Seminary Fen Wetland Complex Phase 2 Study

and

Hydrologic and Ecological Assessment of Alternative Corridors

TH 41 Tier 1 DEIS Study

Prepared for
SRF Consulting Group
Minnesota Department of Transportation

Draft

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Preface and Summary

This report describes the methodologies and findings of a hydrologic and ecological assessment of six alternative corridors for the new river crossing of TH 41 in Scott and Carver Counties, proposed by the Minnesota Department of Transportation. Three of the six alternative alignments that are under consideration are near the Seminary Fen Wetland Complex in Carver County, east of Chaska, Minnesota. The Seminary Fen Wetland Complex includes examples of calcareous fen, which is a unique and sensitive type of wetland that is afforded special protection by the state of Minnesota (M.S. 103G.223; M.R. 7050; M.R. 8420).

This study is Phase 2 of the study of the Seminary Fen Wetland Complex. Phase 1 of the study was conducted in 2005 to characterize the wetlands, including: field studies addressing hydrology, water chemistry, soils, and vegetation (Figure A). Results of the Phase 1 study indicated that the extent of calcareous fen in the Seminary Fen Wetland Complex may be larger than previously recognized. This Phase 2 study focus is on describing the additional calcareous fen areas and assessing the potential hydrologic and ecological impacts to the Seminary Fen Wetland Complex that are represented by the three eastern alignment alternatives (which are near the Seminary Fen Wetland Complex). The Phase 2 study also assesses the potential hydrologic and ecological impacts to other natural communities near the three western alignment alternatives (which are not proximal to the Seminary Fen Wetland Complex).

Report Organization

The report is organized into two independent sections. The first section of the report describes the hydrologic assessment of the six corridors and includes a detailed description of the groundwater

modeling methodologies, the results of simulating the hydrologic effects of construction and post-construction activities for the six alternative alignments, and opportunities for hydrologic mitigation. The second section of the report describes the ecological characterization of the Seminary Fen Wetland Complex, the delineation of calcareous fen areas, the ecological assessment of the potential impacts of each of the six corridors on natural communities, and opportunities for ecological mitigation. The ecological assessment makes use of the findings of the hydrologic assessment.

Summary of Findings: Hydrologic Assessment

The hydrogeologic effects that are analyzed include: (1) a lowering or raising of the water table or the pressure head of groundwater-transmitting geologic units; (2) a reduction or increase in the groundwater contribution to surface-water features, such as streams and wetlands; (3) a change in groundwater flow patterns (direction and rate); and (4) the identification of groundwater flow patterns from potential sources of contamination to potential receptors (e.g., pathways for road salt and runoff to seep into the ground and migrate via groundwater).

The evaluation of hydrogeologic effects from the various Highway 41 corridor alternatives makes use of computer groundwater flow models, specifically developed and calibrated for this area and for these evaluations. The widely used and well-accepted groundwater modeling code MODFLOW was used to evaluate hydrogeologic effects during and after construction and to compared these effects for the various alternative alignments.

Based on the results of the modeling analyses, the following are concluded:

1. Dewatering of bridge piers with the use of a coffer dam and bottom seal results in only very localized draw down of the water table and reductions in seepage. The modeling results indicate that the drawdown effects and seepage reduction in some areas of the Seminary Fen Wetland Complex with this construction method employed will not be widespread and will not cover the entire Seminary Fen Wetland Complex.

2. Of the three alternatives closest to the Seminary Fen (eastern alignments), Alternative E-1 is predicted to have the least impact on the Seminary Fen Wetland Complex in terms of the drawdown during construction, reduced discharge of groundwater to some areas of the Seminary Fen Wetland Complex during construction, and in terms of discharge of

degraded groundwater to the fen after construction. Alternative E-1 is also predicted to have the lowest total dewatering rate of the three alternatives located nearest the Seminary Fen Wetland Complex.

3. Alternative E-1A is predicted to have the greatest effect on seepage to the Seminary Fen Wetland Complex areas during construction, followed by Alternative E-2. However, Alterative E-1A is predicted to have result in a net increase in seepage to areas in the Seminary Fen Wetland Complex, as a result of some rerouting of seepage paths through compaction of soils, forming shallow barriers to flow.

4. Alternatives E-1A and E-2 have a greater likelihood of transmitting salt spray to areas in the Seminary Fen Wetland Complex via groundwater transport than Alternative E-1. Alternative E-1 primarily affects the westernmost portion of the Seminary Fen Wetland Complex and does not appear to generate flow paths that would be directed to the higher-quality fen areas in the eastern portion of the Seminary Fen Wetland Complex. Changes in recharge, resulting from increased impervious areas upgradient (north) of the Seminary Fen Wetland Complex were predicted to be very small.

