West Virginia GIS Technical Center
West Virginia University
Department of Geology and Geography Eberly College of Arts and Sciences

September 22, 2021

TO: Hussein Elkhansa
Geospatial Transportation Information Section
Planning Division
WV Division of Highways
1900 Kanawha Blvd. East, Bldg. 5
Charleston, WV 25305-430

Re: Phase II Scanning Project Proposal

Dear Hussein,

Enclosed are the modified proposal and budget with the 32.5% indirect cost rate for continuation of the scanning project to scan and publish archival digital highway plan sets for the WV Department of Transportation. The proposed budget of $614,318.00 will scan 225,000 sheets or an estimated 3,750 highway plan books.

This next proposed phase of the project will benefit from numerous efficiencies achieved from the initial project. Better hardware, automated work tasks, and a streamlined management system have cut the scanning costs in half while tripling the number of plan sets scanned.

Please do not hesitate to call If you have any questions, or need clarifications, about the proposal.

Sincerely,

Kurt Donaldson

Kurt Donaldson
Project Manager
WV GIS Technical Center
West Virginia University
e-mail: kdonalds@wvu.edu

Contents

PROJECT SCOPE

Major Objectives: Continue to scan and publish digital highway plan sets for the WV Division of Highways and completely finish scanning all the plans located at the headquarters' warehouse.

Overview: The West Virginia GIS Technical Center (WVGISTC) is scanning West Virginia Department of Transportation's (DOT) large format highway plan sheets into digital raster images. For every highway plan set a single Adobe PDF file is created along with a spatially referenced index map. An online application named the Highway Plans Locator (www.mapwv.gov/DOTplans) allows for the publishing, searching, viewing, and downloading all scanned highway plans. Importantly, the web application permits fast discovery and online retrieval of the electronic highway plans.

Phase I Scope (Completed): The first phase of the project scanned 50,000 highway plan sheets or 852 highway plans during a two-year time period. A web viewer called the Highway Plans Locator was created for searching and downloading all the highway plans. Other features of the online tool include a view of the plan's geographic location and integration with the ProjectWise content management system.

Phase II Scope (Completed): The second phase scanned 225,000 sheets or an **estimated 3,750 (8,000 – 7997 = 7148)** (7000 – 852 = 6148) 6,200 highway books during a three-year time period. This phase completed the scanning all the ROW and Bridge plans. Other tasks during this phase will add select digital highway plan sets already scanned by the District Offices, enhance the Highway Plans Locator to perform spatial queries, and improve the cross-referencing of specific plan sets by linking other highway databases such as the bridge BARS# database to the scanning database.

Phase III Scope (Proposed): The second phase will scanned 225,000 sheets or an estimated 3,750 highway books during a three-year time period. This phase completed the scanning all the ROW and Bridge plans which should be an attainable goal based on estimates from the WV Division of Highways. Other tasks during this phase will add select digital highway plan sets already scanned by the District Offices, enhance the Highway Plans Locator to perform spatial queries, and improve the cross-referencing of specific plan sets by linking other highway databases such as the bridge BARS# database to the scanning database.

Improved Scanning Efficiencies: This next continuation phase of the project will benefit from numerous efficiencies developed from the initial project. Better hardware, automated work tasks, and a streamlined management system have cut the scanning costs in half while tripling the number of plan sets scanned. Some of these improved efficiencies include:

- Hardware Upgrades: Purchasing of 2 new scanners in 2915 that scan sheets faster and with better image quality. Adding more memory to the local workstations for image processing large numbers of files.
- *Automation of Work Tasks:* Developing automated and semi-automated programs for many of the work tasks (imager processing, PDF generation, publishing, file naming, etc.)
- *Streamlined Management System:* Creating a scanning tracking database using SQL Server and Access databases to effectively manage scan work tasks and publish finished products to the online Highway Plans Locator.

PROECT BENEFITS

The benefits of the scanning project for WV DOT include an (1) improved management/archival system and a (2) faster and easier method for accessing archival highway plans.

- **Improved Management and Archival System**
  - Eliminates lost drawings, misfiled drawings, and deterioration of drawings.
  - Consolidates record plan sets in one location in digital database. Currently engineering plans, right-of-way plans, shop drawings, bridge plans, and roadway plans are stored in multiple physical locations.
  - Electronic database manages the plan sets and associated documents.
  - Long-term digital storage integrated with ProjectWise content management system.
- **Faster and Easier Access to Highway Plans**
  - By anyone, at any time, from anywhere.
  - Improved document accessibility for both internal and external users.
  - Access by non-spatial or spatial map queries. Quickly exchange query results of specific plans with others.

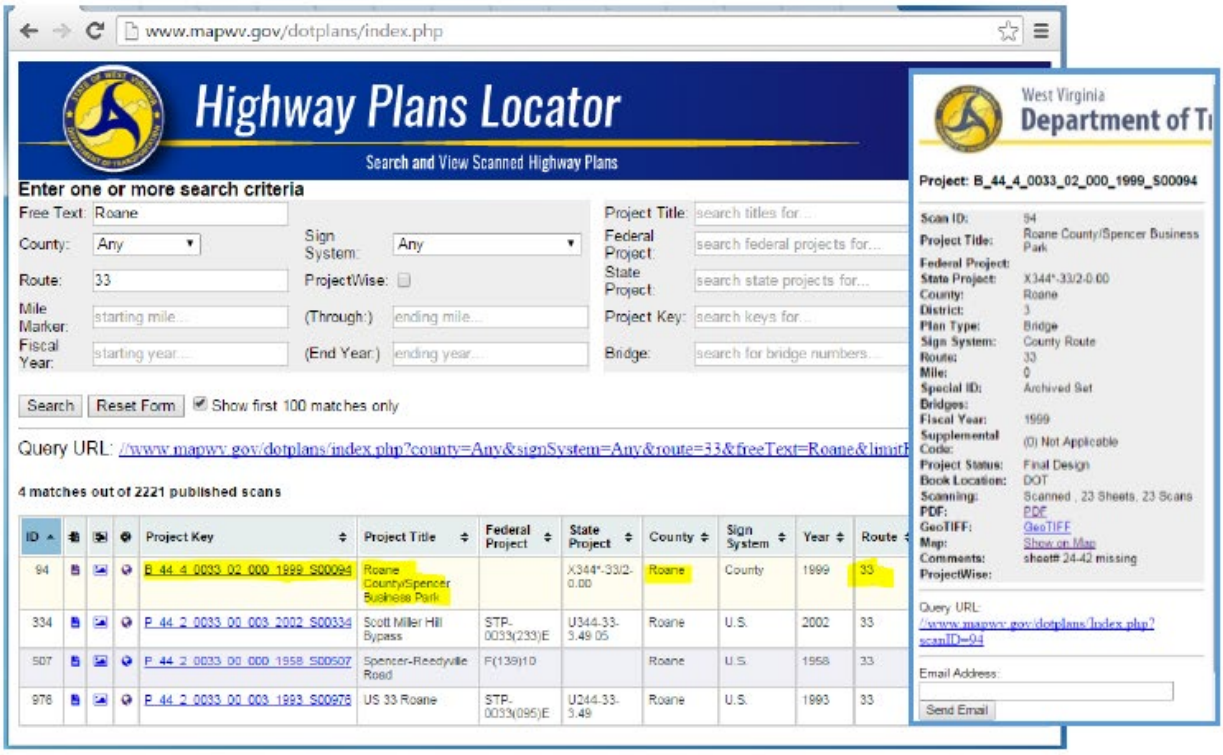
Archival Document Retrieval: The Old Way

