-64	I-64-1(35)19		19	4/10/2014
61	Interstate 64 (Westmoreland District)	I-34-1(31)0, PHASE 5		44	4/10/2014
62	I-64	I-64-1(14)30		9	4/15/2014
63	Interstate Route NO. 64 (Union District)	I-64-2(3)46, S-2	S-71(10)	42	4/15/2014
64	I-64 (Barboursville & Grant District)	I-64-1(7)19	S 675(1)	55	4/23/2014
65	I-64 (Kyle & Guyandot District)	I-64-1(31)0, PHASE 3		32	4/23/2014
66	I-64	I-64-1(3)13		38	4/24/2014
67	I-64 (Ceredo District)	I-64-1(31)0, PHASE 2		27	4/24/2014
68	I-64 (Barboursville & Grant Districts)	I-64-1(7)19	S-675(1)	37	4/24/2014
69	I-64	I-64-1(14)30		59	4/25/2014
70	Johnson Cemetery Reinternment	I-64-1(31)0		10	4/25/2014
71	I-64	LSI-64-1(1)0		14	4/25/2014
72	I-64	I-64-1(63)0		5	4/25/2014
73	I-64 (Slide Correction)	I-64-1(65)8		5	4/25/2014
74	I-64 (Guyandotte District)	I-64-1(63)0		6	4/25/2014
75	I-64 (Huntington District)	I-64-1(31)0 Phase 4		18	4/25/2014
76	I-64 (Pocatalico District)	I-64-1(22)41		20	4/25/2014
77	Beckley/Stratton Junior High School Access Road		X341-21/15-0.00	39	4/26/2014
78	Hough Street Bridge		S325-1/16-0.00	17	4/26/2014
79	Shinnston-Lumberport Road	STP-0020(133)EQ	S317-20-24.52	7	4/28/2014
80	Lumberport Road	STP-0018(082)EQ	S317-18-3.24	7	4/28/2014
81	East Main Street		U317-S20-0.80	7	4/28/2014
82	Town of Matewan Curb Construction		U330-49-8.66	9	4/28/2014
83	Stewartstown Road Left Turn Lane	NH-0119(099)E	U331-119-18.50	9	4/28/2014
84	Page-Deepwater Road	STP-0061(029)EQ	S310-61-19.47	43	4/29/2014
85	Shinnston-Lumberport Road	STP-0020(133)EQ	S317-20-24.52	17	4/29/2014
86	I-79 - U.S. 250 Road	STP-7373(009)EQ	U325-73/73-2.67	56	4/29/2014
87	Lookout-Rainelle Road	STP-0060(138)EQ	S310-60-35.48	46	4/30/2014
88	Clarksburg Expressway	NH-0050(134)E	S317-50-15.46	37	4/30/2014
89	Bush Creek Ind. Park Access		X328-16/25-0.00	19	5/1/2014
90	Garden Street Bridge Project	BR-6079(002)E	S313-60/79-0.17	14	5/1/2014
91	Wardenville Bridge	PLH-0259(012)E	S316-259-32.64	34	5/1/2014
92	Race Track Road		U325-58-1.00	100	5/2/2014

