AGENDA

CHARTER TOWNSHIP OF MERIDIAN
TOWNSHIP BOARD – REGULAR MEETING
September 15, 2026 6:00 PM

1. CALL MEETING TO ORDER
2. PLEDGE OF ALLEGIANCE/INTRODUCTIONS
3. ROLL CALL
4. PRESENTATIONS
   A. Rick Stacy Retirement

5. CITIZENS ADDRESS AGENDA ITEMS AND NON-AGENDA ITEMS
6. TOWNSHIP MANAGER REPORT
7. BOARD MEMBER REPORTS OF ACTIVITIES AND ANNOUNCEMENTS
8. APPROVAL OF AGENDA
9. CONSENT AGENDA
   A. Communications
   B. Minutes-September 1, 2026 Regular Township Board Meeting
   C. Bills
   D. Form L-4029 2026 Tax Rates
   E. Audit Services RFP Selection
   F. Hydraulic Passenger Elevator Modernization and Preventative Maintenance Contract Awards
   G. Ordinance 2026-10 – Introduction for Adoption – Mass Timber provisions in the MUPUD and CPUD Ordinances
   H. Planned Unit Development #26-026 – Vacant Hannah Boulevard – Capstone Collegiate Communities – Set Public Hearing

10. HEARINGS
    A. 2027 Township Budget

11. BOARD ACTION ITEMS
    A. 4690 Okemos Road Proposed Brownfield Plan
    B. Permanent Speed Display Sign Master Plan and Policy

12. BOARD DISCUSSION ITEMS
    A. 2027 Township Budget

13. COMMENTS FROM THE PUBLIC
14. OTHER MATTERS AND BOARD MEMBER COMMENTS
15. ADJOURNMENT

All comments limited to 3 minutes, unless prior approval for additional time for good cause is obtained from the Supervisor. Appointment of Supervisor Pro Tem and/ or Temporary Clerk if necessary. Individuals with disabilities requiring auxiliary aids or services should contact the Meridian Township Board by contacting: Township Manager Tim Dempsey, 5151 Marsh Road, Okemos, MI 48864 or 517.853.4258 - Ten Day Notice is Required.

Meeting Location: 5151 Marsh Road, Okemos, MI 48864 Township Hall

9.A

CONSENT AGENDA
BOARD
COMMUNICATIONS

Outlook

Assistance requested

From haven5095 [redacted]
Date Thu 8/27/2026 4:08 PM
To Board <Board@meridian.mi.us>

Some people who received this message don't often get email from [redacted] Learn why this is important

I agree that the leaf backpack blowers are really loud. I own one. But the problem is not the blower, in my case I had to buy one because 6 of my neighbors do not take care of their leaves in the fall (ever). I can take care of my leaves on my property, but it is a full time job taking care of the leaves blowing into my yard (and I am not talking about from the trees).
If you want to take care of a problem, find out where the problem started. The solution is have a law that it is enforced with zoning thru property taxes, in which people need to take care of their own leaves week after week. I do.
Thank you,
John Haven
[redacted]

Sent from my Galaxy

Outlook

Re: October

From Scott Hendrickson <hendrickson@meridian.mi.us>
Date Wed 8/26/2026 4:15 PM
To Anna J. Kalush McCaughna [redacted] Board <Board@meridian.mi.us>

Good Afternoon Anna,

Thank you so much for reaching out!

Our next listening session is TUESDAY October 27th from 6:00 - 7:30 pm at St. Luke Lutheran Church (5589 Van Atta Road, Haslett, MI 48840).

Can you please let me know where it says Thursday so that we can make sure that gets updated?

Thanks so much and hope to see you there!

Scott Hendrickson
Supervisor, Meridian Township
hendrickson@meridian.mi.us
5151 Marsh Road | Okemos, MI 48864

MERIDIAN TOWNSHIP
EST. 1842
A Prime Community

From: Anna J. Kalush-McCaughna [redacted]
Sent: Wednesday, August 26, 2026 4:07 PM
To: Board <Board@meridian.mi.us>
Subject: October

Some people who received this message don't often get email from [redacted] Learn why this is important

Hello!
The next listening session is listed as Thursday, October 27 but date is a Tuesday.
Is the date Tuesday the 27th or Thursday the 29th?
Thank you for the clarification,
Respectfully,
Anna McCaughna

Sent from Yahoo Mail for iPhone

From: Calvin Clarence
To: Board
Subject: Swimming
Date: Thursday, September 3, 2026 6:07:44 AM

> Some people who received this message don't often get email from [redacted]. Learn why this is important

Hey Coach,

I'm looking for swimming lessons for my kids and I wanted to check if you have any available spaces at the moment. They're still beginners, so I'd like them to focus on the basics, such as getting comfortable in the water and learning the correct technique.
Could you please tell me how your lessons usually work, and provide me with your current schedule and rates?

Thanks so much for your time. I look forward to hearing from you.
Best regards.

9.B

CONSENT AGENDA
PROPOSED BOARD MINUTES

PROPOSED MOTION:

(1) Move to approve and ratify the minutes of the Regular Meeting of September 1, 2026 as submitted.(1)

ALTERNATE MOTION:

(1) Move to approve and ratify the minutes of the Regular Meeting of September 1, 2026 with the following amendment(s):[insert amendments]

CHARTER TOWNSHIP OF MERIDIAN
REGULAR MEETING TOWNSHIP BOARD -**DRAFT**-
5151 Marsh Road, Okemos MI 48864-1198
517.853.4000, Township Hall Room
TUESDAY, September 1, 2026, 6:00PM

PRESENT: Supervisor Hendrickson, Clerk Demas, Treasurer Burghardt, Trustee Lentz, Trustee Trezise, and Trustee Wilson.

ABSENT: Trustee Sundland

STAFF: Township Manager Dempsey, Deputy Manager and Public Works Director Opsommer, IT Director Gebes, Fire Chief Hamel, Finance Director Blonde, Neighborhoods and Economic Director Clark

1. CALL MEETING TO ORDER

   Supervisor Hendrickson called September 1, 2026, Regular Township Board meeting to order at 6:00 pm.

2. PLEDGE OF ALLEGIANCE/INTRODUCTIONS

   Supervisor Hendrickson led the Pledge of Allegiance.

3. ROLL CALL

   Clerk Demas called the roll. Six Board Members present.

   Trustee Sundland was absent.

4. PRESENTATIONS

   A. Okemos Public Schools Superintendent Matt Olson

      Superintendent Olson gave an update on Okemos School District current projects and future projects in the planning phase.

   B. 2027 Budget & Five-Year Financial Forecast

      Township Manager Dempsey presented the 2027 Proposed Budget and a Five-Year Financial Forecast.

      Board discussion occurred including questions about whether the Five-Year Forecast will be updated every year and if additional services have been considered to add revenue.

      Board members comments included adding funding for new required voting equipment in the proposed 2027 budget and understanding the conservative approach taken for revenue estimates included in the five-year financial forecast.

5. CITIZENS ADDRESS AGENDA ITEMS AND NON-AGENDA ITEMS

   Supervisor Hendrickson opened public comment at 6:55 pm.

The opportunity to speak was provided to the public.

Supervisor Hendrickson closed public comment at 6:56 pm.

6. TOWNSHIP MANAGER REPORT

Township Manager Dempsey spoke about the following:

- Reminder that the office will be closed on September 7, 2026, for Labor Day.

7. BOARD MEMBER REPORTS OF ACTIVITIES AND ANNOUNCEMENTS

Trustee Lentz thanked management for the employee recognition picnic and congratulated the retirement of former Executive Director of Finance at Okemos Public Schools, Elizabeth Lentz.

Trustee Trezise stated he attended the meeting to discuss Haslett Road along with Supervisor Hendrickson, Clerk Demas, and Treasurer Burghardt.

Treasurer Burghardt gave a reminder that September 14 is the last day to pay taxes without a penalty and the ways taxes can be paid.

Supervisor Hendrickson stated that the Haslett Road meeting was not only about the bike path but also about safety including vehicular and pedestrian traffic.

8. APPROVAL OF AGENDA

Trustee Wilson moved to approve the agenda. Seconded by Treasurer Burghardt.

VOICE VOTE: **YEAS: Supervisor Hendrickson, Clerk Demas, Treasurer Burghardt, Trustee Lentz, Trustee Trezise, and Trustee Wilson.**

NAYS: NONE

Motion carried: 6-0

9. CONSENT AGENDA

Supervisor Hendrickson listed the consent agenda items.

Closed session minutes were provided to Board members.

Trustee Trezise moved to approve the consent agenda with the amendment to the regular meeting minutes as discussed. Seconded by Clerk Demas.

A correction was requested by the motion maker regarding a clerical error on page 7 in the August 18, 2026 Regular Township Board minutes.

ROLL CALL VOTE: **YEAS: Supervisor Hendrickson, Clerk Demas, Treasurer Burghardt, Trustee Lentz, Trustee Trezise, and Trustee Wilson**.

NAYS: NONE

Motion carried: 6-0

10. HEARINGS

A. 4690 Okemos Road Proposed Brownfield Plan

Director Clark gave a brief description of the project.

Supervisor Hendrickson opened the Public Hearing at 7:06 pm.

The consultant Connor Zook from Triterra, and the developer, Srinivas Kandula gave a presentation of the project.

Public comment opened at 7:15 pm.

The opportunity to speak was provided to the public.

Public comment closed at 7:15 pm.

Supervisor Hendrickson closed the Public Hearing at 7:15 pm.

11. BOARD ACTION ITEMS

None.

12. BOARD DISCUSSION ITEMS

A. 4690 Okemos Road Proposed Brownfield Plan

Director Clark provided the background of this project and what the future plans are.

Board discussion occurred including questions about whether commercial is included in the plan and the timeline of the project.

B. Mass Timber Ordinance

Director Schmitt provided information on mass timber, how it's used and how the ordinance came to be.

Board discussion occurred including the sustainability of mass timber and the costs.

13. COMMENTS FROM THE PUBLIC

Supervisor Hendrickson opened public comment at 7:55 pm.

The opportunity to speak was provided to the public.

Supervisor Hendrickson closed public comment at 7:55 pm.

14. OTHER MATTERS AND BOARD MEMBER COMMENTS

Trustee Wilson commented on the budget and asked for an internal audit on the elections fund. Clerk Demas provided additional information regarding the uses of the elections fund.

15. ADJOURNMENT

Trustee Lentz moved to adjourn. Supported by Trustee Wilson.

VOICE VOTE **YEAS: Supervisor Hendrickson, Clerk Demas, Treasurer Burghardt, Trustee Lentz, Trustee Trezise, and Trustee Wilson.**

NAYS: NONE

Motion carried: 6-0

The meeting adjourned at 8:01 pm.

_____
Scott Hendrickson
Township Supervisor

_____
Angela Demas
Township Clerk

To: **Board Members**

From: **Bernadette Blonde, Finance Director**

Date: **September 15, 2026**

Charter Township of Meridian
Board Meeting
9/15/2026

MOVE THAT THE TOWNSHIP BOARD APPROVE THE TOWNSHIP INVOICES/EXPENSES AS FOLLOWS:

COMMON CASH		**$**	**1,053,629.96**
PUBLIC WORKS		**$**	**16,119.56**
TRUST & AGENCY		**$**	**72,071.43**
	TOTAL CHECKS:	**$**	**1,141,820.95**
CREDIT CARD TRANSACTIONS			
8/26 to 9/9		**$**	**10,981.06**
	TOTAL PURCHASES:	**$**	**1,152,802.01**
ACH PAYMENTS		**$**	**764,984.18**

Vendor Name	Description	Amount
1. A T & T		
	AUG 28 - SEP 27 2026 - INTERNET M1 321840834	207.14
	SEP 5 - OCT 4 2026 - INTERNET F3 327704413	160.44
	TOTAL	367.58
2. ABONMARCHE CONSULTANTS INC		
	2026 LOCAL ROAD PROGRAM ENGINEERING & INSPECTION CO	13,303.77
	2027 LRP ENGINEERING CONTRACT FOR MILL & FILL TREAT	4,442.95
	TOTAL	17,746.72
3. ALLEGRA PRINT & IMAGING		
	DOOR HANGERS FOR CP&D DEPT. 500 CT	486.07
4. AMERICAN RENTALS		
	2026 TRANSFER STATION PORTABLE TOILET RENTAL	98.00
5. ANGELA DEMAS		
	MILEAGE - OVERAGE FOR LUNCH - FOR MAMC EDUCATION DA	97.97
6. APOLLO FIRE APPARATUS SALES		
	MP - FIRE - ENGINE 93	62.50
7. AT & T		
	SEP 7 - OCT 6 2026 - TELEPHONE M1 8310015874452	873.40
	SEP 7 - OCT 6 2026 - INTERNET M1 8310015874474	1,138.83
	TOTAL	2,012.23
8. AUTO VALUE OF EAST LANSING		
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	0.00
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	213.60
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	60.88
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	117.18
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	43.98
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	195.80
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	136.20
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	17.49
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	418.96
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	142.68
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	166.39
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	137.58
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	4,921.99
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	208.37
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	1.19
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	34.38
	MOTOR POOL - FLEET REPAIR PARTS 2026 - 2ND PO	239.99
	TOTAL	7,056.66
9. BARKHAM & CO		
	2026 MOWING/TRIMMING OF THE BICYCLE/PEDETRIAN PATHW	6,580.00
10. BOARD OF WATER & LIGHT		
	2026 BWL STREETLIGHT SERVICE	891.04
11. BOUNDTREE MEDICAL		
	MISC AMBULANCE SUPPLIES (NEEDLES, GLOVES, O2 RESUS	2,769.08
	DISINFECTANT	158.28
	STANDING PO FOR MEDICAL SUPPLIES/AMBULANCE SUPPLIES	36.72
	IV CATHETERS, EXTRICATION COLLAR, WIPES	1,138.90
	HAND WIPES (QTY: 5 BOXES)	47.95
	TOTAL	4,150.93
12. BOYNTON FIRE SAFETY SERVICE		
	PARKS - HARTRICK PARK BACKFLOW RE-INSPECTION	85.00
	BUILDINGS - SC - REPAIR AND TEST BACKFLOW`	880.00
	TOTAL	965.00

Vendor Name	Description		Amount
13. BRIGHTLINE TECHNOLOGIES			
	SEP 2026 - AUVIK NETWORK & SAAS MONITORING & MANAGE		1,055.00
	SEP 2026 - ACRONIS BACKUP SERVER		2,518.00
	SEP 2026 - BRIGHTLINE QUICKHELP SUBSCRIPTION		1,462.00
	SEP 2026 - OFFSITE REPLICATION AGREEMENT		4,070.00
	SEP 2026 - HPE 6TB HARD DRIVE FOR ACRONIS SERVER		610.00
		TOTAL	9,715.00
14. BULL ENTERPRISES			
	JANITORIAL SERVICES FOR TOWNSHIP BUILDINGS -2026		8,822.00
15. CINTAS CORPORATION #725			
	MECHANICS UNIFORM RENTAL		54.89
	FIRST AID KIT RESTOCK		330.49
		TOTAL	385.38
16. CITY PULSE			
	TWP NOTICES		229.03
	TWP NOTICES		317.46
		TOTAL	546.49
17. COMCAST			
	SEP 16 - OCT 15 2026 - INTERNET + TV F1 85291141602		179.85
	SEP 20 - OCT 19 2026 - TV F1 8539114160280677		14.95
		TOTAL	194.80
18. CONSUMERS ENERGY			
	UTILITY ASSISTANCE 1030-3409-2868		500.00
19. CONWAY SHIELD INC			
	HELMET SHIELDS FOR NEW HIRE AND PROMOTIONS		186.50
20. COURTNEY WISINSKI			
	REIMBURSEMENT MOVIE NIGHT IN THE PARK SUPPLIES		24.00
21. CRYSTAL FLASH			
	MOTOR POOL - FLEET FUEL 2026 - 2ND PO		20,841.37
22. DELL MARKETING LP			
	POWEREDGE R7515 PRO SUPPORT		1,297.14
	MICROSOFT 365 ENTERPRISE ANGREEMENT 2026 TO 2027 -		94,606.33
		TOTAL	95,903.47
23. DONALD L BROWN			
	SUMMER CONCERT SERIES - 9/2/2026 PERFORMANCE		1,600.00
24. EDGEWOOD VILLAGE APARTMENTS			
	EMERGENCY RENTAL ASSISTANCE		582.00
25. ELECTRICAL TERMINAL SERVICE			
	MP - SUPPLIES		20.19
26. GEAR WASH			
	TURNOUT GEAR REPAIR & CLEANING (WORK ORDER 30644)		228.00
27. GENERAL CODE LLC			
	UPDATED CODE OF ORDINANCE		2,106.00
28. GRAINGER			
	ROAD FLARES FOR PATROL VEHICLES		216.41
29. GRANGER WASTE SERVICES			
	2026 - SEASONAL TRASH SERVICE IN PARKS		269.60
30. GREAT LAKES BREATHING AIR			
	CASCADE FILL STATION SERVICE AND REPAIR, INCLUDING		321.88
31. HABITAT REVIVAL			
	2026 TOWAR WOODS PRESERVE BRUSH HOGGING		3,000.00
32. INGHAM COUNTY REGISTER OF DEEDS			
	RECORDING FEE FOR PATHWAY EASEMENT AT EAST LANSING		30.00
33. JENNIFER SORIA			
	MAMC MILEAGE REIMB - JENNIFER SORIA		107.01
	LUNCH FOR MAMC EDUCATION DAY		12.17
		TOTAL	119.18

Vendor Name	Description	Amount
34. KCI		
	NOTICE OF CANCELLATION CARD	327.12
35. KEBS INC		
	SURVEY OF LIVERANCE ST PROPERTIES FOR LAND ACQUISIT	2,250.00
36. KLEYN MOBILE REPAIR, LLC		
	MP - FIRE - 150	1,163.63
37. LAFONTAINE FORD OF LANSING		
	MP - POLICE - 721	595.74
	MP - CPD - 129	718.32
	TOTAL	1,314.06
38. LANSING REAL GREEN LAWN CARE INC		
	2025-2026 GROUNDS MAINTENANCE CONTRACT - 12/7/2025-	4,600.00
39. LANSING SECURITY & LOCKSMITH		
	BUILDINGS - POLICE - HANDICAP DOOR CONTROLLER	832.00
40. LANSING UNIFORM COMPANY		
	WINTER COAT FOR OFC. ELLIOTT	209.95
	FIRE UNIFORMS (FF THOMAS)	175.85
	PANTS FOR OFC. BERMAN	94.95
	HAT BADGES (QTY: 2) AND HAT STRIPS (QTY: 3)	239.90
	JACKET & BELT FOR SETH PEBLEY	189.90
	FIRE UNIFORMS (PENNELL, STURM, HENGESBACH, KOZLOWSK	752.45
	FIRE UNIFORMS (FF KRAMER)	139.95
	TOTAL	1,802.95
41. LEXISNEXIS RISK DATA MGT LLC		
	POLICE ACCURINT QUERY SERVICE JULY 2026	200.00
	POLICE ACCURINT QUERY SERVICE AUG 2026	200.00
	TOTAL	400.00
42. LIVINGSTON COUNTY EMS		
	PARAMEDIC TUITION FOR FF ZOE HEDRICK (4 SEMESTERS)	5,400.00
43. MANNIK AND SMITH GROUP INC		
	2026 MERIDIAN TWP PARKS AND REC 5-YEAR PLAN	1,237.00
	2026 MERIDIAN TWP PARKS AND REC 5-YEAR PLAN	1,237.00
	TOTAL	2,474.00
44. MEDICAL MANAGEMENT SYSTEMS OF		
	2026 COLLECTION FEE FROM AMBULANCE BILLINGS	9,382.42
45. MEI TOTAL ELEVATOR SERVICES		
	BUILDINGS - QUARTERLY ELEVATOR SERVICE	668.44
46. MERIDIAN TOWNSHIP RETAINAGE		
	2026 LOCAL STREET MILLING AND RESURFACING CONTRACT	76,480.60
47. MICHELLE COX		
	MILEAGE FOR MAMC EDUCATION DAY	107.01
	LUNCH FOR MAMC EDUCATION DAY	14.85
	TOTAL	121.86
48. MICHIGAN PAVING		
	2026 LOCAL STREET MILLING AND RESURFACING CONTRACT	688,325.43
49. MORRIES OKEMOS FORD		
	MP - POLICE - 720	129.95
50. MY GREEN MICHIGAN LLC		
	COMPOST SERVICE AT MARKETPLACE AUGUST 2026	177.00
51. NORTHERN WILDLIFE SERVICES, LLC		
	BUILDINGS - SERVICE CENTER - TRAPPING GROUND HOGS A	450.00
52. PEOPLEFACTS LLC		
	AUGUST CREDIT CHECK SERVICE FEE	16.67
53. PIONEER MFG.CO/PIONEER ATHLETICS		
	REPLACEMENT SOCCER NETS	632.24
	2026 - ADDITIONAL ATHLETIC FIELD PAINT	5,813.04
	TOTAL	6,445.28

Vendor Name	Description		Amount
54. PRINTING SYSTEMS INC			
	ELECTION TAB INSERTS		9.20
	POSTAGE VOTER ID CARDS		776.78
		TOTAL	785.98
55. PROGRESSIVE AE			
	2026 LAKE LANSING SAD PROFESSIONAL SERVICES CONTRAC		1,536.82
56. PRO-TECH MECHANICAL SERVICES			
	REPLACE THERMOSTAT AT HISTORICAL VILLAGE CHAPEL		452.20
57. PURITY CYLINDER GASES INC			
	HYDROSTATIC CYLINDER TEST (8-17-2026)		220.00
58. QUALITY TIRE INC			
	MP - SCRAP TIRES		97.00
	MP - POLICE STOCK		888.00
	MP - POLICE STOCK		740.00
	MP - POLICE - 721		592.00
	MOTOR POOL TIRES - 2026 1ST PO		1,076.00
	MP - POLICE STOCK		592.00
		TOTAL	3,985.00
59. REDWOOD LANDSCAPING			
	TOWNSHIP SIGN LANDSCAPING BED MAINTENANCE		288.40
	LAWN MOWING SERVICES FOR AUGUST 2026 FOR CODE ENFOR		625.00
		TOTAL	913.40
60. SAFETY KLEEN			
	MP - CLEAN PARTS WASHER		406.97
61. SCS SYSTEMS			
	EMERGENCY SEPTIC ALARM DUE TO STORMS - TOWNER ROAD		500.00
62. SPARROW PAYMENT PROCESSING CENTER			
	*NEED PROCESSED BY 8.31.26 - FOLLOW-UP TESTING FROM		648.28
63. SPARTAN BARRICADING			
	ROAD CLOSURE BARRICADING FOR 2026 CELEBRATE MERIDIA		1,134.00
64. SPINK INSULATION			
	HAND CHECK PLEASE CAHP /CHILL PROJECT FOR 3246 E		3,980.00
65. ST MARTHA CONFERENCE OF			
	EMERGENCY RENTAL ASSISTANCE		639.45
66. STAPLES			
	OFFICE SUPPLIES		1,333.24
67. STATE OF MICHIGAN			
	3RD QUARTER MDHHS - QUALITY ASSURANCE ASSESSMENT -		2,877.22
68. STEPHEN GERHART JR			
	FOOD FOR AUGUST ELECTION		515.51
	MILEAGE FOR MAMC EDUCATION DAY		107.01
		TOTAL	622.52
69. STRYKER MEDICIAL			
	STRYKER CHILD RESTRAINT SYSTEM FOR FOUR (4) AMBULAN		12,960.00
70. T MOBILE			
	CELLULAR 517.980.0920 960267378		31.35
71. USA TODAY MEDIA CORP			
	PUBLISHING		488.50
72. VARIPRO BENEFIT ADMINISTRATORS			
	2026 RETIREE MEDICARE SUPPLEMENT		20,449.80
73. VERIZON CONNECT			
	VEHICLE DATA 100000198152		1,435.50
74. VERIZON WIRELESS			
	2026 VERIZON WIRELESS MOBILE SERVICES 686304174-000		2,300.37
75. W.S. DARLEY & CO			
	FIRE HOSE (6 LENGTHS OF 1.75 IN., 50 FT. HOSE IN RE		4,099.92
76. WEST SHORE SERVICES			
	OUTDOOR WARNING SIREN REPAIR (SITE 3, 3998 VAN ATTA		2,481.00
77. YOUNG CHEVROLET OF ST JOHNS INC			
	MP - FIRE - 749		460.06

Vendor Name / Description	Amount
TOTAL - ALL VENDORS	1,053,629.96
BANK TOTALS:	
Bank GF53 FIFTH THIRD COMMON CASH	1,053,629.96

EXP CHECK RUN DATES 09/15/2026 - 09/15/2026
JOURNALIZED OPEN AND PAID
BANK CODE: PW53 - CHECK TYPE: PAPER CHECK

Vendor Name	Description	Amount
1. A+J TRAINING		
	CLASS A CDL TRAINING - STEVEN SLOAN	350.00
2. CENTRAL PARK PLACE II LLC		
	OVER PAYMENT ON FINAL - REFUND	229.27
3. FERGUSON WATERWORKS #3386		
	WATER - CURB BOX LIDS	611.50
4. GREATER LANSING TITLE & ESCROW		
	2948 COLONY DR - OVERPMT FINAL BILL	78.95
5. HYDROCORP		
	8/1/26-7/31/27 - CROSS CONNECIOTN PROGRAM SERVICES	2,844.34
6. IDC CORPORATION		
	SEWER - LIFT STATION CONTROLS MAINTENANCE 2026 - 1S	1,223.88
7. MIDWEST POWER EQUIPMENT		
	SEWER - IRRIGATION REPAIR SUPPLIES - GRAND RIVER FO	16.75
8. OLGER BROTHERS SAND & GRAVEL		
	WATER - SAND , GRAVEL & TOPSOIL 2026	860.96
	WATER - SAND , GRAVEL & TOPSOIL 2026	985.84
	TOTAL	1,846.80
9. TETRA TECH OF MICHIGAN, PC		
	2026 COMPREHENSIVE RATE STUDY	7,628.77
10. VERIZON WIRELESS		
	2026 VERIZON WIRELESS MOBILE SERVICES 686304174-000	659.16
	2026 VERIZON WIRELESS MOBILE SERVICES 686304174-000	630.14
	TOTAL	1,289.30
TOTAL - ALL VENDORS		16,119.56

BANK TOTALS:

Bank PW53 PUBLIC WORKS	16,119.56

EXP CHECK RUN DATES 09/15/2026 - 09/15/2026
JOURNALIZED OPEN AND PAID
BANK CODE: TA53 - CHECK TYPE: PAPER CHECK

Vendor Name	Description	Amount
1. BENNETT HOLDING LLC		
	2026 Sum Tax Refund 33-02-02-29-376-009	1,743.09
2. CBL PROPERTIES		
	2026 Sum Tax Refund 33-02-02-22-101-006	64,931.20
3. CLUTE RYONN		
	2026 Sum Tax Refund 33-02-02-03-406-002	2,387.54
4. DANIEL DAPKUS & LILIANA TORRES		
	2026 Sum Tax Refund 33-02-02-20-276-008	20.00
5. GREATER LANSING TITLE & ESCROW		
	2026 Sum Tax Refund 33-02-02-04-401-003	2,894.70
6. WAGENKNECHT, LARRY & AMY		
	2026 Sum Tax Refund 33-02-02-02-412-004	94.90
TOTAL - ALL VENDORS		72,071.43

BANK TOTALS:

Bank TA53 TRUST & AGENCY	72,071.43

Transaction Date	Account Name	Transaction Amount	Transaction Merchant Name
2026/08/27	ROBERT STACY	$9.70	THE HOME DEPOT #2723
2026/08/31	ROBERT STACY	$123.81	SITEONE LANDSCAPE SUPPLY,
2026/08/27	TYLER KENNELL	$224.15	GRAINGER
2026/08/26	TYLER KENNELL	$320.91	THE HOME DEPOT #2723
2026/08/27	TYLER KENNELL	$49.86	THE HOME DEPOT #2723
2026/08/28	TYLER KENNELL	$10.48	THE HOME DEPOT #2723
2026/08/31	TYLER KENNELL	$224.07	GRAINGER
2026/09/04	TYLER KENNELL	$51.45	THE HOME DEPOT #2723
2026/09/03	TYLER KENNELL	($46.36)	GRAINGER
2026/08/28	MICHAEL HAMEL	$500.82	NFPA NATL FIRE PROTECT
2026/09/05	MICHAEL HAMEL	($3.43)	ETSY.COM*RUSTICBUCKEYEWW
2026/09/04	MICHAEL HAMEL	$649.00	MAGNUM ELECTRONICS INC
2026/09/06	MICHAEL HAMEL	$47.89	AMAZON MKTPL*5365T5P72
2026/09/04	MICHAEL HAMEL	$57.19	ETSY.COM*RUSTICBUCKEYEWW
2026/09/08	MICHAEL HAMEL	$839.04	AMAZON.COM*5L52844I1
2026/08/27	JACOB FLANNERY	$55.93	THE HOME DEPOT #2723
2026/08/31	JACOB FLANNERY	($36.85)	SITEONE LANDSCAPE SUPPLY,
2026/08/31	JACOB FLANNERY	$664.82	THE HOME DEPOT 2723
2026/08/31	JACOB FLANNERY	$8.92	THE HOME DEPOT #2723
2026/09/01	JACOB FLANNERY	$1.48	THE HOME DEPOT #2723
2026/09/02	CHRISTOPHER JOHNSON	$50.87	JETS PIZZA - MI-053 MOTO
2026/08/28	BRIAN PENNELL	$350.00	STATE OF MI EMS
2026/08/26	KATIE LOVE	$604.86	BWL*10268221
2026/08/27	ANGELA DEMAS	$41.04	TST*MAX & EMILYS EATERY
2026/09/01	DERRICK BOBB	$47.79	THE HOME DEPOT #2723
2026/09/04	ROBERT CARETTI	$74.29	WAL-MART #2866
2026/09/06	ROBERT CARETTI	$162.93	AMAZON MKTPL*539J02PB0
2026/09/05	CHARLES MALESKO	$22.97	MEIJER STORE #025
2026/09/05	CHARLES MALESKO	$87.73	THE HOME DEPOT 2723
2026/08/26	RICHARD GRILLO	$21.00	FACEBK *5LJZG46CK4
2026/08/27	RICHARD GRILLO	$21.00	FACEBK *ZU7KP3JCK4
2026/08/29	RICHARD GRILLO	$35.99	AMAZON MKTPL*5Q4YM2O42
2026/08/28	RICHARD GRILLO	$29.00	FACEBK *MQQMW3ECK4
2026/08/30	RICHARD GRILLO	$120.00	VRC COMPANIES LLC
2026/08/31	RICHARD GRILLO	$29.00	FACEBK *9J8K26SCK4
2026/09/01	RICHARD GRILLO	$29.00	FACEBK *RTTTB4JCK4
2026/08/31	YOUNES ISHRAIDI	$96.90	INDUSTRIAL STORM WATER
2026/08/26	KEITH HEWITT	$70.97	MIDWEST POWER EQUIPMENT
2026/08/31	KEITH HEWITT	$103.29	CATHEY CO
2026/09/02	MICHELLE PRINZ	$205.00	WEB*MLIVE.COM
2026/08/31	MICHELLE PRINZ	$64.10	OFFICEMAX/OFFICEDEPT#3379
2026/08/30	CATHERINE ADAMS	$22.98	AMAZON MKTPL*5Q3497BY1
2026/09/02	ED BESONEN	$27.40	TST* THE TWISTED FORK RES
2026/09/02	ED BESONEN	$25.16	TST* THE TWISTED FORK RES
2026/09/02	ED BESONEN	$55.23	THE CABIN BAR
2026/09/02	ED BESONEN	$108.78	COMFORT INNS
2026/09/04	ED BESONEN	$34.00	BUFFALO WILD WNGS 3049
2026/09/01	BART CRANE	$55.00	SAFE KIDS WORLDWIDE
2026/09/07	BART CRANE	$74.16	AMAZON MKTPL*531JY0510
2026/09/03	DAN PALACIOS	$127.48	THE HOME DEPOT #2723
2026/08/29	ROBERT MACKENZIE	$297.32	AMAZON MKTPL*5Q8NR4LL2
2026/09/02	ROBERT MACKENZIE	$95.00	EGLE DW TRAIN AND CERT
2026/09/04	ROBERT MACKENZIE	$173.25	AMAZON MKTPL*5329X8PP1
2026/09/04	ROBERT MACKENZIE	$206.90	AMAZON MKTPL*533VU3X41

2026/09/01	SAMANTHA DIEHL	$206.28	GB* CENTRAL STATES REG
2026/08/31	SAMANTHA DIEHL	$22.11	HOBBY LOBBY #360
2026/08/31	THOMAS BAKER	$59.98	MIDWEST POWER EQUIPMENT
2026/09/03	THOMAS BAKER	$13.40	MENARDS LANSING SOUTH MI
2026/09/03	THOMAS BAKER	$94.95	THE HOME DEPOT #2723
2026/08/26	COURTNEY WISINSKI	$142.32	SQ *FERAL FLORA
2026/08/26	COURTNEY WISINSKI	$261.22	FORESTRY SUPPLIERS INC
2026/08/27	COURTNEY WISINSKI	$550.00	SWANK MOTION PICTURES IN
2026/08/27	COURTNEY WISINSKI	$67.35	QUALITY DAIRY#31
2026/08/27	COURTNEY WISINSKI	$5.18	QUALITY DAIRY#31
2026/08/28	COURTNEY WISINSKI	$475.00	SQ *PLANET X
2026/08/27	COURTNEY WISINSKI	$27.94	THE HOME DEPOT #2723
2026/09/04	COURTNEY WISINSKI	$70.97	MEIJER STORE #025
2026/09/04	COURTNEY WISINSKI	$410.06	PY *NEXSTAR
2026/09/08	COURTNEY WISINSKI	$118.28	MEIJER STORE #025
2026/08/26	ASHLEY WINSTEAD	$624.84	AMWAY GRAND PLAZA HOTE
2026/09/04	ASHLEY WINSTEAD	$36.54	AMAZON RETA* 530947PV1
2026/09/03	ASHLEY WINSTEAD	$471.37	COSTAR GROUP INC
	TOTAL	$10,981.06	

ACH Transactions

8/27 - 9/9

Date	Payee		Amount	Purpose
9/2/2026	Consumers Energy	$	63,052.41	Utility Transactions Fees
9/2/2026	Various Financial Institutions	$	387,902.41	9/4 Direct Deposit
9/2/2026	EyeMed	$	3,308.42	Employee Vision Insurance
9/2/2026	Blue Care Network	$	29,822.90	Employee Health Insurance
9/3/2026	IRS	$	136,645.48	9/4 Payroll Deductions
9/4/2026	Nationwide	$	12,362.91	Employee Retirement
9/8/2026	State of Michigan	$	20,971.77	Payroll Taxes
9/8/2026	EmPower	$	68,742.77	Employee Retirement
9/9/2026	Invoice Cloud	$	3,135.10	Online Transaction Fees
9/9/2026	WageWorks	$	93.00	COBRA Admin Fee
9/9/2026	Health Equity Fee	$	9.80	Employee Health Savings
9/10/2026	Blue Care Network	$	38,937.21	Employee Health Insurance
	Total ACH Payments	**$**	**764,984.18**	

To: **Township Board**

From: **Bernadette Blonde, Finance Director**

Date: **September 11,2026**

Re: **L-4029 2026 Tax Rate Request**

Attached is the 2026 L-4029 (Tax Rate Request) form for your review and approval. This form certifies the millage rates to be levied for the Township and must be submitted to the County Equalization Department and local taxing jurisdictions on or before September 30, 2026.

The following motion is prepared for Board consideration:

MOVE THAT BOARD APPROVE THE ATTACHED 2026 L-4029 AND AUTHORIZE THE CHAIRPERSON AND CLERK TO SIGN THE DOCUMENT FOR SUBMISSION.

Michigan Department of Treasury
614 (Rev. 07-25)

ORIGINAL TO: County Clerk(s)
COPY TO: Equalization Department(s)
COPY TO: Each township or city clerk

L-4029

2026 Tax Rate Request **(This form must be completed and submitted on or before September 30, 2026)**

MILLAGE REQUEST REPORT TO COUNTY BOARD OF COMMISSIONERS

Carefully read the instructions on page 2.

This form is issued under authority of MCL Sections 211.24e, 211.34 and 211.34d. Filing is mandatory; Penalty applies.

County(ies) Where the Local Government Unit Levies Taxes	2026 Taxable Value of ALL Properties in the Unit as of 5-26-2026
Ingham	**2,505,171,497**
Local Government Unit Requesting Millage Levy	**For LOCAL School Districts: 2026 Taxable Value excluding Principal Residence, Qualified Agricultural, Qualified Forest, Industrial Personal and Commercial Personal Properties.**
Meridian Charter Township	**Not Applicable**

This form must be completed for each unit of government for which a property tax is levied. Penalty for non-filing is provided under MCL Sec 211.119. The following tax rates have been authorized for levy on the 2026 tax roll.

(1) Source	(2) Purpose of Millage	(3) Date of Election	(4) Original Millage Authorized by Election Charter, etc.	(5)** 2025 Millage Rate Permanently Reduced by MCL 211.34d "Headlee"	(6) 2026 Current Year "Headlee" Millage Reduction Fraction	(7) 2026 Millage Rate Permanently Reduced by MCL 211.34d "Headlee"	(8) Sec. 211.34 Truth in Assessing or Equalization Millage Rollback Fraction	(9) Maximum Allowable Millage Levy *	(10) Millage Requested to be Levied July 1	(11) Millage Requested to be Levied Dec. 1	(12) Expiration Date of Millage Authorized
Charter	Operating	12/1959	5.0000	4.1116	0.9971	4.0996	1.0000	4.0996	0.0000	4.0996	None
Extra-Voted Millage	Debt (Streets)	8/2019	1.9429	Not Applicable	1.0000	Not Applicable	1.0000	1.9429	0.0000	1.9429	None
Extra-Voted Millage	Community Services	8/2022	0.1483	0.1465	0.9971	0.1460	1.0000	0.1460	0.0000	0.1460	12/2031
Extra-Voted Millage	Police Protection	11/2020	0.6016	0.5948	0.9971	0.5930	1.0000	0.5930	0.0000	0.5930	12/2035
Extra-Voted Millage	Fire Protection	11/2020	0.6339	0.6267	0.9971	0.6248	1.0000	0.6248	0.0000	0.6248	12/2035
Extra-Voted Millage	Land Preservation	11/2020	0.1000	0.0987	0.9971	0.0984	1.0000	0.0984	0.0000	0.0984	12/2029
Extra-Voted Millage	Police and Fire Protection	8/2017	1.4830	1.4606	0.9971	1.4563	1.0000	1.4563	0.0000	1.4563	12/2026
Extra-Voted Millage	Debt (Fire Station)	11/2012	0.2000	Not Applicable	1.0000	Not Applicable	1.0000	0.2000	0.0000	0.0000	8/2028
Extra-Voted Millage	Pathways	8/2016	0.3333	0.3270	0.9971	0.3260	1.0000	0.3260	0.0000	0.3260	12/2028

Prepared by	Telephone Number	Title of Preparer	Date
Ashley J. Winstead	517-853-4404	Assessor	June 16, 2026

CERTIFICATION: As the representatives for the local government unit named above, we certify that these requested tax levy rates have been reduced, if necessary to comply with the state constitution (Article 9, Section 31), and that the requested levy rates have also been reduced, if necessary, to comply with MCL Sections 211.24e, 211.34 and, for LOCAL school districts which levy a Supplemental (Hold Harmless) Millage, 380.1211(3).

	Signature	Print Name	Date
[X] Clerk / [ ] Secretary		Angela Demas	
[x] Chairperson / [ ] President		Scott Hendrickson	

**Under Truth in Taxation, MCL Section 211.24e, the governing body may decide to levy a rate which will not exceed the maximum authorized rate allowed in column 9. The requirements of MCL 211.24e must be met prior to levying an operating levy which is larger than the base tax rate but not larger than the rate in column 9.*

**** IMPORTANT:** See instructions on page 2 regarding where to find the millage rate used in column (5).

Local School District Use Only. Complete if requesting millage to be levied. See STC Bulletin 2 of 2026 for instructions on completing this section.	
Total School District Operating Rates to be Levied (HH/Supp and NH Oper ONLY)	Rate
For Principal Residence, Qualified Ag, Qualified Forest and Industrial Personal	
For Commercial Personal	
For all Other	

To: **Board Members**

From: **Bernadette Blonde, Finance Director**

Date: **September 11, 2026**

Re: **Auditing Services Contract**

In accordance with the Township's purchasing policy, a Request for Proposals (RFP) was issued for independent auditing services for the fiscal years ending 2026, 2027, and 2028, with options to renew for up to two additional one-year terms. The purpose of the competitive procurement process is to periodically evaluate available audit service providers, confirm competitive pricing, and ensure the Township continues to receive high-quality professional services.

The Township received nine proposals from qualified accounting firms. Proposals were evaluated based on several factors, including governmental auditing experience, qualifications and technical expertise, staffing resources, audit approach, references, responsiveness to the RFP requirements, and cost.

Below list the proposed fees for Financial Statement Audit:

Firm	2026	2027	2028	Total
AHP	$55,125	$56,700	$58,400	$170,225
BHM CPA Group	$49,725	$51,952	$54,290	$155,967
Clark Schaefer Hackett	$50,000	$52,520	$54,621	$157,141
Eide Bailly	$84,500	$89,400	$93,900	$267,800
Gabridge & Co	$59,800	$61,600	$63,500	$184,900
Maner Costerisan	$53,900	$55,900	$57,900	$167,700
Morgan & Associates	$25,950	$26,500	$27,000	$79,450
Rehmann	$68,750	$70,800	$72,900	$212,450
Yeo & Yeo	$48,000	$49,500	$51,000	$148,500

*Single Audit, if required, are not included in above table

Based on the overall evaluation of qualifications, governmental experience, staffing resources, audit approach, references, and cost, staff determined that Yeo & Yeo offers the best value to the Township. Although not the lowest-cost proposal, Yeo & Yeo's fees are highly competitive and are the second lowest among the nine proposals received. Staff believes the firm's depth of governmental experience and available resources provide the greatest assurance of a quality audit engagement and long-term value to the Township.

A motion is prepared for Board consideration:

MOVE THAT THE TOWNSHIP BOARD APPROVE THE SELECTION OF YEO & YEO AS AUDITORS FOR MERIDIAN TOWNSHIP AND AUTHORIZE THE TOWNSHIP MANAGER TO SIGN A THREE-YEAR CONTRACT FOR FISCAL YEARS 2026, 2027 and 2028.

To: **Board Members**

From: **Dan Opsommer, Deputy Township Manager**
Director of Public Works and Engineering

Date: **September 8, 2026**

Re: **Hydraulic Passenger Elevator Modernization and Preventative Maintenance Contract Awards**

Township staff, with the professional assistance of VDA Inc., a leading vertical transportation consulting and inspection company that specializes in elevators, escalators, and moving walks, recently requested proposals to bring the Township's two existing elevators up to current code, including new requirements under the American with Disabilities Act.

The Township received two bids on this RFP. The low bid was from MEI Michigan in the amount of $367,883. MEI Michigan has performed all of the Township's elevator maintenance for many years now to our satisfaction. Given our experience working with MEI Michigan, Township staff are very comfortable awarding this contract to MEI Michigan. Township staff recommend awarding this contract in the amount of $367,883 to the low bidder.

The Board approved funding for this project in the 2026 Township Budget. This project shall be funded out of account #: 401-900.901-974.000 in the Capital Project Fund.

We are happy to answer any questions the Board may have.

The following motions have been prepared for the Board's consideration:

MOVE TO APPROVE THE CONTRACT WITH MEI MICHIGAN IN THE AMOUNT OF $367,883 AND DIRECT THE TOWNSHIP SUPERVISOR TO EXECUTE THE CONTRACT.

MOVE TO APPROVE THE PREVENTATIVE MAINTENANCE AGREEMENT AND DIRECT THE TOWNSHIP SUPERVIOSR TO EXECUTE THE CONTRACT.

Attachment:

1. Hydraulic Passenger Elevator RFP Bid Analysis Report
2. Hydraulic Passenger Elevator Preventative Maintenance Agreement
3. Hydraulic Passenger Elevator RFP
4. Hydraulic Passenger Elevator RFP Technical Specifications
5. Hydraulic Passenger Elevator RFP General Conditions

September 8, , 2026 UPDATED

VIA E-MAIL:
opsommer@meridian.mi.us

Mr. Dan Opsommer, Deputy Township Manager
Meridian Township
5151 Marsh Road
Okemos, Michigan 48864

Re: Meridian Township, 5151 Marsh Road, Okemos, MI
Modernization Bid Analysis – Two (2) Hydraulic Elevators
VDA No. 82329

Dear Mr. Opsommer:

Pursuant with the next steps in supporting the above-mentioned project's scope requirements, we have outlined herein a bid analysis taken strictly from the recently received RFP submittals that is purely subjective in nature.

Based on the market in which we were drawing from, and the vintage of equipment in which we were requesting, the most qualified bidders brought to RFP status were MEI Elevator and Elevator Service.

The base bid requirement established by the specification was the following:

Modernize Two (2) Hydraulic Elevators:

- New Third Party Controller
- New Door Operator
- New Fixtures
- New Car Door
- New Wiring
- All Related Work
- Hydraulic Jack Assembly (Administration Building Only)

Should you have any questions after reviewing this report, please contact our office.

Very truly yours,

Pete Long
Senior Associate

PL/gb
Enclosure

Project Name: 82329-Meridian Township, 5151 Marsh Road, Okemos-Meridian Township

VDA Project No.: 82329

Date: August 24, 2026

BID ANALYSIS & COMPARISON

Bidders	Bidder 1-MEI	Bidder 2-ESI
Modernization Pricing (Elevator Trade)	$ 305,386.00	$ 343,762.00
Related Trade Work (Turn-Key) (Included in Base)	$ 62,497.00	$ 163,850.00
Warranty Maintenance (Included in Base)		
Total Base Bid Pricing:	**$ 367,883.00**	**$ 507,612.00**
Schedule		
Leadtime for Site Survey/Engineering	3.0	4.0
Lead Time for Submittals/Approval Drawings	4.0	4.0
Lead Time for Materials After Approvals	10.0	12.0
Installation Time - Car # TOWNSHIP	6.0	8.0
Installation Time - Car # POLICE	4.0	5.0
Installation Time - Car #	N/A	N/A
Total Project Length (weeks):	**27.0**	**33.0**
Alternate No. 1 Description WBO Deduct	$(14,747.00)	N/A
Change in Schedule (Per Unit)	N/A	N/A

Interim and Maintenance Pricing	Bidder 1-MEI	Bidder 2-ESI
Interim Maintenance Pricing (Per Month)	$ 222.66	$ 680.00
Long Term Maintenance Pricing (Per Month)	$ 500.00	$ 600.00
Long Term First Year Annual Price (total)	$ 6,000.00	$ 7,200.00
Hourly Rates (Modernization Project) - Additional Work		
Modernization Mechanic - Regular Time	$ 395.00	$ 170.00
Modernization Mechanic - Premium Only Time	$ 676.00	$ 400.00
Modernization Team (Mech + Helper) - Regular Time	$ 790.00	$ 315.00
Modernization Team (Mech + Helper) - Premium Only Time	$ 990.00	$ 700.00
Modernization Team (Mech + Helper) - Double Time	$ 1,352.00	$ 750.00
Other Bid Related Notes		
Clarifications (Contract and Terms)	See MEI Tab	See ESI Tab
Clarifications (Scope of Work or Elevator Spec)	No Well Drilling	Included/Qualified
Clarifications (Maintenance & Warranty)	See MEI Tab	See ESI Tab
Equipment Details		
Per Specifications	Per Specifications	Per Specifications
Summary of Pricing (With Alternates/Other Calculations)	**Bidder 1-MEI**	**Bidder 2-ESI**
Base Price (From Above)	$ 367,883.00	$ 507,612.00
Alternate No. 1	$ (14,747.00)	N/A
Total Contract Price (Dependent on Selections)	**$ 353,136.00**	**$ 507,612.00**
Total Project Duration (Weeks)	**27.0**	**33.0**

MEI Elevator

MEI Elevator provided a base bid of $367,883 including Related Work.

Final pricing prior to best & final pricing with the added alternate is:

Base bid without related work	$305,386
Related Work:	$62,497
Alternate No. 1	
Deduct for WBO option	$(14,747)
Total:	**$353,136.00**

Elevator Service

Elevator Service provided a base bid of $507,612, including Related Work.

Final pricing prior to best & final pricing with the added alternate is:

Base bid without related work	$507,612
Related Work:	$Included in number shown above
Total:	**$507,612.00**

BID COMPARISON UPDATE KEY POINTS: (see August 26, 2026 email for additional information)

1) Should we negotiate the lump sum price for the hydraulic Cylinder Sleeve alternative now as well? **I have met with MEI and the cost of the sleeve is included in their base bid.**
2) Maintenance Pricing: See email dated 9/1/26 that contains an updated post modernization agreement for service from MEI. **This quate matches your current coverage and pricing level.**

Notes from 8/26 email:
I put together the attached bid tab to assist me in comparing the two bids we received. We are very comfortable awarding the contract to MEI as they have done all of our elevator work for many years now. **MEI will by my recommendation as well. They did not include a well drilling number for the Administration Elevator. Elevator Service did. With the amount ESI used for well drilling added to the MEI quote, the MEI number is still the better number of the two. I would be the most comfortable if we negotiate a lump sum price with MEI on the well drilling ahead of awarding the contract so we get a fair price. Is this something VDA could work on with MEI before we put this contract award in front of the Township Board? Absolutely will assist with this. I had taken the liberty of reaching out to MEI for a firm quote on the drilling. They expect to have that to me in the next two days. It is important to note that if the Administrative Elevator has an existing casing we can work**

with the State of Michigan in allowing a Hydraulic Cylinder Sleeve that will have a cost associated with it, but much more economical than drilling. Should we negotiate the lump sum price for the hydraulic Cylinder Sleeve alternative now as well?

Some questions for you:

1. For bid items F, G, and H, I assume this is the monthly amount we would pay is simply to have them on standby and then we would pay the hourly rates listed in exhibit A of the bid in addition to the monthly amount, correct? **Those amounts are for the monthly maintenance of the elevators. F & G are included in the base bids. H is for maintenance after the modernization warranty period is complete. The hourly rates are for additional work out side of the Mod or Maint. My understanding is that our elevators only have to be serviced and examined every 90 days under Michigan Administrative Code R. 408.7025? Is that incorrect and we're required to do it monthly, or are you simply recommending that we do monthly? Our General Fund is really tight right now, so we would prefer to stay with quarterly unless we're legally obligated to do monthly. The price is better than what MEI is currently charging us per quarter ($668.44), so that is good. If we are legally only obligated to do quarterly servicing and examination, can you ask MEI if they would honor the $500 price? I don't see why the price would change as it's still just the cost to come out and service and examine both elevators one time. Quarterly is the code required visitation schedule. The elevator companies price jobs on a monthly basis. Cost difference on maintenance comes down to the coverage. You have a lubrication and inspection contract in place now. Once the warranty expires, 12 months after turnover of the elevator, Full Maintenance should be considered, but if operationally everything is running reliably, Lubrication and Inspection coverage can certainly be considered. I will get this clarified with MEI as well. Thank you for the clarification. If you could just get quarterly pricing, then we will have both options available and can continue to discuss the pros and cons.**
2. For the monthly deduction for elevator cars being out of service, I assume the monthly deduction does not kick in until after the amount of time the contractor listed under bid items E.1.-E.4., correct? Is it by the specific car, or the total weeks between the two cars? **That number is the deduct when a car is removed from service for the modernization. It is a per car price.**
3. This is my oversight on the initial RFP review, but it doesn't appear that we have a completion clause. How do we compel the contractor to complete the project by a certain timeframe? **The contractors are used to penalty clause. We (VDA) always ask for $500 per day past an agreed upon schedule. The elevator contractors usually want to negotiate the amount. We can certainly have that conversation and get a clause in place for this project. Please negotiate this prior to us presenting the contract for award. Got it. I will work directly with MEI on the open issues. Let me know if you have any additional questions.**

END OF REPORT

MEI TOTAL ELEVATOR SOLUTIONS

Michigan Office
12499 Belden Ct.
Livonia, MI 48150
Phone: (248)486-4017 Fax: (248)446-8444
www.meiusa.com

PREVENTATIVE MAINTENANCE AGREEMENT

This Maintenance Agreement ("***Agreement***") is proposed as of this 31th day of August , 2026 (the "***Effective Date***") between MEI Total Elevator Solutions ("***MEI***"), and ***"Customer":*** MERIDIAN, CHARTER TOWNSHIP OF, 5151 MARSH RD, OKEMOS, MI 48864. MEI and Customer are collectively referred to herein as the "***Parties***" or individually as a "***Party***". MEI proposes to furnish certain maintenance services to Customer as provided herein.