5. Of the three alternatives furthest from the Seminary Fen, Alternative W-2 is predicted to have the least impact on local water resources in terms of drawdown. None of the western alignments are predicted to generate excessive drawdown if the depth of dewatering is limited to within 5 feet of ground surface as assumed in this modeling.

In summary, of the three eastern alignments, Alternative E-1 has the potential for the least impact to the Seminary Fen Wetland Complex from seepage and salt spray-transport aspects. The three western alternative alignments have very little drawdown impact and would not affect the Seminary Fen Wetland Complex.

There are some limited opportunities for mitigation of effects. The use of the coffer dam and seal in dewatering for construction of bridge piers is the most obvious opportunity (and was assumed to be used in all pier constructions in the Seminary Fen Wetland Complex). Minimizing compaction during construction is another area of mitigation. There are, however, mitigation opportunities available in the restoration of the hydrology by removing abandoned drain tile and improving drainage through the railroad embankment.

Summary of Findings: Fen Study

The field investigation from the Phase 2 study indicates that there is a larger area of calcareous fen present within the Seminary Fen Wetland Complex than was disclosed by previous assessments. Earlier surveys did not identify this area as fen, most likely because it is overgrown with woody vegetation, particularly wetland shrubs. Calcareous fen has been documented in Areas 1, 2 and 3, and the Phase 2 study area (Figure A). The highest quality portion of calcareous fen is found in the northeast corner of Area 1. This assessment is based on hydrological and chemical conditions and the number and abundance of fen-indicator and state-protected plant species. However, protected species occur throughout all areas mapped as calcareous fen.

Technical criteria published by the Minnesota Department of Natural Resources were used to determine the extent of calcareous fen in the Phase 2 study area. The criteria pertain to hydrology, soils, water chemistry, and vegetation. Within the Phase 2 study area, groundwater discharge is present, satisfying the hydrology criterion. Soil and water chemistry criteria area also met. Most sample sites within the Phase 2 area satisfied vascular plant and bryophyte criteria. In many locations, fen vegetation is less abundant than in other fen areas of the Seminary Fen Wetland Complex, but the dense woody vegetation has probably reduced its abundance compared to historic levels. Substantial portions of the Phase 2 study area are ecologically degraded due to altered hydrology and invasive species encroachment in addition to woody vegetation (Figure B). Some areas that do not currently support fen vegetation may have in the past and could be restored. Without active management and restoration, the extent and abundance of fen vegetation is expected to continue to decline. By the time TH 41 is constructed, there may be little or no fen vegetation present in the Phase 2 study area, although wetlands will persist. Conversely, management could increase the abundance and distribution of fen vegetation by the time TH 41 is constructed. However, no management or restoration plans currently exist for any part of the Seminary Fen Wetland Complex, which includes both privately- and publicly-owned parcels.

Fen ecosystems are known to be particularly sensitive to environmental degradation, and alterations in chemistry, soils or hydrology can negatively impact characteristic fen vegetation. None of the alternatives are anticipated to pose a direct threat to the highest quality fen communities in Area 1 and lower quality fen communities in Area 3. Indirect impacts may occur from Corridors E-1, E-1A, and E-2 through factors such as increased abundance of invasive species and migration of road salt into groundwater and subsequent discharge. However, the

complexity of interacting factors prevents an unequivocal prediction of the likelihood or severity of these potential impacts..

Fen areas identified in Phase 2 are at risk of loss of all fen vegetation from Alternatives E-1A and E-2. A combination of factors could result in this loss. These factors include peat compaction or subsidence, temporary dewatering, road salt, shading, loss of wetland vegetation, habitat fragmentation, and expansion of invasive species. Impacts could extend beyond construction limits and affect the entire Phase 2 study area. However, past and ongoing ecological degradation, not associated with TH 41, may eliminate fen vegetation from the site.

