

A stylized map of North America in shades of blue. A black dot marks the location of Denver, Colorado, with the word "DENVER" in bold, black, sans-serif capital letters to its right.

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Inbound & Outbound Peña Boulevard Reconstruction

Michael Cloud P.E.
Engineer
February 5, 2015



DENVER INTERNATIONAL AIRPORT
TOGETHER WE SOAR

Overview

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- DIA Facts and Project Overview
- Peña Boulevard History with Alkali Silica Reactivity
- Removal vs. Rubbilization
- Drainable Base
- Safety and Shoulder Erosion Mitigation
- Review and Lessons Learned



DIA Facts

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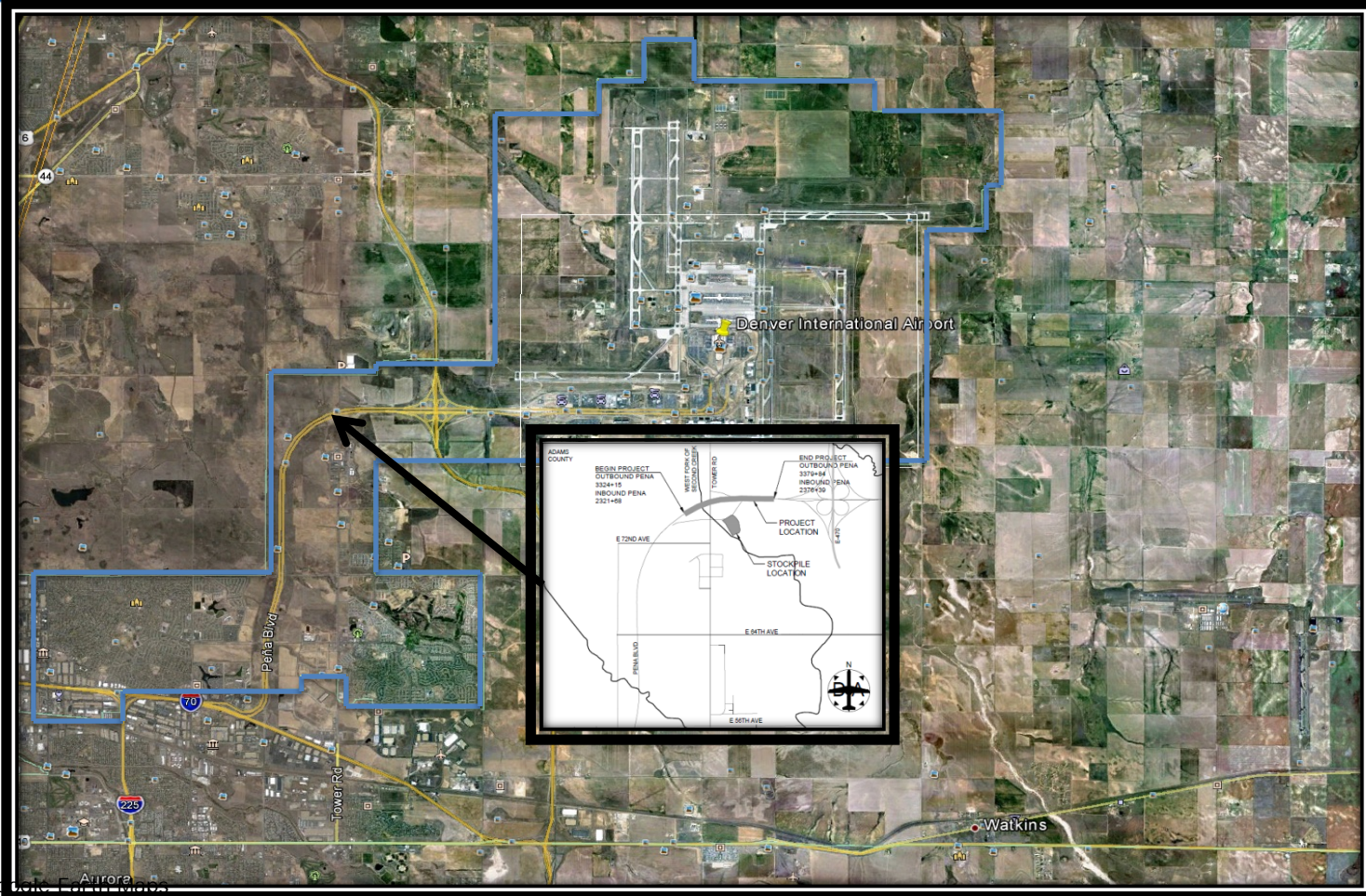