Equipment/Service Frequency:

Elevator Name	Building Address	Elevator ID or Serial #	Elevator Type	Elevator Style	Service Frequency
MERIDIAN TWP MUNICIPAL	5151 MARSH RD	14617	HYDRO	PASSENGER	QUARTERLY
MERIDIAN TWP PUBLIC SAFETY	5147 MARSH RD	27847	HYDRO	PASSENGER	QUARTERLY

Agreement

1. SERVICES

Subject to the provisions of this Agreement, MEI will perform the services described below for the benefit of Customer (the "***Services***"). If Customer requests services not covered by this Agreement, Customer agrees to pay MEI for such additional Service at MEI's then-current rates. MEI may agree with Customer to provide additional scheduled services, in which case additional maintenance agreements may be signed. Services will be provided pursuant to the terms and conditions in this Agreement and MEI's Terms and Conditions (the "***T&C***").

2. SERVICE FEES

Customer shall pay to MEI the amount of $2,671.92 per year during the first year of the Initial Term, payable on the following frequency: **$2,671.92/Year**. Thereafter, Customer shall deliver to MEI payments in the amount of MEI's then-current rates for the Services ("Service Fees"), payable in the same frequency specified above. All pricing is exclusive of applicable taxes and shall be adjusted by MEI on an annual basis. This proposed pricing is only valid if signed within ninety (90) days from date of proposal as stated in the first page of this Agreement.

3. TERM AND TERMINATION

Each of the Services will be provided for the term starting on 09/01/2026 and continuing for 36 months thereafter (the "***Initial Term***"). Upon expiration of the Initial Term, the term shall automatically renew for successive thirty six (36) month terms (each a "***Renewal Term***", and together with the Initial Term, "***Term***"), unless either Party gives the other Party written notice of its intent not to renew at least ninety (90) days prior to the expiration of the then-current Term.

If, at any time, the Customer reasonably determines that MEI is not conducting their service at a level of competency or effort consistent with the general standards or customs of the Agreement, the Customer shall have the right to terminate this Agreement. Before terminating, the Customer must notify MEI in writing, of any grievances. If grievances cannot be remedied within 45 business days, purchaser has the right to terminate the Agreement with a 30-day written notice.

4. PAYMENT TERMS

All Service Fees are due and payable to MEI on a Net 30-day basis. If Customer fails or refuses to pay MEI all or any part of the Services Fees when due, MEI may use any remedy specified in the T&C. Service Fee invoices issued under this Agreement will be billed as of the first business day of the Service cycle, for Services to be performed during said cycle. Invoices issued under this Agreement for additional work will be billed as the work is performed and are due and payable to MEI on a Net 30-day basis.

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Livonia, MI 48150
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5. DESCRIPTION OF SERVICES

MEI will provide the following services as applicable by equipment type except as excluded within this contract:

- Lubricate Components as required
- Inspection of:
  - Door equipment
  - In-Cab operating panel, inclusive of floor designation buttons, switches, position indicator, emergency alarm bell and lights
  - Light curtains (Customer is responsible for wiping and keeping lenses clean. Using liquids is not recommended)
  - Cartop equipment
  - Rails & rail brackets
  - Fasteners
  - Slide and roller guides
  - Slow down and limit switches
  - Hall station fixtures, buttons and light bulbs
  - Hoistway
  - Elevator pit and pit devices (Debris removal from pits is not included in this Agreement. MEI will work with Customer to negotiate a resolution)
  - Traveler cables
  - Door closers
  - Door hanger rollers
  - Door gibs
  - Secondary fire/explosion retainers
  - Hydraulic jack and piston
  - Elevator sills where not accessible to non-qualified personnel (Customer is responsible for keeping sills free of debris)
  - Controllers, including relays, resistors, contacts, coils, leads, transformers, timing devices and solid-state components.
- Inspection and testing of in-cab emergency phone
  - Trouble shooting due to inoperable or faulty phone lines will be billable at current charge out rates.

MEI will provide Customer with proposals for any repairs/upgrades required, or recommended, on the equipment.

Except as set forth herein, no services, parts or other work is included or intended by this agreement. The equipment consists of mechanical and electrical devices subject to wear and tear, deterioration and malfunction as a result of causes out of our control. The Services do not guarantee against failure of or malfunction, but are intended to reduce wear and tear and pro-long life of equipment.

MEI has no liability or responsibility for the following items of elevator equipment: rail alignment, car enclosure (including removable panels, door panels, car gates, plenum chambers, hung ceilings, light diffusers, light ballasts, light tubes and bulbs, handrails, mirror and floor coverings); hoistway, inserts, brackets, gates, doors, frames and sills; cylinders, plungers and buried equipment; smoke or heat sensors; sump pumps, ventilation equipment, electrical feeders and main line disconnects; emergency bells, batteries, battery packs, battery lowering, battery back-up and emergency power systems; security access, card reader, security camera systems; fire alarm systems, car lighting, machine room lighting, pit lighting, emergency lighting, emergency phone or emergency phone wiring; or machine room and hoistway temperature control systems and failure of any and all equipment resulting from failure or inadequate operation of temperate control systems.

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6. WORK HOURS/CALLBACKS

MEI's 24-hour elevator service center will dispatch a technician to perform emergency minor adjustment callback service when contacted in the event of an untimely elevator malfunction. Customer will be charged according to the callback service coverage defined within this section of the Agreement. If Customer cancels the callback service after the technician is dispatched, Customer will only be invoiced for the time and travel incurred by the technician.

The Services listed above will be performed during MEI's normal working hours (8am-4:30pm Monday through Friday, excluding holidays). If Customer desires examination or minor adjustment callback service, the customer will be charged for the service at MEI's then-current Regular, Overtime or Double Time hourly billing rates for each hour worked.

7. ADDITIONAL TERMS

The provision of the Services and payment therefore is subject to, and Customer agrees to be bound by the T&C as published by MEI from time to time, a current copy of which is attached hereto. This Agreement: (i) may be executed in counterparts, including electronic counterparts, each of which shall be deemed an original but all of which shall be deemed one and the same Agreement; (ii) is binding upon and inures to the benefit of MEI and Customer and their respective successors, transferees, or assignees; (iii) together with the T&C, constitutes the entire agreement between the Parties with respect to the subject matter hereof, superseding all prior agreements, representations, communications and understandings, oral or written; and (iv) may not be amended except by a written agreement signed by both Parties. If there is a conflict between the terms of this Agreement and the T&C, the Agreement shall govern and supersede the T&C.

8. SPECIAL CONDITIONS

The following is a list of (a) additional services that will be included within the Services; or (b) products or services that are excluded from the Services, within the scope of the Agreement:

Special Conditions by Elevator:

ID	Elevator Name	Elevator Description	Manufacturer	Elevator Type	TESTS	
					Cat1	Cat3
1	MERIDIAN TWP MUNICIPAL	MI14617	OTIS	HYDRO	☑	☑
2	MERIDIAN TWP PUBLIC SAFETY	MI27847	DOVER	HYDRO	☑	☑

☑ = Included

Cat1 (No Load Safety Test) - This test is completed annually in accordance with ASME A17.1 standards.
Cat3 (Full Load Safety Test) - Performed with a rated load and speed, completed every 3 years, in accordance with ASME A17.1 standards.

- Phone monitoring is not included in this agreement. It is the responsibility of the customer to provide and maintain phone monitoring service.

9. CREDIT AUTHORIZATION

By signing this Agreement, Customer hereby applies for credit and affirms financial responsibility, ability and willingness to pay invoices in accordance with the terms of this Agreement. The provided information is warranted to be true and complete. Customer hereby authorizes MEI to verify and collect information on Customer, including, but not limited to, bank references, trade credit references, consumer and/or commercial credit reports. Customer agrees to pay: (i) a monthly finance charge equal to the maximum applicable state rate on all past due balances; and (ii) all costs of collection and attorney's fees incurred by MEI arising from any default by Customer under this Agreement.

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Customer agrees that all decisions with respect to the extension or continuation of credit shall be in the sole discretion of MEI.

IN WITNESS WHEREOF, each Party represents that it has caused this Agreement to be executed by an authorized agent or representative who, on the date of such signing, has the necessary authority, corporate, municipal, or otherwise, to bind the Party. By signing below, Customer agrees to engage MEI to perform the Services in accordance with this Agreement and the T&C, and agrees to pay for all Services.

MEI Total Elevator Solutions	Accepted by: **(CUSTOMER)**
By: _____	By: _____
Signature: _____	Signature: _____
Title: _____	Title: _____
Date: _____	Date: _____

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MEI TERMS AND CONDITIONS ("T&C")

1. Purchase and Payment. Pursuant to the applicable Maintenance Agreement, purchase order or quote (collectively, ***"Agreement"***), Customer agrees to purchase, the Product or Services described in the Agreement. Except as defined herein, all capitalized terms have the meaning ascribed to them in the Agreement. Customer agrees to pay all sums specified in the Agreement within 2 days of the due date, without any deduction or setoff. MEI reserves the right to: (i) apply fuel surcharges as applicable and necessary when rates of these goods exceed the normal allowances calculated into a service Schedule; and (ii) add all applicable taxes as prescribed by law. Customer shall pay any and all of Customer's third-party vendor fees, such as accounts receivable / payable administrators. All credit card payments made by Customer may be subject to the addition of credit card processing fees. If customer elects to pay MEI by credit card, Customer agrees to these fees. Customer agrees to receive MEI's invoices electronically, and if Customer requires other delivery, shall pay MEI's then-current delivery fee.

2. Standard Warranty. MEI warrants that any new Product, including materials and equipment to be furnished as part of the Product, shall be of good quality, in conformance with all legal requirements, and will be free from defects in material and workmanship for twelve (12) months from the date of installation (the ***"Standard Warranty"***). Any refurbished parts, if available, carry a warranty that such parts shall be of good quality and free from defects in materials and workmanship for a period of ninety (90) days from installation. This Standard Warranty shall not apply to: (i) any Product that has been subject to misuse, misapplication, neglect (including without limitation improper maintenance and storage), accident, improper installation, modification (including without limitation use of unauthorized parts of attachments), adjustment or repair; or (ii) damage, loss, or diminution of or to any Product related to normal wear and tear, or usage of wear parts. (iii) damage caused by disasters such as fire, flood, wind, lightning, electrical surge or power outage; (iv) corrosion from exposure to liquids or atmospheres; (v) any parts or components installed or modified by a non-MEI mechanic during the term or extended term of the Agreement with MEI; or (vi) Customer's failure to properly clean or care for the Product. Notwithstanding any contrary provision or agreement, MEI's maximum liability for Products, whether in contract, negligence, or strict liability in tort, is limited to the repair or replacement of the Product at issue, or the parts thereof.

3. Service Terms and Conditions.

(a) **Excluded Services.** Except as specified in the Agreement, the Services specifically exclude the following, which at Customer's option may be performed separately by MEI at MEI's then-current rates: (i) repairs or damage related to Customer negligence, misuse of the Services; (ii) repairs required as a result of persons other than MEI's authorized representatives performing any maintenance, modification, or relocation of any equipment, accessories, products, or software necessary to MEI's performance of Services; (iii) repair or damages to Customer's property (real or personal) necessitated by or related to accident, theft, unexpected loss, abuse, electrical power failure, flood, fire, lightning, or corrosive environments; (iv) repairs or service calls necessitated by complete or partial failure of transmission medium (ie telephone lines, computer networks, or worldwide web) or for equipment malfunction caused by such transmission medium, or interference caused by third parties beyond the control of MEI, power surges, liquids, or repair or maintenance of a transmission line; (v) Customer initiated reprogramming of or interference with any equipment, custom or special products, or software necessary to MEI's performance of Services. MEI specifically excludes any equipment defined by MEI as proprietary/single source, including but not limited to software (including software upgrades), service and diagnostic tools, removable electronic media devices, proprietary suspension traction equipment and any/all additional software, equipment, manuals or procedures not available and/or deemed obsolete by the OEM. MEI has no liability or responsibility for problems arising from building compression, shifting hoistway enclosures, or for damage resulting from the performance of any safety test. MEI is not responsible for any defects in design or installation or for abuse to the equipment which occurred prior to maintenance by MEI, whether or not such defects in design or installation or abuse are observed by MEI prior to commencement of Services.

(b) **Customer's Obligations.** Customer shall: (i) furnish and maintain a dedicated phone line for use with the emergency phone in the elevator cab, assure such phone lineâ€™s continuous operation for emergency phone use, notify MEI of any problems that occur with this line, and Customer will immediately correct any problems; (ii) when required by applicable code, furnish and maintain a dedicated data/internet connection (with code compliant backup power) for use with the emergency two-way video/visual communication device(s) in the elevator cab, insure its continuous operation for emergency use, notify MEI of any problems that occur with this connection, and Customer will immediately correct any problems. Any charges imposed by a 3rd party to allow for monitoring capabilities of the emergency two-way video/visual communication device(s) will be in addition to the pricing provided herein and subject to additional markup; (iii) cooperate with MEI in all matters relating to the Services, and respond promptly to MEI's request to provide direction, information, approvals, authorizations and decisions; (iv) obtain and maintain all necessary permits related to the equipment; and provide all wiring prints and diagrams and a copy or version of the controller software; and (v) not provide itself or allow provision by others of any other services related to the equipment referenced in the Agreement. Customer agrees to provide MEI with full immediate access to all areas of Customer's facility in which the elevator(s) and associated equipment is located. Failure to provide such access will result in the Service Fees being earned and payable by Customer, even if the applicable Service is not completed. Customer shall maintain the machine rooms(s) and elevator pit area(s) to be free from water, debris and stored materials. MEI is not responsible or liable for personal injury or property damage due to the action or failure of any part of the elevator equipment during testing. If subsequent repairs are necessary to obtain proper operation of the equipment to meet the requirements of these tests, such work will be proposed at additional cost under separate work order. Any testing of emergency/standby power systems that require completion outside standard hours will be billed at current charge out rates. It is Customer's responsibility for the cost of correcting all elevator code violations existing at the time the Agreement is executed. If such code violations or other outstanding safety violations are not corrected within thirty (30) days, MEI may cancel the Agreement without penalty by providing thirty (30) days written notice to Customer. For the safety of our employees and our collective liability, Customer will not allow any other party (including its own employees) to make alterations, additions, adjustments, repairs or replacements of any component or part of the equipment during the term, or any renewal terms of the Agreement, without providing MEI with advance written notice prior to Customerâ€™s authorization of any work by others. Customerâ€™s notice must include all copies of proposal(s) by others for MEI to review. If any work by others is completed without such prior written notice to MEI, any components or related components of the scope completed by others will immediately be EXCLUDED from coverage in this Agreement, and MEI reserves the right to cancel the Agreement at its sole discretion, upon written notice to Customer. For work completed by others following the above notice to MEI, MEI may

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review the completed work and determine if the same is included or excluded from coverage under this Agreement. If during the Term, Customer refuses to undertake repairs or modernize its Equipment after MEI has reasonably determined Customerâ€™s Equipment has reached end of useful life or itâ€™s not economical for either party to continue to repair the existing Equipment, then MEI shall have the right to terminate this Agreement upon twenty (20) days advanced written notice to Customer, with Customer having the right to cure during such twenty (20) day period. In accordance with OSHA requirements, Customer shall inform MEI and its employees who will perform work activities in areas which contain ACM and/or PACM of the presence and location of ACM and/or PACM in such areas which may be contacted during work before entering the area. Other than as expressly disclosed in writing, Customer warrants that MEI's work area at all times meets applicable OSHA permissible exposure limits (PEL's). Notwithstanding anything contained to the contrary within this bid or contract: (a) MEI's work shall not include any abatement or disturbance of asbestos containing materials (ACM) or presumed asbestos containing materials (PACM); (b) Any work in a regulated area as defined by Section 1910 or 1926 of the Federal OSHA regulations is excluded from MEI's scope of work without an applicable change order to reflect the additional costs and time; (c) MEI shall have the right to discontinue its work in any location where suspected ACM or PACM is encountered or disturbed, and the time period specified in the bid or contract for MEI to complete its work shall be extended until the same is abated; and (d) Any asbestos removal or abatement, or delays caused by such, required in order for MEI to perform its work shall be the Customer's sole responsibility and expense. After any removal or abatement, Customer shall provide documentation that the asbestos has been abated from the MEI work area and air clearance reports shall be made available upon request prior to the start of MEI's work.

4. Limitations. Unless directly resulting from MEI's gross negligence or willful misconduct, nothing herein or in the Agreement shall be construed to mean that MEI assumes any liability for any accidents or injury to persons or property. Customer retains all liability and responsibility for accidents or injuries to any person or property while riding on or being in or about the subject elevators or related equipment.

(a) **DAMAGES**. IN NO EVENT SHALL MEI OR ANY OF ITS EMPLOYEES, OFFICERS, MANAGERS, DIRECTORS, OWNERS, SUCCESSORS OR ASSIGNS BE LIABLE UNDER THE AGREEMENT OR THESE T&C TO CUSTOMER OR ANY THIRD PARTY FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, EXEMPLARY, SPECIAL OR PUNITIVE DAMAGES, INCLUDING ANY DAMAGES FOR BUSINESS INTERRUPTION, LOSS OF USE, DATA, REVENUE OR PROFIT, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, REGARDLESS OF WHETHER SUCH DAMAGES WERE FORESEEABLE AND WHETHER OR NOT CUSTOMER WAS ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

(b) **MAXIMUM LIABILITY**. EXCEPT WHERE A LIABILITY DIRECTLY RESULTS FROM MEI'S GROSS NEGLIGENCE OR WILLFUL MISCONDUCT, WITHOUT LIMITING THE PROVISION OF SECTION 4(a), IN NO EVENT SHALL MEI'S AGGREGATE LIABILITY EXCEED, WITH RESPECT TO PRODUCTS OR SERVICES, THE GREATER OF: (I) $25,000; OR (II) THE TOTAL AMOUNT PAID TO MEI PURSUANT TO THE AGREEMENT IN THE TWELVE-MONTH PERIOD PRECEDING THE EVENT GIVING RISE TO THE CLAIM. The prior sentence limiting liability and damages is a material part of the Agreement, and MEI would not have sold the Product or provided the Services on terms as favorable to Customer as set forth in the Agreement.

(c) **EXCLUSIVE REMEDY**. CUSTOMER'S SOLE REMEDY WITH RESPECT TO PRODUCTS SHALL BE THE STANDARD WARRANTY, AND MEI'S SOLE LIABILITY SHALL BE COMPLIANCE WITH THE STANDARD WARRANTY.

5. Indemnification. Each Party (as *"Indemnifying Party"*) shall indemnify, defend and hold harmless the other Party and its officers, managers, directors, employees, successors and assigns (collectively, *"Indemnified Party"*) against all losses, damages, liabilities, claims, actions, judgments, settlements, awards, costs, or expenses of whatever kind, including reasonable attorneys' fees, actually incurred by Indemnified Party or actually awarded against Indemnified Party, resulting from: (i) breach or non-fulfillment of any representation, warranty or covenant under the Agreement by Indemnifying Party, its employees or agents; (ii) any negligent or more culpable act or omission of Indemnifying Party and its employees and agents (including without limitation reckless or willful misconduct) in connection with the performance of its obligations under the Agreement; (iii) bodily injury, death of any person or damage to real or tangible personal property caused by the negligent or more culpable acts or omissions of Indemnifying Party, its employees or agents (including any reckless or willful misconduct); or (iv) any failure by Indemnifying Party to comply with any applicable federal, state or local laws, regulations or codes in the performance of its obligations under the Agreement. Notwithstanding the foregoing, MEI shall not be obligated to indemnify any Customer Indemnified Party if the loss or damage arises from or relates to breach of the Agreement by, or negligence or misconduct of, Customer or its employees, agents, managers, representatives, or contractors.

6. Default. An event of default ("***Event of Default***") under the Agreement or these T&C shall occur upon the occurrence of all or any one of the following events: (i) Customer does not pay any amount due to MEI under the Agreement; (ii) Customer ceases doing business as a going concern; (iii) Customer makes an assignment for the benefit of its creditors or admits in writing to its inability to pay its debts as they become due; (iv) Customer files, or has filed against it, a petition in bankruptcy or for its reorganization, arrangement, composition or readjustment under any state insolvency law or Customer liquidates all or a substantial part of its assets not in the ordinary course of its business, dissolves or takes other similar action; (v) Customer has taken or allowed any action or permitted any condition, that has compromised the health, safety, or code compliance of the Product or Service; or (vi) Customer shall default in the performance of any of its obligations arising under the Agreement, these T&C, any service schedule, or any other agreement between Customer and MEI, and such default is not cured within fifteen (15) days of MEI providing notice of same. MEI shall not be default of this Agreement unless and until Customer has notified MEI in writing of the alleged default, and MEI has had thirty (30) days to remedy the alleged default.

7. Remedies. Upon the occurrence of any Event of Default, MEI may at its option and without notice or demand, exercise all or any one of the following remedies: (a) suspend provision of Services, but Customer shall continue to pay all Service Fees through the end of the Term, even if Services are suspended, (b) upon written notice to Customer, terminate this Agreement and any other agreement between Customer and MEI; and/or (c) take additional action as may be appropriate to mitigate additional damages to MEI; The foregoing remedies are cumulative and may be exercised successively or concurrently.

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8. Assignment. MEI may without the consent of Customer, assign MEI's rights and obligations under the Agreement, and may subcontract any portion of MEI's performance of the Agreement to a third-party. Customer may not assign the Agreement or otherwise transfer its rights or obligations under the Agreement to any third-party without the prior written consent of MEI. In the event of the sale, lease, assignment or other transfer of Customer's facility described herein, Customer agrees to disclose in writing to such successor the Agreement, and if all of Customers' obligations under the Agreement are not assumed in writing by such successor, Customer agrees to continue to be bound by the terms hereof.

9. Governing Law; Venue. The validity, construction and performance of the Agreement and these T&C shall be governed by and construed in accordance with the law of the state where the Services are performed, without reference to any choice of law principals, but the specific performance provisions and right of MEI to seek injunctive relief for Customer's breach of the covenants contained herein may also be enforced in any other state wherever such breach occurs, and in accordance with the laws of such other state, to the extent necessary to secure enforcement in such other jurisdiction.

10. Force Majeure. MEI shall not be liable for any failure of performance hereunder due to causes beyond its reasonable control, including but not limited to: act of God, fire, flood, earthquake, terrorist act, national emergency, war, strike, lock-out, change in law, work stoppage or other labor difficulty, action or inaction of an independent third party utilized in providing the Services, or unavailability of materials.

11. Waiver of Jury Trial. Each Party agrees that any controversy that may arise under the Agreement, including schedules attached to the Agreement, is likely to involve complicated and difficult issues and, therefore, each Party irrevocably and unconditionally waives any right it may have to a trial by jury in respect of any legal action arising out of or relating to the Agreement, or the transactions contemplated hereby.

12. General Provisions. The following sections of the T&C shall survive termination or expiration of the Agreement: 2, 3, 4, 5, 6, 7, 9, 10, 11, and 12. The relationship of the parties created by the Agreement is that of independent contractors and not partners, joint ventures, agents, or otherwise. No waiver by either Party of any right under, or breach of, any provision of the Agreement shall be construed as a waiver of any continuing or succeeding breach of such provision or right. The Agreement these T&C: (i) are binding upon and inure to the benefit of MEI and Customer and their respective successors, transferees, or assignees; and (ii) constitute the entire agreement between the Parties with respect to the subject matter of the Agreement, superseding all prior agreements, representations, communications and understandings, oral or written. A determination that any provision of the Agreement is invalid or unenforceable shall not affect the other provisions of the Agreement. The Agreement may not be amended or modified except by a written agreement signed by both Parties. In the event of a conflict between the main body of the Agreement and these T&C, the Agreement will take precedence, and shall supersede and be controlling over the T&C. By accepting delivery of the Products or Services, Customer is also agreeing to these T&C. Except for the money due upon an open account, no action may be brought for any breach of the Agreement or these Terms and Conditions more than one (1) year after the accrual of such cause of action. Customer agrees to receive invoices, notices and other communications under this Agreement at the address listed in the Agreement until Customer notifies MEI in writing of any changes in mailing address. Failure to notify MEI of any address changes does not change the delivery status of delivered invoices or other notices. Customer agrees to promptly notify MEI of any billing errors and understands that its failure to notify MEI does not change the due date or payment status of an invoice.

Please provide the following required information at the time the signed contract is returned:

Invoice Contact

Name: _____ Phone Number: _____

Email: _____ Fax Number: _____

Billing Address: _____

*Please provide tax exempt documentation should it be applicable

If PO's are required for Service or Trouble Calls, please provide the initial PO number(s) for each type of billing:

_____

Service Ticket Contact (Optional – Only fill out if your organization requires notice)

List the person you would like to receive the electronic Service Ticket, which will be sent following the completion of each Preventative Maintenance.

Name: _____ Phone Number: _____

Email: _____

Site Contact

Who is the primary contact on site for our mechanics?

Name: _____ Phone Number: _____

Email: _____

Are there special instructions for gaining access to the building as well as the elevator equipment? (Basement, Machine Room…)

_____

_____

Are keys required for mechanics to access the locations or elevator machine room? _____

Provide the phone number assigned to the elevator emergency phone.

_____

Please ensure all wiring diagrams and prints are available in your elevator equipment room. If you are relieving another provider from service, please ensure they do not take those prints, as they are YOUR property and are required to be available per State code.

To: **Township Board Members**

From: **Timothy R. Schmitt, *AICP***
Director of Community Planning and Development

Date: **September 10, 2026**

Re: **Ordinance 2026-10 – Mass Timber – Introduction**

Earlier this year, the Corridor Improvement Authority discussed a regional push towards the utilization of Mass Timber construction, of which MSU is an industry leader in. After discussion with Planning Staff, the CIA recommended the Planning Commission review the MUPUD and CPUD ordinances to determine if Mass Timber could be incorporated as an amenity for qualifying projects under these two zoning districts. The Planning Commission discussed the matter throughout Spring and Summer, referring the matter back to the CIA at one point for further discussion. Eventually, both boards recommended approval of the attached ordinance, which would make Mass Timber a level 3 amenity under the MUPUD and an amenity option under the CPUD. Information from each of the Planning Commission meetings can be found below.

April 13, 2026: PACKET, VIDEO, MINUTES
May 11, 2026: PACKET, VIDEO, MINUTES
June 8, 2026: PACKET, VIDEO, MINUTES
July 13, 2026: PACKET, VIDEO, MINUTES
July 27, 2026: PACKET, VIDEO, MINUTES
August 10, 2026: PACKET, VIDEO, MINUTES (not yet available)

The Township Board discussed the matter initially at their September 1, 2026 meeting. (PACKET, VIDEO, MINUTES [not yet available])

Staff **recommends approval for introduction** of the proposed ordinance at this time to amend the Code of Ordinances to allow Mass Timber construction as an amenity in the CPUD and MUPUD districts. Staff has provided the following recommended motion and attached resolution to introduce the ordinance. At the Board's request, Staff has also included the broader ordinance for context.

> **Move to adopt the resolution approving for introduction Text Amendment #2026-10 to amend the Code of Ordinances of the Charter Township of Meridian at Article IV, District Regulations, to update the standards therein for inclusion of Mass Timber as an amenity in the MUPUD and CPUD Districts.**

Attachments

1. Resolution to approve for Introduction Ordinance 2026-10
2. Ordinance 2026-10 – Mass Timber
3. Existing MUPUD Ordinance
4. Existing CPUD Ordinance

RESOLUTION TO APPROVE – Introduction **Text Amendment #2026-10 Mass Timber**

RESOLUTION

At a regular meeting of the Township Board of the Charter Township of Meridian, Ingham County, Michigan, held at the Meridian Municipal Building, in said Township on the 15th day of September, 2026, at 6:00 p.m., Local Time.

PRESENT: _____

_____

ABSENT: _____

The following resolution was offered by _____ and supported by _____.

WHEREAS, Mass Timber broadly refers to a construction type that utilizes engineered and layered structural wood components as the primary source of construction material for the building; and

WHEREAS, the Corridor Improvement Authority is interested in promoting Mass Timber construction within the Township and asked the Planning Commission to review potential ordinance updates that would allow this; and

WHEREAS, the Planning Commission reviewed the matter and agreed that Mass Timber could be included as an amenity in certain zoning districts, notably, the Mixed Use Planned Unit Development District (MUPUD) and the Commercial Planned Unit Development (CPUD); and

WHEREAS, the Planning Commission discussed the matter at their regular meetings on April 13th, May 11th, June 8th, and July 13th meetings, held a public hearing for the proposed changes at their regular meeting on July 27, 2026 meeting and recommended the changes to the ordinance at their August 10, 2026 meeting; and

WHEREAS, the Township Board reviewed the proposal at their September 1, 2026 meeting and raised no major concerns, directing Staff to bring the ordinance back for introduction;

NOW THEREFORE, BE IT RESOLVED THE TOWNSHIP BOARD OF THE CHARTER TOWNSHIP OF MERIDIAN hereby INTRODUCES FOR PUBLICATION AND SUBSEQUENT ADOPTION Ordinance No. 2026-10, entitled "An Ordinance to amend the Zoning Ordinance of the Charter Township of Meridian at Article IV, District Regulations, to update the standards for the inclusion of Mass Timber as an amenity in the MUPUD and CPUD Districts"; and

BE IT FURTHER RESOLVED that the Clerk of the Charter Township of Meridian is directed to publish the Ordinance in the form in which it is introduced at least once prior to the next regular meeting of the Township Board.

ADOPTED: YEAS: _____

NAYS: _____

STATE OF MICHIGAN)
) ss
COUNTY OF INGHAM)

I, the undersigned, the duly qualified and acting Clerk of the Township Board of the Charter Township of Meridian, Ingham County, Michigan, DO HEREBY CERTIFY that the foregoing is a true and complete copy of a resolution adopted at a regular meeting of the Township Board on the 15th day of September, 2026.

_____
Angela Demas
Township Clerk

ORDINANCE NO. 2026-10

AN ORDINANCE TO AMEND THE ZONING ORDINANCE OF THE CHARTER TOWNSHIP OF MERIDIAN AT ARTICLE IV, DISTRICT REGULATIONS, TO UPDATE THE STANDARDS FOR THE INCLUSION OF MASS TIMBER AS AN AMENITIY IN THE MUPUD AND CPUD DISTRICTS

THE CHARTER TOWNSHIP OF MERIDIAN ORDAINS:

Section 1. Section 86-440(e)(4), Mixed Use Planned Unit Development, is hereby amended to read as follows:

The following list of possible amenities is weighted to recognize more substantial project features may fulfill the requirement for multiple amenities. Other amenities not listed below may be considered, provided they meet the criteria established in Section 86-440(e)(4) and subject to the sole approval and discretion of the Township Board.

a. Project features counting as three amenities are those amenities that have the largest potential environmental and/or social impact on the Township as a whole and are generally not found in a non-MUPUD project. At least one amenity from this section shall be required for any MUPUD project that requires four or more total amenities for approval.

    1. Leadership in Energy and Environmental Design (LEED) certification by the United States Green Building Council at the Silver level or higher for the project or individual buildings in the project. Alternative rating systems may be considered.
    2. Multilevel parking decks or underground parking.
    3. A minimum of 20% of the total units within the development identified as affordable housing units.
    4. The overall project includes at least 25% of the total gross floor area of all buildings identified for nonresidential uses, such as retail stores, restaurants, offices, or similar land uses.
    5. Vertical mixing of land uses for the entire project and in each building.
    6. Alternative energy generation systems on-site producing at least 50% of the energy consumed by the development.
    7. Dedicated outdoor gathering space in the form of a central green, plaza, or square which is to function as a focal point for the project and serve as an area where social, civic, or passive activities can take place. This area shall be at least 20% of the total building footprint or 5,000 contiguous square feet (whichever is greater) and designed to serve as a visual and functional civic amenity for sitting, viewing, or other similar outdoor activity.
    8. Public art, either on-site or at an approved off-site location, at 1% of the project cost designed to withstand natural elements and reasonable public contact.
    9. Mass timber construction

Section 2. Section 86-444(e)(3)(f), Commercial Planned Unit Development District, is hereby amended to read as follows:

Site and building design:

1. Underground utilities.
2. Combination of first floor awnings and upper floor balconies adjacent to a public street.

3. Porches on any structure.
4. Multilevel or underground parking.
5. Ornamental paving treatments for sidewalks and/or parking areas such as, but not limited to, concrete masonry unit pavers, brick, stone or pervious concrete or asphalt.
6. Innovative lighting.
7. Sidewalk planters located in the vicinity of sidewalks and/or outdoor seating areas.
8. Public access to new technology including wireless access points, electronic information displays, excluding unsolicited electronic broadcast information.
9. Consolidation of multiple land parcels into one to facilitate an integrated design.
10. Fountain.
11. Mass Timber construction

Section 3. Section 86-2, Definition, is hereby amended to add the following:

Mass Timber – A category of framing styles characterized by the use of large, engineered wood panels, often paired with engineered wood columns and beams.

Section 4. Validity and Severability. The provisions of this Ordinance are severable and the invalidity of any phrase, clause or part of this Ordinance shall not affect the validity or effectiveness of the remainder of the Ordinance.

Section 5. Repealer Clause. All ordinances or parts of ordinances in conflict therewith are hereby repealed only to the extent necessary to give this Ordinance full force and effect.

Section 6. Savings Clause. This Ordinance does not affect rights and duties matured, penalties that were incurred, and proceedings that were begun, before its effective date.

Section 7. Effective Date. This Ordinance shall be effective seven (7) days after its publication or upon such later date as may be required under Section 402 of the Michigan Zoning Enabling Act (MCL 125.3402) after filing of a notice of intent to file a petition for a referendum.

ADOPTED by the Charter Township of Meridian Board at its regular meeting this **XXth** day of **XXXXXXX**, 2026.

_____
Scott Hendrickson, Township Supervisor

_____
Angela Demas, Township Clerk

Chapter 86. Zoning

ARTICLE IV. District Regulations

DIVISION 4. Other Districts

§ 86-440. Mixed Use Planned Unit Development (MUPUD).

[Ord. No. 2004-08, 10-31-2004; Ord. No. 2005-11, 11-27-2005; Ord. No. 2006-08, 12-31-2006; Ord. No. 2007-12, 10-28-2007; Ord. No. 2008-04, 4-13-2008; Ord. No. 2010-02, 2-28-2010; Ord. No. 2011-08, 7-5-2011; amended 5-15-2018 by Ord. No. 2018-06; 12-7-2021 by Ord. No. 2021-07]

(a) The purpose of the Mixed Use Planned Unit Development (MUPUD) section is to create more walkable pedestrian-oriented developments by promoting and accommodating developments in rational mixed patterns that respect Meridian Township's transitional land use concept to protect, enhance and preserve natural resources. The second purpose is to encourage rehabilitation of existing structures to include those originally built or partially built before zoning ordinances were adopted, and in such a manner that will maintain traditional urban design to preserve and enhance community resources.

The intent of this section is two-fold.

(1) Meet Township goals through well-planned, integrated, high-quality mixed use development and redevelopment projects:

a. Enhance health and safety goals through requirements for walkability, pedestrian orientation and high-quality, durable, building materials.

b. Increase Township prosperity goals and citizen welfare through appreciated property values which will support necessary public services.

c. Actualize our cultural heritage through citizen pride in creative, new places to walk to, shop at and work in that retain a flavor of Meridian Township's rich history.

d. Enhance diversity goals with new types of residential uses in close-knit community design.

e. Improve our natural environment goal through mixed use redevelopment with incentives for more intensely landscaped buffers and open spaces designed to complement Township parks and green space plans.

(2) Improve the potential for financially attractive and high-quality mixed use projects in the Township while meeting Township goals of a safe, healthy and sustainable community.

a. Enhance incentives for investment through the ability to mix residential with nonresidential uses within the same development.

b. Allow flexibility in setback and parking requirements.

c. Encourage redevelopment by allowing increases in density in exchange for providing specified community amenities.

d. Achieve attractive and commercially successful core areas through cooperative development projects with one or more landowners.

(b) Definitions.

AFFORDABLE HOUSING

Housing in which a household making not more than 80% of the Area Median Income is paying not more than 30% of their gross income for housing costs, including utilities.

AMENITY

Extraordinary project feature that provides usable benefit to both the occupants of the development and to the general public and reflects the scale of the facility, building, or place.

AWNING

A roof-like cover, often fabric, metal, or glass designed and intended for protection from weather or as a decorative embellishment, and which projects from a wall or roof of a structure over a window, walk, door, or the like.

BALCONY

A platform that projects from the wall of a building and is surrounded by a railing or balustrade, for the private use of tenants.

CLOSE-KNIT COMMUNITY

A style of land development advocating smaller, narrower lots, shallower yards and setbacks, smaller and more intensely used spaces, etc., that is less land consumptive than traditional suburban development.

GREEN ROOF

A flat or slightly sloped roof with a layer of vegetation planted over a waterproofing system that is installed on the top of the roof.

MONUMENT SIGN

A freestanding sign, in which the entire bottom (base) is in contact with the ground and is independent of any other structure.

NONRESIDENTIAL USE

A use that does not contain or provide facilities for people to live on the premises.

ORNAMENTAL

Something that is either decorative or something that provides aesthetic quality to an object required for another purpose.

PEDESTRIAN-ORIENTED DEVELOPMENT

Development designed with an emphasis primarily on the street sidewalk and on pedestrian access to the site and building, rather than on auto access and parking areas with design bearing a definite relationship to the human dimension. The building is generally placed close to the street and the main entrance is oriented to the street sidewalk. There are generally windows or display cases along building facades which face the street. A pedestrian-oriented neighborhood offers variety in housing clustered around well-defined neighborhood centers which support jobs, nonresidential activity, and a range of amenities to sustain lively streets and gathering places. It offers a gradient density from open space to high-intensity nonresidential cores. The layout of pathways, streets and transportation corridors minimizes conflict between walking, biking, and driving.

REDEVELOPMENT

The process by which an existing developed area is rehabilitated, restored, renovated, expanded and/or reused. Redevelopment may also mean a site that contains an existing building(s) to be removed.

SIGN PROGRAM

A plan of all signs proposed to be installed in an MUPUD project submitted for approval to create a coordinated project theme of uniform design elements such as color, lettering style, size, and placement consistent with the context of the project and its surroundings and the purpose and intent of this section.

WAIVER

Permission to depart from the requirements or standards of the underlying zoning district in return for the provision of amenities.

(c) Permitted locations and uses.

(1) Locations.

a. MUPUD projects shall be permitted in the C-2, C-3, and CR zoning districts, where public water and sewer are available.

b. MUPUD projects shall be permitted in the PO and C-1 districts where public water and sewer are available, provided that when adjacent to land zoned and developed in a single-family residential district, the height of buildings in the MUPUD shall be no taller than the abutting residential district would allow.

(2) Uses.

a. In the C-1, C-2, C-3, and CR zoning districts, all uses permitted by right and by special use permit in the underlying zoning district or districts where a project includes more than one zoning district, provided that the purpose and intent of this section is incorporated within the total development plan.

b. In the PO zoning district, all uses in the C-1 and PO zoning district permitted by right and by special use permit are permitted in a PO zoning MUPUD project.

c. Single- and multiple-family residential uses up to a density of 14 dwelling units per acre when developed in conjunction with the redevelopment of an existing building(s) for a use permitted by right or by special use permit in the underlying zoning district and on the same parcel of land. The density may be increased to 18 dwelling units per acre by offering four additional amenities.

d. Single- and multiple-family residential uses up to a density of 10 dwelling units per acre when developed in conjunction with the development of an undeveloped site for a use permitted by right or by special use permit in the underlying district and on the same parcel of land.

e. For an MUPUD project within the Okemos Downtown shown on Map 1, the Haslett Downtown shown on Map 2, and the Meridian Mall property shown on Map 3,[1] the Township Board may, in its sole discretion, approve a higher density per acre of residential dwelling units and/or an increase in the height of a building based upon the proposed MUPUD complying with the following performance criteria:

1. Architectural design and placement of building(s) on the parcel(s) will be consistent with the architectural standards set forth in the Master Plan and shall include sustainability and environmental considerations, including, but not limited to, energy usage from renewable energy resources or achieving LEED certification for the buildings proposed.

2. The building height is no more than four stories above the finished grade. A fifth story may be allowed where there is a minimum of a ten-foot setback for such fifth story from the predominant first-floor facade elevation. Overall height from the finished grade to the top of the wall may not exceed 60 feet. Floor-to-ceiling height shall be a minimum of 14 feet for first floor nonresidential uses and a minimum of nine feet for all upper floors, regardless of use.

3. A parking plan that provides a design for any parking structures that is unified with the main building through the use of similar building materials, color, and architectural style. The parking plan shall provide opportunities for shared parking, accessways, and driveways with adjoining properties or provide additional parking spaces that may be used by the public.

4. An innovative design that includes a number of different dwelling unit types, sizes, and floor plans available within the MUPUD.

5. Common areas and/or amenities for residents and the general public, including, but not limited to, gathering spaces, gardens, courtyards, pavilions, pocket parks, swimming pools, exercise rooms, storage rooms, lockers, and covered parking.

6. The overall project promotes nonmotorized and shared transportation by providing convenient access to the public pedestrian/bicycle pathway system and public transportation systems as outlined in the Master Plan.

7. The buildings generally provide for nonresidential uses on the ground floor(s), and the development demonstrates a financially viable plan for long-term sustainable nonresidential space usage.

8. The higher density of any project will not negatively impact the character, aesthetics, safety, or welfare of surrounding businesses and neighborhoods.

9. Any potential for increased traffic is addressed by the project and solutions are provided.

10. Where feasible, the project makes an effort to preserve and use existing structures or provides explanations to justify why such preservation and use is not possible.

11. A minimum of two amenities from Subsection (e)(4)a shall be required for all projects under this subsection.

[1] *Editor's Note: Maps 1 and 2 are* ***included as an attachment to this chapter****. Map 3 is on file in the Township offices.*

f. Uses may be mixed vertically and/or horizontally.

(d) MUPUD projects may be phased, provided each phase incorporates a use permitted in the underlying zoning district and includes one or more amenities, based on the number of waivers required in each phase. Phasing plans shall be evaluated for the proportionality of permitted use(s) to residential use(s). Phasing plans shall be submitted with the original MUPUD application.

(e) Amenities.

(1) General guidelines.

a. Every MUPUD shall incorporate one or more amenities.

b. Every request for a density bonus shall incorporate four or more amenities in addition to those required by Subsection (e)(1)a.

c. Waivers from zoning ordinance standards may only be granted by the Township Board in exchange for amenities. For every one waiver requested at least one amenity must be provided.

d. Amenities shall not be combined or counted more than once or counted toward any other requirement of the ordinance.

e. To the greatest extent feasible, amenities shall be visible and/or accessible to the public from a fully improved street, and/or a benefit to the general public.

(2) Amenities acceptable for consideration by the Township shall meet one or more of the following criteria:

a. Type, value and number of amenities shall be proportionate to the size and/or cost of the project, and the number of waivers requested.

b. Support of goals expressed in this section, the adopted Township Master Plan, or other applicable adopted plans.

c. Consistency and compatibility with the intended use of the site.

d. Continuity of design elements.

e. Appropriate and harmonious with the surrounding area.

f. Potential to act as a catalyst for improvements to surrounding sites.

(3) Timing of project amenities.

a. One or more amenities must be provided in each project phase if a phased development is proposed.

b. For single-phase projects, all amenities shall be constructed prior to final certificate of occupancy for any building.

c. For multi-phase projects, amenities shall be constructed prior to final certificate of occupancy for any building in the phases in which the amenities are approved.

d. When affordable housing is included as an amenity, as near as possible to an equal amount of affordable housing units shall be provided in each building.

(4) The following list of possible amenities is weighted to recognize more substantial project features may fulfill the requirement for multiple amenities. Other amenities not listed below may be considered, provided they meet the criteria established in Section **86-440(e)(4)** and subject to the sole approval and discretion of the Township Board.

a. Project features counting as three amenities are those amenities that have the largest potential environmental and/or social impact on the Township as a whole and are generally not found in a non-MUPUD project. At least one amenity from this section shall be required for any MUPUD project that requires four or more total amenities for approval.

1. Leadership in Energy and Environmental Design (LEED) certification by the United States Green Building Council at the Silver level or higher for the project or individual buildings in the project. Alternative rating systems may be considered.

2. Multilevel parking decks or underground parking.

3. A minimum of 20% of the total units within the development identified as affordable housing units.

4. The overall project includes at least 25% of the total gross floor area of all buildings identified for nonresidential uses, such as retail stores, restaurants, offices, or similar land uses.

5. Vertical mixing of land uses for the entire project and in each building.

6. Alternative energy generation systems on-site producing at least 50% of the energy consumed by the development.

7. Dedicated outdoor gathering space in the form of a central green, plaza, or square which is to function as a focal point for the project and serve as an area where social, civic, or passive activities can take place. This area shall be at least 20% of the total building footprint or 5,000 contiguous square feet (whichever is greater) and designed to serve as a visual and functional civic amenity for sitting, viewing, or other similar outdoor activity.

8. Public art, either on-site or at an approved off-site location, at 1% of the project cost designed to withstand natural elements and reasonable public contact.

b. Project features counting as two amenities are those amenities that have an environmental and/or social impact on the Township as a whole, but are more focused on benefits to the development and may or may not be found in a non-MUPUD project.

1. 75% of all building facades are covered with natural materials such as brick or stone.

2. Interior, individual bicycle lockers or locker banks equal to the amount of bike parking required for the site.

3. Green roofs incorporated into the building design.

4. New enhanced public transit stops, when located on or adjacent to property proposed for an MUPUD project. New stops for locations not currently served by the public transit system shall be determined in coordination and with approval from local transit providers. The public transit stop shall include seating, shelter, and other elements approved by a local transit provider.

5. Electric car charging stations installed on the project site. A minimum of four charging stations shall be required to qualify.

6. A mix of dwelling unit types (such as one-, two-, or three-bedroom units) with no more than 50% of one type of dwelling unit provided in the development.

7. Public outdoor seating plazas adjacent to or visible and accessible from the street, including, but not limited to, benches or other outdoor seating not associated with an outdoor café.

8. Public recreation resources for active recreation or informal spontaneous recreation, such as ball fields, tennis courts, swimming pools, pickleball courts, or other similar activities. Resources shall be open and accessible to the general public.

9. Ornamental paving treatments for all sidewalks and parking areas on the site, such as pavers, brick, or pervious concrete or asphalt. A maintenance plan shall be required for the use of such paving treatments.

c. Project features counting as one amenity are those amenities that generally benefit only the development and may be found in a non-MUPUD project. Only one amenity from this section shall be counted toward the total number of required amenities for an MUPUD.

1. Green space exceeding the underlying permeable surface regulation by at least 10%.

2. Dedicated parking for e-scooters or other alternative mobility options, separate from bicycle parking areas.

3. Installation of waterless urinals or other low-flow plumbing fixtures throughout the project.

4. Wireless access points available to the general public.

5. Sidewalk planters intermittently placed along all public streets and internal private streets and drives at a spacing of 25 feet.

6. Decorative lighting along all public streets and internal private streets, drives, and in all parking lots.

7. Grey water recycling systems.

8. Privately maintained courtyards, plazas, project parks, and rooftop gardens and similar features with seating for the public.

9. Enhancement of an existing public transit stop, when located on or adjacent to the property proposed for an MUPUD. The public transit stop shall include seating, shelter, and other elements approved by a local transit provider.

(f) Design standards.

(1) General restrictions.

a. Except as noted elsewhere in this section, the yard, setback, lot size, type and size of dwelling unit, frontage requirements, and impervious surface regulations and restrictions are generally waived for the MUPUD, provided that the spirit and intent of this section, as defined in Subsection **86-440(a)** above, are incorporated with the total development plan. The Planning Commission may recommend, and the Township Board shall establish, all requirements by means of the approval of the planned unit development.

b. Maximum height in an MUPUD shall be no higher than 45 feet, except for those MUPUD projects within the Okemos Downtown as shown on Map 1, the Haslett Downtown shown on Map 2, and the Meridian Mall property, shown on Map 3[2] as outlined in Subsection (c)(2)e previously. Exceptions provided in Section **86-591** shall continue to apply.

[2] *Editor's Note: Maps 1 and 2 are **included as an attachment to this chapter**. Map 3 is on file in the Township offices.*

c. Except as stated above, all requirements regarding floodways, floodplains and wetlands in the conservancy district shall apply to the MUPUD.

d. Metal and portable buildings shall be prohibited.

(2) Structure.

a. Building materials shall include, but are not limited to, wood, brick, clapboards, beadboard, glass, and stone. Other materials, such as vinyl, aluminum, and other metal sidings should be avoided. All buildings shall be completed on all sides with acceptable finishing materials. Any element not specifically mentioned in this section shall otherwise conform to other provisions of the Code of Ordinances.

b. Diversity and variety in architectural design is encouraged.

1. Architectural design shall be consistent with pedestrian-oriented development.

2. Property owners shall be encouraged to design and construct their building facades so that improvements relate to and are sensitive to nearby historical features, blend with the facades of adjacent buildings and complement streetscape improvements in the area.

3. Buildings greater than 50 feet in width shall be divided into increments of no more than 50 feet through articulation of the facade.

4. Windows shall cover no less than 50% of nonresidential street level facades, and awnings shall be provided over all street level windows.

5. All mechanical, heating, ventilation, and air conditioning (HVAC) and like systems shall be screened from street level view on all sides by an opaque structure or landscape material selected to complement the building.

6. Railings, benches, trash receptacles and/or bicycle racks, if provided, shall be of commercial quality, and complement the building design and style, subject to the approval of the Director of Community Planning and Development.

7. Upper floor balconies are required adjacent to any street for any residential unit.

(3) Parking.

a. Setbacks for parking areas from the public street, adjoining properties, and when adjacent to residentially zoned properties shall be established during the review process. Consideration should be given to preservation of existing residential neighborhoods and heritage trees.

b. The number of required off-street parking spaces shall comply with Section 86-755 of the Code of Ordinances, which outlines the schedule of requirements for parking spaces. The Township Board may reduce the number of off-street parking spaces required for a development. In doing so, the Township Board shall establish a reasonable number of required off-street parking spaces based on the characteristics associated with the property and availability of other sources of parking or the provision of amenities in lieu of parking.

c. Parking lots shall only be permitted in a side or rear yard. In no case shall a parking lot extend beyond the front façade of a building.

d. Bicycle parking shall be separated from automobile parking and meet the provisions of Section **86-760**.

(4) Landscaping shall generally comply with the applicable provisions of the Code of Ordinances.

a. Project landscaping shall be designed to preserve existing significant natural features and to buffer service areas, parking, or dumpsters. Additional landscaping may be required in order to protect adjacent properties.

b. A mix of evergreen and deciduous plants and trees are preferred with seasonal accent plantings to add to the visual appeal of the area.

c. Native plant species are encouraged.

d. Maintenance of landscaped areas shall be subject to Subsection **86-758(3)** of the Code of Ordinances.

(5) All outdoor lighting associated with nonresidential and multiple-family residential projects in an MUPUD project area shall conform to Article **VII** in Chapter **38** of the Code of Ordinances and is subject to the approval of the Director of Community Planning and Development. Streetlighting intended to provide illumination for pedestrians on the sidewalk shall not exceed 15 feet in height.

(6) Each applicant shall submit a sign program illustrating each proposed sign type, its size and location as part of the MUPUD project's application materials. The Director of Community Planning and Development may be authorized to approve the entire sign program, or any part of the sign program, as part of the site plan review process.

a. General guidelines.

1. Signs shall be designed to enhance the pedestrian experience, reflect and complement the character of the building, and respect the overall character of the area in an attractive and functional manner.

