INDIANA DEPARTMENT OF TRANSPORTATION

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Room N925 CM
Indianapolis, Indiana 46204

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Eric Holcomb, Governor
Joe McGuinness, Commissioner

AGENDA

April 20, 2017 Standards Committee Meeting

MEMORANDUM

April 04, 2017

TO: Standards Committee

FROM: Scott Trammell, Secretary

RE: Agenda for the April 20, 2017 Standards Committee Meeting

A Standards Committee meeting is scheduled for 09:00 a.m. on April 20, 2017 in the N955 Bay Window Conference Room. Please enter meeting through the double doors directly in front of the conference room.

The following items are listed for consideration:

A. GENERAL BUSINESS ITEMS

OLD BUSINESS

(No items on this agenda)

NEW BUSINESS

1. Approval of the Minutes from the March 16, 2017 meeting

B. CONCEPTUAL PROPOSAL ITEMS

OLD BUSINESS

(No items on this agenda)

NEW BUSINESS

(No items on this agenda)

C. STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS PROPOSED ITEMS

OLD BUSINESS

Item No. 7 17/02/16 (2016 SS)	Mr. Boruff	pg 3

Standard Drawings:

808-DLIM-01	DOTTED LINE MARKING DRAWING INDEX *AND* GENERAL NOTES
808-DLIM-02	DOTTED LINES FOR FREEWAY ACCELERATION LANES
808-DLIM-03	DOTTED LINES FOR FREEWAY DECELERATION LANES
808-DLIM-04	FREEWAY SHORT AUXILIARY LANES AND *EXTENDED AUXILIARY* LANES ~~DROPS~~
808-DLIM-05	*FREEWAY LANE DROPS AND* ROUTE SPLIT ~~WITH DEDICATION LANES~~
808-DLIM-06	LANE DROPS AT INTERSECTIONS
808-DLIM-07	*DOTTED LINES FOR FREEWAY DOUBLE ACCELERATION LANES*
808-DLIM-08	*DOTTED LINES FOR FREEWAY DOUBLE DECELERATION LANES*
808-DLIM-09	*MAJOR DIVERGE OR ROUTE SPLIT WITH OPTION LANE*

NEW BUSINESS

Item No. 1 (2016 SS)	Mr. Beeson	pg 22

Recurring Special Provisions:

413-R-634	FULL DEPTH RECLAMATION, FDR
XXX-R-XXX	*CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR*
XXX-R-XXX	*ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR*

Item No. 2 (2016 SS)	Mr. Beeson	pg 55

Recurring Special Provision:

416-R-638	COLD IN-PLACE RECYCLING, CIR

Item No. 3 (2016 SS)	Mr. Beeson	pg 70
SECTION 215	CHEMICAL MODIFICATION OF SOILS	

cc: Committee Members
FHWA
ICI

Mr. Boruff
Date: 04/20/17
(OLD BUSINESS ITEM)

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD DRAWINGS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The standard drawings for the dotted line pavement markings at auxiliary lanes and lane drops do not show details for dual lane entrance or exit ramps, nor are details included for auxiliary lanes that extend past an exit gore.

PROPOSED SOLUTION: Update the 808-DLIM series to show the typical dotted line and pavement message markings for dual lane entrance and exit ramps, as well as for auxiliary lanes that extend past an exit gore.

APPLICABLE STANDARD SPECIFICATIONS: 808

APPLICABLE STANDARD DRAWINGS: 808-DLIM-01 through 808-DLIM-06

APPLICABLE DESIGN MANUAL SECTION: §502-2.02(06)

APPLICABLE SECTION OF GIFE: No

APPLICABLE RECURRING SPECIAL PROVISIONS: No

PAY ITEMS AFFECTED: No

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Yes, ad hoc review by Joiner Lagpacan, Dave Boruff, Luis Laracuente, Mark Orton, and Dana Plattner

IMPACT ANALYSIS (attach report): Yes, attached.

Submitted By: Joe Bruno on behalf of Dave Boruff

Title: Traffic Administration Engineer

Organization: INDOT

Phone Number: (317) 234-7949

Date: 3/27/2017

Mr. Boruff
Date: 04/20/17
(OLD BUSINESS ITEM)

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD DRAWINGS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

Construction costs? No

Construction time? No

Customer satisfaction? Yes

Congestion/travel time? Yes

Ride quality? No

Will this proposal reduce operational costs or maintenance effort? No

Will this item improve safety:

For motorists? Yes

For construction workers? No

Will this proposal improve quality for:

Construction procedures/processes? Yes

Asset preservation? No

Design process? Yes

Will this change provide the contractor more flexibility? No

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders? No

Is this proposal needed for compliance with:

Federal or State regulations? No

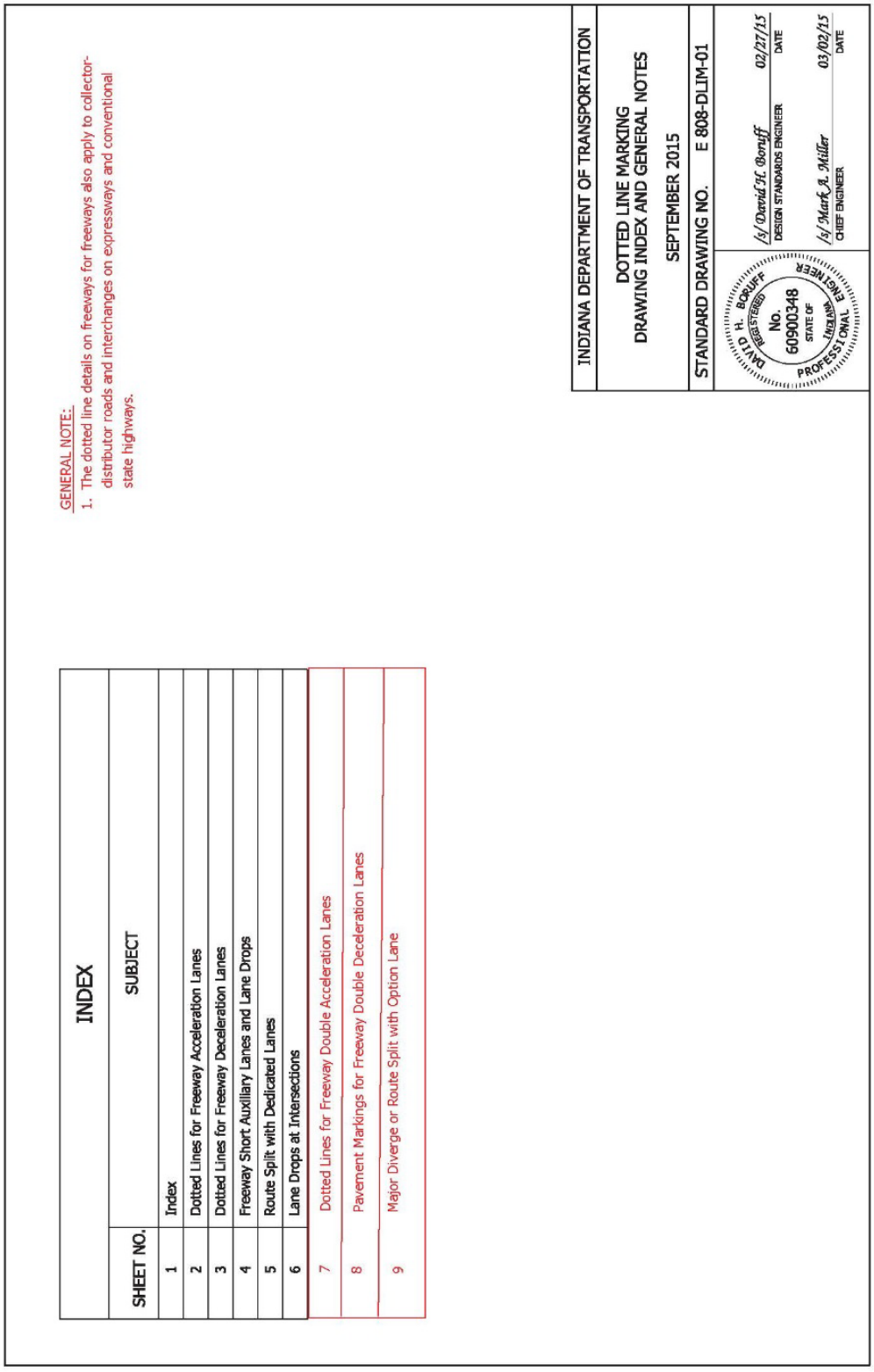
AASHTO or other design code? No

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda: N/A

REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-01 DOTTED LINE MARKING DRAWING INDEX AND GENERAL NOTES (WITH MARKUPS)



INDEX

SHEET NO.	SUBJECT
1	Index
2	Dotted Lines for Freeway Acceleration Lanes
3	Dotted Lines for Freeway Deceleration Lanes
4	Freeway Short Auxiliary Lanes and Lane Drops
5	Route Split with Dedicated Lanes
6	Lane Drops at Intersections
7	Dotted Lines for Freeway Double Acceleration Lanes
8	Pavement Markings for Freeway Double Deceleration Lanes
9	Major Diverge or Route Split with Option Lane

GENERAL NOTE:
1. The dotted line details on freeways for freeways also apply to collector-distributor roads and interchanges on expressways and conventional state highways.

INDIANA DEPARTMENT OF TRANSPORTATION

DOTTED LINE MARKING
DRAWING INDEX AND GENERAL NOTES

SEPTEMBER 2015

STANDARD DRAWING NO. E 808-DLIM-01

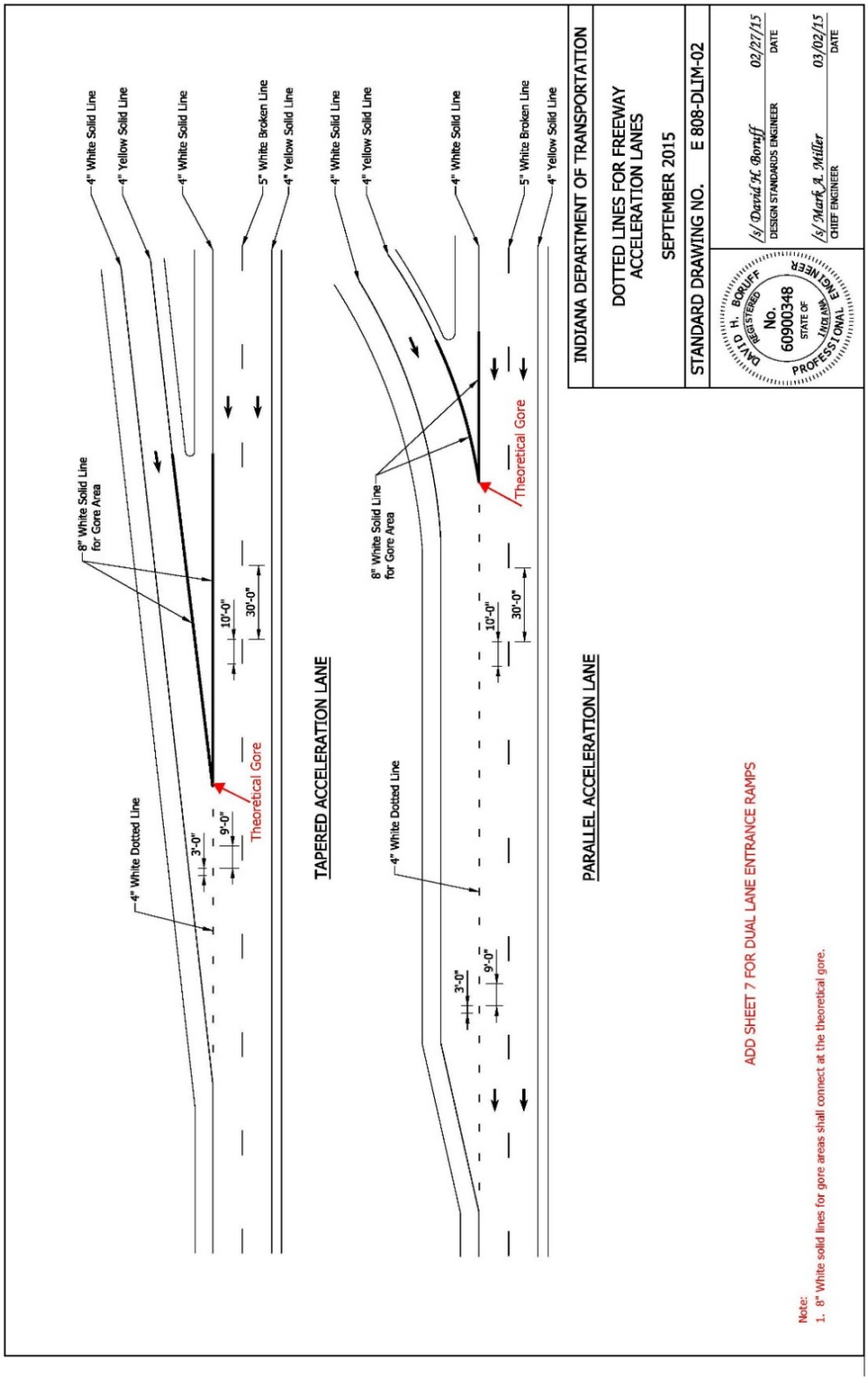
DAVID H. BORUFF REGISTERED No. 60900348 STATE OF INDIANA PROFESSIONAL ENGINEER

/s/ David H. Boruff 02/27/15
DESIGN STANDARDS ENGINEER DATE

/s/ Mark A. Miller 03/02/15
CHIEF ENGINEER DATE

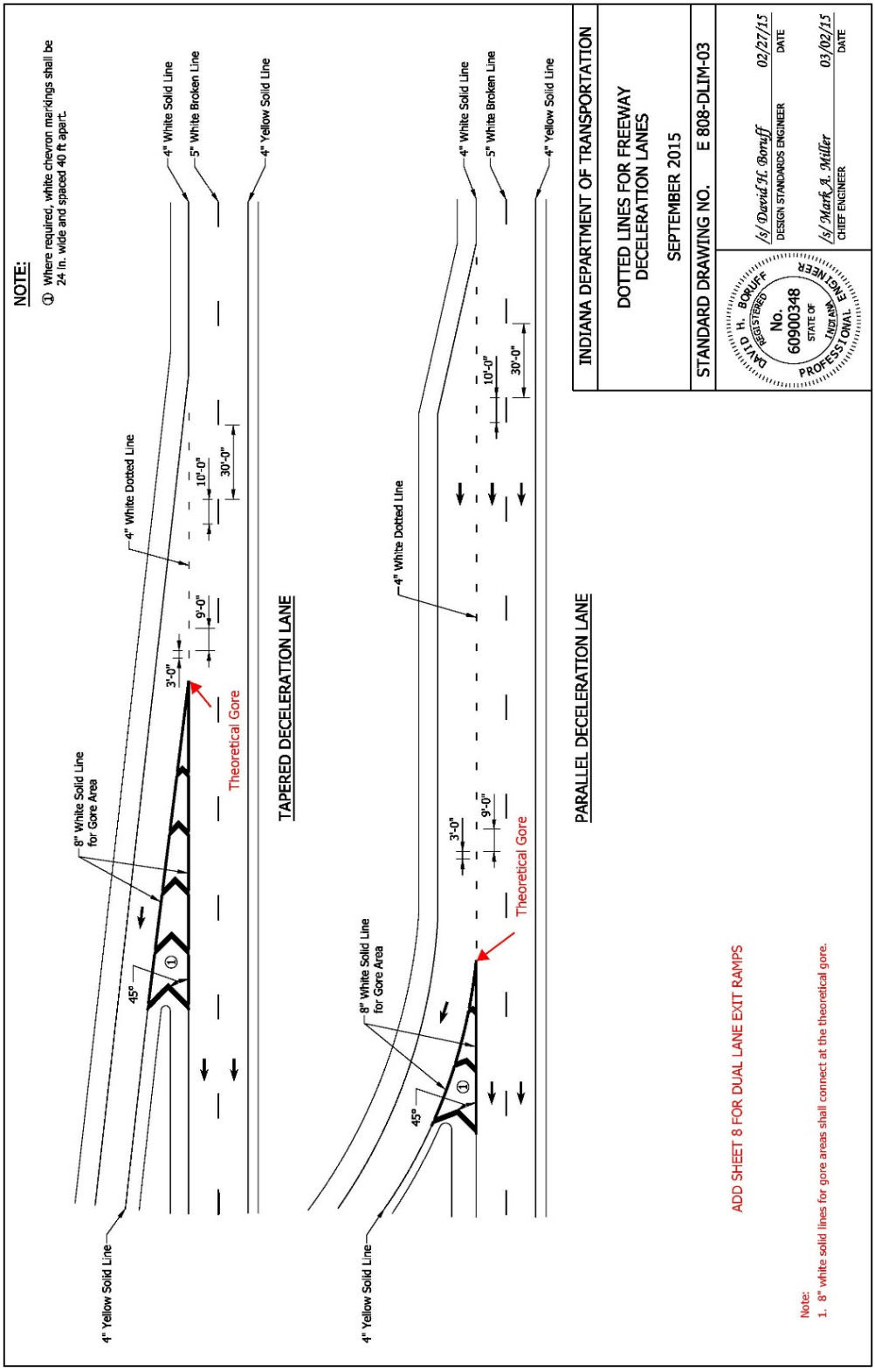
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-01 DOTTED LINE MARKING DRAWING INDEX AND GENERAL NOTES (WITH MARKUPS)