Archival Document Retrieval: The New Way

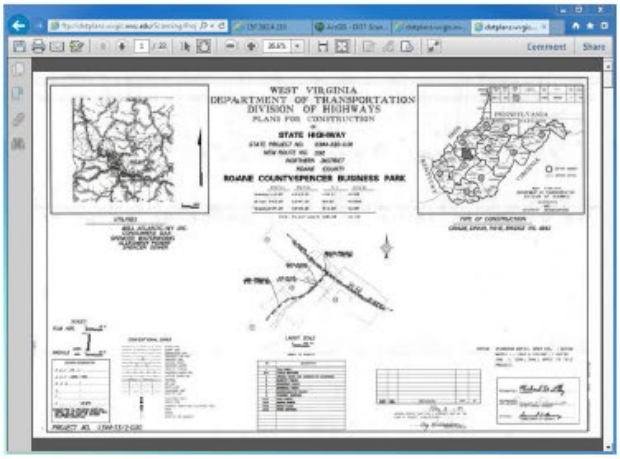
WV DOT SCANNED HIGHWAY PLANS

(http://www.mapwv.gov/DOTplans)

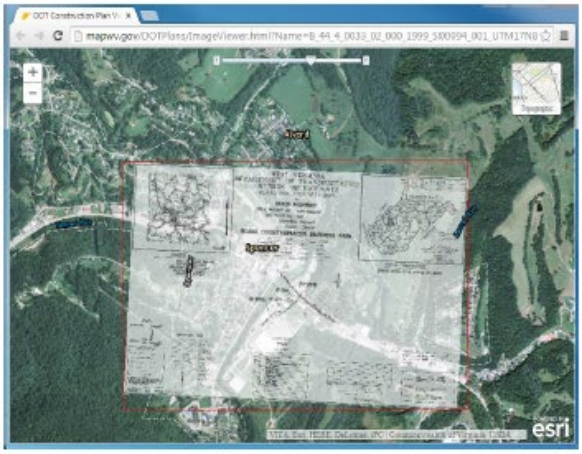
1. Locate Scanned Highway Plans via Internet



2. View Highway Plans via PDF Reader



3. View or Locate Plans via Web Map



SCANNING PROCEDURES OVERVIEW

Presently scanning is done for six types of highway plans: right-of-way plans, bridge plans, construction design plans, shop drawings, half-sized plans, and as-built plans.

The scanning project consists of seven major work tasks which are briefly described below. For a more detailed explanation refer to the **Scan Procedural Manual**.

7 Major Work Tasks

(1) Book Preparation and File Naming: The WV Division of Transportation provides a transmittal sheet with key information about each highway plan book. This information is entered into a Scanning Database which consists of basic transportation fields for identifying the highway book, unique scan order and project key identifiers, scan information for tracking progress and work tasks, index map coordinates, and useful online links for the PDF Book, geographic location, ProjectWise location, etc. During this step a unique scan order identifier is assigned to each highway plan book.

(2) Sheet Scanning: Before the scanning commences, the scanner is configured according the size of the plan. Every large sheet is scanned at 300 dpi and 8-bit indexed color to a TIFF file format. To maintain the proper sheet order and sequencing, the sheet page number and scanned page number are identical and follow precise naming conventions established by the Division of Highways. Due the extensive use of the scanners, the scanners are cleaned and calibrated routinely to achieve high-quality image scans. Document protectors are utilized whenever necessary to protect the sheet or the scanner. The sheet scanning task consumes the most time or involves 80% of the total work tasks.

(3) Image Processing: Image processing batch routines are performed on the scanned images to enhance image quality and crop out white space in the margins.

(4) PDF Book: The scanned sheets of each highway plan book are combined into a single Adobe PDF file and optimized for reduced size and text recognition.

(5) Geo-Reference Highway Index Map: The index map sheet of each project plan set is spatially referenced to associate each highway plan set to a geographic location. Maps are geo-referenced to the majority UTM Zone 17, map units in meters, file format GeoTIFF. Typically, geo-referencing of a map requires between 10 to 20 minutes according to how quickly control points can be determined.

(6) Quality Control and File Renaming: Quality control and management procedures are executed to ensure work tasks are done in an efficient and satisfactory manner. Quality control procedures include:

- Verify file name accuracy
- Verify completion of image processing
- Verify completion/accuracy of PDF
- Verify completion/accuracy of GeoTIFF
- Update Tracking Database's QC Checklist sheet
- Back-up all files onto project server FTP drive

File Renaming: During this step all the files named with the unique 5-digit Scan Order Number (e.g., S01149) are expanded to a 28-character, fixed-length Project Key Number (e.g., B_06_1_0064_00_011_2012_S01149). The Project Key provides more information about the plan to include: Plan Type, County Code, Sign System Code, Route, Sub-Route, Begin Mile Marker, Scan Order Number, Fiscal Year, and ScanID.

(7) Publishing: The final process of the WV Division of Highways Plan Scanning Project is to publish the scanned TIFFs, PDFs, and GeoTIFFs to the project's FTP directory and online application. The publishing tasks are executed with several python scripts. Final quality control checks are performed on the Highway Plans Locator website to make sure all the web links are correct.

Figure 1: DOT Scanning Workflow

Figure 2: Technicians performing scanning and image processing work tasks

SYSTEM DESIGN

The highway plan scanning project 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. Virtualized servers and a Storage Area Network (SAN) are used for storing the application, databases, and scanned images. Refer to the **System Technical Document** for more detailed information.

