Needs Study of North Dakota Roads and Bridges

Status Report

Interim Economic Impact Committee

October 8, 2013

Upper Great Plains Transportation Institute
North Dakota State University

Study Objectives

- Forecast investment needs for county and township roads and bridges over the next 20 years

- Quantify investments needed for efficient year-round freight transportation while providing travelers with acceptable roadway service

Study Results

- Infrastructure needs – county & township roads & bridges
  - Statewide (summation of all jurisdictions)
  - County level (by surface type and jurisdiction)
  - 20-year estimates reported by biennium

Study Process

- Data collection on existing roads & bridges
- Analyze data
- Project future use – volumes & types
- Develop long-term need projections

Enhanced Data Collection - Status

- County & township surveys
- Traffic counts – volume & types
- Ride quality – NDDOT Pathways van
- Structural data - falling weight deflectometer (FWD) and ground penetrating radar (GPR)
- Traffic projections – ag & oil

Data Collection - Status

- Roadway jurisdiction/ownership surveys:
  - County major collector (CMC/Federal Aid)
  - County – non-CMC
  - Township
  - Township owned, but maintained by the county
  - Private
  - Status: 50 of 53 counties have submitted maps
  - Very good progress

Data Collection - Status

- Survey of counties and townships
  - 2011-13 study: 51 county & 230 township responses
  - Current study: All counties and townships are being surveyed
- Status
  - Surveys have been sent out to the counties; awaiting response

Data Collection - Status

- Traffic counts – volume and classification data on county and township roads for travel demand models and ESAL (equivalent single axle load) calculations:
  - Joint collection - NDDOT staff and NDSU students
  - Number of counts to be taken - 1000+
  - Number of classification counts – 670
  - Data collection 98% complete
  - Remaining counts completed by November

County Traffic Counts 2013

Data Collection - Status

- Structural data - falling weight deflectometer (FWD) and ground penetrating radar (GPR)
  - Verify prior estimates on subgrade strength
  - Western ND – test all pavements not recently improved
  - Eastern ND – selected based on agricultural production facilities and other major traffic generators
  - 1560 miles tested

Data Collection - Status

- Traffic projections – ag & oil
  - Oil production
    - Multiple discussions with Oil & Gas Division
    - Data on underlying assumptions expected early October
  - Agricultural production
    - All data has been collected
    - Forecasts of crop types and yields will be developed following discussions with NDSU Extension and producer groups

Data Collection Status

- Oil locations:
  - Most locations have been obtained
  - UGPTI still needs confirmation from industry for the following locations
    - Sand locations (NDDOT and industry)
    - Transload facilities (NDDOT and industry)

Data Collection - Status

- Agriculture locations:
  - Elevator movement data has been obtained
  - Most recent 5 years of crop and production data have been processed

Data Collection – Cost Projections

- Aggregate (gravel) costs
- Gravel production techniques
- Placement costs
- Transportation costs from pit to roads
- Dust suppressant usage/costs
- Stabilization usage/costs
- Intermediate practices
  - Stabilization armor coat
  - Double chip seal/armor coat
  - Others

Data Transparency

- Traffic counts will be displayed via a website maintained by UGPTI
- Roadway condition information will be available via the Web to all stakeholders
- County level costs will be published on the UGPTI website

Traffic Model

Projections for:

- Oil
- Agriculture
- Passenger
- Manufacturing
- Through traffic

Traffic Model Goals

- Update and enhance the county and local roads traffic projection model developed for the 2011-13 Legislative study
- Expanded data sets and enhanced models will facilitate better need and cost projections

Traffic Model

- Modeling
  - The entire modeling process will utilize Cube Base, Voyager and Cargo methodology
  - Specific models for agricultural commodities and oil movements
  - Inclusion of direct passenger modeling
  - Coordination with NDDOT - network modeling necessarily includes state highways

Oil – Drilling Process	Number of Trucks	Inbound or Outbound
Sand	100	Inbound
Water (fresh)	450	Inbound
Water (waste)	225	Outbound
Fracturing tanks	115	Both
Rig equipment	65	Both
Drilling mud	50	Inbound
Chemical	5	Inbound
Cement	20	Inbound
Pipe	15	Inbound
Scoria/gravel	80	Inbound
Fuel trucks	7	Inbound
Frac/cement pumper trucks	15	Inbound
Workover rigs	3	Both
Total trucks	2,300	