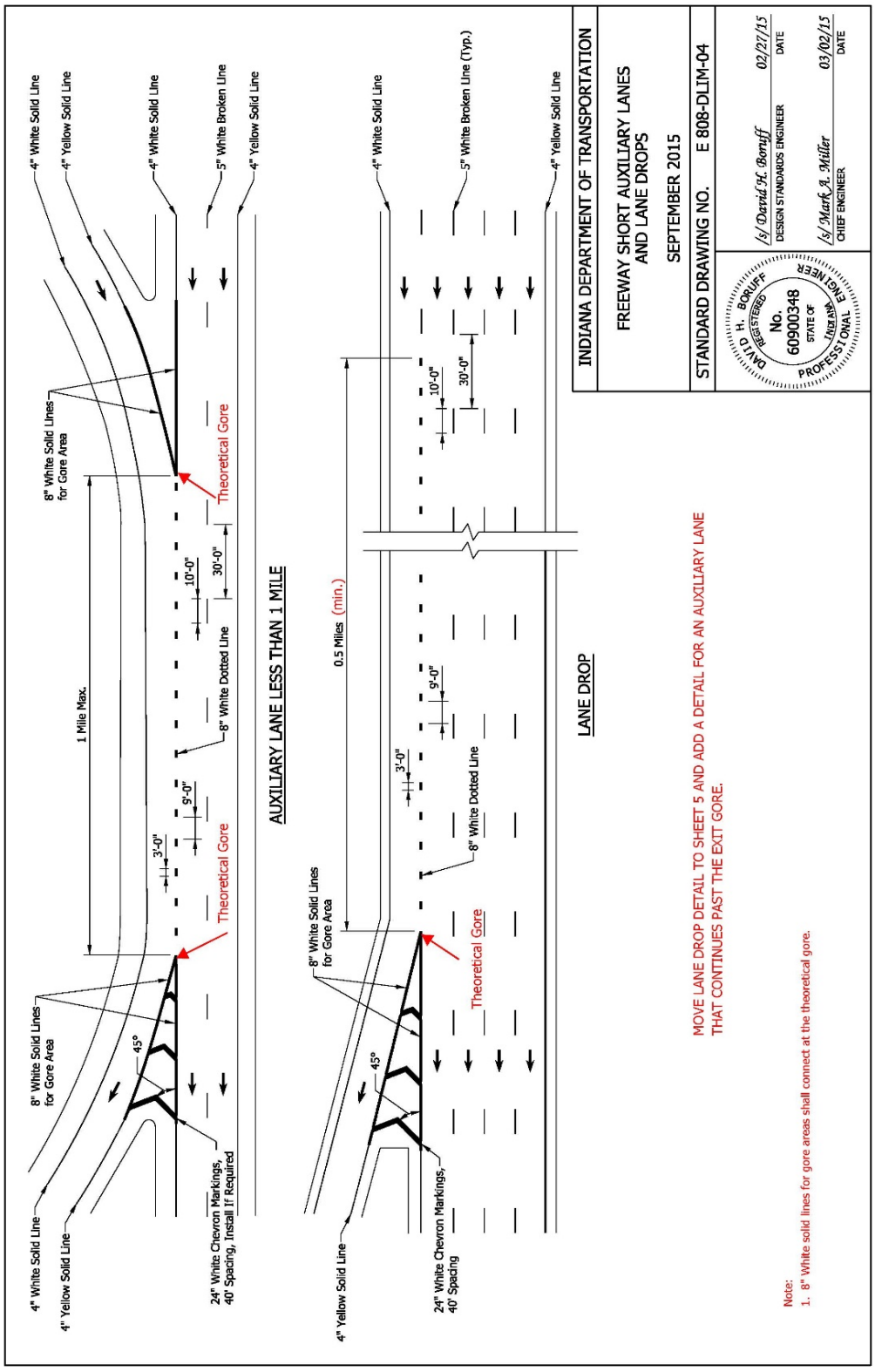
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-03 DOTTED LINES FOR FREEWAY DECELERATION LANES (WITH MARKUPS)



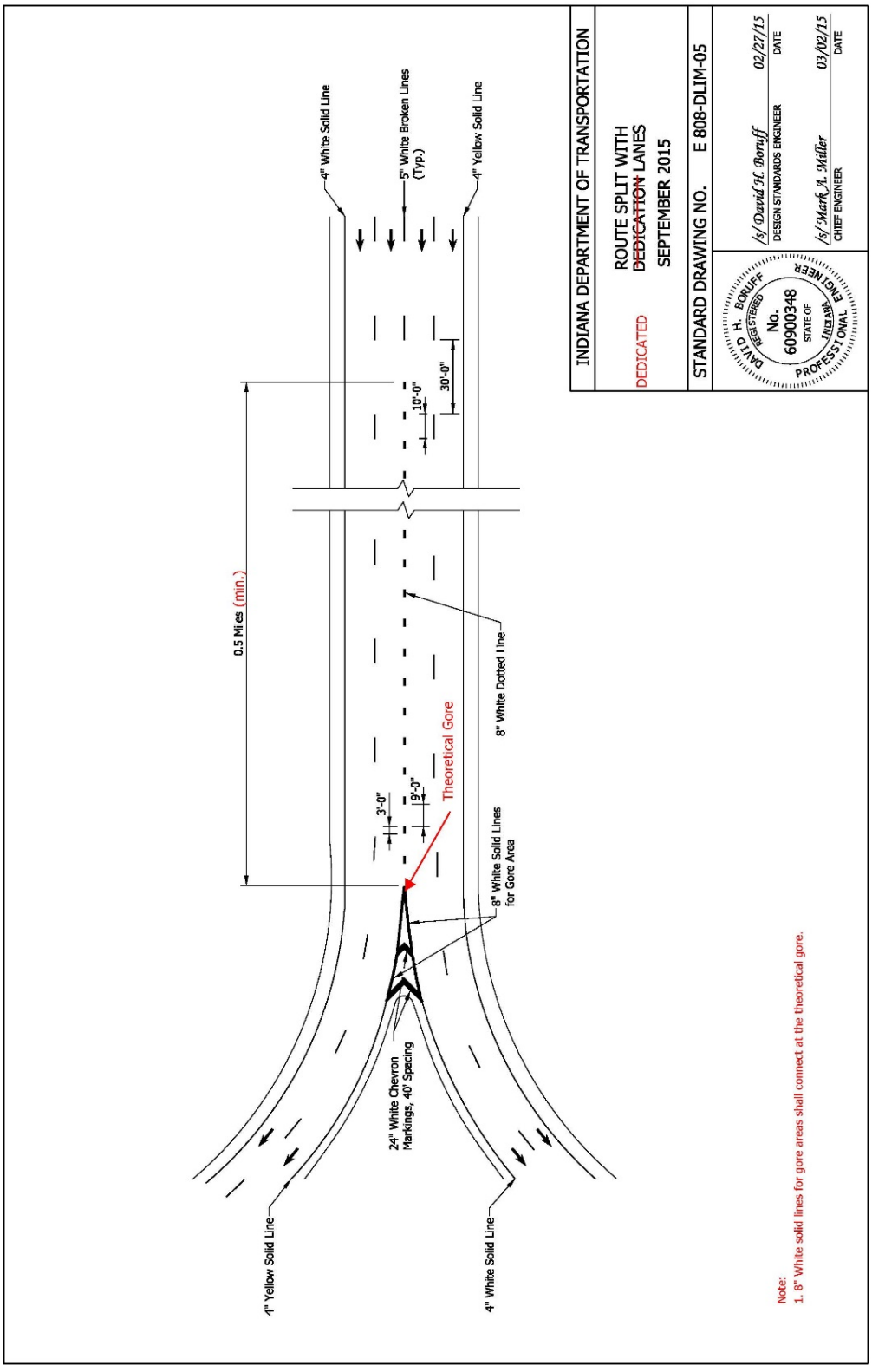
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-04 FREEWAY SHORT AUXILIARY LANES AND LANE DROPS (WITH MARKUPS)



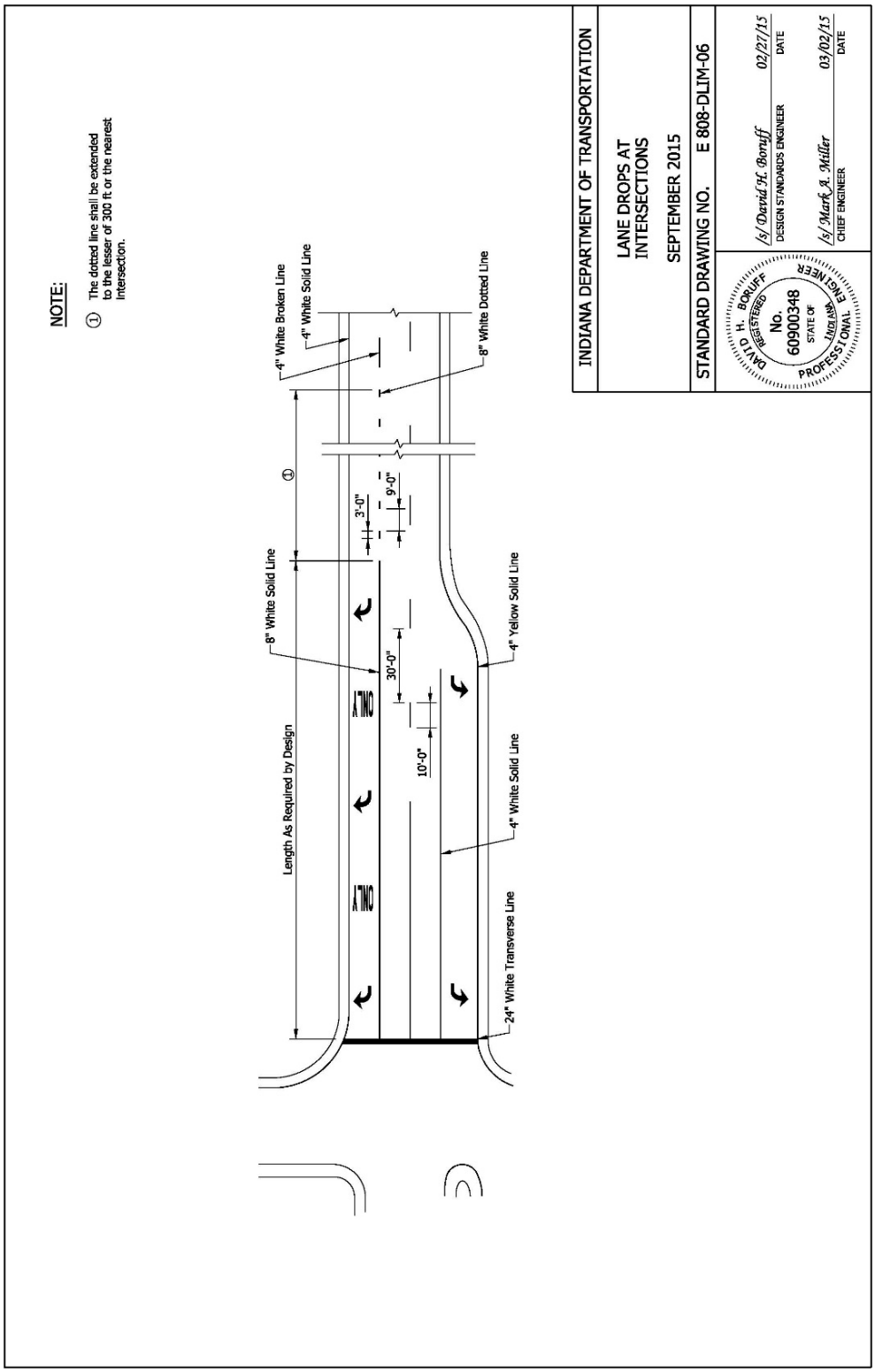
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-05 ROUTE SPLIT WITH DEDICATION LANES (WITH MARKUPS)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-06 LANE DROPS AT INTERSECTIONS (WITH MARKUPS)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-01 DOTTED LINE MARKING DRAWING INDEX AND GENERAL NOTES (DRAFT)

INDEX

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GENERAL NOTE:

1. The dotted line details for freeways also apply to collector-distributor roads and interchanges on expressways and conventional state highways.

INDIANA DEPARTMENT OF TRANSPORTATION

DOTTED LINE MARKING
DRAWING INDEX AND GENERAL NOTES

SEPTEMBER 2017

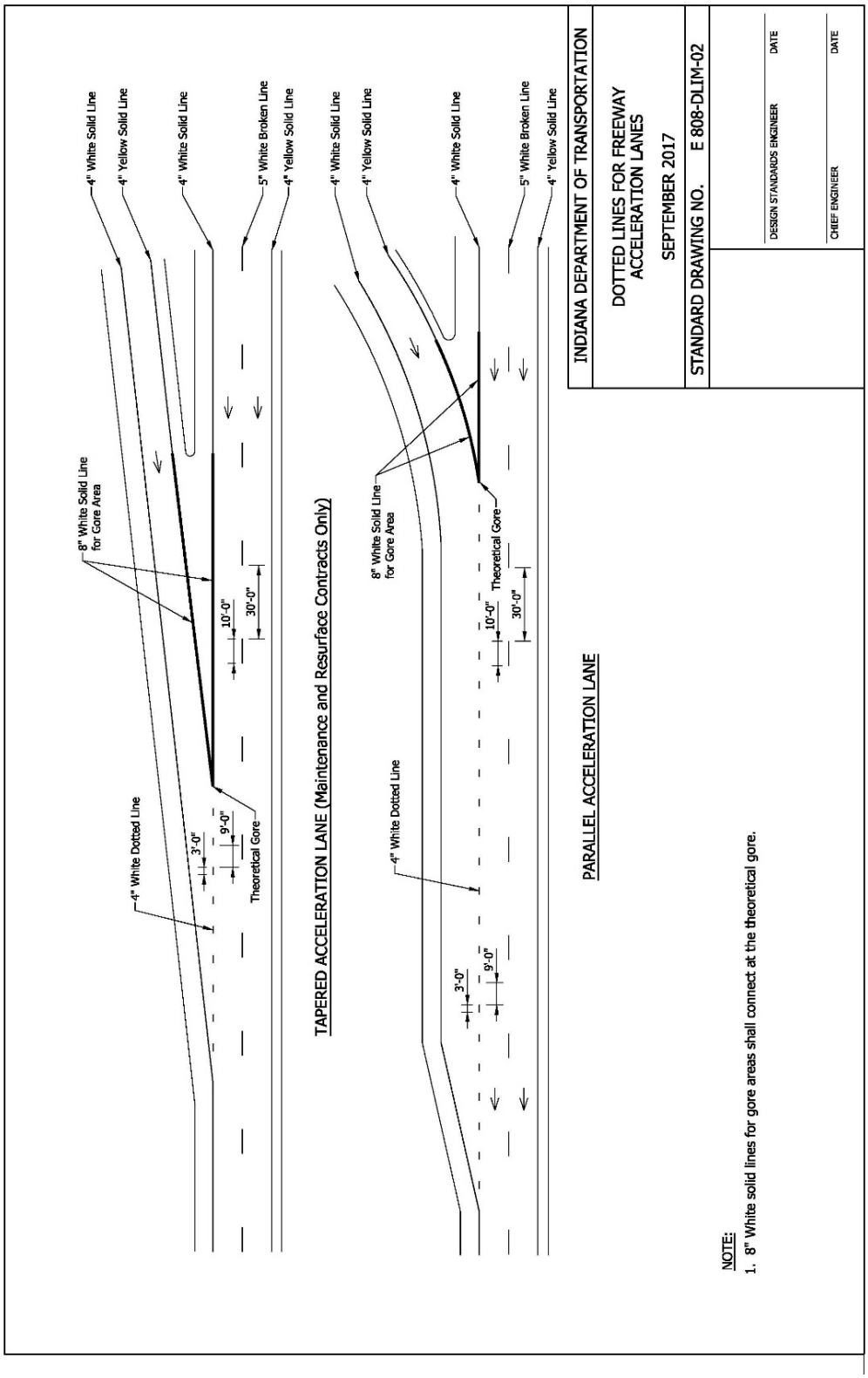
STANDARD DRAWING NO. E 808-DLIM-01

DESIGN STANDARDS ENGINEER DATE

CHIEF ENGINEER DATE

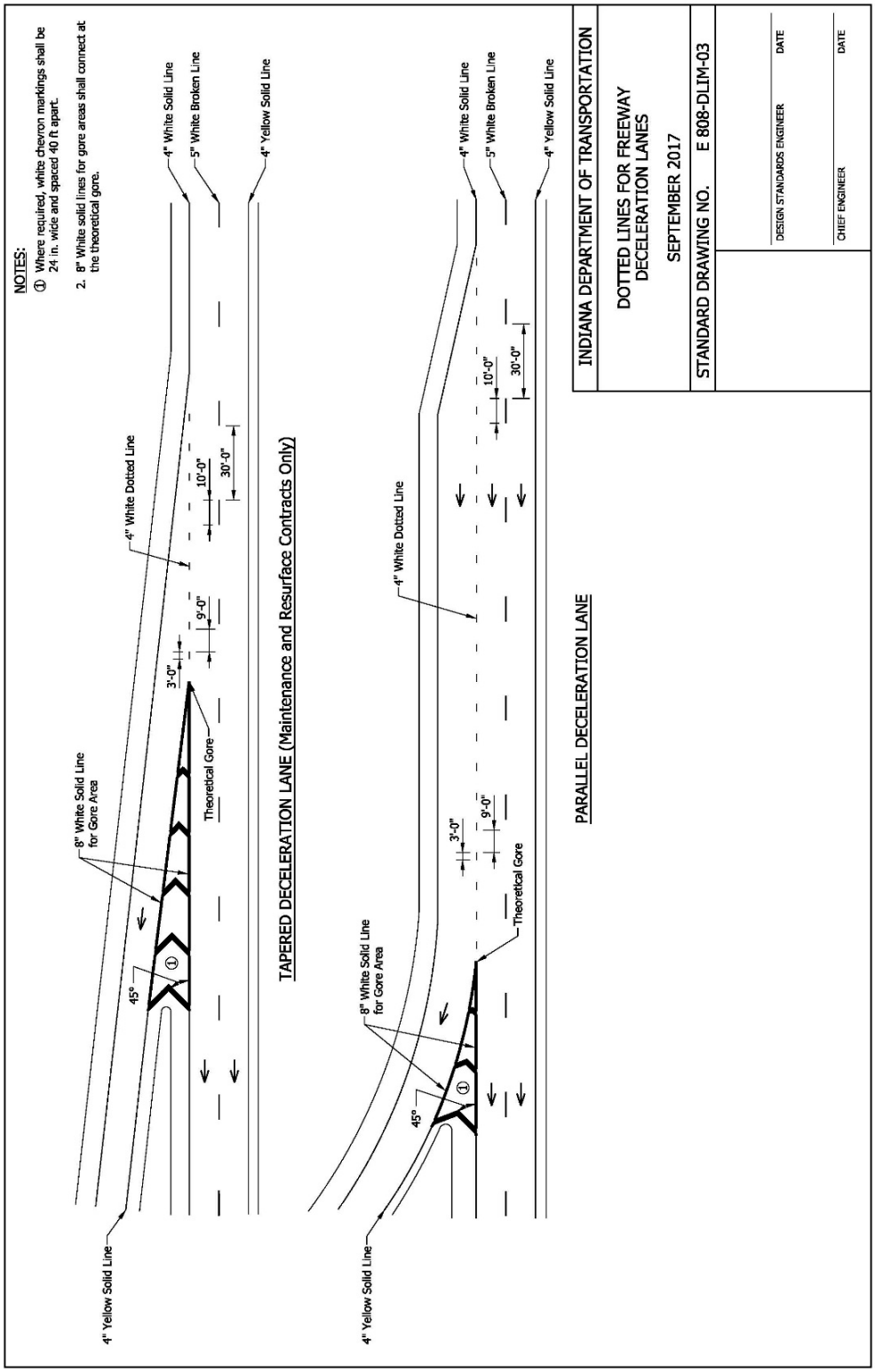
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-02 DOTTED LINES FOR FREEWAY ACCELERATION LANES (DRAFT)