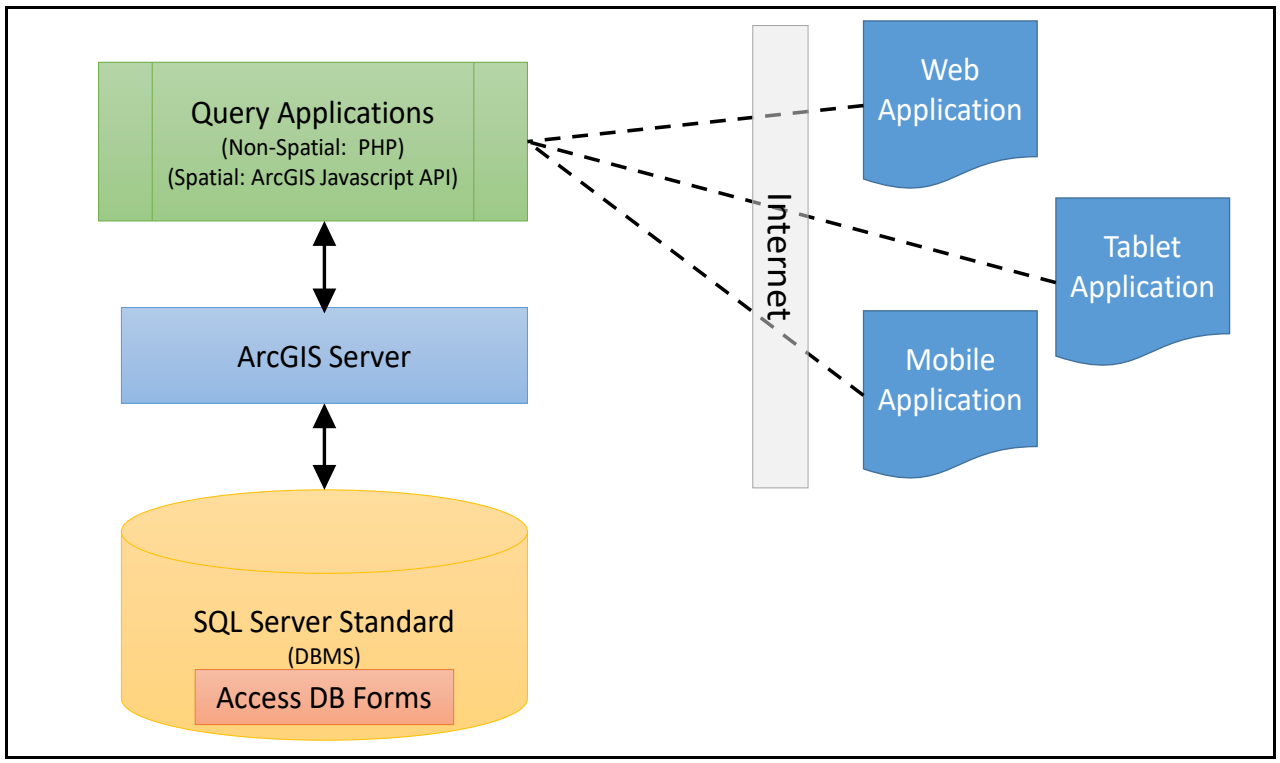


Figure 4: System Architecture

EXPECTED ACCOMPLISHMENTS AND DELIVERABLES

Phase II of the scanning project is organized into seven work tasks and deliverables.

Task 1: Scan Highway Plan Sheets

Specific activities associated with this task are to:

- Scan 225,000 highway sheets (estimated 3,750 plan sets) provided by the WV DOH
  - Scan individual sheets as Tagged Image File Format (TIFF) image files that correspond to page number of plan set. Files are compressed to ZIP files to reduce file sizes.
  - Image process all individual plan sheets according to specifications
  - Create a PDF Book of all multi-page documents combined into a single portable document format (.pdf) for each plan set.
  - Geo-reference the index map of each project book
  - Priority of work is to completely scan all the right-of-way and bridge plans

Task 2: Add Digital Plan Sets from District Offices

Specific activities associated with this task are to:

- Add ROW and construction highway plan sets already scanned at District Offices
- Evaluate quality and completeness of digital scans at District Offices
- Create procedures for processing and adding digital highway scans
  - Develop online transmittal form for creating project and scan identifiers
  - Create a field identifier or modify project key to denote scans from District Office
  - Set up FTP protocols for transferring digital files
- Add an estimated 3,000 highway plan sets from other District Offices

Task 3: Web App Enhancement: Upgrade Highway Plans Locator to Query by Geographic Location

Specific activities associated with this task are to:

- Create a customized online map application according to WV DOT specification with geographic search functions and links to highway plans for viewing and download.
- View prototype using ArcGIS.com
- See Appendix F for preliminary specifications

Task 4: Web App Enhancement: Develop Cross-Walks between Scanning & Other DOH Databases

Specific activities associated with this task are to:

- Explore procedures for linking Scanning Database to supplemental or archival highway information
  - Link bridge plan numbers to BARS# numbers database
  - Link to microfilm database of 1960-70's era

Task 5: Provide Project Management Services

Specific activities associated with this task are to:

- Maintain Scanning Project Tracking Database (SQL Server/Access Databases) which records all relevant information about scanned highway plan sets
- Maintain and update the Highway Plans Locator (http://www.mapwv.gov/dotplans) application that includes allowing users to perform non-spatial queries of scanned highway plans
- Coordinate with client to develop user specifications for new work flow protocols

- Submit quarterly progress reports about objectives and milestones accomplished
- Publish special reports that summarize plans by type or other data elements
- Create customized reports that indicate, for example, duplicate or related plan sets
- Update Scan Procedural Manual and System Technical Document
- Writing utility programs
- Hiring and training of new personnel

Task 6: Provide System Administrative Services

Specific activities associated with this task are to:

- Perform system administration and maintenance of application. Technical support services include hardware and software operating system upgrades. Maintain backup system with virtual servers. Update monthly security patches on all servers. Install and maintain all necessary hardware and software licenses (Esri software, MS SQL Server, etc.).
- Maintain Highway Plan Locator application on production servers at a high level of performance. Provide technical support of application include the processing of troubleshooting calls.

Task 7: Provide Project Reports and Outreach Services

Specific activities associated with this task are to:

- Develop quick start guide for accessing Highway Plans Locator
- Present project at meetings, user groups, conferences, etc.

PERFORMANCE PERIOD

The performance period is 3 years performance period (6/1/2017 until 5/31/2020).

#	*Work Task*		*Year 1*	*Year 2*	*Year 3*
1	Scan 225,000 Highway Plan Sheets (75,000 sheets per year)		75,000	150,000	225,000
2	Add Digital Plan Sets from Districts Offices				30,000
3	New Spatial Viewer for Locating Highway Maps by Geographical Queries				
4	Link Scanning Highways Database to Other Databases				
5	Project Management Services (Maintain Tracking Database and Highway Plans Locator)				
6	System Administrative Services				
7	Outreach Services				

BUDGET

The 3-year budget proposed for the second phase of the scanning project is $614,318.18. This phase of the project will scan 225,000 sheets (or an estimated 3,750 plan sets) and create a PDF book and spatially-referenced index map of each highway plan set. Other tasks include adding 3,000 digital plan sets from the District Offices, developing a customized spatial query tool for the Highway Plan Locator web application, and developing cross-walks between other highway databases and the scanning database. Project management, system administrative, and outreach services are also in the budget. Additional expenses include costs for hardware supplies, travel, and indirect charges.

