

## **APPENDIX B**

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### **THE PROJECT**

#### **B.1 Design Surveys**

Michigan Department of Transportation (MDOT) receives requests for various types of survey support from a number of sources. These requests are prioritized and scheduled. Depending on a number of factors, surveys may be performed “in house” by MDOT design survey personnel, or requests for proposal may be sent to those surveying firms pre-qualified under MDOT standards.

A survey project typically begins with a Survey Order. In general, the Survey Order specifies what must be done, where it must be done, and the degree of accuracy and precision to which it must be done. The Survey Order more particularly provides a description of the project, a map defining the limits of the survey, general and special requirements of the survey, special or unusual aspects of the survey, the Control Section Number, the Job Number and may include coding for the charging of time.

Upon receipt of the Survey Order, the project surveyor shall contact the MDOT survey project manager to discuss each item. Both parties must clearly understand the requirements specified in the scope of work. It is the responsibility of the survey project manager to clearly define the scope of work, to provide answers and guidance to the surveyor as needed and to properly evaluate the completed project. It is the responsibility of the surveyor to clearly understand the scope of work, to properly design, conduct, monument and package the survey, and to meet requirements for accuracy and precision.

The survey project manager and the project surveyor should be aware of any special requirements when working in the vicinity of airports or railroads, e.g., The Federal Aviation Administration (FAA) may require heights and position in latitude and longitude of proposed or relocated utility poles.

#### **B.2 Research**

The project surveyor is responsible for conducting thorough and accurate research prior to beginning the field survey. Research will improve the survey design and increase the efficiency of project functions. Proper research is the key to optimal performance with minimal error.

The MDOT Design Survey Office will assist the surveyor in obtaining information on file with the Department. Previous survey notes; road, bridge, and right of way plans, along with witnesses to control

points are generally readily available. Older survey notes are archived at the Records Center in Lansing, Michigan and may take several days to retrieve. National Geodetic Survey (NGS) data sheets for both horizontal and vertical control monuments are available via the Internet (See **Part VII, Control Surveying**).

All research data must be submitted to MDOT with the project portfolio(s) in the section to which the research applies.

### **B.3 Safety**

The surveyor must adhere to all applicable OSHA and MIOSHA safety standards to include use of personal protective equipment and appropriate traffic signage and warning systems.

All required permits shall be obtained by the project surveyor and be on hand as required.

The project surveyor shall contact **Miss DIGG at 1-800-482-7171** prior to any underground excavation.

(See **Appendix C, Safety**)

### **B.4 Relationships With Property Owners**

The people of the State of Michigan have empowered the professional surveyor with a special trust regarding rights to trespass when conducting surveys. Surveyors should make every effort to conduct themselves in a professional manner. The prudent surveyor will always seek permission to access private property. (See **Appendix A, The Professional Surveyor**)

### **B.5 The Surveyor's Report**

The Surveyor's Report is an executive summary of everything that happened or failed to happen in the conduct of the survey. In general, the Surveyor's Report will address; the Scope of Work; Uncertainties in Control to include horizontal and vertical control, real property, datums and coordinate systems; Uncertainties in Observations to include field and office methodology and a discussion of expected or required outcomes compared with obtained outcomes; Uncertainties in Results to include sketches, maps, hard data, digital data, monumentation, etc.; and Recommendations, if any.

In addition, each category of survey has unique requirements for what must be contained in the Surveyor's Report. Basic requirements may be found in the appropriate parts of this manual. Further

items may be required or appropriate as the project dictates.

## **B.6 Project Submittal**

A project may consist of one or more general survey categories. General categories include Photogrammetric Control Surveys (PPMS Task 3320), Road Surveys (PPMS Task 3330), Bridge (Structure) Surveys (PPMS Task 3340) and Hydraulics Surveys (PPMS Task 3350). **EACH CATEGORY MUST BE PACKAGED SEPARATELY FOR TRANSMITTAL**, even though more than one is contained in the same Survey Order, Authorization or Request. Photo control notes are NEVER submitted as part of a road survey. Bridge and Hydraulic notes are always packaged separately and never submitted as part of a Road Survey. If necessary, survey notes and data may be duplicated if common or relevant to different categories of surveys completed simultaneously.

There may be six general types or sections of information relative to each survey category. When the survey is completed, survey information is compiled in separate sections in the following order:

### **B.6.1 Section I. Administrative Data**

Contains in the following order:

- a. MDOT Transmittal Form
- b. Table of Contents
- c. Survey Order, Authorization or Request
- d. Surveyor's Report
- e. Drainage Report (If Required)
- f. Any Indexed Diskettes or Compact Disks (CD's)

Reports and the Table of Contents shall be in both hard copy and digital form.