Traffic Model

- Outbound Crude Oil Shipments
  - Drilling and hydraulic fracturing equipment
  - Wastewater
  - Outbound oil to transload locations or final destinations

Agricultural Analysis

Known — Crop production

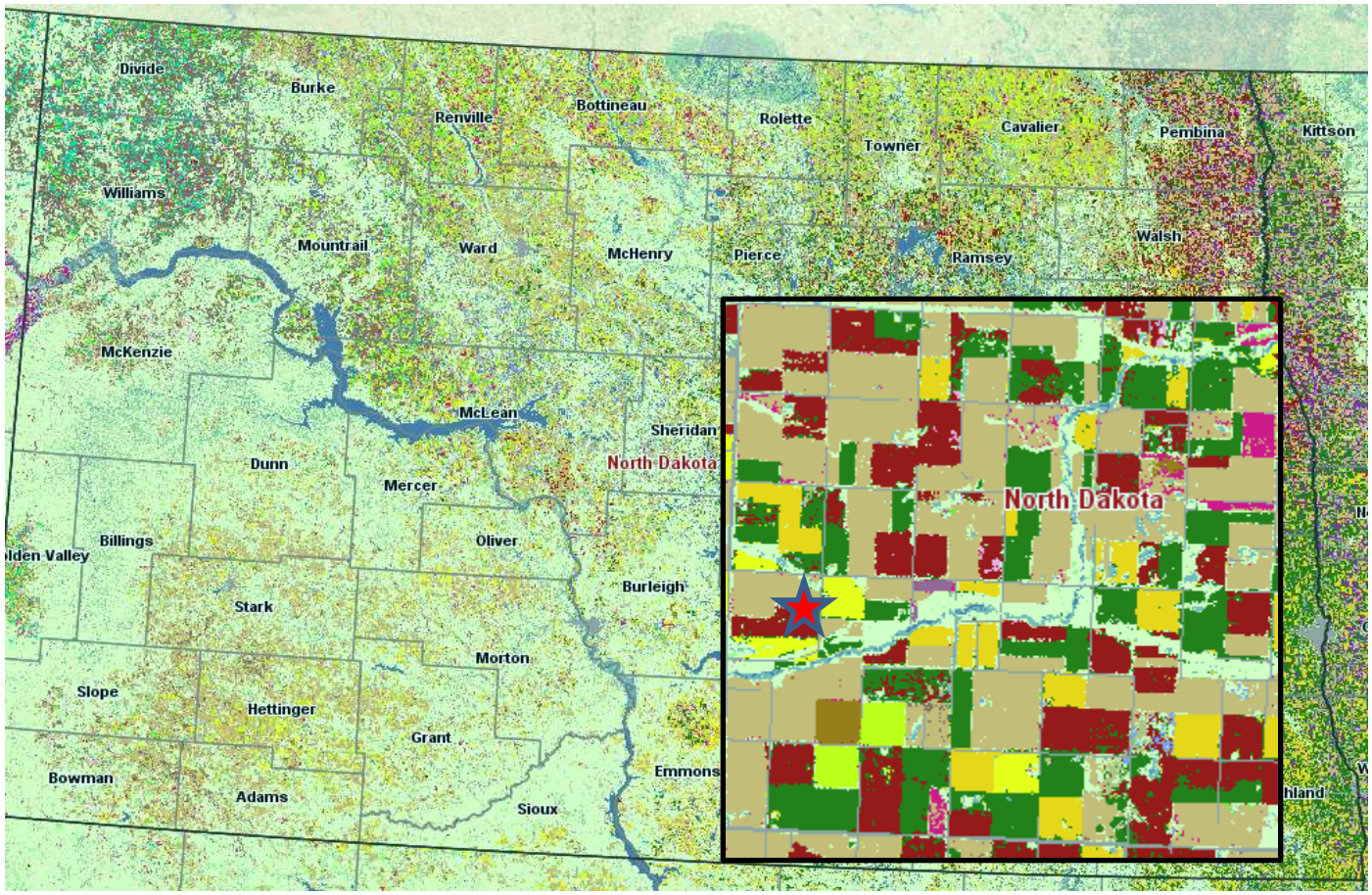
Predict — Truck trips and routes

Known — Elevator & plant demands

Estimate — Segment specific traffic

Data: crop production (NASS), elevator volumes (NDPSC), in-state processors (survey), road network (NDDOT-GIS Hub), local road data (2008 survey)