SCANNING, PDF BOOK, GEO-REFERENCING COSTS (Task 1): About 80% of the paper-to-digital conversion involves the scanning process at $1.25 per sheet or $75.07 per book for a typical plan set of 60 sheets (See Appendix B). Additional per book costs are as follows: $8.09 to create a single PDF file of each plan set, $3.24 to geo-reference each index map, and $7.82 for other tasks such as file management and quality control for each plan set. The total cost for the scanning, PDF book creation, geo-referencing, and associated tasks is $94.22 per book or a $1.57 per sheet cost. A student labor rate of $15.12/hour plus graduate student fringe rate of 7.0% totals to $16.18 per hour. *Total scanning and file/image processing costs are $353,322.02.*

DIGITAL PLANS FROM DISTRICT OFFICES (Task 2): An estimated 3,000 plans will be imported into the centralized archival scanning database. Since the electronic PDF books are already created, the only processing tasks required are cataloging the books into the scanning database and geo-referencing the index maps for spatial queries. The estimated cost per book is $11.06 for which the same aforementioned labor rates apply. *Total cataloging and processing costs of the electronic PDF plans sets from the District Offices are $33,169.00.*

APPLICATION TOOL ENHANCEMENTS (Tasks 3 & 4): Funding to create a customized spatial query tool for the Highway Plan Locator web application (Task 3) and to cross-reference other DOH databases to the scanning database (Task 4). *Total cost for the web application enhancements is $25,430.73.*

SERVICE-RELATED COSTS (Tasks 5 thru 7): Service-related costs are subdivided into three categories: project management services, system administrative services, and outreach services. Project management services include maintaining the Highway Plan Tracking Database (SQL Server/Access Databases) which records all relevant information about scanned highway plan sets, automating work tasks with geo-processing utility programs, submitting progress reports, creating customized scanning reports, hiring and training new personnel, etc. System administrative services include technical support for hardware and software operating upgrades, troubleshooting calls, security updates, backup protocols, maintaining software licenses, etc. Outreach services include promotional materials about the project, presenting on the project at conferences, user group meetings, etc. All labor rates for students and full-time personnel will be confirmed by the WVU Office of Sponsored Programs. A student labor rate (Research Assistant I.357, PG 15) at $15.12/hour plus graduate student fringe rate of 7.0% totals to $16.18 per hour. The hourly wages of benefit eligible full-time personnel are determined from annual salaries divided by 1,950 hours per year. *Total service-related costs are $39,857.95.*

HARDWARE/SUPPLY COSTS: This project requires the constant use of two large-format scanners which periodically require the replacement of consumable parts. A total of six external drive devices are required for offsite storage and transferring files to WV DOT. In addition, 8 TB of internal storage are needed for publishing and serving the scanning files and PDF books online. Supply costs include protective carriers for scanning plan sheets that are torn, folded, or delicate. See the attachment that

provides individual quotes for the scanner replacement parts, scanner protector carrier sheets, and internal/external storage devices. *The total cost for hardware and supplies is $7,475.86.*

TRAVEL: Travel costs associated with transporting plan books between Charleston and Morgantown are $4,380.80. The amount covers 20 trips from Morgantown to Charleston and back; four of the trips include overnight stays. Standard mileage ($0.54 per mile), per diem ($54 per day), and lodging rates ($107 per day) apply. *Total travel costs are $4,380.80.*

FACILITIES & ADMINISTRATION COSTS: An indirect rate of 32.5% is applied to the project at a cost of $150,681.82.

No costs for digitizing were included in the budget, but if costs were to be calculated, a rate of $15.12 per hour cost would apply. See Appendices A and B for tables and graphs associated with the Phase II budget.

CONTACTS

The following individuals will serve as contacts and technical liaisons for this project:

WV Division of Highways	
Hussein Elkhansa (Admin) GIS Section Head Program Planning & Administrative Division WV Division of Highways 1900 Kanawha Blvd. East, Bldg. 5 Charleston, WV 25305-430 Phone: (304) 558-9657 Hussein.S.Elkhansa@wv.gov	**Kevin Huffman** (Technical) Information Unit Manager Engineering Division WV Division of Highways 1334 Smith Street Charleston WV 25301 Phone: (304) 284-7576 Kevin.A.Huffman@wv.gov

WV GIS Technical Center	
Kurt Donaldson (Admin) GIS Manager West Virginia University West Virginia GIS Technical Center 330 Brooks Hall PO Box 6300 Morgantown, WV 26505-6300 Phone: (304) 293-9467 kdonalds@wvu.edu	**Eric Hopkins** (Technical) GIS Analyst West Virginia University West Virginia GIS Technical Center 330 Brooks Hall PO Box 6300 Morgantown, WV 26505-6300 Phone: (304) 293-9463 ehopkins@wvu.edu

APPENDIX A – Phase II Budget

Estimates		Total Costs, Scans, Time Period	
Est. Sheets per Plan Book	60	Total Cost (with F&A)	$614,318
Total Cost per Sheet (direct costs)	$1.57	Total Sheets Scanned	225,000
Total Cost per Plan Book (direct costs)	$94.22	Maps Geo-Referenced	1 per book
Total Books Completed	3,750	Performance Period	3 years

Phase II Budget (3 years)					
Item	Work Tasks	Unit Price	Unit Type	Quantity	Extended Price
** SCAN, PDF BOOK, GEO-REF **	1				**353,322.02**
Sheet Scanning task only		$1.25	per Sheet	225,000	281,523.27
PDF Book / Geo-Reference Index Map / Publishing / Other Tasks		$19.15	per Book	3,750	71,798.75
** DISTRICT DIGITAL PLANS **	2	$11.06	per Book	3,000	**33,169.00**
Web Application Enhancements	3-4				**25,430.73**
Services (Project Mgmt, System Admin, Outreach)	5-7				**39,857.95**
** HARDWARE/SUPPLIES **					**7,475.86**
Scanner #1 Replacment Parts		$712	per year	3	2,136.00
Scanner #2 Replacment Parts		$712	per year	3	2,136.00
Scanner Protector Carrier Sheets "D" Size		$93	per sheet	8	744.00
4 TB Internal Server Storage		$525	per drive	2	1,049.98
4 TB External Storage Devices		$145	per drive	2	289.98
6 TB External Storage Devices		$250	per drive	4	999.96
External Drive Cases		$20	per drive	6	119.94
Travel					**4,380.80**
Total Direct Costs					463,636.36
Facilities & Administration (32.5%)					**150,681.82**
Total Costs					**$ 614,318.18**

APPENDIX B – Phase II Costs Breakdown

Scan, PDF Book, Geo-Reference, QC/Publishing Costs Breakdown (Work Tasks 1 & 2)

Major Task	Sub Tasks	Unit	Average Time (Minutes)	Avg. Sheets per Project	Total Minutes	Total Hours	Hourly Rate	Est. Per Sheet Cost	Est. Cost Per Project
Scan $1.25 per sheet or $75.07 per book	Map book disassembly / assembly, file naming, page numbering	Project Book	30		30	0.5	$ 16.18	$ 0.13	$ 8.09
	Scan Document Sheets	Sheet	2.5	x 60	150	2.1	$ 16.18	$ 0.55	$ 33.27
	Image Processing	Sheet	2	x 60	120	2.0	$ 16.18	$ 0.54	$ 32.36
	Update Tracking Database	Project Book	5		5	0.1	$ 16.18	$ 0.02	$ 1.35
	total		39.5		305	4.64	$ 16.18	**$ 1.25**	**$ 75.07**
Adobe PDF $8.09 per book	Create Adobe PDF Book of all map sheets	Project Book	30		30	0.50	$ 16.18	**$ 0.13**	**$ 8.09**
							$ 16.18		
Geo-Reference $3.24 per book	Geo-reference	1 sheet/Project Book	10	x 1	10	0.17	$ 16.18	$ 2.70	$ 2.70
	Update GeoRef Sheet Database	Project Book	2		2	0.03	$ 16.18	$ 0.54	$ 0.54
	total		12		**12**	0.20	$ 16.18	**$ 0.05**	**$ 3.24**
Publish Files to Web App / Quality Control Tasks $7.82 per book	Publishing files to Web Map	Project Book	4.5		4.5	0.08	$ 16.18	$ 0.02	$ 1.21
	Copy all files to internal and external drives	Project Book	14.5		14.5	0.24	$ 16.18	$ 0.07	$ 3.91
	Quality Control - Check PDF, GeoTIFF, file renaming	Project Book	10		10	0.17	$ 16.18	$ 0.04	$ 2.70
	total		29		**29.00**	**0.48**	$ 16.18	**$ 0.13**	**$ 7.82**
	grand total				**376.00**	**5.82**	$ 16.18	**$ 1.57**	**$ 94.22**
					min. per book	hours per book		cost per sheet	cost per book