- Opening Date: February 28, 1995
- Location: 23 miles northeast of downtown Denver
- Elevation: 5,431 feet above sea level
- Size: 34,000 acres, 53 square miles
- Runways: Six runways; 4 north/south and 2 east/west



Project Overview

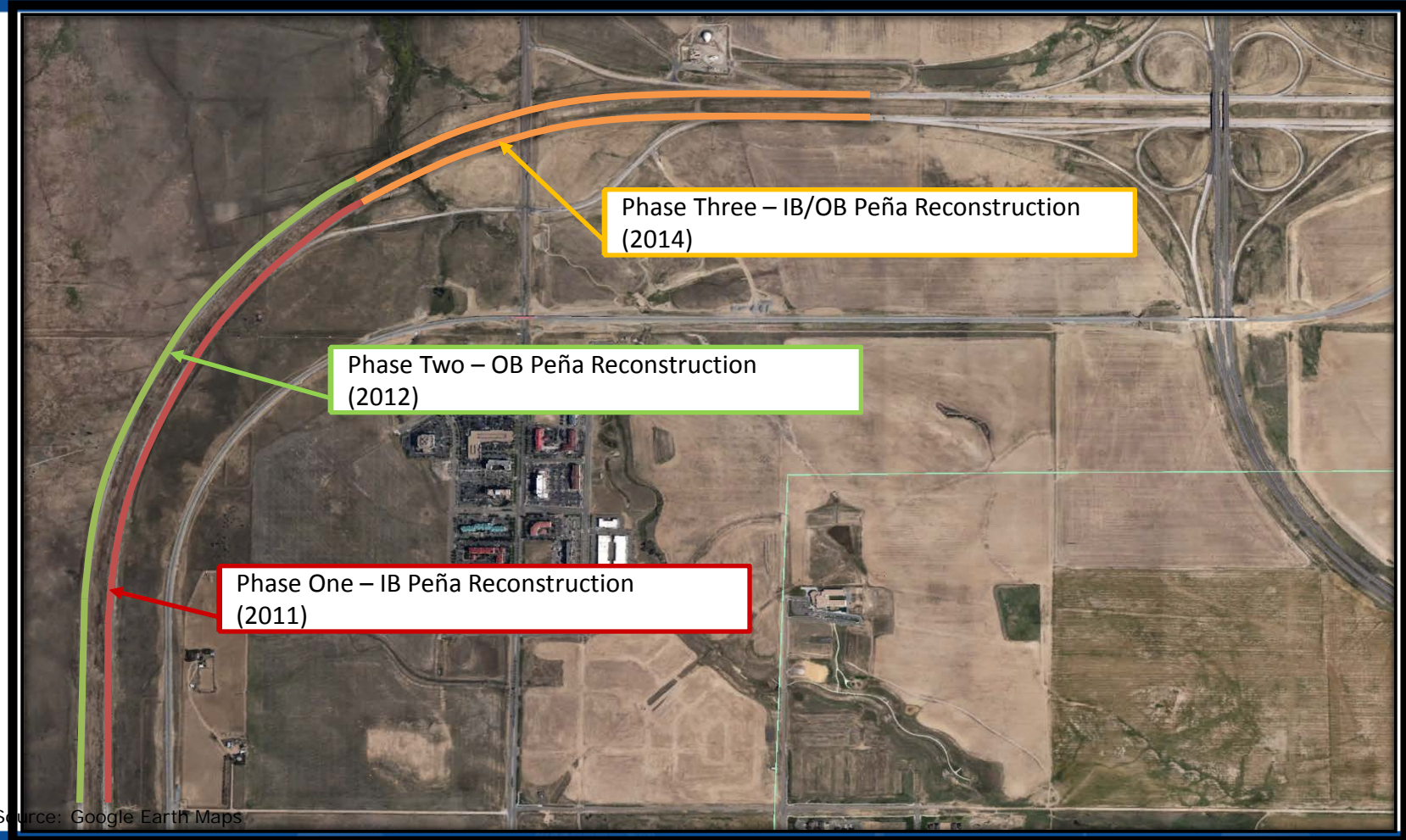
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Source: Google Earth Maps