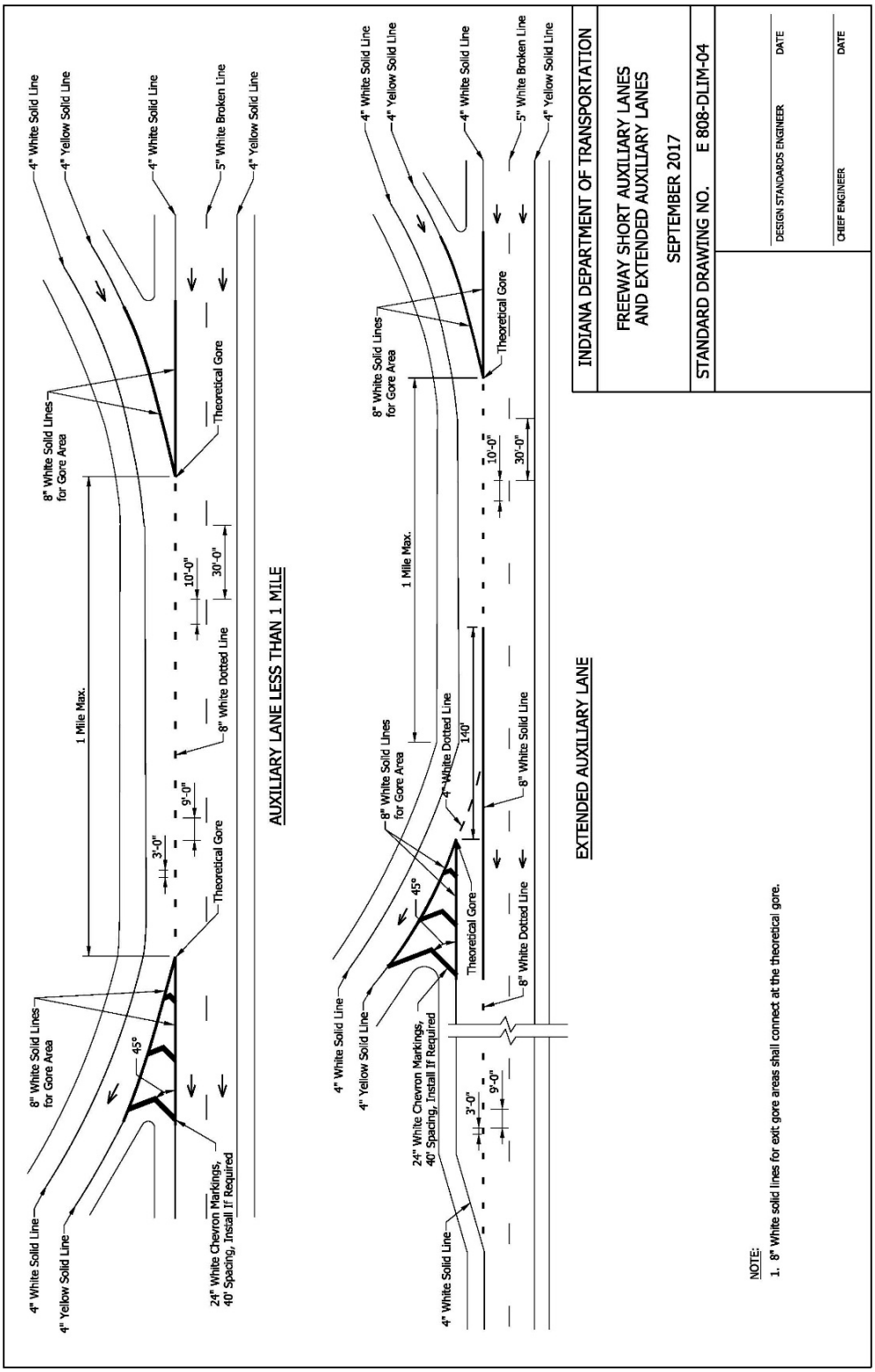
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-03 DOTTED LINES FOR FREEWAY DECELERATION LANES (DRAFT)



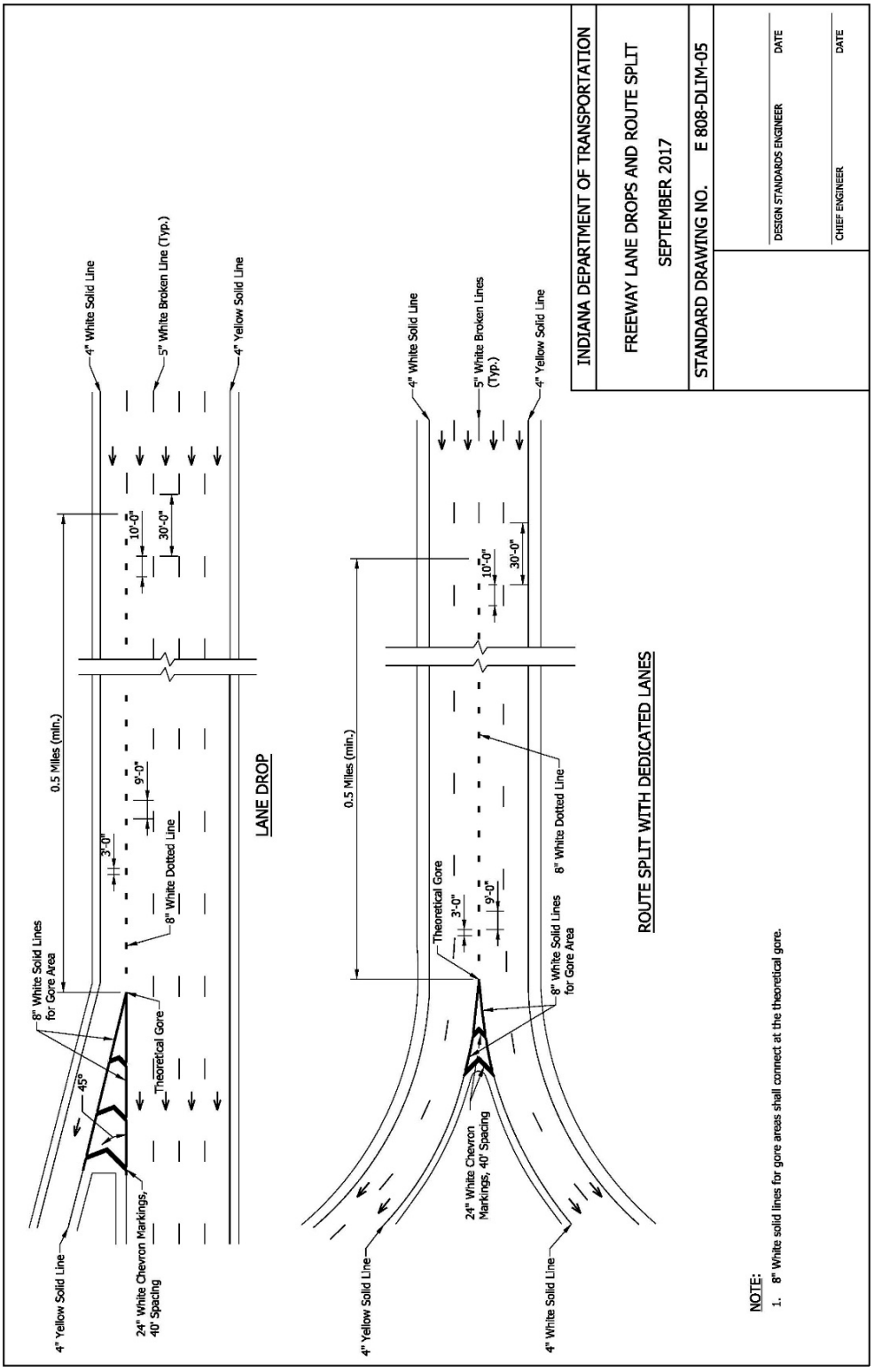
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-04 FREEWAY SHORT AUXILIARY LANES AND EXTENDED AUXILIARY LANES (DRAFT)



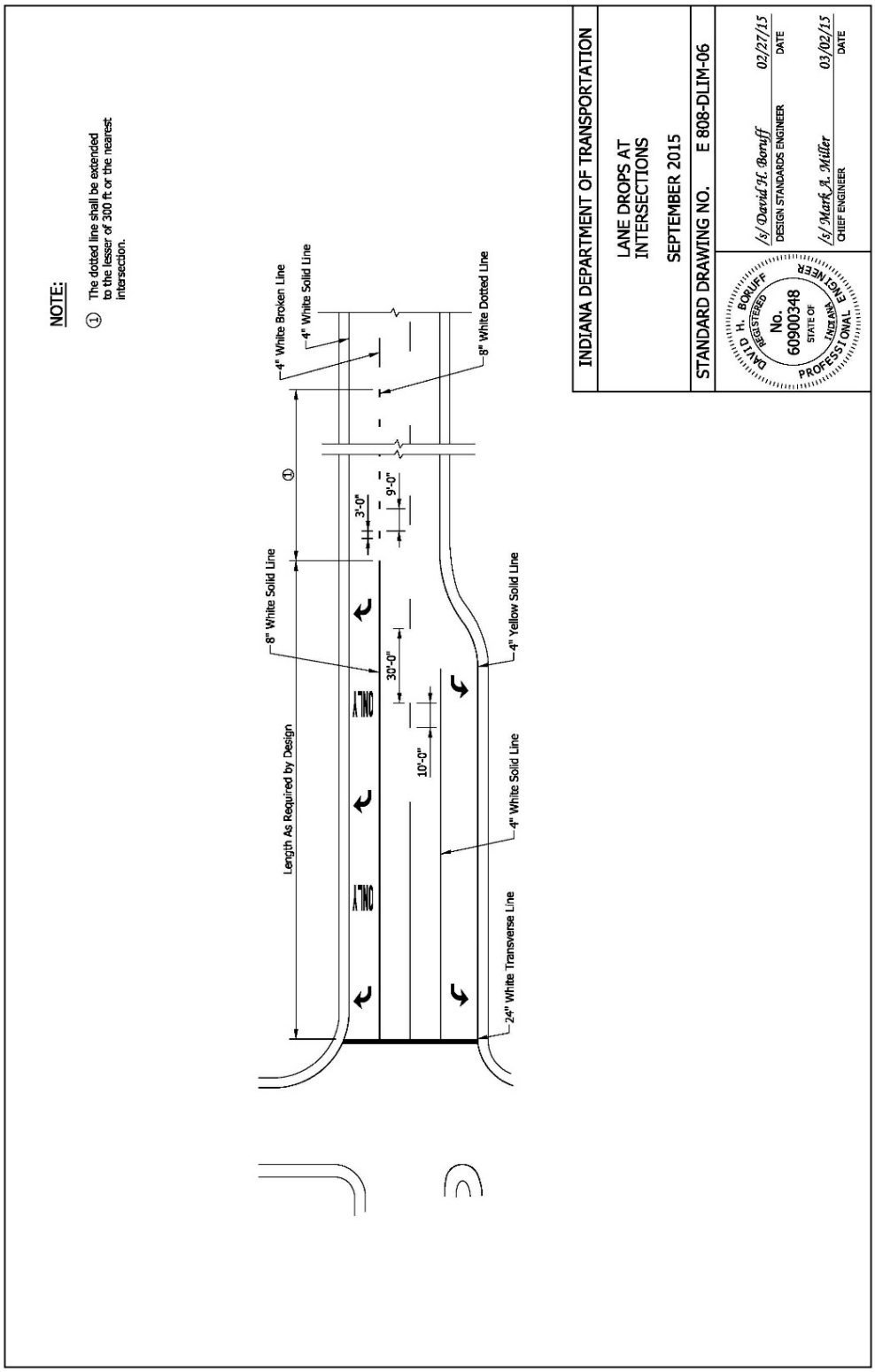
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-05 FREEWAY LANE DROPS AND ROUTE SPLIT (DRAFT)



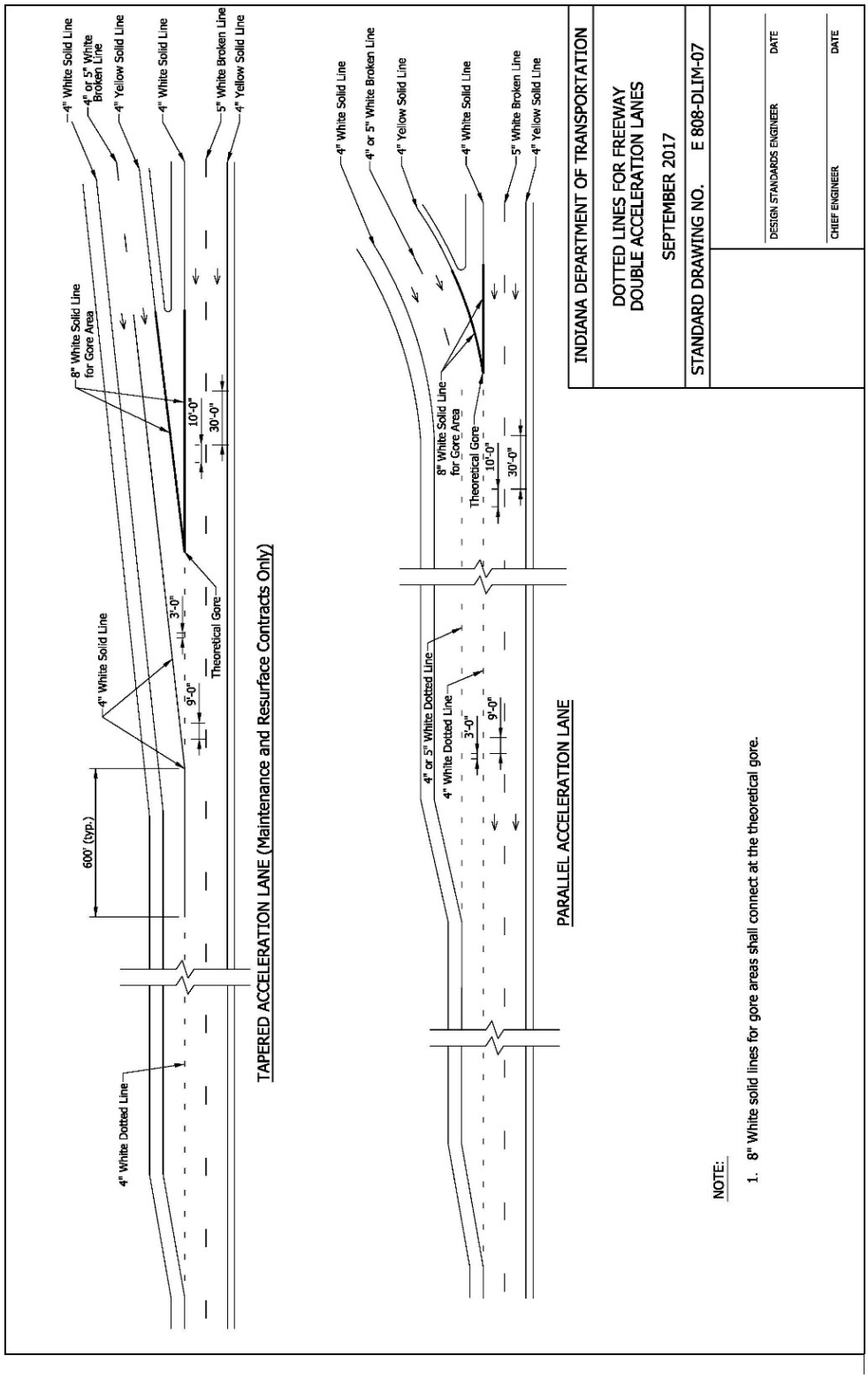
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-06 LANE DROPS AT INTERSECTIONS (DRAFT)