Crop Production and Location



Modeling - Road Maintenance

- Life-cycle cost analysis - practices
  - Graveling and blading
    - Normal levels (e.g. regraveling every 5 years, blade once per month)
    - Increased levels (e.g. regraveling every 3-4 years, blade twice per month)
    - High levels (e.g. regraveling every 2-3 years, blade once per week)
    - Usage of dust suppressant on impacted roads

Gravel Road Analysis

- Intermediate improvements
  - Graveling and base stabilization
  - Graveling and base stabilization with armor coat
  - Others as reported at the county level
- Asphalt surface

Gravel Road Analysis

- Traffic model results segmented based on traffic levels
- County-specific practices will be used as the base maintenance practices
- Life cycle costs of each maintenance practice will be calculated (i.e. 20-year cost of graveling)
- Maintenance type/improvement selected for each AADT (annual average daily traffic) class based upon minimum life cycle cost

Pavement Analysis

- Pavement deterioration and recommended improvement process
  - Estimate remaining life given current condition and traffic levels
    - Verify past assumptions on subgrade strength
    - Apply traffic projections and present serviceability rating
  - Determine recommended improvements and costs based on width, starting condition, and future traffic estimates

Bridge Analysis

- 2,666 bridges on county/local system
  - 46% (1,232) more than 50 years old (theoretical design life)
  - 23% (595) more than 70 years old

Bridge Analysis

- Condition/appraisal data from National Bridge Inventory (NBI)
  - Structurally deficient (SD) – one or more components rated in "poor" condition (≤4 on 0-9 scale)
  - Functionally obsolete (FO) – bridge is not designed to carry modern traffic volume, speed, size or weight
  - Bridges with SD or FO status may require posting or closure

Bridge Analysis

- Current Needs
  - Rehabilitation/replacement eligibility based on FHWA criteria
  - Rehabilitation/replacement costs based on NDDOT project costs
  - Current inventory: 25% (676) deficient, 7% (190) obsolete bridges
  - Prioritize backlogged projects based on detour vehicle-miles traveled, including bridge weight restrictions

Bridge Analysis

- Preventive Maintenance
  - Maintenance activities and intervals based on county surveys, FHWA recommendations
  - Maintenance costs based on county survey

Bridge Analysis

- Bridge Deterioration Models
  - Developed empirical models to forecast deck/superstructure/substructure deterioration
    - Bridge age and age squared as continuous variables
    - Indicator variables:
      - Reconstruction history
      - ADT level (high and low)
      - Bridge material (timber, steel, and concrete)

- NBI 2012 data

Bridge Analysis

- Future Needs
  - Apply deterioration models to forecast deck/superstructure/substructure condition
  - Forecast year of rehabilitation/replacement
  - Short span bridges to be replaced by box culverts
  - Bridge closings will not be predicted
    - closings at the discretion of local road authority

NDSU-UGPTI Study Team

- Denver Tolliver – UGPTI Director
- Alan Dybing – Associate Research Fellow
  - Traffic modeling/HERS-ST modeling
- Tim Horner – Program Director
  - Pavement/bridge costing & project coordination
- Brad Wentz – Program Director
  - Pavement condition, traffic data, & county scenarios
- Andrew Bratlien – Transportation Research Engineer
  - Pavement non-destructive testing & bridge deterioration
- Jon Mielke – Program Administrator

Study Timeline

Task	Start Date	Completion Date
Traffic counts	June 2013	October 2013
Traffic modeling	June 2013	January 2014
Jurisdiction data collection	June 2013	September 2013
Road condition assessment	July 2013	September 2013
Non-destructive testing	July 2013	November 2013
Cost & practices survey	August 2013	October 2013
Assumptions data collection	August 2013	August 2013
Roadway analysis	Fall 2013	May 2014
Bridge analysis	Fall 2013	May 2014
Final report		June 2014

Study Outputs

- Final report – electronic and hard copy
  - Methods
  - Assumptions
  - Procedures
  - Summary of data
  - Results – needs (by biennium)
    - Roads
      - Statewide
      - By county
      - By surface type
    - Bridges
      - Statewide
      - By county

Study Outputs

- Final report – collected data available via web
  - Condition assessment
  - Traffic counts
  - Enhanced roadway data
  - Cost projections
- Significant enhancements over 2011-13 study
- Extremely complex – tight timeframe
- On schedule

Questions?

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Updates and background posted at
www.ugpti.org/