2. Signs shall not cover or obscure architectural features of buildings.

3. Signs shall be properly maintained.

4. Signs or sign faces shall not be changed or installed without a new building permit and in accordance with an approved sign program.

b. The following sign types are permitted in an MUPUD project. Except as indicated below, the number and size of signs shall be approved as part of the project's application for the MUPUD project approval.

1. Wall signs, defined as a sign mounted flat against, or painted on, the wall of a building (not in a window) with the exposed face of the sign in the plane parallel to the face of the wall.

    i. One wall sign for each business with direct access to a public street shall be permitted. The size of the sign is based on the underlying zoning district in which the MUPUD project is located.

    ii. One additional wall sign, no larger than two square feet, shall be permitted for each tenant with direct access to a public street and shall be located on the wall surface adjacent to a tenant's main entry. Restaurants may add an additional two square feet to this sign.

    iii. Multi-tenant buildings with a shared entrance shall be permitted six square feet of wall signage, to be located adjacent to the shared entrance.

2. Up to 30% of the area of an awning or canopy may be used for signage, separate from the wall sign. Such signs shall not be internally lit.

3. One projecting sign per business with direct access to a public street shall be permitted, up to a maximum size of six square feet. The lowest edge of a projecting sign shall be no lower than eight feet above the sidewalk elevation.

4. No more than 40% of a window's area shall be used for signage. Up to 10% of that area may consist of completely opaque signs. Etched glass and similar artistic designs shall not be considered opaque.

5. Freestanding signs are generally not permitted in an MUPUD project. Exceptions for freestanding signs of the monument type may be permitted when a building is set back a minimum of 15 feet from the right-of-way line with the resulting yard set aside for permanent public open space. In such case, the size, location and design of the sign shall be reviewed and approved as part of the overall sign program.

(7) Sidewalks shall be a minimum of five feet in width, except in two specific scenarios:

a. When the sidewalk(s) is immediately adjacent to an outdoor seating cafe, the sidewalk shall be a minimum of seven feet in width to provide additional maneuverability; and

b. When the sidewalk(s) is immediately adjacent to an off-street parking area, where vehicles may overhang on the sidewalk, the sidewalk shall be a minimum of seven feet in width to provide additional maneuverability.

(8) Where a site submitted for mixed use PUD approval is located on a route of the Township's pedestrian/bicycle pathway master plan, construction or reconstruction of the route shall conform to Township standards for pedestrian/bicycle pathways.

(g) Procedure.

(1) Each applicant shall meet with the Director of Community Planning and Development regarding the preparation of the MUPUD application prior to submittal. It is not required that any person requesting such a meeting be an owner of or holder of an equitable interest in the subject property.

(2) An applicant is urged to meet with owners and occupants of surrounding properties to apprise them of a proposed development, share the physical design, receive comments, and revise the proposal accordingly prior to submitting an official application. The Township will assist by providing property owner and occupant contact information and attend meetings as deemed necessary.

(3) A property owner, prospective applicant or their representative may submit an optional concept plan for review and comment by the Planning Commission and/or Township Board.

a. Purpose.

1. To acquaint the Planning Commission and/or Township Board with the proposed project.

2. To receive guidance regarding the proposed design's compatibility with the purpose, intent and standards of the MUPUD ordinance.

3. To reduce the applicant's time and cost.

b. Submittal requirements.

1. A written request to initiate a concept plan review submitted to the Director of Community Planning and Development.

2. A written summary of the project (amount and type of uses, basis for the design concept).

3. A concept plan drawn to scale containing the following information:

i. Boundaries and acreage of the site.

ii. Zoning.

iii. Adjacent road network.

iv. General layout of buildings, interior access roads and unique design elements.

v. General location of known features affecting the site layout such as, but not limited to, floodplain, wetlands, woodlands, railroads, drains, rivers or rivers and streams, parkland, etc.

4. A list of the amenities proposed for the project, along with descriptions and locations of each.

c. Review procedure.

1. Upon receipt of a written request and other required data and information, the Director of Community Planning and Development shall review the concept plan.

2. Within 30 days of the date of receiving a complete request, the Director shall forward to the Planning Commission and/or Township Board the concept plan and accompanying data along with any written comments from the Director. The Planning Commission and/or Township Board shall concurrently review the concept plan and may offer comments or suggestions on the design. Comments or suggestions made during the review of the concept plan shall not be binding on the Township or the applicant.

(4) Required data and information for an MUPUD.

a. A complete application accompanied by the appropriate fee.

b. A site plan drawn to an engineer's scale of the total property involved, showing its location in the Township and its relation to adjacent property.

c. A schematic layout of the proposed storm sewer system.

d. A document generally describing the proposed phasing program for the MUPUD, including all dwelling units, nonresidential units, recreation and other facilities, and open space improvements.

e. A two-foot contour topographic map drawn at the same scale as the site plan and showing the existing relief features on the site.

f. A sign program.

g. Natural features study for previously undeveloped properties. The natural features study shall include a written description of the features to be retained, removed, or modified, and the proposed measures to mitigate any negative impacts on the site and adjacent properties. Natural features to be addressed include, but are not limited to, wetlands, significant stands of trees or individual trees greater than 12 inches dbh, floodways, floodplains, water features, identified groundwater vulnerable areas, slopes greater than 20%, ravines, and wildlife habitats and vegetative cover types with potential to sustain significant or endangered wildlife.

h. Traffic study where the project will exceed 250 vehicle trips during the peak hour of the adjacent roadway.

i. Building elevations drawn to scale and in color.

j. The developer shall provide the Township with copies of any comments from other reviewing agencies, such as:

1. The Ingham County Road Department.

2. The Ingham County Drain Commissioner.

3. Michigan Department of Transportation (if applicable).

4. Michigan Department of Environment, Great Lakes, and Energy (if applicable).

5. Township Environmental Commission (if applicable).

6. Township Engineering Department.

7. Township Fire Department.

k. The developer shall provide proof of property ownership, or a letter from the owner authorizing the request and proof of property ownership from the author of the letter.

l. A list of the amenities proposed for the project, along with descriptions and locations of each.

m. A list of waivers requested for the project, along with descriptions, dimensions, and locations of each, as well as justification or reasons why each waiver is being requested.

(5) Upon submittal of a complete application, the Planning Commission shall hold a public hearing. Notices for public hearings shall comply with the provisions outlined in Subsection **86-65(b)** of the Code of Ordinances.

(6) Following the public hearing, the Planning Commission will make a decision on whether to recommend approval of the request, recommend approval with conditions of the request, or recommend denial of the request, to the Township Board. The Planning Commission shall make such a recommendation to the Township Board, within 30 days of the date the planned unit development was placed on the Commission's agenda. The thirty-day period may be extended if the applicant consents.

(7) After receiving a recommendation from the Planning Commission, the Township Board shall conduct a public hearing which shall be preceded by notice as specified in Subsection **86-65(b)** of the Code of Ordinances. Following the public hearing, the Township Board shall make a determination to approve, modify, or deny the request. The Township Board shall make such a determination within 30 days of the date the planned unit development was placed on the Board's agenda. The thirty-day period may be extended if the applicant consents.

The Township Board may place conditions on the development in order to guarantee consistency with the purpose and intent of the MUPUD ordinance, which includes, but is not limited to, providing walkable, pedestrian-friendly communities and ensuring compatibility with

surrounding residential neighborhoods on adjacent sites. Conditions may include, but are not limited to, the following subjects:

a. Hours of operation.

b. Total square footage allotted/required for the nonresidential uses.

c. Location, design, and orientation of specific nonresidential uses which may locate within the development and their placement in relationship to neighboring uses.

d. Proportion of the development which may be occupied by individual nonresidential uses or by all nonresidential uses.

e. Maximum noise levels emitted.

f. Lighting levels, direction, and timing.

g. Sufficiency of parking.

h. Enhancement of walkability within the development and connectivity to surrounding uses.

i. Landscaping and screening.

(8) The MUPUD review and approval shall serve as the special use permit review and approval for any use, requirement, or other activity requiring special use permit approval in the underlying zoning district, including a special use permit required under Section **86-658** of the Code of Ordinances, provided the use or other activity requiring special use permit approval is identified before the Township Board approves the Mixed Use Planned Unit Development.

a. Any use subject to special use permit review that is proposed after an MUPUD project is approved must be processed pursuant to the special use permit requirements set forth in Chapter **86**, Article **II**, Division 4, of the Code of Ordinances.

b. An MUPUD application to redevelop an existing use or property previously approved by special use permit shall be considered a new application for MUPUD review under this section.

(9) Upon approval by the Township Board of the MUPUD, the developer shall submit a complete application to the Department of Community Planning and Development for site plan review, as outlined in the Code of Ordinances. The site plan review process shall be subject to the standards outlined in Chapter **86** of the Code of Ordinances.

(10) Any condition imposed upon an MUPUD shall be part of the record and remain unchanged, unaltered, and not expanded upon, except with the mutual consent of the Township and the landowner. The Township and developer shall enter into a formal, written MUPUD agreement outlining the project, waivers approved, amenities, conditions of approval, and any other relevant items related to the project.

(h) Effect of issuance.

(1) The effective date of an approved MUPUD shall be the date of the Township Board decision.

(2) If construction related to the MUPUD has not commenced within two years after the effective date, approval shall be void, except a one-year extension may be considered if a written request is submitted to the Department of Community Planning and Development prior to the expiration date and subsequently approved by the Township Board.

(3) Once a phase in a multi-phased MUPUD is under construction, the next phase must commence construction within one year of the certificate of occupancy being issued for the first building in the previous phase. The Township Board may grant a one-year extension for commencement of construction on any future phase if a written request is submitted to the Department of Community Planning and Development prior to one year elapsing from the certificate of occupancy on the previous phase.

(i) Amendments.

(1) The property owner may apply for an amendment in writing to the Director of Community Planning and Development. The Director shall make a determination as to whether a proposed amendment constitutes a major or minor amendment to the original planned unit development.

(2) A major amendment shall have a significant impact on the MUPUD and the conditions of its approval, which shall include, but not be limited to:

a. Building additions located outside a building envelope as shown on the approved MUPUD site plan.

b. Building additions in excess of 2,000 square feet in gross floor area.

c. Addition of land to the mixed use PUD.

d. Expansion of a use that increases the required off-street parking.

e. Any addition of 50 or more residential dwelling units to the MUPUD project.

f. Any reduction in nonresidential space in a building(s) by 25% or more of the usable floor area.

(3) All amendments not deemed to be major amendments by the Director of Community Planning and Development shall be considered a minor amendment.

(4) Process to amend an MUPUD.

a. Major amendments shall follow the same procedure set forth in this section for new applications, including, but not limited to, submitting an application and fee, but review and a decision on the amendment shall be limited only to the Township Board.

b. The Director of Community Planning and Development shall initiate the following review process for minor amendments:

1. An application for an amendment to an MUPUD shall be submitted to the Director of Community Planning and Development.

2. A fee shall be paid at the time of filing the application in the amount established in the schedule of fees adopted by the Township Board.

3. Upon submittal of a complete application, the Director of Community Planning and Development shall hold a public hearing. Notice of said public hearing shall comply with the provisions outlined in Subsection **86-65** of the Code of Ordinances.

4. Following the public hearing and after adequate review and study of the application, the Director of Community Planning and Development shall make a decision to approve, approve with conditions, or deny the minor amendment request within 60 days of the public hearing date. The sixty-day period may be extended if the applicant consents.

5. Upon approval of a minor amendment by the Director of Community Planning and Development, the applicant shall submit a complete site plan review application to the Department of Community Planning and Development, as outlined in Chapter **86** of the Code of Ordinances.

6. Any condition imposed upon a minor amendment to an MUPUD by the Director of Community Planning and Development shall remain unchanged, unaltered, and not expanded upon, unless the change is reviewed and authorized by the Director of Community Planning and Development.

c. All amendments and/or new or changed conditions of approval shall be formalized in a written amendment to the MUPUD agreement between the Township and the developer.

d. An aggrieved person may appeal the decision of the Director of Community Planning and Development to the Township Board in accordance with Section 86-188.

(j) The provisions of this section shall be enforced in the manner provided elsewhere in this Code of Ordinances. Any development that is not otherwise in conformance with these regulations shall not be approved.

Chapter 86. Zoning

ARTICLE IV. District Regulations

DIVISION 4. Other Districts

§ 86-444. Commercial Planned Unit Development (C-PUD).

[Ord. No. 2011-13, 8-16-2011]

(a) Purpose and intent.

(1) To encourage investment in obsolete, underused, vacant or nonconforming commercial properties by providing an alternate development review process.

(2) To provide reasonable flexibility for modifications to or redevelopment of commercial sites to ensure the continuing economic viability of the Township's commercial areas.

(3) To provide an opportunity for the Township to collaborate with stakeholders to promote the goals of the Township.

(4) To promote innovative and environmentally conscious site design and utilization.

(5) To implement the goals of the master plan such as smart growth, walkability and compact development.

(6) To encourage projects marketable to the public.

(b) Definitions.

AMENITY
Aesthetic, practical or other characteristics of a development that increase its desirability to a community. Amenities may differ from development to development.

WAIVER
Permission to depart from the requirements or standards of the underlying zoning ordinance.

(c) Permitted locations. C-1, C-2, C-3 (commercial) and CS (community service).

(1) Permitted uses. All uses permitted by right and by special use permit in the underlying zoning district(s).

a. The commercial planned unit development (commercial PUD) approval shall serve as the special use permit review and approval for any use or other activity requiring special use permit approval in the underlying zoning district, provided the use or other activity requiring special use permit approval is identified before the Township Board approves the commercial PUD. Any use subject to special use permit review proposed after a commercial PUD approval must be processed pursuant to the special use permit requirements set forth in Chapter **86**, Article **II**, Division 4 of the Code of Ordinances.

b. The commercial PUD approval shall serve as the special use permit for any project subject to § **86-658** of the Code of Ordinances; a separate special use permit shall not be required.

c. A commercial PUD application to redevelop an existing use previously approved by special use permit shall act as the request to amend the existing special use permit.

(d) Minimum commercial planned unit development (commercial PUD) performance objectives.

(1) Provide good internal and external access to the street for pedestrians and bicycles (e.g., a minimum of conflict points between vehicles and pedestrians and cyclists).

(2) Minimize environmental impacts by using green building and site development techniques.

(3) Enhance access to all alternative transportation modes including public transportation.

(4) Use of quality building materials.

(5) Provide for buffering between any conflicting feature of the design and an adjacent residential land use.

(6) Adherence to smart growth principles.

(7) Preference for parking located in the rear or side yard.

(e) Amenities.

(1) Requirements and guidelines.

a. Every commercial PUD shall incorporate one or more amenities.

b. Waivers from zoning ordinance standards may be granted by the Township Board in exchange for amenities.

c. Amenities shall not be combined or counted more than once or counted toward any other requirement of the ordinance.

d. When multiple amenities are proposed multiple criteria categories should be represented.

e. Amenities shall be visible and/or accessible to the public from a fully improved street, and/or a benefit to the general public.

(2) Criteria. Amenities acceptable for consideration by the Township shall meet one or more of the following criteria:

a. Type, value and number of amenities shall be proportionate to the size and/or cost of the project.

b. Variety of amenity categories represented.

c. Support of goals expressed in this section, the Township Board policy manual, the master plan, or other applicable adopted plans.

d. Consistency and compatibility with the intended use of the site.

e. Continuity of design elements.

f. Appropriate and harmonious with the surrounding area.

g. Potential to act as a catalyst for improvements to surrounding sites.

(3) Categories listing examples of possible amenities.

a. Conservation:

1. Any alternative energy system.
2. Grey water recycling.
3. Green roofs.
4. Electric car charging stations.
5. Activities or technologies listed for Leadership in Energy and Environmental Design (LEED) certification by the U.S. Green Building Council or certification criteria of organizations with similar goals; for example, American Society of Landscape Architects (ASLA) Sustainable Sites Initiative (SITES) or the Society of Environmentally Responsible Facilities (SERF).

b. Environment:

1. Significantly increased pervious surfaces.
2. Rehabilitation of degraded sites.
3. Green space exceeding the underlying permeable surface regulation.
4. Rehabilitation of green space designated as links on the greenspace plan.
5. Street trees installed at a 20% higher density or one-inch caliper larger than required by the Code of Ordinances.

c. Accessibility:

1. Transit stops. The addition or relocation of one or more transit stops when supported by a local transit provider.
2. Foot and bicycle pathways and sidewalks that connect with the Township's pedestrian/bicycle pathway system and routes identified in the Township's greenspace plan via a public right-of-way or public access easement.
3. Covered bicycle storage on site.

d. Parks, recreation and culture for active and passive activities:

1. Public recreation resources.
2. Public cultural venues.
3. Public art at 1% of the project cost designed to withstand natural elements and reasonable public contact for at least 10 years.

e. Social interaction:

1. Outdoor gathering spaces or outdoor eating spaces of 300 square feet or more.
2. Public outdoor seating plazas adjacent to or visible and accessible from the street including, but not limited to, benches or other outdoor seating not associated with an outdoor cafe.
3. Privately maintained courtyards, plazas, pocket parks, and rooftop gardens and similar features with seating for the public.

f. Site and building design:

1. Underground utilities.
2. Combination of first floor awnings and upper floor balconies adjacent to a public street.

3. Porches on any structure.
4. Multilevel or underground parking.
5. Ornamental paving treatments for sidewalks and/or parking areas such as, but not limited to, concrete masonry unit pavers, brick, stone or pervious concrete or asphalt.
6. Innovative lighting.
7. Sidewalk planters located in the vicinity of sidewalks and/or outdoor seating areas.
8. Public access to new technology including wireless access points, electronic information displays, excluding unsolicited electronic broadcast information.
9. Consolidation of multiple land parcels into one to facilitate an integrated design.
10. Fountain.

(f) Design standards.

(1) Building materials.

a. Buildings shall be constructed of wood, brick, clapboards, beadboard, glass, and stone.

b. The use of vinyl, aluminum, and other metal sidings should be avoided.

(2) Accessories.

a. Railings, benches, trash receptacles, and bicycle racks shall be of commercial quality, and complement the building design and style, subject to the approval of the Director of Community Planning and Development.

b. All mechanical systems shall be screened from street level view on all sides by an opaque structure or landscape material selected to complement the building.

(3) General standards. Unless specifically waived by the Township Board, sites developed under this section shall comply with all standards found in the underlying zoning district as well as:

a. Chapter **38**, Article **VII**, outdoor lighting.

b. Chapter **86**, Article **V**, Division 1, § **86-473**, street trees.

c. Chapter **86**, Article **VII**, signs and advertising structures.

d. Chapter **86**, Article **VIII**, Division 2, off-street parking and loading, for automobile and bicycle parking, and parking lot landscaping standards.

(g) Procedures.

(1) Preapplication conference. Each applicant shall confer with the Department of Community Planning and Development regarding the preparation of the planned unit development application. The general proposal in the form of a conceptualized site plan shall be reviewed by the Director of Community Planning and Development in a preapplication conference prior to submission of the commercial PUD application. The Director of Community Planning and Development shall furnish the applicant with requirements of the planned unit development application. It is not required that any person requesting a preapplication conference be an owner of or holder of an equitable interest in the subject property.

(2) An applicant is urged to meet with owners and occupants of surrounding properties to apprise them of a proposed development, share the physical design, receive comments, and revise the proposal accordingly prior to submitting an official application. The Township will assist by providing property owner and occupant contact information.

(3) Concept plan (optional). A property owner, prospective applicant or their representative may submit a concept plan for review and comment by the Planning Commission and Township Board.

a. Purpose:

1. To acquaint the Planning Commission and Township Board with the proposed project.

2. To provide guidance regarding the proposed design's compatibility with the purpose, intent and standards of the commercial PUD ordinance.

3. To reduce the applicant's time and cost.

b. Submittal requirements:

1. A written request to initiate a concept plan review submitted to the Director of Community Planning and Development.

2. A written summary of the project (amount and type of uses, basis for the design concept).

3. A concept plan drawn to scale containing the following information:

i. Boundaries and acreage of the site.

ii. Zoning.

iii. Adjacent road network.

iv. General layout of buildings, interior access roads and unique design elements.

v. General location of known features affecting the site layout such as, but not limited to, floodplain, wetlands, woodlands, railroads, drains, rivers or rivers and streams, parkland, etc.

c. Review procedure:

1. Upon receipt of a written request and other required data and information, the Director of Community Planning and Development shall review the concept plan.

2. Within 30 days of the date of receiving a complete request the director shall forward to the Planning Commission and Township Board the concept plan and accompanying data along with any written comments from the director. The Planning Commission and Township Board shall concurrently review the concept plan and may offer comments or suggestions on the design. Comments or suggestions made during the review of the concept plan shall not be binding on the Township or the applicant.

(4) Application.

a. Applications shall be submitted to the Department of Community Planning and Development on a special form for that purpose. Each application shall be accompanied by the payment of a fee in accordance with the duly adopted schedule of fees. No part of any fee shall be refundable.

1. Required data and information:

i. A map drawn to an engineer's scale of the total property showing its location in the Township and its relation to adjacent property.

ii. A reproducible two-foot contour topographic map drawn at the same scale as the site plan and showing the existing relief features on the site.

iii. A site plan of the proposed planned unit development design.

iv. A site analysis indicating the principal factors which influenced design decisions. The analysis shall include, but need not be limited to, soil conditions, topography, surrounding land uses, and surrounding pedestrian and vehicular circulation systems.

v. A schematic layout of the proposed storm sewer system.

vi. A document generally describing the proposed phasing program.

vii. A natural features study, as applicable.

viii. A traffic assessment or a traffic impact study may be required as specified in Section **86-130**.
[Amended 8-4-2022 by Ord. No. 2022-08]

ix. Building elevations drawn to scale (in color).

x. Proof of property ownership or a letter from the property owner authorizing the request submitted with proof of property ownership from the author of the letter.

xi. A written request identifying each waiver and proposed amenity shall be submitted with the commercial PUD application. Examples of waivers are:

A. Reduction in required lot area and lot width.

B. Reduction in front yard setbacks to move buildings closer to the road.

C. Reduction in side and rear setback requirements for structures and parking.

D. Increase in impervious surface coverage.

E. Reduction or elimination of building perimeter landscaping.

F. Reduction of the required parking spaces when the request is accompanied by a supporting study and/or agreement for shared parking on an adjacent or nearby site.

G. Exceed maximum building height.

2. Local agency review. The developer shall provide the Township with copies of comments from the following reviewing agencies, as applicable:

i. Ingham County Road Commission.

ii. Michigan Department of Environmental Quality.

iii. Ingham County Drain Commissioner.

iv. Michigan Department of Transportation.

(5) Planning Commission review.

a. Hearing. Upon submittal of a complete application, the Planning Commission shall hold a public hearing.

1. Notice of public hearing. Notices shall comply with the provisions outlined in Subsection **86-65(b)** of the Code of Ordinances.

2. Planning Commission decision. Following the public hearing and after adequate review and study of the application, the Planning Commission shall recommend approval, modification, or denial, to the Township Board, within 60 days of the public hearing date and shall within said 60 days, report its action to the Township Board. The sixty-day period may be extended if the applicant consents.

(6) Township Board hearing and decision. After receiving a recommendation from the Planning Commission, the Township Board shall conduct a public hearing which shall be preceded by notice as specified in § **86-65(b)** of the Code of Ordinances. Following the public hearing the Township Board shall make a determination to approve, modify, or deny the commercial PUD within 30 days of the public hearing date. The thirty-day period may be extended if the applicant consents.

(7) Site plan review. Upon approval by the Township Board, the developer shall submit a complete site plan review application to the Department of Community Planning and Development, as outlined in Chapter **86** of the Code of Ordinances.

(8) Any condition imposed upon a commercial PUD shall be part of the record and remain unchanged, unaltered, and not expanded upon, unless the change, alteration or expansion of a condition(s) is reviewed and authorized by the Township Board. The Township shall maintain a record of conditions which are changed.

(h) Effect of issuance.

(1) When permit becomes void. If the commercial PUD or construction related to the commercial PUD has not commenced within 24 months after the effective date of the commercial PUD, such approval shall be void.

(2) Time for completion. All construction related to the commercial PUD must be completed within 36 months from the effective date of the approval, unless specifically approved as a phased development. If an extension is granted, all construction related to the commercial PUD shall be completed within 48 months from the effective date of the commercial PUD, unless specifically approved as a phased development.

(3) Reestablishment. An approved commercial PUD shall not be reestablished without obtaining new approval from the Township Board in accordance with this division, unless the site has been converted to a use permitted by right or a subsequent use received a new commercial PUD.

(4) Extension request. If the commercial PUD, or construction related to the commercial PUD, has not commenced within 24 months from the effective date of the special use permit, an extension may be requested in writing prior to the expiration date. An extension shall be reviewed and approved or denied in writing by the Township Board.

(i) Amendments.

(1) Generally. The property owner may apply for an amendment in writing to the Director of Community Planning and Development. The director shall make a determination as to whether a proposed amendment constitutes a major or minor amendment to the original planned unit development.

(2) Major amendments. A major amendment shall have a significant impact on the commercial PUD and the conditions of its approval, which shall include, but not be limited to:

a. Building additions located outside a building envelope as shown on the approved commercial PUD site plan.

b. Building additions that reduce any setback shown on the approved commercial PUD site plan.

c. Building additions in excess of 2,000 square feet for buildings under 20,000 square feet in gross floor area or 10% of an existing building over 20,000 square feet in gross floor area.

d. Expansion of a use that results in an additional 100 or more vehicle trip ends during the peak hours.

e. Addition of land to the commercial PUD equal to or more than 20,000 square feet for existing sites less than 40,000 square feet in area or two times the original site size for

sites over 40,000 square feet.

f. Expansion of a use that anticipates a 10% or greater increase in required off-street parking.

g. Any addition to a legal nonconforming site.

(3) Minor amendments. All amendments not deemed to be major amendments by the Director of Community Planning and Development shall be considered a minor amendment.

(4) Process to amend a commercial PUD:

a. Major amendments shall follow the same procedure set forth in this section for new applications, including, but not limited to, submitting an application and fee.

b. Minor amendments. The Director of Community Planning and Development shall initiate the following review process:

1. Application. An application for an amendment to a commercial PUD shall be submitted to the Director of Community Planning and Development.

2. Fee. A fee shall be paid at the time of filing the application in the amount established in the schedule of fees adopted by the Township Board.

3. Hearing. Upon submittal of a complete application, the Director of Community Planning and Development shall hold a public hearing.

i. Notice of the public hearing. Notices shall comply with the provisions outlined in Subsection **86-65(b)** of the Code of Ordinances.

ii. Director of Community Planning and Development decision. Following the public hearing and after adequate review and study of the application, the Director of Community Planning and Development shall make a decision to approve, approve with conditions or deny the minor amendment request within 60 days of the public hearing date. The sixty-day period may be extended if the applicant consents.

4. Site plan review. Upon approval of a minor amendment by the Director of Community Planning and Development, the applicant shall submit a complete site plan review application to the Department of Community Planning and Development, as outlined in Chapter **86** of the Code of Ordinances.

5. Any condition imposed upon a minor amendment to a commercial PUD by the Director of Community Planning and Development shall remain unchanged, unaltered, and not expanded upon, except unless the change is reviewed and authorized by the Director of Community Planning and Development.

c. Appeal. An aggrieved person may appeal the decision of the Director of Community Planning and Development to the Township Board in accordance with § **86-188**.

(j) Enforcement. The provisions of this article shall be enforced in the manner provided elsewhere in this Code of Ordinances. Any development that is not otherwise in conformance with these regulations shall not be approved.

To: **Board Members**

From: **Timothy R. Schmitt, *AICP***
Director of Community Planning and Development

Date: **September 10, 2026**

Re: **Planned Unit Development 26-026 – Vacant Hannah Boulevard – Capstone Collegiate Communities – Set public hearing**

Earlier this year, the Planning Commission recommended approval of and the Township Board ultimately approved a proposal to rezone the vacant properties at the end of Hannah Boulevard and Eyde Parkway. This was done as a conditional rezoning, a condition of which was that the applicant is required to submit for a Planned Unit Development review on the property within 24 months of the approval of the rezoning. This was the method to ensure that the project would be developed consistently with the concept plan approved as part of the conditional rezoning. The applicant has now submitted the PUD request, which is consistent with the concept plan that was approved under the conditional rezoning.

Planned Unit Development proposals require public hearings at both the Planning Commission and Township Board level in order to be considered. The Planning Commission is currently reviewing the proposal and will make a recommendation to the Board in the near future. However, given the changes in the meeting calendar after Labor Day, we are asking the Board to pre-schedule the necessary public hearing at the township Board for the October 20, 2026 meeting. The matter will also be on the agenda for discussion at that meeting.

Move to set the public hearing for PUD 26-026, Vacant Hannah Boulevard, Capstone Collegiate Communities project, for the October 20, 2026 Township Board meeting.

10.A/12.A

To: **Township Board**

From: **Tim Dempsey, Township Manager**
Bernadette Blonde, Finance Director

Date: **September 11, 2026**

Re: **Public Hearing & Discussion – 2027 Recommended Budget**

As required by the Charter Township Act and the Budget Hearings of Local Governments Act, a public hearing must be held prior to the adoption of the Fiscal Year 2027 Budget. Notice of the hearing was published in the City Pulse. The Board received the 2027 Recommended Budget at its September 1, 2026 meeting.

The purpose of this public hearing is to provide residents with the opportunity to comment on the proposed budget prior to final adoption.

Attachment:

1. 2027 Recommended Budget

To: **Township Board**

From: **Neighborhoods & Economic Development Director, Amber Clark**

Date: **September 15, 2026**

Re: **4690 Okemos Road Brownfield Plan**

Summary:

September 1, 2026 the Township Board held a public hearing regarding the proposed 4690 Okemos Brownfield Plan. The Plan requests the use of school operation millage to support a 16 year Plan and 15 year capture for rehabilitation purposes. This is made possible through the amended PA 381, allowing non-core communities the ability to gain access to fund infrastructure and housing subsidy. The Meridian Township Brownfield Authority (MTBRA), has discuss the 4690 Okemos Road Plan over two meetings. The Plan was noticed in the paper and notification was submitted to impacted tax jurisdictions to allow for comment. No comments in opposition to the Plan were received. The MTBRA approved by resolution, the support of the Plan at their August 13th, 2026 Meeting. The Township Board has the item on the agenda tonight to determine if the project constitutes a public purpose and if they support the proposed Plan as presented.

4690 Brownfield Plan Details:

The rehabilitation of the 1.3 acre site; two mixed-use buildings and one commercial building.

Activity		**Funding Category**
Environmental Costs	$15,800	EGLE
Total EGLE Eligible Activities	**$15,800**	
Demolition	$154,350	MSHDA
Asbestos, Lead, Site Prep & Infrastructure	$154,475(asbestos & Infrastructure)	MSHDA
Housing Subsidy	$332,598	MSHDA
Total MSHDA Eligible Activities	**$641,423**	MSHDA

Activity		Funding Category
Contingency 15%	$92,323	MSHDA
Interest (up to 5% simple)	$71,149	MSHDA
Work Plan Preparation	$24,000	MSHDA
Work Plan Implementation	$50,000	MSHDA
Plan Application Fee	$7,000	MSHDA
Total Developer Reimbursement	**$901,695**	MSHDA
BRA Admin Fees	$110,234	MSHDA
LBRF Capture	$54,835	MSHDA
State BRF Fees	$56,327	MSHDA
Base Taxable Value	$750,000	
Projected Taxable Value	$1,736,250 by 2028	

Rehabilitation Details:

Building 1 (4696 Okemos Road)	**Type:** Mixed Use First Floor Commercial Suites	**Commercial Suites Quantity:** 5
	Type: Second Story Housing One (1) single bedroom unit & One (1) two bedroom unit.	**Residential Quantity: 2 Units** **1- Single bedroom** **1- Two bedroom**
Building 2 (4690 Okemos Road)	**Type:** Mixed Use First Floor Commercial Suites	**Commercial Suites Quantity:** 2
	Type: Second Story Housing Five (5) single bedroom units	**Residential Quantity: 5 Units** **5- Single bedroom**
Building 3 (2114 Hamilton)	**Type:** Commercial	**Commercial Suites Quantity:** 4

The Brownfield will support the full rehabilitation of the 3 buildings and adjoining parking lot. The Plan includes a housing subsidy for 16 years at the property. The Developer will be required to deed restrict the units at or below 120% of the area median income (AMI) for the duration of the Plan. Five (5) one bedroom units in building #1, 4690 Okemos Road, will be rehabilitated to include a larger footprint, updated modern layouts and finishing's. Two (2) housing unit in building #2,

4696 Okemos Road, will be rehabilitated to include two larger footprint units, with modern finishing's.

Developer Details:

Local developers VistaLuxe Realty, LLC purchased the properties in 2024 with the vision and intent to rehabilitate the site. VistaLuxe Realty are local developers that live in Meridian Township, are eager to make improvements to the heart of our Downtown. The property includes two mixed used buildings with residential housing units on the second story, and commercial suites on the ground floor. Beautification and enhanced exterior improvements are also included. This project once completed will vastly enhance the attractiveness of the downtown.

Staff strongly suggested a rehabilitation and not a total demolition to reduce costs. The Township has been actively engaged in redevelopment in the downtown district. Previous developments that have proposed full demolition of the site, run into several hurdles when attempting to get to construction. The preservation of the site should expedite the reconstruction and eliminate hurdles related to road or drain improvements. The below table details the elements of the proposed Plan.

Economic Feasibility:

4690 Okemos road and associated parcels are situated on the northeast block, in the heart of the downtown in Meridian Township. For over two decades the community, downtown development authority, and Township have been actively working to address to decline in commercial space in this district. Development in this area is such a priority the Township designated the area as a "PICA". Focusing on updating our ordinance and development standards, recent updates like to our commercial parking lot requirements have made this renovation a possibility.

The proposed project is one of the smaller Brownfield requests we've had in years. Similar to the redevelopment at the Haslett Marathon at 1619 Haslett road, this project would only see a small incremental increase over each year. Due to the plan proposing a 16 year term, the rental restrictions of the residential units will also be 16 years. The developers have also requested interest to be included with the reimbursement for this plan. Our policy requires the developer remit a formal request for the use of interest, with supporting documentation that the interest is required in order to have the project completed.

Board Decision Criteria:

When considering a Brownfield Plan, Public Act 381, as amended PA 90 of 2023 requires that the highest level of a governing body, to determine whether the Plan constitutes a public purpose. Public purpose is not defined in the Act, but the Natural Resources and Environmental Protection Act, which is referenced in PA 381, provides some guidance. This includes whether or not a project provides significant and measureable environmental, community, and economic benefits. Economic benefits are generally considered private investment, increases in taxable value, and job creation. If

a public purpose is identified, the Board can approve the Plan or approve the Plan with modifications.

Public purpose can be determined in several ways. Some of the most common are related to the investment the development will provide the community, contamination/clean-up of an obsolete property, removal of asbestos, redevelopment of a functionally obsolete property, increased development activity, and now with our updated policy, housing developments that will support incomes at or below 120% of the Area Median Income (AMI). The Township Board may elect to take action and adopt the Brownfield Plan. A motion is prepared for your consideration:

> **MOVE TO ADOPT THE RESOLUTION IN SUPPORT OF THE 4690 OKEMOS ROAD BROWNFIELD PLAN FOR PROPERTIES AT 4690-4696 OKEMOS ROAD, 4703 MOORE STREET, 0 MOORE STREET, & 2114 HAMILTON ROAD, WITH A TOTAL INCREMENT REVENUE OF $2,090,504 AND DEVELOPER REIMBURSEMENT NOT TO EXCEED $901,695, FOR 16 YEARS.**

Attachments:

1. 4690 Okemos Brownfield Presentation & Site Renderings
2. 4690 Brownfield proposed Brownfield Plan dated August 10, 2026
3. Draft MTBRA Meeting Minutes – August 13, 2026
4. Resolution in Support of 4690 Okemos Road Brownfield Plan

TRI TERRA

BROWNFIELDS | ENVIRONMENTAL CONSULTING | NATURAL RESOURCES

Okemos Project

4690 Okemos Road, Okemos, MI

Brownfield Redevelopment Project

www.triterra.us

Eligible Property

Project Name:

- 4690 Okemos Road Brownfield

Developer:

- VistaLuxe Realty LLC

Subject Property:

- 4696 & 4690 Okemos Road, 4703 & 0 Moore Street, 2114 Hamilton Road
- ~1.46-acres total
- Parcels 33-02-02-21-406-(002, 003, 004, 005, and 006)

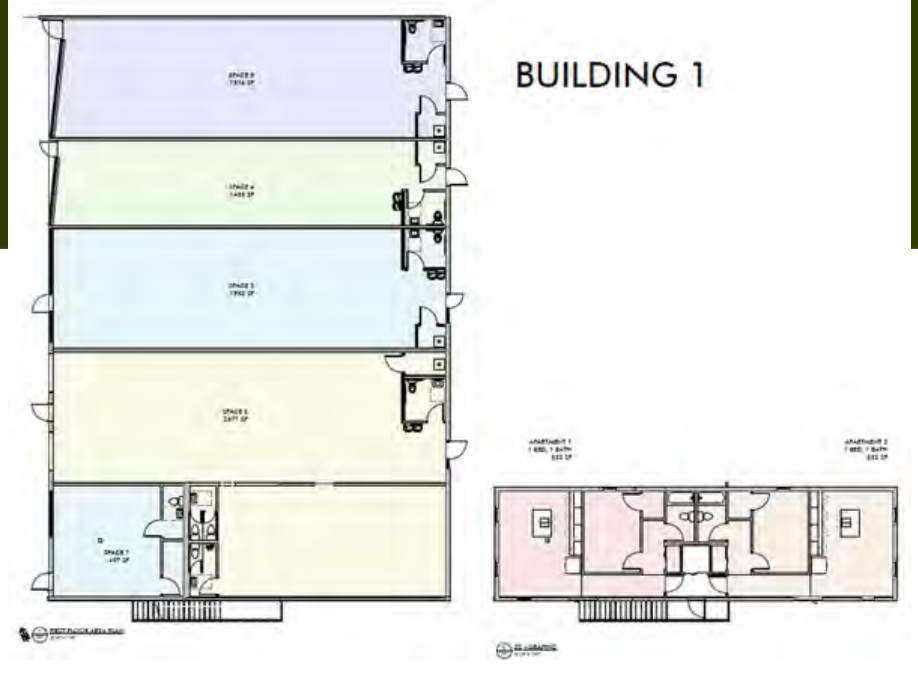
Eligible Status:

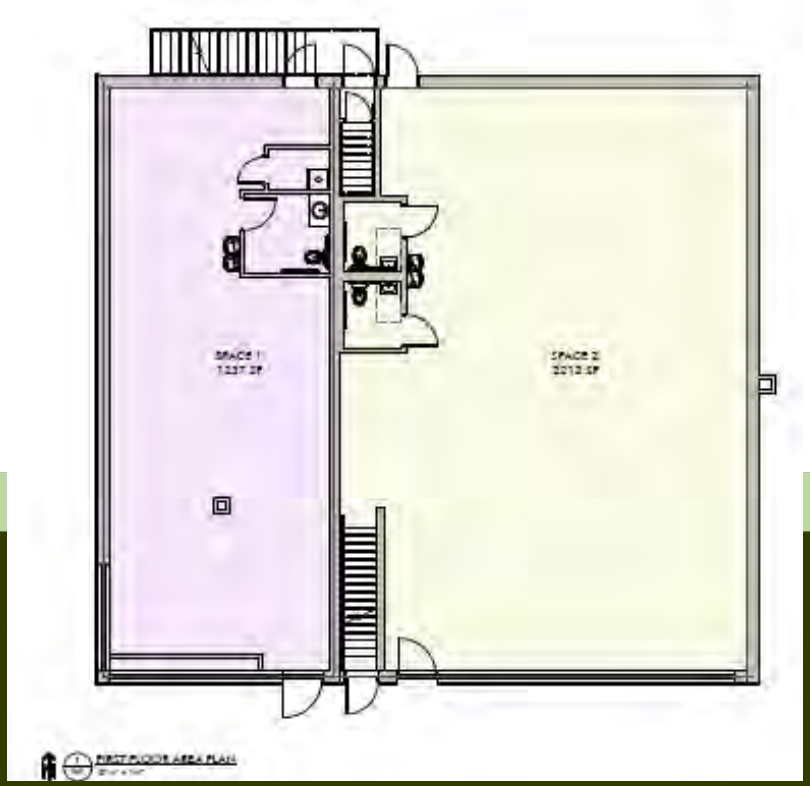
- Housing Property
- Adjacent and Contiguous

Project Summary

Redevelopment:

- Renovation of two mixed-use buildings and one commercial building
- 10 new full-time jobs, 8 new part-time jobs, retains 10 current full-time jobs
- $5,352,105 million total investment
- Estimated to increase SEV from $750,000 to $1,736,250





Project Summary

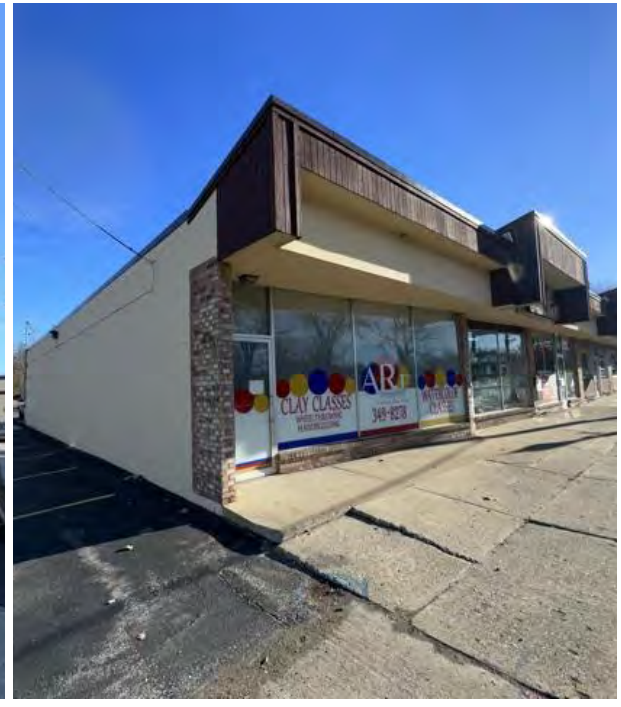
Redevelopment:

- Rehabilitation will include 7 residential units and 11 commercial units across 3 buildings
- Promotes future reactivation of surrounding buildings

BUILDING 1

Before ReDevelopment

- 5 Commercial Suites
- One(1) Two Bedroom Unit



After Re-Development

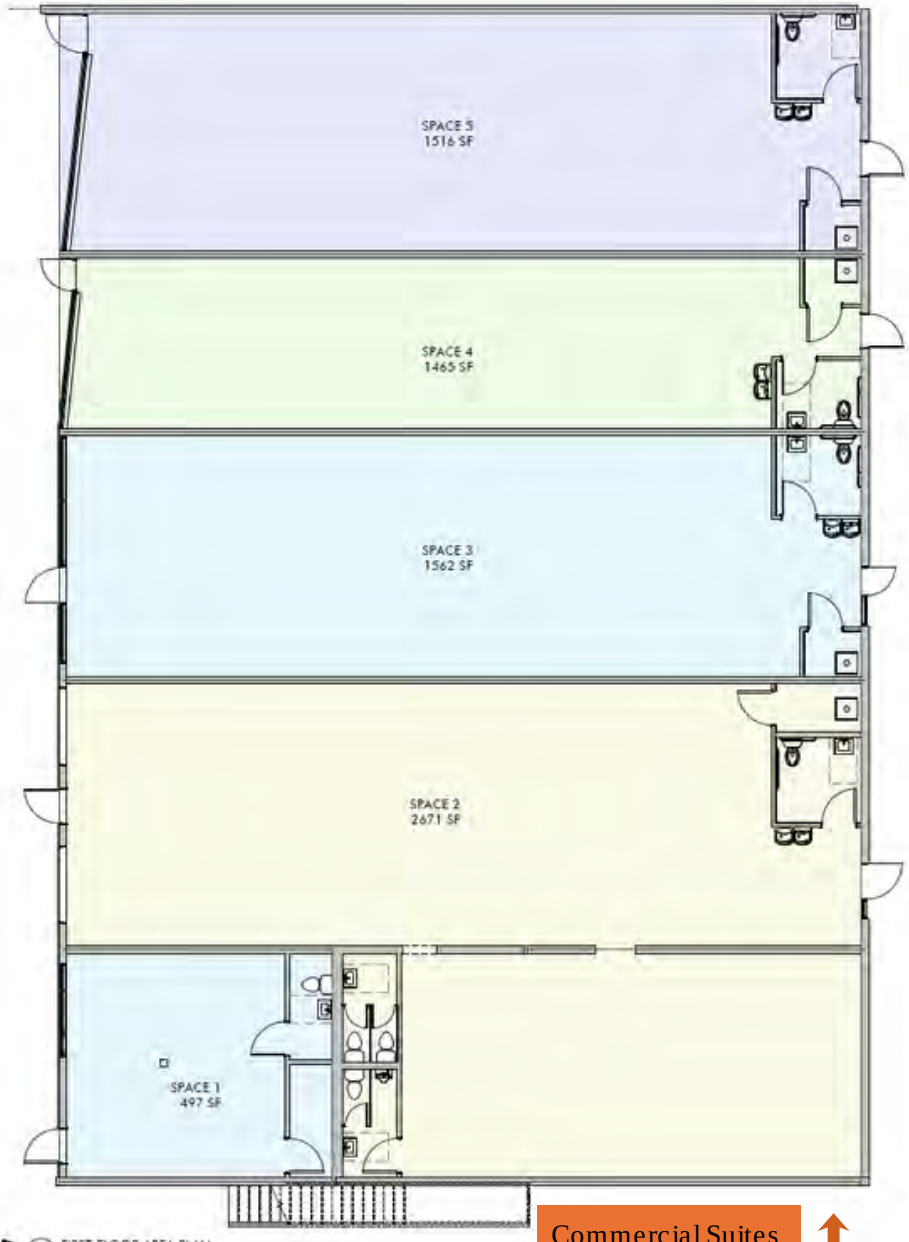
- 5 Commercial Suites
- One(1) One Bedroom Unit
- One(1) Two Bedroom Unit

Commonly "4696 Okemos Road"

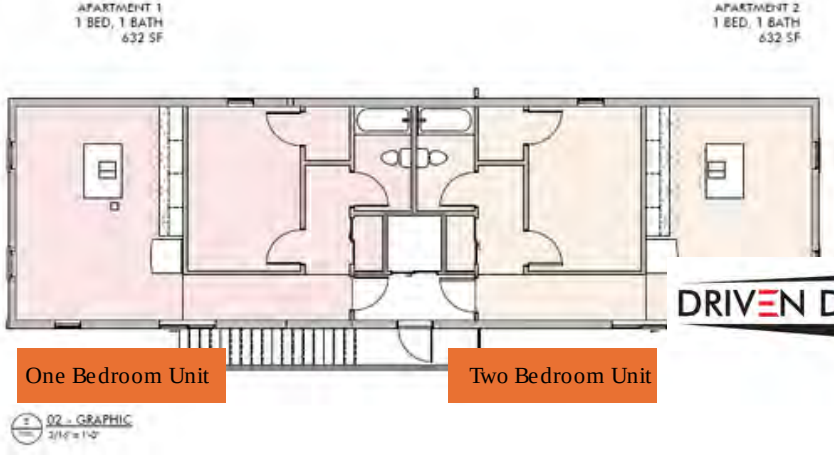
Okemos Road

BUILDING 1

Commonly “4696 Okemos Road”



Commercial Suites



One Bedroom Unit

Two Bedroom Unit

DRIVEN DESIGN

BUILDING 2

Before ReDevelopment

- 2 Commercial Suites
- Six(6) One Bedroom Unit

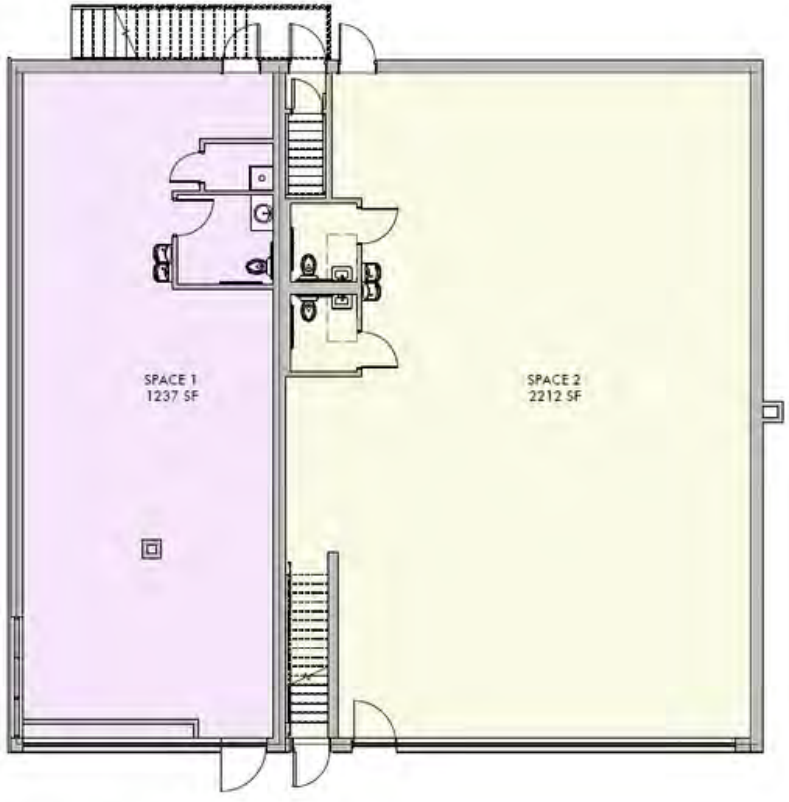
After Re-Development

- 2 Commercial Suites
- Five(5) One Bedroom Unit

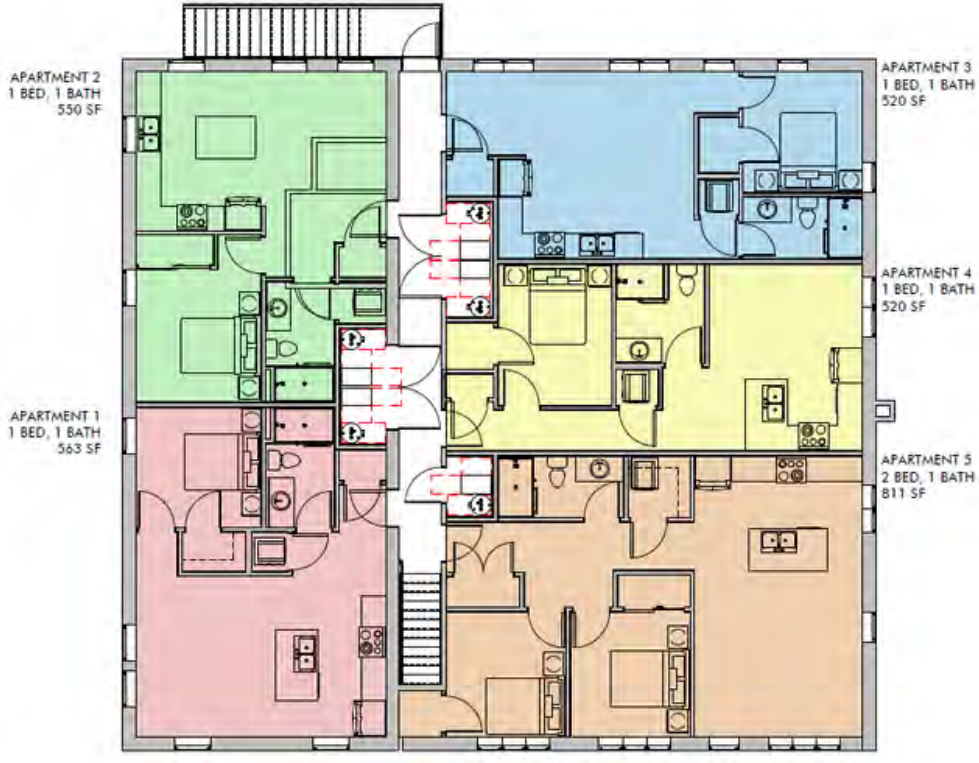
Commonly 4690 Okemos Rd

BUILDING 2

Commonly “4690 Okemos Road”



FIRST FLOOR AREA PLAN
3/16" = 1'-0"



SECOND FLOOR AREA PLAN
3/16" = 1'-0"

Commercial Suites

Five One-Bedroom Units

DRIVEN DESIGN

BUILDING 3

Before ReDevelopment

- 4 Commercial Suites

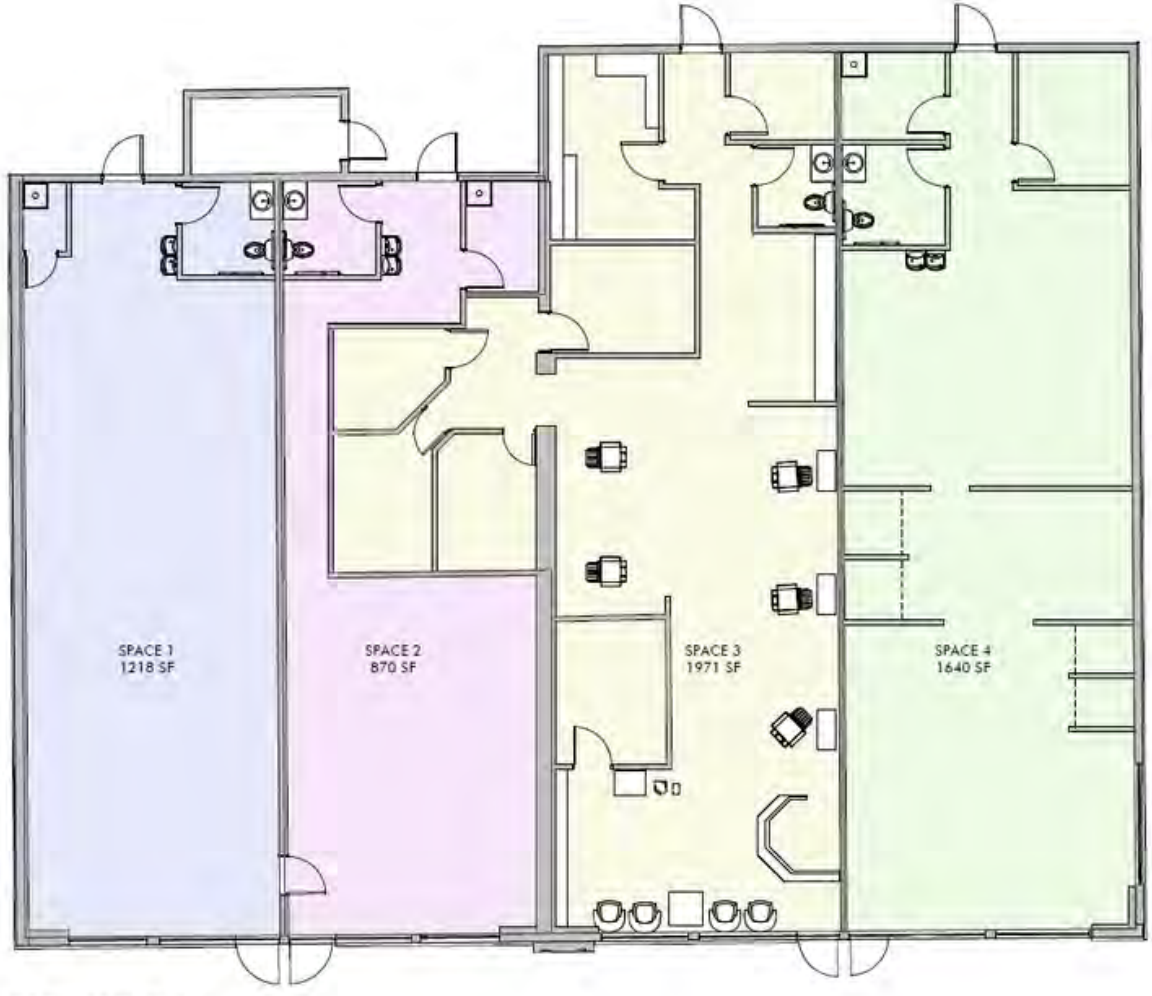
After Re-Development

- 4 Commercial Suites

2114 Hamilton Rd

BUILDING 3

Commonly “2114 Hamilton Road”



FIRST FLOOR AREA PLAN

Commercial only

DRIVEN DESIGN

Project Timeline & Key Milestones

Project Planning (6-12 Months)

- Architectural Plans
- Brownfield Investigation
- Identifying Capital Stack

Funding Research & Applications (4-8 Months)

- MT Brownfield Plan + Submission to MSHDA
- MI Neighborhood Program Application

MI Neighborhood Rehabilitation (MIN 4-6 Months)

- LOI Submission by Meridian Township
- Acceptance to Apply
- Application Submission within 180 days
- Environmental Review
- Completion of rehabilitation

Commence MIN Construction (6-8 Months)

- MIN Application Reimbursement Draws
- Completion of Construction (CofO)
- Apartment Leasing
- Rental Income Verification

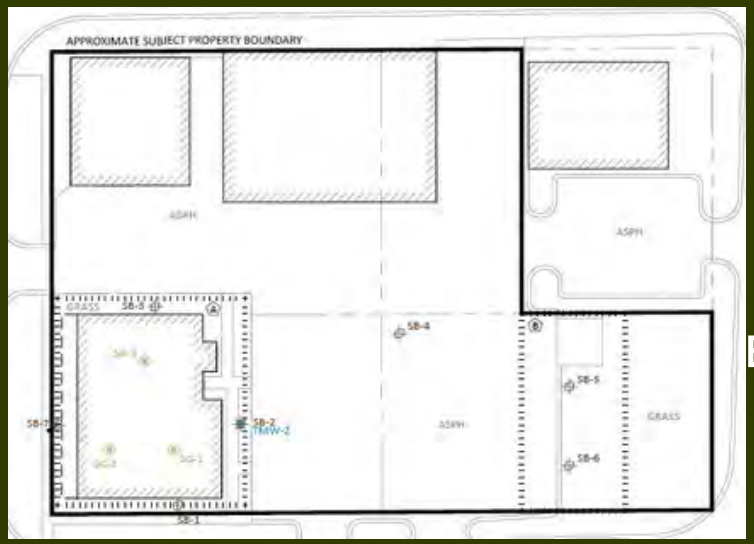
Commence Commercial Construction

- Completion of Interior updates
- Completion of exterior site work
- Commercial Leasing
- Submission of Brownfield Reimbursement Requests

Goal Alignment

- "Expanding the supply of affordable and attainable housing for LMI households"
  - 51% or more of the units will be subject to 80% AMI rates/incomes (5-year minimum)
  - 100% of units will be subject to 120% AMI rates/incomes (length of the Housing TIF or +20 years)
- "Rehabilitating aging housing and commercial structures to prevent further blight and loss of affordable units"
  - Holistic rehab of the property will bring 7 uninhabitable units back to the market and address various environmental "RECs".
  - Façade improvements will address any instances of blight affecting the property and will provide more attractive storefronts for visitors and community residents alike.
  - Both commercial and residential units will be brought to 2026/2027 code, ensuring long-lasting and safe spaces for years to come.
- "Revitalizing key mixed-use districts to support economic development and resident access to services"
  - The creation of dense housing above newly renovated commercial businesses greatly contributes to the circular flow within the downtown corridor.
  - The proposed development finds itself within close proximity to public transit options and businesses that support basic needs (like grocery, pharmaceuticals, entertainment, etc.)