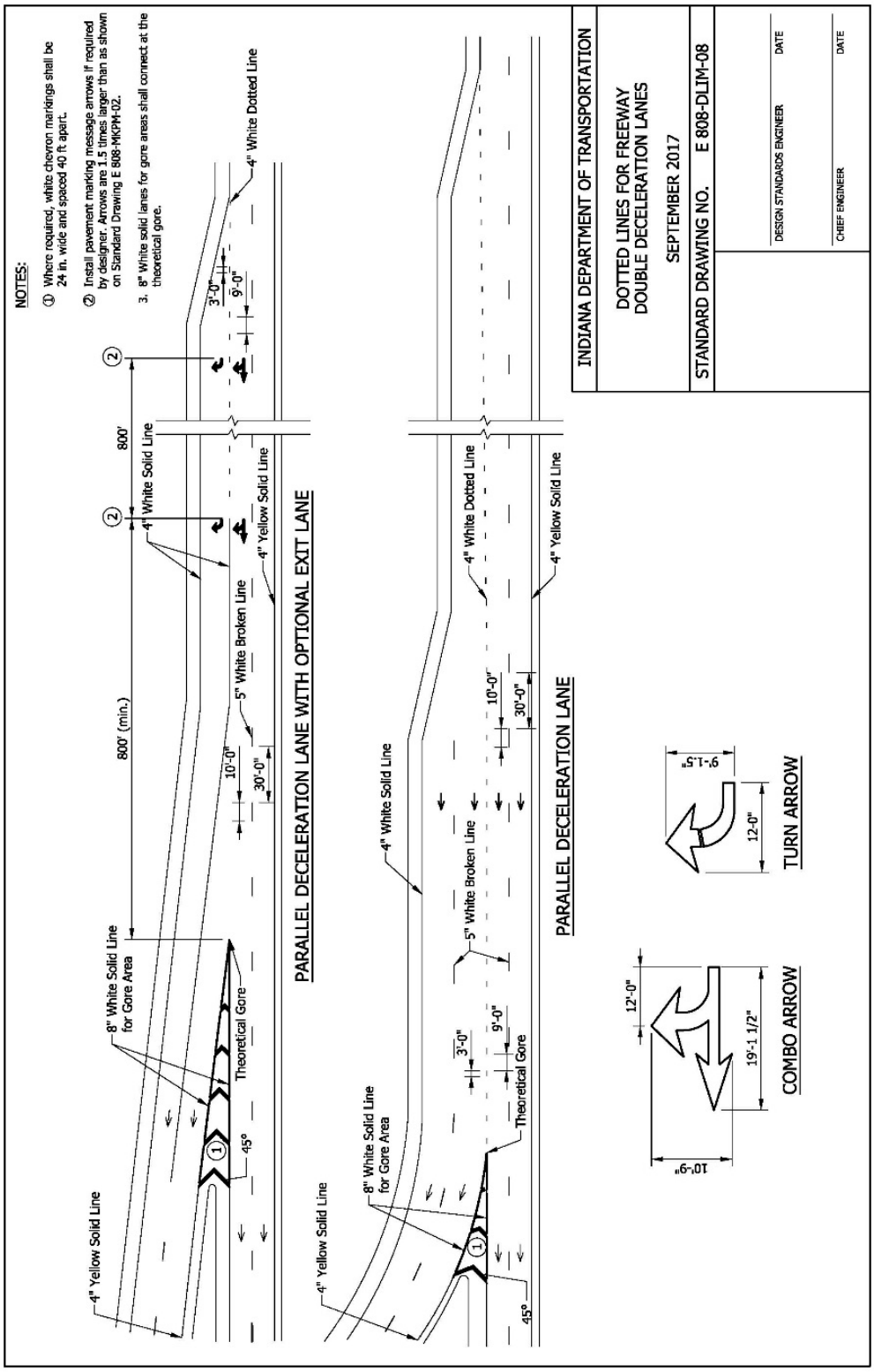
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-07 DOTTED LINES FOR FREEWAY DOUBLE ACCELERATION LANES (DRAFT)



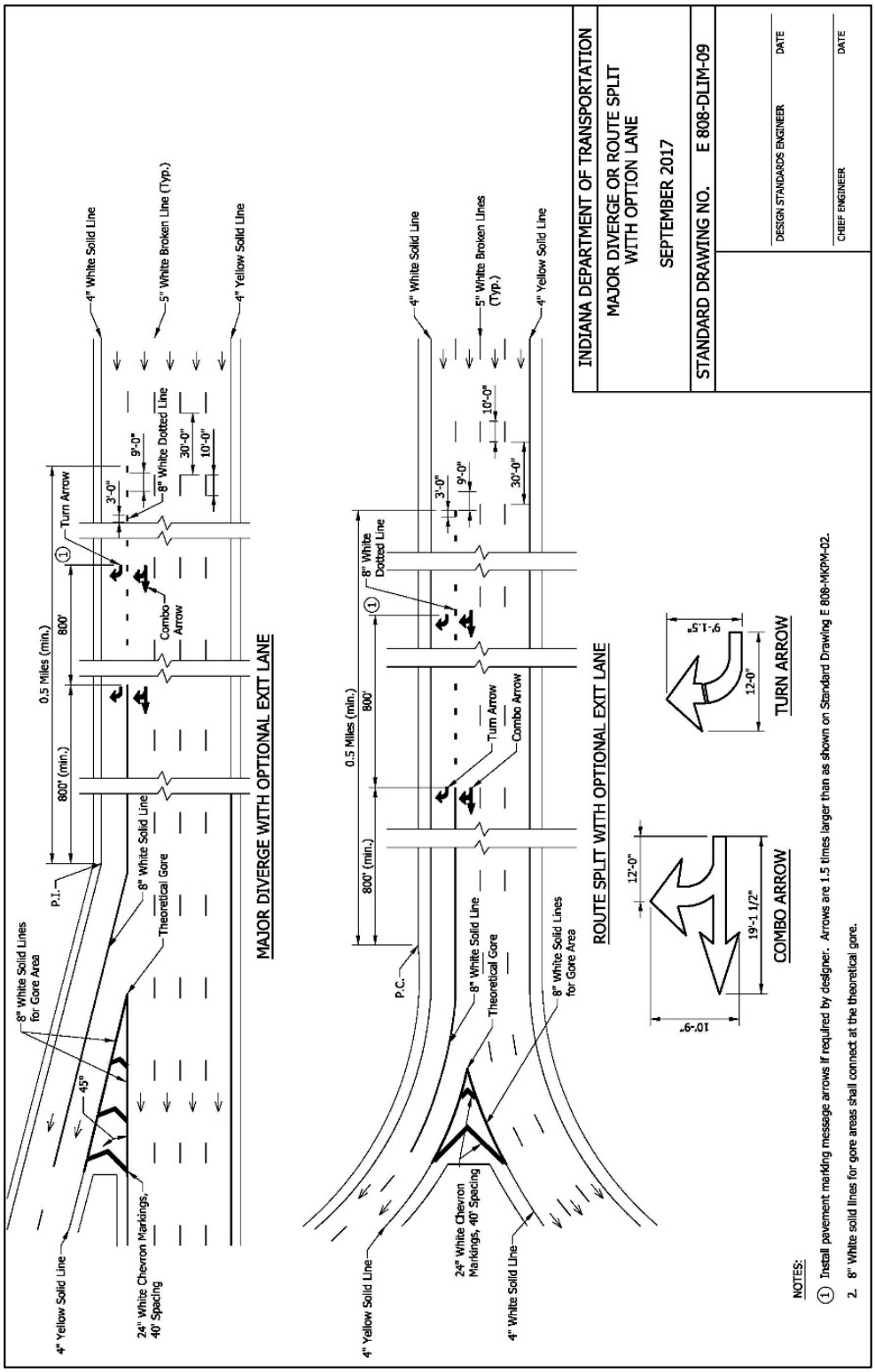
REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-08 DOTTED LINES FOR FREEWAY DOUBLE DECELERATION LANES (DRAFT)



REVISION TO STANDARD DRAWINGS (OLD BUSINESS ITEM)

808-DLIM-09 MAJOR DIVERGE OR ROUTE SPLIT WITH OPTION LANE (DRAFT)



BACKUP 01 (OLD BUSINESS ITEM)

IDM 502-2.02(21) PAVEMENT WORD, SYMBOL, AND ARROW MARKINGS (PROPOSED DRAFT)

(Proposed changes shown highlighted gray)

502-2.02(21) Pavement Word, Symbol, and Arrow Markings

Figure 502-2 O provides information on the layout of pavement word and arrow markings near an at-grade intersection. The use of additional word and symbol markings within each lane requires approval of the district traffic engineer. Conditions that can warrant additional word and arrow markings include sight distance restrictions or obstruction of the primary markings by queued vehicles. The "ONLY" word marking is not used except where a through lane becomes a mandatory turn lane.

Arrow markings should be used at the beginning and end of two-way left-turn lanes as shown in Figure 502-2G. Additional arrow markings at two-way left-turn lanes may be considered where appropriate to emphasize the proper use of the lane.

Arrow markings must be used at an approach to an intersection for a through lane that becomes a mandatory turn lane. Arrow markings should be provided for all lanes on an intersection approach if there is a lane-drop situation or there is a shared left-through lane on the major street.

On freeways, arrow markings should be used at optional exit lanes in combination with ground mounted lane control signs at locations where advance overhead arrow-per-lane guide signs are not present or will not be included in the project. When arrow markings are used on freeways, durable pavement marking materials should be specified.

The *IMUTCD*, the INDOT *Standard Specifications*, and INDOT *Standard Drawings* provide additional guidance relative to the design of word, symbol, and arrow markings.

COMMENTS AND ACTION (OLD BUSINESS ITEM)

801-DLIM (ENTIRE SERIES)

DISCUSSION:

Motion: Second: Ayes: Nays: FHWA Approval:	Action: _____ Passed as Submitted _____ Passed as Revised __ __ Withdrawn
Standard Specifications Sections referenced and/or affected: 808 begin pg 818. Recurring Special Provision affected: NONE Standard Drawing affected: 808-DLIM Design Manual Sections affected: 502-2.02 GIFE Sections cross-references: NONE	_____ 2020 Standard Specifications _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ Create RPD (No. _____) Effective _____ Letting _____ GIFE Update _____ SiteManager Update

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: Full-depth reclamation is a cold recycling process performed in-place and is limited to a maximum recycling depth of 10". The end users of RSP 413-R-634 have requested the two stabilizer types, i.e. asphalt emulsion and cement, be each represented by their own specification.

PROPOSED SOLUTION: Delete RSP 413-R-634 and create two new RSP documents in its place; one for asphalt emulsion stabilization and one for cement stabilization. The two new RSP documents include current industry standards and practices.

APPLICABLE STANDARD SPECIFICATIONS: 413

APPLICABLE STANDARD DRAWINGS: N/A

APPLICABLE DESIGN MANUAL SECTION: N/A

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: N/A

PAY ITEMS AFFECTED: N/A

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Cold Recycling Committee comprised of Michael Prather, Nathan Awwad and Kumar Dave from INDOT, Jason Wielinski and Megan Yount from HRG, Joe Hile from Specialties, Inc, Doug McPherson from Mt. Carmel Stabilization and David Harness from Alt & Witzig.

IMPACT ANALYSIS (attach report): yes

Submitted By: Matthew Beeson

Title: State Materials Engineer

Organization: INDOT

Phone Number: 317-610-7251 x 204

Date: 03/27/17

Mr. Beeson
Date: 04/20/17

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

- Construction costs? Yes
- Construction time? Yes
- Customer satisfaction? Yes
- Congestion/travel time? No
- Ride quality? Yes

Will this proposal reduce operational costs or maintenance effort? Yes

Will this item improve safety:

- For motorists? N/A
- For construction workers? N/A

Will this proposal improve quality for:

- Construction procedures/processes? Yes
- Asset preservation? Yes
- Design process? N/A

Will this change provide the contractor more flexibility? Yes

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders? N/A

Is this proposal needed for compliance with:

- Federal or State regulations? N/A
- AASHTO or other design code? N/A

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda:

REVISION TO SPECIAL PROVISIONS
413-R-634 FULL DEPTH RECLAMATION, FDR (PROPOSED TO DELETE)

413-R-634 FULL DEPTH RECLAMATION, FDR

(Revised 05-19-16)

The Standard Specifications are revised as follows:

SECTION 413, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 413 - BLANK*FULL DEPTH RECLAMATION, FDR*

413.01 Description

This work shall consist of pulverizing and stabilizing an existing asphalt pavement and underlying material to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.

413.02 Quality Control

A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the pulverization operation. The QCP shall include the proposed RBC mix design; a start to finish process description to include discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the stabilized RBC and the stabilization process applied to the RBC or subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

QC TESTING	
Test	*Frequency**
Depth of Pulverization	*1 per 500 ft*
Pulverized Material Gradation	*1 per 0.5 day of production*
Asphalt Emulsion Content or Cement Application Rate	*1 per 500 ft*
Optimum Moisture and Maximum Dry Density	*1 per 0.5 day of production*
Compacted In-Place Field Density	*1 per 1000 ft*

* *The Contractor shall perform all QC tests within the first 500 ft after startup or after any change in the mix design.*

MATERIALS

413.03 Materials

RBC shall consist of a homogenous blend of asphalt pavement in addition to base and subgrade materials that are combined with asphalt or cement materials, water, additives and corrective aggregate, when required. The actual materials used are dependent on the mix design and project requirements.

Materials for use in RBC shall be in accordance with the following:

REVISION TO SPECIAL PROVISIONS

413-R-634 FULL DEPTH RECLAMATION, FDR (PROPOSED TO DELETE)

*Asphalt Emulsion .....As Defined**
Aggregate to correct the RBC gradation:
1. *Coarse or Dense Graded Aggregate, Class C or Higher 904.03*
2. *Fine Aggregate.....904.02*
3. *Reclaimed asphalt pavement, RAP, shall be the product resulting from the cold milling or crushing of an existing HMA pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.*

Fly Ash, Class C.....901.02
Lime.....913.04(b)
Portland Cement, Type I .....901.01(b)
Water 913.01

** The requirements for asphalt emulsion shall be in accordance with the following:*

CHARACTERISTIC	TEST METHOD	MIN.	MAX.
Viscosity, Saybolt Furol @ 77°F (25°C), s	AASHTO T 59	20	100
Sieve Test, No. 20, retained on sieve, %	AASHTO T 59		0.10
Storage Stability Test, 24 h, %	AASHTO T 59		1.0
Distillation Test[1], Residue by Distillation, %	AASHTO T 59	64.0	
Oil Distillate by volume, %	AASHTO T 59		1.0
Penetration, 77 °F, 100 g, 5 s, dmm	AASHTO T 49	50	200
Note 1: Modified AASHTO T 59 – distillation temperature of 347 ± 9°F with a 20 minute hold.			

413.04 Mix Design

The mix design and all associated testing shall be performed, using samples of the existing pavement and underlying material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates and concrete or HMA and asphalt, depending on the stabilizing additive used. Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor is responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs of either type for approval at least 15 calendar days prior to beginning the pulverization operation. The maximum dry density and optimum moisture content of the final mix design shall be determined in accordance with AASHTO T 180. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

Asphalt stabilized RBC mix designs[1, 2, 3] shall be comprised of asphalt emulsion and have a design gradation of 100% passing the 2 in. (50 mm) sieve, ≥ 35% passing the No.4 (4.75 mm) sieve and 2% to 20% passing the No.200 (75 µm) sieve.

The design strength shall be as follows:

Test	*Procedure*	*Requirement*
Indirect Tensile Strength[4, 5]	*ASTM D 4867*	*45 psi, min., dry* *30 psi, min., wet*

Notes:
1. *Allowable ratio of asphalt stabilizer to total cementitious shall be 3:1 min.*
2. *Allowable total cementitious shall be 1.0% max.*
3. *30 gyration, 6 in. diameter specimens prepared in accordance with AASHTO T 312.*
4. *Indirect tensile strengths shall be determined on fully cured specimens.*
5. *Dry specimens tested at 25°C; wet specimens tested at 25°C at minimum 55% saturation after 24 h soak.*

Cement stabilized RBC mix designs shall have a design gradation of 100% passing the 2 in. (50 mm) sieve, ≥ 55% passing the No.4 (4.75 mm) sieve and 5% to 20% passing the No.200 (75 µm) sieve. The 7-day unconfined strength shall be based on the overlay lay rate specified on the plans:

Test	*Procedure*	*Requirement*
7-Day Unconfined Strength	*ASTM D 1633, Method A*	*see notes 1, 2, 3*

Notes:
1. *300 psi minimum when a HMA overlay with a total lay rate ≥ 330 lb/sq yd is specified on the plans.*
2. *400 psi minimum when a HMA overlay with a total 165 lb/sq yd ≤ lay rate < 330 lb/sq yd is specified on the plans.*
3. *500 psi minimum when a HMA overlay with a total lay rate < 165 lb/sq yd or an applied seal coat surface is specified on the plans.*

CONSTRUCTION REQUIREMENTS

413.05 Construction Requirements

Snowplowable raised pavement markers shall be removed in accordance with 808.11(e) and all areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to pulverization operations.

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

Adjustments may be made to the stabilizer, water, additives and corrective aggregate, when required, to produce a RBC with optimal performance that meets specification requirements.

The stabilizer used in cement stabilized RBC and the additives used in either asphalt or cement stabilized RBC may be dry powder or slurry with a minimum dry solids content of 30%. The Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used.

413.06 Equipment

REVISION TO SPECIAL PROVISIONS

413-R-634 FULL DEPTH RECLAMATION, FDR (PROPOSED TO DELETE)

The equipment shall be capable of pulverizing the existing asphalt and underlying materials. The equipment used for mixing the pulverized materials with stabilizer, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement to the lines, grades and guidelines provided herein and as shown on the plans.

The equipment shall consist of the following major components:

(a) Spreaders and Distributors

Spreaders or distributors used to apply dry powder additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction. Corrective aggregate, when required, may be placed by a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader.

(b) Additive Slurry Storage and Supply Equipment

Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.

(c) Mixing and Reclaiming Equipment

Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to a depth of 14 in. shall be used. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA and be so designed that they may be accurately adjusted vertically and held in-place. The machine shall not weigh less than 25,000 lbs and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.

The mixer or reclaimer shall be fitted with an integrated water and stabilizer injection system capable of introducing material into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water or stabilizer shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.

