

Standard Operating Procedure (SOP) for Identifying and Surveying a Roadway Centerline

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Overview

The purpose of this procedure is to establish a standardized approach for identifying and surveying a roadway centerline (CL) of two-lane undivided highways. Keep in mind the following:

- **The CL is determined based on the middle of a split roadway, the crown of the road, and the CL joint.** Judgement should be applied in cases where these elements do not align precisely. While this document acknowledges the locations of the alignments for divided multi-lane roadways and the alignment techniques shown here could be used to develop a best fit alignment, the level of traffic and complexity of the projects dictate that those projects will have individual survey and alignment criteria developed during the scoping of those projects.
- **The responsibility for determining the roadway centerline (CL) alignment lies with each NDOT District.** This SOP establishes the standardized methods the District will use to identify and survey the CL in the field. The goal is to ensure consistency and accuracy across all projects and provide a reliable foundation for roadway design and digital delivery.
- **The centerline will be identified in the field using the criteria and survey methods outlined in this SOP.** Once collected, the data will be processed by the District representative, and the District will be responsible for creating a best-fit alignment based on the surveyed data. The District will then review, finalize, and certify the alignment. The finalized alignment will be delivered in the LandXML format for integration into design workflows. This alignment shall be certified by a licensed professional engineer stating that the practices of determining the alignment as outlined in this SOP were followed and the LandXML provided is the centerline of the road as determined in the field. There is a template letter attached to this SOP that will be submitted in OnBase as “NDOT DIST Pre-Letting

Correspondence” and shall have the global description of “Certification of Field-Determined Best-Fit Centerline”.

- **Once the best-fit centerline alignment is submitted, Roadway Design should use it as the basis for their Design Alignment.** If adjustments beyond renumbering stationing are necessary, Roadway Design must coordinate with the District. While alignment changes may be warranted based on design criteria, the District should be informed of those modifications. Roadway Design is responsible for creating and signing the alignment files provided to the contractor, including the LandXML from the design file. Quality control checks should be conducted at both the PIH stage and at plan turn-in stage.
- **Accuracy and repeatability are critical to the integrity and usefulness of roadway centerline survey data.** A precise and consistent approach ensures that the surveyed centerline reflects the true horizontal alignment of the existing roadway, which is foundational for all subsequent design, construction, and asset management activities. Inaccurate or inconsistent data can result in costly design errors, misaligned improvements, or incorrect assessments of roadway conditions. Repeatability — being able to reproduce similar results under the same conditions — ensures that multiple survey crews, working at different times or in different locations, will produce data that aligns correctly and can be confidently integrated into statewide digital delivery systems. By adhering to this SOP and emphasizing both accuracy and repeatability, we help create a dependable dataset that supports better planning, decision-making, and long-term infrastructure quality.

Centerline Identification Criteria

Before identifying the centerline in the field, it's important to pull the as-built plans for the project to locate the PI (Point of Intersection), PC (Point of Curvature), and PT (Point of Tangency). These points are critical for accurately understanding the horizontal alignment of the roadway and the frequency of the survey points should increase between the PC and the PT as described below. By referencing the as-builts, we can ensure that we get a shot at or near these key locations during field collection. Often the PC or PT locations can be closely approximated by using distances from as-built features like culverts or driveways. From that Capturing these points allows for better curve fitting and helps verify whether the existing alignment has shifted or remained consistent with the original construction. It's also useful for comparing any recent changes or overlays to the initial design.

Undivided Two-Lane Highways

To determine the centerline (CL) location, follow this order of precedence:

1. If the joint falls on the crown of the road **and** is within **two inches** of the middle of the split roadway, that joint is the CL point to be surveyed.
2. If the joint falls on the crown of the road, but is **outside** the two-inch split tolerance, the CL point should still be taken on the crown of the road **if** each side meets the minimum roadway width (typically 12 feet).
3. If the joint and the crown **do not coincide**, use the joint or crown location **closest** to the center of the road as the CL point, confirming each side meets the minimum roadway width (typically 12 feet).

(Notes on Splitting the Road and Determining Centerline Features)

When identifying the centerline of a roadway, it is essential to understand how to properly split the road and measure its total width. Measurements should be taken from the edge of mainline surfacing on one side to the edge of mainline surfacing on the other side. In many cases, grass, dirt, or debris may obscure the true pavement edge, especially along older or low-traffic roads. Survey crews may need to dig slightly or clean off the edge of the pavement to accurately locate and measure to the surfacing edge. This ensures a true representation of the traveled surface and supports consistent determination of the roadway's midpoint.