Project Overview

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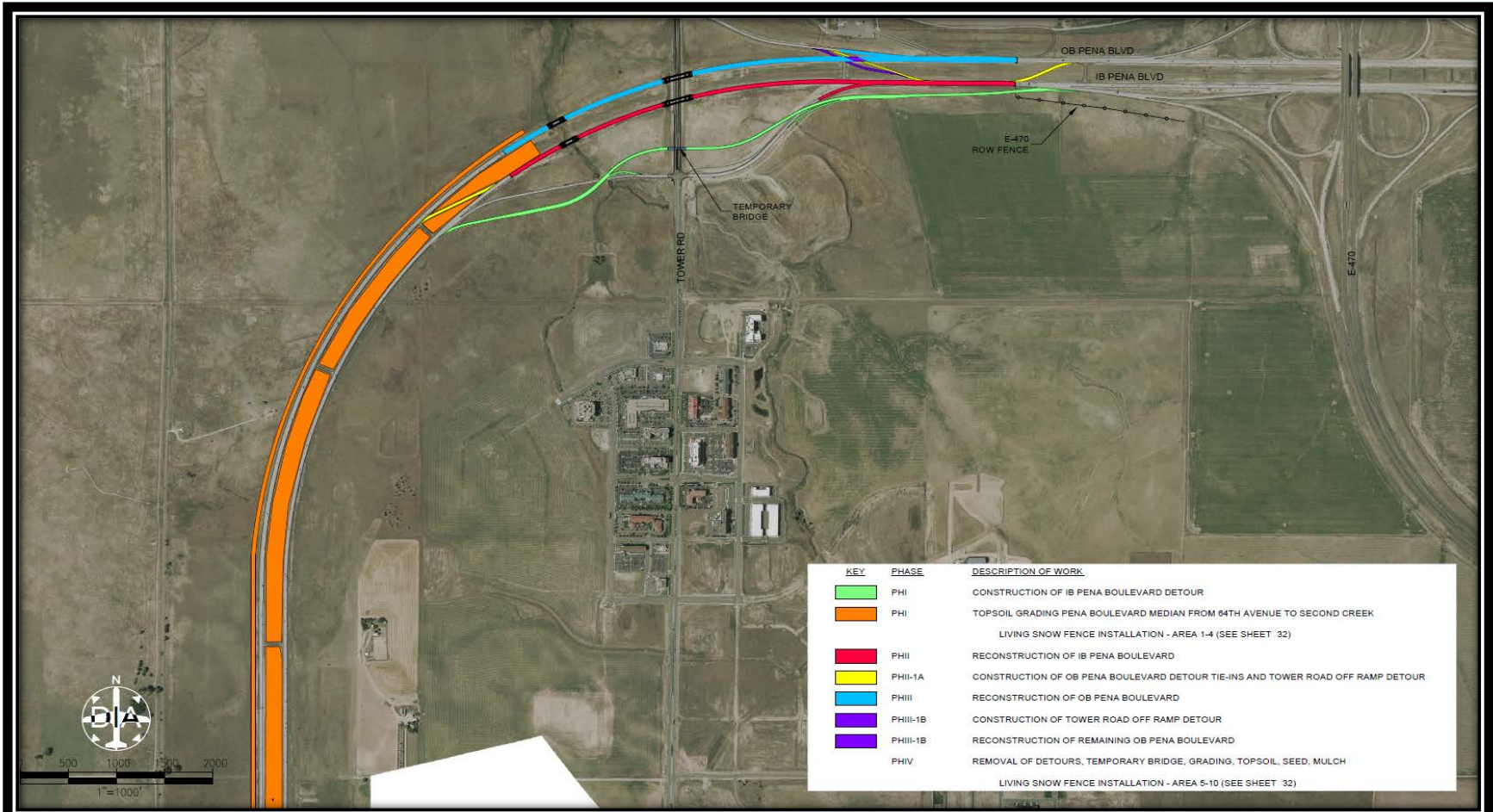