Brownfield Conditions



Environmental Conditions:

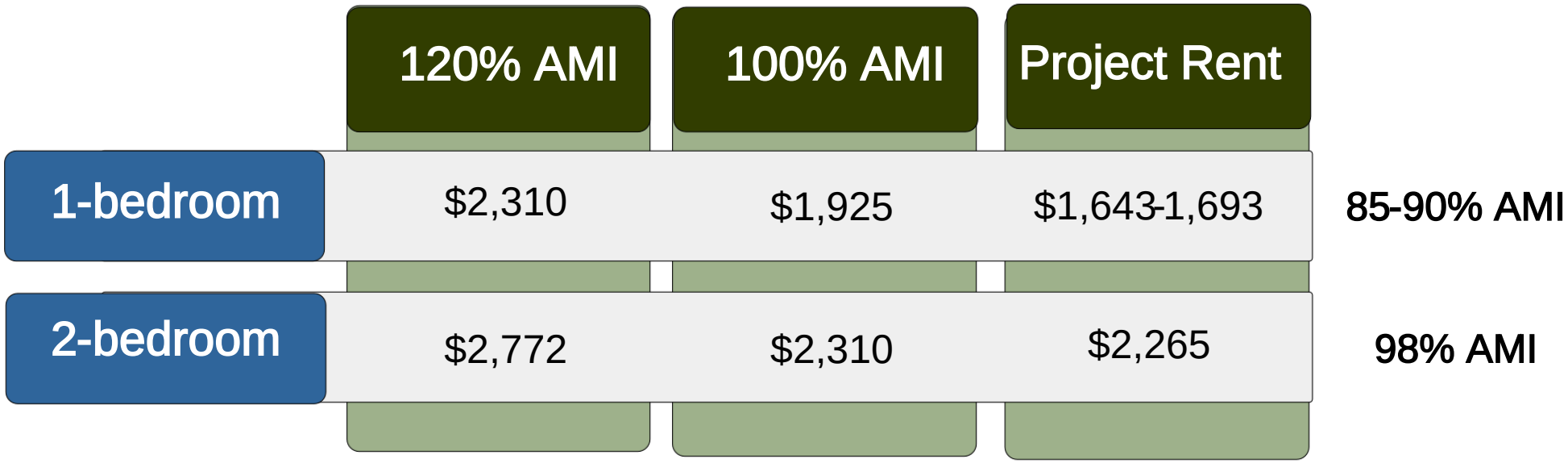
- Phase II Site Investigation revealed no contamination present in soil, groundwater, or soil gas

Eligibility:

- Seven residential housing units proposed across three buildings
- Parcels adjacent to eligible property

Project Rental Rates vs Area Median Income

Rent By Bedroom in Ingham County



New Taxes- Captured for Eligible Activities

EGLE Eligible Activities	
Pre-Approved Activities	$15,800
Subtotal EGLE Activities	**$15,800**

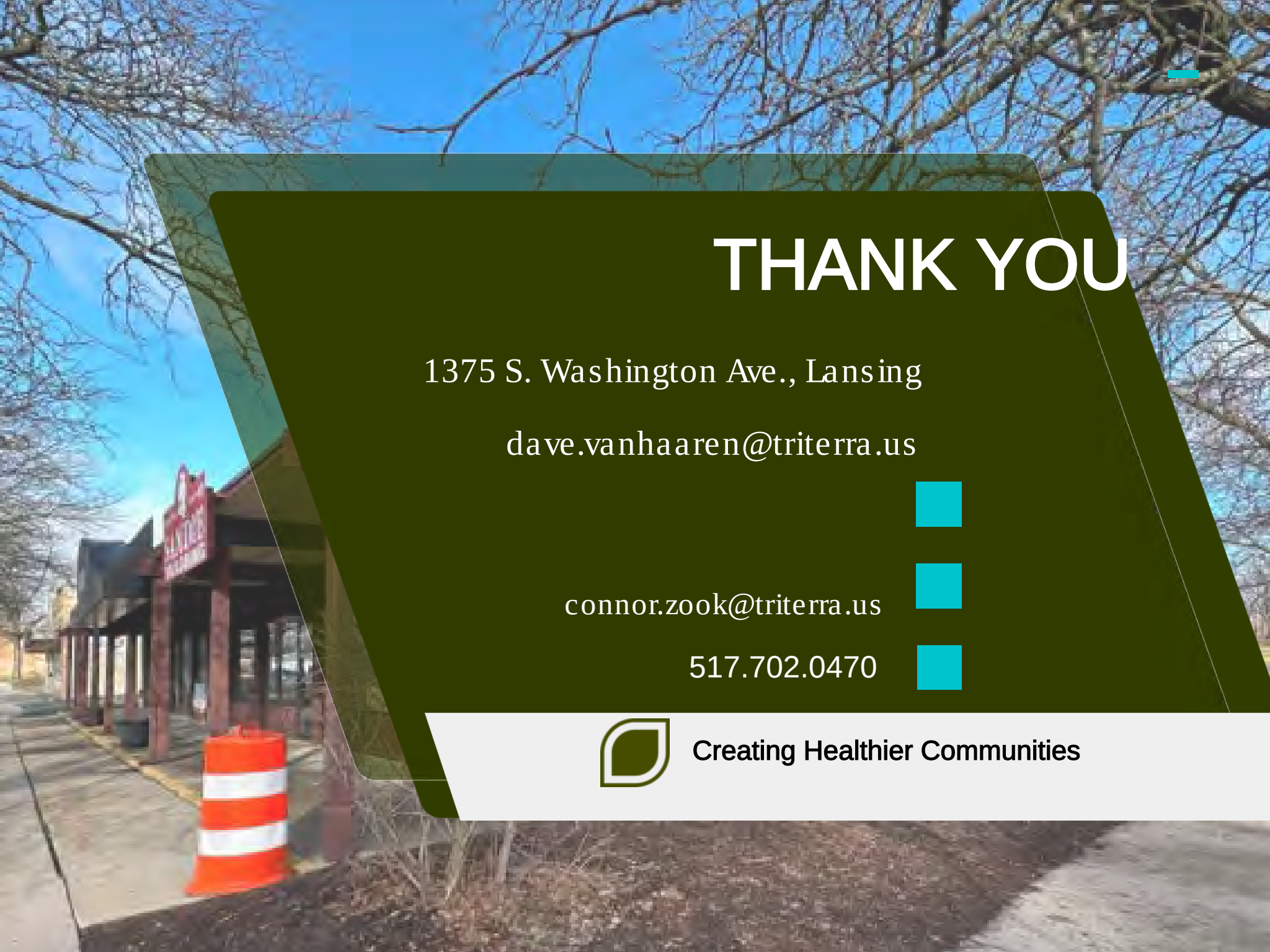
MSHDA Eligible Activities	
Asbestos and Lead Activities	$115,100
Demolition	$154,350
Infrastructure Improvements	$39,375
Housing Development Activities	$332,598
Subtotal MSHDA Activities	**$641,423**

Contingency (15%)	**$92,323**
Brownfield Plan and Act 381 Work Plan Preparation	**$24,000**
Brownfield Plan and Act 381 Work Plan Implementation	**$50,000**
Brownfield Plan Application Fee	**$7,000**
Interest (up to 5% simple)	**$71,149**
Total Eligible Cost for Reimbursement	**$901,695**

Distribution of Taxes

Total Taxes- 15 Years

Developer Reimbursement	$901,695	43.1%
State Brownfield Revolving Fund	$56,327	2.7%
BRA Administrative Fees (10%)	$110,234	5.3%
Local Brownfield Revolving Fund (LBRF) (5%)	$54,835	2.6%
Base Taxes and Debt (Not Captured)	$967,413	46.3%
Grand Total	**$2,090,504**	**100.0%**



THANK YOU

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517.702.0470

Creating Healthier Communities

MERIDIAN TOWNSHIP
BROWNFIELD REDEVELOPMENT AUTHORITY

BROWNFIELD PLAN

4690 Okemos
4690 Okemos Road
Okemos, Michigan 48846

Prepared For:

Meridian Brownfield Redevelopment Authority
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Okemos, Michigan 48864
Contact: Amber Clark
Neighborhoods & Economic Development Director
Email: clark@meridian.mi.us
Phone: 517-853-4568

Prepared By:

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1375 S. Washington Avenue, Suite 100
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Phone: 517-853-2152 | 517-853-2154

August 10, 2026

Approved by the Meridian Township BRA on _____, 2026
Approved by the Meridian Charter Township Board of Trustees on _____, 2026

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

PROJECT SUMMARY

Project Name:	4690 Okemos
Developer:	VistaLuxe Realty LLC (the "Developer") Mr. Satheesh Veeramachaneni Mr. Srinivas Kandula 2003 Birch Bluff Dr Okemos, Michigan 48864
Property Location:	4696 Okemos Road, 4703 Moore Street, 0 Moore Street, 4690 Okemos Road, and 2114 Hamilton Road, Okemos, Ingham County, Michigan 48864
Parcel Information:	Parcels 33-02-02-21-406-(002, 003, 004, 005, and 006) comprised of ~1.46 acres.
Type of Eligible Property:	"Housing Property" and "Adjacent and Contiguous"
Project Description:	A redevelopment of the Property located at 4696 Okemos Road, 4703 Moore Street, 0 Moore Street, 4690 Okemos Road, and 2114 Hamilton Road in Okemos, Meridian Township, Ingham County, Michigan. The project includes the renovation of two mixed-use buildings and one commercial building totaling seven residential units and eleven commercial spaces. Brownfield eligible activities include EGLE pre-approved activities, asbestos and lead activities, demolition activities, infrastructure improvement activities (private), housing development activities in the form of qualified rehabilitation, contingency (15%), preparation and implementation of a Brownfield Plan and Act 381 Work Plan, a brownfield application fee, and up to 5% simple interest. This rehabilitation project includes both mixed-use and commercial-only buildings. EGLE pre-approved activities are eligible for the entire eligible property (mixed-use and commercial-only). MSHDA eligible activities are eligible, and proposed in this Plan, for mixed-use buildings only.

Total Capital Investment: Total capital investment is estimated at $5,352,105, of which $901,695 is currently proposed for Brownfield Reimbursement to the Developer.

Estimated Job Creation/Retention: This project anticipates creating 10 new full-time jobs, 8 new part-time jobs, and retaining 10 current full-time jobs.

Duration of Plan: The duration of the Plan is projected to be 16 years in total and includes capture of Tax Increment Revenue (TIR) for reimbursement to the Developer for 15 years (first year of capture anticipated as 2028).

Total Captured Tax Increment Revenue: $1,123,091

Distribution of New Taxes Paid	
Developer Reimbursement	$901,695
Sub-Total Reimbursement	***$901,695***
State Brownfield Revolving Fund	$56,327
BRA Administrative Fees	$110,234
Local Brownfield Revolving Fund	$54,835
Sub-Total BRF Deposits and Administrative Fees	***$221,396***
Grand Total	***$1,123,091***

1.0 INTRODUCTION

The Meridian Township Brownfield Redevelopment Authority (the "Authority" or "BRA"), duly established by resolution of the Meridian Charter Township Board of Trustees (the "Township"), pursuant to the Brownfield Redevelopment Financing Act, Michigan Public Act 381 of 1996, MCLA 125.2651 et. seq., as amended ("Act 381"), is authorized to exercise its powers within the Meridian Charter, Michigan.

1.1 Proposed Redevelopment and Future Use for Each Eligible Property

The Project is a complete redevelopment of the Property and includes the renovation of two mixed-use buildings and one commercial building. The planned construction will transform currently deteriorating buildings into vibrant mixed-use and commercial buildings.

The newly rehabilitated buildings will include a total of seven residential units and eleven commercial spaces: two (2) residential units and five (5) commercial spaces in Building 1; five (5) residential units and two (2) commercial spaces in Building 2; and four (4) commercial spaces in Building 3.

The total anticipated investment into the project is estimated at $5,352,105. The project will result in the transformation of deteriorating buildings in Meridian Township, Ingham County. This project will dramatically improve the appearance of the Property.

The improvements to the Property will be permanent and significantly increase the taxable value of the Property. These improvements will also assist in increasing the property values of nearby properties.

The Project would not be possible without financial support through Brownfield tax increment financing (TIF).

This project anticipates creating 10 new full-time jobs, 8 new part-time jobs, and retaining 10 current full-time jobs.

1.2 Eligible Property Information

This Plan is presented to support the Developer in the redevelopment of five parcels of land, located at 4690 Okemos Road in Okemos, Ingham County, Michigan (the "Property"). The location of the Property is depicted in Figure 1.

The Property consists of five parcels of land totaling approximately 1.46 acres. The Property is fully defined in the following table and Section 2.8 of this Brownfield Plan.

Eligible Property		
Address	**Tax ID**	**Basis of Eligibility**
4696 Okemos Road	33-02-02-21-406-002	"Housing property"
4703 Moore Street	33-02-02-21-406-003	"Housing property" and "Adjacent and Contiguous"
0 Moore Street	33-02-02-21-406-004	"Housing property" and "Adjacent and Contiguous"
4690 Okemos Road	33-02-02-21-406-005	"Housing property"
2114 Hamilton Road	33-02-02-21-406-006	"Adjacent and Contiguous"

The Property is zoned Commercial (C-2) and is located within Meridian Township, Ingham County.

The Property is surrounded by commercial properties. Property layout and boundaries are depicted in Figure 2. The legal description of the Property is included in Attachment A.

Based on a review of historical information, several houses existed on the Property from at least 1938 until 1956. By 1950, the two existing commercial buildings 1 and 2 were constructed on the western portion of the Property and utilized by residential apartments, retail shops, and restaurants. In 1958, the existing commercial building 3 was constructed on the southwestern portion of the Property and utilized by a gasoline service station with seven associated USTs. In 1977 building 3 was utilized by retail shops and offices. The Property is currently occupied by Art Unlimited, New Thai Kitchen, Okemos Barber Shop, Sandie's Tailoring, and Honey Home Interiors.

1.2.1 Environmental

Environmental assessments and investigations (e.g. Phase I ESA) known to have been performed at the Property are completed in 2025. Soil samples, groundwater samples, and soil gas samples have been collected and analyzed for the following parameters: volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), Michigan 10 Metals (arsenic, barium, cadmium, total chromium, copper, lead, selenium, silver, zinc, and mercury).

The analytical results of the soil samples, groundwater samples, and soil gas samples revealed no detectable concentrations of VOCs, PAHs, or Michigan 10 Metals exceeding the current Part 201 Residential Generic Cleanup Criteria (GCC). Soil gas, soil, and groundwater sample locations are depicted in Figure 3.

1.2.2 Specific Housing Need

According to the Tri-County Regional Planning Commission's 2023 draft Regional Housing Action Plan, the state housing ecosystem is identified as a priority, with a goal for the Tri-County area being to "Increase the efficiency and effectiveness of the housing ecosystem by enhancing collaboration on housing among…local governments…and the wide variety of private sector organizations that make up the housing ecosystem." The proposed project is an outstanding example of an opportunity for collaboration between local government (the Township) and the private sector (the Developer) on a housing project. Another such goal is to "Increase the supply of the full spectrum of housing that is affordable and attainable to Michigan residents." The proposed project accomplishes this goal by providing an array of housing unit types that are affordable and attainable. The Plan further goes on to address strategies for completing each goal, one such strategy to achieve the later goal is "Advocate at the federal and state levels for increased funding, including gap funding, to support affordable and attainable housing ranging from small- to large-scale housing development." Although this strategy specifically outlines federal and state levels, it is also important to consider an increase in gap funding at the local and regional levels. The proposed project will utilize gap funding through tax increment financing to develop a small-scale mixed use housing property in an area plagued with vacancy and deteriorating buildings.

This plan seeks to utilize MSHDA Housing TIF (Housing TIF). If successful, the use of Housing TIF means that rent prices, for units utilizing Housing TIF, will be kept attainable to persons at or below 120% Area Median Income (AMI) for a period of 15 years or the term of the reimbursement. According to Meridian Township's BRA Policies and Procedures "The proposed redevelopment project must provide no less than 20% of all dwelling unit types in an approved Plan evenly distributed throughout the project/development site. The Affordable dwelling units shall be leased to an Income Qualified Household earning 120% of the AMI or below as defined by MSHDA." Of the seven (7) total units being created, three (3) units (~43%) will be income restricted and kept attainable to persons at or below 120% AMI. Attainability will be enforced and verified through the requirements set forth by the BRA and MSHDA. Local workforce housing price points were determined by MSHDA's annually published Income and Rent Limits document and will be kept attainable through a restrictive covenant on the property. At the end of this section (1.2.2) is a table of unit types, corresponding rent limits at 120% of the area median income, and projected rental rates for units subject to Housing TIF, as proposed.

The total cost related to rehabilitation activities is estimated at $602,048. Qualified rehabilitation activities consist of activities necessary to make a housing unit suitable for rent to an income qualified household, those that bring the structure into conformance with minimum local building code standards, and those which improve the livability of units while also meeting those standards. This project includes qualified rehabilitation activities in both the commercial and residential portions of the mixed-use buildings, related to fire suppression, plumbing, HVAC, and/or electrical.

Type	Count	120% AMI[1]	Project Rent[2]
1-bedroom	2	$2,310	Base Rent: $1,450-1,500 Utilities: $193 **Total: $1,643-1,693** (85-90% AMI)
2-bedroom	1	$2,772	Base Rent: $2,000 Utilities: $265 **Total: $2,265** (98% AMI)

[1] Based on MSHDA Income and Rent Limits, dated May 1, 2026.
[2] Utilities are estimated. Not all tenants will require additional fees.

1.2.3 Job Growth Data

According to the Bureau of Labor Statistics, both labor force and employment have grown in the last four years. From 2021 through 2024 the labor force in the Lansing-East Lansing Metropolitan Area grew by almost 25,209 people, a 10.9% increase. Labor force and employment growth over the ten-year period of 2014-2024 was 6.2% and 7.9% respectively. The labor force and employment numbers continue to rebound since the Covid-19 pandemic (see table below) and have surpassed the pre-pandemic numbers; more housing is necessary to accommodate the growing labor force of the Lansing-East Lansing Metropolitan Area in Michigan.

Year	Labor Force	Employment
2020	241,025	222,423
2021	231,169	219,374
2022	239,863	229,705
2023	250,065	240,640
2024	256,378	245,108

1.2.4 Eligibility

The Property is considered an "eligible property" as defined by Act 381, Section 2 because: (a) the Property meets the definition of a "Housing property" under Section 2(y)(ii); and (b) the parcels located at 2114 Hamilton Road (33-02-02-21-406-006), 4703 Moore Street (33-02-02-21-406-003, and 0 Moore Street (33-02-02-21-406-004) are adjacent and contiguous to the "Housing property" parcel and development of the adjacent and contiguous parcels is estimated to increase the captured taxable value of the "Housing property" parcel.

2.0 INFORMATION REQUIRED BY SECTION 13(2) OF THE STATUTE

2.1 Description of Costs to Be Paid with Tax Increment Revenues

The Developer will be reimbursed with the new local and state taxes levied by the Project for the costs of eligible activities necessary to support redevelopment of the Property. The activities that are intended to be carried out at the Property are considered "eligible activities" as defined by Sec 2 of Act 381.

Brownfield eligible activities include EGLE pre-approved activities, demolition activities, infrastructure improvement activities (private) housing development activities in the form of qualified rehabilitation, contingency (15%), preparation and implementation of a Brownfield Plan and Act 381 Work Plan, a brownfield application fee, and up to 5% simple interest.

This rehabilitation project includes both mixed-use and commercial-only buildings. EGLE pre-approved activities are eligible for the entire eligible property (mixed-use and commercial-only). MSHDA eligible activities are eligible, and proposed in this Plan, for mixed-use buildings only.

The costs of eligible activities included in, and authorized by, this Plan will be reimbursed with incremental local and state tax revenues generated by the Property and captured by the BRA, subject to any limitations and conditions described in this Plan and the terms of a Reimbursement Agreement between the Developer and the Authority (the "Reimbursement Agreement").

2.2 Summary of Eligible Activities

The total cost of activities eligible for Developer reimbursement from TIR is projected to be $901,695. The eligible activities are summarized in the table on the following page.

Summary of Eligible Activities	
EGLE Eligible Activities	
Pre-Approved Activities	$15,800
EGLE Eligible Activities Sub-Total	**$15,800**
MSHDA Eligible Activities	
Asbestos and Lead Activities	$115,100
Demolition Activities	$154,350
Infrastructure Improvement Activities	$39,375
Housing Development Activities	$332,598
MSHDA Eligible Activities Sub-Total	**$641,423**
Contingency (15%)	$92,323
Brownfield Plan and Act 381 Work Plan Preparation	$24,000
Brownfield Plan and Act 381 Work Plan Implementation	$50,000
Brownfield Plan Application Fee	$7,000
Interest (up to 5% simple)	$71,149
Total Eligible Cost for Reimbursement	**$901,695**

A detailed breakdown of eligible activities is provided in Table 1, Brownfield Eligible Activities.

The costs listed above are estimated and may increase or decrease depending on the nature and extent of unknown conditions encountered on the Property. The actual cost of those eligible activities encompassed by this Brownfield Plan that will qualify for reimbursement from tax increment revenues captured by the BRA shall be governed by the terms of a Reimbursement Agreement. No costs of eligible activities will be qualified for reimbursement except to the extent permitted in accordance with the terms and conditions of the Reimbursement Agreement and Section 2 of Act 381 of 1996, as amended (MCL 125.2652).

The Reimbursement Agreement, this Brownfield Plan, and the MSHDA Act 381 Work Plan will dictate the total cost of eligible activities subject to reimbursement. As long as the total cost limit described in this Brownfield Plan and the MSHDA Act 381 Work Plan is not exceeded, line-item costs of Eligible Activities may be adjusted within MSHDA Eligible Activities after the Brownfield Plan is approved.

2.3 Estimate of Captured Taxable Value and Tax Increment Revenues

The costs of eligible activities included in, and authorized by, this Brownfield Plan will be reimbursed with incremental local and state tax revenues generated by the Property and captured by the BRA.

The 2026 taxable value of the Property is $750,000. This is the initial taxable value for this Brownfield Plan.

The projected taxable value is estimated at $1,736,250 in 2028. The actual taxable value will be determined by the City Assessor after the development is completed.

This plan seeks to utilize MSHDA Housing TIF (Housing TIF). If successful, the use of Housing TIF means that rent prices, for units utilizing Housing TIF, will be kept attainable to persons at or below 120% Area Median Income (AMI) for a period of 15 years or the term of the reimbursement. According to Meridian Township's BRA Policies and Procedures "The proposed redevelopment project must provide no less than 20% of all dwelling unit types in an approved Plan evenly distributed throughout the project/development site. The Affordable dwelling units shall be leased to an Income Qualified Household earning 120% of the AMI or below as defined by MSHDA." Of the seven (7) total units being created, three (3) units (~43%) will be income restricted and kept attainable to persons at or below 120% AMI. Attainability will be enforced and verified through the requirements set forth by the BRA and MSHDA. Local workforce housing price points were determined by MSHDA's annually published, Income and Rent Limits document.

It is estimated that the BRA will capture tax increment revenues from 2028 through 2042 to allow for reimburse the Developer for eligible activity costs and BRA capture to administer the Brownfield Plan.

The estimated taxable value and estimated tax increment revenue by year and in aggregate for this Project are presented in Table 2, Tax Increment Revenue Capture Estimates, and Table 3, Tax Increment Revenue Allocation Table.

The captured incremental taxable value and associated tax increment revenue will be based on the actual increased taxable value from all real and personal taxable improvements on the Property as determined by the local assessor and the actual millage rates levied by the various taxing jurisdictions during each year of the plan. The actual tax increment captured will be based on taxable value set through the property assessment process by the local unit of government and the millage rates set each year by the taxing jurisdictions.

2.4 Method of Financing Plan Costs and Description of Advances by the Municipality

The Developer is ultimately responsible for financing the costs of its specific eligible activities included in this Plan. The BRA will not advance any funds to finance the Developer eligible activities described in this Plan. All Plan financing commitments and activities and cost reimbursements authorized under this Plan shall be governed by the Reimbursement Agreement. The inclusion of eligible activities and estimates of costs to be reimbursed in this Plan is intended to authorize the BRA to fund such reimbursement. The amount and source of any tax increment revenues that will be used for purposes authorized by this Plan, and the terms and conditions for such use and upon any reimbursement of the expenses permitted by the Plan, will be provided solely under the Reimbursement Agreement contemplated by this Plan.

Reimbursements under the Reimbursement Agreement shall not exceed the cost of eligible activities and reimbursement limits described in this Brownfield Plan.

2.5 Maximum Amount of Note or Bonded Indebtedness

Eligible activities are to be financed by the Developer. The BRA will not incur any note or bonded indebtedness to finance Brownfield eligible activities outlined in this Brownfield Plan.

2.6 Duration of Brownfield Plan

The duration of this Plan is projected to be 16 years total with 15 years of tax capture after the first year of tax capture anticipated as 2028. The duration of the Plan includes 15 years of Tax Increment Revenue (TIR) capture for reimbursement to the Developer.

In no event shall the duration of the Plan exceed 35 years following the date of the resolution approving the Plan, nor shall the duration of the tax capture exceed the lesser of the period authorized under subsections (4) and (5) of Section 13 of Act 381 or 30 years, except as authorized by those subsections or other provisions of Act 381. Further, in no event shall the beginning date of the capture of tax increment revenues be later than five years after the date of the resolution approving the Plan.

2.7 Estimated Impact of Tax Increment Financing on Revenues of Taxing Jurisdictions

The table on the following page presents a summary of the new tax revenues generated by the taxing jurisdictions whose millage is subject to capture by the BRA under this Brownfield Plan. These are estimations based on the components of the proposed redevelopment.

Projected Impact on Taxing Jurisdictions			
Taxing Unit	**New Taxes to Taxing Units**	**New Taxes Captured for Developer Reimbursement, BRA Fees, and the LBRF**	**Total New Taxes**
School Operating	$3,856	$334,107	$337,963
State Education Tax	$643	$112,012	$112,654
Land Preserve	$32	$1,822	$1,853
Rec/Srs/Hum Serv	$47	$2,704	$2,751
Meridian Bikepath	$105	$6,035	$6,140
Meridian Police	$190	$10,977	$11,168
Meridian Fire	$201	$11,566	$11,767
Meridian Parks	$209	$12,037	$12,246
Airport Auth	$224	$12,901	$13,124
Okemos Building and Site	$315	$18,179	$18,494
Police and Fire	$467	$26,956	$27,424
CADL-Library	$499	$28,765	$29,264
CATA/Regular	$956	$55,157	$56,113
Lansing Comm College	$1,203	$69,414	$70,617
Meridian Township	$1,316	$75,883	$77,198
Ingham ISD Operating	$1,993	$114,950	$116,943
Ingham County Operating	$3,981	$229,628	$233,609
Okemos Debt	$131,430		$131,430
Road Impr Debt	$36,479		$36,479
Total	**$184,145 (14.1%)**	**$1,123,091 (85.9%)**	**$1,307,235 (100%)**

Impact to specific taxing jurisdictions is further presented in Table 2, Tax Increment Revenue Capture Estimates, and a schedule of tax increment revenue is presented in Table 3, Tax Increment Revenue Allocation Table.

2.8 Legal Description, Property Map, Statement of Qualifying Characteristics and Personal Property

A parcel information card and Certified Boundary Survey containing the legal description of the Property is provided in Attachment A. The general Property location and boundaries are shown in Figures 1 and 2.

The Property includes all tangible personal property that now or in the future comes to be owned or installed on the Property by the Developer or occupants.

Eligible Property		
Address	**Tax ID**	**Legal Description**
4696 Okemos Road	33-02-02-21-406-002	MP 2281 LOTS 2 AND 3 BLOCK 2 EXC. N 95 FT. OKEMOS
4703 Moore Street	33-02-02-21-406-003	MP 2280 LOT 1 BLOCK 2 OKEMOS
0 Moore Street	33-02-02-21-406-004	MP 2284 LOT 6 EXC. S 100 FT. BLOCK 2 OKEMOS
4690 Okemos Road	33-02-02-21-406-005	MP 2283 MP 2282 LOT 5 EXC. S. 100 FT. OF E 11 FT., BLOCK 2 & LOT 4, BLK 2 OKEMOS
2114 Hamilton Road	33-02-02-21-406-006	MP 2283-1 2284-1 S 100 FT. OF E 11 FT. OF LOT 5, BLOCK 2 ALSO S 100 FT. OF LOT 6 BLOCK 2 OKEMOS

The general Property location and characteristics are described in Section 1.2 and depicted on Figures 1 and 2.

The Property is considered an "eligible property" as defined by Act 381, Section 2 because: (a) the Property meets the definition of a "Housing property" under Section 2(y)(ii); and (b) the parcels located at 2114 Hamilton Road (33-02-02-21-406-006), 4703 Moore Street (33-02-02-21-406-003, and 0 Moore Street (33-02-02-21-406-004) are adjacent and contiguous to the "Housing property" parcel and development of the adjacent and contiguous parcels is estimated to increase the captured taxable value of the "Housing property" parcel.

The Property includes all tangible personal property that now or in the future comes to be installed on the Property by the Developer or occupants.

2.9 Estimates of Residents and Displacement of Individuals/Families

No occupied residences are involved in the redevelopment, no persons reside at the Property, and no families or individuals will be displaced as a result of this development.

2.10 Plan for Relocation of Displaced Persons

No persons will be displaced as a result of this development. Therefore, a plan for relocation of displaced persons is not applicable and is not needed for this Brownfield Plan.

2.11 Provisions for Relocation Costs

No persons will be displaced as result of this development, and no relocation costs will be incurred. Therefore, provision for relocation costs is not applicable and is not needed for this Brownfield Plan.

2.12 Strategy for Compliance with Michigan's Relocation Assistance Law

No persons will be displaced as result of this development. Therefore, no relocation assistance strategy is needed for this Brownfield Plan.

2.13 Description of the Proposed Use of Local Brownfield Revolving Fund

The BRA has established a LBRF. LBRF monies will not be used to finance or reimburse eligible activities incurred by the Developer as described in this Plan.

The LBRA will capture 5% of new local taxes generated from the Property per year for the duration of the Plan for deposit into the BRA's its LBRF. Total deposits into the LBRF will not exceed the sum total equivalent of 5 years of local tax increment revenue.

2.14 Other Materials that the Authority or Governing Body Considers Pertinent

The Authority and the Township, as the governing body, in accordance with the Act, may amend this Brownfield Plan in the future in order to fund additional eligible activities associated with the Project or the Property described herein.

FIGURES

TRI TERRA

FIGURE 1 SUBJECT PROPERTY LOCATION

4690 OKEMOS ROAD
OKEMOS, MICHIGAN 48864

INGHAM COUNTY
T4N, R1W, SECTION 21

PROJECT NUMBER 23-3611

TRI TERRA

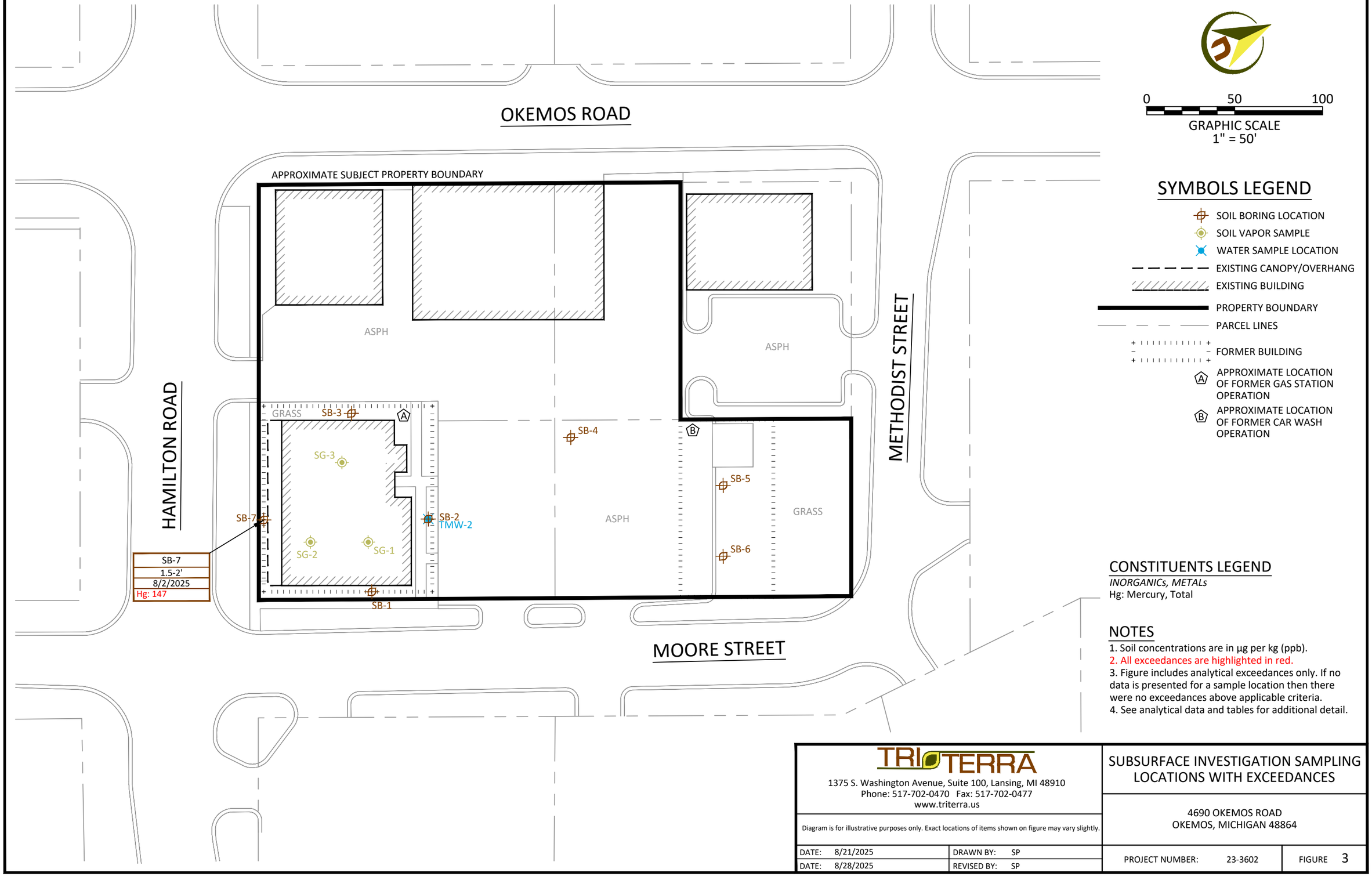
FIGURE 2

ELIGIBLE PROPERTY BOUNDARY MAP

PROJECT NUMBER 23-3602

4690 OKEMOS ROAD
OKEMOS, MICHIGAN 48864

CREATED BY: CZ
04/01/2026



CONSTITUENTS LEGEND

INORGANICs, METALs
Hg: Mercury, Total

NOTES

1. Soil concentrations are in µg per kg (ppb).
2. All exceedances are highlighted in red.
3. Figure includes analytical exceedances only. If no data is presented for a sample location then there were no exceedances above applicable criteria.
4. See analytical data and tables for additional detail.

TRI TERRA
1375 S. Washington Avenue, Suite 100, Lansing, MI 48910
Phone: 517-702-0470 Fax: 517-702-0477
www.triterra.us

Diagram is for illustrative purposes only. Exact locations of items shown on figure may vary slightly.

DATE:	8/21/2025	DRAWN BY:	SP
DATE:	8/28/2025	REVISED BY:	SP

SUBSURFACE INVESTIGATION SAMPLING LOCATIONS WITH EXCEEDANCES

4690 OKEMOS ROAD
OKEMOS, MICHIGAN 48864

PROJECT NUMBER: 23-3602

FIGURE 3

TABLES

Table 1
Brownfield Eligible Activities
4690 Okemos Road
Okemos, MI

ELIGIBLE ACTIVITIES	NO. OF UNITS	UNIT TYPE	UNIT RATE	ESTIMATED TOTAL COST	REIMBURSEMENT ALLOCATION		
					EGLE ACTIVITIES	MSHDA ACTIVITIES	LOCAL-ONLY ACTIVITIES
EGLE ELIGIBLE ACTIVITIES							
Pre-Approved Activities							
Phase I Environmental Site Assessments	1	LS	$ 2,600	$ 2,600	$ 2,600		
Phase II Site Investigations	1	LS	$ 13,200	$ 13,200	$ 13,200		
EGLE ELIGIBLE ACTIVITIES SUB-TOTAL				**$ 15,800**	**$ 15,800**	**$ -**	**$ -**
MSHDA ELIGIBLE ACTIVITIES							
Asbestos and Lead Activities							
Asbestos - Survey/Assessment	1	LS	$ 10,100	$ 10,100		$ 10,100	
Asbestos - Abatement, Air Monitoring, and Oversight	1	LS	$ 100,000	$ 100,000		$ 100,000	
Abestos Abatement - Soft Costs	1	LS	$ 5,000	$ 5,000		$ 5,000	
Subtotal Asbestos and Lead Activities				***$ 115,100***	**$ -**	**$ 115,100**	***$ -***
Demolition							
Demolition - Building & Site	1	LS	$ 147,000	$ 147,000		$ 147,000	
Demolition - Soft Costs	1	LS	$ 7,350	$ 7,350		$ 7,350	
Subtotal Demolition Activities				***$ 154,350***	***$ -***	***$ 154,350***	***$ -***
Infrastructure Improvements							
Private Infrastructure							
Parking Lot	1	LS	$ 37,500	$ 37,500		$ 37,500	
Infrastructure Improvements - Soft Costs	1	LS	$ 1,875	$ 1,875		$ 1,875	
Subtotal Infrastructure Improvement Activities				***$ 39,375***	***$ -***	***$ 39,375***	***$ -***
Housing Development Activities							
Qualified Rehabilitation	1	LS	$ 316,760	$ 316,760		$ 316,760	
Qualified Rehabilitation - Soft Costs - Developer/General Contractor Fees	1	LS	$ 15,838	$ 15,838		$ 15,838	
Subtotal Housing Development Activities				**$ 332,598**	***$ -***	***$ 332,598***	**$ -**
MSHDA ELIGIBLE ACTIVITIES SUB-TOTAL				**$ 641,423**	**$ -**	**$ 641,423**	**$ -**
EGLE and MSHDA ELIGIBLE ACTIVITIES SUB-TOTAL				**$ 657,223**	**$ 15,800**	**$ 641,423**	**$ -**
Contingency (15%)				$ 92,323	$ -	$ 92,323	
Brownfield Plan Preparation	1	LS	$ 24,000	$ 24,000	$ 577	$ 23,423	
Brownfield Plan Implementation	1	LS	$ 50,000	$ 50,000	$ 1,202	$ 48,798	
Brownfield Plan Application Fee	1	LS	$ 7,000	$ 7,000	$ -	$ -	$ 7,000
Interest (up to 5%, simple)				$ 71,149	$ 1,854	$ 69,295	
TOTAL ELIGIBLE COST FOR REIMBURSEMENT				**$ 901,695**	**$ 19,433**	**$ 875,262**	**$ 7,000**
State Brownfield Revolving Fund				$ 56,327			
BRA Administrative Fees				$ 110,234			
Local Brownfield Revolving Fund (LBRF)				$ 54,835			
GRAND TOTAL				**$ 1,123,091**			
					2.16%	*97.07%*	*0.78%*

NOTES:
These costs and revenue projections should be considered approximate estimates based on expected conditions and available information.
It cannot be guaranteed that the costs and revenue projections will not vary from these estimates.
Costs for Phase I ESAs, Phase II ESAs, Asbestos Surveys, Brownfield Plan are excluded from contingency calculation.