It's also important to recognize that roads may not be perfectly symmetrical due to original construction methods or later widening efforts. For instance, during initial construction, the paving operation may have had slight roll-out or drift, leading to uneven lane widths. In some cases, a 28-foot top (total paved width) was targeted, but the distribution may not be a perfect 14 feet per lane. Additionally, certain segments may have been widened over time — particularly on the inside (low) edge of a curve — by one foot or more, leading to further asymmetry. These variations should be taken into account when identifying the true centerline.

Furthermore, maintenance activities over the years — such as patching, chip seals, overlays, or blade patches — can alter the visual appearance and elevation of the crown or even obscure or shift the visible centerline joint. In some areas, repeated maintenance may have built up the roadway surface on one side more than the other, unintentionally shifting the crown or eliminating a visible joint altogether. When such conditions are encountered, crews should use best judgment and refer to original construction records (as-builts) to inform centerline determination, while ensuring all field decisions are documented.)

Divided Highways

Divided highways should be evaluated for survey and alignment needs individually for each project. Additionally, the survey methods will vary based on the project and level of traffic.

In general for divided highways, two separate alignments must be identified and surveyed — **one for each direction of travel**. These alignments are known as **profile gradelines (PGLs)**. The survey point for each direction should be established at the **inside (median) edge of the 12-foot inside lane**, located between the inside shoulder and the inside travel lane.

This location is consistent with current Nebraska Department of Transportation design practices and provides a clear, repeatable survey reference for digital design and construction workflows.

Below are the guidelines for where the PGL can be found; however, because the inside shoulder joint may not exist or may not be distinguishable the centerline joint of the inside lane is used and a measured 12-foot offset is applied.

General Guidance for Establishing Profile Gradelines:

1. Standard Condition – Crowned Surface with Depressed Median (≤ 54 feet):
For multi-lane facilities with crowned surfaces and depressed medians 54 feet wide or less, the profile grade point and axis of rotation should be located at the inside edge of the 12-foot inside lane in both directions of travel (see Roadway Design Manual, Exhibit 3.4a). This supports consistent drainage and typical cross slope transitions.
2. Superelevation Transitions:
 - For the outer roadway, the axis of rotation begins at the centerline of all lanes and shifts to the inside edge of the inside lane once reverse crown is achieved.
 - For the inner roadway, the axis of rotation remains at the inside edge of the inside lane, aligning with the profile grade point throughout the transition.
3. Tangent Surface with Depressed Median (≤ 54 feet):
For divided highways with tangent surfaces, the axis of rotation should again be located at the profile grade point—the inside edge of the 12-foot inside lane—ensuring the median remains level through curves (see Exhibit 3.5a).
4. Wide Medians (> 54 feet):
Where medians exceed 54 feet in width, the profile grade point and axis of rotation

may shift to the centerline of the individual lanes, particularly where there is no geometric or drainage advantage to maintaining the edge alignment.

5. **Raised Medians and Surfaced Medians:**

For multi-lane facilities with raised medians, both the profile grade point and axis of rotation should be placed at the inside edge of the 12-foot inside lane, consistent with standard design intent.

6. **Ramps:**

Single-Lane: Both the profile grade point and axis of rotation should be placed at the interface of the 16-foot lane and the 8-foot shoulder.

Multi-Lane: Case-by-case depending on existing condition. District and Roadway Design should coordinate regarding the location of the profile grade point.

Survey Methodology

In addition to standard survey practices used on transportation projects, the following guidance provides specific requirements for identifying and collecting roadway centerline (CL) data. These procedures are intended to ensure consistency, accuracy, and compatibility across projects. When surveying the CL, crews should follow this methodology in conjunction with general data collection protocols to support alignment development and digital design efforts.

- Centerline survey shots, known as eccentric points (ECC), should be collected:
 - Every **250 feet** in tangent sections.
 - Every **50 feet** in curved sections.
 - One on each end of the paving section of bridges.
- A **GPS base-to-rover setup** should be used for collecting data; network-based methods should not be utilized.
- These points can be taken using the standard point collection timing, but Bipod legs should be used during the collection to ensure a quality shot.
- The points should be stored using the ECC feature code.

Data Processing and Quality Control

- The ECC points should be processed separately from the rest of the survey data.