#	Project Title	Federal Project Number	State Project Number	Total Sheets	Date Scanned
93	Upshuer County Industrial Park Connector		X349-33/15-0.00	39	5/6/2014
94	Bush Creek Bridges		U328-SCS-1.00	17	5/7/2014
95	North Fork Hughes River (Bunnell)		U343-SCS-3.	47	5/7/2014
96	Patteson Drive Left Lane	STP-0705(001)EQ	U331-705-0.00	31	5/7/2014
97	Roane County/Spencer Business Park		X344*-33/2-0.00	23	5/8/2014
98	Fairview Concrete Girder Bridge		S325-218-11.47	45	5/9/2014
99	Evansville W-Beam Bridge No. 15721	BH-0092(012)E	S339-92-2.95 00	49	5/9/2014
100	Hutchinson Branch Bridge No. 4717	BR-0039(045)E	S334-39-19.36	34	5/9/2014
101	Swago Creek Bridge		S338-219/5-0.01	30	5/12/2014
102	McMullen Bridge	BR-0063(004)E	S348-6/3-4.70	29	5/12/2014
103	State Line T-Beam Bridge	BR-0050(133)E	S339-50-28.05	39	5/12/2014
104	Charles Town Bypass	ACF-0340(012)	X319-340-4.86 02	97	5/13/2014
105	Maintenance Headquarters Site Preparation		G049-UCM/H-1.01	32	5/14/2014
106	District 9 Headquarters		G013-HDQ-1. 00	5	5/14/2014
107	Dunlavy Ridge Bridge		S327-76-0.05	36	5/14/2014
108	Appalachian Corridor D East of CR 50/2 to Interstate 77	APD-0282(127)C	X354-D-7.00 09	139	5/14/2014
109	0.34 Miles South of CO. 8 to CO. 8 (Wiltshire Blvd.)	DPC-0042(059)C	U319-9-2.28 04	73	5/15/2014
110	Kings Creek Bridge	BR-0002(361)E	S315-2-3.04 00	171	5/15/2014
111	Clifford Hollow - Hardy Co.1	APD-0484(125)C	X316-H-101.92 06	157	5/19/2014
112	29th Street Bridge	BRST-3310(002)E	S306-60-6.11	104	5/20/2014
113	Charles Town Bypass	ACF-0009(048)	X319-340-4.86	156	5/21/2014
114	Canvas-nettie Road		U334-39-34.55	66	5/22/2014
115	Teletech Holdings LT LN		U319-8-2.77	9	5/22/2014
116	Charles Town Bypass	ACF-0009(058)	X319-340-4.86(04)	30	5/22/2014
117	Tollgate P. O. Bridge		S343-10-5.99	22	5/23/2014
118	North Fork Hughes River (Bunnell)		U343-SCS-3.	165	5/27/2014
119	CO.RT. 6 TO WV 55	HDH-0484(110)	X316-H-101.92 03	186	5/28/2014
120	Lower exchange replacement bridge		S304-19/26-8.17	16	5/30/2014
121	US 19 Bridge over Meadow River	F-0019(059)	S334-19-0.01	21	5/30/2014
122	Davisson Run Road	STP-0098(005)EQ	U317-98-0.00	6	5/30/2014
123	North Bridgeport Bypass Route 50 Connector		X317-279-0.00	20	6/2/2014
124	Broad Run Bridge	NFA-0023(002)	S309-23-4.23	15	6/2/2014
125	Walker Systems Industrial Access +1		U354-14-25.27 00	12	6/2/2014
126	University Avenue, Morgantown	F-0119(019)	U331-119-12.91-(00)	14	6/2/2014
127	Route 19 Reloc. Bridge Over Meadow River	APD-482(28)C-2		31	6/2/2014
128	Molded Acoustical Products Facility Access Roads	APL-1019(513)S	X325-73/24-0.00	14	6/2/2014
129	Left Hand Run Bridge	NFA-TIM3)003)	S344-58/2-1.70	21	6/4/2014
130	Booths Creek and Owl Creek		S331-77-1.17	23	6/4/2014
131	Enterprise Road		S317-19/2-0.00 02	29	6/4/2014
132	Fairmont Ave +1(I/s)	STP-0019(069)S	U331-19-9.16	15	6/4/2014
133	King Lear Road	NFA-TIM5(003)	S319-25/5-1.74	15	6/5/2014
134	Epps Bridge	Br-2204(001)E	S312-220/4-0.99	26	6/5/2014
135	Ellenboro Bridge - Pedestrian Trail and Bridge	STP-0016(84)EQ	U343-16-22.49 00	20	6/5/2014
136	US Route 50 E.B. 8 W.B. Over Goose Creek	F-0050(058)	S309-50-5.61,00	37	6/5/2014
137	Oakvale Twin Bridges No. 2814	F 0460 (011)	S328-460-21.71	26	6/5/2014
138	Lavalette I/S Improve	CM-0152(023)E	U350-152-41.65	62	6/5/2014
139	Upper Cove Road		U316-SCS/27-1.00	71	6/6/2014
140	Fbi Access Road NO. 1		X317-13/5-1.99(01)	56	6/6/2014
141	US 52 Butler & Ceredo Districts	DPS-0011	U350-52-10.85 00	507	6/13/2014

#	Project Title	Federal Project Number	State Project Number	Total Sheets	Date Scanned
142	Z Tower Road	STP-0046(015)S	U329-46-18.01	123	6/10/2014
143	Midway Plaza to South of Madison Branch	STP-0010(210)	S323-10-13.56 02	182	6/16/2014
…					
184	Ashford Truss Bridge	BR-0001(112)E	S303-1-8.28 00	155	9/2/2014
			average	**70**	