(d) Motor Grader

A motor grader for pre-shaping, aerating, spreading and final shaping of the material shall be provided. The motor grader shall have a cross slope indicator.

(e) Rollers

The RBC shall be compacted using self-propelled rollers, complete with properly operating scrapers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.

(f) Water Trucks

Water truck for supplying water to the reclaimer or roadway for addition of moisture and for curing during the reclaiming operation shall be provided. The water truck shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.

413.07 Weather Restrictions

The work shall not be performed when the soil, aggregate or subgrade is frozen, when the ambient temperature is below 45°F or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The Engineer may restrict work when the weather is foggy or rainy.

413.08 Pulverization

The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader. The pre-determined full depth of HMA, base and subgrade materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture shall be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system. The base course shall not contain roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the asphalt or cement stabilizer.

For asphalt stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in.(50 mm) sieve and ≥ 35% passing the No.4 (4.75 mm) sieve.

For cement stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and ≥ 55% passing the No.4 (4.75 mm) sieve.

When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters

or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. Additionally, no fabric piece shall have a dimension exceeding a length of 4 in.

Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.

Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the RBC.

413.09 Stabilization

The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.

Asphalt stabilizing materials shall have an application tolerance determined by adding ± 0.25% to the percent total asphalt emulsion content.

Cement stabilizing materials shall have an application tolerance determined by adding ± 0.5% to the percent total cement content.

The Contractor can request the stabilizing percentage to exceed the upper tolerance provided the mix design evaluated the RBC properties at or above the requested percentage. The request will be subject to approval by the Engineer.

The stabilized material shall be spread and leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of ± 1/2 in. from the plan RBC elevation by using a motor grader or other mechanical means prior to profile milling.

The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.

413.10 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

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(a) demonstrate the equipment, materials and processes proposed to produce a RBC layer in accordance with specification requirements;

(b) determine the optimal rates for the stabilizer, water and any additives recommended for the reclaimed material;

(c) determine the sequence and manner of rolling necessary to obtain strength in one uniformly compacted layer.

The optimum moisture content and maximum dry density of the RBC shall be determined in accordance with AASHTO T 180. The moisture content, at the start of compaction, shall be within - 1% to + 2% of the design optimum.

A control strip will be accepted when a five consecutive test average of 95% of the design maximum dry density with no single test below 94% of the design maximum dry density is demonstrated. A control strip that does not meet the density requirements shall be reworked at no additional cost.

The RBC density shall be achieved with the same equipment, materials and construction methods used on the accepted control strip and monitored in accordance with AASHTO T 310 in the direct transmission mode for the remainder of compaction operations.

All tests shall be conducted at the stated QC testing frequencies. A new control strip shall be constructed if changes are made to the original mix design, equipment or construction methods.

413.11 Curing

The stabilized RBC shall be cured for a sufficient time period to allow proofrolling.

Asphalt stabilized RBC shall be cured for a time period that achieves in-place moisture contents below 2.5% or the in-place moisture contents have stabilized at 50% or less of the design optimum moisture content for a continuous time period of five days.

Cement stabilized RBC shall be cured for a time period that achieves the minimum required seven day unconfined strength.

The planned method and duration of curing for asphalt or cement stabilized RBC shall be detailed in the QCP.

413.12 Asphalt Milling

The stabilized RBC shall be asphalt milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

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413-R-634 FULL DEPTH RECLAMATION, FDR (PROPOSED TO DELETE)

413.13 Proofrolling

The stabilized RBC shall be proofrolled in accordance with 203.26, after asphalt milling operations have been completed, using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.

The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade in accordance with 207. The process for achieving subgrade stabilization and replacing the RBC material shall be detailed in the QCP. The reworked areas shall be proofrolled for final acceptance.

In locations of failing subgrade the RBC shall be removed and subgrade treatment shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.

413.14 Underdrain Installation

Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.

413.15 RBC Overlay

The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.

The RBC shall be swept with a rotary power broom in accordance with 409 immediately prior to placing the overlay. The RBC shall be swept lightly to avoid damage to the RBC.

A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.

Monuments shall be reestablished in accordance with 615.10.

413.16 Opening to Traffic

The FDR treated pavement shall be opened to traffic, in addition to local traffic and construction equipment, only after the overlay atop the RBC has been constructed.

413.17 Method of Measurement

The RBC will be measured by the square yard complete in place. Additional stabilizing material, when required, will be measured by the ton in accordance with 109.05(b) for the type specified. Subgrade treatment will be measured in accordance with 207.05. Aggregate, when used to correct the RBC gradation, will be measured by the ton of material used. Asphalt milling will be measured in accordance with 306.09. HMA patching, type B will be measured in accordance with 304.06. Re-established monuments will be measured by the number of units installed in accordance with 615.13. Removal of

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snowplowable raised pavement markers will be measured in accordance with 808.12.

413.18 Basis of Payment

The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. The accepted quantities of additional stabilizing material will be paid for at the contract unit price per ton for the type specified, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Aggregate used to correct the RBC gradation will be paid for at the contract unit price per ton, complete in place. Asphalt milling will be paid for in accordance with 306.10. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Corrective Aggregate	*TON*
Full Depth Reclamation	*SYS*
Stabilizing Material, Asphalt Emulsion	*TON*
Stabilizing Material, Portland Cement	*TON*

The costs of the RBC mix design and QC testing shall be included in the cost of the full depth reclamation.

The costs of removing grass and vegetation, pulverizing, stabilizing, compacting and curing the RBC shall be included in the cost of the full depth reclamation.

The costs of the asphalt emulsion or portland cement stabilizing material shall be included in the cost of the stabilizing material pay item.

The costs of removing existing material to maintain profile shall be included in the cost of the asphalt milling.

In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.

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XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR

(Adopted xx-xx-17)

The Standard Specifications are revised as follows:

SECTION XXX, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION XXX – CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR

XXX.01 Description

This work shall consist of pulverizing and stabilizing an existing asphalt pavement along with existing base and subgrade materials to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.

XXX.02 Just in Time Training, JITT

The Engineer and Contractor are required to attend a JITT course regarding FDR and both must mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project field location convenient for all project construction personnel responsible for FDR operations and inspection to attend.

The JITT course shall be held during normal working hours and be completed not more than 14 days prior to the start of FDR operations.

The contractor shall provide a JITT instructor experienced in the construction methods, materials and test methods associated with cement stabilized FDR. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least 5 business days before the course is to be taught.

XXX.03 Quality Control

A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the pulverization operation. The QCP shall include the proposed FDR mix design; a start to finish process description to include discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the cement stabilized RBC and the stabilization process applied to the RBC or subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

QC TESTING	
Test	*Frequency[1,2]*
Depth of Pulverization	*1 per 500 ft*
Pulverized Material Gradation	*1 per 0.5 day of production*

In-place Moisture of Pulverized Material	*1 per 0.5 day of production*
Cement Application Rate	*1 per 500 ft*
Maximum Density and Moisture Content of Stabilized Material	*1 per 0.5 day of production*
Compacted In-Place Field Density	*1 per 1000 ft*

Notes:
1. *The Contractor shall perform all QC tests within the first 500 ft after startup or after any change in the mix design.*
2. *Testing frequency is based upon linear feet of FDR laydown.*

MATERIALS

XXX.04 Materials

RBC shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, base and subgrade materials that are combined with cement, water, and when required, recycling additives such as corrective aggregate. The cement may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the FDR mix design and project requirements.

Materials for use in RBC shall be in accordance with the following:

Corrective aggregate to adjust gradation or supplement material volume:
1. *Coarse or Dense Graded Aggregate, Class C or Higher 904.03*
2. *Fine Aggregate.....904.02*
3. *RAP, shall be the product resulting from the cold milling or crushing of an existing asphalt pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.*

Portland Cement, Type I .....901.01(b)
Water 913.01

XXX.05 Mix Design

The FDR mix design shall be in accordance with ITM 595 and comprised of existing RAP, existing base and subgrade materials, cement and if necessary, recycling additives. The 7-day unconfined strength shall be based on the overlay lay rate specified on the plans:

Test	*Procedure*	*Requirement*
7-Day Unconfined Strength	*ASTM D 1633, Method A*	*see notes 1, 2, 3*

Notes:
1. *300 psi minimum when a HMA overlay with a total lay rate ≥ 330 lb/sq yd is specified on the plans.*
2. *400 psi minimum when a HMA overlay with a total 165 lb/sq yd ≤ lay rate < 330 lb/sq yd is specified on the plans.*
3. *500 psi minimum when a HMA overlay with a total lay rate < 165 lb/sq yd or an applied seal coat surface is specified on the plans.*

The mix design and all associated testing shall be performed using samples of the existing pavement, base and subgrade material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates, and concrete.

The sulfate content for the subgrade material shall be less than or equal to 1000 ppm as determined in accordance with ITM 510.

Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor is responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs for approval at least 15 calendar days prior to beginning the pulverization operation. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

CONSTRUCTION REQUIREMENTS

XXX.06 Roadway Preparation

Snowplowable raised pavement markers shall be removed prior to FDR operations in accordance with 808.11(e).

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to FDR operations, properly covered and filled with material compatible with the FDR mix design to maintain traffic.

All areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to pulverization operations.

XXX.07 Equipment

The equipment shall be capable of pulverizing the existing asphalt pavement, base and subgrade materials. The equipment used for mixing the pulverized materials with cement, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement in accordance to 105.03.

The equipment shall consist of the following major components:

(a) Spreaders and Distributors

Spreaders or distributors used to apply dry powder additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction. Corrective aggregate, when required, may be placed by a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader.

(b) Additive Slurry Storage and Supply Equipment

Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.

(c) Mixing and Reclaiming Equipment

Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to the depth specified. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA and be so designed that they may be accurately adjusted vertically and held in-place. The machine shall not weigh less than 25,000 lbs and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.

The mixer or reclaimer shall be fitted with an integrated water injection system capable of introducing the water into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.

(d) Motor Grader

A motor grader for pre-shaping, aerating, spreading and final shaping of the material shall be provided. The motor grader shall have a cross slope indicator.

(e) Compaction Equipment

The RBC shall be compacted using self-propelled rollers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.

(f) Water Trucks

Water truck for supplying water to the reclaimer or roadway for addition of moisture during the reclaiming operation shall be provided. The water truck shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.

XXX.*08 Weather Restrictions*

The work shall not be performed when the soil, aggregate or subgrade is frozen, when the ambient temperature is below 40°F or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The Engineer may restrict work when the weather is foggy or rainy. FDR shall not be performed before May 1st or after October 1st.

XXX.*09 Pulverization*

The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader. The pre-determined full depth of asphalt pavement, base and subgrade materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture shall be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system. The base course shall not contain roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the cement stabilizer.

For cement stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and ≥ 55% passing the No.4 (4.75 mm) sieve.

When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. Additionally, no fabric piece shall have a dimension exceeding a length of 4 in.

Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.

Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the RBC.

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XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

XXX.10 Stabilization

The cement used to stabilize the RBC may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used. The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.

The in-place moisture content of the pulverized material prior to cement addition shall be within -1% to +2% of the design moisture content as determined by the mix design.

Cement stabilizing materials shall have an application tolerance determined by adding ± 0.5% to the percent total cement content.

The cement shall be incorporated into the pulverized material at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of cement at various portions of the project.

The Contractor can request the cement percentage to exceed the upper tolerance provided the mix design requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

XXX.11 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

(a) demonstrate the equipment, materials and processes proposed to produce a RBC layer in accordance with specification requirements;

(b) determine the optimal rates for the cement, water and any additives recommended for the reclaimed material;

(c) determine the sequence and manner of rolling necessary to obtain strength requirements in one uniformly compacted layer.

The RBC density shall be achieved with the same equipment, materials, construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside the tolerances of the original mix design, equipment or construction methods.

The processed material shall be uniformly compacted in one layer to a minimum of 95% of the maximum density. Maximum density shall be determined in accordance with

AASHTO T 180 at the required QC frequency from a representative sample collected after the cement has been added and mixed into the pulverized material but prior to compaction.

Compaction shall be monitored in accordance with AASHTO T 310 in the direct transmission mode and continue to reach a minimum of 95% of the established maximum density during the control strip and for the remainder of the compaction operation.

Compaction equipment shall be in accordance with XXX.07(e). Initial compaction shall be within 500 feet of the reclaiming unit using either a vibratory pad-foot roller, a pneumatic tire roller or a combination of the two. The pass counts shall continue to increase until the cleat indentations from the pad-foot roller are no more than 3/16 in. in depth and light can be seen between the pad-foot and RBC interface or there are no wheel impressions from the pneumatic tire roller remaining in the RBC.

The cement stabilized material shall be bladed and shaped by a motor grader in accordance with XXX.07(d) to remove any remaining roller marks or indentations then leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of ± 1/2 in. from the plan RBC elevation prior to profile milling.

Intermediate and final compaction shall be applied to the bladed and shaped RBC using either a pneumatic tire roller, a single or double drum vibratory steel roller or a combination of the two. Finish rolling shall not be performed in vibratory mode. The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.

Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

The technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken not to over compact the mat.

All tests shall be conducted at the stated QC testing frequencies throughout FDR operations.

XXX.12 Opening to Traffic

Opening to traffic shall be at the discretion of the Contractor after sufficient cure time has been applied to the RBC so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with 409.

After opening to traffic, the surface of the RBC shall be maintained in a condition suitable for the safe movement of traffic.

XXX.13 Maintenance

The Contractor shall maintain the RBC in a manner satisfactory to the Engineer until the surface course has been constructed.

Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new HMA or final surface sealing. Patching shall be in accordance with 304. The excavated patch areas shall be filled and compacted with HMA or RBC material as directed by the Engineer. No direct payment will be made for damage or repair unless approved by the Engineer.

XXX.*14 Curing*

Before placing the final surfacing, the cement stabilized RBC shall remain in-place for a minimum of three days and meet one of the following conditions:

(a) there is less than 3.0 % moisture remaining in the mixture, or

(b) the in-place moisture contents have remained constant at 50% or less of the design optimum moisture content for a continuous time period of five days.

The planned method and duration of curing for cement stabilized RBC shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the pavement final cure, but no later than November 1.

XXX.15 Milling

The cement stabilized RBC shall be milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

XXX.16 Proofrolling

The cement stabilized RBC shall be proofrolled in accordance with 203.26 using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.

The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade in accordance with 207.

The process for achieving subgrade stabilization and replacing the RBC material shall be detailed in the QCP. The reworked areas shall be proofrolled for final acceptance.

In locations of failing subgrade the RBC shall be removed and subgrade treatment shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.

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XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

XXX.17 Underdrain Installation

Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.

XXX.18 RBC Overlay

The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.

The RBC shall be swept of all loose material and standing water with a rotary power broom in accordance with 409 immediately prior to placing the surface. The RBC shall be swept lightly to avoid damage to the RBC.

A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.

Monuments shall be reestablished in accordance with 615.10.

XXX.19 Method of Measurement

The RBC will be measured by the square yard complete in place. Cement will be measured by the ton in accordance with 109.05(b). Subgrade treatment will be measured in accordance with 207.05. Aggregate to adjust the RBC gradation will be measured by the ton of material used. HMA patching, type B will be measured in accordance with 304.06. Milling will be measured in accordance with 306.09. Re-established monuments will be measured by the number of units installed in accordance with 615.13. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.

XXX.20 Basis of Payment

The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. Cement will be paid for at the contract unit price per ton, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Aggregate used to adjust the RBC gradation will be paid for at the contract unit price per ton, complete in place. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Milling will be paid for in accordance with 306.10. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Corrective Aggregate	*TON*
Full Depth Reclamation, FDR	*SYS*
Stabilizing Material, Portland Cement	*TON*

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XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

Milling, Profile..... SYS

The costs of the FDR mix design and QC testing shall be included in the cost of the full depth reclamation.

The costs associated with removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be included in the cost of the full depth reclamation.

The costs associated with pulverizing, stabilizing, compacting curing and maintenance of the RBC shall be included in the cost of the full depth reclamation.

The cost associated with mixing water shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to supplement material volume shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to adjust the RBC gradation shall be included in the cost of the corrective aggregate pay item.

The cost of the cement stabilizing material shall be included in the cost of the stabilizing material pay item.

The cost of milling the cement stabilized RBC to maintain profile shall be included in the cost of the milling.

In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.

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XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR
(PROPOSED NEW)

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR

(Adopted xx-xx-17)

The Standard Specifications are revised as follows:

SECTION XXX, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION XXX – ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR

XXX.01 Description

This work shall consist of pulverizing and stabilizing an existing asphalt pavement and base material, excluding subgrade, to construct a reclaimed base course, RBC, to the approved design properties in accordance with 105.03.

XXX.02 Just in Time Training, JITT

The Engineer and Contractor are required to attend a JITT course regarding FDR and both must mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project field location convenient for all project construction personnel responsible for FDR operations and inspection to attend.

The JITT course shall be held during normal working hours and be completed not more than 14 days prior to the start of FDR operations.

The contractor shall provide a JITT instructor experienced in the construction methods, materials and test methods associated with asphalt emulsion stabilized FDR. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least 5 business days before the course is to be taught.

XXX.03 Quality Control

A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the pulverization operation. The QCP shall include the proposed FDR mix design; a start to finish process description to include discussion on corrective action measures; a list of proposed equipment; a list of proposed QC tests and testing frequencies; the curing methods applied to the asphalt emulsion stabilized RBC and the stabilization process applied to the RBC or subgrade after a failed proofroll. All QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

QC TESTING	
Test	*Frequency[1,2]*
Depth of Pulverization	*1 per 500 ft*
Pulverized Material Gradation	*1 per 0.5 day of production*
In-place Moisture of Pulverized Material	*1 per 0.5 day of production*

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

Asphalt Emulsion Content	*1 per 500 ft*
Maximum Density and Moisture Content of Injected Material	*1 per 0.5 day of production*
Compacted In-Place Field Density	*1 per 1000 ft*

Notes:
1. *The Contractor shall perform all QC tests within the first 500 ft after startup or after any change in the mix design.*
2. *Testing frequency is based upon linear feet of FDR laydown.*

MATERIALS

XXX.04 Materials

RBC shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, and base materials that are combined with asphalt emulsion, water, and when required, recycling additives such as corrective aggregate or cement. Cement recycling additives used in asphalt emulsion stabilized RBC may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the FDR mix design and project requirements.