- The ECC data file should be labeled as the Control# Alignment.dgn (Example: 12345 Alignment.dgn).
- The Proposed Alignment File should be referenced into the survey data and verified for correct location alignment.

Alignment Creation in OpenRoads Designer (ORD)

After collecting and processing the surveyed centerline (ECC) points, the alignment should be generated in OpenRoads Designer (ORD) using regression analysis tools. This method enables users to create a best-fit horizontal alignment by selecting ECC points as input data, ensuring the alignment closely matches the existing roadway geometry. Adjusting the regression analysis tool settings and data inputs helps refine the best-fit alignment, maintaining accuracy within six inches of the surveyed ECC points.

Begin by importing the ECC points into the ORD design file and assigning them to a regression line. Use the "Best Fit Horizontal" tool within the Geometry Regression tools to create the alignment, adjusting as necessary to reflect the most representative path of the existing roadway. The resulting alignment should then be reviewed, named according to district standards, properly stationed, and prepared for XML export. A step-by-step video tutorial to assist with the regression process in ORD and ensure consistency in application across all Districts can be found using the link below.

[Regression Centerline Training Video](#)

Naming Convention for the LandXML

- Control#Highway#.XML (Example: 12345US6.XML)

Field Verification of Best-Fit Alignment

After the best-fit centerline alignment has been created in OpenRoads Designer, the survey crew shall return to the field with the finalized alignment to perform a verification check. This step is critical to ensure that the generated alignment accurately reflects the existing roadway and that any assumptions made during the regression process are confirmed on the ground.

Survey crews should select a minimum of 10 representative locations evenly distributed throughout the project limits to compare the best-fit alignment with the actual roadway features. These check locations should include a mix of tangent sections, points of curvature (PC), points of tangency (PT), and especially points of intersection (PI), as these are critical for confirming horizontal geometry. Curved sections should be prioritized for

closer examination, as these areas are more prone to alignment discrepancies. At each location, a field shot should be taken on the visible centerline feature and compared to the corresponding point on the proposed alignment. Any significant deviations should be documented and reviewed with the District representative that created the alignment.

In areas where ECC data is sparse, curve geometry is complex, or alignment discrepancies are suspected, the regression tool best-fit alignment may yield inaccurate results. If alignment data deviates beyond the six-inch tolerance from the surveyed centerline (ECC) points, the District representative should request additional survey data. In such cases, the survey crew must return to the field to verify existing ECC data and/or collect more points, which should then be incorporated into a revised regression analysis to refine the alignment. The final alignment must accurately represent the existing roadway, minimizing the risk of design and construction errors. If the regression tool cannot produce the desired alignment, an alignment correction may be necessary and should be included in the project scope. Once the alignment has been finalized, a finished LandXML should be generated and sent to the engineer in the District that is going to review and certify the alignment. The certification letter will be placed in Onbase as previously described and the LandXML will be placed in ProjectWise in the following location: NDOT Production- Documents- District #- Control Number- District- Field Data

Consultant Survey Requirements

Consultants performing roadway centerline (CL) surveys under contract with the Nebraska Department of Transportation (NDOT) shall be responsible for executing all steps outlined in this Standard Operating Procedure (SOP) for Identifying and Surveying a Roadway Centerline. This includes full responsibility for centerline identification, data collection, alignment creation, field verification and signing of the alignment as described in the SOP. **Anywhere the term “District” is used in the SOP, the survey consultant shall assume and fulfill that role with the same expectations for accuracy, quality, and deliverables.** This item of work will be included in the scope of services if it is an expected deliverable or potentially added if there is capacity in the existing contract and both parties agree.

Memorandum

To:

From:

Through:

Date:

Subject: Certification of Field-Determined Best-Fit Centerline

Project Number: [Insert Project Number]

Project Name: [Insert Project Name]

To Whom It May Concern:

This letter certifies that the centerline for the referenced project was identified in the field and processed using the criteria outlined in the applicable SOP. A best-fit alignment was developed based on surveyed data, reviewed, and finalized by the District.

As a licensed professional engineer, I certify that the SOP procedures were followed and the file [File Name].XML represents the field-determined centerline. This LandXML file was submitted in ProjectWise.

Roadway Design should use this alignment as the basis for the Design Alignment. Any changes beyond stationing updates must be coordinated with the District.

Sincerely,

[Insert Name]

[Insert Title]

[Insert Company]