Table 2
Tax Increment Revenue Capture Estimates
4690 Okemos Road
Okemos, MI

Estimated Taxable Value (TV) Increase Rate: 2% per year

Calendar Year			**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
Plan Year			**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Capture Year			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Base Taxable Value (TV)			$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000
Estimated New TV			$ 1,736,250	$ 1,770,975	$ 1,806,395	$ 1,842,522	$ 1,879,373	$ 1,916,960	$ 1,955,300	$ 1,994,405	$ 2,034,294
Incremental Difference for (New TV - Base TV)			$ 986,250	$ 1,020,975	$ 1,056,395	$ 1,092,522	$ 1,129,373	$ 1,166,960	$ 1,205,300	$ 1,244,405	$ 1,284,294
School Capture	**Millage Rate**										
School Operating	18.0000		$ 17,753	$ 18,378	$ 19,015	$ 19,665	$ 20,329	$ 21,005	$ 21,695	$ 22,399	$ 23,117
State Education Tax (SET)	6.0000		$ 5,918	$ 6,126	$ 6,338	$ 6,555	$ 6,776	$ 7,002	$ 7,232	$ 7,466	$ 7,706
School Total:	24.0000	*39.55%*	**$ 23,670**	**$ 24,503**	**$ 25,353**	**$ 26,221**	**$ 27,105**	**$ 28,007**	**$ 28,927**	**$ 29,866**	**$ 30,823**
Local Capture	**Millage Rate**										
Land Preserve	0.0987		$ 97	$ 101	$ 104	$ 108	$ 111	$ 115	$ 119	$ 123	$ 127
Rec/Srs/Hum Serv	0.1465		$ 144	$ 150	$ 155	$ 160	$ 165	$ 171	$ 177	$ 182	$ 188
Meridian Bikepath	0.3270		$ 323	$ 334	$ 345	$ 357	$ 369	$ 382	$ 394	$ 407	$ 420
Meridian Police	0.5948		$ 587	$ 607	$ 628	$ 650	$ 672	$ 694	$ 717	$ 740	$ 764
Meridian Fire	0.6267		$ 618	$ 640	$ 662	$ 685	$ 708	$ 731	$ 755	$ 780	$ 805
Meridian Parks	0.6522		$ 643	$ 666	$ 689	$ 713	$ 737	$ 761	$ 786	$ 812	$ 838
Airport Auth	0.6990		$ 689	$ 714	$ 738	$ 764	$ 789	$ 816	$ 843	$ 870	$ 898
Okemos Building and Site	0.9850		$ 971	$ 1,006	$ 1,041	$ 1,076	$ 1,112	$ 1,149	$ 1,187	$ 1,226	$ 1,265
Police and Fire	1.4606		$ 1,441	$ 1,491	$ 1,543	$ 1,596	$ 1,650	$ 1,704	$ 1,760	$ 1,818	$ 1,876
CADL-Library	1.5586		$ 1,537	$ 1,591	$ 1,646	$ 1,703	$ 1,760	$ 1,819	$ 1,879	$ 1,940	$ 2,002
CATA/Regular	2.9886		$ 2,948	$ 3,051	$ 3,157	$ 3,265	$ 3,375	$ 3,488	$ 3,602	$ 3,719	$ 3,838
Lansing Comm College	3.7611		$ 3,709	$ 3,840	$ 3,973	$ 4,109	$ 4,248	$ 4,389	$ 4,533	$ 4,680	$ 4,830
Meridian Township	4.1116		$ 4,055	$ 4,198	$ 4,343	$ 4,492	$ 4,644	$ 4,798	$ 4,956	$ 5,116	$ 5,281
Ingham ISD Operating	6.2284		$ 6,143	$ 6,359	$ 6,580	$ 6,805	$ 7,034	$ 7,268	$ 7,507	$ 7,751	$ 7,999
Ingham County Operating	12.4421		$ 12,271	$ 12,703	$ 13,144	$ 13,593	$ 14,052	$ 14,519	$ 14,996	$ 15,483	$ 15,979
Local Total:	36.6809	*60.45%*	**$ 36,177**	**$ 37,450**	**$ 38,750**	**$ 40,075**	**$ 41,426**	**$ 42,805**	**$ 44,211**	**$ 45,646**	**$ 47,109**
Total Capturable Taxes:	**60.6809**	***100.00%***	**$ 59,847**	**$ 61,954**	**$ 64,103**	**$ 66,295**	**$ 68,531**	**$ 70,812**	**$ 73,139**	**$ 75,512**	**$ 77,932**
Non-Capturable Millages	**Millage Rate**										
Okemos Debt	7.0000		$ 6,904	$ 7,147	$ 7,395	$ 7,648	$ 7,906	$ 8,169	$ 8,437	$ 8,711	$ 8,990
Road Impr Debt	1.9429		$ 1,916	$ 1,984	$ 2,052	$ 2,123	$ 2,194	$ 2,267	$ 2,342	$ 2,418	$ 2,495
Total Non-Capturable Taxes:	**8.9429**		**$ 8,820**	**$ 9,130**	**$ 9,447**	**$ 9,770**	**$ 10,100**	**$ 10,436**	**$ 10,779**	**$ 11,129**	**$ 11,485**

Notes:

Table 2
Tax Increment Revenue Capture Estimates
4690 Okemos Road
Okemos, MI

Estimated Taxable Value (TV) Increase Rate: 2%

			2037	2038	2039	2040	2041	2042			
Calendar Year			**2037**	**2038**	**2039**	**2040**	**2041**	**2042**			
Plan Year			**11**	**12**	**13**	**14**	**15**	**16**			
Capture Year			**10**	**11**	**12**	**13**	**14**	**15**			
Base Taxable Value (TV)			$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000	$ 750,000			
Estimated New TV			$ 2,074,979	$ 2,116,479	$ 2,158,809	$ 2,201,985	$ 2,246,025	$ 2,290,945			
Incremental Difference for (New TV - Base TV)			$ 1,324,979	$ 1,366,479	$ 1,408,809	$ 1,451,985	$ 1,496,025	$ 1,540,945			
School Capture	**Millage Rate**								**Total New Taxes**	**Pass-Through**	**Captured**
School Operating	18.0000		$ 23,850	$ 24,597	$ 25,359	$ 26,136	$ 26,928	$ 27,737	$ 337,963	$ 3,856	$ 334,107
State Education Tax (SET)	6.0000		$ 7,950	$ 8,199	$ 8,453	$ 8,712	$ 8,976	$ 9,246	$ 112,654	$ 643	$ 112,012
School Total:	24.0000	*39.55%*	**$ 31,800**	**$ 32,795**	**$ 33,811**	**$ 34,848**	**$ 35,905**	**$ 36,983**	**$ 450,617**	**$ 4,498**	**$ 446,119**
Local Capture	**Millage Rate**										
Land Preserve	0.0987		$ 131	$ 135	$ 139	$ 143	$ 148	$ 152	$ 1,853	$ 32	$ 1,822
Rec/Srs/Hum Serv	0.1465		$ 194	$ 200	$ 206	$ 213	$ 219	$ 226	$ 2,751	$ 47	$ 2,704
Meridian Bikepath	0.3270		$ 433	$ 447	$ 461	$ 475	$ 489	$ 504	$ 6,140	$ 105	$ 6,035
Meridian Police	0.5948		$ 788	$ 813	$ 838	$ 864	$ 890	$ 917	$ 11,168	$ 190	$ 10,977
Meridian Fire	0.6267		$ 830	$ 856	$ 883	$ 910	$ 938	$ 966	$ 11,767	$ 201	$ 11,566
Meridian Parks	0.6522		$ 864	$ 891	$ 919	$ 947	$ 976	$ 1,005	$ 12,246	$ 209	$ 12,037
Airport Auth	0.6990		$ 926	$ 955	$ 985	$ 1,015	$ 1,046	$ 1,077	$ 13,124	$ 224	$ 12,901
Okemos Building and Site	0.9850		$ 1,305	$ 1,346	$ 1,388	$ 1,430	$ 1,474	$ 1,518	$ 18,494	$ 315	$ 18,179
Police and Fire	1.4606		$ 1,935	$ 1,996	$ 2,058	$ 2,121	$ 2,185	$ 2,251	$ 27,424	$ 467	$ 26,956
CADL-Library	1.5586		$ 2,065	$ 2,130	$ 2,196	$ 2,263	$ 2,332	$ 2,402	$ 29,264	$ 499	$ 28,765
CATA/Regular	2.9886		$ 3,960	$ 4,084	$ 4,210	$ 4,339	$ 4,471	$ 4,605	$ 56,113	$ 956	$ 55,157
Lansing Comm College	3.7611		$ 4,983	$ 5,139	$ 5,299	$ 5,461	$ 5,627	$ 5,796	$ 70,617	$ 1,203	$ 69,414
Meridian Township	4.1116		$ 5,448	$ 5,618	$ 5,792	$ 5,970	$ 6,151	$ 6,336	$ 77,198	$ 1,316	$ 75,883
Ingham ISD Operating	6.2284		$ 8,253	$ 8,511	$ 8,775	$ 9,044	$ 9,318	$ 9,598	$ 116,943	$ 1,993	$ 114,950
Ingham County Operating	12.4421		$ 16,486	$ 17,002	$ 17,529	$ 18,066	$ 18,614	$ 19,173	$ 233,609	$ 3,981	$ 229,628
Local Total:	36.6809	*60.45%*	**$ 48,601**	**$ 50,124**	**$ 51,676**	**$ 53,260**	**$ 54,876**	**$ 56,523**	**$ 688,709**	**$ 11,737**	**$ 676,972**
Total Capturable Taxes:	**60.6809**	***100.00%***	**$ 80,401**	**$ 82,919**	**$ 85,488**	**$ 88,108**	**$ 90,780**	**$ 93,506**	**$ 1,139,326**	**$ 16,235**	**$ 1,123,091**
Non-Capturable Millages	**Millage Rate**										
Okemos Debt	7.0000		$ 9,275	$ 9,565	$ 9,862	$ 10,164	$ 10,472	$ 10,787	$ 131,430	$ 131,430	$ -
Road Impr Debt	1.9429		$ 2,574	$ 2,655	$ 2,737	$ 2,821	$ 2,907	$ 2,994	$ 36,479	$ 36,479	$ -
Total Non-Capturable Taxes:	**8.9429**		**$ 11,849**	**$ 12,220**	**$ 12,599**	**$ 12,985**	**$ 13,379**	**$ 13,781**	**$ 167,909**	**$ 167,909**	**$ -**
									$ 1,307,235	**$ 184,145**	**$ 1,123,091**

Table 3
Tax Increment Revenue Reimbursement Allocation Table
4690 Okemos Road
Okemos, MI

Developer/City Projected Reimbursement	Proportionality	School & Local Taxes	Local-Only Taxes	Total
State	43.2%	$ 389,792	$ -	**$ 389,792**
Local	56.8%	$ 504,903	$ 7,000	**$ 511,903**
TOTAL		**$ 894,695**	**$ 7,000**	**$ 901,695**
EGLE	2.2%	$ 19,433		
MSF	97.8%	$ 875,262		

Estimated Total Years of Capture:	**15**

	Calendar Year	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**
	Plan Year	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Capture Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Available Tax Increment Revenue (TIR)										
Total State Tax Capture Available		$ 23,670	$ 24,503	$ 25,353	$ 26,221	$ 27,105	$ 28,007	$ 28,927	$ 29,866	$ 30,823
Capture for State Brownfield Revolving Fund (3 mills of SET) (25-Yrs)		$ 2,959	$ 3,063	$ 3,169	$ 3,278	$ 3,388	$ 3,501	$ 3,616	$ 3,733	$ 3,853
State Tax Increment to Taxing Unit (Final Year "Pass-Through")		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
State TIR Available for Reimbursement to Developer		$ 20,711	$ 21,440	$ 22,184	$ 22,943	$ 23,717	$ 24,506	$ 25,311	$ 26,133	$ 26,970
Total Local Tax Capture Available		$ 36,177	$ 37,450	$ 38,750	$ 40,075	$ 41,426	$ 42,805	$ 44,211	$ 45,646	$ 47,109
Capture for BRA Administrative Fees (10% of available TIR)		$ 5,985	$ 6,195	$ 6,410	$ 6,630	$ 6,853	$ 7,081	$ 7,314	$ 7,551	$ 7,793
Capture for Local Brownfield Revolving Fund (LBRF) (5% of available TIR)		$ 2,992	$ 3,098	$ 3,205	$ 3,315	$ 3,427	$ 3,541	$ 3,657	$ 3,776	$ 3,897
Local Tax Increment to Taxing Unit (Final Year "Pass-Through")		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Local TIR Available for Reimbursement to Developer		$ 27,200	$ 28,157	$ 29,134	$ 30,130	$ 31,147	$ 32,183	$ 33,241	$ 34,319	$ 35,419
Total State & Local TIR Available for Reimbursement to Developer		$ 47,911	$ 49,598	$ 51,318	$ 53,073	$ 54,864	$ 56,689	$ 58,552	$ 60,452	$ 62,389
DEVELOPER	Beginning Balance									
	$ 901,695	**$ 853,784**	**$ 804,186**	**$ 752,868**	**$ 699,795**	**$ 644,931**	**$ 588,241**	**$ 529,690**	**$ 469,238**	**$ 406,848**
MSF/MSHDA Eligible Activities	$ 875,262	$ 835,240	$ 786,719	$ 736,515	$ 684,595	$ 630,923	$ 575,465	$ 518,185	$ 459,046	$ 398,012
State Tax Reimbursement	$ 381,325	$ 20,261	$ 20,975	$ 21,702	$ 22,445	$ 23,202	$ 23,974	$ 24,762	$ 25,565	$ 26,384
Local Tax Reimbursement	$ 493,937	$ 19,761	$ 27,546	$ 28,501	$ 29,476	$ 30,470	$ 31,484	$ 32,519	$ 33,574	$ 34,650
EGLE Eligible Activities	$ 19,433	$ 18,544	$ 17,467	$ 16,352	$ 15,200	$ 14,008	$ 12,777	$ 11,505	$ 10,192	$ 8,837
State Tax Reimbursement	$ 8,466	$ 450	$ 466	$ 482	$ 498	$ 515	$ 532	$ 550	$ 568	$ 586
Local Tax Reimbursement	$ 10,967	$ 439	$ 612	$ 633	$ 654	$ 677	$ 699	$ 722	$ 745	$ 769
LOCAL-ONLY Activities	$ 7,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Local-Only Tax Reimbursement	$ 7,000	$ 7,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL ANNUAL DEVELOPER REIMBURSEMENT		**$ 47,911**	**$ 49,598**	**$ 51,318**	**$ 53,073**	**$ 54,864**	**$ 56,689**	**$ 58,552**	**$ 60,452**	**$ 62,389**

Table 3
Tax Increment Revenue Reimbursement Allocation Table
4690 Okemos Road
Okemos, MI

Administrative Fees & Loan Funds*	
State Brownfield Revolving Fund	$ 56,327
BRA Administrative Fees	$ 110,234
Local Brownfield Revolving Fund	$ 54,835

* During the life of the Plan

	2037 11 10	2038 12 11	2039 13 12	2040 14 13	2041 15 14	2042 16 15	TOTALS
Available Tax Increment Revenue (TIR)							
Total State Tax Capture Available	$ 31,800	$ 32,795	$ 33,811	$ 34,848	$ 35,905	$ 36,983	
Capture for State Brownfield Revolving Fund (3 mills of SET) (25-Yrs)	$ 3,975	$ 4,099	$ 4,226	$ 4,356	$ 4,488	$ 4,623	**$ 56,327**
State Tax Increment to Taxing Unit (Final Year "Pass-Through")	$ -	$ -	$ -	$ -	$ -	$ 4,498	**$ 4,498**
State TIR Available for Reimbursement to Developer	$ 27,825	$ 28,696	$ 29,585	$ 30,492	$ 31,417	$ 32,360	
Total Local Tax Capture Available	$ 48,601	$ 50,124	$ 51,676	$ 53,260	$ 54,876	$ 56,523	
Capture for BRA Administrative Fees (10% of available TIR)	$ 8,040	$ 8,292	$ 8,549	$ 8,811	$ 9,078	$ 5,652	**$ 110,234**
Capture for Local Brownfield Revolving Fund (LBRF) (5% of available TIR)	$ 4,020	$ 4,146	$ 4,274	$ 4,405	$ 4,539	$ 2,544	**$ 54,835**
Local Tax Increment to Taxing Unit (Final Year "Pass-Through")	$ -	$ -	$ -	$ -	$ -	$ 11,737	**$ 11,737**
Local TIR Available for Reimbursement to Developer	$ 36,541	$ 37,686	$ 38,853	$ 40,044	$ 41,259	$ 48,327	
Total State & Local TIR Available for Reimbursement to Developer	$ 64,366	$ 66,382	$ 68,438	$ 70,536	$ 72,675	$ 80,687	
DEVELOPER							
	$ 342,483	**$ 276,101**	**$ 207,663**	**$ 137,127**	**$ 64,452**	**$ (0)**	
MSF/MSHDA Eligible Activities	$ 335,044	$ 270,104	$ 203,152	$ 134,148	$ 63,052	$ -	
State Tax Reimbursement	$ 27,220	$ 28,073	$ 28,942	$ 29,829	$ 30,734	$ 27,257	**$ 381,325**
Local Tax Reimbursement	$ 35,748	$ 36,867	$ 38,009	$ 39,174	$ 40,362	$ 35,795	**$ 493,937**
EGLE Eligible Activities	$ 7,439	$ 5,997	$ 4,510	$ 2,978	$ 1,400	$ -	
State Tax Reimbursement	$ 604	$ 623	$ 643	$ 662	$ 682	$ 605	**$ 8,466**
Local Tax Reimbursement	$ 794	$ 819	$ 844	$ 870	$ 896	$ 795	**$ 10,967**
LOCAL-ONLY Activities	$ -	$ -	$ -	$ -	$ -	$ -	
Local-Only Tax Reimbursement	$ -	$ -	$ -	$ -	$ -	$ -	**$ 7,000**
TOTAL ANNUAL DEVELOPER REIMBURSEMENT	**$ 64,366**	**$ 66,382**	**$ 68,438**	**$ 70,536**	**$ 72,675**	**$ 64,452**	
							$ 1,123,091

ATTACHMENT A

Parcel Records

4696 OKEMOS RD

OKEMOS, MI 48864
Parcel #33-02-02-21-406-002 Account Number: OKEM-004696-0000-01
Property Owner: VISTALUXE REALTY LLC

Owner and Taxpayer Information

Owner	VISTALUXE REALTY LLC 2003 BIRCH BLUFF DR OKEMOS, MI 48864

Taxpayer	SEE OWNER INFORMATION

General Information for Tax Year 2026

Property Class	201 COMMERCIAL-IMPROVED
School District	OKEMOS PUBLIC SCHOOLS
MG	*No Data to Display*
RENTAL	*Not Available*
C. AREA	*Not Available*
INFLUENCE	*Not Available*
Historical District	*Not Available*
SOLAR/EV	*Not Available*

Unit	02 MERIDIAN TOWNSHIP
Assessed Value	$77,500
Taxable Value	$77,500
State Equalized Value	$77,500
Date of Last Name Change	03/18/2025
Notes	*Not Available*
Census Block Group	*No Data to Display*
Exemption	*No Data to Display*

Principal Residence Exemption Information

Effective Date	*No Data to Display*

Principal Residence Exemption	June 1st	Final
2026	0.0000%	0.0000%

Previous Year Information

Year	MBOR Assessed	Final SEV	Final Taxable
2025	$125,100	$85,000	$85,000
2024	$123,400	$123,400	$90,191
2023	$119,600	$119,600	$85,897

Land Information

Zoning Code	C-2
Land Value	$92,400
Renaissance Zone	No
ECF Neighborhood	2005 OKEMOS DOWNTOWN RETAIL
Lot Dimensions/Comments	*No Data to Display*

Total Acres	0.212
Land Improvements	*Not Available*

Renaissance Zone Expiration Date	*No Data to Display*
Mortgage Code	*No Data to Display*
Neighborhood Enterprise Zone	No

Lot(s)	Frontage	Depth
No lots found.		

Legal Description

MP 2281 LOTS 2 AND 3 BLOCK 2 EXC. N 95 FT. OKEMOS.

Sale History

Sale Date	Sale Price	Instrument	Grantor	Grantee	Terms of Sale	Liber/Page	Comments
12/20/2024	$1,300,000.00	WD	MERIDIAN INVESTORS LLC	VISTALUXE REALTY LLC	19-MULTI PARCEL ARM'S LENGTH	2024-030417	
06/14/2012	$115,000.00	WD	STASI, JULIA A	MERIDIAN INVESTORS LLC	21-NOT USED/OTHER	2012-027198	LAND CONTRACT FULFILLMENT
03/04/1997	$115,000.00	LC	STASI, JOSEPH & JULIA	HICKS BROTHERS REAL ESTATE	03-ARM'S LENGTH	2439-0134	

Building Information - 1610 sq ft Stores - Retail (Commercial)

Floor Area	1,610 sq ft
Occupancy	Stores - Retail

Estimated TCV	*Not Available*
Class	C
Stories Above Ground	1
Basement Wall Height	0 ft
Year Built	1956
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	80%

Average Story Height	12 ft
Identical Units	*Not Available*
Year Remodeled	1997
Heat	Package Heating & Cooling
Functional Percent Good	69%
Effective Age	49 yrs

We have released our refreshed version of BS&A Online as of April 1st.

4703 MOORE ST

OKEMOS, MI 48864
Parcel #33-02-02-21-406-003
Property Owner: VISTALUXE REALTY LLC

Parcel is Vacant

Owner and Taxpayer Information

Owner	VISTALUXE REALTY LLC 2003 BIRCH BLUFF DR OKEMOS, MI 48864

Taxpayer	SEE OWNER INFORMATION

General Information for Tax Year 2026

Property Class	202 COMMERCIAL-VACANT
School District	OKEMOS PUBLIC SCHOOLS
MG	*No Data to Display*
RENTAL	*Not Available*
C. AREA	*Not Available*
INFLUENCE	*Not Available*
Historical District	*Not Available*
SOLAR/EV	*Not Available*

Unit	02 MERIDIAN TOWNSHIP
Assessed Value	$80,000
Taxable Value	$80,000
State Equalized Value	$80,000
Date of Last Name Change	03/18/2025
Notes	*Not Available*
Census Block Group	*No Data to Display*
Exemption	*No Data to Display*

Principal Residence Exemption Information

Effective Date	*No Data to Display*

Principal Residence Exemption	June 1st	Final
2026	0.0000%	0.0000%

Previous Year Information

Year	MBOR Assessed	Final SEV	Final Taxable
2025	$106,700	$92,500	$92,500
2024	$106,700	$106,700	$50,954
2023	$106,700	$106,700	$48,528

Land Information

Zoning Code	C-2
Land Value	$160,000
Renaissance Zone	No
ECF Neighborhood	2005 OKEMOS DOWNTOWN RETAIL
Lot Dimensions/Comments	*No Data to Display*

Total Acres	0.375
Land Improvements	*Not Available*

Renaissance Zone Expiration Date	*No Data to Display*
Mortgage Code	999
Neighborhood Enterprise Zone	No

Lot(s)	Frontage	Depth
No lots found.		

Legal Description

MP 2280 LOT 1 BLOCK 2 OKEMOS.

Sale History

Sale Date	Sale Price	Instrument	Grantor	Grantee	Terms of Sale	Liber/Page	Comments
12/20/2024	$1,300,000.00	WD	MERIDIAN INVESTORS LLC	VISTALUXE REALTY LLC	19-MULTI PARCEL ARM'S LENGTH	2024-030417	

We have released our refreshed version of BS&A Online as of April 1st.

MOORE ST

OKEMOS, MI 48864
Parcel #33-02-02-21-406-004
Property Owner: VISTALUXE REALTY LLC

Parcel is Vacant

Owner and Taxpayer Information

Owner	VISTALUXE REALTY LLC 2003 BIRCH BLUFF DR OKEMOS, MI 48864

Taxpayer	SEE OWNER INFORMATION

General Information for Tax Year 2026

Property Class	202 COMMERCIAL-VACANT
School District	OKEMOS PUBLIC SCHOOLS
MG	*No Data to Display*
RENTAL	*Not Available*
C. AREA	*Not Available*
INFLUENCE	*Not Available*
Historical District	*Not Available*
SOLAR/EV	*Not Available*

Unit	02 MERIDIAN TOWNSHIP
Assessed Value	$32,500
Taxable Value	$32,500
State Equalized Value	$32,500
Date of Last Name Change	03/18/2025
Notes	*Not Available*
Census Block Group	*No Data to Display*
Exemption	*No Data to Display*

Principal Residence Exemption Information

Effective Date	*No Data to Display*

Principal Residence Exemption	June 1st	Final
2026	0.0000%	0.0000%

Previous Year Information

Year	MBOR Assessed	Final SEV	Final Taxable
2025	$42,200	$37,000	$37,000
2024	$42,200	$42,200	$6,310
2023	$42,200	$42,200	$6,010

Land Information

Zoning Code	C-2
Land Value	$64,400
Renaissance Zone	No
ECF Neighborhood	2005 OKEMOS DOWNTOWN RETAIL
Lot Dimensions/Comments	*No Data to Display*

Total Acres	0.148
Land Improvements	*Not Available*

Renaissance Zone Expiration Date	*No Data to Display*
Mortgage Code	999
Neighborhood Enterprise Zone	No

Lot(s)	Frontage	Depth
No lots found.		

Legal Description

MP 2284 LOT 6 EXC. S 100 FT. BLOCK 2 OKEMOS.

Sale History

Sale Date	Sale Price	Instrument	Grantor	Grantee	Terms of Sale	Liber/Page	Comments
12/20/2024	$1,300,000.00	WD	MERIDIAN INVESTORS LLC	VISTALUXE REALTY LLC	19-MULTI PARCEL ARM'S LENGTH	2024-030417	

4690 OKEMOS RD

OKEMOS, MI 48864
Parcel #33-02-02-21-406-005
Property Owner: VISTALUXE REALTY LLC

Owner and Taxpayer Information

Owner	VISTALUXE REALTY LLC 2003 BIRCH BLUFF DR OKEMOS, MI 48864

Taxpayer	SEE OWNER INFORMATION

General Information for Tax Year 2026

Property Class	201 COMMERCIAL-IMPROVED
School District	OKEMOS PUBLIC SCHOOLS
MG	*No Data to Display*
RENTAL	*Not Available*
C. AREA	*Not Available*
INFLUENCE	*Not Available*
Historical District	*Not Available*
SOLAR/EV	*Not Available*

Unit	02 MERIDIAN TOWNSHIP
Assessed Value	$382,500
Taxable Value	$382,500
State Equalized Value	$382,500
Date of Last Name Change	03/18/2025
Notes	*Not Available*
Census Block Group	*No Data to Display*
Exemption	*No Data to Display*

Principal Residence Exemption Information

Effective Date	*No Data to Display*

Principal Residence Exemption	June 1st	Final
2026	0.0000%	0.0000%

Previous Year Information

Year	MBOR Assessed	Final SEV	Final Taxable
2025	$634,300	$399,000	$399,000
2024	$669,600	$669,600	$219,896
2023	$637,600	$637,600	$209,425

Land Information

Zoning Code	C-2
Land Value	$206,800
Renaissance Zone	No
ECF Neighborhood	2005 OKEMOS DOWNTOWN RETAIL
Lot Dimensions/Comments	*No Data to Display*

Total Acres	0.475
Land Improvements	*Not Available*

Renaissance Zone Expiration Date	*No Data to Display*
Mortgage Code	999
Neighborhood Enterprise Zone	No

Lot(s)	Frontage	Depth
No lots found.		

Legal Description

MP 2283 MP 2282 LOT 5 EXC. S. 100 FT. OF E 11 FT., BLOCK 2 & LOT 4, BLK 2 OKEMOS.

Sale History

Sale Date	Sale Price	Instrument	Grantor	Grantee	Terms of Sale	Liber/Page	Comments
12/20/2024	$1,300,000.00	WD	MERIDIAN INVESTORS LLC	VISTALUXE REALTY LLC	19-MULTI PARCEL ARM'S LENGTH	2024-030417	

Building Information - 6678 sq ft Stores - Retail (Commercial)

Floor Area	6,678 sq ft
Occupancy	Stores - Retail

Estimated TCV	*Not Available*
Class	C
Stories Above Ground	1
Basement Wall Height	0 ft
Year Built	1962
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	70%

Average Story Height	12 ft
Identical Units	*Not Available*
Year Remodeled	*No Data to Display*
Heat	Package Heating & Cooling
Functional Percent Good	80%
Effective Age	64 yrs

Building Information - 6678 sq ft Stores - Retail (Commercial)

Floor Area	6,678 sq ft
Occupancy	Stores - Retail

Estimated TCV	*Not Available*
Class	C
Stories Above Ground	2
Basement Wall Height	0 ft
Year Built	1962
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	70%

Average Story Height	12 ft
Identical Units	*Not Available*
Year Remodeled	*No Data to Display*
Heat	Package Heating & Cooling
Functional Percent Good	100%
Effective Age	45 yrs

Building Information - 7308 sq ft Stores - Retail (Commercial)

Floor Area	7,308 sq ft
Occupancy	Stores - Retail

Estimated TCV	*Not Available*

Class	C
Stories Above Ground	2
Basement Wall Height	10 ft
Year Built	1968
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	69%

Average Story Height	12 ft
Identical Units	*Not Available*
Year Remodeled	*No Data to Display*
Heat	Package Heating & Cooling
Functional Percent Good	100%
Effective Age	64 yrs

Building Information - 7308 sq ft Multiple Residences (Commercial)

Floor Area	7,308 sq ft
Occupancy	Multiple Residences

Estimated TCV	*Not Available*
Class	C
Stories Above Ground	2
Basement Wall Height	10 ft
Year Built	1968
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	60%

Average Story Height	12 ft
Identical Units	*Not Available*
Year Remodeled	*No Data to Display*
Heat	Package Heating & Cooling
Functional Percent Good	100%
Effective Age	64 yrs

2114 HAMILTON RD

OKEMOS, MI 48864
Parcel #33-02-02-21-406-006 Account Number: HAMI-002114-0000-02
Property Owner: VISTALUXE REALTY LLC

Owner and Taxpayer Information

Owner	VISTALUXE REALTY LLC 2003 BIRCH BLUFF DR OKEMOS, MI 48864

Taxpayer	SEE OWNER INFORMATION

General Information for Tax Year 2026

Property Class	201 COMMERCIAL-IMPROVED
School District	OKEMOS PUBLIC SCHOOLS
MG	*No Data to Display*
RENTAL	*Not Available*
C. AREA	*Not Available*
INFLUENCE	*Not Available*
Historical District	*Not Available*
SOLAR/EV	*Not Available*

Unit	02 MERIDIAN TOWNSHIP
Assessed Value	$177,500
Taxable Value	$177,500
State Equalized Value	$177,500
Date of Last Name Change	03/18/2025
Notes	*Not Available*
Census Block Group	*No Data to Display*
Exemption	*No Data to Display*

Principal Residence Exemption Information

Effective Date	*No Data to Display*

Principal Residence Exemption	June 1st	Final
2026	0.0000%	0.0000%

Previous Year Information

Year	MBOR Assessed	Final SEV	Final Taxable
2025	$273,600	$186,500	$186,500
2024	$268,100	$268,100	$186,323
2023	$256,300	$256,300	$177,451

Land Information

Zoning Code	C-2
Land Value	$110,000
Renaissance Zone	No
ECF Neighborhood	2005 OKEMOS DOWNTOWN RETAIL
Lot Dimensions/Comments	*No Data to Display*

Total Acres	0.253
Land Improvements	*Not Available*

Renaissance Zone Expiration Date	*No Data to Display*
Mortgage Code	999
Neighborhood Enterprise Zone	No

Lot(s)	Frontage	Depth
No lots found.		

Legal Description

MP 2283-1 2284-1 S 100 FT. OF E 11 FT. OF LOT 5, BLOCK 2 ALSO S 100 FT. OF LOT 6 BLOCK 2 OKEMOS.

Sale History

Sale Date	Sale Price	Instrument	Grantor	Grantee	Terms of Sale	Liber/Page	Comments
12/20/2024	$1,300,000.00	WD	MERIDIAN INVESTORS LLC	VISTALUXE REALTY LLC	19-MULTI PARCEL ARM'S LENGTH	2024-030417	

Building Information - 6164 sq ft Stores - Retail (Commercial)

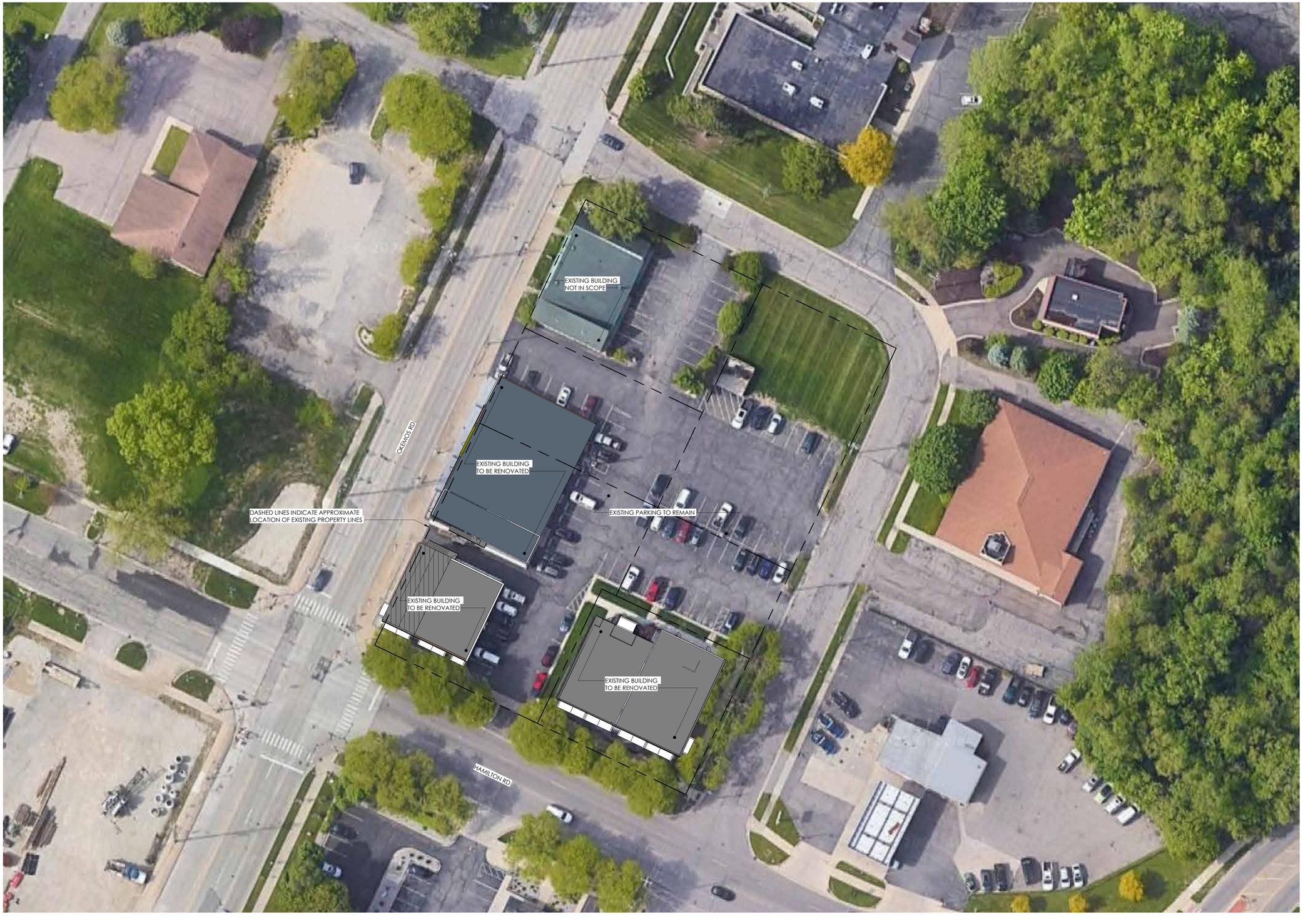
Floor Area	6,164 sq ft
Occupancy	Stores - Retail

Estimated TCV	*Not Available*
Class	C
Stories Above Ground	1
Basement Wall Height	0 ft
Year Built	1958
Percent Complete	0%
Physical Percent Good	35%
Economic Percent Good	80%

Average Story Height	14 ft
Identical Units	*Not Available*
Year Remodeled	1977
Heat	Package Heating & Cooling
Functional Percent Good	90%
Effective Age	47 yrs

ATTACHMENT B

Site Plans



1 C101 **SITE PLAN**
1" = 30'-0"

DRIVEN DESIGN

ARCHITECTURE/INTERIOR DESIGN
Driven Design Studio PLLC
117 West Michigan Avenue
Battle Creek, MI 49017
(269) 753-8040
cody@drivendesignstudio.com

OWNER
Owner Name
Owner Address
Owner City
Owner Phone Number
Owner Email

NOT FOR CONSTRUCTION

PROJECT NAME
OKEMOS PROJECT
PROJECT ADDRESS
4690 OKEMOS RD, OKEMOS MI

ISSUE/REVISION
ISSUE 1 - Date

DRAWN BY CMN
DATE 2/11/2026 11:09:14 AM
SCALE 1" = 30'-0"
STAMP

PROJECT NUMBER
2025.033

ARCHITECTURAL SITE PLAN
C101

1 C100 **FIRST FLOOR PLAN**
1" = 20'-0"

2 C100 **SECOND FLOOR PLAN**
1" = 20'-0"

DRIVEN DESIGN

ARCHITECTURE/INTERIOR DESIGN
Driven Design Studio PLLC
117 West Michigan Avenue
Battle Creek, MI 49017
(269) 753-8040
cody@drivendesignstudio.com

OWNER
Owner Name
Owner Address
Owner City
Owner Phone Number
Owner Email

NOT FOR CONSTRUCTION

PROJECT NAME
OKEMOS PROJECT
PROJECT ADDRESS
4690 OKEMOS RD, OKEMOS MI

ISSUE/REVISION
ISSUE 1 - Date

DRAWN BY CMN
DATE 4/3/2025 11:14:43 PM
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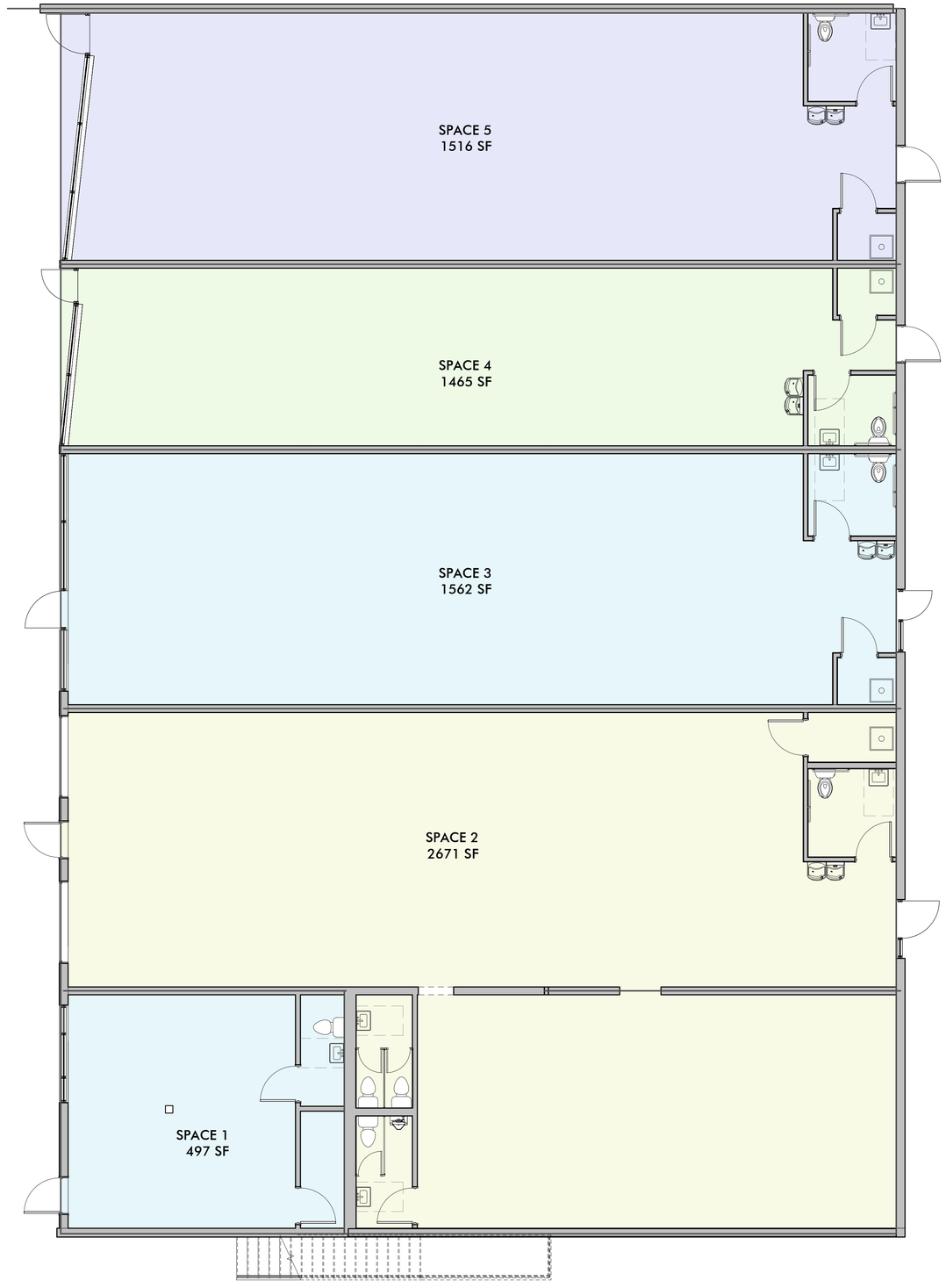
STAMP

PROJECT NUMBER
2025.033

ARCHITECTURAL SITE PLAN

C100

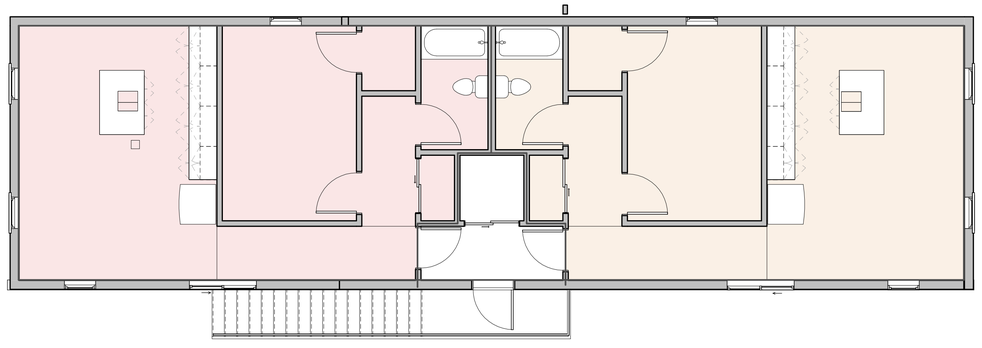


1 T005 **FIRST FLOOR AREA PLAN**
3/16" = 1'-0"

BUILDING 1

APARTMENT 1
1 BED, 1 BATH
632 SF

APARTMENT 2
1 BED, 1 BATH
632 SF



2 T005 **02 - GRAPHIC**
3/16" = 1'-0"

DRIVEN DESIGN

ARCHITECTURE/INTERIOR DESIGN
Driven Design Studio PLLC
117 West Michigan Avenue
Battle Creek, MI 49017
(269) 753-8040
cody@drivendesignstudio.com

OWNER
Srinivas Kandula
Satish Veeramachineni
Okemos
luxrealty@gmail.com

NOT FOR CONSTRUCTION

PROJECT NAME
OKEMOS - BUILDING 1
PROJECT ADDRESS
4690 OKEMOS ROAD

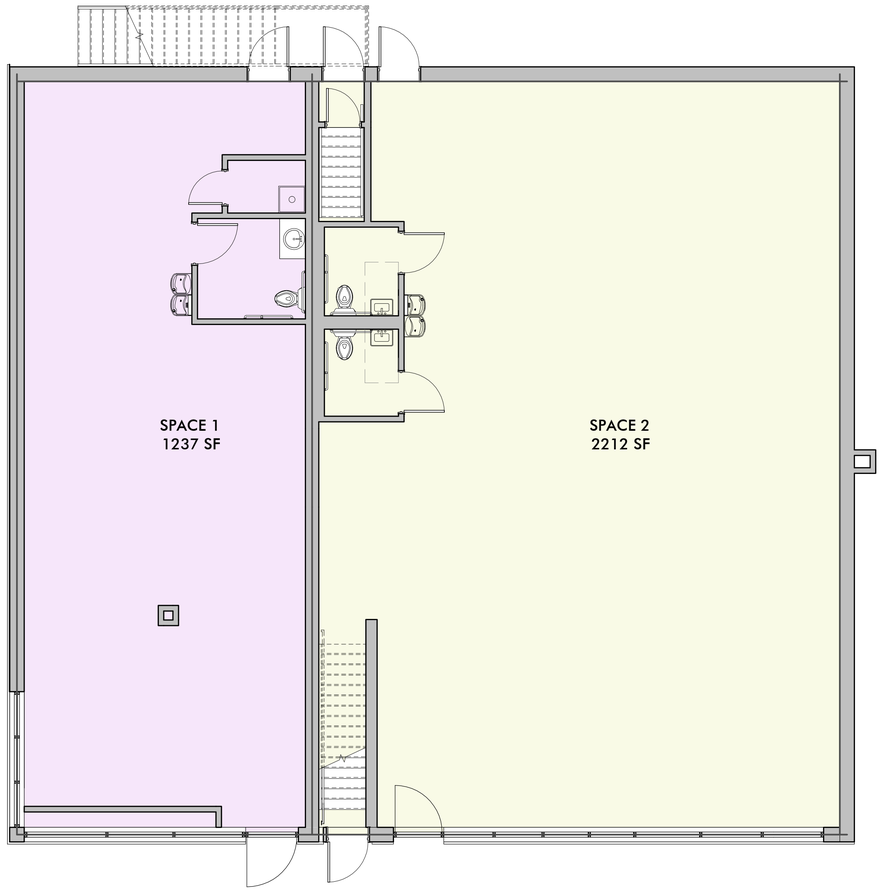
ISSUE/REVISION
ISSUE 1 - Date

DRAWN BY CMN
DATE 4/3/2025 10:57:06 PM
SCALE 3/16" = 1'-0"
STAMP

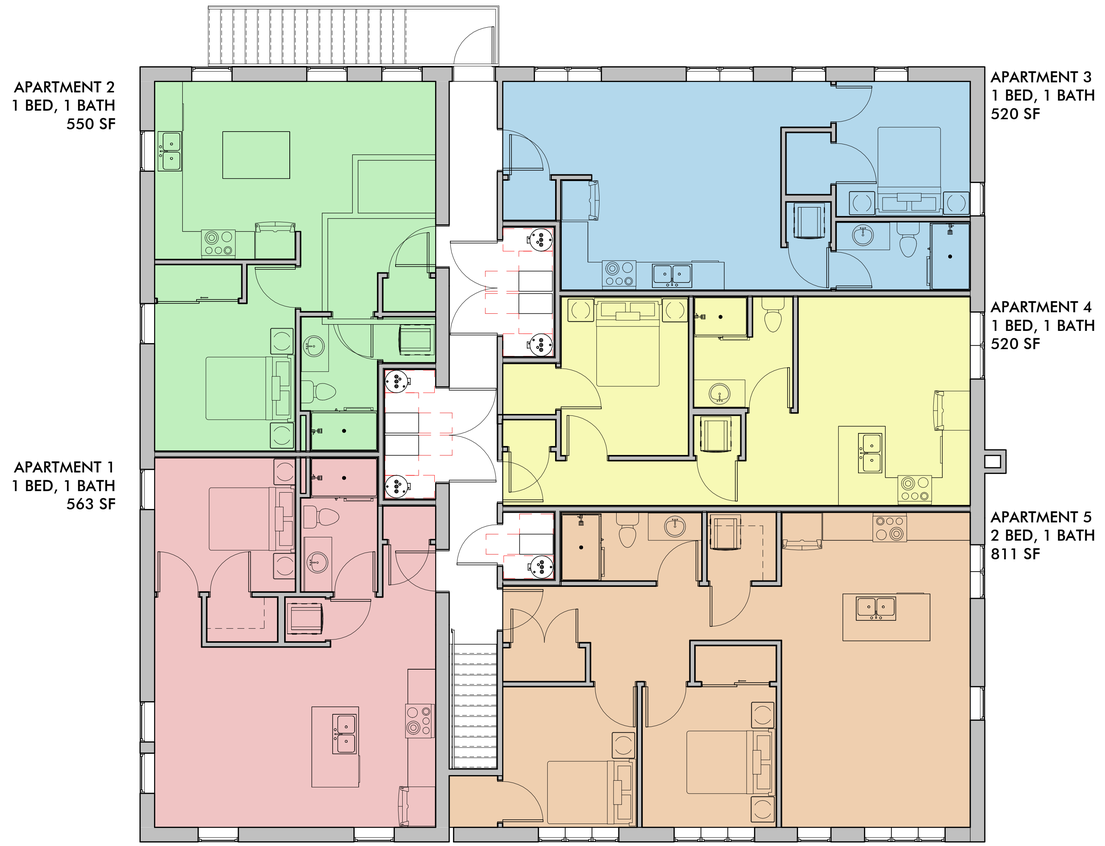
PROJECT NUMBER
2025.033

AREA PLANS
T005

BUILDING 2



1 T005 **FIRST FLOOR AREA PLAN**
3/16" = 1'-0"



2 T005 **SECOND FLOOR AREA PLAN**
3/16" = 1'-0"

DRIVEN DESIGN

ARCHITECTURE/INTERIOR DESIGN
Driven Design Studio PLLC
117 West Michigan Avenue
Battle Creek, MI 49017
(269) 753-8040
cody@drivendesignstudio.com

OWNER
Srinivas Kandula
Satish Veeramachineni
Okemos
luxrealty@gmail.com

NOT FOR CONSTRUCTION

PROJECT NAME
OKEMOS - BUILDING 2
PROJECT ADDRESS
4690 OKEMOS ROAD

ISSUE/REVISION
ISSUE 1 - Date

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DATE 4/3/2025 10:56:52 PM
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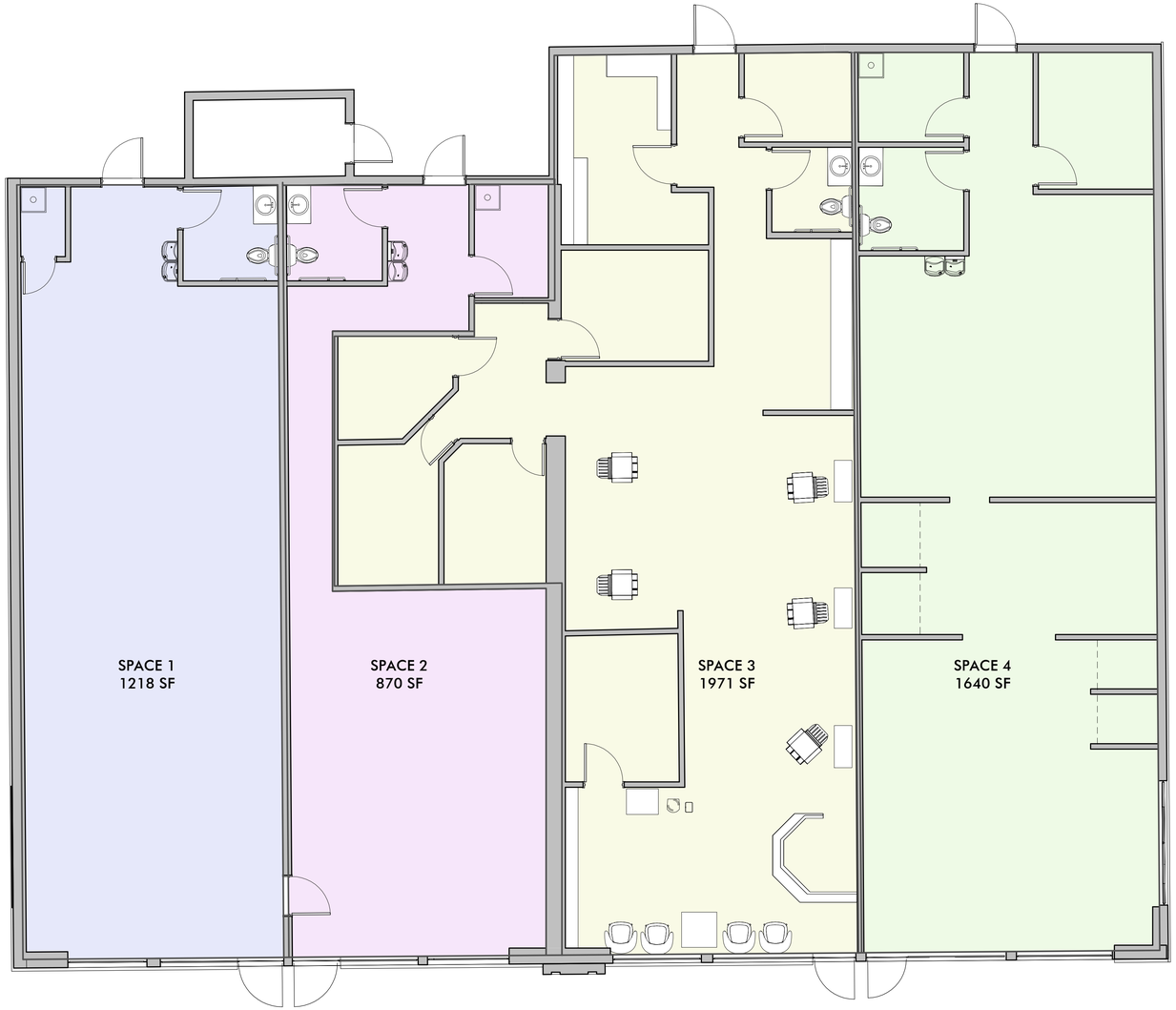
STAMP

PROJECT NUMBER
2025.033

AREA PLANS

T005

BUILDING 3



1 T005 **FIRST FLOOR AREA PLAN**
3/16" = 1'-0"

DRIVEN DESIGN

ARCHITECTURE/INTERIOR DESIGN
Driven Design Studio PLLC
117 West Michigan Avenue
Battle Creek, MI 49017
(269) 753-8040
cody@drivendesignstudio.com

OWNER
Srinivas Kandula
Satish Veeramachineni
Okemos
luxrealty@gmail.com

NOT FOR CONSTRUCTION

PROJECT NAME
OKEMOS - BUILDING 3
PROJECT ADDRESS
4690 OKEMOS RD, OKEMOS, MI

ISSUE/REVISION
ISSUE 1 - Date

DRAWN BY CMN
DATE 4/3/2025 10:56:20 PM
SCALE 3/16" = 1'-0"
STAMP

PROJECT NUMBER
2025.033

AREA PLANS
T005

Charter Township of Meridian
Brownfield Redevelopment Authority (BRA)
Township Municipal Building, 5151 Marsh Road, Okemos, MI 48864
Thursday, August 13, 2026– Minutes -DRAFT

Members Present: Brandon Brooks, Jeff Theuer, James Houthoofd, Township Manager Tim Dempsey, Tom Frazier, and Dave Ledebuhr

Members Absent: None

Others Present: Neighborhoods & Economic Development Director Amber Clark and Executive Assistant Michelle Prinz

1. CALL MEETING TO ORDER

   Chair Theuer called the meeting to order at 9:03am.

2. APPROVAL OF AGENDA

   MOTION BY MEMBER FRAZIER TO APPROVE THE AGENDA. SUPPORTED BY MEMBER BROOKS. MOTION PASSES 6-0.

3. APPROVAL OF MINUTES

   a. July 9, 2026 Draft Meeting Minutes

   MOTION BY MEMBER BROOKS TO APPROVE THE JULY 9, 2026 MEETING MINUTES. SUPPORTED BY MEMBER LEDEBUHR. MOTION PASSES 6-0.

4. FINANCIAL REPORT

   a. Brownfield Financial Report

   Director Clark shared the financial report and reviewed the revenue and expenditures for the four brownfield projects. The ending fund balance is $831,902.21.

5. PUBLIC REMARKS

   None.

6. NEW BUSINESS

a. 4690 Okemos Road/VistaLuxe Realty Brownfield Plan Proposal

Director Clark announced that the BRA has received the application for the redevelopment project at 4690 Okemos Road. The Township's third-party reviewer, AKT Peerless, has reviewed the application and agrees that it meets Township policy. The total Plan is 16 years and has a requirement on the housing affordability for the seven units. The proposed BRA Plan is scheduled to have a public hearing at the Township Board on September 1, 2026. Connor Zook from Triterra and the developer were present to answer questions regarding the Plan. The entire construction period for the project is estimated at two years with the rehabilitation of the housing units as Phase 1 and the façade improvement Phase 2. There was discussion around the calculation of the $71,000 interest payment and how/when it will be paid. Manager Dempsey and Mr. Zook emphasized that interest payments will come from TIF funds only. It was discussed that the reimbursement agreement will detail the interest payments. Director Clark will work on the agreement along with Township Attorneys.

MOTION BY MEMBER LEDEBUHR TO ADOPT THE RESOLUTION AUTHORIZING THE HOUSING BROWNFIELD REDEVELOPMNET PLAN FOR 4690 OKEMOS ROAD, WITH TOTAL REIMBURSEMENT NOT TO EXCEED $901,695. SUPPORTED BY MEMBER BROOKS. MOTION PASSES 6-0.

b. American House Meridian MTT Legal Fees Reimbursement

Director Clark shared the invoice from Fahey Schultz Burzych Rhodes PLC of reimbursable funds from the BRA to Meridian Township for work done on the amended American House Meridian BRA reimbursement agreement and its impact on their MTT case.