Source: Google Earth Maps



Project Overview

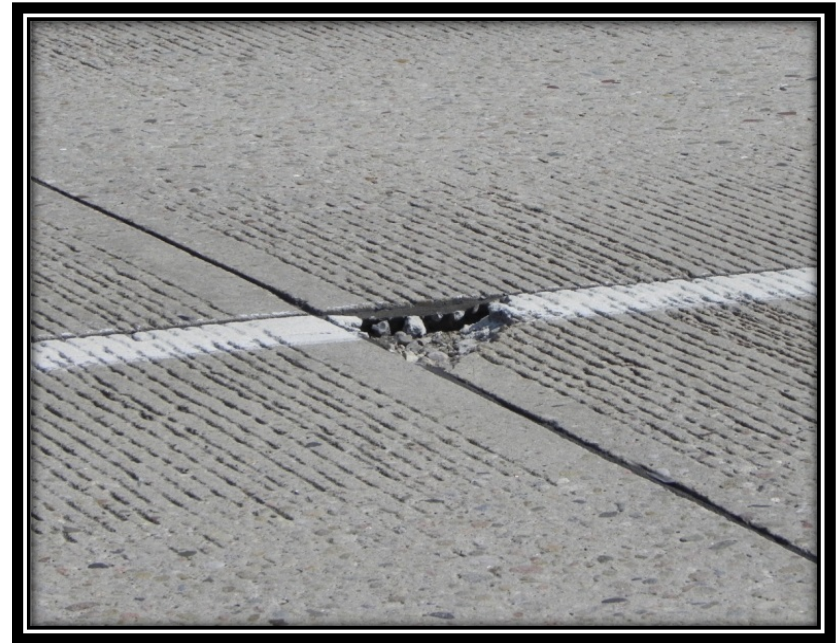
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Alkali Silica Reactivity (ASR)

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- Alkali Silica Reactivity (ASR) is the reaction between the cement paste and the aggregates that causes deterioration of concrete.



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Alkali Silica Reactivity (ASR)

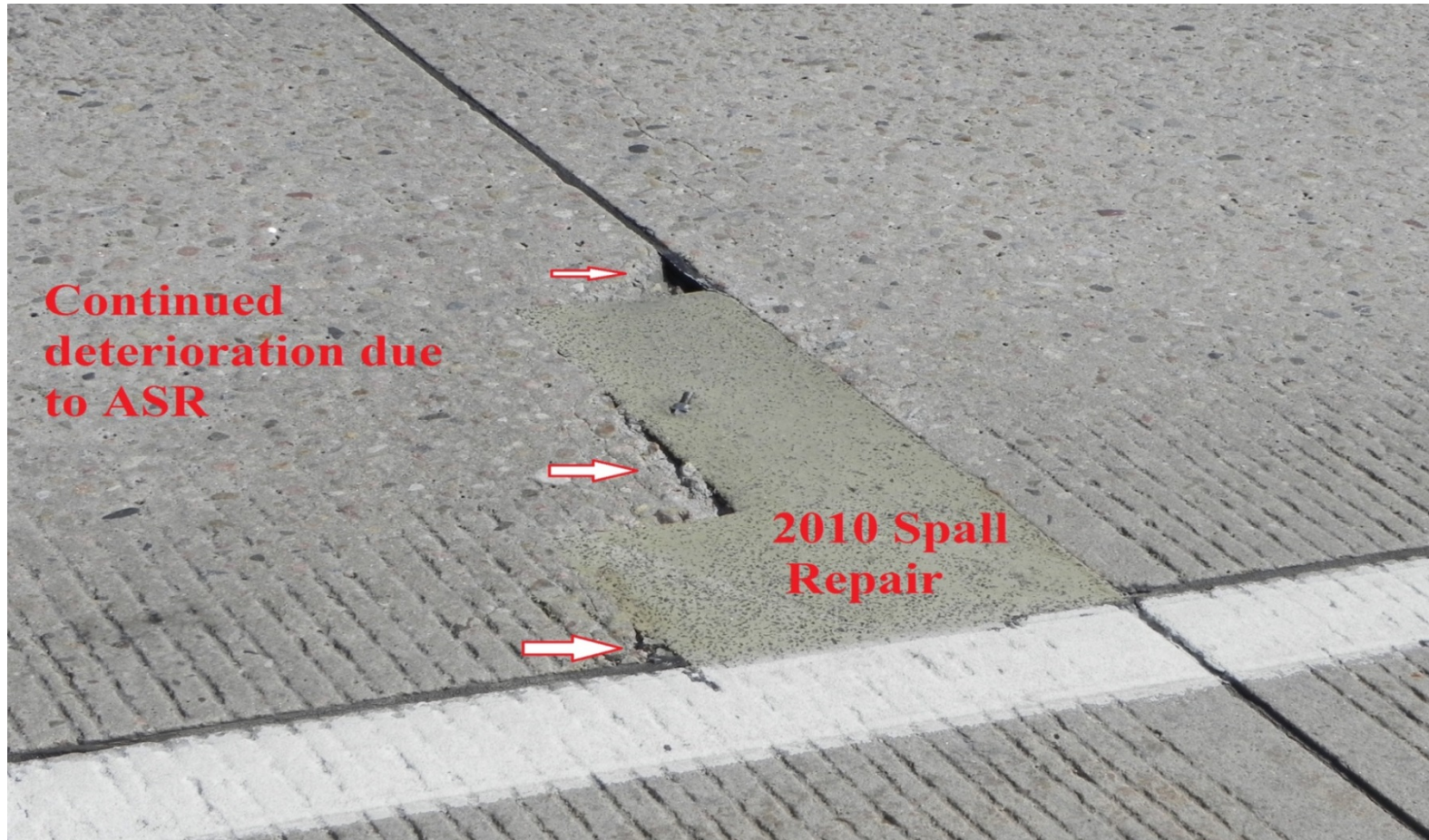
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- Repairs
 - Patch Material is a high density rubber. Similar to the material that super balls are made of.