Notes:

- GIS Technician Rate - Research Asst I, PG 15 at $15.12/hour plus graduate student fringe rate of 7.0% = $16.18 per hour
- The hourly wages of benefit eligible full-time personnel are determined from annual salaries divided by 1,950 hours per year
- Estimated number of sheets per project book: 60
- Only index map sheet per book georeferenced
- Georeferencing time ranges from 10 to 20 minutes depending on source imagery accuracy and available control points

Services Cost Breakdown (Work Tasks 3-7)

Personnel Costs for 3 years						*Percent Effort by Task*		
Item	**Hourly Wage**	**# Hours**	**Base Salary**	**Fringe (%)**	**Total Salary**	**Web Tools % Effort (Tasks 3-4)**	**Services % Effort (Tasks 5-7)**	**Total Cost & Effort**
(1) GIS Manager (Kurt Donaldson)	$35.89	440	$15,792	23.5	$19,503	3,901	15,602	19,503
						20%	80%	100%
(2) System Administration / Programmer (Frank LaFone)	$33.65	60	$2,019	23.5	$2,493	249	2,244	2,493
						10%	90%	100%
(3) GIS Project Leader (Eric Hopkins)	$28.85	440	$12,694	23.5	$15,677	784	14,893	15,677
						5%	95%	100%
(4) GIS Programmer (Yibing Han)	$24.62	440	$10,833	23.5	$13,379	13,379		13,379
						100%		100%
(5) Student GIS Programmer (Jim Schindling)	$15.12	440	$6,653	7.0	$7,118	5,339	1,780	7,118
						75%	25%	100%
(6) Student GIS Analyst Mcwreath)	$15.12	440	$6,653	7.0	$7,118	1,780	5,339	7,118
						25%	75%	100%
Total			$54,643		**$65,289**	25,431	39,858	**65,289**

Hardware and Supply Costs

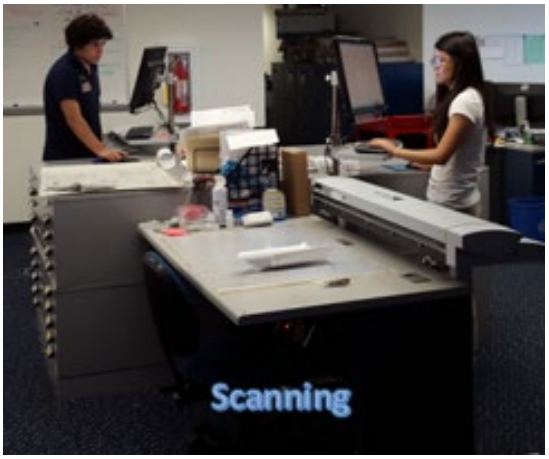
Table A: Phase II Scanner Costs (estimated 2017-20)

ITEM	ITEM COST	UNIT	QTY	TOTAL
Scanner #1 Replacment Parts	$712	per year	3	$2,136
Glass SC42 Glass Assembly	$332			
SC42 Hold Up Roller	$344			
Hold Up Roller Support Bar	$36			
Scanner #2 Replacment Parts	$712	per year	3	$2,136
Glass SC42 Glass Assembly	$332			
SC42 Hold Up Roller	$344			
Hold Up Roller Support Bar	$36			
Scanner Protector Carrier Sheets "D" Size	$93	per sheet	8	$744
TOTAL				$5,016

Table B: Other Hardware/Supply Costs (estimated 2017-20)

ITEM	ITEM COST	UNIT	QTY	TOTAL
4 TB Internal Server Storage	524.99	per drive	2	1,049.98
4 TB External Storage Devices	144.99	per drive	2	289.98
6 TB External Storage Devices	249.99	per drive	4	999.96
External Disk Enclosures	19.99	per drive	6	119.94
TOTAL				$2,460