Materials for use in RBC shall be in accordance with the following:

*Asphalt Emulsion .....As Defined**
Corrective aggregate to adjust gradation or supplement material volume:
1. *Coarse or Dense Graded Aggregate, Class C or Higher 904.03*
2. *Fine Aggregate.....904.02*
3. *RAP, shall be the product resulting from the cold milling or crushing of an existing asphalt pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.*

Portland Cement, Type I .....901.01(b)
Water 913.01

** The requirements for asphalt emulsion shall be in accordance with the following:*

FDR Asphalt Emulsion[1,3]			
Test	*Procedure*	*Minimum*	*Maximum*
Viscosity, Saybolt Furol @ 77°F (25°C), s	*AASHTO T 59*	*20*	*100*
Sieve Test, No. 20, retained on sieve, %	*AASHTO T 59*		*0.10*
Storage Stability Test, 24 h, %	*AASHTO T 59*		*1.0*
Distillation Test[2], Residue by Distillation, %	*AASHTO T 59*	*64.0*	
Oil Distillate by volume, %	*AASHTO T 59*		*1.0*
Penetration, 77 °F, 100 g, 5 s, dmm	*AASHTO T 49*	*50*	*200*

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR
(PROPOSED NEW)

Notes:

1. *The asphalt emulsion shall be selected for the project by the asphalt emulsion supplier based on the Contractor's mixture design. The penetration of the supplied asphalt emulsion shall be within ± 25 dmm of the penetration of the design emulsified asphalt. The asphalt emulsion shall be received on the job site at a temperature no greater than 120ºF.*
2. *Modified AASHTO T 59 - distillation temperature of 350 ± 9°F (177 ± 5˚C) with a 20 minute hold.*
3. *Type A certification will be required to be furnished by the asphalt emulsion supplier.*

XXX.05 Mix Design

The FDR mix design shall be in accordance with ITM 594 and comprised of existing RAP, existing base material, asphalt emulsion and if necessary, recycling additives. The mix design and all associated testing shall be performed using samples of the existing pavement and base material from the project site representing the reclaiming depth, by a design laboratory that is AASHTO Material Reference Laboratory, AMRL, accredited for soil, aggregates, HMA and asphalt.

Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor is responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned RBC shall be the minimum sampling frequency for mix design preparation.

The Contractor shall provide a mix design or designs for approval at least 15 calendar days prior to beginning the pulverization operation. The mix design shall include all test results performed. If new materials are added, a new mix design, including the revised test results, shall be submitted at least one day prior to implementation.

CONSTRUCTION REQUIREMENTS

XXX.06 Roadway Preparation

Snowplowable raised pavement markers shall be removed prior to FDR operations in accordance with 808.11(e).

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the RBC during milling operation.

Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to FDR operations, properly covered and filled with material compatible with the FDR mix design to maintain traffic.

All areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to pulverization operations.

XXX.07 Equipment

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR
(PROPOSED NEW)

The equipment shall be capable of pulverizing the existing asphalt pavement and base materials. The equipment used for mixing the pulverized materials with asphalt emulsion, water, additives and corrective aggregate, when required, shall be capable of producing a homogenous and uniformly blended RBC. The equipment used for placement of the RBC shall be capable of placement in accordance to 105.03.

The equipment shall consist of the following major components:

(a) Spreaders and Distributors

Spreaders or distributors used to apply dry powder additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction. Corrective aggregate, when required, may be placed by a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader.

(b) Additive Slurry Storage and Supply Equipment

Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.

(c) Mixing and Reclaiming Equipment

Only self-propelled, high powered, minimum 500 hp rotary mixers or reclaimers capable of mixing in-place to the depth specified. The minimum cutting drum width shall be 7 ft and fitted with cutting teeth capable of trimming earth, aggregate and HMA and be so designed that they may be accurately adjusted vertically and held in-place. The machine shall not weigh less than 25,000 lbs and shall have the strength and rigidity so that it shall not develop a center deflection of more than 1/8 in.

The mixer or reclaimer shall be fitted with an integrated water and asphalt emulsion injection system capable of introducing both materials into the cutting drum during the mixing process. The metering device shall be capable of automatically adjusting the flow of material to compensate for any variation in the amount of reclaimed material introduced into the mixing chamber. The water or asphalt emulsion shall be calculated on a volumetric basis tied to a speed gauge, ft/min, using a calibrated meter that is capable of accurately measuring the amount of material to within 0.5% of the rate required. Automatic digital readings shall be displayed for both the flow rate and total amount of reclaimed material in appropriate units of weight and time.

(d) Motor Grader

A motor grader for pre-shaping, aerating, spreading and final shaping of the material shall be provided. The motor grader shall have a cross slope indicator.

(e) Compaction Equipment

The RBC shall be compacted using self-propelled rollers. The number, weight and types of rollers shall be as necessary to obtain the required compaction throughout the entire RBC thickness. The rollers may be used in any combination and may include a pneumatic tire roller, an 84 in. wide drum vibratory pad-foot roller equipped with a knockdown blade or a 10 t minimum single or double drum vibratory steel roller.

(f) Water Trucks

Water truck for supplying water to the reclaimer or roadway for addition of moisture during the reclaiming operation shall be provided. The water truck shall be capable of providing a controlled and consistent spray without eroding or otherwise damaging the compacted RBC.

XXX.08 Weather Restrictions

The work shall not be performed when the soil, aggregate or subgrade is frozen, when the ambient temperature is below 50°F or when freezing temperatures are anticipated within seven days of the end of RBC placement. The Engineer may restrict work when the heat index is greater than 100°F. The Engineer may restrict work when the weather is foggy or rainy. FDR shall not be performed before May 1st or after October 1st.

XXX.09 Pulverization

The existing pavement shall be pulverized and stabilized in separate operations. Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader, a conventional paver or by tailgating with end dump trucks and spread to a uniform thickness with a motor grader. The pre-determined full depth of asphalt pavement and base materials shall be pulverized, along with the corrective aggregate, to a homogenous mixture. The mixture shall be brought to the desired moisture content during this process by means of surface application or through the mixing or reclaiming equipment's integrated fluid injection system. The base course shall not contain subgrade, roots, sod, topsoil, weeds, wood or any material deleterious to its reaction with the asphalt emulsion.

For asphalt emulsion stabilized RBC, the pulverization shall produce a gradation that has 100% passing the 2 in. (50 mm) sieve and ≥ 35% passing the No.4 (4.75 mm) sieve.

When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the RBC does not affect the performance parameters or inhibit placement or compaction of the RBC. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the

necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. Additionally, no fabric piece shall have a dimension exceeding a length of 4 in.

Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the pulverization process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.

Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the RBC.

XXX.10 Injection

An additive used in asphalt emulsion stabilized RBC may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used. The pulverized surface shall be scarified or knifed prior to applying materials in slurry form to prevent runoff or ponding. Any dry additives used shall be spread onto the pulverized surface using a mechanical spreader. The pulverized material shall be mixed with the stabilizer and additives as required by the mix design to create a homogeneous RBC.

The in-place moisture content of the pulverized material prior to asphalt emulsion injection shall be within -1% to +2% of the design moisture content as determined by the mix design.

Asphalt stabilizing materials shall have an application tolerance determined by adding ± 0.25% to the percent total asphalt emulsion content.

The asphalt emulsion shall be incorporated into the pulverized material at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of asphalt emulsion at various portions of the project.

The Contractor can request the asphalt emulsion percentage to exceed the upper tolerance provided the mix design requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

XXX.11 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

(a) demonstrate the equipment, materials and processes proposed to produce a RBC layer in accordance with specification requirements;

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

(b) determine the optimal rates for the asphalt emulsion, water and any additives recommended for the reclaimed material;

(c) determine the sequence and manner of rolling necessary to obtain specified density requirements in one uniformly compacted layer.

The RBC density shall be achieved with the same equipment, materials, construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside the tolerances of the original mix design, equipment or construction methods.

The processed material shall be uniformly compacted in one layer to a minimum of 95% of the maximum density. Maximum density shall be determined in accordance with AASHTO T 180 at the required QC frequency from a representative sample collected after injection but prior to compaction.

Compaction shall be monitored in accordance with AASHTO T 310 in the direct transmission mode and continue to reach a minimum of 95% of the established maximum density during the control strip and for the remainder of the compaction operation.

Compaction equipment shall be in accordance with XXX.07(e). Initial compaction shall be within 500 feet of the reclaiming unit using either a vibratory pad-foot roller, a pneumatic tire roller or a combination of the two. The pass counts shall continue to increase until the cleat indentations from the pad-foot roller are no more than 3/16 in. in depth and light can be seen between the pad-foot and RBC interface or there are no wheel impressions from the pneumatic tire roller remaining in the RBC.

The asphalt emulsion stabilized material shall be bladed and shaped by a motor grader in accordance with XXX.07(d) to remove any remaining roller marks or indentations then leveled in accordance with 301.07. The profile grade and cross section of the RBC shall be finished within a tolerance of ± 1/2 in. from the plan RBC elevation prior to profile milling.

Intermediate and final compaction shall be applied to the bladed and shaped RBC using either a pneumatic tire roller, a single or double drum vibratory steel roller or a combination of the two. Finish rolling shall not be performed in vibratory mode. The compaction operation shall be performed while the RBC remains in a workable condition and continued until roller marks no longer appear.

Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

The technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken not to over compact the mat.

All tests shall be conducted at the stated QC testing frequencies throughout FDR operations.

XXX.12 Opening to Traffic

Opening to traffic shall be at the discretion of the Contractor after sufficient cure time has been applied to the RBC so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with 409.

After opening to traffic, the surface of the RBC shall be maintained in a condition suitable for the safe movement of traffic.

XXX.13 Maintenance

The Contractor shall maintain the RBC in a manner satisfactory to the Engineer until the surface course has been constructed.

Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new asphalt concrete or final surface sealing. Patching shall be in accordance with 304. The excavated patch areas shall be filled and compacted with HMA or RBC material as directed by the Engineer. No direct payment will be made for damage or repair unless approved by the Engineer.

XXX.14 Curing

Before placing the final surfacing, the asphalt emulsion stabilized RBC shall remain in-place for a minimum of 3 days and meet one of the following conditions:

(a) there is less than 3.0 % moisture remaining in the mixture, or

(b) the in-place moisture contents have remained constant at 50% or less of the design optimum moisture content for a continuous time period of five days.

The planned method and duration of curing for asphalt emulsion stabilized RBC shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the pavement final cure, but no later than November 1.

XXX.15 Milling

The asphalt emulsion stabilized RBC shall be milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

XXX.16 Proofrolling

The asphalt emulsion stabilized RBC shall be proofrolled in accordance with 203.26 using a tandem or tri-axle dump truck loaded to the legal limit and operated between 2 to 4 mph over the RBC. The Engineer will determine the limits for any area that has deflection or rutting greater than 1/2 in.

The Contractor shall rework the areas failed in proofrolling by re-pulverizing and re-stabilizing the RBC in-place at no additional cost or by removing the RBC and stabilizing the subgrade in accordance with 207.

The process for achieving subgrade stabilization and replacing the RBC material shall be detailed in the QCP. The reworked areas shall be proofrolled for final acceptance.

In locations of failing subgrade the RBC shall be removed and subgrade treatment shall be placed in accordance with 207. HMA patching, type B shall be placed in accordance with 304.

XXX.17 Underdrain Installation

Underdrain installation in accordance with 718, when required, shall begin after having completed the proofrolling.

XXX.18 RBC Overlay

The overlay atop the RBC shall be as shown on the plans. The overlay shall be placed after having completed the proofrolling.

The RBC shall be swept of all loose material and standing water with a rotary power broom in accordance with 409 immediately prior to placing the surface. The RBC shall be swept lightly to avoid damage to the RBC.

A tack coat shall be required only for the HMA overlay and shall be applied to the RBC in accordance with 406 immediately following sweeping operations.

Monuments shall be reestablished in accordance with 615.10.

XXX.19 Method of Measurement

The RBC will be measured by the square yard complete in place. Asphalt emulsion will be measured by the ton in accordance with 109.05(b). Subgrade treatment will be measured in accordance with 207.05. Aggregate to adjust the RBC gradation will be measured by the ton of material used. HMA patching, type B will be measured in accordance with 304.06. Milling will be measured in accordance with 306.09. Re-established monuments will be measured by the number of units installed in accordance with 615.13. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR
(PROPOSED NEW)

XXX.20 Basis of Payment

The RBC will be paid for as full depth reclamation at the contract unit price per square yard, complete in place. Asphalt emulsion will be paid for at the contract unit price per ton, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Aggregate used to adjust the RBC gradation will be paid for at the contract unit price per ton, complete in place. HMA patching, type B will be paid for in accordance with 304.07, of the thickness specified on the plans. Milling will be paid for in accordance with 306.10. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Corrective Aggregate	*TON*
Full Depth Reclamation, FDR	*SYS*
Stabilizing Material, Asphalt Emulsion	*TON*
Milling, Profile	*SYS*

The costs of the RBC mix design and QC testing shall be included in the cost of the full depth reclamation.

The costs associated with removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be included in the cost of the full depth reclamation.

The costs associated with pulverizing, stabilizing, compacting, curing and maintenance of the RBC shall be included in the cost of the full depth reclamation.

The cost associated with mixing water shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to supplement material volume shall be included in the cost of the full depth reclamation.

The cost associated with portland cement when used as an additive shall be included in the cost of the full depth reclamation.

The cost associated with aggregate when used to adjust the RBC gradation shall be included in the cost of the corrective aggregate pay item.

The cost of the asphalt emulsion shall be included in the cost of the stabilizing material pay item.

REVISION TO SPECIAL PROVISIONS

XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR (PROPOSED NEW)

The cost of milling the asphalt emulsion stabilized RBC to maintain profile shall be included in the cost of the milling.

In the locations of failing subgrade, removal of the RBC shall be included in the cost of subgrade treatment.

COMMENTS AND ACTION

413-R-634 FULL DEPTH RECLAMATION, FDR (PROPOSED TO DELETE)
XXX-R-XXX CEMENT STABILIZED FULL DEPTH RECLAMATION, FDR
XXX-R-XXX ASPHALT EMULSION STABILIZED FULL DEPTH RECLAMATION, FDR

DISCUSSION:

Motion: Second: Ayes: Nays: FHWA Approval:	Action: _____ Passed as Submitted _____ Passed as Revised __ __ Withdrawn
Standard Specifications Sections referenced and/or affected: NONE Recurring Special Provision affected: SEE PROPOSAL Standard Drawing affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2020 Standard Specifications _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ Create RPD (No. _____) Effective _____ Letting _____ GIFE Update _____ SiteManager Update

Mr. Beeson
Date: 04/20/17

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO SPECIAL PROVISIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: RSP 416-R-638 requires revision to reflect current industry standards and practices.

PROPOSED SOLUTION: Revise RSP 416-R-638 as submitted.

APPLICABLE STANDARD SPECIFICATIONS: 416

APPLICABLE STANDARD DRAWINGS: N/A

APPLICABLE DESIGN MANUAL SECTION: N/A

APPLICABLE SECTION OF GIFE: N/A

APPLICABLE RECURRING SPECIAL PROVISIONS: N/A

PAY ITEMS AFFECTED: N/A

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Cold Recycling Committee comprised of Michael Prather, Nathan Awwad and Kumar Dave from INDOT, Jason Wielinski and Megan Yount from HRG and David Harness from Alt & Witzig.

IMPACT ANALYSIS (attach report): yes

Submitted By: Matthew Beeson

Title: State Materials Engineer

Organization: INDOT

Phone Number: 317-610-7251 x 204

Date: 03/27/17

Mr. Beeson
Date: 04/20/17

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO SPECIAL PROVISIONS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? No

Will approval of this item affect the Approved Materials List? No

Will this proposal improve:

Construction costs? Yes

Construction time? Yes

Customer satisfaction? Yes

Congestion/travel time? No

Ride quality? Yes

Will this proposal reduce operational costs or maintenance effort? Yes

Will this item improve safety:

For motorists? N/A

For construction workers? N/A

Will this proposal improve quality for:

Construction procedures/processes? Yes

Asset preservation? Yes

Design process? N/A

Will this change provide the contractor more flexibility? Yes

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders? N/A

Is this proposal needed for compliance with:

Federal or State regulations? N/A

AASHTO or other design code? N/A

Is this item editorial? No

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda:

REVISION TO SPECIAL PROVISIONS

416-R-638 COLD IN-PLACE RECYCLING, CIR

(Note: Proposed changes shown highlighted gray)

416-R-638 COLD IN-PLACE RECYCLING, CIR

(Adopted 05-19-16)

The Standard Specifications are revised as follows:

SECTION 416, BEGIN LINE 1, INSERT AS FOLLOWS:

SECTION 416 - COLD IN-PLACE RECYCLING, CIR

416.01 Description

This work, cold in-place recycling, CIR, shall consist of milling and pulverizing a portion of the existing asphalt pavement to specified depth and maximum size, mixing asphalt emulsion, water and additives to produce a recycled asphalt layer. This material shall then be placed and compacted to the approved design properties in accordance with 105.03.

416.02 Just in Time Training, JITT

The Engineer and Contractor are required to attend a JITT course regarding CIR and both must mutually agree on the course instructor, course content and training site. The training class shall be conducted at a project field location convenient for all project construction personnel responsible for CIR operations and inspection to attend.

The JITT course shall be held during normal working hours and be completed not more than 14 days prior to the start of CIR operations.