Alkali Silica Reactivity (ASR)

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Removal vs. Rubbilization

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- What is Rubbilization?



- Sustainable Product?
 - Advantages
 - Cost Comparison



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Removal vs. Rubbilization

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Removal vs. Rubbilization

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- Multi-Head Breaker Method
 - Pavement Breaker. Breaking of the concrete pavement shall be accomplished with a self-contained, self-propelled, unit with hammers mounted laterally in pairs with half the hammers in a forward row and the remainder diagonally offset in a rear row so that there is continuous breakage from side to side. The lift height of the hammers shall be independently adjustable. The equipment shall have the capability of rubblizing a 13 foot lane in a single pass.
 - Steel Roller. A steel vibratory roller fitted with a "Z" pattern grid on the drum face having a gross weight of not less than 10 tons, operated in vibratory mode, shall be used to settle and seat the rubblized pavement.



Removal vs. Rubbilization

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Removal vs. Rubbilization

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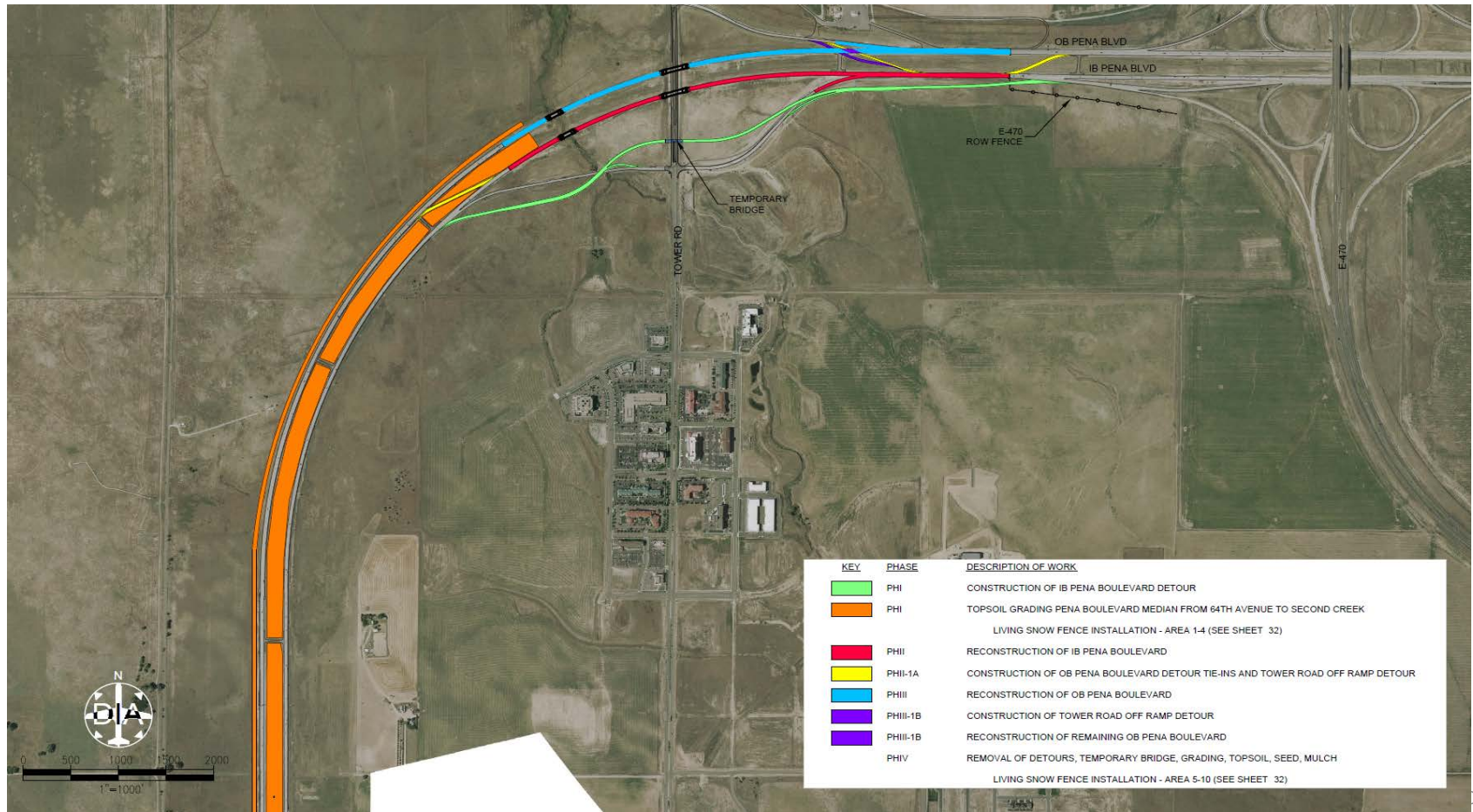
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Removal vs. Rubbilization