MOTION BY MEMBER BROOKS TO APPROVE AND AUTHORIZE A REIMBURSEMENT TO THE TOWNSHIP'S GENERAL FUND FOR LEGAL FEES PAID TO FAHEY SCHULTZ, TO BE ISSUED FROM THE MERIDIAN TOWNSHIP BROWNFIELD REDEVELOPMENT AUTHORITY ADMINISTRATIVE FUNDS IN THE AMOUNT OF $943.00. SUPPORTED BY MEMBER HOUTHOOFD. MOTION PASSES 6-0.

7. OLD BUSINESS

a. 2027 Brownfield Redevelopment Authority Budget

Director Clark presented the proposed 2027 BRA Budget. The budget in the BRA Fund includes $1,246,368.56 in revenue and $1,080,138.03 in expenses. There was discussion that the $20,000 in contractual services expense may not be necessary.

MOTION BY MEMBER LEDEBUHR TO ADOPT THE ATTACHED BUDGET FOR 2027 SUBMIT THE ANNUAL BUDGET TO THE TOWNSHIP BOARD, AND PLACE IT ON THE WEBSITE. SUPPORTED BY MEMBER FRAZIER. MOTION PASSES 6-0.

8. PROJECT UPDATES

Director Clark mentioned that she has a strong inclination that the Elevation will be sold.

9. PUBLIC REMARKS

None.

10. ADJOURNMENT

Meeting adjourned at 9:49am.

Next meeting on September 10, 2026 at 9:00am in the Town Hall Room.

RESOLUTION

At a regular meeting of the Meridian Township Board of the Charter Township of Meridian, Ingham County, Michigan, held at the Meridian Municipal Building, on the 15th day of September 2026, at 9:00 a.m., Local Time.

PRESENT:

ABSENT:

The following resolution was offered by Member _____and supported by _____.

WHEREAS, VistaLuxe Realty, LLC has requested approval of the Brownfield Plan for 4690 Okemos Road and adjourning properties at the northeast corner of Hamilton and Okemos road, allowing for reimbursement of eligible costs through tax increment revenue created from development at the site; and

WHEREAS, the Meridian Township Brownfield Redevelopment Authority discussed the brownfield plan and voted to recommend approval to the Township Board at its meeting on August 13, 2026; and

WHEREAS, the Township Board held a public hearing at its meeting on September 1, 2026, as required by the Brownfield Redevelopment Financing Act; and

WHEREAS, the proposed brownfield plan constitutes a public purpose under the Brownfield Redevelopment Financing Act, Public Act 381 of 1996, as amended, specifically in that this project qualifies entirely as a "Housing" project, enabling the rehabilitation of seven housing units previously established at the site. The condition of these units are currently below standard and do not meet modern housing codes for rental units. The site sits immediately adjacent to historic contamination, however the site itself is not exposed to contamination that will require remediation. VistaLuxe Realty, LLC, proposes a full rehabilitation of the mixed-used site, beginning with the second story housing units. At certificate of occupancy, 3 of the units will have restricted rental rates, per the property deed, that will remain fixed until the expiration of the Brownfield Plan and Agreement; and

WHEREAS, the restricted rental rates must be maintained at or below 120% of the area median income, providing affordable housing units in Meridian Township for the duration of the Brownfield Plan, and increasing the economic activity in the Downtown Okemos Potential Intensity Change Area (PICA); and

WHEREAS, the proposed plan meets the requirements for a brownfield plan as established in Public Act 381, as amended, and the property included in the Plan was determined to be an eligible Housing Facility or is a directly adjacent property, which is permitted under the Act; and

WHEREAS, the proposed method of financing the costs of the eligible activities are reasonable and necessary to carry out the purposes of Public Act 381, as amended PA 90 of 2023; and

WHEREAS, the proposed eligible activities are reasonable and necessary to adequately address brownfield eligible housing conditions on the site and provide protection to public health, safety and the environment; and

WHEREAS, the proposed brownfield plan is capped at $1,123,091 over an 16 year period, with the Meridian Township Brownfield Redevelopment Authority capturing a maximum of $110,234 for administration, $54,835 for the Local Brownfield Revolving Fund (LBRF), the State Brownfield Revolving Fund capturing a maximum of $56,327, for total tax increment reimbursement to the development, based on the actual costs of eligible activities, not to exceed $901,695; and

WHEREAS, the amount of captured taxable value estimated to result from the adoption of the plan is reasonable and is expected to be created, if the development proceeds as expected; and

WHEREAS, the Township Board supports the intent of the brownfield plan to facilitate the redevelopment and restoration of environmental and economic viability to the parcel included in the plan.

NOW THEREFORE, BE IT RESOLVED THAT THE MERIDIAN TOWNSHIP BOARD OF THE CHARTER TOWNSHIP OF MERIDIAN hereby approves the 4690 Okemos Road and Various Properties Brownfield Plan, subject to the following conditions.

1. Approval is in accordance with the brownfield plan prepared by Triterra, with a revision date of August 10th, 2026.

ADOPTED: YEAS:

NAYS:

STATE OF MICHIGAN)
) ss
COUNTY OF INGHAM)

I, DO HEREBY CERTIFY that the foregoing is a true and a complete copy of a resolution adopted at a regular meeting of the Township Board on the 15th day of September, 2026.

_____
Angela Demas
Township Clerk
Meridian Charter Township

To: **Board Members**

From: **Dan Opsommer, Deputy Township Manager**
Director of Public Works and Engineering

Rick Grillo, Chief of Police

Date: **September 8, 2026**

Re: **Permanent Dynamic Speed Display Sign Master Plan and Policy**

As the Board is aware, speeding and pedestrian safety are two of the most common complaints that the Township receives.

In our continued effort to calm traffic and improve pedestrian safety, we are looking at deploying permanent dynamic speed display signs on roadways that meet specific criteria.

When staff presented this for the first time under discussion at the August 18, 2026 meeting, the Board requested two things:

1. Research that speaks to the effectiveness of dynamic speed display signs.

We have attached a research paper from the U.S. Department of Transportation (USDOT) that speaks to this question. This USDOT study used published research to perform a comprehensive review of the effectiveness of dynamic speed feedback signs (DSFSs) where effectiveness was measured by vehicle speed reductions.

This research paper found quantitative evidence that DSFSs are effective in reducing mean and/or average speeds, 85th percentile speeds, and the percentages of drivers over the speed limit in a range of contexts. Across all types of vehicles and different installation locations and conditions, the clear majority of studies found significant reductions in speeds at the DSFSs when the DSFSs are activated.

Overall, reductions of 4 mph were estimated for passenger vehicles as a result of DSFS installation, and reductions between 2 to 4 mph at the DSFS were estimated across all vehicle types in the different contexts assessed. A reduction in speed of just a few mph can significantly reduce injury from crashes, demonstrating that DSFSs can be effective tools in saving lives.

2. Clarification that the signs do not have cameras.

We can confirm that the signs we wish to purchase, which are from RadarSign, do NOT have cameras.

Memo to Township Board
September 8, 2026
Re: Permanent Dynamic Speed Display Sign Master Plan and Policy

On Monday, August 10, the Ingham County Road Ad Hoc Committee adopted the attached policy to allow for the deploying of permanent dynamic speed display signs under certain conditions.

The signs currently cost $3,812.50 per sign. Therefore, Township staff are recommending that we start by applying for four locations with 5 signs:

1. Southbound Marsh Road as you enter Meridian Township from Bath Township.
2. Northbound Okemos Road just south of the Mount Hope Road intersection within the school zone.
3. Haslett Rd in the 25-mph zone between Marsh Road and Pine Ridge Drive.
4. Hulett Road, between the curve and the CSX railroad crossing, one sign in each direction of traffic to replace the two existing speed humps that are being removed as part of the Hulett Road reconstruction project that is current in progress.

The Ingham County Road Department has reviewed these locations and concurs with these recommendations from Township staff.

We look forward to discussing this new master plan and policy with the Board in greater detail.

Motion that has been prepared for the Board's consideration:

> **MOVE TO ADOPT THE PERMANENT DYNAMIC SPEED DISPLAY SIGN MASTER PLAN AND POLICY**

Attachments:

1. Township Permanent Dynamic Speed Display Sign Master Plan
2. Township Permanent Dynamic Speed Display Sign Policy
3. Ingham County Road Department Policy
4. U.S. DOT Effectiveness of Dynamic Speed Feedback Signs Volume I: Literature Review and Meta-Analysis

MERIDIAN TOWNSHIP
Permanent Speed Display Sign Master Plan

N

Legend

Roadways where permanent speed display signs are approved

Department of Public Works
5151 Marsh Road
Okemos, MI 48864
517.853.4440
dpw@meridian.mi.us

Permanent Dynamic Speed Display Sign Policy

Deployment of permanent dynamic speed display signs is a new program being developed by the Township to help calm traffic and address speeding within the community. The installation of permanent dynamic speed display signs is dependent upon funding availability and Ingham County Road Department approval.

The Township will prioritize the installation of permanent dynamic speed display signs based on the following criteria:

1. Within school zones, or within 300' of school zones.
2. Primary roads with 25 mph zones.
3. To replace an existing speed hump/s.
4. Within 300' of a change in the posted speed limit on a roadway.
5. Within 1,000' of entering the Township.

Roadways that have been approved for the installation of permanent dynamic speed display signs are shown on the Permanent Dynamic Speed Display Master Plan.

To make a request for a permanent speed display sign, please contact dpw@meridian.mi.us or 517.853.4440.

Adopted:

INGHAM COUNTY
ROAD DEPARTMENT

Dynamic Speed Display Policy

Adopted: 8/10/2026

1. Purpose
The purpose of this policy is to establish clear criteria and procedures for the installation, use, and maintenance of speed feedback (radar display) signs on roadways under the jurisdiction of the Ingham County Road Department (ICRD). These devices are intended to encourage voluntary speed compliance and improve roadway safety.

2. Scope
This policy applies to all permanent and temporary speed feedback sign installations on certified public roadways maintained by ICRD. It does not apply to private roads, uncertified roads, or signs placed by law enforcement for temporary enforcement purposes.

3. Definitions
• **Speed Feedback Sign** – An electronic sign displaying a driver's current speed, typically activated by radar.
• **Permanent Installation** – A sign mounted on a fixed pole with permanent power supply or solar array.
• **Temporary Installation** – A portable or trailer-mounted unit deployed for short-term speed awareness needs.
• **Requesting Agency** – Township, municipality, law enforcement agency, or other approved entity submitting the installation request.

4. Policy Overview
4.1 All speed feedback signs must comply with the Michigan Manual on Uniform Traffic Control Devices (MMUTCD) and applicable state and federal standards.
4.2 Permanent installations require an engineering review by ICRD.
4.3 Temporary signs may be deployed only by law enforcement or approved agencies; ICRD does not deploy temporary units.
4.4 Funding for new installations must be provided by the requesting township or agency unless otherwise agreed upon.
4.5 Maintenance responsibilities must be clearly defined in a written agreement before installation.

INGHAM COUNTY
ROAD DEPARTMENT

5. Criteria for Installation

The following criteria must be met for consideration of a permanent speed feedback sign:

• Documented speeding concerns supported by traffic studies, crash history, or law enforcement input.
• Appropriate roadway classification and speed environment.
• Adequate sight distance and safe sign placement area.
• No foreseeable conflicts with utilities, drainage, or existing infrastructure.
• Confirmation that the requested location is on a certified public roadway under ICRD jurisdiction.

6. Request and Approval Process

6.1 Requests must be submitted by a local Township Board or a law enforcement agency (Township Police or the Ingham County Sheriff's Office).
6.2 The requesting agency must submit the following:
• A completed Permit Application
• Requested location map or GPS coordinates
• Supporting data (speed study, crash report, etc.)
• Funding source and proposed maintenance plan
6.3 ICRD staff will conduct an engineering review to determine feasibility.
6.4 If approved, ICRD will issue a permit outlining installation requirements and responsibilities.

7. Funding and Maintenance

7.1 The purchasing, installation, power supply, and long-term maintenance of permanent speed feedback signs are the responsibility of the requesting township or agency.
7.2 ICRD may assist with installation or inspection when appropriate.
7.3 Any repairs or replacements are the responsibility of the entity named in the maintenance agreement.

8. Removal or Relocation

ICRD reserves the right to remove or require relocation of any speed feedback sign if it becomes a safety hazard, is no longer functional, does not comply with current standards, or conflicts with roadway improvements.

9. Enforcement and Data Use

Speed feedback signs may not be used as enforcement devices. Any data collection features must comply with applicable privacy and data-handling guidelines and be coordinated with law enforcement agencies.

10. Effective Date

This policy becomes effective upon approval by the ICRD Ad Hoc Committee.

U.S. Department
of Transportation
National Highway
Traffic Safety
Administration

NHTSA

DOT HS 813 170-A

August 2021

Effectiveness of Dynamic Speed Feedback Signs Volume I: Literature Review and Meta-Analysis

DISCLAIMER

Suggested APA Format Citation:

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This reported is accompanied by a second volume,

Fisher, D. L., Breck, A., Gillham, O., & Flynn, D. (2021, August). *Effectiveness of dynamic speed feedback signs, Volume II: Technical appendices and annotated bibliography* (Report No. DOT HS 813 170-B). National Highway Traffic Safety Administration.

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7. Authors	**8. Performing Organization Report No.**
Donald L. Fisher, Andrew Breck, Olivia Gillham, Daniel Flynn	
9. Performing Organization Name and Address	**10. Work Unit No. (TRAIS)**
John A. Volpe National Transportation Systems Center 55 Broadway Cambridge, MA 02142	**11. Contract or Grant No.**
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered**
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes
Randolph Atkins, was the contracting officer's representative.

16. Abstract
This study uses published research to perform a comprehensive, quantitative review of the effectiveness of dynamic speed feedback signs (DSFSs) where effectiveness was measured by vehicle speed reductions. In 2019 over one-quarter (26%) of all fatal crashes were speeding-related, and speeding-related vehicle crashes cost society hundreds of billions of dollars each year. Lowering excess speeds to reduce these human, societal, and economic costs is therefore a major focus of safety officials and highway engineers. This study focuses on DSFSs, which present drivers with real-time feedback on their speed. This report presents evidence that DSFSs can be effective in reducing mean speeds, 85th percentile speeds, and the percentages of drivers over the speed limit in a range of contexts. Across all types of vehicles and different installation locations, the clear majority of studies found significant reductions in speeds at the DSFSs when the DSFSs are activated. Overall, reductions of 4 mph at the DSFS were estimated for passenger vehicles as a result of DSFS installation, and reductions between 2- to 4 mph at the DSFS were estimated across all vehicle types in the different contexts assessed. As reductions in speed of just a few mph can significantly reduce injury from crashes, these effects demonstrate that DSFSs can be effective tools in saving lives.

This reported is accompanied by a second volume, *Effectiveness of Dynamic Speed Feedback Signs, Volume II: Technical Appendices and Annotated Bibliography*.

17. Key Words	18. Distribution Statement
speeding, speeding countermeasures, dynamic speed feedback signs, DSFS	Document is available to the public from the National Technical Information Service, www.ntis.gov.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	81	

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

Table of Contents

1. Executive Summary

1.1. Rationale

This study uses published research to perform a comprehensive, quantitative review of the effectiveness of dynamic speed feedback signs (DSFSs) in different contexts where effectiveness was measured by vehicle speed reductions. The results include a literature review and statistical meta-analysis (Volume I), and an annotated bibliography (Volume II). This report presents evidence that a DSFS can be an effective tool for managing speeds and improving safety; results show statistically and practically significant speed reductions across a range of circumstances.

In 2019 over one-quarter (26%) of all fatal crashes were speeding-related (National Center for Statistics and Analysis, 2021). Speeding-related vehicle crashes cost society hundreds of billions of dollars each year (Blincoe, Miller, Zaloshnja, & Lawrence, 2015). Lowering excess speeds to reduce these human, societal, and economic costs is therefore a major focus of safety officials and highway engineers. A variety of tools are available to increase compliance with posted speeds, including educational interventions such as social media campaigns and billboards; enforcement tools such as uniformed officer presence and automated speed enforcement; and engineering tools such as speed bumps and rumble strips. This study focuses on DSFSs, which present drivers with real-time feedback on their speed, and can combine features of all three of these types of tools, education, enforcement, and engineering.

A DSFS measures the speed of an approaching vehicle with radar and displays the speed to the driver. The key function of the DSFS is to allow a driver to "self-enforce" speed by comparing the driver's operating speed with the posted speed limit (Cruzado & Donnell, 2009). In some cases, DSFSs are combined with automated enforcement technologies. In addition, DSFSs can be considered engineering tools, as added display elements on the roadway, and as an educational tool by informing drivers how their driving behavior aligns with the posted speed limit and expected norms.

This report presents evidence that DSFSs can be effective in reducing mean speeds, 85th percentile speeds, and the percentages of drivers over the speed limit in a range of contexts. Across all types of vehicles and different installation locations, the clear majority of studies found significant reductions in speeds at the DSFSs when the DSFSs are activated. Overall, reductions of 4 mph at the DSFS were estimated[1] as a result of DSFS installation for passenger cars, and reductions of 2 to 4 mph at the DSFS were estimated across all vehicle types in the different contexts assessed. Reductions in speed of just 5 percent, such as lowering speeds by 2 mph from 40 to 38 mph, can reduce fatal vehicle-pedestrian strikes by 20 percent (Nilsson, 2004). Lowering speeds by 4 mph, for example from 42 to 38 mph, can reduce the risk of fatal vehicle-pedestrian strikes from 50 percent to 37 percent (Tefft, 2011). These effects demonstrate that DSFSs can be effective tools in saving lives.

[1] The meta-analysis models provide estimates of average reductions in speed that are a function of the sample sizes of the different sites where speed is measured and the variability in the observations at those sites.

1.2. Dynamic Speed Feedback Signs

Dynamic speed feedback signs come in many shapes and combinations. For purposes of this report, they include portable, changeable message signs (PCMSs), speed monitoring displays (SMDs), and speed display trailers (SDTs). For example, in a typical, simple installation a speed limit sign is located upstream of the DSFS (say the posted speed is 25 mph) and the message on the DSFS is activated when the vehicle's speed is greater than 30 mph: "Reduce Speed to 25 mph" (Bullough et al., 2012). Other messages may be activated for drivers at or under the speed limit, such as "Give us a brake" (Brewer et al., 2006); for drivers over the speed limit a sequence of messages would appear as the speeding drivers approach the DSFSs: (a) "Slow Down," (b) "Your Speed" and (c) "driver's actual speed."

1.3. Literature Review

A number of studies have assessed the effectiveness of DSFSs, but to date no comprehensive, quantitative review has been conducted on the overall effectiveness of DSFSs in different contexts. Given the large number of previous studies, end users in the highway safety community are faced with the challenge of sifting through the existing studies to locate appropriate research that addresses their safety needs. As consequence a literature review was initiated. The search for documents that report the effect of DSFS on driver behavior was undertaken from March 9 to March 16, 2016, by Volpe and MIT library staff. A total of 106 national and international publications were identified. Focusing on domestic studies, 77 publications were reviewed, of which 43 passed the relevance and quality screening.

The literature review (Section 3, Volume I) begins with a discussion of the characteristics of studies important to people thinking about implementing similar studies, factors important to consider to those interested in evaluating the effectiveness of a DSFS installation, and the major safety focal points, dependent variables, and hypotheses.

Five safety focal points were identified: work zones, school zones, transition zones, straight sections, and curves. Three dependent variables were dominant: the mean speed, the 85th percentile speed, and the percentages of vehicles traveling over the speed limit. Finally, in deciding if and in what situation to install a DSFS, traffic engineers must consider what type of speed reduction is desired. Three effects (and associated hypotheses) were considered. First, the installation of a DSFS can influence speeds at the DSFS when it is activated. Second, the activation of the DSFS can also affect the speed of vehicles downstream of the DSFS. And third, the deactivation of the DSFS can have a lingering effect on the speed of vehicles at the DSFS and downstream of the DSFS sometime after the DSFS has been deactivated (also called the *halo effect*). In this study, we refer to tests of these three effects on vehicle speeds as the activation hypothesis, the downstream hypothesis, and the deactivation hypothesis. Published studies consider different combinations of these hypotheses by different names, and this study combines them all into a unified framework for the first time (Section 3.4, Volume I).

The literature review concludes with a vote count across sites for each dependent variable and each hypothesis, both overall and for each of the five safety focal points. The vote count tabulates the number of studies with statistically significant results in support of a given hypothesis. The major findings of the vote count are presented together with the major findings of the meta-analysis after a discussion below of the rationale and methodology used in the meta-analysis (Sections 1.5 – 1.7, Volume I).

1.4. Meta-Analysis

The meta-analysis (Section 4, Volume I) builds on the vote count in the literature review by analyzing the data from the published literature to assess not just the number of studies that report a significant change in the speed after the installation of DSFS, but also the estimated change in speed across all studies. This meta-analysis can also be used to identify the differences in the estimated size of the change in speed across different installation contexts (safety focal points), vehicle types, and methods of measuring DSFS effectiveness.

The statistical approach of the meta-analysis requires detailed data on the number of vehicles sampled, mean speeds, and the variability of these speeds. To carry out this analysis, data from 43 publications were compiled. A single publication can include more than one study, each of which can contain observations for more than one DSFS site. For example, a single publication might include two studies, one of the effects of a DSFS at work zones and one of the effects at school zones. The study of work zones might have reported observations on the changes in the mean speed and 85th percentile speed at four sites while the study on school zones might have reported observations on just mean speed from six sites. Thus, the one publication would include 2 studies, 10 sites and 14 observations (4 sites × 2 observations in the first study, 6 sites × 1 observation in the second study). Each speed measurement at a site is considered an observation. In total, there were 57 studies reviewed, which included over 5,000 observations.

1.5. Results

1.5.1. Aggregate Results

We begin with a discussion of the aggregate results for each of the three hypotheses and three dependent variables. We present information from the vote count, the meta-analysis or both, depending on what was available.

1.5.1.1. Activation Hypothesis

Out of 145 statistical evaluations of the decrease in mean speed at the DSFSs, 133 showed significant decreases, 8 showed no change, and 4 showed increases (Figure 1). The results at the overwhelming majority of sites, 92 percent, were consistent with the activation hypothesis that the speed would decrease at the DSFS. The meta-analysis was consistent with the vote count results. Overall, significant reductions of 2 to 4 mph at the DSFS were estimated across all vehicle types in the different contexts assessed. Although there were fewer analyses of changes in the 85th percentile speed and changes in the percentage of drivers traveling over the speed limit, in both cases the number of sites consistent with the hypothesis that there would be a reduction was clearly much larger than the alternative hypothesis (Figure 1).

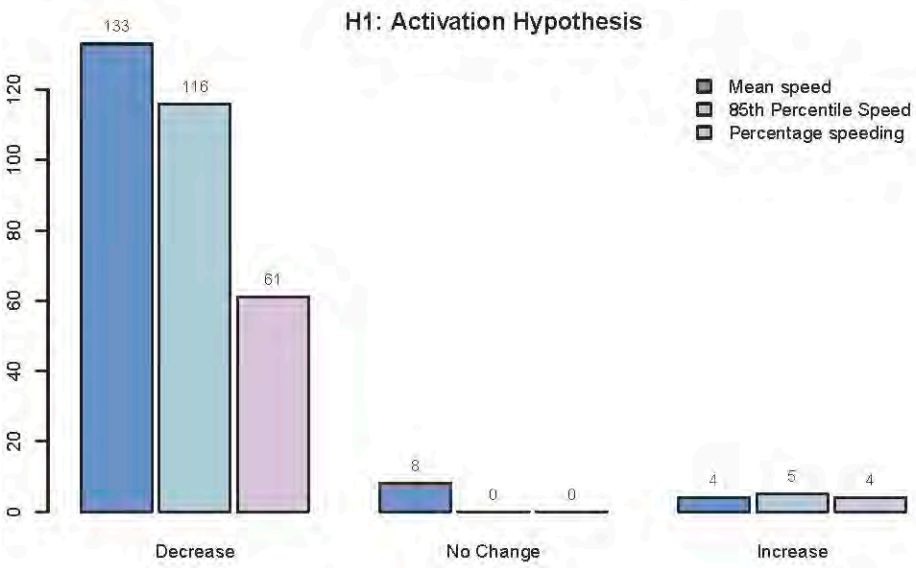

Figure 1. Activation hypothesis: Vote count results

1.5.1.2. Downstream Hypothesis

The change in speed downstream of the DSFS while the DSFS is activated can be measured with respect to the speed upstream of the DSFS or the speed at the DSFS. Using the upstream speed as a reference point, over two-thirds (68.2%) of the sites are consistent with the downstream hypothesis (Figure 2). Speed changes downstream of the DSFS varied between decreases of 5 mph and increases of 4 mph, depending on the comparison point selected. Compared to changes in speed adjacent to the DSFS (the activation hypothesis), the above percentage (68.2%) represents a smaller percentage of sites consistent with the downstream hypothesis. However, again using the upstream speed as a reference point, the percentage of sites consistent with the hypothesis that there would be a reduction in the 85th percentile speed at the downstream location when the DSFS was activated (92.1%) and that there would be a reduction in the percentage of drivers traveling over the speed limit (88.3%) both remained high (Figure 2).

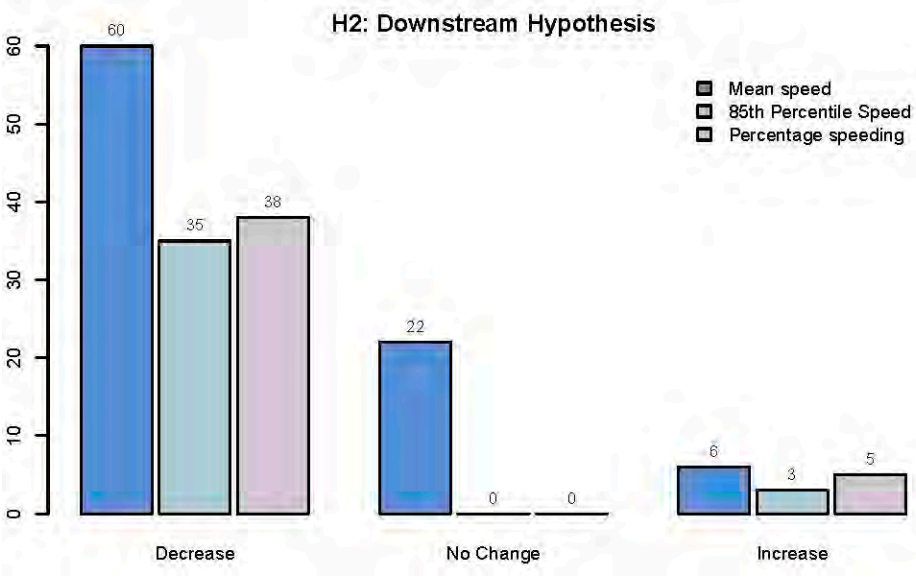

Figure 2. Downstream hypothesis: Vote count results

1.5.1.3. Deactivation Hypothesis

There were many fewer sites that reported information relevant to the deactivation hypothesis. The change in speed at the DSFS after deactivation can be measured relative to the DSFS sensor before activation or relative to the DSFS during activation. For the sites that measured the speed at the DSFSs after deactivation relative to the speed at the DSFS sensor before activation, all three showed significant decreases in speed. The magnitude of the mean speed change following DSFS removal varied between a decrease of 2 mph and increase of 1 mph, depending on the point of comparison used (the upstream speed before activation or the speed at the DSFS during activation). A decrease would be expected at the DSFS after deactivation relative to the upstream speed before activation if there was a continuing effect of the activation of the DSFS on the speed of the drivers, even following the removal of the sign.

1.5.2. Safety Focus

The major vote count and meta-analysis findings for the five safety focal points are presented below as they bear on an evaluation of reductions in mean speed at the DSFS (the activation hypothesis). Results that are more detailed are presented in the literature review and the meta-analysis.

1.5.2.1. Work Zones

In work zones drivers are required to increase their attention not only to address the reduced speed of other vehicles, but also to address the added dangers of construction equipment, roadway design and markings, and pedestrian activity. The literature review found that 45 of 52 sites showed a significant decrease in speeds in work zones when DSFSs were installed, with mean speed reductions at the DSFS during activation of 2.75 mph being estimated in the meta-analysis.[2]

[2] This reduction was estimated under Hypothesis 1A; activation effect normalized.

1.5.2.2. School Zones

School zones showed a similar effectiveness for DSFS, with 24 of 28 sites showing significant reductions in mean vehicle speed at the DSFSs during sign activation. Speed reductions at the DSFS of 3.21 mph were estimated overall in school zones across all vehicle types, during DSFS activation.[3] Studies found that speeds were reduced in school zones at the DSFS during activation for time periods of up to 12 months (O'Brien & Simpson, 2012), and by up to 9 mph (Ullman & Rose, 2005).

1.5.2.3. Transition Zones

Rural roads are the most dangerous roadway functional class in terms of speeding-related fatal crashes, with 41 percent of all speeding-related fatal crashes in 2018 (National Center for Statistics and Analysis, 2020) occurring on rural non-interstate roads. As drivers transition from rural roads to more densely settled areas, the required reductions in speed may be substantial. DSFS installations were effective in significantly reducing vehicle speeds at the DSFSs during activation in all 29 sites that examined their effect in transition zones, with speeds reductions estimated of 2.79 mph.[4]

1.5.2.4. Curves

Horizontal curves require the full attention of drivers, with some sites showing that longer reaction times are required to maintain safe vehicle operation on curves (Tribbett et al, 2000). DSFSs are effective in reducing speeds in this context, with all 29 sites that assessed mean speeds presenting significant reductions at the DSFS during activation. The meta-analysis estimated that speed reductions were 2.27 mph overall along curves.[5]

1.5.3. Vehicle Type

The activation hypothesis was also evaluated for different classes of vehicles and the results suggest that vehicle type in addition to safety focus is an important consideration in measuring DSFS effectiveness. Across all of the safety focal points, passenger cars demonstrated larger reductions in mean vehicle speed at the DSFS than trucks. Considering just the effect of DSFS activation, the magnitude of the speed decrease for passenger cars was estimated as approximately double (4.7 mph) that of trucks (2.9 mph).[6]

[3] This reduction was estimated under Hypothesis 1B; activation effect at the site of the DSFS.
[4] This reduction was estimated under Hypothesis 1A; activation effect normalized.
[5] This reduction was estimated under Hypothesis 1A; activation effect normalized.
[6] This reduction was estimated under Hypothesis 1B; activation effect at the site of the DSFS.

1.6. Annotated Bibliography

Finally, an annotated bibliography (Volume II) presents the details of each of the 43 publications reviewed in a consistent format, allowing an in-depth examination of the sign types, study designs, and unique characteristics of each study. We begin each review of an article with information on the study identifying information, relevance screening, and quality screening. We continue the review with a simple list of information relevant to the study, in five categories:

1. What hypotheses were evaluated;
2. What dependent variables were used to evaluate the hypotheses;
3. What were the results of those evaluations;
4. What were the characteristics of the study the practitioner needs to know to implement the DSFS in a particular setting, and
5. What are the aspects of the experimental design the researcher needs to know to evaluate the goodness of the study?

We have already discussed the first three of these categories. Details of a study that a practitioner needs to know to determine whether the study is relevant includes information such as:

- safety focus,
- classes of vehicles,
- posted speeds,
- type of DFS display,
- level of service,
- roadway type,
- roadway environment,
- presence of sidewalks, and
- sensor type.

Details of the study a researcher needs to know to evaluate the quality of or conduct a study include

- sensor positions;
- timing of the speed measurements prior to, during, and after activation of the DSFS; and
- experimental design.

1.7. Discussion and Limitations

There are several factors that must be considered when interpreting the results, the primary one of which is the way in which each of the three hypotheses are evaluated. We can best make this clear by way of an example (a complete discussion is included in Section 3.4, Volume I). As an example, we will choose the activation hypothesis.

First, the activation hypothesis can be directly tested as the change in vehicle speeds at the location where the DSFS will be installed, comparing the speeds of cars prior to installation of a DSFS (Car 1, 56 mph) to the speeds of cars when the sign is installed and active (Car 2, 46 mph) (Figure 3). Here there is a reduction of 10 mph. We refer to this as the "same site" measurement. This measure is commonly made in the literature, and is adequate for a considering, in general, how much a DSFS can reduce driver speed. One consideration, however, is that roadway conditions may have changed between the two time points that are measured, so vehicle speeds may differ for reasons other than the DSFS installation.

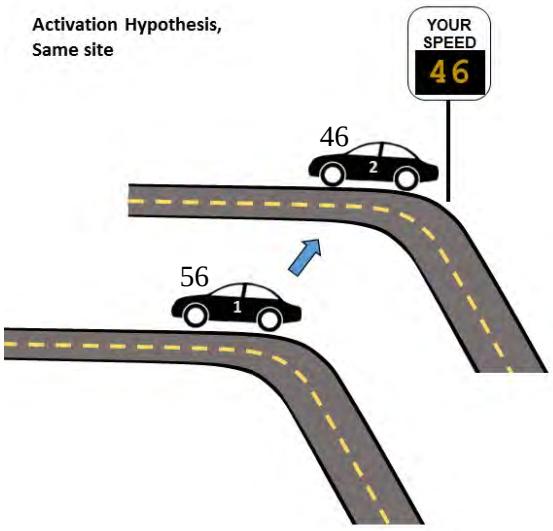

Figure 3. Activation hypothesis, same site. (Car 1 before activation, Car 2 during activation)

There are three ways to evaluate the activation hypothesis. To meaningfully interpret our findings on the activation hypothesis, one needs to understand the three different ways one can evaluate this hypothesis. Researchers generally choose only one way of evaluating the hypothesis and do not mention the alternatives or the limitations of the one that they choose.

An alternative method that studies have used to address the activation hypothesis is to measure speeds during the same trip, comparing vehicle speeds upstream of the site of DSFS installation (Car 2 at position before DSFS, 56 mph) to speeds adjacent to the DSFS (same car at DSFS, 46 mph) (Figure 4). This example also shows a speed reduction of 10 mph. As with the "same site" measurement, this "same trip" measurement method also may include changes in speed driven by factors besides the DSFS installation. This is particularly true since DSFSs are installed at sites where vehicle speeds are expected to decrease, such as prior to school zones or along horizontal curves. Thus this "same trip" measurement of the activation hypothesis is expected to only partly reflect the effect of the DSFS itself. Both these first two measures of the activation

effect have merit and, in the literature both show significant reductions in vehicle speed, but they do not fully isolate the effect of the DSFS from other roadway factors.

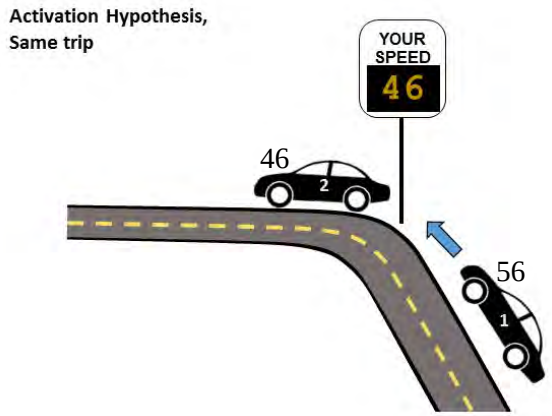

Figure 4. Activation hypothesis, same trip. (Car 2 at position before DSFS, Car 2 at position at DSFS)

To most accurately capture the effect of DSFS in reducing speed, ideally both changes in speed at the two sites (upstream and adjacent) and at the two points in time (prior to installation and during installation) would be considered. While more complex, this measurement would most specifically isolate the effect of the DSFS activation. Here the difference in the speeds at the DSFS before and during activation (the speed of Car 1 minus the speed of Car 2 at the DSFS, or 10 MPH) (Figure 5), compared with the difference in the speeds of these same two cars upstream of the DSFS before and during activation (the speed of Car 1 minus the speed of Car 2 upstream of the DSFS, or 5 mph). If the difference of differences is negative (i.e., if the difference in the upstream speeds of the two cars minus the difference in the DSFS speed of the two cars is negative), then there is a net reduction in speed at the DSFS. Here we see a net reduction of only 5 mph, as opposed to the above two methods ("same site" and "same trip") that each show a reduction of 10 mph. This test of the activation hypothesis helps to account for differences in speed that may be due to any factors other than the DSFS itself. This measure of DSFS effectiveness is referred to in this study as a *normalized effect*, and was encountered less often in the literature, but should be considered the most accurate representation of the activation effect of DSFS in reducing driver speeds.

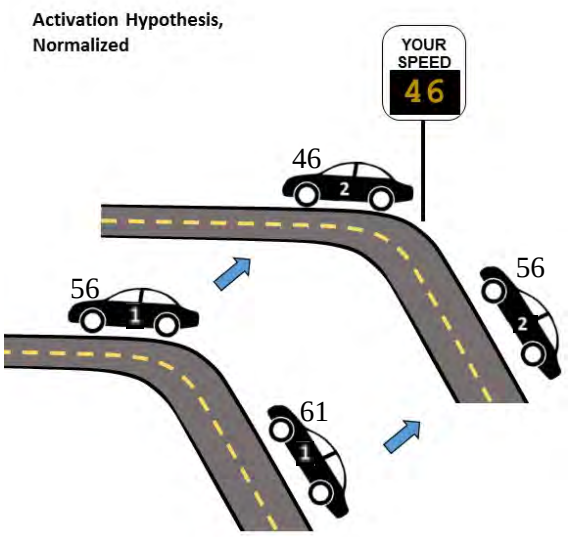

Figure 5. Activation hypothesis, normalized

Other factors must also be considered when interpreting the results from a given study beside the exact hypotheses that were evaluated. We describe these factors in the literature review. They include, as noted above, the DSFS implementation characteristics (Section 3.6, Volume I) and the study design characteristics (Section 3.7, Volume I). Importantly, for every study in the literature review where a result was not consistent with the activation hypothesis and mean speed was the dependent measure, the reasons why such might have been the case are described. The simple vote count is just that, a vote count, and does not reflect the subtleties inherent in some studies. For example, we see in some studies that the vehicle speeds were already at or below the posted speed limit before the installation of the DSFS. In such studies, there is no reason to expect an effect of DSFS on a reduction in the vehicle speed and, indeed, there was none.

1.8. Summary

By reviewing results and re-analyzing the data from the published literature (Volume I), the vote count and meta-analysis show that DSFSs are effective in reducing average vehicle speeds in all cases with sufficient data, as indicated either by the vote count or meta-analysis. The overall speed reductions of 4 mph for passenger cars at the DSFS can lead to substantial reductions in speeding-related crashes, reducing the human toll of fatal crashes. The annotated bibliography (Volume II) provides a summary of each study, with index tables to allow readers to quickly find relevant studies supporting this review.

2. Introduction

2.1. Background

Speeding-related crashes continue to be a serious problem. Over the last decade, more than a quarter (26% in 2019) of all fatal crashes have been speeding-related (NCSA, 2021). NHTSA's *2011 National Survey of Speeding Attitudes and Behaviors* found that 30 percent of drivers were regular speeders and another 40 percent of drivers sped at least some of the time (Schroeder et al., 2013). In this same survey, the most widely approved countermeasure for speeding were DSFSs. The use of these signs was supported by 87 percent of speeders and 91 percent of sometime-speeders. Similarly, focus groups in NHTSA's *Motivations for Speeding* study were also very supportive of DSFSs (Richard et al., 2013).

There have been many studies focusing on the effectiveness of DSFSs in reducing vehicle speeds. These studies vary substantially in roadway context, design, and study goal. An initial scan of the literature by NHTSA indicated that the studies focusing on DSFSs have included conditions with varying safety focal points (roadway departures, pedestrians, intersections, work zones), roadway types (collector, arterial, interstate, local), speed limits (from 25 to 65 mph), DSFS characteristics (e.g., stationary versus mobile units), and locations (urban, suburban, rural). At least one study looked at the use of DSFSs in conjunction with speed enforcement (Bloch & Automobile Club of Southern California, 2007). There was also at least one literature synthesis (Donnell & Cruzado, 2007) that covered 12 research studies on the effectiveness of DSFSs. Although most studies that were reviewed showed reductions in both mean speeds and 85th percentile speeds while the DSFSs are deployed, with one study (Tribbett et al., 2000) showing a reduction in crashes, the results were mixed, with some studies showing no reduction in speed and others an actual increase in speed.

It is important to keep in mind throughout this report that reductions in speed of even a few miles an hour can have a large impact on fatalities and injuries to pedestrians (Kloeden et al., 1997). For example, at relatively low speeds the risk of severe injury for 30-year-old pedestrians decreases from 50 percent to 25 percent as the speed at impact decreases by 6.5 mph from 33.5 mph to 26.0 mph (Tefft, 2011). The risk of severe injury for 70-year-old pedestrians decreases from 81 percent to 57 percent when the speeds at impact are decreased similarly. At slightly higher speeds, the risk of death for 30-year-olds decreases from 50 percent to 37 percent as the speed at impact decreases by 4 mph from 44.5 mph to 40.5 mph. The risk of death for 70-year-olds decreases from 81 percent to 71 percent as the speed at impact decreases by the same amount. Reductions in speed of even 4 to 6 mph can be of large practical significance when it comes to reducing the frequency of severe injuries and fatalities.

2.1.1. Reductions in Speed at the DSFS Location: Activation Hypothesis

There are three ways to evaluate the activation hypothesis. To interpret meaningfully our findings on the activation hypothesis, one needs to understand the three different ways one can evaluate this hypothesis. Researchers generally choose only one way of evaluating the hypothesis and do not mention the alternatives or the limitations of the one that they do choose. First, the activation hypothesis can be directly tested as the change in vehicle speeds at a given location, comparing speeds prior to installation of a DSFS (Car 1, 56 mph) to speeds when the sign is installed and active (Car 2, 46 mph) (Figure 6). Here there is a reduction of 10 mph. This measure is commonly made in the literature, and is adequate for a considering, in general, how

much a DSFS can reduce driver speed. One consideration, however, is that roadway conditions may have changed between the two time points that are measured, so that vehicle speeds may differ for reasons other than the DSFS installation.

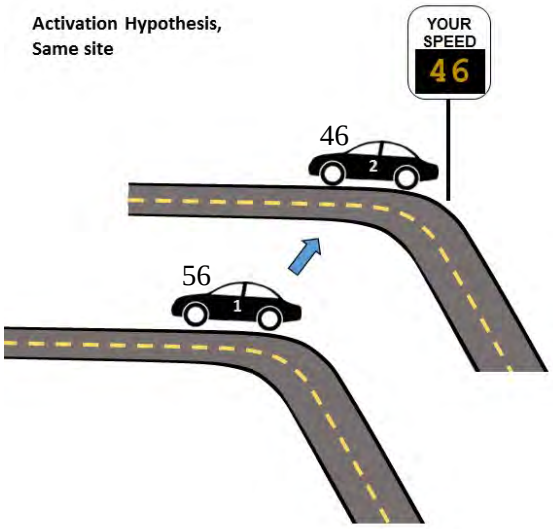

Figure 6. Activation hypothesis, same site

An alternative method that studies have used to address the activation hypothesis is to measure speeds during the same trip, comparing vehicle speeds upstream of the site of DSFS installation (Car position 1, 56) to speeds adjacent to the DSFS (Car position 2, 46) (Figure 7). This example also shows a speed reduction of 10 mph. As with the "same site" measurement, this measurement method also may include changes in speed driven by factors besides the DSFS installation. This is particularly true since DSFS are installed at sites where vehicle speeds are expected to decrease, such as prior to a school zone or along a horizontal curve. Thus this "same trip" measurement of the activation hypothesis is expected to only partly reflect the effect of the DSFS itself. Both of these first two measures of the activation effect have merit and, in the literature, both show significant reductions in vehicle speed, but they do not fully isolate the effect of the DSFS from other roadway factors.

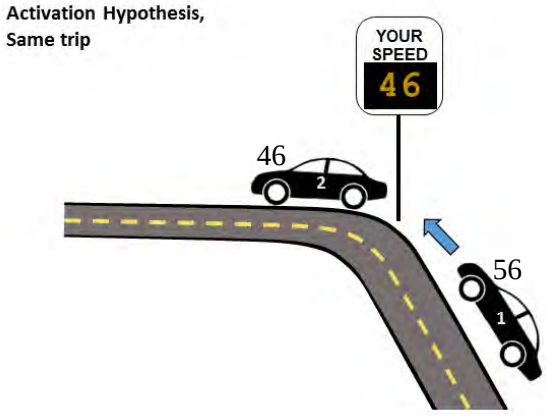

Figure 7. Activation hypothesis, same trip

To most accurately capture the effect of DSFS in reducing speed, ideally both changes in speed at the two sites (upstream and adjacent) and at the two points in time (prior to installation and during installation) would be considered. While more complex, this measurement would most specifically isolate the effect of the DSFS activation. Here the difference in the speeds at the DSFS before and during activation (the speed of Car 4 minus the speed of Car 2 (Figure 8. activation hypothesis, normalized, compared with the difference in the speeds upstream of the DSFS before and during activation (the speed of Car 3 minus the speed of Car 1). If the difference of differences is negative, then there is a net reduction in speed at the DSFS. Here we see a net reduction of only 5 mph, as opposed to the above two methods that each show a reduction of 10 mph. This test of the activation hypothesis helps to account for differences in speed that may be due to any factors other than the DSFS itself. This measure of DSFS effectiveness is referred to in this study as a *normalized effect*, and was encountered less often in the literature, but should be considered the most accurate representation of the activation effect of DSFS in reducing driver speeds.

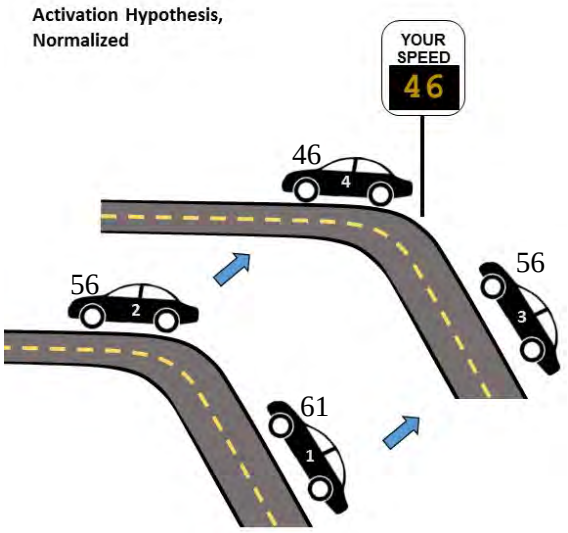

Figure 8. Activation hypothesis, normalized

2.1.2. Reductions in Speed Downstream of the DSFS: Downstream Hypothesis

Safety officials may also consider using a DSFS to reduce speeds at a downstream location. For instance, it may be desired to begin tapering vehicle speeds well upstream of a transition zone between a rural highway and a more densely settled area. In this case, considering the downstream hypothesis would be appropriate. If the sign is placed too far upstream of the location of interest, vehicle speeds may recover to prior levels, so assessing the distance between the sign and the measurement location is critical. Just as for the activation hypothesis, considerations of the baseline comparison case are important, and in the literature both comparisons at the same time (Figure 9) and same site are presented. The downstream hypothesis has more variations than the activation hypothesis, since it is possible to consider both the site adjacent to the DSFS or upstream of the DSFS as baseline comparisons. These considerations are discussed further in the literature review and meta-analysis sections of this report.

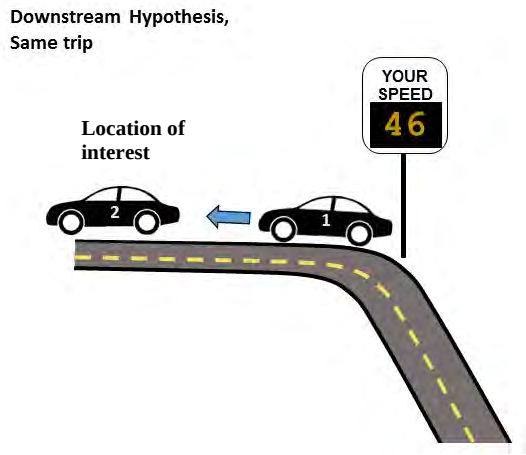

Figure 9. Downstream hypothesis, same trip.

With respect just to reductions in speed downstream of the DSFS, using the upstream speed as the baseline, over two-thirds (68.2%) of the studies are consistent with the hypothesis that there would be a reduction in the mean speed downstream of the DSFS during the activation of the DSFS (H2). Compared to changes in speed adjacent to the DSFS (H1), this represents a smaller percentage of studies. However, the percentage of studies consistent with the hypothesis that there would be a reduction in the 85th percentile speed at the downstream location when the DSFS was activated (92.1%) and that there would be a reduction in the percentage of drivers traveling over the speed limit (88.3%) both remained high.

2.1.3. Reductions in Speed After Deactivation of the DSFS: Deactivation Hypothesis

Finally, safety officials may consider temporarily installing a DSFS, for example, as part of a mobile operation in a work zone or as a test case to evaluate DSFS effectiveness. Upon removal of the DSFS, it is possible that a "halo effect" of continued reductions in driver speed may be observed. Some authors have tested this deactivation hypothesis. As with the downstream hypothesis, there are number of combinations of measurement in time (Figure 10) and space that are possible. For deactivation effects as shown in Figure 10, the published literature indicates that these halo effects can occur, although too few studies have been conducted to assess the statistical significance of this effect.

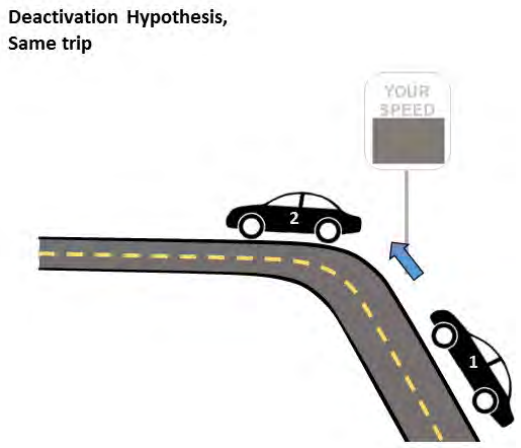

Figure 10. Deactivation hypothesis, same time. Removed DSFS indicated in grey.

2.2. Objectives of Study

Given the large number of previous studies, end users in the highway safety community are faced with the challenge of sifting through the existing studies to locate appropriate research that addresses their needs. To reduce that burden, the Volpe National Transportation Systems Center (Volpe) was asked to conduct a comprehensive review of the existing literature on DSFS from 2000 to the present, produce an annotated bibliography of all studies found, and undertake a systematic and quantitative review of these studies, including a meta-analysis. This report aims to provide an important resource for both highway safety practitioners interested in reducing speeding and speeding-related crashes and researchers interested in doing further research on this important and widely accepted traffic safety countermeasure.

The remainder of this report is divided into three sections: the literature review (Volume I, Section 3), the meta-analysis (Volume I, Section 4), and the annotated bibliography (Volume II). Material in these sections is necessarily linked and we will make clear the interconnections where it is important to do such.

3. Literature Review

3.1. Literature Review Summary

Speed has long been known to be a major contributor to crashes. This report addresses the effect that DSFSs can have on lowering speeds. The Volpe National Transportation Systems Center undertook a literature search for studies of DSFS effectiveness, focusing on domestic publications that reported changes in speed in terms of mean speed, 85th percentile speed, or percentage of vehicles in excess of posted speed limits. For each study that met the initial relevance and quality screening criteria, a detailed review was written and data were collected. These reviews are included in the annotated bibliography in Volume II. The data were used for the meta-analysis in Section 4 of this volume.

A total of 108 national and international publications were identified in the initial literature search. Focusing on the domestic studies, 77 publications were reviewed, of which 43 passed the relevance and quality screening.

This literature review summarizes the results of each publication using a vote-counting approach. A single publication can include more than one study, each of which can contain measurements for more than one DSFS site. A total of 725 sites were included in this review. Vote-counting here refers to summing the number of sites across all studies that show significant support for each outcome of the three hypotheses: the activation hypothesis -- the change in the mean speed at the DSFS when it was activated (labeled here as H1), the downstream hypothesis -- the change in the mean speed downstream of the DSFS when the DSFS is activated (H2), and the deactivation hypothesis -- the change in the mean speed at the DSFS after it is activated (H3). Vote counts are given for the change in the mean speed, the 85th percentile speed, and the percentage of drivers traveling over the posted speed limit for each of the three hypotheses.