### **B.6.2 Section II. Control**

Contains research, observations, calculations and reports detailing the horizontal and vertical reference systems established for the survey.

### **B.6.3 Section III. Alignment**

Contains all information used to establish alignment and witnesses for all alignment points.

### **B.6.4 Section IV. Property**

Contains all information defining the real property affecting the project. Retracement data of the Public Land Survey System (PLSS), recorded plats, certified surveys and property ties are placed here.

### **B.6.5 Section V. Mapping**

All survey research, observations, calculations, reports and maps detailing topography, elevations, utilities, drainage and the like are placed here.

### **B.6.6 Section VI. Miscellaneous**

Data not assignable to one of the other sections may be placed here. The Surveyor's Report should specify any items placed here.

Project surveyors should refer to the Survey Order and appropriate parts of this manual for unique requirements for a particular category of survey.

Information shall be submitted in 10" by 12" divided portfolios with flap covers. As many portfolios shall be used as needed. Each portfolio shall be labeled on the outside as follows:

SURVEY NOTES FOR:

Structure Number \_\_\_\_\_ Survey Order \_\_\_\_\_  
CONTROL SECTION \_\_\_\_\_ JOB NUMBER \_\_\_\_\_ ROUTE \_\_\_\_\_  
LOCATION AND PROJECT LIMITS DATE \_\_\_\_\_

BY (Organization) SURVEYOR John J. Doe LICENSE # 12345

Sections within the portfolio shall be labeled as to the type of data contained within. While a single portfolio may contain several sections, no section shall contain more than one data type. Every sheet in the portfolio shall be marked with the Control Section, Job Number, Section, Date of Submittal, and Page Number. Each computer disk shall be labeled with the Control Section, Job Number, Data Type and File Names.

Any and all electronic text files must be submitted in ASCII format. Graphic files must be in Microstation “.dgn” format. Electronic survey data will include all data collector files in both unedited and final edited form. Files may be submitted as self-extracting, compressed files produced by common archiving utilities. When completing surveys for MDOT design squads, CAiCE archived files are the required format for survey data. All data must be submitted on high density, 3-1/2 inch, DOS formatted diskettes or CD-ROM. Disks shall be placed in a separate section of the portfolio in protective envelopes.

## B.7 QA/QC Checklist

**To insure completeness of design survey projects the project surveyor shall complete, sign, seal and submit with the Surveyor’s Report The MDOT Design Surveys QA/QC Certification Checklist for all Design Survey projects.** The checklist is included as [Annex A](#) to this appendix.

## B.8 Summary

The tools and technology available to produce surveys and construction plans have changed radically in the past few years. The ability to collect and process survey data electronically has eliminated much of the manual labor associated with presenting these data. On the other hand, many of the checks and balances built into the old systems have been lost. Thorough planning, redundant observations, careful review and proper interpretation of output by the project surveyor are critical components of every survey.

The described method of assembling data for submission will make transfer to the designers fast and

accurate. Archiving data for future use is simplified when materials are not bound.

## MDOT Design Surveys QA/QC Certification Check List

The purpose of this checklist to insure that critical items are checked prior to submitting the project for review and acceptance. The proper use of this document should drastically reduce the amount of time spent by MDOT and Consultant personnel correcting oversights and omissions from the project. The last page of this list is to be used to provide a brief explanation of why an item is being omitted. If a particular item is not applicable simply check NA, no explanation is necessary. **Failure to complete and include this list with the final project portfolio will result in the immediate return of the portfolio for completion.**

1.1. NA

**Portfolio:**

\_\_\_\_ \_\_\_\_ Two complete sets of survey data has been compiled for delivery.  
\_\_\_\_ \_\_\_\_ Portfolio Labeled as per Scope.

**Portfolio Pocket Contents:**

**Administrative:**

\_\_\_\_ \_\_\_\_ MDOT QA/QC Certification Check List  
\_\_\_\_ \_\_\_\_ MDOT transmittal form 222  
\_\_\_\_ \_\_\_\_ MDOT authorization letter  
\_\_\_\_ \_\_\_\_ Copy of scope of work  
\_\_\_\_ \_\_\_\_ Copy of proposed work schedule  
\_\_\_\_ \_\_\_\_ All correspondence  
(change of scope, change of schedule, phone records etc.)  
\_\_\_\_ \_\_\_\_ Comprehensive project survey report  
\_\_\_\_ \_\_\_\_ All Project files archived on 88.9 mm (3.5") HD Diskettes or Compact Disc (CD)  
including:  
CAiCE archive (.arc or .zip), MicroStation drawing file (.DGN)  
\_\_\_\_ \_\_\_\_ All required ASCII files or WordPerfect documents.