Estimated Total Number of Sheets per Plan

Based on the 184 project plan books sent to us WVU for scanning, it is estimated that:

- **a typical plan has 70 sheets per plan book**
- only the index map sheet will be geo-referenced; however, some project books may have more than one index map sheet
- based on Project Database status as of 12/30/2014

Original Right-of-Ways Tracking Database

The original Right-of-Way Projects Database provided by WV DOT will be utilized as a reference to track the project books. Currently the database has 9,163 records and 17 fields. Unnecessary fields may need to be deleted while additional fields to track which projects have been scanned should include:

- Project Book Scanned
- Number of Maps Scanned
- Number of Maps Georeferenced
- Date of Scan
- Initials of person who performed scan

Some records have both state and federal project numbers while certain text fields like Project Title are quite long and will result in a long file name. Not every field in the Project Database has information recorded such as the Project Title, Project Number, or Project Date. Consequently, missing information like Project Title will be added to the Project Database if it is present when the sheets are being scanned. More consultations with WV DOT are needed on this subject. No database for construction plans was provided.

New DOT Project Database

A new Project Database was created which incorporates fields (field names uppercase) from the original DOT database. The new Project Database has 40 fields and auto generates the *Project Key* from select data fields. The database is shared as Google Document to allow multiple user access. Some of the data fields are auto-generated from other fields. Select fields are used by the Web map index.

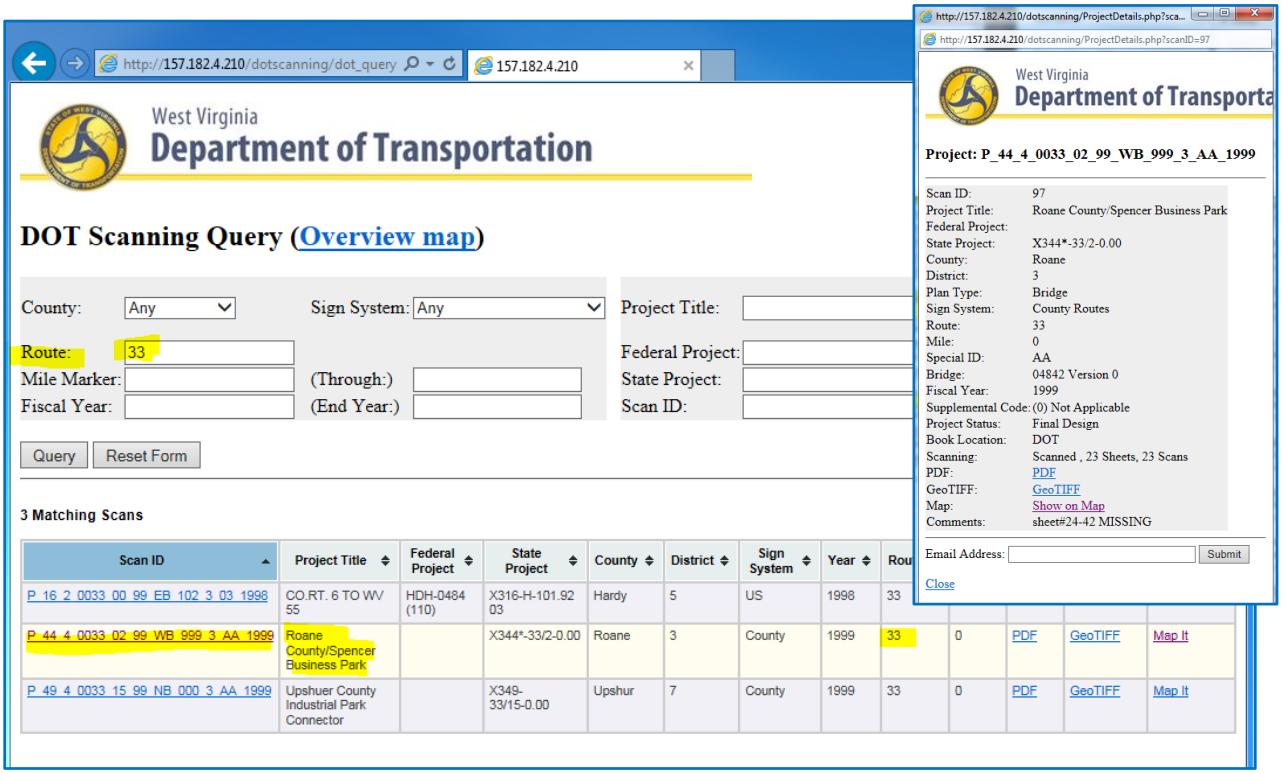
Short Name	Long Name	Auto-Generated	Web Map Index	Description
scan_order	WVGISTC scan order of books			Corresponds to the order in which the project book was scanned.
OLD_PROJKEY	Old Project Key			Corresponding key of old database
PROJTITLE	Project Title		Yes	Project title as it appears on the cover sheet.
FEDPROJ	Federal Project Number		Yes	Federal Project number as it appears on the cover sheet.
STPROJ	State Project Number		Yes	State Project number as it appears on the cover sheet
county1	County 1		Yes	County location of the project
county2	County 2			Additional county location of the project
DISTRICT	District			State district location of the project
sign_system	Sign System			The sign system of the route.
ROUTENO	Route Number			Project route number
SUBROUTE	Sub-route Number			Secondary project route number
MICROROLL	Microfilm Roll ID			ID number of the corresponding microfilm
ORIGFILE	?			Old database field, exact definition unknown
TURNPIKE	?			Old database field, exact definition unknown
FILENO	?			Old database field, exact definition unknown
MISCINFO	Miscellaneous Information			Old database field, exact definition unknown
LOCATION				Old database field, exact definition unknown
PROJLENT	Project Length			Old database field, exact definition unknown
PRINT	?			Old database field, exact definition unknown
PROJDATE	Project Date			Old database field, exact definition unknown
fiscyear	Fiscal Year		Yes	Project fiscal year as it appears on the cover sheet