3-Year Costs for Hardware & Supplies				**$7,475.86**



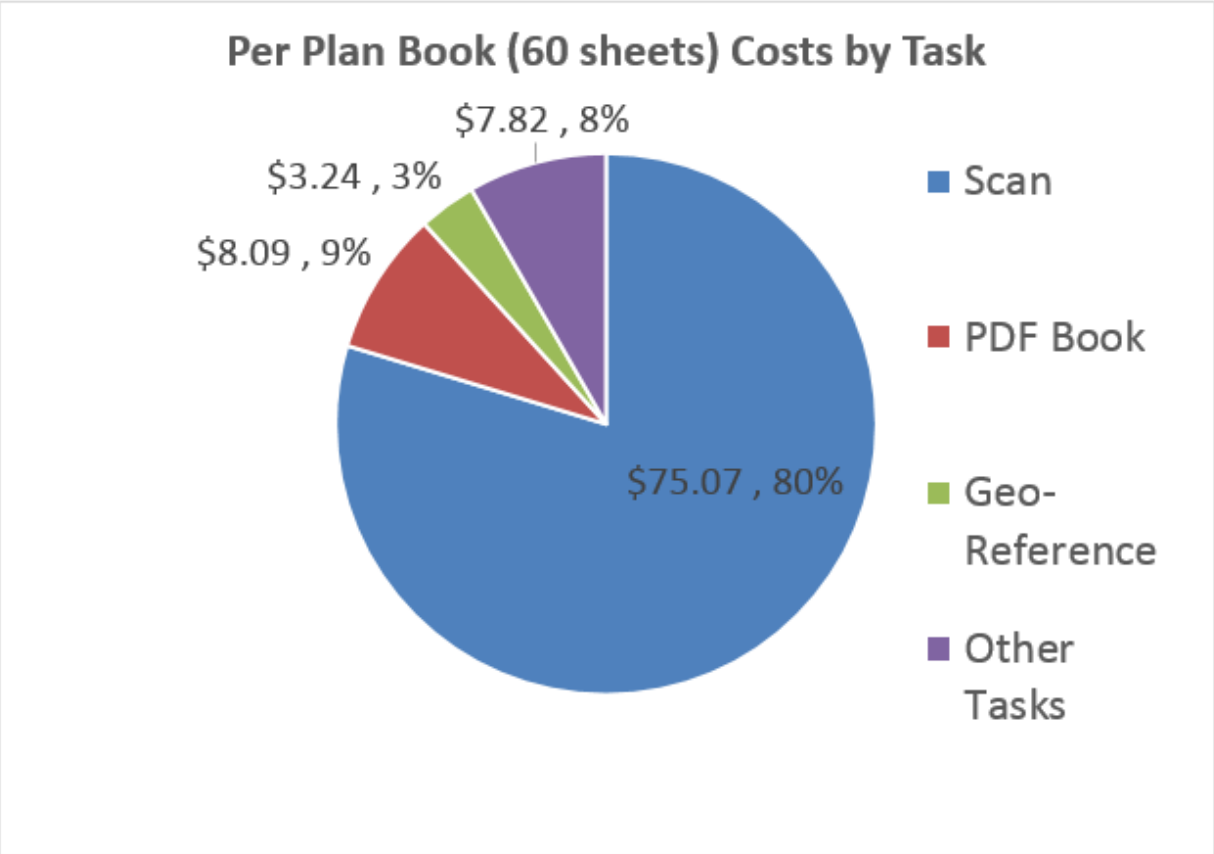
Two Large-Format Scanners

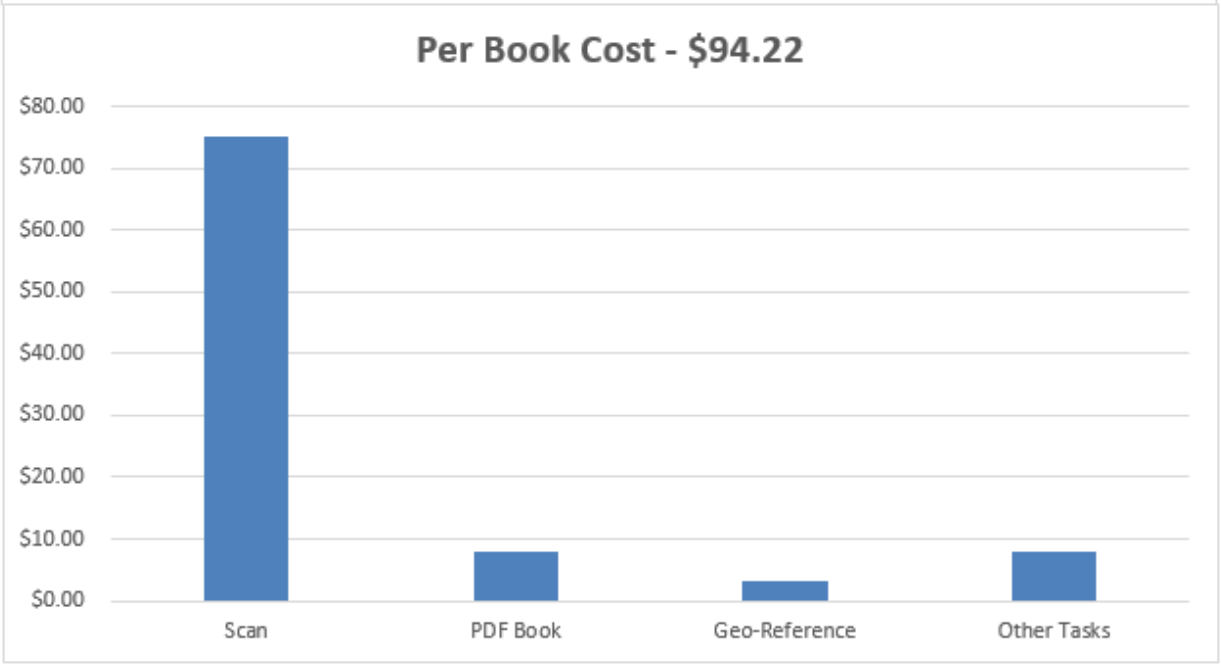
Travel Costs Breakdown

Travel Item	Unit		Qty	Cost
Lodging	$ 107.00	per day	4	$428
Per Diem Meals	$ 54.00	per day	8	$432
Total Mileage (.54 per mile x 326 miles) from Morgantown to Charleston and return trip	$ 176.04	per mile	20	$3,521
sum				**$4,380.80**

Travel: 20 trips from Morgantown to Charleston and back; four of those trips include overnight stays

Per Plan Book Costs by Work Task ($94.22 per book cost)





APPENDIX C – Scanning Project Work Estimates

Plan Type	Code	# Plans Scanned	% Total Inventory Scanned	% Total Inventory to Scan	Estimated # Total Plans	Estimated # Remaining Plans
ROW Plans	R	555	33%	67%	1,682	1,127
Bridge Plans	B	775	33%	67%	2,348	1,573
Construction Plans	P	415	10%	90%	4,150	3,735
Half-Sized Plans	H	184	23%	77%	800	616
Shop Drawings	S	7	4%	96%	157	150
As Built*	A	16	-	-	-	-

*The As Built plans are located in each of the 10 District Office's construction division. Each district has a unique way of organizing these files and will require time from WV DOT to re-organize the plans for scanning accuracy.

Scanning Priorities for Phase II:

1) Bridge and ROW Plans
2) Construction and Shop Drawings
3) Digital District Files and As Built Plans

The scanning priorities for Phase II are the bridge and right-of-way plans. As of August 2016, 63 of 120 drawers of bridge files and 30 of 517 drawers of right of way files have been scanned. It is important to note that the ROW file drawers are twice as deep (4") as the bridge files (2").

File Cabinets that store DOH Highway Plans

APPENDIX D – Technical Documentation and Resources

1) **Procedural Manual** (24 August 2016)
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/Scan_Procedural_Manual_20160824.pdf

https://data.wvgis.wvu.edu/pub/temp/DOH/scan/Scan_Procedural_Manual_20160824.pdf

2) **System Technical Document** (24 August 2016)
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/Scan_Technical_Document_20160824.pdf

https://data.wvgis.wvu.edu/pub/temp/DOH/scan/Scan_Technical_Document_20160824.pdf

3) **Undergraduate Research Day at the Capitol** (25 February 2016)
   a) WV MetroNews Talkline Interview with Hoppy Kercheval
   ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_TalklineHoppyInterview.mp3
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_TalklineHoppyInterview.mp3

https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_TalklineHoppyInterview.mp3

   b) Poster:
   ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_UndergraduateScanningProjectPoster.JPG

   https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_UndergraduateScanningProjectPoster.JPG

   c) Pictures:
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_Capitol_Picture_MetroNews.jpg
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_Capitol_Picture_MetroNews.jpg

   i) ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_Capitol_Poster_Display.jpg
   https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160225_Capitol_Poster_Display.jpg

   ii)

4) **Project Presentation for WV DOT GIS Day** (17 November 2015) prepared by Kurt Donaldson and Kevin Huffman
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/WV_DOT_Scanning_Project_20151117.pptx
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/WV_DOT_Scanning_Project_20151117.pptx

5) **Scanning Technicians**

   a) June 2015: ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20150605_ScanTechnicians.jpg
   https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20150605_ScanTechnicians.jpg

b) May 2016: ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/20160525_ScanTechnicians.jpg
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/20160525_ScanTechnicians.jpg

6) **Pictures of 50K Milestone Scan Celebration** (7 July 2015)

a) Picture 1:
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/WVU_50K_Scan_Celebration_2015-07-22.jpg
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/WVU_50K_Scan_Celebration_2015-07-22.jpg

b) Picture 2:
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/WVU_50K_Scan_Celebration_2015-07-22_cake.jpg
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/WVU_50K_Scan_Celebration_2015-07-22_cake.jpg