In this summary of the literature review, we report only on the vote counts for mean speed; results for 85th percentile speed and percent of drivers speeding are found in the literature review. With respect to the change in the mean speed at the DSFS when it was activated (H1), measurements for 145 separate sites were reported. Of these, 133 were consistent with decreases in speed at the DSFS when it was activated; 8 showed no change; and 4 showed increases. With respect to the change in the mean speed downstream of the DSFS when the DSFS was activated (H2), 88 separate analyses were reported. Sixty of these were consistent with decreases in the mean speed downstream of the DSFS, 22 showed no change, and 6 showed increases in speed. Finally, with respect to the change in the mean speed after the DSFS was deactivated (H3), 3 studies were found, all of which reported significant decreases in the mean vehicle speed.

Additionally, the report separates out for each safety focus (work zone, school zone, transition zone, horizontal curve, or straight section) the vote count for the three main hypotheses. Critically, the safety focus summary includes a discussion of why those studies that were not consistent with the hypotheses might have included elements in the installation of a DSFS that are things to avoid when implementing a DSFS.

The vote count shows only the number of studies that provide evidence consistent with or not consistent with a given hypothesis. One would also like to know the exact size of the reduction in speed in order to predict the effect on crashes (Tefft, 2011). The meta-analysis (Section 4) shows the quantitative reductions in speed to be expected under different circumstances, for each of the hypotheses tested.

We have referred above to three main hypotheses, because each of the main hypotheses (activation hypothesis, downstream hypothesis, and deactivation hypothesis) has several ways of being evaluated, based on where and when the vehicle speeds are measured. The literature review discusses in detail the rationale for the different ways in which each of the three main hypotheses were evaluated and points to the advantages and disadvantages of each different method.

Based on the positive results, as reported above, traffic engineers may decide that it is useful to implement a DSFS in a particular location or that further study is needed. Not surprisingly, each of the studies reviewed vary greatly in terms of how the DSFS is implemented and how the experimental evaluation of the effect of the DSFS is undertaken. These characteristics were recorded for each study and are discussed in the literature review as well. Taken together, these results provide traffic engineers with the information that they need for planning a successful DSFS installation and provide researchers with the information that they require in determining exactly how the effects of the DSFS were evaluated.

This report is the first systematic synthesis of the numerous hypotheses, dependent and implementation variables, and experimental design characteristics that have been reported in studies of the effects of DSFS. As such, we hope that it paves the way for some standardization in the reporting of the experimental studies. This standardization can make it easier for future researchers to understand exactly what was done in each study and undertake additional analyses or new studies.

We continue below with a discussion of

- Methods used in the literature search and vote count,
- Typology of the characteristics of the studies including:
    - Three different hypotheses that were evaluated,
    - Three dependent variables that were used to evaluate those hypotheses,
    - Variables that define a DSFS implementation, and
    - Different experimental designs that were used to evaluate the hypotheses, and
- Detailed report (vote count) of the effectiveness of DSFSs with each of the five different safety focal points for each of the three different hypotheses and three different dependent variables along with an in-depth discussion of those studies that showed no effect of the DSFS on the mean speed at the DSFS or an actual increase in speed at the DSFS after activation.

3.2. Literature Search Methods

The search for documents that report the effect of DSFS on driver behavior was undertaken from March 9 to March 16, 2016, by Volpe and MIT library staff. A total of 108 national and international publications were identified. Focusing on domestic studies, 77 publications were reviewed, of which 43 passed the relevance and quality screening.

3.2.1. Search Words and Phrases

The words and phrases used in the literature search were relevant to the project's key research questions:

- How are DSFSs being used to regulate speed?
- What are the extant findings regarding the effectiveness of DSFSs?

Searches started with the keywords (including the word variations) listed in Group 1 in the box below (Table 1). If the number of items retrieved was too large with the keywords used from Group 1, then the search words from Group 1 were combined one at a time with the keywords listed in Group 2. Only one of the Group 1 terms met these criteria, "speed limit signs," with over 2,660 records. Any of the search terms in the tables that ended in "s" were wildcards with *. Wildcards allow one to search for all variants of a term. For example, "warning sign*" includes "warning sign," "warning signs," and "warning signage." The reader will notice that many keywords are placed into groups (e.g., speed contains a number of keywords). Where keywords were listed under a group term, only the subordinate keywords were used in searches. However, in the one case where a group term had no subordinate keywords, "Traffic Calming Measures," it was used as the search term along with "Traffic Calming" (TRID, TRB's database, uses traffic calming as a thesaurus term).

Table 1. Search Words

Group 1	**Group 2**
• Speed o Dynamic speed display signs (DSDS) o Speed display signs o Dynamic warning signs o Dynamic speed feedback signs (DSFS) o Speed feedback signs o Driver feedback signs o Speed monitoring displays (SMD) o Speed displays o Speed display trailer o Dynamic displays o Speed warning signs o Variable message speed limit signs o Speed limit signs o Speed minders o Speed indicator device (SID) o Speed reduction treatments o Radar speed signs o Radar speed check signs o Photo-radar displays • Curves o Dynamic curve warning signs o Advance curve warnings • Traffic calming measures	• Locations o Curves o School zones o Work zones o Intersections o Transition zones • Treatment effects o Speed reduction o Speed decreases o 85th percentile speed reductions

Seven extensive databases were searched: Transportation Research International Documentation (TRID), National Transportation Library, WorldCat, Academic Search Complete, PsychINFO, Web of Science, and Science Direct. Together, these databases provide a comprehensive coverage of academic and governmental transportation-related research.

3.2.2. Results of Search

The search yielded 106 references, placed into different categories (Table 2). It was decided initially to review only domestic studies given the differences in roadway design, traffic regulations, and driving cultures around the world. This led to the exclusion of 30 studies; however, one of those studies had already been reviewed prior to the decision to focus on just domestic articles. This review is included in the annotated bibliography, but it was not used for the other components of this study. Of the 76 remaining domestic sources, 19 were redundant. For example, a study that appeared as a "proceedings" article with one set of authors and title might also appear as a journal article with different authors, different titles, or seemingly different content. Of the remaining 57 articles, 3 could not be located (retrieved from the URL or other internet searches), leaving 54 articles to be screened for relevance and quality.

Table 2. Summary of publications evaluated for literature review.

Decision	**Number**
Included	43
Data article (42)	
Review article (1)	
Redundant	19
International	29
No speed data	5
Sign not relevant to speeds	6
Not able to retrieve	3
Synthesis (included)	1
Total	106

The screening process was two-tiered. First, a study was reviewed for relevance. If it passed this screening, the study was then reviewed for quality. To measure study relevance, two questions were asked of a study, following a standard practice in systematic literature reviews (Cooper et al., 2009). The relevance criteria were as follows.

1. Is this study an empirical investigation of the effectiveness of DSFSs?
2. Is the outcome measure crashes, fatal crashes, and/or some function of traffic speeds?

In 6 of the studies, the signs that were used did not report driver speed. That left 49 studies to review for quality.

To measure the quality of the studies that made it through the relevance screening, three questions were asked of each study.

1. Were the study population and the context of the study well described?
2. Were the exposure variables valid implementations of the conditions that they were meant to represent?
3. Was the outcome variable both a reliable and valid measure of the outcome of interest?

In 5 of the studies no speed data were reported. That left 43 studies, one of which was a literature review. The literature review was not included in the set of 42 studies that were used for the vote count.

3.2.3. Types of Dynamic Feedback Signs

Across these publications, different types of DSFSs were employed, including portable changeable message signs (PCMSs), speed monitoring displays (SMDs), and speed display trailers (SDTs). The configurations of signs and messages, which are included as part of a DSFS deployment, varied widely across installations. Examples of the types of configurations commonly encountered are presented in Appendix B (Volume II), and details on the configurations of signs in each publication are presented in the annotated bibliography (Volume II).

3.2.4. Article Review Template

The 43 included articles were reviewed in detail and are included in a separate annotated bibliography (Volume II). Each review has four sections:

1. A list of the features of the study, including details on the implementation of the DSFS and the design of the study;
2. A summary of the study or studies included in the article;
3. A schematic diagram indicating the location of the speed sensors and DSFS as well as the geometry of the roadway where the treatment was applied at each site; and
4. A graphic of the DSFSs used.

A detailed description of each section is included in Appendix C of Volume II.

3.3. Vote Count Methods

For each of the three hypotheses and each dependent variable, we counted the number of sites where a decrease, an increase, or no change in speed was noted. Complete descriptions of the hypotheses are described below in Section 3.4. We then present these summaries as a vote count (Koricheva & Gurevitch, 2016). In a vote count, the number of significant results for each alternative hypothesis is simply summed across studies. This type of review is quantitative in the sense that significant results are summed, but does not take into account the size of the effect (i.e., how many mph speeds were reduced as a result of the DSFS), the sample size, or the variability of the effect size. These factors require more data to consider and are included in the meta-analysis in Section 4.

The specifics of the vote count are as follows. Assume a study had *n* sites with one statistical evaluation at each site. Suppose that for a particular hypothesis and particular dependent variable, the results from *m* of the *n* sites were consistent with a particular hypothesis, $m \leq n$. Then, *m* votes were tallied as consistent with the hypothesis and $n - m$ votes as not consistent with the hypothesis. The $n - m$ were further partitioned into those that showed no change in speed and those that showed an increase in speed.

Consider a single hypothetical study. Suppose the mean speed was measured at the DSFS before activation and then again at the DSFS during activation (H1B, a particular variation of the DSFS activation hypothesis; see Section 3.4.1). Suppose there were 12 sites. Suppose significant reductions in speed were recorded at 9 of the 12 sites, no significance change in speeds were recorded at 2 sites, and an increase in speed was recorded at 1 site. Then, Volpe would add 9 votes as supporting the DSFS activation hypothesis (a reduction in speed at the DSFS when it is activated), 2 votes as showing no change in speed, and 1 vote as showing an increase in speed.

In the unusual case that several vehicle classes were measured at one site, these were counted separately. So, for example suppose there were 2 sites and the speed of both trucks and cars were recorded at both sites. Then, if the speeds were reduced at the DSFS for cars and there was no change for trucks, this would be recorded as 2 votes for a decrease and 2 votes for no change.

3.4. Hypotheses

There are three major hypotheses evaluated in the studies. The DSFS activation hypothesis (H1) is used to evaluate the following question: At the location of the DSFS, are speeds reduced after the DSFS is activated? The DSFS downstream activation hypothesis (H2) answers the following question: Downstream of the DSFS, are speeds reduced after the DSFS is activated? The DSFS deactivation hypothesis (H3) answers the question: After removal of the DSFS, are speeds reduced at the DSFS from what they were when the DSFS was activated? Upon further inspection, it became clear that there were three different variations of H1, five different variations of H2, and five different variations of H3. Use of this typology would help future researchers by standardizing the terminology, facilitating the search for a study relevant to a hypothesis of particular interest.

3.4.1. Hypothesis 1: Activation Effect at DSFS

There are three different variations on the activation hypothesis H1. These variations can lead to very different conclusions about the effectiveness of a DSFS. One might wish it were simply a matter of answering the question: Is the speed reduced or is it not reduced at the DSFS when the DSFS is activated? However, because studies often used different ways of answering this question, and because there are different ways of evaluating the hypothesis, it is important that the reader understand the different variations of the DSFS activation hypothesis.

First, consider the ideal measurement. To assess how the activation of a DSFS reduces driver speed, the ideal measurement would account for the change in vehicle speed from prior to the sign installation to during sign activation. The ideal measurement would also account for any change in the upstream speeds that occurred prior to the sign installation and during the sign installation. Such a measurement is given on the following page in Equation 1:

H1A: $(During_{DSFS} - Before_{DSFS}) - (During_{Upstream} - Before_{Upstream})$

Equation 1

In Equation 1 the measured quantity is negative if the reduction in speed observed between measurements made at the DSFS before and during activation is larger than the change in speed observed upstream before and during activation.

This is made clear in Figure 11. Rows in the tables in the Required Data column represent locations of the sensor measuring speed (upstream of the DSFS, adjacent to the DSFS, or downstream of the DSFS), and column represent times during which the measurements of speed are made (before activation of the DSFS, during activation of the DSFS, or after deactivation of the DSFS). The first in Equation 1, in blue, is the difference that occurs in the speeds of the cells labelled B and A in Figure 11. The second value in Equation 1, in green, is the difference that occurs in the speeds of the cells labelled D and C in Figure 11. Note that the difference of differences is negative if there is a reduction in speed.

Hypothesis Code	Hypotheses	Speed Reduction Formula	Required Data
H1A	Activation Effect at DSFS, normalized relative to upstream	$(During_{DSFS} - Before_{DSFS}) - (During_{Upstream} - Before_{Upstream})$	Timing: Before / During / After; Location: Upstream (C, D,), Adjacent (A, B,), Downstream (, ,)
H1B	Activation Effect at DSFS, relative to before	$(During_{DSFS} - Before_{DSFS})$	Timing: Before / During / After; Location: Upstream (, ,), Adjacent (A, B,), Downstream (, ,)
H1C	Activation Effect at DSFS, relative to upstream	$(During_{DSFS} - During_{Upstream})$	Timing: Before / During / After; Location: Upstream (, D,), Adjacent (, B,), Downstream (, ,)

Figure 11. Hypotheses H1A, H1B, and H1C. The locations upstream, adjacent, and downstream are all relative to the DSFS.

Second, one can compare the speed at the DSFS during activation to the speed at the DSFS before activation. We can represent this quantitatively as the difference in the speed at the DSFS during the activation of the DSFS ($During_{DSFS}$) and the speed at the DSFS before the activation of the DSFS ($Before_{DSFS}$)[7]:

$$H1B: (During_{DSFS} - Before_{DSFS})$$

Equation 2

We refer to this as hypothesis H1B (measures made at same location at different times). This is made clear graphically in Figure 11. Note the result in Equation 2 is negative if there is a reduction in speed.

Third, one can compare the speed at the sensor upstream of the DSFS during activation of the DSFS with the speed at the DSFS during the activation of the DSFS (H1C; measures made at different locations at the same time). This appears in Figure 11 and is expressed quantitatively as:

$$\mathbf{H1C}: \left(During_{DSFS} - During_{Upstream}\right)$$

Equation 3

Again, the difference is negative if there is a reduction in speed.

Either of the second and third measures has limitations. H1B does not control for differences in the upstream speed before and during activation. H1C does not control for differences in the speed before activation that may exist between the sensor upstream of the DSFS and at the DSFS. Algebraically, controlling for the differences in H1B leads to a quantity that is identical to what is obtained when one controls for the differences in H1C; either way results in H1A.

An example shows how these methods of assessing the activation effect of the DSFS differ in critical ways. Assume the following values for the speeds measured before and after the activation of the DSFS both upstream of the DSFS and adjacent to the DSFS:

- $During_{DSFS} = 30$
- $Before_{DSFS} = 40$
- $During_{Upstream} = 45$
- $Before_{Upstream} = 50$

Evaluating H1A we find a reduction in speed of 5 mph (Figure 12), evaluating H1B we find a reduction in speed of 10 mph, and evaluating H1C we find a reduction in speed of 15 mph. Any negative value for the change in speed is consistent with the desired outcome. However, the different ways of evaluating H1 could lead to large differences in the effect sizes computed in a meta-analysis.

[7] Note that we could also have written $During_{DSFS}$ as $During_{Adjacent}$ and $Before_{DSFS}$ as $Before_{Adjacent}$ (see Figure 11).

Hypothesis Code	Hypotheses	Speed Reduction Formula	Required Data
H1A	Activation effect at DSFS, normalized relative to upstream	$(During_{DSFS} - Before_{DSFS}) - (During_{Upstream} - Before_{Upstream}) = -5$	Timing: Before / During / After Location: Upstream — 50 / 45 / Adjacent — 40 / 30 / Downstream — / /
H1B	Activation effect at DSFS, relative to before	$(During_{DSFS} - Before_{DSFS}) = -10$	Before / During / After Upstream — / / Adjacent — **40** / **30** / Downstream — / /
H1C	Activation effect at DSFS, relative to upstream	$(During_{DSFS} - During_{Upstream}) = -15$	Before / During / After Upstream — / **45** / Adjacent — / **30** / Downstream — / /

Figure 12. Quantitative example: Activation hypotheses H1.

3.4.2. Hypothesis 2: Downstream Activation Effect

To test whether vehicles reduce speeds downstream of the DSFS, there are now three possible comparisons: the downstream sensor before activation with the downstream sensor during activation; the upstream sensor during activation with the downstream sensor during activation, and the DSFS sensor during activation with the downstream sensor during activation.

Consider the first two comparisons: the speed at the downstream sensor before activation with the speed at the downstream sensor during activation (labeled H2B) and the speed at the upstream sensor during activation with the speed at the downstream sensor during activation (H2C). If we subtract the comparison sensor speed from the downstream sensor speed during activation the result should be negative. Moreover, when we control either for changes in speed that might have occurred simply as a function of differences in the time of the two measurements that are used to evaluate H2B or for the changes in speed that occurred simply as a function of differences in the locations of the two measurements that are used to evaluate H2C, we get one and the same algebraic quantity (which we label as H2A). These three hypotheses and their corresponding formulas are represented in Figure 13 (H2A, H2B, and H2C, parallels of H1A, H1B and H1C). It is clear from the computations why, as before, it is important to be certain about just what hypothesis one is evaluating. Any computation that produces a significant negative result is associated with a favorable outcome.

Hypothesis Code	Hypotheses	Speed Reduction Formula	Required Data
H2A	Activation Effect Downstream of DSFS, normalized relative to upstream	$(During_{Downstream} - Before_{Downstream}) - (During_{Upstream} - Before_{Upstream}) = -5$	Timing: Before / During / After Location: Upstream (50, 45,); Adjacent (, ,); Downstream (35, 25,)
H2B	Activation Effect Downstream of DSFS, relative to before	$(During_{Downstream} - Before_{Downstream}) = -10$	Before / During / After Location: Upstream (, ,); Adjacent (, ,); Downstream (35, 25,)
H2C	Activation Effect Downstream of DSFS, relative to upstream	$(During_{Downstream} - During_{Upstream}) = -20$	Before / During / After Location: Upstream (, 45,); Adjacent (, ,); Downstream (, 25,)
H2A'	Activation Effect Downstream of DSFS, normalized relative to adjacent	$(During_{Downstream} - Before_{Downstream}) - (During_{DSFS} - Before_{DSFS}) = 0$	Before / During / After Location: Upstream (, ,); Adjacent (40, 30,); Downstream (35, 25,)
H2C'	Activation Effect Downstream of DSFS, relative to adjacent	$(During_{Downstream} - During_{DSFS}) = -5$	Before / During / After Location: Upstream (, ,); Adjacent (, 30,); Downstream (, 25,)

Figure 13. Quantitative example: Downstream hypotheses H2.

Finally, consider the third comparison, the speed at the adjacent sensor during activation with the speed at the downstream sensor during activation (H2C′). The desirable outcome is no change in the speed at the downstream sensor, the hope being that the effect of the DSFS will not dissipate with distance from the DSFS. If we control for the differences in speed that might occur simply because of a difference in location, we get the normalized quantity we label as H2A′. These last hypotheses and their corresponding formulas are represented in Figure 13 (H2A′ and H2C′).

Note that we can normalize H2B either with respect to the changes in speed across time at the upstream sensors or the changes in speed across time at the adjacent sensors. The normalized quantity, H2A, for H2B with respect to changes in speed across time at the upstream sensors,

will not necessarily be the same as the normalized quantity, H2A′, for H2B with respect to the changes in speed across time at the adjacent sensors (compare the speed reduction formula in Row 1 of Figure 13 with the speed reduction formula in Row 4 of the same figure). Also note that H2B is the same as H2B′ and therefore it is not listed in Figure 13.

An example can help make clear of the difference between H2 unprimed and H2 primed hypotheses (Figure 13). Note that the results are all negative for the three variations of H2: H2A, H2B and H2C. If the result were negative and significant, the result is consistent with the hypothesis that there is an effect of the activation of the DSFS on the downstream sensor when the comparison point is the upstream sensor. However, look now at the results for H2 primed where the comparison point is adjacent to the DSFS. If we look only at the difference in the speed of the vehicles at the DSFS and the downstream sensor while the DSFS is activated, then we see a reduction of 5 mph (H2C′). If we look only at the difference in speed at the downstream sensors across time we see a reduction in speed of 10 mph (H2B or H2B′). However, consider the normalized versions of H2B′ and H2C′, what we refer to as H2A′. In this example, no change in speed is observed.

Finally, we should note that, as discussed above, the normalization of H2B with respect to the upstream sensors shows a reduction in speed of 4 mph (H2A = -5) whereas the normalization of H2B with respect to the adjacent sensors shows no change in speed (H2A′ = 0). Both answers are correct as normalizations of H2B (a reduction in speed of 5 mph, H2A, or no reduction in speed, H2A′), they just reference different questions or hypotheses.

3.4.3. Hypothesis 3: Deactivation Effect at the DSFS

Just as there are three pairwise comparisons for the downstream sensor, so too there are three pairwise comparisons for evaluating the effect of the deactivation of the DSFS: the speed at the DSFS after its deactivation compared to the speed at the DSFS before its activation; the speed upstream of the DSFS after its deactivation with the speed at the DSFS after its deactivation; and the speed at the DSFS during the activation to the speed at the DSFS after its activation. Note that as with hypothesis 2, for hypothesis 3 the first two pairwise comparisons should be negative if the speed at the DSFS after its deactivation is slower than it was before its activation. Similarly, the third pairwise comparison should show no change if the speed at the DSFS after its deactivation does not increase from what the speed was at the DSFS during its activation. Again, there are different ways of making the computations with the un-normalized (H2B, H2C, H2B′) and normalized (H3A, H3A′) hypotheses (Figure 14).

Hypothesis Code	Hypotheses	Speed Reduction Formula	Required Data
H3A	Deactivation effect at DSFS, normalized relative to upstream	$(After_{DFSF} - Before_{DSFS}) - (After_{Upstream} - Before_{Upstream}) = -10$	Timing: Before / During / After; Location: Upstream (50, , 55), Adjacent (40, , 35), Downstream (, ,)
H3B	Deactivation effect at DSFS, relative to before	$(After_{DSFS} - Before_{DSFS}) = -5$	Before / During / After; Location: Upstream (, ,), Adjacent (40, , 35), Downstream (, ,)
H3C	Deactivation effect at DSFS, relative to after	$(After_{DSFS} - After_{Upstream}) = -20$	Before / During / After; Location: Upstream (, , 55), Adjacent (, , 35), Downstream (, ,)
H3A′	Deactivation effect at DSFS, normalized relative to upstream	$(After_{DSFS} - During_{DSFS}) - (After_{Upstream} - During_{Upstream}) = -5$	Before / During / After; Location: Upstream (, 45, 55), Adjacent (, 30, 35), Downstream (, ,)
H3B'	Deactivation effect at DSFS, relative to during	$(After_{DSFS} - During_{DSFS}) = 5$	Before / During / After; Location: Upstream (, ,), Adjacent (, 30, 35), Downstream (, ,)

Figure 14. Quantitative example: Deactivation hypotheses H3.

3.5. Dependent Variables

Three dependent variables were selected: the mean speed, the 85th percentile speed and the percentage of drivers traveling above the speed limit. The mean speed, 85th percentile speed and percentage of drivers traveling above the speed limit could be evaluated in three separate ways for H1, five ways for H2 and five ways for H3, as described above:

1. Mean speed: H1, H2, H3 – report of difference in the mean speed for each hypothesis (column 3, Figure 12, Figure 13, Figure 14) and the statistical significance of the evaluation of the difference in the mean speeds for each hypothesis
2. 85th percentile speed: H1, H2, H3 – report of difference in the 85th percentile speed for each hypothesis and the statistical significance of the evaluation of the difference in the 85th percentile speeds for each hypothesis; and

3. Percentage of drivers over the speed limit: H1, H2, H3 – report of difference in the percentage of drivers over the speed limit for each hypothesis and the statistical significance of the evaluation of the percentage of drivers over the speed limit for each hypothesis.

The dependent variables described above, all different functions of speed, are the ones most often reported in the studies and most closely tied to crashes (National Center for Statistics and Analysis, 2020). By indicating for each hypothesis and each dependent variable whether there was a significant effect, we are able to provide the information on the number of studies showing a significant effect in the overall vote count analyses above (Section 3.3) and in the vote count analyses for each separate safety focus below (Section 3.6.1). Moreover, in the later report on meta-analyses (Section 4, Volume I) we also incorporate the effect size and sample size into the resulting analyses.

3.6. DSFS Implementation Characteristics

The characteristics that define the particular context in which a DSFS is implemented are important to consider when evaluating DSFS effectiveness. The DSFS implementation characteristics that are reported most commonly across all studies are the safety focus, class of vehicle, and posted speed. These are the DSFS implementation characteristics that are the focus of this literature review and the meta-analysis. In addition, numerous implementation characteristics, such as DSFS display or roadway type, may contribute to the effectiveness of DSFS. These additional characteristics are not commonly reported across all studies, so it is challenging to generalize how they contribute to DSFS effectiveness. These additional characteristics are discussed here, and further details for individual studies are available in the annotated bibliography (Volume II).

3.6.1. Studied Implementation Characteristics

Safety focus: work zone, school zone, transition zone, curve, straight section. The safety focus refers to the element of the traffic system that is the target of safety improvement. There is no standard definition of safety focus. We identified five safety focal points: work zone, school zone, transition zone, curved section, and straight section. An example of a transition zone would be the area between the end of a high-speed rural highway and the beginning of a town center. There are no agreed upon national definitions of some of the safety focal points such as work zones (Turner, 2015).

The reductions in speed that one can expect as a function of the safety focus because of either the geometry (curved versus straight sections) and context (work zone versus school zone) may vary greatly. For example, we have found that the DSFS leads to more dramatic reductions in speed at transition zones than it does in straight sections.

Classes of vehicles: passenger, truck, multiple, unspecified. Four vehicle classes are considered in the literature: passenger, trucks, multiple, or unspecified. In this context, multiple would mean that at some sites there are trucks only, while other sites are passenger vehicles only. There are clear standards for the definition of these different vehicles and within each class there are many subclasses. For example, the Federal Motor Carrier Safety Administration has many different subclasses of trucks (e.g., Class A, Class B and Class C) (Federal Motor Carrier Administration, 2014). We relied on the authors to indicate whether passenger vehicles, trucks, or both were being considered in an evaluation. Some previous authors reported in the literature

that DSFS have a different effect on trucks and passenger vehicles in speed reductions, but no comprehensive review of this has been conducted.

Posted speed: upstream speed (mph), DSFS speed (mph), downstream speed (mph), multiple, unspecified. There is often only one posted speed limit upstream of the DSFS and at the DSFS. Sometimes there is one posted speed limit downstream of the DSFS. However, sometimes there will be several posted speeds upstream or downstream of a DSFS. We chose the posted speed limits closest to the upstream sensor, the DSFS, and the downstream sensor. If there is not an upstream sensor, we chose the posted speed limit that is closest to a location on the road where the DSFS first becomes visible, but is not yet visible. Since it is generally the case that a sign with numbers 1 inch high are visible at 30 feet (Bertucci, 2006), the numerals on a speed limit sign that are 11.7 inches high (Federal Highway Administration, 2012) should be legible at 386 feet. If there is not a downstream sensor, we use the downstream posted speed limit that is closest to the point at which the speed needed to be reduced the most (e.g., for school zone, this would typically be the crosswalk). By multiple posted speeds, we mean a study where there are several sites and the posted speed limits at the various locations with respect to the DSFS vary. The differences in the posted speed limits upstream of the DSFS and at the DSFS appear to have a large effect on the change in speed that a DSFS might generate. This is especially clear in transition zones from a rural highway to a rural local road running through a small town.

3.6.2. Additional Implementation Characteristics

Besides the commonly reported implementation characteristics above, additional characteristics were reported less consistently for some individual studies. Still, the characteristics are relevant for assessing DSFS effectiveness and are described here for future consideration for both analyzing and implementing DSFS. Additional detail on individual studies is available in the annotated bibliography.

DSFS Display. DSFSs at a minimum must display speeds. In addition, some DSFSs are unlit, relying on reflective surfaces only to display the speeds, while others flash the speed or flash an additional graphic. The flashing element could be an additional signal to drivers to call attention to the sign, such as alternately flashing lights. There is reason to believe that the effectiveness of the DSFS may vary with the above descriptions. For example, it is well known that flashing displays attract attention (Christ & Abrams, 2006). That alone could make a study with a flashing DSFS more effective than one without a flashing DSFS.

Level of service: free flow, other, multiple, not specified. The level-of-service (LOS) is noted as free flow, other, or not specified. There are standard definitions for defining different levels of service (Transportation Research Board, 2010). When available, results from free flow data are used, as these most accurately represent the behavior of individual drivers.

The activation effect at the DSFS, as measured by the difference in speeds between the time before it was activated and the time after it was activated, could be due solely to differences in the level of service. Thus, it is important to know the LOS from the standpoint of validating the experimental design. But, more generally, there may be very different reductions one might expect in free flow conditions than one would expect in congested conditions. Specifically, in congested conditions one would expect a DSFS to have little effect.

Roadway type: freeway, arterial, collector, local, multiple, unspecified. The roadway type feature can assume any one of six values: freeway, arterial, collector and local, along with multiple types in some studies and unspecified in still other studies. The FHWA (2012) defines the classification of roadway networks. Sometimes highway is not differentiated from arterial. While no studies have focused on the influence of roadway type on the effectiveness of a DSFS, and this was not a principal focus of this study, roadway types were collected when available to serve future analyses.

Roadway area: urban, suburban, rural, multiple, unspecified. The roadway area feature has five values: urban, suburban, rural, multiple, and unspecified. The FHWA (2013) typically uses just the first three classifications; however, some studies additionally refer to exurbs. Urban areas are typically defined as communities with more than 100,000 people. The population range in the suburbs is anywhere from 10,000 to over a 1,000,000. Exurbs are defined as communities with 1,000 to 20,000 people that are largely inhabited by commuters. Rural areas are settled places outside of towns and cities and usually have fewer than 10,000 people.

Sidewalk: present, absent, unspecified. A number of articles mention whether sidewalks are present where the DSFS is positioned. It is arguably the case the sidewalks should have a speed calming effect on drivers (South Carolina Department of Transportation, 2006). Whether that means that effect will interact with the effect of the DSFS or not remains unknown.

Sensor type: pneumatic, radar, lidar, ANPR, multiple, not specified. There are typically four ways in which speed is measured: pneumatic tubes, radar, lidar, and automatic number plate recognition cameras. The effectiveness of particular sensor types in measuring speed reductions was considered to be of interest in assessing DSFS effectiveness. It is important to note that the reports of the studies typically do not address the reliability or accuracy of the units that are being used to record speed.

Mobile units: yes, no (fixed), multiple, not specified. The DSFS units are almost always mobile, though occasionally they are fixed. With locations that require a continuing DSFS presence (in essence a permanent placement), there may be economic and other considerations about whether to use a mobile DSFS or a fixed DSFS.

Types of treatment: DSFS, DSFS + police, DSFS + other. Some studies include additional enforcement interventions. Since our focus is on DSFS, we review only interventions that include a DSFS, e.g., a DSFS plus a police car presence. If more than one intervention is applied at the same site at the same time or in close succession, this can affect the results and either needs to be captured or be treated as a disqualifying factor for the study.

3.7. Study Design Characteristics

The studies vary greatly in the way they are designed. The details of the design are critical to evaluate, both for assessing why a particular study did or did not show significant results, and for the design of future studies. As with the DSFS implementation characteristics, there is a distinction between study design characteristics that are commonly reported and thus allow generalization across studies, and additional characteristics that are less commonly reported or are not easily generalizable.

3.7.1. Studied Design Characteristics

Sensor Positions. The three main hypotheses and their variations presented in Section 3.4 are distinguished by the timing and location of the speed measurements. Sensor position is therefore critical in assessing the effectiveness of DSFS. There are two descriptors considered in this review, the position and number of the sensors. In addition, a graphic of the sensor, posted speed limit, and DSFS positions is included for each study in the annotated bibliography.

There are often sensors upstream or downstream of the DSFS, just as there are several posted speed limits. Rarely are there several sensors at the DSFS. We record the number of sensors upstream of the DSFS, at the DSFS, and downstream of the DSFS. We consider upstream sensors to be sensors closest to the DSFS at the point at which the speed limit on the DSFS becomes visible, but is still not recognizable using the standard relation between legibility distance and letter size (Bertucci, 2006). We consider downstream sensors to be sensors closest to the point where the speeds need to be reduced the most. The sensor positions can have a critical impact on the effect of the DSFS. For example, if the upstream sensor is close to the DSFS, so close that the DSFS is visible, then the effect of the DSFS may be reduced some.

3.7.2. Additional Design Characteristics

In addition to the sensor position characteristics, additional study design characteristics can have a large influence on the strength of the speed reduction effect of a DSFS. These characteristics, namely the timing of when signs are activated or deactivated and the experimental design, are essentially unique to each study. Therefore, they do not present opportunities for generalizing how they influence DSFS effectiveness. Given the importance of these characteristics, they are described here. Further detail on each feature is available for individual studies in the annotated bibliography.

3.7.2.1. Timing of speed measurement prior, during, and after activation

Two aspects of the timing of speed measurements are important to consider prior to activation of the DSFS:

i. Over how long a period is speed measured before the activation of the DSFS: O_1(interval)?

ii. How long before activation of the DSFS were speed measures taken: T_1(interval)?

For example, if the speed was measured for one week at a point three weeks before the DSFS was activated, we would indicate O_1(1 week), T_1(3 weeks). There can be several experimental designs in a single study. We indicate only the intervals associated with the first experimental design for a particular study (or specify which experimental design is being detailed).

If the DSFS activation hypothesis is measured by the difference in the speeds at the upstream sensor before activation and DSFS sensor during activation, then the long difference in time between the speed measurements upstream and the speed measurements at the DSFS could be a potential confound (e.g., weather might change radically and therefore speeds).

Four features of the timing of speed measurement were considered during DSFS activation:

i. Over how long a period is speed measured: DSFS(*interval*, measurement 1, measurement 2, ….)?

ii. Times after activation of DSFS when speed is measured: DSFS(interval, *measurement 1, measurement 2,* ….)

iii. Time of day when speed measured: a.m./p.m.; and

iv. Peak when speed measured: peak/off peak.

The first value of the first feature (i) is the period of time (*interval*) over which the DSFS is activated. The entries for the values of the second feature (ii) (*measurement 1, measurement 2*) are the points in time during the activation of the DSFS that measurements are recorded. So, for example, the DSFS might be activated for a month and the speeds would be measured at the end of weeks 1, 2, 3 and 4: DSFS(one month, week 1, week 2, week 3, week 4). Measurements would have been taken for just the last day of each week or for the entire week. The DSFS may become less effective as the period of time over which it is installed increases. In addition, the times at which the measurements are taken would appear to be critical (ii).

In addition to the timing of the activation, two features were considered for the timing of measurements following deactivation of a DSFS:

i. How long a time period after the DSFS was deactivated intervened between deactivation of the DSFS and the measurement of vehicle speeds at the DSFS: T2(interval)?

ii. How long after DSFS removal/deactivation were the measurements of speed taken: O2(interval)

The effects of the DSFS, once it is deactivated, may dissipate as the interval between its deactivation and the measurement of speeds after the deactivation is increased.

3.7.2.2. Experimental Design

The experimental design is a complex feature. At least five components are required to specify for a single treatment at a single location the details of the feature. In particular, with just one treatment in a given location, there are three measurement periods: before the DSFS has been activated (before), during the time when the DSFS is activated (during), and after the DSFS is deactivated or removed (after). The experimental design includes:

- the duration of the period O_1(duration) over which measurements are taken of the dependent variable before the DSFS is activated,
- the interval T_1(duration) between the end of the before measurement period and the beginning of the activation of the DSFS,
- the period of time for which the DSFS is activated and when measurements of the dependent variable are taken DSFS(duration, measurement 1, measurement 2,…),
- the interval T_2(duration) between the end of the activation of the DSFS and the first measurement of the dependent variable after the deactivation, and
- the duration of the period O_2(duration) during which measurements are taken after the deactivation.

So, for example, for Cruzado and Donnell (2009), the experimental design is indicated as:

i. O_1(ns) – T_1(ns) -- DSFS(1 week, 1st week) – T_2(0) – O_2(1 week); and

ii. O_1(ns) – T_1(ns) – DSFS(2 weeks, 1st week, 2nd week) – T_2(0) – O_2(1 week, 2 weeks).

There are two treatments in separate locations. The above design indicates that neither the duration of the first measurement period nor the time between the first measurement period and the activation of the DSFS were specified (ns): O_1(ns), T_1(ns). In the first condition, the DSFS was activated for a week and the measurements of speed were taken during this first week DSFS(1 week, 1st week), and then the measurements after deactivation were taken immediately after, T_2(0), for a period of 1 week, O_2(1 week). In the second condition, the DSFS was activated for 2 weeks and measurements of speed were taken during the first week and second week DSFS(2 weeks, 1st week, 2nd week). The measurements were taken after the DSFS was deactivated exactly, T_2(0), one week and two weeks later, O_2(1 week, 2 weeks).

In another example (Walter and Broughton, 2011), there were three conditions in separate locations:

i. O_1(1 week) – T_1(0) – DSFS(1 week, 1st week) –T_2(0) – O_2(1 week, 2 weeks);

ii. O_1(1 week) – T_1(0) – DSFS(2 weeks, continuously) –T_2(0) – O_2(1 week, 2 weeks); and

iii. O_1(1 week) – T_1(0) – DSFS(3 weeks, continuously) –T_2(0) – O_2(1 week, 2 weeks).

At some sites the DSFS was operational for one week, for some two weeks, and for some three weeks. Measurements were taken one week before the DSFS was operational and one and two weeks after the DSFS was deactivated. Measurements were taken continuously while the DSFS was in operation. Thus, as compared with the first design, separate measurements were not reported for the first, second and third weeks of operation of the DSFS.

We include durations whenever possible because, in the studies reviewed, these time spans between measurements and over which measurements are taken can vary greatly (from minutes to years). The many variations of experimental design limit generalization across designs, but are presented in a consistent fashion in the annotated bibliography.

3.8. Vote Count Results Overall

The vote count approach to reviewing the literature summarizes the number of significant results for each hypothesis, generalizing across these aspects of DSFS implementation characteristics and study design characteristics. The evidence from the vote count is consistent with the conclusion that speeds are reduced when a DSFS is activated at the DSFS (H1), are reduced downstream of the DSFS when the DSFS is activated (H2), and are reduced at the DSFS after the DSFS is activated. For example, we found 133 sites where a statistically significant reduction in speed was recorded as a result of activation of the DSFS (H1). Only eight sites showed no change in speed, and only four sites showed a statistically significant increase in speed.

3.8.1. H1: Activation Hypothesis

The vote count for the DSFS activation hypothesis, aggregated across all three variations in this hypothesis (see Section 3.4), is presented in Figure 15 separately for the mean speed, the 85th percentile speed, and the percentage of drivers over the speed limit. Out of 145 evaluations of the decrease in speed at the DSFS, 133 showed a significant decrease, eight showed no change, and

four showed an actual increase. The overwhelming majority of studies, 92 percent, were consistent with the hypothesis that the speed would decrease at the DSFS. Although there were fewer analyses of changes in the 85th percentile speed and changes in the percentage of drivers traveling over the speed limit, in both cases the number of studies consistent with the hypothesis that there would be a reduction in the 85th percentile speed and the percentage of drivers traveling over the speed limit was clearly much larger than the alternative hypothesis. With respect to reductions in the 85th percentile speed, 116 of the 121 analyses showed a significant reduction (95.9%). With respect to reductions in the percentage of drivers traveling over the speed limit, 61 of the 65 statistical analyses showed a significant reduction in this percentage (93.8%).

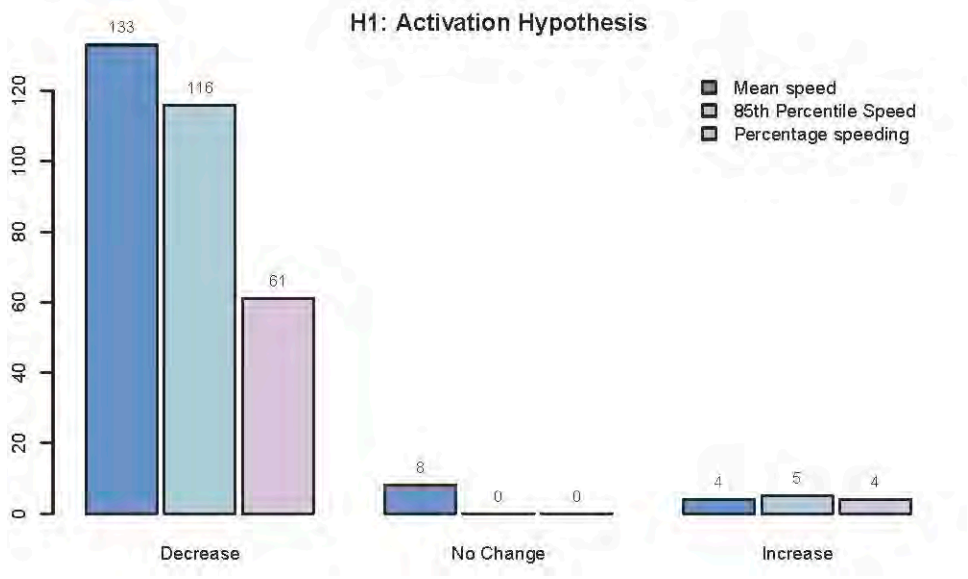

Figure 15. H1: Activation hypothesis

3.8.2. H2: Downstream Activation Hypothesis

The change in speed downstream of the DSFS while the DSFS is activated can be measured with respect to the speed upstream of the DSFS or the speed at the DSFS. The vote count for the downstream activation hypothesis (H2) is based on the upstream speed as the reference (H2A, H2B and H2C; see Section 3.4.2) and is presented in Figure 16. Over two-thirds (68.2%) of the studies are consistent with the hypothesis that there would be a reduction in the mean speed downstream of the DSFS during the activation of the DSFS (H2). Compared to changes in speed adjacent to the DSFS (H1), this represents a smaller percentage of studies. However, the percentage of studies consistent with the hypothesis that there would be a reduction in the 85th percentile speed at the downstream location when the DSFS was activated (92.1%) and that there would be a reduction in the percentage of drivers traveling over the speed limit (88.3%) both remained high.

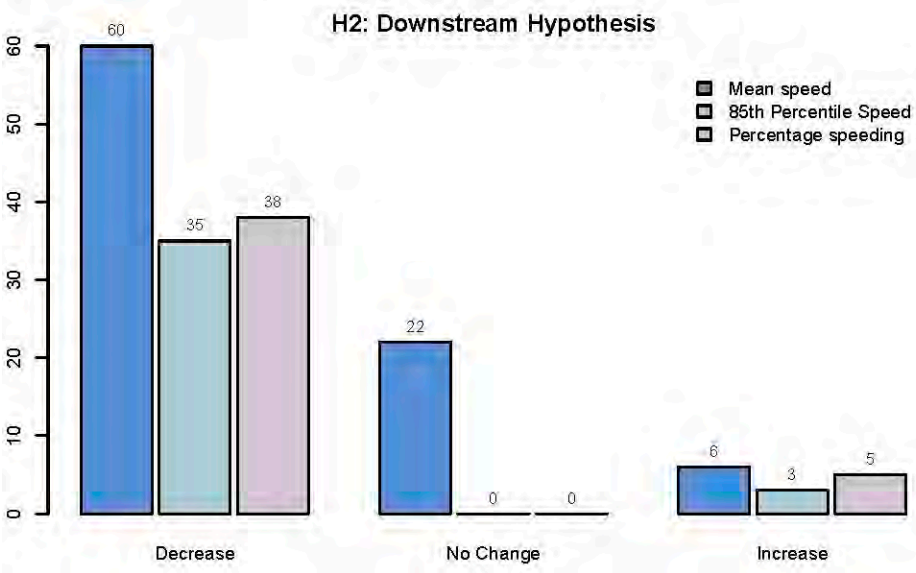

Figure 16. H2: Downstream activation hypothesis

3.8.3. H3: Deactivation Hypothesis

There were many fewer studies that reported information relevant to the deactivation hypothesis. The change in speed at the DSFS after deactivation can be measured relative to the DSFS sensor before activation or relative to the DSFS during activation. For the studies that measured the speed at the DSFS after deactivation relative to the speed at the DSFS sensor before activation (H3A, H3B, H3C; see Section 3.4.3), all three showed significant decreases in speed. A decrease would be expected if there was a continuing effect of the activation of the DSFS on the speed of the drivers, even following the removal of the sign.

3.8.4. Limitations

The reader should be aware that there are clear limitations to using a vote count to determining the relative support for or against a particular hypothesis (Koricheva & Gurevitch, 2016). Among other things, the vote count does not weight the studies by the number of observations, measure the size of the effect, or show the variability around that effect size. This information is contained below in the meta-analysis.

3.9. Vote Count Results by Safety Focus

Above, we have presented a vote count overall (Section 3.8), which provides a summary of the effect of DSFSs on speed. While the vast majority of the studies were consistent with the DSFS having a positive effect on safety, some studies indicated there was no effect or, in some cases, a negative effect. It may be that DSFS work best for one set of safety focal points, but not others. Additionally, by identifying the reason that in some cases the DSFS does not produce the desired results, common explanations of why a given implementation did not work other than the safety focus may arise.

This section begins with a discussion of the vote count by each safety focus with respect to the effect of the DSFS on a reduction in the mean speed, the 85th percentile speed at the DSFS, and the percentage of drivers over the speed limit for hypotheses H1, H2 and H3. An example of the

installation is provided for each category (e.g., an actual example of a work zone for the work zone safety focus). Details on individual installations are described in the annotated bibliography. Finally, within a safety focus is a discussion of any studies that are not consistent with the primary hypothesis, H1, showing no effect of the DSFS on the mean speed at the DSFS. The mean speed at the DSFS is used to understand unexpected results, as many more studies analyzed the change in the mean speed at the DSFS after it was activated (H1) than analyzed either the change in the mean speed downstream of the DSFS (H2) or the change in speed at the DSFS after it was deactivated (H3).

Overall, the safety focus most commonly studied was work zones. For all of the speed measures examined and all hypotheses tested, DSFS reduced driver speed significantly in the overwhelming majority of cases. School zones were the next most commonly studied, followed by transition zones, curved sections, and straight sections of a roadway. A summary of all the results is presented in Table 3 and analysis of each of the safety focal points follows.

Table 3. Count of significant results for reductions in driver speed for the three hypotheses (H1: Activation effect, H2: Downstream activation effect, H3: Deactivation effect) by speed measure, across the five safety focal points.

Safety Focus	Hypothesis	Measures	Decrease	No Decrease	Proportion
Work Zone	H1	Mean Speed	45	7	0.87
		85th Percentile	30	5	0.86
		% Over Speed Limit	37	4	0.90
	H2	Mean Speed	45	19	0.70
		85th Percentile	29	2	0.94
		% Over Speed Limit	32	5	0.86
	H3	Mean Speed	3	0	1.00
		85th Percentile	3	0	1.00
		% Over Speed Limit	3	0	1.00
School Zone	H1	Mean Speed	24	4	0.86
		85th Percentile	17	0	1.00
		% Over Speed Limit	16	0	1.00
	H2	Mean Speed	1	3	0.25
		85th Percentile	1	0	1.00
		% Over Speed Limit	0	0	-
	H3	Mean Speed	0	0	-
		85th Percentile	0	0	-
		% Over Speed Limit	0	0	-
Transition Zone	H1	Mean Speed	29	0	1.00
		85th Percentile	11	0	1.00
		% Over Speed Limit	3	0	1.00
	H2	Mean Speed	1	1	0.50
		85th Percentile	0	1	0.00
		% Over Speed Limit	1	0	1.00
	H3	Mean Speed	0	0	-
		85th Percentile	0	0	-
		% Over Speed Limit	0	0	-

Safety Focus	Hypothesis	Measures	Decrease	No Decrease	Proportion
Curved Section	H1	Mean Speed	29	0	1.00
		85th Percentile	27	0	1.00
		% Over Speed Limit	3	0	1.00
	H2	Mean Speed	10	5	0.67
		85th Percentile	3	0	1.00
		% Over Speed Limit	3	0	1.00
	H3	Mean Speed	0	0	-
		85th Percentile	0	0	-
		% Over Speed Limit	0	0	-
Straight Zone	H1	Mean Speed	3	1	0.75
		85th Percentile	31	0	1.00
		% Over Speed Limit	0	0	-
	H2	Mean Speed	0	0	-
		85th Percentile	0	0	-
		% Over Speed Limit	0	0	-
	H3	Mean Speed	0	0	-
		85th Percentile	0	0	-
		% Over Speed Limit	0	0	-

3.9.1. Work Zone

The following articles focused in part or in whole on work zones (see reference section).

1. Bowie, 2003
2. Brewer et al., 2006
3. Fontaine & Carlson, 2001
4. Fontaine, 2008
5. Gambatese & Jafarnejad, 2015
6. Gambatese & Zhang, 2014
7. Hajbabie et al., 2011
8. Mattox et al, 2007
9. McCoy & Pesti, 2001
10. McCoy et al., 1995
11. Medina et al., 2009
12. Meyer, 2000
13. Pesti & McCoy, 2011
14. Reddy et al., 2008
15. Roberts & Smaglik, 2012

16. Sarasua et al., 2006

17. Teng et al., 2009

The particular hypotheses and significant findings for each study are reported in Table A1 in Appendix A in Volume II.

3.9.1.1. Vote-count

Seventeen articles were reviewed that focused on the effect of the DSFS in work zones. With respect to the changes in the mean speed at the DSFS, 52 analyses were undertaken of changes in the mean speed at the DSFS (H1). Of the 52 analyses, 45 were consistent with a reduction in the mean speed at the DSFS (86.5%). Seven of the analyses indicated no change in the mean speed. These 7 analyses were spread over 3 studies (Gambatese & Zhang, 2014; Fontaine, 2008; Sarasua, Ogle, & Chowdhury, 2006) (Figure 17). The relative number of studies favoring H2 (85.7%) and H3 (90.2%) were roughly consistent with those favoring H1.

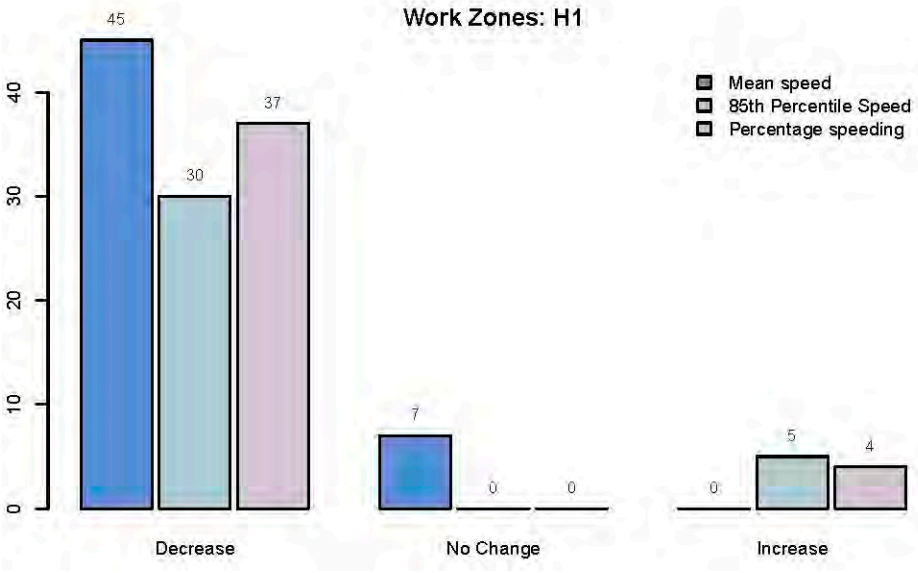

Figure 17. Work Zones: H1 Activation Hypothesis

With respect to changes in the mean speed at the downstream sensor, while the DSFS was activated, a total of 64 analyses were reported (H2). Of these, 45 were consistent with decreases in the mean speed at the downstream sensor (70.3%), 13 with no change in the mean speed (20.3%), and 6 with an actual increase in the mean speed (9.4%). Similar changes are noted in the 85th percentile speed and the percentage of drivers traveling over the speed limit (Figure 18).