**Control:**

\_\_\_\_ \_\_\_\_

Control point List with:

Datum \_\_, witnesses \_\_, Coordinates with Std. Err. \_\_, station-offsets \_\_, Scale Factors \_\_.

\_\_\_\_ \_\_\_\_

Bench List with:

Datum \_\_, Descriptions \_\_, Elevations \_\_, station-offsets \_\_.

1.2. NA

\_\_\_\_ \_\_\_\_

G.P.S./traverse adjusted coordinates with standard errors

\_\_\_\_ \_\_\_\_

Horizontal and Vertical Least Squares Adjustments

\_\_\_\_ \_\_\_\_

Level adjustment report showing mm error per  $\sqrt{\text{km}}$

\_\_\_\_ \_\_\_\_

Sketch or plot of network or traverse

\_\_\_\_ \_\_\_\_

NGS or MDOT data sheets of existing control

\_\_\_\_ \_\_\_\_

DDPROC - .ha files printout

**Alignment:**

\_\_\_\_ \_\_\_\_

A sketch or CADD drawing of the alignment with:

stationing \_\_, horizontal coordinates \_\_, curve data \_\_, alignment points found or set \_\_, and a station equation to existing stationing in feet \_\_.

\_\_\_\_ \_\_\_\_

Control sketch with control points, government corners and alignment plotted.

\_\_\_\_ \_\_\_\_

A report discussing in detail how the alignment was determined.

\_\_\_\_ \_\_\_\_

The witness list with description and coordinates for the alignment points found or set.



**Property:**

- \_\_\_\_ \_\_\_\_ Copies of all LCRCs required for the project.
- \_\_\_\_ \_\_\_\_ Government Corner list with:  
Corner names \_\_, Coordinates and 4 witnesses \_\_, Indication of which corners are in danger of destruction \_\_.
- \_\_\_\_ \_\_\_\_ Section Corner ties to the alignment with station, distance and bearing along the section line.
- \_\_\_\_ \_\_\_\_ Section map with bearings, distances between Government corners.
- \_\_\_\_ \_\_\_\_ Copy of submittals to county Remonumentation (if required)
- \_\_\_\_ \_\_\_\_ Copies of all research documents, tax maps, tax descriptions, deeds, recorded plats, surveys, etc.
- \_\_\_\_ \_\_\_\_ A separate plot of alignment showing all property irons found.
- \_\_\_\_ \_\_\_\_ A station-offset listing of property irons.

**Mapping:**

1.3. NA

- \_\_\_\_ \_\_\_\_ A legible planimetric plot, including:  
contours \_\_, MDOT Feature Codes and Cell Library \_\_, Centerline alignment shown \_\_.
- \_\_\_\_ \_\_\_\_ A second plot showing all surface materials, utility connectivity and other pertinent notes or comments.
- \_\_\_\_ \_\_\_\_ All plots certified as per scope.
- \_\_\_\_ \_\_\_\_ All field survey notes obtained for this project.
- \_\_\_\_ \_\_\_\_ Drainage structure inventory shall be:  
correlated to the structures shown on the plot \_\_, include all pertinent data about the structures: Station and offset \_\_, coordinates \_\_, structure name \_\_, rim elevations \_\_, invert depths with corresponding computed invert elevation \_\_, pipe sizes \_\_, directions \_\_, structure cover type \_\_, complete culvert info \_\_, headwall or end section description \_\_.
- \_\_\_\_ \_\_\_\_ Drainage Report.
- \_\_\_\_ \_\_\_\_ A list of all utilities noting utility name, address, phone number and contact person.

\_\_\_\_ Station Offset report of all utility features.

\_\_\_\_ As-Built plans from each utility.

**Miscellaneous:**

\_\_\_\_ Miscellaneous Information Included

**Bridge Specific Information:**

\_\_\_\_ Sketch of structure\* in elevation view including:

Ref. Line to Ref. Line Dimensions \_\_\_\_, Ref. Pt. Elevs. \_\_\_\_, Ref Pt. Stations \_\_\_\_, Underclearance Elev. \_\_\_\_, Abutment and Pier cap Elev. \_\_\_\_, Ftg. Elev. (if requested) \_\_\_\_,

\_\_\_\_ Sketch of structure\* in Plan View including:

Ref. Pt. Elevs. \_\_\_\_, Ref Pt. Stations \_\_\_\_, Alignment \_\_\_\_, Angle of Crossing \_\_\_\_, Deck dimensions \_\_\_\_, Abutment and Pier cap dimensions \_\_\_\_.