The contractor shall provide a JITT instructor experienced in the construction methods, materials and test methods associated with asphalt emulsion stabilized CIR. A copy of the course syllabus, handouts and presentation materials shall be submitted to the Engineer at least 5 business days before the course is to be taught.

416.~~02~~03 Quality Control

A quality control plan, QCP, shall be submitted to the Engineer a minimum of 15 calendar days prior to beginning the CIR operation. The QCP shall include the proposed CIR mix design, a start to finish process description to include discussion on corrective action measures, a list of proposed equipment, a list of proposed QC tests and testing frequencies, and the curing methods applied to the CIR. All Contractor QC test results shall be maintained during the duration of the contract and made available to the Engineer upon request.

The following table provides the type and minimum frequency for tests.

QC TESTING	
Test	*Frequency*[1,2]
Depth of Pulverization	*1 per 500 ft*

Pulverized Material Gradation	*1 per 0.5 day of processing*
Asphalt Emulsion Content	*1 per 500 ft*
Water Content	*1 per 500 ft*
Compacted In-Place Field Density	*1 per 1000 ft*
Note 1: The Contractor shall perform all quality control tests within the first 500 ft after startup or after any change in the mix design.	
Note 2: Testing frequency is based upon linear feet of CIR processing.	

MATERIALS

416.~~03~~04 Materials

CIR shall consist of a homogenous blend of reclaimed asphalt pavement, RAP, combined with asphalt emulsion, water, and when required, recycling additives such as corrective aggregate or cement~~, when required~~. Cement recycling additives used in asphalt emulsion stabilized CIR may be dry powder or slurry with a minimum dry solids content of 60%. The actual materials used are dependent on the CIR mix design and project requirements.

Materials for use in CIR shall be in accordance with the following:

*Asphalt Emulsion .....As Defined**
Corrective ~~A~~aggregate to ~~correct the CIR~~ adjust gradation or supplement material volume:

1. *Coarse or Dense Graded Aggregate, Class C or Higher 904.03*
2. *Fine Aggregate.....904.02*
3. *~~Reclaimed asphalt pavement~~, RAP~~,~~ shall be the product resulting from the cold milling or crushing of an existing ~~HMA~~ asphalt pavement. The RAP coarse aggregate shall be processed so that 100% passes the 1 1/2 in. (37.5 mm) sieve.*

Portland Cement, Type I .....901.01(b)
Water 913.01

** The requirements for asphalt emulsion shall be in accordance with the following:*

CIR ASPHALT EMULSION [1,3]			
Test	*Procedure*	*Minimum*	*Maximum*
Viscosity, Saybolt Furol, @ 77 °F, SFS	*AASHTO T 59*	*20*	*100*
Sieve Test, No. 20, retained on sieve, %	*AASHTO T 59*		*0.10*
Storage Stability Test, 24 hr, %	*AASHTO T 59*		*1.0*
Distillation Test[2], Residue from distillation, %	*AASHTO T 59*	*64.0*	
Oil distillate by volume, %	*AASHTO T 59*		*1.0*
Penetration, 77 °F, 100 g, 5 s, dmm	*AASHTO T 49*	*50*	*200*
Note 1: The asphalt emulsion shall be selected for the project by the asphalt emulsion supplier based on the Contractor's mixture design. The penetration of the supplied asphalt emulsion shall be within ± 25~~%~~ dmm of the penetration of the design ~~emulsified~~ asphalt emulsion.			

	The asphalt emulsion shall be received on the job site at a temperature no greater than 120ºF.
Note 2:	*Modified AASHTO T 59 – distillation temperature of ~~347~~350 ± 9°F with a 20 minute hold.*
Note 3:	*Type A certification will be required to furnished by the asphalt emulsion supplier.*

416.~~04~~05 Mix Design

The CIR mix design shall be in accordance with ITM 592 and comprised of existing RAP, asphalt emulsion and if necessary, recycling additives. The mix design and all associated testing shall be performed, using samples of the existing pavement material from the project site representing the recycling depth, by a design laboratory that is AMRL accredited in HMA and asphalt. Additional mix designs shall be performed when the in-place material changes significantly in order to establish representative mixes for the entire job. The Contractor shall be responsible for obtaining all samples required to develop the mix design. One sample per lane mile of planned CIR shall be the minimum sampling frequency for mix design preparation.

~~CIR mix designs shall be comprised of existing RAP, emulsified asphalt and recycling additives if necessary. The CIR mixture shall have a design gradation of 100% passing the 1 1/2 in. (37.5 mm) sieve. The minimum CIR mix design requirements shall meet all of the requirements specified in ITM 592.~~

The Contractor shall provide a mix design or designs for approval at least 15 calendar days prior to beginning the CIR operation. The mix design shall include all test results performed. If new materials are added, a new mix design, including the updated test results, shall be submitted at least one day prior to implementation.

CONSTRUCTION REQUIREMENTS

416.06 Roadway Preparation

Snowplowable raised pavement markers shall be removed prior to CIR operations in accordance with 808.11(e).

Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the pulverized material during milling operation.

Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to CIR operations, properly covered and filled with material compatible with the CIR mix design to maintain traffic prior to CIR operations.

All areas of soft or yielding subgrade, as shown on the plans, shall be corrected prior to CIR operations.

416.~~05~~07 Equipment

The recycling equipment shall be capable of milling the existing ~~roadway~~ asphalt pavement, sizing the resulting RAP and mixing the RAP with the materials stipulated in the

mix design. The recycling equipment shall be capable of meeting the specified sizing requirement with either the milling process or with additional sizing equipment. The recycling equipment shall be capable of producing a homogenous and uniformly coated CIR mixture by mixing the RAP with the asphalt emulsion, water and any other additives, either in the cold planer housing or in an additional mixing chamber. The equipment used for placement of the CIR mixture shall be capable of the placement in accordance to 105.03.

The CIR equipment shall consist of the following major components.

(a) Cold In-Place Recycler Equipment

The cold in-place recycling equipment will include either a single unit recycler or a multi-unit recycler.

1. Single Unit Recycler

The single-unit recycler shall be a self-propelled cold milling machine/cold recycling machine with a down cutting cutter head capable of pulverizing and recycling the existing HMA pavement to ~~a maximum~~ the depth specified ~~of 5 in.~~, incorporate the asphalt emulsion and water and mix the materials to produce a homogenous mixture. The machine shall have two systems for adding ~~emulsified~~ asphalt emulsion and water, with each system having a full width spray bar with a positive displacement pump interlocked to the machine's ground speed to insure that the amount of ~~emulsified~~ asphalt emulsion and water being added is automatically adjusted with changes to the machine's ground speed. Each additive system shall have its own spray bar equipped with two nozzles per foot of spray bar and be capable of incorporating up to 7 gal./sq yd of asphalt emulsion or water. Individual valves on the spray bar shall be capable of being turned off as necessary to minimize asphalt emulsion and water overlap on subsequent passes.

2. Multi-Unit Recycler

A multi-unit recycler may be utilized instead of a single unit recycler. The multi-unit train shall contain the following:

a. A self-propelled cold milling machine that is capable of pulverizing the existing ~~bituminous~~ asphalt material in a single pass to the depth shown on the plans and to a minimum width of not less than 12 1/2 ft. The machine shall have automatic depth controls to maintain the cutting depth to within ± 1/4 in. of that shown on the plans, and shall have a positive means for controlling cross slope elevations. The use of a heating device to soften the pavement will not be allowed.

b. A material sizing unit having screening and crushing capabilities to reduce the cold pulverized material to the appropriate size. The screening and crushing unit shall have a closed circuit system capable of continuously returning oversized material to the crusher.

All of the pulverized material, 100%, shall be processed to the maximum size requirements specified.

c. A mixing unit equipped with a belt scale for the continuous weighing of the pulverized and sized ~~bituminous~~asphalt material and a coupled/interlocked computer controlled liquid metering device. The mixing unit shall be an on-board completely self-contained pugmill. The liquid metering device shall deliver the amount of asphalt emulsion to within ± 0.25% of the required amount by weight of the pulverized ~~bituminous~~asphalt material. The asphalt emulsion pump shall be sufficient capacity to allow emulsion contents up to 4.0% by weight of pulverized material. Also, automatic digital readings shall be displayed for both the flow rate and total amount of pulverized ~~bituminous~~asphalt material and asphalt emulsion in appropriate units of weight and time.

(b) Spreaders for Dry Cement

Spreaders used to apply dry cement recycling additives shall be non-pressurized mechanical vane-feed, cyclone or screw type capable of providing a consistent, accurate and uniform distribution of material while minimizing dust during construction.

(c) Additive Slurry Storage and Supply Equipment

Slurry shall be produced using a batch or continuous-flow type stationary mixer equipped with calibrated metering and feeding devices that introduce the cement, water and additives into the mixer in the specified quantities. Additive slurry storage and supply equipment shall have agitators or similar equipment to keep the slurry in suspension when held in the slurry batch or storage tanks. Slurry shall be kept in suspension during transport using agitator equipment.

(~~c~~d) Spreading of Corrective Aggregate

Corrective aggregate, when required shall be placed with a mechanical spreader or a conventional paver.

(~~d~~e) Water Truck

A water truck for supplying water to the milling equipment during CIR operation shall be provided. The water truck system shall be able to supply the mixing chamber, if necessary, so as to provide an independent source of water to properly disperse the asphalt emulsion.

(~~e~~f) ~~Paving~~Laydown Equipment

The processed CIR mixture shall be spread uniformly across the recycling width using either a self-propelled paver in accordance with 409.03(c) or screed integral to the recycling equipment.

In either case, the screed shall be controlled by electronic grade and cross slope control. The equipment shall be of sufficient size and power to spread the recycled material in one continuous pass, without segregation, in accordance with 105.03. Heating of the screed shall not be allowed.

In utilizing a self-propelled paver, material shall either be loaded directly into the paver hopper from the recycling equipment or loaded by a pickup device from a windrow.

If utilizing a pickup device, it shall be capable of removing and transferring the entire windrow of recycled mix in a single pass. The pick-up machine shall be within 150 ft of the mixing unit throughout the treatment process.

(fg) ~~Rollers~~Compaction Equipment

~~Compaction of the CIR mixture shall be completed using self propelled rollers complete with properly operating scrapers and water spray systems.~~ Compaction equipment shall be in accordance with 409.03(d). The number, weight, and types of rollers shall be as necessary to obtain required compaction. At a minimum, the following rollers shall be used:

1. *At least one pneumatic tired roller in accordance with 409.03(d)3 with a minimum weight of not less than ~~2~~220 tons. ~~The tires on the pneumatic roller shall be evenly inflated and matched in size and profile as to maximize compactive effort.~~*

2. *At least one double drum vibratory roller in accordance with 409.03(d)4 with a minimum weight of not less than 10 tons.*

416.~~06~~08 Weather Restrictions

The Engineer may restrict work when the weather is foggy or rainy. CIR operations shall be performed when the RAP temperature, or pavement surface temperature, is above 50ºF with overnight ambient temperatures above 35ºF. Recycling may be performed during light precipitation so long as the Contractor can demonstrate that the performance of the CIR pavement will not be adversely affected. The Engineer may restrict work when the heat index is greater than 100°F. The CIR shall not be performed before May 1st or after October 1st.

~~416.07 Roadway Preparation~~

~~Grass and other vegetation shall be removed from the edge of the existing pavement to prevent contamination of the pulverized bituminous material during milling operation.~~

~~Snowplowable raised pavement markers shall be removed prior to CIR operations in accordance with 808.11(e).~~

~~Grade adjustments of existing structures shall be made in accordance with 720.04 except existing structures shall be lowered prior to CIR operations, properly covered and~~

~~*filled with material compatible with the CIR mix design to maintain traffic prior to CIR operations.*~~

~~*All areas of soft or yielding subgrade, as indicated on project plans, shall be corrected prior to CIR operations.*~~

416.~~08~~09 Processing and Mixing Operation

For CIR mixtures, the pulverization shall produce a gradation that has 100% passing the 1 1/2 in. (37.5 mm) sieve.

Corrective aggregate, when required, shall be spread onto the existing surface using a mechanical spreader or a conventional paver.

An additive used in asphalt emulsion stabilized CIR may be dry powder or slurry and the Contractor shall address the application methods and fugitive dust control procedures in the QCP when dry powder materials are used.

The pulverized material shall be processed through a mixing unit capable of combining the pulverized material, asphalt emulsion, and any additives to produce a homogenous recycled mixture. The asphalt emulsion shall be ~~incorporated~~injected into the pulverized ~~bituminous~~ asphalt material at the initial rate determined by the mix design and approved by the Engineer. Sampling and mix design may determine different levels of asphalt emulsion at various portions of the project.

When a paving fabric is encountered during the pulverization operation, the Contractor shall make the necessary changes in equipment or operations so that incorporation of shredded fabric into the CIR does not affect the performance parameters or inhibit placement or compaction of the CIR. The Contractor shall be required to remove and properly dispose of oversized pieces of paving fabric. The Contractor shall make the necessary adjustments in equipment or operations so that the shredded fabric in the recycled material is no more than 5 sq in. Additionally, no fabric piece shall have a dimension exceeding a length of 4 in.

Rubberized crack filler, durable pavement markings, loop wires, and other non-pavement materials shall be removed as observed from the roadway during the CIR process. Residual materials that cannot be completely removed may be incorporated into the mixture if the Contractor can demonstrate that those added materials will not adversely affect performance.

Any such materials retained in the mixture shall be appropriately sized and blended so as to not adversely affect the strength of the CIR.

Asphalt emulsion shall have an application tolerance determined by adding ± 0.25% to the percent total asphalt emulsion content recommended by the mix design.

The Contractor can request the asphalt emulsion percentage to exceed the upper tolerance provided the mix design ~~evaluated the CIR properties at or above~~requirements are satisfied at the requested percentage. The request will be subject to approval by the Engineer.

416.~~09~~10 Control Strip and Compaction

A minimum 500 ft long control strip shall be conducted the first day of production to verify the construction process meets the requirements as specified. The control strip shall allow the Contractor to:

(a) Demonstrate the proposed equipment, materials and processes can produce a CIR layer in accordance with specification requirements.

(b) Determine the optimal rates for the ~~emulsified~~ asphalt emulsion, water and any additives recommended for the reclaimed material.

(c) Determine the sequence and manner of rolling necessary to obtain specified density requirements.

The CIR density shall be achieved with the same equipment, materials, ~~and~~ construction methods and density requirements used on the accepted control strip. A new control strip shall be constructed if changes are made outside of the tolerances of the original mix design, equipment or construction methods.

A rolling pattern that produces the maximum obtainable density, or optimum field density, shall be determined during the control strip ~~to achieve optimum field density~~. The Contractor shall provide a sequence and manner of rolling ~~which will define maximum compaction~~ by establishing a ~~rolling~~ roller pass versus density chart that shows the progress of densification from initial lay down through ~~maximum obtainable~~optimum field density using a properly calibrated nuclear gauge in accordance to ~~ASTM D 2950~~ AASHTO T 310. Production may continue after approval of the control strip.

The Contractor shall perform compaction testing in accordance with AASHTO T 310 during production to ensure compaction is between 97% and 102% of the ~~target~~ optimum field density established during the control strip. If two successive tests indicate compaction is over 102% or below 97% of the ~~target~~optimum field density, a new rolling pattern and roller pass versus density chart shall be established.

The technician shall be on site, observing all compaction efforts and approving areas as they reach minimum relative compaction. Care shall be taken not to over compact the mat.

Any type of rolling effort that causes cracking, displacement or other type of pavement distress shall be discontinued until such time as the problem can be resolved and approved by the Engineer.

Rollers shall not be started or stopped on recycled material unless when changing direction during the compaction process.

All tests shall be conducted at the stated QC testing frequencies throughout CIR operations. ~~A new control strip shall be constructed if changes are made to the original mix design, equipment or construction methods.~~

416.~~10~~11 Opening to Traffic

~~After compaction of the recycled material, no traffic, including that of the Contractor, shall be allowed on the completed recycled material for at least two hours. After two hours, vehicle traffic may be allowed on the recycled material. This time may be adjusted by the Engineer to allow establishment of sufficient cure so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by power brooming.~~

~~After opening to traffic, the surface of the recycled pavement shall be maintained in a condition suitable for the safe movement of traffic.~~

~~If locations of failing subgrade are found below the CIR, the CIR shall be removed and subgrade treatment per geotechnical recommendations shall be placed in accordance with 207. HMA Patching Type B shall be placed in accordance with 304.~~

Opening to traffic shall be at the discretion of the Contractor after sufficient cure time has been applied to the CIR so traffic will not initiate raveling or permanent deformation. All loose particles that may develop on the pavement surface shall be removed by a rotary power broom in accordance with 409.

After opening to traffic, the surface of the recycled pavement shall be maintained in a condition suitable for the safe movement of traffic.

416.~~11~~12 Maintenance

The Contractor shall maintain the recycled pavement in a manner satisfactory to the Engineer until the surface course has been constructed.

Any damage to the completed recycled material shall be repaired by the Contractor prior to the placement of new asphalt concrete or final surface sealing. Patching shall be in accordance with 304. The excavated patch areas shall be filled and compacted with HMA or CIR material as directed by the Engineer. No direct payment will be made for damage or repair unless approved by the Engineer.

416.~~12~~13 Curing

~~The CIR mixture shall be cured for a time period that achieves in-place moisture contents below 2.5%, and approval by the Engineer prior to the placement of the HMA overlay. The planned method and duration of curing for CIR shall be in accordance with~~

~~*416.02. The specified surface course shall be placed within two weeks of the pavement final cure, but no later than November 1.*~~

Before placing the final surfacing, the recycled surface shall remain in-place for a minimum of 3 days and meet one of the following conditions:

(a) there is less than 3.0 percent moisture remaining in the mixture, or

(b) The material has remained in-place for a minimum of 10 days without rainfall.

The planned method and duration of curing for CIR shall be in accordance with the QCP. The specified surface course shall be placed within two weeks of the pavement final cure, but no later than November 1.