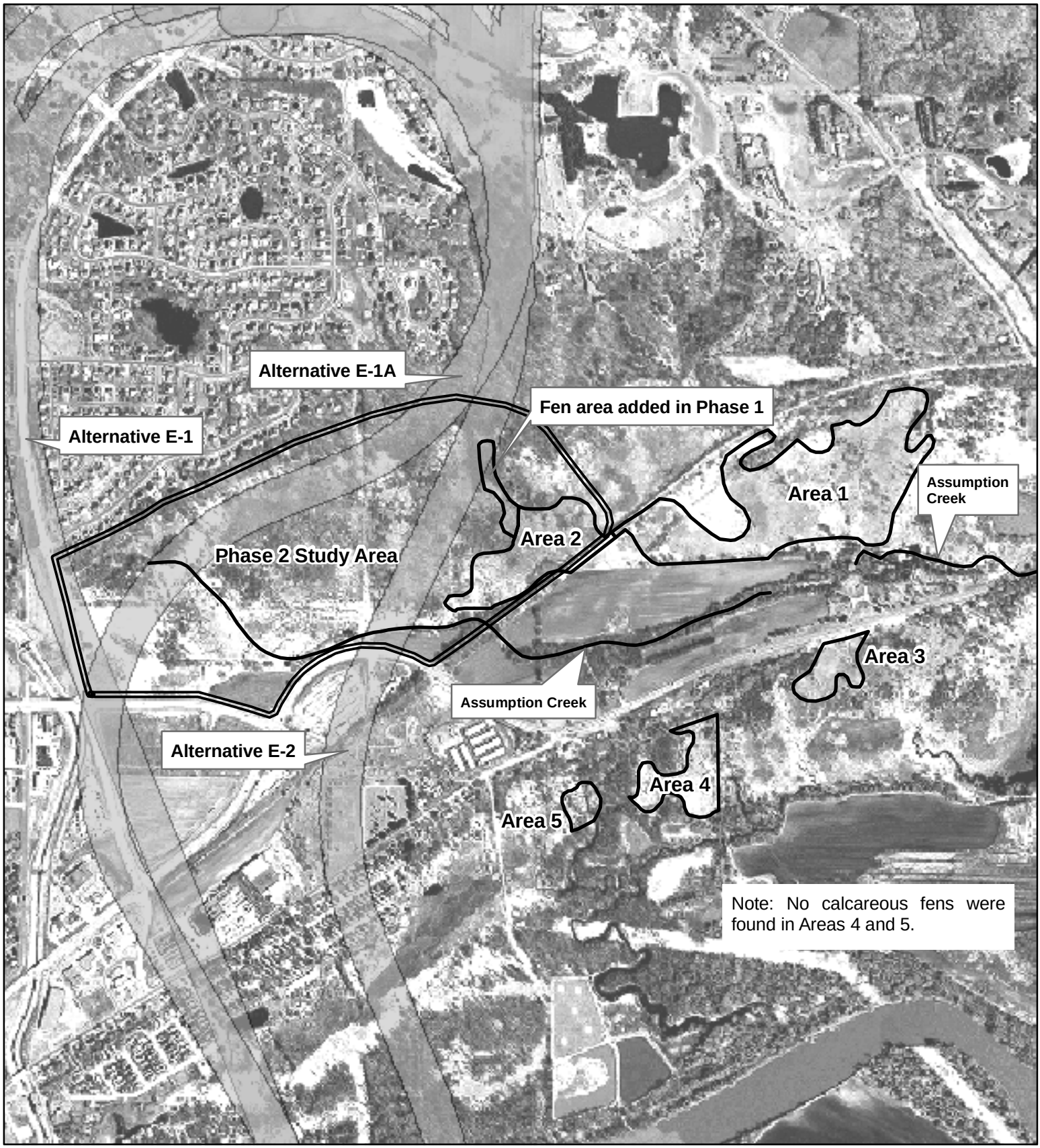
Impacts in the Phase 2 study area can be reduced, although not entirely eliminated, through techniques such as coffer dams, mats under construction equipment, dormant season construction and dewatering, alternative bridge de-icing technology, and surface water discharge and erosion controls. Numerous opportunities for restoration exist throughout the Seminary Fen Wetland Complex. Invasive species, hydrologic alterations, erosion, and woody vegetation all pose threats to the ecological integrity of the calcareous fen and associated wetlands. Restoration and management could reverse or contain ongoing degradation and could be used as compensatory mitigation for unavoidable impacts from TH 41.

Summary of Findings: Alternative Corridors Vegetation Study

A comparison of the natural communities in all six alignments demonstrates that Alignment C-2A would directly impact the largest acreage of native vegetation and high quality vegetation as well as impacting the greatest acreage of indirect habitat degradation. Alignment E-1 would generally have the least impacts. The other four alignments would have more moderate impacts. The western three alignments (C-2, C-2A, and W-2) would fragment relatively large tracts of native vegetation on the Minnesota River floodplain. However, the western alignments are not anticipated to impact the Seminary Fen Wetland Complex. The eastern three alignments (E-1, E-1A, and E-2) would fragment smaller floodplain communities, and alignments E-1A and E-2 would impact portions of calcareous fen within the Seminary Fen Wetland Complex.

A field review of existing bridges in the region was performed, although none of the bridges occupy environmental settings identical to the Seminary Fen Wetland Complex. Observations suggest that impact to vegetation relate to the height and exposure of the bridges..The greatest

abundance of native vegetation is found under higher bridges in more open areas compared to lower, less exposed bridges. Height and openness apparently allow greater penetration of light and precipitation under the bridge, favoring native vegetation over invasive or exotic species. Such physical conditions may also allow for better dilution and flushing of road salts and, subsequently, potential spread of salt impacts over a larger area.