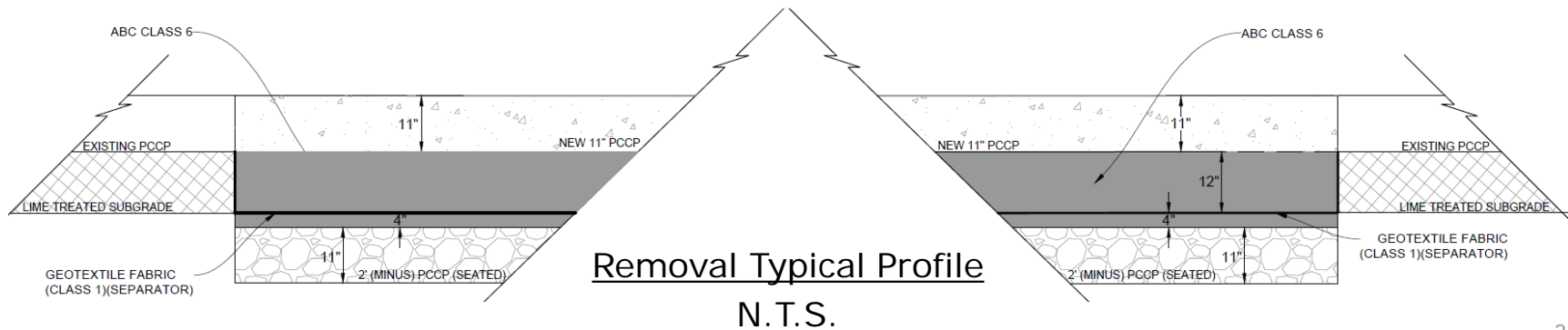
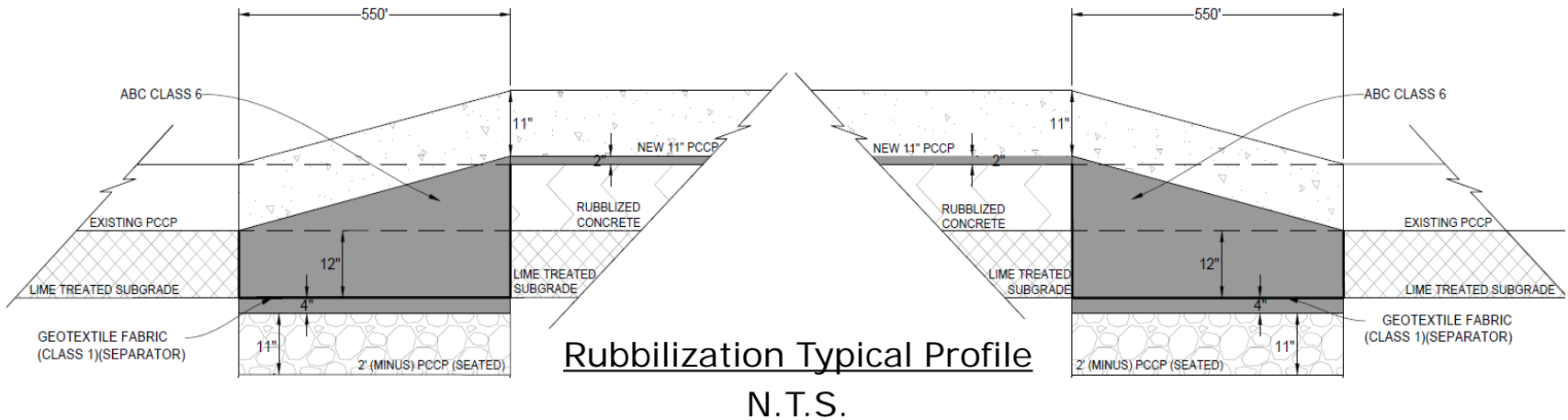
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- Looking at the numbers for 100,000 square yards of PCCP.