416.~~13~~14 ~~Asphalt~~ Milling

The CIR shall be milled in accordance with 306 to the specified cross-slope in preparation for the overlay. Construction engineering in accordance with 105.08(b) shall be provided.

416.~~14~~15 CIR Surface Course

The surface course atop the CIR shall be as shown on the plans.

The CIR shall be swept of all loose material and standing water with a rotary power broom in accordance with 409 immediately prior to placing the ~~overlay~~surface. The CIR shall be swept lightly to avoid damage to the CIR.

A tack coat shall be required only for the HMA overlay and shall be applied to the CIR in accordance with 406 immediately following sweeping operations.

~~*The surface course atop the CIR shall be as shown on the plans.*~~

Monuments shall be reestablished in accordance with 615.10

416.~~15~~16 Method of Measurement

The CIR will be measured by the square yard, complete in place. Asphalt emulsion will be measured by the ton in accordance with 109.05(b). Subgrade treatment will be measured in accordance with 207.05. ~~Corrective a~~Aggregate~~, when used~~ to ~~correct~~ adjust the CIR gradation~~,~~ will be measured by the ton of material used. ~~Stabilizing material, Portland cement, used as a recycling additive will be measured by the ton in accordance with 109.05(b). Asphalt milling will be measured in accordance with 306.09.~~ HMA Patching will be measured in accordance with 304.06. Milling will be measured in accordance with 306.09. Re-established monuments will be measured by the number of units installed in accordance with 615.13. Grade adjustment of existing structures will be

measured in accordance with 720.06. Removal of snowplowable raised pavement markers will be measured in accordance with 808.12.

416.~~16~~17 Basis of Payment

The CIR will be paid for at the contract unit price per square yard, complete in place. ~~The accepted quantities of additional stabilizing material will be paid for at the contract unit price per ton for the type specified, complete in place.~~ Asphalt emulsion will be paid for at the contract unit price per ton, complete in place. Subgrade treatment will be paid for in accordance with 207.06. Aggregate used to adjust the CIR gradation will be paid for at the contract unit price per ton, complete in place. ~~Asphalt milling will be paid for in accordance with 306.10.~~ HMA patching will be paid for in accordance with 304.07, of the thickness specified on the plans. Milling will be paid for in accordance with 306.10. Re-established monuments will be paid for at the contract unit price per each complete in place in accordance with 615.14. Grade adjustment of existing structures will be paid for at the contract unit price in accordance with 720.07. Removal of snowplowable raised pavement markers will be paid for in accordance with 808.13.

Payment will be made under:

Pay Item	***Pay Unit Symbol***
Cold In-~~p~~Place Recycling, CIR	*SYS*
Corrective Aggregate	*TON*
Stabilizing Material, Asphalt Emulsion	*TON*
Milling, Profile	*SYS*
~~Stabilizing Material, Portland Cement~~	*~~TON~~*

The costs ~~associated with~~ of the CIR mix design and ~~quality control~~QC testing shall be included in the cost of the CIR.

The costs associated with removal of grass and vegetation, rubberized crack filler, durable pavement markings, loop wires and other non-pavement materials shall be included in the cost of the CIR.

The costs associated with ~~removal of grass and vegetation,~~ pulverizing, stabilizing, compacting, curing and maintenance of the CIR not related to failing subgrade shall be included in the cost of the CIR.

The cost associated with mixing water shall be included in the cost of the CIR.

The cost associated with aggregate when used to supplement material volume shall be included in the cost of the CIR.

The cost associated with portland cement when used as an additive shall be included in the cost of the CIR.

REVISION TO SPECIAL PROVISIONS

416-R-638 COLD IN-PLACE RECYCLING, CIR

The cost associated with aggregate when used to adjust the CIR gradation shall be included in the cost of the corrective aggregate pay item.

The cost~~s associated with~~ of the asphalt emulsion shall be included in the cost of the stabilizing material pay item.

The cost~~s associated with removing existing material~~ of milling the asphalt emulsion stabilized CIR to maintain profile shall be included in the cost of the ~~asphalt~~ milling.

In the locations of failing subgrade, removal of the CIR shall be included in the cost of subgrade treatment.

COMMENTS AND ACTION

416-R-638 COLD IN-PLACE RECYCLING, CIR

DISCUSSION:

Motion: Second: Ayes: Nays: FHWA Approval:	Action: _____ Passed as Submitted _____ Passed as Revised __ __ Withdrawn
Standard Specifications Sections referenced and/or affected: NONE Recurring Special Provision affected: 416-R-638 COLD IN-PLACE RECYCLING, CIR Standard Drawing affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2020 Standard Specifications _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ Create RPD (No. _____) Effective _____ Letting _____ GIFE Update _____ SiteManager Update

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

PROPOSAL TO STANDARDS COMMITTEE

PROBLEM(S) ENCOUNTERED: The following problems are noted in Sec 215:

Too much time allowed for mix design review.
Gradation testing is not currently specified.
Curing is very important for chemically modified soils and is not specified in current specs.
DCP compaction criteria is an issue for 14 in. thick subgrade.
LWD compaction test is not currently available.
Changing from lime to cement during mix design caused payment issues and cost overruns/change orders.

PROPOSED SOLUTION: Reduced review time from five to three and soils requirements are comprehensive.

1. ITM 516 is added for gradation testing.
2. Curing time is added.
3. DCP blow counts was revised for 14 in.
4. LWD compaction test is added.
5. When specified, cement and lime will be separate pay item
6. A number of editorial revisions.

APPLICABLE STANDARD SPECIFICATIONS: 215

APPLICABLE STANDARD DRAWINGS: NA

APPLICABLE DESIGN MANUAL SECTION: NA

APPLICABLE SECTION OF GIFE: Yes

APPLICABLE RECURRING SPECIAL PROVISIONS: yes

PAY ITEMS AFFECTED: Yes

APPLICABLE SUB-COMMITTEE ENDORSEMENT: Stabilization contractors

IMPACT ANALYSIS (attach report):

Submitted By: Matt Beeson for Geotechnical Services

Title: State Materials Engineer

Organization: Office of Materials Management

Phone Number: 317-610-7251x204

Date: 03/27/17

Mr. Beeson
Date: 04/20/17

STANDARD SPECIFICATIONS, SPECIAL PROVISIONS AND STANDARD DRAWINGS

REVISION TO STANDARD SPECIFICATIONS

IMPACT ANALYSIS REPORT CHECKLIST

Explain the business case as to why this item should be presented to the Standards Committee for approval. Answer the following questions with Yes, No or N/A.

Does this item appear in any other specification sections? 207

Will approval of this item affect the Approved Materials List? NA

Will this proposal improve:

Construction costs? Yes

Construction time? yes

Customer satisfaction? Yes

Congestion/travel time? NA

Ride quality? NA

Will this proposal reduce operational costs or maintenance effort? Yes

Will this item improve safety:

For motorists? NA

For construction workers? NA

Will this proposal improve quality for:

Construction procedures/processes? NA

Asset preservation? NA

Design process? Yes

Will this change provide the contractor more flexibility? Yes

Will this proposal provide clarification for the Contractor and field personnel? Yes

Can this item improve/reduce the number of potential change orders? Yes

Is this proposal needed for compliance with:

Federal or State regulations?

AASHTO or other design code?

Is this item editorial?

Provide any further information as to why this proposal should be placed on the Standards Committee meeting Agenda:

REVISION TO STANDARD SPECIFICATIONS

SECTION 215 – CHEMICAL MODIFICATION OF SOILS

(Proposed changes shown highlighted gray.
RSP 215-R-629 CHEMICAL MODIFICATION OF SOILS, approved by the Standards Committee on June 18, 2015 and incorporated into 2018 SS)

The Standard Specifications are revised as follows:

SECTION 215, BEGIN LINE 1, DELETE AND INSERT AS FOLLOWS:

SECTION 215 – CHEMICAL MODIFICATION OF *SUBGRADE* SOILS

215.01 Description

This work shall consist of the modification of *subgrade* soils by uniformly mixing portland cement, fly ash, lime, or a combination of the materials with soil to aid in strength gain and achieving the workability of soils ~~having excessive moisture content~~.

MATERIALS

215.02 Materials

Materials shall be in accordance with the following:

Fly Ash, *Class C* 901.02
Lime .....913.04(b)
Portland Cement, Type I .....901.01(b)
Water 913.01

Quicklime or Portland cement may be used dry or as a slurry.

Soils for chemical modification shall meet the minimum following requirements:

MINIMUM SOILS PROPERTIES FOR CHEMICAL MODIFICATION		
Soil Property	*Test Method*	*Requirement*
Maximum Dry Density, min.	*AASHTO T 99*	*95 pcf*
Organic Material, max.	*AASHTO T 267*	*6%*
Sulfate Content, max.	*ITM 510*	*1,000 ppm*

Table 1

~~Soils containing greater than 6% by dry weight calcium/magnesium carbonate, or organic material, or having a maximum dry density of less than 95 pcf, or with a soluble sulfate content greater than 1,000 ppm shall not be used in the subgrade. The density shall be determined in accordance with AASHTO T 99, the loss on ignition shall be determined in accordance with AASHTO T 267, the calcium/magnesium carbonate shall be determined in accordance with ITM 507, and the sulfate content shall be determined in accordance with ITM 510.~~

SECTION 215, BEGIN LINE 37, DELETE AND INSERT AS FOLLOWS:

The quantities for hydrated lime, quicklime, or portland cement shall be based on 4.0% of the maximum dry density of the soils. The quantities for lime by-products shall be

based on 5.0% of the maximum dry density of the soils. The quantities for fly ash class C shall be based on 12.0% of the maximum dry density of the soils. ~~Class F fly ash shall not be used except in combination with lime or cement.~~

If hydrated lime, quick lime, lime by-products or portland cement are used, test results and the geotechnical consultant recommendations shall be submitted to the Engineer prior to use. If fly ash or any combination of chemical modifiers are used, the test results and the geotechnical consultant recommendations shall be submitted to the Engineer and to the Office of Geotechnical Services for approval at least ~~five~~*three* business days prior to use. If the modifier as bid is not appropriate for the soils encountered, portland cement shall be used. Portland cement, fly ash, lime, and lime by-products shall be from the Department's list of approved sources.

SECTION 215.07, BEGIN LINE 75, INSERT AND DELETE AS FOLLOWS:

215.07 Spreading of Chemical Modifiers

Where ~~t~~*T*ype A-6 or A-7 soils are used or encountered, the surface shall be scarified to the specified depth prior to distribution of the chemical modifier. If a combination of modifiers is used, the modifiers shall be mixed mechanically prior to being incorporated. The chemical modifier shall be distributed uniformly by a cyclone, screw-type, or pressure manifold type distributor. If a slurry is used, the surface shall be scarified prior to the distribution of the slurry. The chemical modifier shall not be applied when wind conditions create problems in adjacent areas or create a hazard to traffic on any adjacent roadway. The spreading of the chemical modifier shall be limited to an amount which can be incorporated into the soil within the same work day. If weather causes stoppage of work or exposes the chemical modifier to washing or blowing, additional chemical modifier may be spread when the work resumes.

215.08 Mixing

The chemical modifier, soil, and water when necessary, shall be thoroughly mixed by rotary speed mixers or a disc harrow. The mixing shall continue until a homogenous layer of the required thickness has been obtained. One hundred percent of the material, exclusive of rock particles, shall pass a 1 in. (25 mm) sieve and at least 60% shall pass a No. 4 (4.75 mm) sieve. The mixing depth shall be 14 in.

The gradation test shall be performed in accordance with ITM 516.

The chemically modified soil mixture shall be at least 2% above the optimum moisture content during mixing and compaction. Water shall not be added to the chemically modified soil when the moisture content of the soil exceeds 3% above optimum moisture. Water shall be added during mixing only.

215.09 Compaction

Compaction of the mixture shall begin as soon as practicable after mixing and shall be in accordance with ~~203 or~~ 207.03 ~~as applicable~~. Compaction after mixing shall be as follows:

(a) For portland cement modified soils, mixing shall be completed within 1 h of portland cement placement and grading and final compaction shall be completed within 3 h after mixing.

(b) Fly ash modified soils shall be compacted within 4 h.

(c) Lime modified soils shall be compacted within 24 h.

Compaction ~~A~~*a*cceptance of chemically modified soils will be determined ~~by measuring the compaction with a Dynamic Cone Penetrometer, DCP,~~ in accordance with *ITM 508 or* ITM 509 *or with a Light Weight Deflectometer, LWD, in accordance with 203.24(b)*[Note: approved by Standards Committee on 06/18/15 meeting, RSP 215-R-629]. Testing of the chemically modified soils will begin 24 hours after compaction.

Acceptance of the compaction of chemically modified soils will be determined by averaging three LWD tests obtained at random stations determined in accordance with ITM 802. The average deflection shall be equal to or less than the maximum allowable deflection allowed in table. The frequency of LWD testing will be three tests for each 1,400 cu yd of chemically modified soils.

MAXIMUM ALLOWABLE DEFLECTION FOR CHEMICALLY MODIFIED SOIL	
Material Type	*Maximum Allowable Deflection, mm*
Lime Modified Subgrade	*0.30*
Cement Modified Subgrade	*0.27*

Table 2

For measuring the compaction with a DCP [Note: approved by Standards Committee on 06/18/15 meeting, RSP 215-R-629], ~~T~~*t*hree random test locations will be determined in accordance with ITM 802 for each ~~1,500 lft~~*1,400 cu yd* of chemically modified soil for each 2-lane pavement section. The average of the blow counts obtained at the three random locations will be the DCP blow count representing the ~~1,500 lft~~*1,400 cu yd* ~~section~~. Blow counts of ~~15~~*13* and above will be used to determine the average for the top 6 in. of a 14 in. lift. Blow counts of 14 and above will be used to determine the average for the bottom 8 in. of a 14 in. lift. Blow counts of ~~18~~*16* and above will be used to determine the average for the 8 in. lift. Locations with test results less than the specified minimum blow counts will be retested and shall be reworked if the minimum blow count is not obtained.

The chemically modified soil lift shall meet the following requirements for compaction:

(a) The average DCP blow count shall not be less than ~~17~~*15* for the top 6 in. of a 14 in. lift.

(b) The average DCP blow count shall not be less than 16 for the bottom 8 in. of a 14 in. lift.

(c) The average DCP blow count shall not be less than ~~20~~*18* for an 8 in. lift.

Moisture tests for chemically modified soils mixture ~~will~~*shall* be performed *in accordance with ITM 506* every 4 h during chemical and soils mixing. One gradation test ~~in accordance with 215.08~~ ~~will~~*shall* be performed for each 2,500 lft of chemically modified soil for each 2-lane pavement section *in accordance with 215.08*.

Construction traffic or equipment will not be allowed on the treated soils until the soil meets the *compaction* ~~DCP~~ test requirements.

215.10 Curing

~~The moisture content of the mixture shall be at the optimum moisture content or above the optimum moisture content as determined by the mix design in accordance with 215.03. Moisture content will be determined in accordance with ITM 506. Moisture content shall be maintained above the optimum moisture content for the first 48 h after mixing with quicklime or hydrated lime.~~*Moisture content shall be maintained above the optimum moisture content for the first 48 h after mixing.*

215.11 Proofrolling

Proofrolling shall be performed in accordance 203.26. The proofrolling shall cover the entire subgrade surface. The maximum allowable deflection or rutting in subgrade shall not be greater than 1/2 in.

215.1~~1~~*2* Method of Measurement

The accepted quantity of chemically modified soils will be measured by the square yard, complete in place *in an accordance with 207. When specified, cement or lime will be measured separately*. All removal and replacement required to modify the soils below the specified depth will be measured in accordance with 203.27(b).

215.1~~2~~3 Basis of Payment

The accepted quantity of chemically modified soils will be paid for by the square yard, complete in place. All removal and replacement required to modify the soils below the specified depth will be paid for in accordance with 203.28.

Adjustment of materials for chemical modification that exceeds the limits of 215.03 will be included in a change order for materials only and paid for as chemical modifier adjustments. If mix design test results show that the chemical modifier as bid by the Contractor is not appropriate and the strength of the modified soil can not be achieved, a price adjustment will be made for the use of portland cement. The price adjustment will be calculated at a cost equal to the difference in the invoice cost of the chemical modifier found to be appropriate for use and the invoice or quoted delivered cost of the chemical modifier as bid by the Contractor. This adjustment will be included in a change order and

will be paid for as chemical modifier adjustments. *Fly ash will not considered for price adjustment*. Payment for chemical modifier adjustments will be made for direct delivered material costs incurred by the Contractor and shall not include any other markups.

Payment will be made under:

Pay Item	**Pay Unit Symbol**
Chemical Modification, Soils.....	SYS

The cost of performing the laboratory tests, providing an approved geotechnical consultant, scarification of the subgrade, spreading and mixing of the chemical modifier and soil, compaction of the resultant mixture, shaping the subgrade, work required due to adjustments of modifier proportioning, additional modification required due to weather conditions, correction of deficient areas, water required for the modification process, modified subgrade trimming, *moisture and gradation testing* and all operations needed to meet the requirements of this specification shall be included in the cost of the pay items of this section.

COMMENTS AND ACTION

SECTION 215 – CHEMICAL MODIFICATION OF SOILS

DISCUSSION:

Motion: Second: Ayes: Nays: FHWA Approval:	Action: _____ Passed as Submitted _____ Passed as Revised __ __ Withdrawn
Standard Specifications Sections referenced and/or affected: SECTION 215 BEGIN PG 222. Recurring Special Provision affected: 215-R-629 CHEMICAL MODIFICATION OF SOILS Standard Drawing affected: NONE Design Manual Sections affected: NONE GIFE Sections cross-references: NONE	_____ 2018 Standard Specifications _____ Revise Pay Items List _____ Create RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Revise RSP (No._____) Effective _____ Letting RSP Sunset Date: _____ Standard Drawing Effective _____ Create RPD (No. _____) Effective _____ Letting _____ GIFE Update _____ SiteManager Update