2005 Aerial Photograph

Phase 1 Study Areas

Phase 2 Study Area

N

0 125 250 500 Meters

0 500 1,000 2,000 Feet

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Figure A
PHASE 1 AND PHASE 2 STUDY AREAS
Seminary Fen Phase 2 Study
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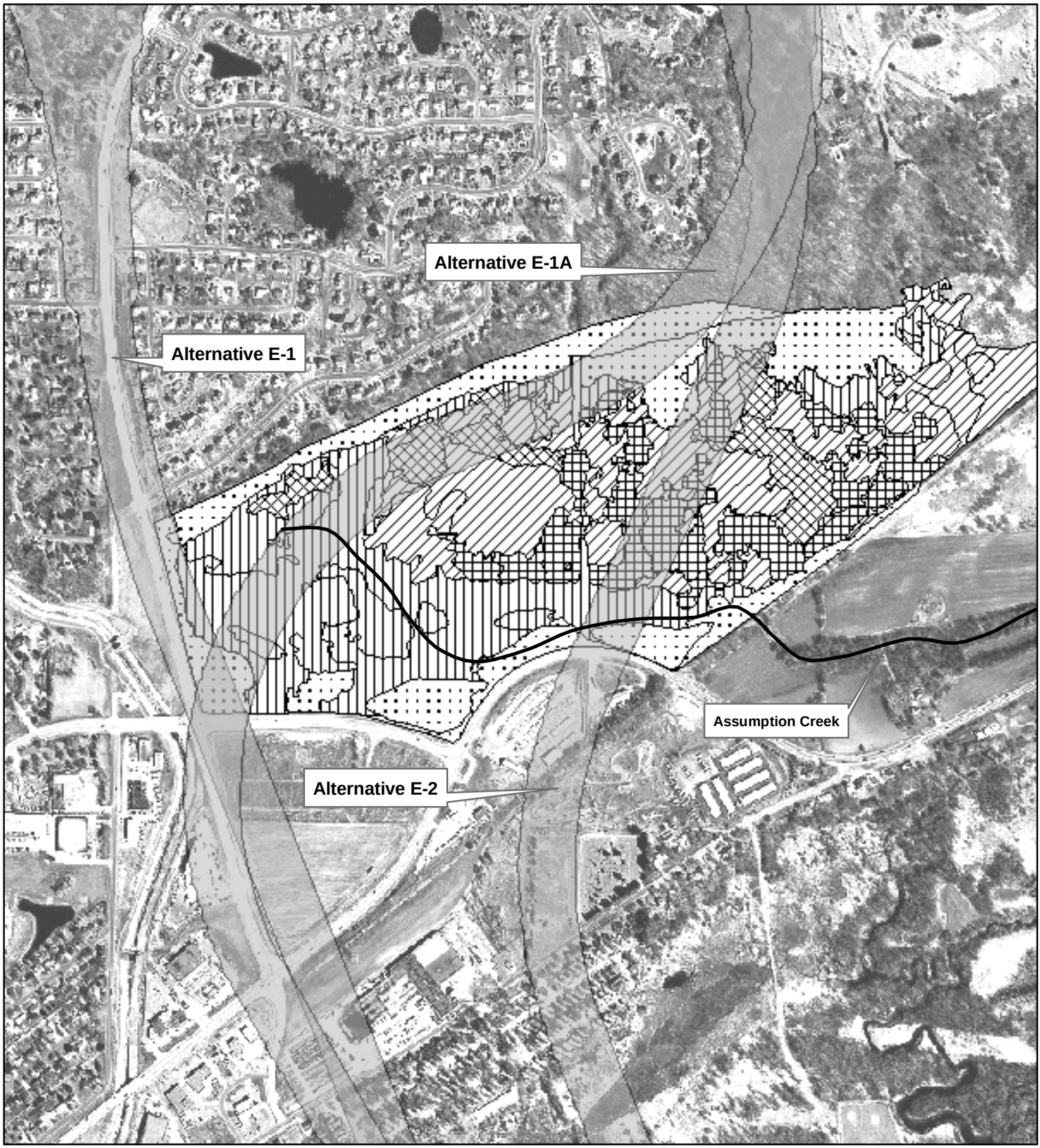

2005 Aerial Photograph

Fen Status

- Meets fen criteria
- Meets fen criteria; short sedge fen possible
- Possible historic and restorable fen
- Possible historic fen but severely degraded
- Upland

N

0 50 100 200 Meters

0 250 500 1,000 Feet

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Figure B
CALCAREOUS FEN STATUS
PHASE 2 STUDY AREA
Seminary Fen Phase 2 Study
SRF/MNDOT-DRAFT

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