Removals

	Unit	Unit Price
Removal of Concrete	SY	\$3.60
4-inches ABC Class 6	TON	\$14.50
Geotextile Class 1 Separator	SY	\$3.00
Total =		\$949,275.00

vs.

Rubbilization

	Unit	Unit Price
2-inches ABC Class 6	TON	\$14.50
Rubbilization	SY	\$3.00
Total =		\$444,637.50

- Risk???

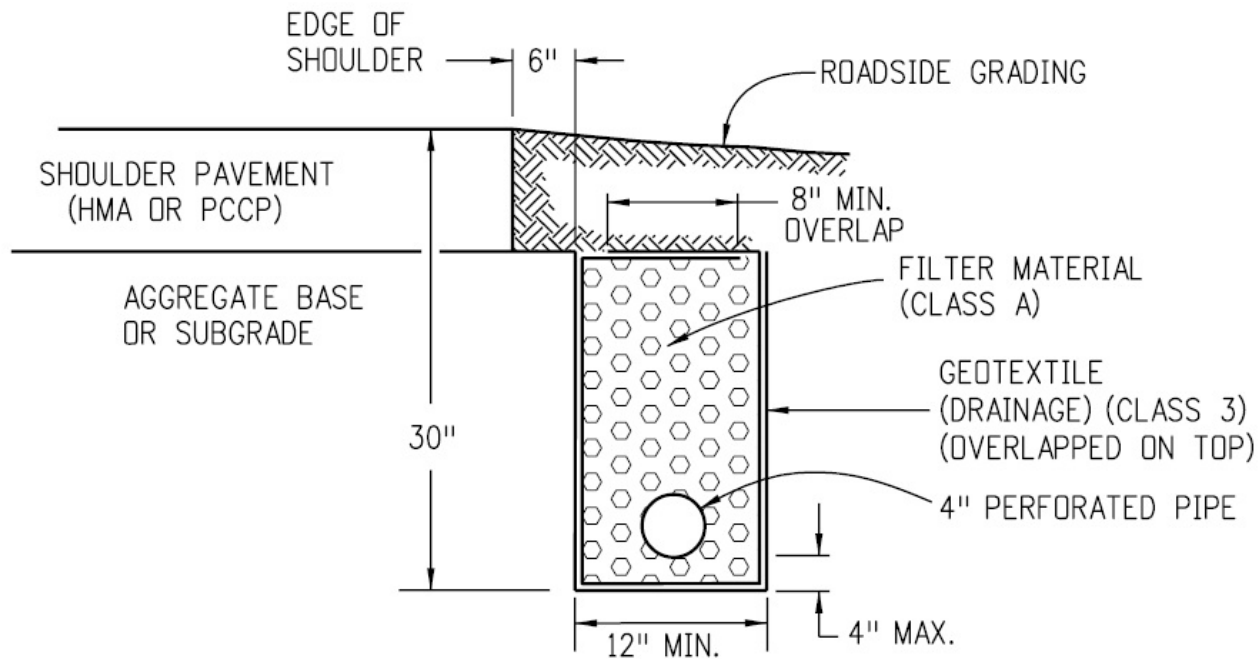
Removals	Rubbilization
Weather (Soft Spots)	Minimal Soft Spots
Cost (e.g. Trucking, Materials)	
Time	



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Drainable Base

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PIPE EDGE DRAIN



Drainable Base

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Drainable Base

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- The need for drainable base?