7) **Phase I Project Proposal and Budget** (5 January 2015)
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/wvDOT_scan_proposal_5Jan2015.pdf
https://data.wvgis.wvu.edu/pub/temp/DOH/scan/wvDOT_scan_proposal_5Jan2015.pdf

8) **Phase II Project Proposal and Budget** (31 August 2016)
ftp://ftp.wvgis.wvu.edu/pub/temp/DOH/scan/wvDOT_scan_proposal_31Aug2016.pdf
9) **<< update to 2017 >>**

APPENDIX E – Staff Pictures

MetroNews Radio Interview about Scanning Project

APPENDIX F – Spatial Query Specifications

Customized Web Map Application

The objective of Project Work Task #3 is to enhance the current Highway Plans Locator (www.mapWV.gov/DOTplans) so that users can perform geographical queries. Users would execute spatial queries by a buffered geographic point or polygon to locate highway plans of interest. A user would then browse through the selected highway plans from the resulting query in which individual highway plan sets can be viewed online or downloaded. In addition, a simple identifier tool function will allow users to randomly select and view detailed information of specific highway plans. In a side panel, the resulting records from the spatial search query can be further filtered or refined using key fields (county, route, sign system, etc.).

A rudimentary prototype using ArcGIS.com illustrates the concept. A customized web map query 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 query application can be customized to user requirements set forth by the WV Division of Highways.

Map functions could include:

- Customized user interface.
- View spatially referenced scans (GeoTiffs).
- Perform **spatial queries** by buffered point or polygon.
- A side panel to **filter or refine search queries** based on key fields (county, route, sign system, etc.). Other search parameters could be Project Title or Project Key.
- **Display detailed information** about each highway plan in side panel.
- **Highlight, Viewing and Download functions** to select highway map of interest.
- An **identify function** to select a single highway plans and view results.
- **Zoom to** County, Street Address, Geographic Coordinates.
- Display various **background and reference layers**.
- Add **other useful map functions**: transparency slider for highway maps, print map, measure tool, bookmarks, shared link tool, etc.

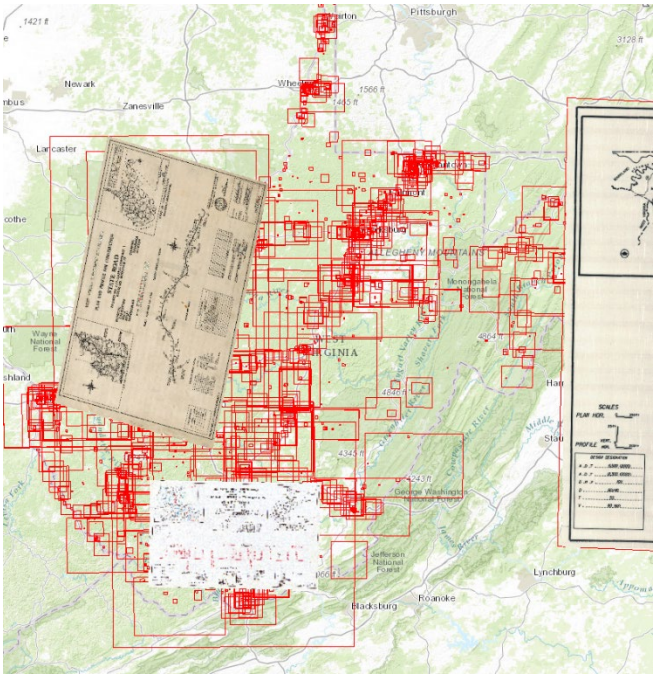
Automatically Update Web Map Index

Another objective of the web application would be the ability to automatically generate a new web map index and corresponding file links when additional map scans are published. Where possible, automatic programming scripts could be developed to expedite updating functions in the application which will decrease costs and minimize human errors during the web application updating procedures.

SPATIAL QUERY (outline):

1) PURPOSE: List and View all highway plans by spatial query
   a) Point query (default)
   b) Polygon Box query (possible option)

2) FUNCTIONS
   a) Lists highway plans (with Map ID) of interest based on spatial query
      i) View PDF Plan
      ii) Download PDF Plan
      iii) Download GeoTIFF
      iv) Zoom to plan of interest
      v) Provide Map Details
   b) Base Layer Options
      i) Commercial base layers (default layer Esri Roads)
      ii) WV base layers
   c) Overlay Layer Options
      i) County Boundaries
      ii) WV DOT Roads
      iii) District Boundaries
      iv) Mile Markers
   d) Map Transparency
   e) Measure Tool
   f) Map Transparency
   g) Customized Zoom Level
   h) Print Map
   i) Zoom To Features
   j) Access FTP Folder
   k) Shared Map Link



Search Highway Plans by Geographic Location

APPENDIX G – Procedures Outline

7/24/2016

1) Book Preparation & File Naming

a) Receive Project Book(s) from WVDOT
   i) Transmittal sheet provided by WV DOT
      (1) Denote if plan is located in ProjectWise
   ii) Project Key provided by WVDOT
   iii) Scan Order # designated by WVGISTC
   iv) Remove clips/tape/staples from sheets
   v) Rearrange pages in proper sequence if necessary.
   vi) Review page number suffixes
   vii) Enter Project Book information into dbo_Scanning sheet in MS Access
   viii) Information found on Project Book cover sheet
   ix) Project Key found on transmittal sheet
   x) Create project folder on scanning machines to contain scanned images:
   xi) Name project folder with Scan Order #

File Naming

b) File Naming
   i) Designate Scan Order # on Project Key/Transmittal Sheet
   ii) Pull information from Project Key/Transmittal Sheet and Book to add to the DOT Scanning Database
      (1) Includes:
         (a) Processing Status
         (b) Publication Status
         (c) Project Title
         (d) Federal Project
         (e) State Project
         (f) County ID
         (g) County 2 ID
         (h) District
         (i) Sign System ID
         (j) Route Number
         (k) Sub Route Number
         (l) Fiscal Year
         (m) Sheet Count
         (n) Plan Type
         (o) Scan Date
         (p) Book Location
         (q) Comments
         (r) Supplemental Code ID
         (s) Direction ID

(t) Begin Mile
(u) Project Status
(v) Special Code ID
(w) Special ID
(x) Bridge Number
(y) URN (Uniform Resource Name) for ProjectWISE