Short Name	Long Name	Auto-Generated	Web Map Index	Description
sheet_total	Sheet Total		Yes	Total number of sheets/pages
scan_total	Scan Total			Total number of scans generated
type	Project Type		Yes	Indicates if the project is a Right of Way (R) or a Construction Plan (P).
scandate	Scan Date			Date the project book was scanned
book_location	Project Book Phycial Location			Current physical location of the project book (DOT or TC)
technician	Technician			Technician(s) who performed the scanning
comments	Comments			Additional comments/issues regarding the scanning process.
projectkey	Project Key	Yes		The unique ID number generated for each project book. The following 11 fields are concatenated to create this number.
type	Project Type	Yes	Yes	Indicates if the project is a Right of Way (R) or a Construction Plan (P).
countyno	County Number			Corresponding number for the county in the 'county1' field above.
sign_system	Sign System			The sign system of the route. 1 = Interstate, 2 = US Route, 3 = State Route, 4 = County Route
routeno	Route Number	Yes		Project route number
subroute	Sub-route Number	Yes		Secondary project route number
suppcode	Supplemental Code			Supplemental code provided by WV DOT
direction	Project Direction			Code representing the azimuthal orientation of the project route, provided by WV DOT
begin_mile	Beginning Milepost			Starting milepost of the project route
statusID	Status ID			Project Status ID provided by WV DOT
special_ID	Special ID			Project Special ID provided by WVDOT
fiscyear	Fiscal Year	Yes		Project fiscal year as it appears on the cover sheet

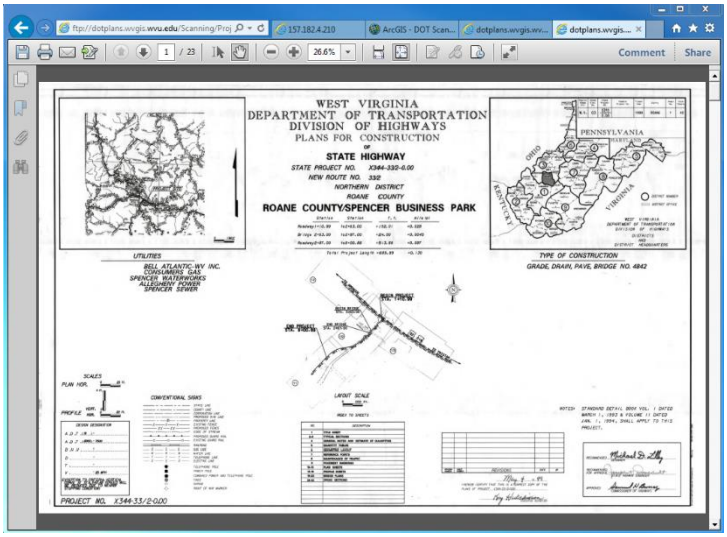
APPENDIX F: Highway Plan Finder

(www.mapWV.gov/dotplans)