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Drainable Base

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Safety and Shoulder Erosion

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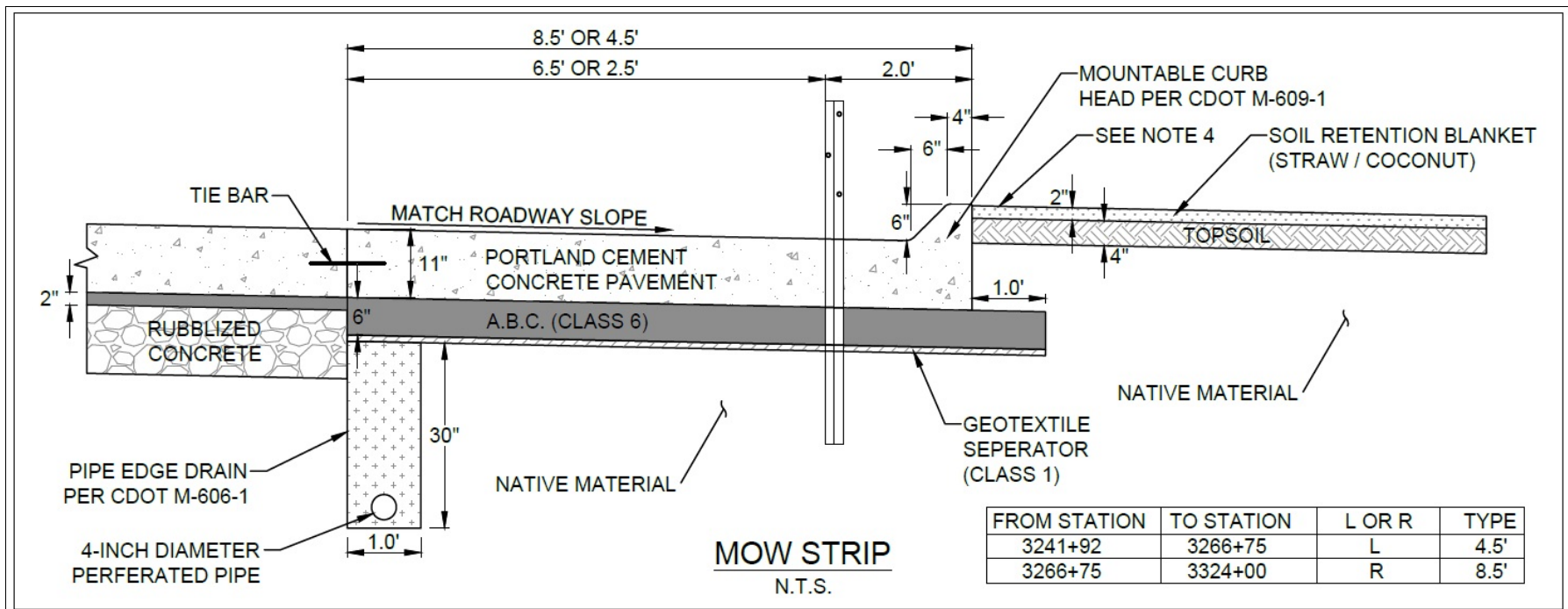
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Safety and Shoulder Erosion

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Safety and Shoulder Erosion

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Review and Lessons Learned

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- Rubbilization
 - Install edge drains prior to rubbilization.
 - Eliminates difficulty of installation and provides a better product.
 - The rubbilized material along the edge of roadway will not meet the specification requirements due to the un-confined space.
 - Perform test pits up front to evaluate the gradation and to provide a set process or procedure for meeting the specification requirements.
 - Identify soft spots and stabilize as necessary with the rubbilized concrete.



Review and Lessons Learned

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- Removal of Concrete (Seating)
 - Break concrete into 2-foot minus nominal dimension.
 - Smaller dimension preferred.
 - Account for 20-25% overrun of ABC Class 6 to fill the voids.



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