\_\_\_\_ Explanation of how reference point location was determined.

\* If plans are available this information may be shown on existing plan sheets.

**CAiCE File**

1.6. NA

\_\_\_\_ Project Name is MDOT Job Number (#####c)

\_\_\_\_ CAiCE Project Description field is filled out

\_\_\_\_ Correct Units (metric) selected in System Settings

\_\_\_\_ Correct Datum Selected in System Settings

\_\_\_\_ Z Coordinate value set to 3.3 in System Settings

\_\_\_\_ Station format set to xxx.yyy.yyy in System Settings

\_\_\_\_ Correct MDOT Feature Table Attached prior to Data importation

\_\_\_\_ Correct MDOT Cell Library Attached prior to Data importation

_____	_____	Only MDOT Feature Codes Used
_____	_____	All points have appropriate Descriptions
_____	_____	Text size set to 1 (metric)
_____	_____	Desired plot scale checked with designer
_____	_____	Cell Scale set to: _____ 1.0 (1:1000), _____ .5 (1:500), _____ .25 (1:250)
_____	_____	Contour Interval set to .5 in DTM Settings
_____	_____	Max. Offset for contour smoothing set to 0.3 in DTM Settings.
_____	_____	All survey chains edited and properly connected prior to DTM creation.
_____	_____	All survey chain crossings resolved.
_____	_____	All survey chain curves checked for correctness and aesthetics.
_____	_____	No survey chain curves are shown as chords.
_____	_____	Survey chain Patterns checked for proper direction (guardrail, etc)
_____	_____	Hydro survey chains checked for correct left to right direction.
_____	_____	DTM Surface is named EX (multiple surfaces = EX1, EX2, etc.)
_____	_____	DTM checked for invalid breaklines
_____	_____	DTM checked for invalid point data (spikes/holes)
_____	_____	DTM triangles checked for spikes and dips
_____	_____	Long or invalid triangles have been obscured from TIN
_____	_____	Bridge decks and data suspended above natural terrain/substructures has been removed from the terrain surface prior to triangulation.
_____	_____	Terrain surface beneath bridge decks is included in DTM

**Contour Object Display Settings:**

_____	_____	Contour interval set to .5 regular and 3 index .
_____	_____	All contour colors set to 3 in
_____	_____	Line weights set to 0 regular, 1 Index in
_____	_____	All contour levels set to 12
_____	_____	Index Label spacing set to 20
_____	_____	Label character height set to 0 regular, 1 Index
_____	_____	Label depression contours unchecked
_____	_____	Final contours computed after DTM edits and settings checked

**Display:**

1.7. NA

- \_\_\_\_ Scale and text size checked prior to display
- \_\_\_\_ Survey Chains displayed as per Attachment 'AA'
- \_\_\_\_ Survey Points displayed as per Attachment 'AA'
- \_\_\_\_ Alignment geometry chain Feature Code is SCL
- \_\_\_\_ Alignment geometry chain is displayed
- \_\_\_\_ Contours are displayed
- \_\_\_\_ Point descriptions displayed as per Attachment 'AA' and scope
- \_\_\_\_ All overlapping text has been clearly resolved (if requested in scope)
- \_\_\_\_ All subsurface drainage can be correlated with inventory sheets.
- \_\_\_\_ CAiCE drawing file created and named job # +pl.cdg (#####cpl.cdg)
- \_\_\_\_ Correct seed file selected for MicroStation file conversion
- \_\_\_\_

<b>DATUM</b>	<b>SEED FILE</b>
____ Assumed	____ MiDOT2dm.dgn
____ SPC83 South	____ Seedms.dgn
____ SPC83 Central	____ Seedmc.dgn
____ SPC83 North	____ Seedmn.dgn

- \_\_\_\_
- \_\_\_\_ Correct cell file selected for MicroStation file conversion (midot\_m.cel)
- \_\_\_\_ MicroStation file created and named job # +pl.dgn (#####cpl.dgn)
- \_\_\_\_ MicroStation file of Bridge structures created with Contours (site of Plan)
- \_\_\_\_ CAiCE archive file named Job# (#####c.arc or #####c.zip)
- \_\_\_\_ Project portfolio labeled and includes data as per scope.
- \_\_\_\_
- \_\_\_\_ Scope has been reviewed to insure compliance.

I have reviewed the survey notes and scope of work and certify that all required and requested information is present in the portfolio in compliance with the MDOT Survey Standards of Practice, the survey scope of work and this QA/QC Check List. Any information omitted from this submission has been explained on the sheet attached.

SEAL

\_\_\_\_\_  
Professional Surveyor #

**Explanation of Omissions**

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