2) Scan Document

a) Scanner Settings:
   i) Size – Full auto size
   ii) Auto BW points – Off
   iii) Color Mode – 256 Colors – auto palette
   iv) Resolution – 300
   v) Quality – 1
   vi) File type – TIFF LZW
   vii) Folder – C:\DOT\Imagery\Original Scans\ScanOrder#
      (1) 22x34 = S00000
      (2) 12x18 = S00000
         (a) Change Settings to Manual Width (480) Auto Length
      (3) 8.5x11 = S00000b
b) Configure scanner with *Scan Order #*, page number, and output location
   i) Files are named by the DOH established naming convention
      (1) *ScanOrder-PageNumber.TIF*
      (2) Verify page number accuracy
      (3) Save scans in folder named with *Scan Order #*/TIFF
c) Scan sheets
   i) Wipe each page cleanly with a disposable microfiber cloth in a downward/consistent direction to not spread dirt on sheet
   ii) Check each page for number changes or additional suffixes (generally letters)
   iii) Use the document protector in a case of sheets being dirty, excessively waxy or sticky, torn, brittle or any other reason it can't be scanned like regular sheet
d) Scanner Maintenance: Clean Scanner daily or sooner when necessary and recalibrate scanner when necessary/weekly
e) Re-bind\replace all sheets as it was received
f) Roll sheets and fasten with rubber band
   i) Place transmittal sheet inside roll
   ii) Add colored paper with scan order number to outside of roll
g) Update dbo_ScanningActivity Tracking Database in MS Access:
   i) Book Number
   ii) Date of Action
   iii) Technician performing action
   iv) Action taken
   v) Time worked on Action (minutes)
   vi) Quantity completed (sheets)
   vii) Sheet Count (finished book)
   viii) Scan Count (finished book)
   ix) Additional Comments

h) Complete this process after every completed action or before the end of shift
i) Project Book is now ready to return to WVDOT

3) Image processing

a) Create Photoshop droplets for image adjustment and crop automation
b) Image Process project book folders
   i) Save a copy of the incomplete book onto desktop with file name "TIFF"
   ii) Drag "TIFF" through droplets
   ii) Check each image and crop by hand when necessary

4) PDF Creation

a) Create an action in Adobe Acrobat Pro
   Action Procedure:
   i) Reduce File Size
   ii) Run Recognize Text (using OCR) Tool
   ii) Name action "DOT PDF"
b) Run action "DOT PDF"
c) Check PDF for rotation errors resulting from Text Recognition tool and make necessary corrections.
   i) Every page that has an error needs to be corrected individually without using the Text Recognition Tool by:
      A) Creating a new, single page PDF
      B) Reduce file size
      C) Save PDF
      D) Replace original page with the corrected page from the new PDF
d) Save in ProjectBookFolder/PDF
   i) Naming Convention: *ProjectKey.pdf*

5) Georeference Plan Index Map Sheets

a) Estimate 1 map sheet per project book (cover sheet)
b) Prepare TIFF for geo-referencing
   i) Save a copy of TIFF to a "GEOTIFF" folder on local drive for georeferencing
   ii) Crop out all whitespace/margin
   iii) Adjust image format for Web Map Index compatibility
      (1) Must be in 8-bit, Indexed Color mode
      (2) Brighten TIFF if necessary (no pixels below RGB='10,10,10')
      (3) Create custom color index with index value '0' set to black (RGB='0,0,0')
   iv) If converting to MrSID format:
      (1) Adjust color levels to add minor color data to TIFF if necessary
c) Georeference TIFF
   i) When rectifying, set NoData as '0' to set background transparency
d) Name georeferenced images according to DOT naming conventions
   i) Naming conventions: *ProjectKey_PageNumber_UTM17N83.tif*
   ii) Save in local "GEOTIFF" folder
   iii) Paste in: ProjectBookFolder/*ProjectKey*/GeoTIFF

e) Update Tracking Database's Georeferencing sheet
   i) Scan order number
   ii) Page number
   iii) Amount of time to georeference
   iv) RMS error
   v) Technician initials
   vi) Date
   vii) Additional notes
f) Enter information into dbo_ScanningActivity sheet in MS Access

6) Quality Control/Quality Assurance: Procedures for each Project Book

a) Accuracy/completion of Project Database entry.
b) File-name accuracy
c) Completion/quality of image processing
d) Completion/accuracy/quality of PDF
e) Completion/accuracy of GeoTIFF
f) File renaming and editing with FileRename.pyt
   i) Subfolders:
      (1) TIFF
      (2) PDF
      (3) GeoTIFF
g) Update Tracking Database's QC Checklist sheet (for beginners)
h) Back-up all files onto project server FTP drive and external drive (limited personnel)
i) Update Plan location in dbo_Scanning via MS Access

7) Publishing Web Map

a) *PublishGeoTIFF.pyt* run python tool to copy and replace GeoTIFFs
b) Add rasters to Mosaic Dataset
c) Attributes
   i) Esri GIS attributes automatically created in DOT.mxd file
   ii) Pre-defined attributes in raster mosaic image-service
      (1) PDF link
      (2) Link to Project folder for access to all related files
      (3) Link to zipped GeoTIFF download
d) Execute scripts to update Web Application query and Map
   i) Publish GeoTIFFs Procedure: PublishGeoTIFFs.pyt
   ii) Add Rasters to Mosaic Footprint creation: BuildFootprints.pyt
   iii) Update Footprints in dbo_Scanning MS Access: UpdateFootprints.pyt
e) Switch PublicationStatus field in dbo_Scanning to *Published*
f) All uploaded plans should appear on the web application <mapwv.gov/dotplans/index.php>
g) **Digital Plan Submission**
   i) In the event of digital plan submissions of previously scanned images from WV DOH District offices, technicians will follow the procedures as outlined below. This methodology is subject to change as digital plan submission formats and procedures change.
      (1) File Naming

(2) Image Processing
(3) PDF Creation
(4) Georeference Plan Index Map Sheets
(5) Quality Control/Quality Assurance
(6) Publishing Web Map

h) **Final Website Quality Control**

(1) Locate all project books uploaded in the last publication.
(2) Click and check each of the four links for each project book.
(3) Note any errors that are found in the QC and refer to the Website troubleshooting for information regarding errors.
(4) Make any corrections and continue to Backup procedures.

i) **Back Up Procedures**

(1) External Drive (Weekly) limited access
  (a) Select new Projectbooks from the R: drive
  (b) Copy and Paste books to WVDOT_Scans_B
  (c) Update Transmittal
(2) Internal Servers (conclusion of website QC)
  (a) Select all projectbooks
  (b) Copy and paste into \\projectsrv\BACKUP.

Major Procedural Tasks associated with Hardware, Software, Management Documents

Processing Task	Hardware	Software	Management Documents
Book Preparation & File Naming	Scanning Computers	File Explorer	dbo_scanning
Scan Document	Scanning Computers		GS_performance_tracking dbo_scanningActivity
Image Processing	Local Workstations	Adobe PhotoShop AutoContrast.atn AutoCrop.atn	GS_performance_tracking dbo_scanningActivity dbo_scanning
GeoReference	Local Workstation ProjectSrv	ArcGIS Google Maps	GS_performance_tracking dbo_scanningActivity
PDF Book	Local Workstation ProjectSrv	Adobe PhotoShop "DOT PDF" action	GS_performance_tracking dbo_scanningActivity
QA/QC	Local Workstation External Drive ProjectSrv External Server	FileRename.pyt	GS_performance_tracking dbo_scanningActivity dbo_scanning
Publishing & Web QC		PublishGeoTIFF.pyt BuildFootprints.pyt UpdateFootprints.pyt	dbo_scanning dbo_scanningActivity

More detailed information is provided in the *WV DOH Scanning Project Procedures* manual.