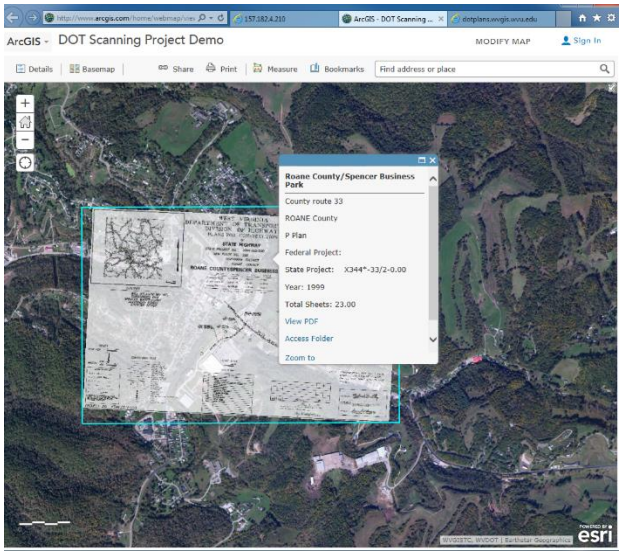
1. Locate Scanned Highway Plans



2. View Highway Plans via PDF Reader



3. View or Locate Plans via Web Map



APPENDIX G: Scan Project Tracking Database Fields

#	DATA FIELDS	Scanning Tracking Database Field Names	LookUp Table or Processing Script	SCAN ID #	SEARCH CRITERIA	BROWSE RECORD	DETAILED RECORD
1	Project Title	ProjectTitle			1	1	1
2	Federal Project #	FederalProject			1	1	1
3	State Project #	StateProject			1	1	1
4	County Name 1 (or Code)	CountyID	*dbo_county*	1	1	1	1
5	County Name 2	County2ID					
6	District #	District					1
7	Plan Type (Construction, Right-of-Way, Bridge)	PlanTypeID	*dbo_ListPlanType*	1			1
8	Sign System Name (or Code)	SignSystemID	*dbo_ListSignSystem*		1	1	1
9	Route #	RouteNumber		1	1	1	1
10	SubRoute #	SubRoute		1			
11	Begin Mile Marker	BeginMile		1	1	1	1
12	Direction	DirectionID	*dbo_ListDirection*				
13	Supplemental Code	SupplementalCodeID	*dbo_ListSupplementalCode*				1
14	Status ID	ProjectStatusID					1
15	Special Code ID	SpecialCodeID, SpecialID	*dbo_ListSpecialCode*				1
16	Bridge # (multiple numbers)	BridgeNumbers			1	1	1
17	Fiscal Year	FiscalYear		1	1	1	1
	*** Scan Info Fields *****						
18	Scan Order # (unique ID)	ID		1	1		1
19	Sheet Total	SheetCount					1
20	Scan Total (# PDF Book Pages)	ScanCount					1
21	Scan Date	ScanDate					1
22	Scan Technician						
23	Scan Notes	Comments					1
24	Plan Location	BookLocationID	*dbo_ListBookLocation*				1
25	Old WV DOT Database Key						
26	Processing Status	ProcessingStatusID	*dbo_ListProcessingStatus*				
27	Publication Status	PublicationStatusID	*dbo_ListPublicationStatus*				
	*** Index Map Fields *****						
28	XMax	Xmax	UpdateFootprintExtent.pyt				
29	XMin	XMin	UpdateFootprintExtent.pyt				
30	YMax	YMax	UpdateFootprintExtent.pyt				
31	YMin	YMin	UpdateFootprintExtent.pyt				
32	Georeferenced Index Map	GeoTIFFSheet					
	** *Link Fields* **						
33	Project Scan ID # (unique ID)		*dbo_wv_ProjectKeyLookup FileRaname.pyt*		1	1	1
34	PDF Book Link		PDFbatch.sequ (Adobe)			1	1
35	Map Link					1	1
36	GeoTIFF Download Link		BuildFootprints.pyt PublishGeoTIFF				1
37	ProjectWise Link	URN (Uniform Resource Name)			1		1
38	Query URL					1	1
					7	12	13	26