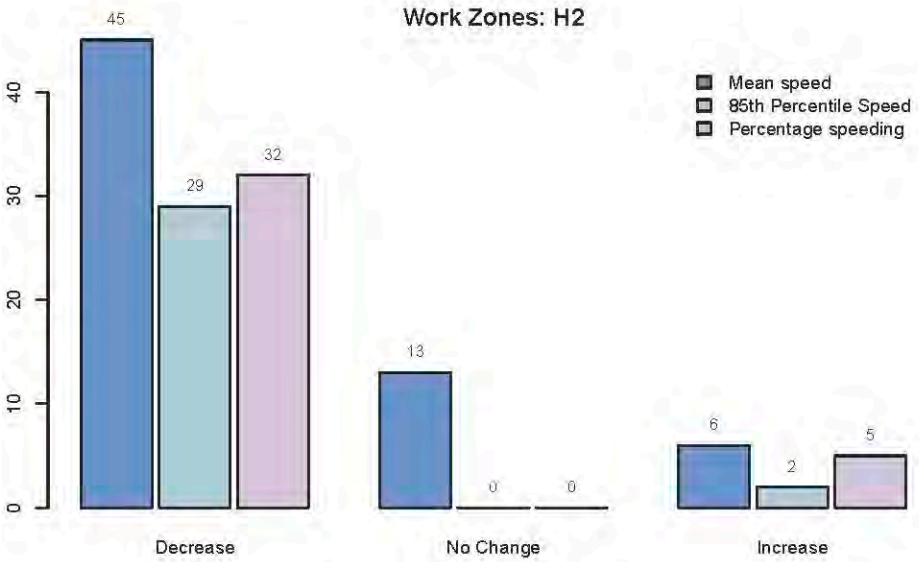

Figure 18. Work Zones: H2 Downstream Activation Hypothesis

Finally, with respect to changes in the mean speed at the DSFS after the DSFS is deactivated, there were very few such analyses, in fact only three such analyses (H3). All showed a halo effect (a continued reduction in the mean speed at the DSFS after deactivation below what it was before activation). The halo effect existed as well for the 85th percentile speed and the percentage of drivers traveling over the speed limit (Figure 19).

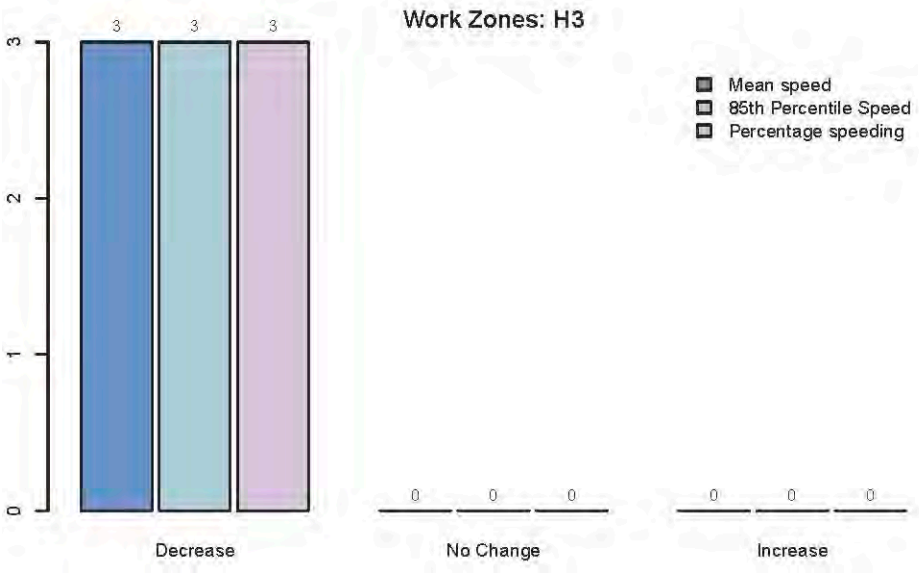

Figure 19. Work Zones: H3 Deactivation Hypothesis

3.9.1.2. Implementation Characteristics

Effectiveness measurements of DSFS in work zones can be influenced by how the DSFS is implemented. An example of an implementation of a mobile DSFS in a work zone is displayed in Figure 20 (Gambatese & Jafarnejad, 2015). The mobile unit was mounted on a truck. A number of different maintenance operations were being undertaken at the time the mobile unit was present including: (a) inspecting light poles with a stop at each light pole and a lane closure and (b) cleaning the drains along the right shoulder of the roadway, also with stops but without a complete lane closure. Within the maintenance work zone, the truck equipped with the DSFS moved at a slow speed (usually 5 to 10 mph) behind the maintenance equipment conducting the work to provide a warning to approaching vehicles about the work zone and to advise drivers of decreases in speed (Shadow Vehicle 2 in Figure 20). Importantly, there was a vehicle upstream of the vehicle with the DSFS that provided warning information (either a four-dot pattern or an arrow when encroaching a lane with a narrow shoulder; Shadow Vehicle 1 in Figure 20). Additionally, a work vehicle that was still further upstream itself had the capability of displaying the same information as the Shadow Vehicle 1. These additional vehicles are unlikely to influence the effect of the activation of the DSFS at the DSFS (H1) or the deactivation of the DSFS at the DSFS (H3). But there is reason to believe that the presence of the information on Shadow Vehicle 1 and the work vehicle may have influenced the speed of drivers downstream of the DSFS when the DSFS was activated.

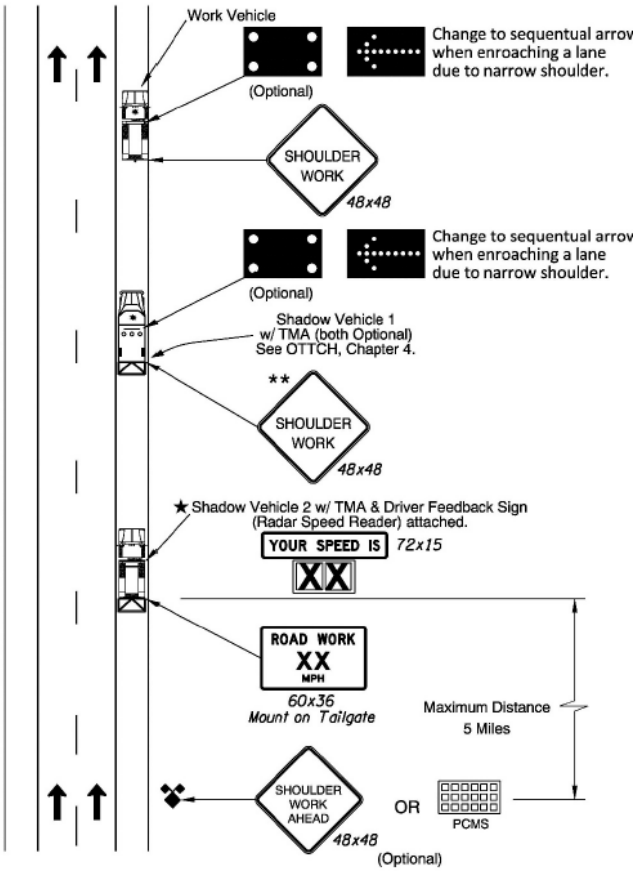

Figure 20. Example work zone implementation of DSFS. (Gambatese & Jafarnejad, 2015)

3.9.1.3. Exceptions

Three studies reported no change in speeds in some work zones at the DSFS (H1). First, in one study there was no statistically significant effect of the DSFS on the mean speed at each of the two work zone sites analyzed in the study (Gambatese & Zhang, 2014). In this study, the DSFS was evaluated by itself only on Day 3 of the first case study (on other days, the DSFS was evaluated in combination with a portable changeable message sign, PCMS, which displayed messages such as, "slow for workers," "workers in roadway," and "narrow lane"). There were two travel lanes in one direction on a section of highway that was being paved. The two lanes tapered to one lane where the paving began somewhere downstream. On Day 3 of the first case study, the contractor paved the roadway shoulder and fully closed the slow lane, moving the passing traffic farther away from the actual work taking place. One might expect that the vehicle speeds would be greater in this case than if the work were directly adjacent to the travel lane. That is, when a closed, buffer lane is provided, vehicle speeds tend to increase.

In a second study, the results were mixed (Fontaine, 2008). There were two sites. The speeds of trucks and cars were measured separately. Thus, there are four measurements of speed over the two sites. Broken out by vehicle class, significant reductions in speed were observed at only one of two sites for trucks. No significant reductions in speed were observed for cars. However, importantly, at all five sensors, the speeds were lower for all vehicles when the DSFS was present. At the location with a reverse curve, the reduction in speed for cars and trucks at the curve when the DSFS was present compared to when standard work zone signage was present was large, respectively -9 and -7 mph. At the location with an activity area, the reduction in speed was smaller for cars than it was for trucks, but still in evidence (respectively -1.4 and -9.8 mph). The authors themselves suggest that it may be the location of the DSFS that is critical. Also, a factor here is that the observations were collected for only one day, thus making a small effect size difficult to detect.

In the third study, only two of the 17 sites that were analyzed showed no reduction in speed (Sarasua et al., 2006). These occurred in maintenance sites where the driver's speed was displayed along with a changeable message sign that told the driver to stay alert if the driver was traveling at or below the speed limit and displayed one of two signs depending on whether a police officer was posted downstream of the sign: "Watch Speed" – no officer – or "Fines Ahead" – officer present. The authors themselves present a convincing case for why speeds were not reduced significantly in the maintenance sites: "A primary reason for this is the inability of the vehicles to speed in the maintenance sites studied due to lane closures, shifting of traffic, and the maintenance activity. The speed reduction range… was from 0.20 to 3.7 mph. In many cases, the actual speeds of vehicles traveling through the maintenance work zone were not high enough to trigger the warning message and thus the vehicles tend to travel at their original speed."

In summary, the seven exceptions to the finding of decreases in the mean speed at the DSFS when it was activated are all arguably reasonable ones. A buffer lane may well serve to decrease the effect of a DSFS (Gambatese & Zhang, 2014). Small sample sizes could easily reduce the power of the statistical test (Fontaine, 2008). And when there is very little ability to speed in a maintenance site as a function of the road geometry, a DSFS would not be expected to slow down the vehicles by much if anything (Sarasua, Ogle, & Chowdhury, 2006). Moreover, it is worth noting that in all seven exceptions there was a non-statistically significant decrease in speed.

3.9.2. School Zone

The following articles focused in part or in whole on school zones (see reference section)

1. Jeihani et al., 2012
2. Lee et al., 2005
3. O'Brien & Simpson, 2012
4. Saito & Ash, 2005
5. Ullman & Rose, 2005

The particular hypotheses and significant findings for each of the studies on school zones are in Table A2 of Appendix A in Volume II.

3.9.2.1. Vote-count

Five publications were reviewed focusing on school zones. With respect to the mean speed at the DSFS, a significant decrease in speed was recorded at 12 sites and increases in speed at three sites (Saito & Ash, 2005) (H1). Importantly, the measures that captured the drivers who were traveling the fastest, the 85th percentile measures and the percentage of drivers of drivers over the speed limit measures, showed significant decreases in speed, as well, except for one site that showed no change in the mean speed (Ullman & Rose, 2005).

Figure 21. School Zone: H1 Activation Hypothesis

Two studies looked at the change in speed downstream of the DSFS after it was activated (H2). One showed a decrease at the one site analyzed (Lee et al., 2005). The other showed increases at the three sites analyzed (Jeihani et al., 2012). Lee et al. also reported a decrease in the 85th percentile speed .

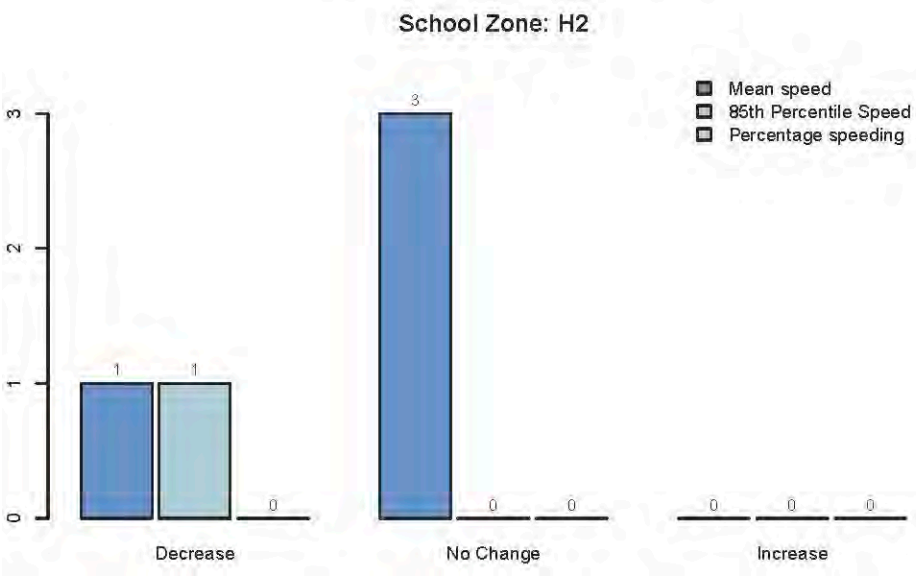

Figure 22. School Zone: H2 Downstream Activation Hypothesis

There were no articles that examined the deactivation effect (H3) in school zones.

3.9.2.2. Implementation Characteristics

An illustrative DSFS in a school zone is displayed below in Figure 23 (Saito & Ash, 2005). The signs were activated only during the time the school was in session. Small LED lights in the numbers would flash if drivers were traveling above the speed limit (25 mph).

Figure 23. DSFS in school zone (Saito & Ash, 2005).

3.9.2.3. Exceptions

In the one study that showed increases in speed at the DSFS in three of the eight locations, clear reasons for the possible increase were given for two of the locations (Saito & Ash, 2005). At one of the locations, drivers were already traveling on average below the speed limit. The introduction of the DSFS increased the speed significantly, but only very slightly. Still, this is an unintended consequence that should be considered before installing a DSFS. At the second of the two locations, the DSFS operated only intermittently because it was solar powered. There is no obvious explanation for why there was an increase in the speed at the third of the three sites. An examination of the characteristics of the DSFS show small dots flashed if the driver was traveling 5 mph over the speed limit. However, the speed itself did not flash. Such dots may not

be effective as an indication that the driver is above the speed limit. Across the four measurement periods during the day, the increase was 1.2 mph.

3.9.3. Transition Zone

The following articles focused in part or in whole on transition zones.

1. Cruzado & Donnell, 2009
2. Hallmark, et al., 2007
3. Hallmark & Hawkins, 2015
4. Hallmark et al., 2013
5. Kamyab et al., 2002
6. Schoenecker et al., n.d.
7. Ullman & Rose, 2005
8. Williamson & Fries, 2015

The particular hypotheses and significant findings for each of the studies on school zones are in Table A2 in Appendix A in Volume II.

3.9.3.1. Vote Count

Of the 29 sites where the change in the mean speed was measured at the DSFS in transition zones, all reported a significant reduction in speed. The 11 analyses of the 85th percentile speed at the DSFS reported a significant reduction. All three analyses of the percentage of travelers over the speed limit reported a significant reduction.

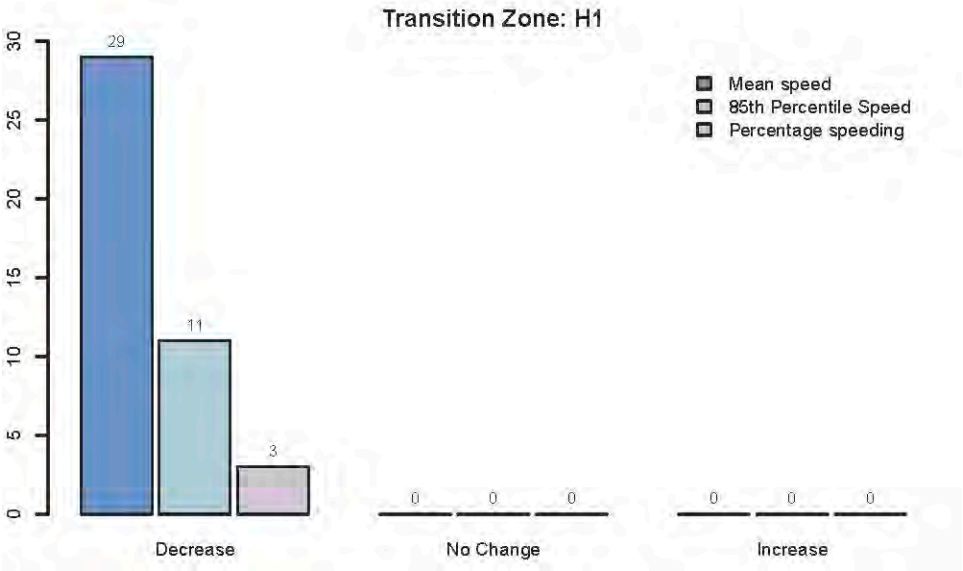

Figure 24. Transition Zone: H1 activation hypothesis

There were too few studies of the effect of the DSFS on the reduction in speed downstream of the DSFS to draw general conclusions regarding transition zones. With respect to the mean speed, the studies were split, one indicating a reduction (Williamson & Fries, 2015), one no change . With respect to the 85th percentile speed, the one analysis available found significant increase in the speed downstream of the DSFS. Finally, with respect to the percentage of travelers over the speed limit, the one analysis reported a reduction (Kamyab et al, 2002).

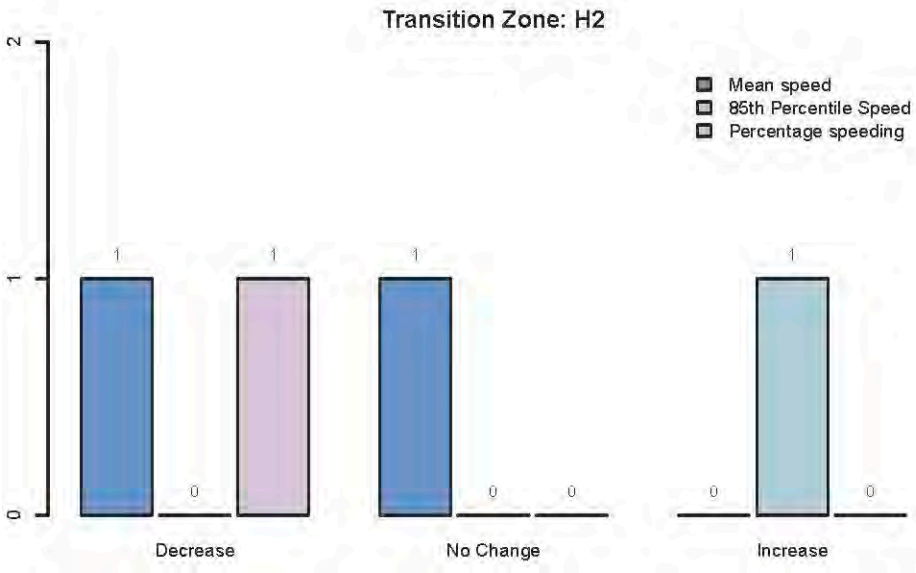

Figure 25. Transition Zone: H2 Downstream Activation hypothesis

There were no analyses of the deactivation effect (H3) in transition zones.

3.9.3.2. Implementation Characteristics

An example implementation of DSFS in a transition zone is given below in Figure 26. In this study, dynamic feedback speed signs were installed at 12 sites in rural Pennsylvania (Cruzado & Donnell, 2009). The sites included both curved and straight sections of roadway where a transition was being made from a two-lane highway to a rural community. The posted speed limits of the highway upstream of the transition zone were 45 mph to 55 mph. The posted speed limits in the transition zone were 25 mph to 35 mph. Figure 26 shows the distance of the speed limit signs to the DSFS (labeled DSDS in the figure) and the location of the sensors and their distance from the DSFS. Often this information needed to be determined from a description written purely in text that could be difficult to piece together.

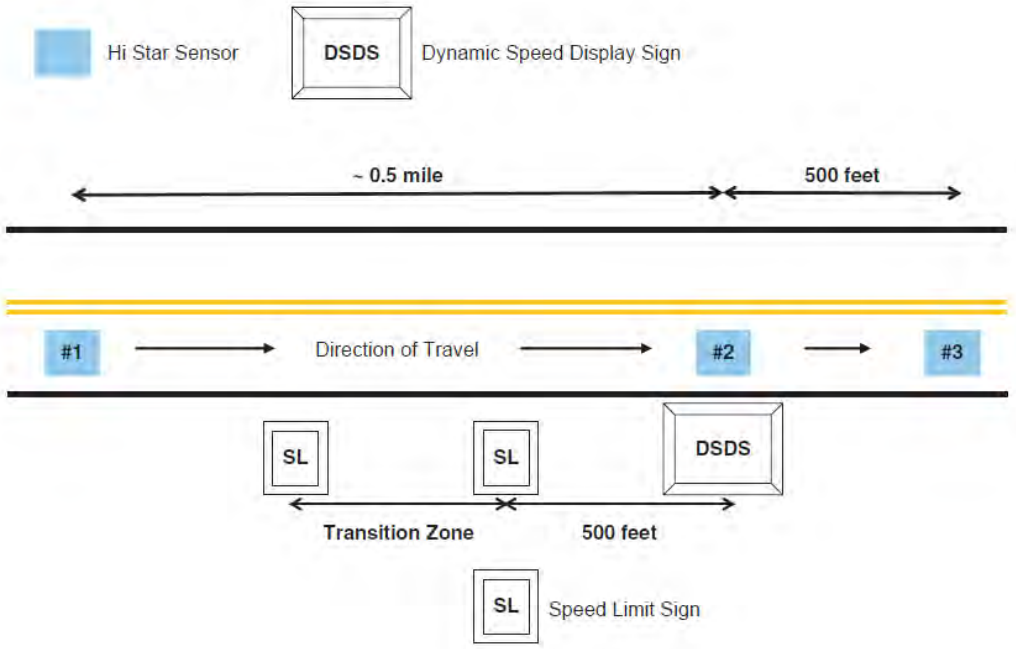

Figure 26. Data collection site setup. (SL = speed limit sign). (Cruzado & Donnell, 2009)

3.9.3.3. Exceptions

All analyses that reported a change in the mean speed at the DSFS when the DSFS was activated indicated a significant reduction.

3.9.4. Curved Section

The following articles focused in part or in whole on curved sections of roadways (see reference section).

1. Bertini et al., 2006)
2. Bullough et al., 2012
3. Drakopoulos & Uprety, 2003
4. Hallmark et al., 2015
5. Knapp & Robinson, 2012
6. Tribbett et al., 2000
7. Ullman & Rose, 2005
8. Western Transportation Institute, 2003

The particular hypotheses and significant findings for each of the studies on curved sections are in Table A4, Appendix A of Volume II.

Vote count. Thirty-four analyses were undertaken of the change in the mean speed at the DSFS after the DSFS was activated on curved sections of roadways. Of these, there was a significant reduction in the mean speed in 29 analyses, and similarly 27 sites showed decreases in the 85th

percentile speed. There were many fewer analyses of the change in the percentage of drivers exceeding the speed limit. All three the analyses indicated a reduction in this percentage.

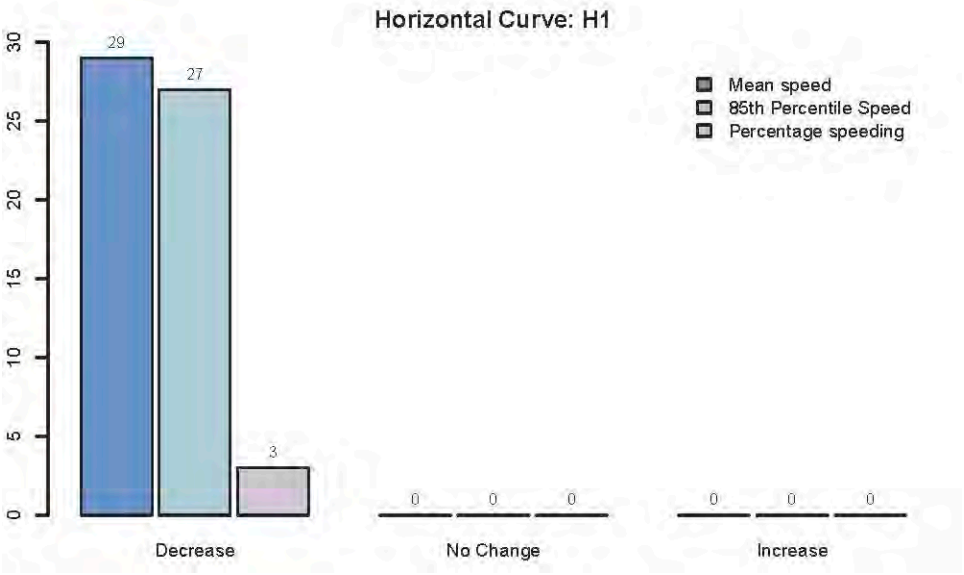

Figure 27. Horizontal Curve: H1 Activation hypothesis

Relatively speaking, there was less support for a decrease in speed downstream of the DSFS after it was activated, 10 analyses showing decreases and five showing no change (Tribbett, McGowen, & Mounce, 2000). The three analyses of the 85th percentile speed and the percentage of drivers traveling over the speed limit showed decreases.

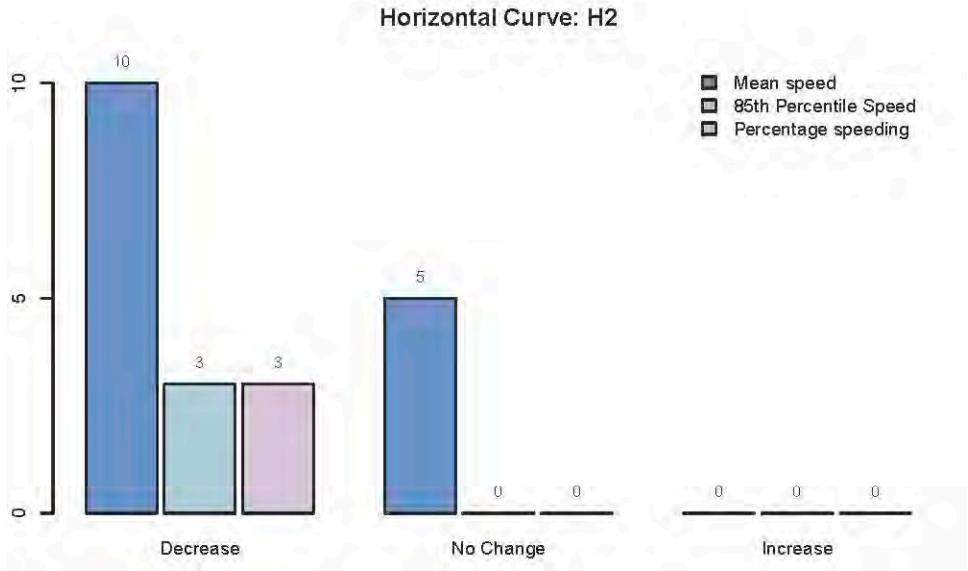

Figure 28. Horizontal Curves: H2 Downstream Activation hypothesis

There were no analyses of the effect of deactivating the DSFS on the speed at the DSFS (H3).

3.9.4.1. Implementation Characteristics

A typical implementation of a DSFS at a curved section is presented below in Figure 29 (Bertini et al., 2006). The DSFS was a two-phase changeable message sign (CMS). The default message for vehicles whose speed was less than 50 mph in the first and second phases was, respectively, "Caution" and "Sharp Curves Ahead." The warning message for vehicles traveling 50 mph to 70 mph in the first and second phases was "Slow Down" and "Your Speed is XX mph." Finally, the excessive speed message for vehicles traveling over 70 mph in the first and second phases was "Slow Down" and "Your Speed is Over 70 mph."

Figure 29. Curved section DSFS. (Before on left; after on right). (Bertini et al., 2006)

3.9.4.2. Exceptions

All sites showed reductions in mean speeds at the DSFS on curved sections. The study of Ullman & Rose (2005) found no change in the mean speed for trucks, but not across all vehicle types. As trucks were already traveling very near the posted speed, 30 mph. At one location they were traveling exactly at that speed before the DSFS was activated. In the other location they were traveling 31.5 mph.

3.9.5. Straight Section

The following articles focused in part or in whole on straight sections of roadway (see reference section).

1. Bloch & Automobile Club of Southern California, 2007
2. Chang et al., 2004
3. City of Englewood, CO, 2014

The particular hypotheses and significant findings for each of the studies on straight sections are in Table A5 of Appendix A in Volume II.

3.9.5.1. Vote count

There were only 3 studies reporting information on straight (tangent) sections, largely in residential neighborhoods. One publication did not report any statistical analyses (City of Englewood, CO, 2014). With regard to the effect on speed at the DSFS (H1), one publication reported both decreases in the mean speed at three sites and increases at one site (Chang, Nolan,

& Nihan, 2004). The third publication (Bloch & Automobile Club of Southern California, 2007) reported statistically significant reductions in 85th percentile speeds along straight sections for all 31 sites examined.

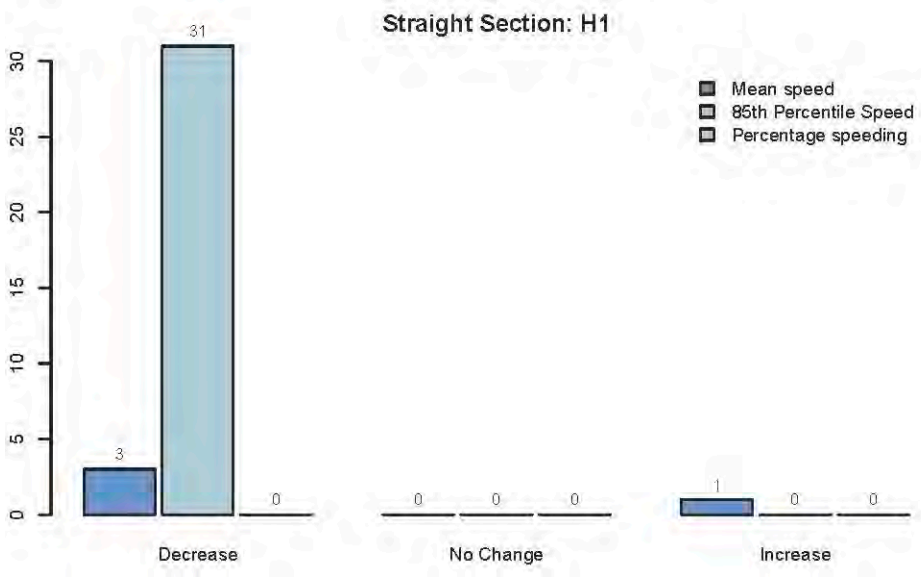

Figure 30. Straight Section: H1 Activation hypothesis

With regard to the effect of the activation of the DSFS on speed downstream of the DSFS (H2) or the halo effect of deactivation of the DSFS, no statistically significant results were reported.

3.9.5.2. Implementation Characteristics

A typical layout for a DSFS on a residential street is displayed below in Figure 31 (Chang et al., 2004). The DSFS is located directly below the speed limit sign.

Figure 31. Chang, Nolan, and Nihan (2004)

3.9.5.3. Exceptions

No studies indicated failure to produce a decrease in speed at the DSFS when it was activated (H1). Given that, we went on to look at possible exceptions to H2. One study found an increase in the speed downstream of the DSFS after it was activated (Chang et al., 2004). Again, we asked why this might have occurred. The authors speculate that it is the fact that this location already had lower speeds: "Because of this sign's close proximity to Helen Keller Elementary School, this location had the lowest average speed of the four locations before installation. It can be speculated that drivers were already respecting the rules of the road, and this suggests that these signs may be better suited for locations with higher average speeds from the outset." However, another explanation is possible. It appears that there is an outlier in the before data in the month of April. The speeds in the 3 months prior to the activation of the DSFS were 21.9 (April 2001), 27.6 (February 2002), and 27.0 mph (June 2002). The speeds in the 4 months during activation were 26.3 (June 2002), 25.9 (August 2002), 26.2 (January 2003), and 25.4 mph (April 2004). The authors did not explore the reason for this possible outlier.

3.10. Discussion

Strong support for the effectiveness of DSFS was found when a vote count is used as the basis for support. Signs reduce the mean speed, the 85th percentile speed and the percentage of drivers traveling above the speed limit at the DSFS (H1, Figure 15), and downstream of the DSFS in large numbers (H2, Figure 16). There are indications of a significant halo effect after the DSFS is deactivated, although the sample size is limited to 3 studies (H3).

The support for the downstream hypothesis is substantial, although less overwhelming than support for the activation hypothesis. Fully 92 percent of the analyses show a significant reduction in speed at the DSFS whereas 68 percent of the analyses show a significant reduction in speed downstream of the DSFS. Importantly, this support is equally strong both adjacent to and downstream of the DSFS for reductions in the 85th percentile speed and reductions in the percentage of drivers traveling over the speed limit (Table 3).

3.10.1. Safety Focus

We identified five primary safety focal points: work zones, school zones, transition zones, curved sections and straight sections. There was a clear variation in the effectiveness of the DSFS on the reduction in speed at the DSFS (H1), with the smallest proportion of studies showing an effect (80%) in school zones and the most in transition zones (100%, Table 3).

The finding that only 80 percent of studies showed significant effects in school zones results partly from the sample size of studies, and particular design features of the studies showing no significant effect. Fifteen studies looked at the effect of the DSFS at school zones, of which 3 reported negative results, all from the same publication (Saito & Ash, 2005). However, 2 of these negative results were easily explained. In one case, vehicles were already traveling at the posted speed limit. In the other case, the signs were not functioning consistently across days given that they were solar powered. In the third case, the speed did not flash if drivers were traveling above the posted speed limit. Instead lights flashed above either side of the posted speed limit. Regardless, as was noted above, the change in speed, although not reduced with the DSFS in, was minimal.

More generally, three factors appeared to reduce the effect of the DSFS on the speed of vehicles. First, it would appear that a DSFS will be less effective at reducing the speeds of trucks than of automobiles. However, this is because the trucks are already traveling at the posted speed limits, thus there is little reason to reduce speed (Ullman & Rose, 2005). Second, it was noticed that a DSFS was less effective if the geometry of the roadway moved the potential for conflict further away from the drivers. So, for example, in one case, a work zone, the travel lane was separated from the workers by a buffer lane (Gambatese & Zhang, 2014). Drivers may well have felt that there was a safe margin separating them from the workers and therefore believed that there was less of a need to reduce their speed. Finally, if drivers of whatever vehicle, not just trucks, were already traveling at the posted speed limits, the DSFS was not likely to reduce the speed of the drivers (Saito & Ash, 2005). In fact, it could increase it, though still keeping it within the posted speed limits.

3.10.2. Limitations

The primary limitation of this review is that many studies did not control for the fact that the observations were taken at different locations or at different times, and thus did not clearly state if they were testing activation, downstream, or deactivation hypotheses. Observations taken at the same location at different times might simply reflect changes across time, not changes introduced by the DSFS. Observations taken at the same time, but across different locations, might simply reflect changes in location, not changes introduced by the DSFS. Thus, many of the studies have results that may be affected by changes in time or location. In this literature review, we point out that there are 13 ways to answer the seemingly straightforward question, does a DSFS have an effect on speed. However, we find that the analyses that control for both confounding factors, report effect sizes that are similar (though not identical) to analyses that do not control for space or time. We hope that in the future, researchers can refer to this report to identify the precise hypotheses they are hoping to test and, ideally, take measures that allow a normalized hypothesis to be evaluated.

The second limitation of this study is that we could not provide an analysis of the effect of the details of the implementation that are most critical to producing the largest reductions in speed. This is primarily a consequence of the studies not reporting what a priori seem critical details, say, how far an upstream posted speed limit is from the DSFS. Without this information, it is not possible to recommend whether the DSFS should be placed, say 600 feet from the last posted speed limit, or say half a mile from the last posted speed limit. If researchers referred to a standard list of study design elements, both those that discussed the details of the DSFS implementation and those that discussed the details of the experimental design, not only would this improve the understanding of the characteristics that influence the effectiveness of a DSFS in a particular study, but it would allow for a meta-analysis aggregating results across studies in order to arrive at a much more general statement as to the effectiveness of the DSFS.

Ultimately, what is most encouraging is that, despite the large variation in so many of the critical details that define each study, the results overall, as measured by a vote count (this section), clearly support the use of DSFS to reduce traffic speeds. The meta-analysis (Section 4, below) informs which of these various details are the most likely to impact the various functions of speed for each of the three different ways of evaluating the effect of a dynamic speed feedback sign.

4. Meta-Analysis

4.1. Meta-Analysis Summary

Each publication from the literature review that measured the effectiveness of DSFS was assessed for availability of the underlying data on vehicle speeds. These data were compiled, along with accompanying data on the location and timing of the speed measurements, vehicle type, safety focus, and any other relevant data. The compiled database was then used to carry out a statistical analysis across all the published studies, a meta-analysis, to estimate the size of the speed reduction effects.

For each of the three major hypotheses, the activation hypothesis, downstream hypothesis, and deactivation hypothesis, reductions in speed were observed when the speeds at the DSFS and downstream of the DSFS were compared with the speeds upstream of the DSFS before activation (H1C, H2C, H3C, Table 5). Although the reductions in speed were observed, these reductions were statistically significant only for the activation hypothesis (Table 8).

For the three variations of the activation hypothesis (Volume I, Section 1.7) the size of the estimated reduction ranged from 2 to 4 mph depending on the actual hypothesis being evaluated (Table 6, Table 7, Table 8), with the largest estimated reduction obtained when the speeds of passenger cars at the DSFS before and during activation were observed (4.14 mph reduction, Figure 3, Table 7). All such reductions were statistically significant.

Safety focal points, surprisingly, did not show consistent differences in the size of the estimated speed reduction. There were only enough observations to compare the different estimates of the size of the estimated speed reduction across safety focal points for studies that evaluated the activation hypothesis using normalized estimates. The smallest speed reduction within a safety focus was for horizontal curves (2.27 mph) and the largest for school zones (3.21 mph, Table 6).

The speed differences in response to DSFS for passenger cars and trucks showed a consistent trend, with trucks less responsive to DSFS than passenger cars. Passenger cars slowed down by approximately 4 mph at the DSFS when it was active, with effects persisting downstream and to some extent even after signs were removed. Trucks exhibited smaller speed reductions in response to DSFS installations. As trucks are traveling more slowly than passenger cars on average, DSFS have smaller effects on their vehicle speed.

Overall, these results indicate that DSFS installations were consistently effective in reducing driver speeds at the DSFS. Speeds also decreased downstream of DSFS installations when measured with respect to the upstream speeds. Following removal of the DSFS, the few studies available indicated that vehicle speeds at the former site of the DSFS remained lower than the speeds were prior to the installation, giving evidence for a “halo effect.” As noted earlier, reductions in speed of even a few miles per hour can be of large practical significance when it comes to reducing the frequency of severe injuries and fatalities (Kloeden et al., 1997). For example, at relatively low speeds the risk of severe injury to pedestrians decreases from 50 percent to 25 percent as the speed at impact decreases from 31 mph to 23 mph (Tefft, 2011). Therefore, the reductions observed here as a result of DSFS installation would be expected to have a substantial effect on public safety.

4.2. Introduction

Following the literature review, it was clear that a sufficient number of publications were available in the literature to carry out a statistical analysis of DSFS effectiveness. While the literature review provided encouraging results about the effectiveness of DSFS installations, it cannot be determined from a simple count whether the results across all studies within a given safety focus are statistically significant. Nor can it be determined how large a reduction in speed is observed and whether that reduction is not only statistically, but also practically significant. The purpose of this research is to conduct a meta-analysis of the studies described above for each of the five safety focal points and for both heavy and light duty vehicles.

The direct and indirect advantages of such a meta-analysis are threefold. First, a meta-analysis allows one to draw general conclusions about the overall statistical significance of an intervention that has been evaluated in several studies, some of which are consistent with the hypothesis one is evaluating and some of which are not (the case with DSFS). Second, a meta-analysis allows one to compute appropriately weighted estimated effect sizes so that one can determine the practical significance of any given effect in different contexts. Specifically, one can estimate the reduction in speed attributable to the installation of a DSFS and then use appropriate tables (or formulas) to map this reduction in speed to a reduction in pedestrian-vehicle injuries and fatalities. Third, in performing a meta-analysis one needs to be very careful to make sure when one is combining studies that the studies are all evaluating the same hypothesis. The last point is especially relevant for DSFS effectiveness studies, as there is not a single hypothesis being tested to evaluate the effect of a DSFS, but rather 13 different hypotheses, as explained in Section 3.4. In addition to contributing to what is known about the effect of a DSFS in different contexts and with different vehicle types, this study provides a novel conceptual framework for identifying and categorizing the 13 different hypotheses. This conceptual framework facilitates the comparison between and among studies, as the hypotheses being evaluated in previous comparisons have typically been unidentified.

To carry out the meta-analysis, publications were reviewed for availability of the underlying data on vehicle speeds, in tabular or graphical form, and data were compiled in a database. The data were then analyzed using a meta-analysis. Meta-analysis is a statistical technique used to draw general conclusions from a set of related studies focused on similar experimental treatments and responses (Glass, 1976). Given sufficiently similar study designs, the sizes of the treatment effects can be pooled to create a meta-data set, which is then analyzed with appropriate weighting based on the variability and number of observations in each study. This meta-analysis aims to provide decision-makers with a quantitative estimate of how much vehicle speed is reduced following installation of a DSFS. Factors such as location, timing, vehicle type, posted speed, safety focus, and others are all considered in the meta-analysis model.

4.3. Methods

4.3.1. Data collection

Literature review publications (above) were assessed for availability of the underlying data on vehicle speeds. Data were entered at two levels.

(a) The descriptor level, which describes the characteristics of each study (the features that identify how the DSFS was implemented, the hypotheses that were evaluated, and the experimental design)

(b) The data level, which was the least-aggregated level of data reported either in tabular or graphical format in the publication. For calculations of effect size, at a minimum, a study would have to report the mean and standard deviation (SD) of vehicle speeds, as well as the number of vehicles observed, at either two points in time or two locations. The difference in whether studies focused on different timing or location of vehicle speed data collection determines that hypotheses can be tested (Section 3.4).

Publications in some cases included more than one study, meaning they tested DSFS with different safety focal points or in combinations with additional treatments such as police cruisers or speed radar enforcement; these are treated as separate studies in the data collection, grouped under the same publication ID. Studies could also include different sites (locations). Publications employed many different combinations of descriptors in the study design (and sometimes at the different sites within a study), and an effort was made to enter data from any relevant descriptor that could be expected to appear in several studies. Key descriptors, including posted speed, safety focus, vehicle type, sign type, and distance from sign the vehicle speeds, were measured.

4.3.2. Calculating Effect Size

Historically, meta-analyses were initially used primarily to assess the odds of a particular outcome, such as the odds a drug treatment would result in a favorable outcome for a patient, and then were expanded to more generally test the size and direction of the outcome across different studies. Both types of tests, assessing the odds of a categorical outcome or the size of a continuous outcome, are dependent on calculating the effect size. For the meta-analysis of DSFS, the outcomes are vehicle speeds at different points in time or at the same point in time and different locations. Three sets of hypotheses regarding the effectiveness of DSFS can be tested, and each requires a different calculation of effect size. These hypotheses are discussed in detail in the literature review (Section 3.4), and summarized here.

1. H1. Activation of the DSFS: adjacent. The extent to which the DSFS reduces driver speed at the DSFS (or immediately adjacent to the DSFS) is the central question for this analysis. The studies tested activation in three ways.

    A. Compute a difference of differences: Compare the difference between the upstream and adjacent vehicle speeds before activation to the difference between the upstream and adjacent vehicle speeds during activation of the DSFS. This is the ideal comparison, or the true effect (Cruzado & Donnell 2009); we refer to it as the *normalized* version of H1;

B. Compare vehicle speeds adjacent to the DSFS before activation and then during activation; and

C. Compare vehicle speeds upstream (of the DSFS) and adjacent (to the DSFS).

2. H2. Activation of the DSFS: downstream. Safety officials may also consider installing a DSFS upstream of a zone of safety focus. For instance, well upstream of a transition zone between a rural highway and a settled area, it may be desired to begin tapering vehicle speeds. In this case, considering the downstream hypothesis (H2) would be appropriate. The downstream hypothesis is the same as the activation hypothesis except that it assesses the effectiveness of the DSFS on reducing vehicle speeds downstream of the DSFS, rather than adjacent to it. If the sign is placed too far upstream of the location of interest, vehicle speeds may recover to prior levels, so assessing the distance between the sign and the measurement location is critical. The studies tested the activation effect downstream in five ways.

   A. (Normalize to upstream). Compute a difference of differences: Compare the difference between the speeds upstream of the DSFS (*upstream*) and speeds downstream of the DSFS (*downstream*) before activation with the difference between the upstream and downstream speeds after activation. This controls for variations in both the time at which the vehicle speeds (before and during activation) are measured and the location at which the vehicle speeds are measured (upstream and downstream of the DSFS);

   B. Compare downstream vehicle speeds during activation to downstream vehicle speeds before activation;

   C. Compare downstream vehicle speeds to upstream vehicle speeds during activation,

   A’. (Normalize to adjacent). Compute a difference of differences: Compare the difference between the speeds adjacent to the DSFS (*adjacent*) and speeds downstream of the DSFS (*downstream*) before activation with the difference between the adjacent and downstream speeds after activation. This controls for variations in both the time at which the vehicle speeds (before and during activation) are measured and the location at which the vehicle speeds are measured (adjacent to the DSFS and downstream of the DSFS); and

   C’. Compare downstream vehicle speed to adjacent speeds during activation.

Note that “H2B'” would compare vehicle speeds downstream of the DSFS during activation to vehicle speeds downstream of the DSFS before activation; this is identical to H2B, so is not listed as a separate hypothesis.

3. H3. Deactivation of the DSFS. Safety officials may consider temporarily installing a DSFS, for example as part of a mobile operation in a work zone or as a test case to evaluate DSFS effectiveness. Upon removal of the DSFS, it is possible that a halo effect of continued reductions in driver speed may be observed. Some authors have tested this deactivation hypothesis. As with the downstream hypothesis, there are five combinations of measurement in time and space that are possible. The first hypothesis (A) normalizes the adjacent speeds after deactivation to the upstream speeds before activation. The second (B) and third (C) hypotheses are subcomponents used in the calculation of A. The fourth hypothesis (A') normalizes the adjacent speeds after deactivation to the upstream speeds

during activation. The third (C) and fifth (B') hypotheses are subcomponents used in the calculation of A'.

A. (Normalize to before activation). Compute a difference of differences: Compare the difference between the speeds upstream of the DSFS (*upstream*) and speeds adjacent to the DSFS (*adjacent*) before activation with the difference between the upstream and adjacent speeds after deactivation.

B. Compare vehicle speeds adjacent to the DSFS before activation to vehicle speeds adjacent to the DSFS after deactivation.

C. Compare upstream vehicle speeds to adjacent vehicle speeds after deactivation.

A'. (Normalize to during activation). Compute a difference of differences: Compare the difference between the speeds upstream of the DSFS (*upstream*) and speeds adjacent to the DSFS (*adjacent*) during activation with the difference between the upstream and adjacent speeds after deactivation.

B'. Compare adjacent vehicle speeds during activation to adjacent vehicle speeds after deactivation.

We calculate the effect size (*ES*) associated with activation of the DSFS appropriately for each hypothesis. The calculation of effect sizes is based on, at minimum, measurements of speeds at two locations at the same time, or at two points in time at the same location. For the hypothesis H1B, for example, the effect size is based on the difference between the mean speeds adjacent to the DSFS *during* the period in which it is active, $\overline{X}_{DuringDSFS}$ and the sample mean speed adjacent to the DSFS *before* activation $\overline{X}_{BeforeDSFS}$.

The *ES* is this difference, placed relative to units of the pooled standard deviation. The value is negative if there is a reduction in speed at the site of the DSFS installation.

$$ES = \frac{\overline{X}_{DuringDSFS} - \overline{X}_{BeforeDSFS}}{SD_{Pooled}},$$

where the pooled standard deviation for this calculation is defined as follows.

$$SD_{Pooled} = \sqrt{\frac{(N_{DuringDSFS}-1)SD_{DuringDSFS}}{N_{DuringDSFS}+N_{BeforeDSFS}-2} + \frac{(N_{BeforeDSFS}-1)SD_{BeforeDSFS}}{N_{DuringDSFS}+N_{BeforeDSFS}-2}}.$$

This effect size calculation is also referred to as the standardized mean difference (*SMD*) (Hedges & Olkin, 1985).

For other hypotheses based on the comparison of two groups, such as comparing the effect of DSFS at two locations, adjacent to the DSFS and upstream of the DSFS (hypothesis H1A), the effect size calculation is similar. These normalized *ES* require a slightly modified calculation, where differences in means rather than means themselves are compared. For example, when the activation effect of the DSFS on vehicle speed is normalized for differences during and before installation, at both the site adjacent to the sign and upstream of the sign, the effect size is calculated on the next page.

$$ES = \frac{(\overline{X}_{DuringDSFS} - \overline{X}_{BeforeDSFS}) - (\overline{X}_{DuringUpstream} - \overline{X}_{BeforeUpstream})}{SD_{Pooled}}.$$

The pooled standard deviation in this case is computed as follows.

$$SD_{Pooled} = \sqrt{\frac{(N_1 - 1)SD_1 + (N_2 - 1)SD_2 + (N_3 - 1)SD_3 + (N_4 - 1)SD_4}{N_1 + N_2 + N_3 + N_4 - 4}}.$$

The subscripts on each variable identify the relevant time and location at which the variable is measured: 1. Adjacent to the DSFS, during activation; 2. Adjacent to the DSFS location but before activation; 3. Upstream of the DSFS during activation; and 4. Upstream of the DSFS location, but before activation. Figure 12, Figure 13, and Figure 14 in the literature review provide the detailed speed reduction formulas for each of the 13 possible combinations of timing and location of vehicle speeds in response to DSFS installation. The specific calculations follow the two forms above, for either the direct or normalized measurement of effect size.

4.3.3. Hypothesis testing

This meta-analysis investigates a single continuous outcome (speed of vehicles) across several studies, with both fixed effects, two moderating variables (posted speed, distance from DSFS at which the speed is measured) and random effects. The random effects are safety focal points (five levels) and vehicle classes (two levels), and studies within publications. The use of several moderating and independent variables along with fixed and random effects in a meta-analysis has also been called meta-regression (van Houwelingen et al., 2002). This type of analysis is best conducted using a mixed-effect model, where the intercepts for the publications and for the studies within publications are the random effects and the moderating and independent variables are the fixed effects. "Random effects" refers to variables in the model that are assumed to be representatives of a larger population (Raudenbush, 2009; Hedges & Vevea, 1998), and are useful as grouping variables when sample sizes are unbalanced between groups.

When possible, the full model was employed as follows.

$$y_i = \beta_0 + \beta_1 posted.speed_i + \beta_2 distance.from.sign_i + U_i + e_i$$

where *i* indexes the site. β_0 refers to the overall intercept, while the terms β_1 and β_2 refer to the coefficients for each of the predictor variables. Each hypothesis did not always include the moderator variables. When no information was available, the moderator variable was dropped from the analysis for the evaluation of a given hypothesis. Where some information was available and an estimate could be made of the moderator variable, it was included in the analysis. As for random effects, at a minimum the statistical analysis always included a term for study, nested within publication ID. In many cases the posted speed and distance from sign values were not available, thus this report focuses on overall speed reduction effect sizes.

The error term has several parts. The first term U_i represents the random effects, which for this model include the effect of study, nested within publication, as well as safety focus and vehicle type. For example, the study-level error term u_i is defined as $u_i \sim N(0, \tau^2)$, a normally distributed error term with a mean of zero and variance τ^2; this variance is estimated in the model. As a random effect, it represents the variability assumed from the larger population of

studies within publication ID from which the specific studies used have been drawn. The random effects allow the model to fit unbalanced data, which is the case for all of the hypotheses tested, and to account for the hierarchical nature of the data, with several studies being conducted in some publications. This mixed effect approach (mixing random and fixed effects) allows estimates for how the different levels of the random effects contribute to the overall effect, for instance how passenger cars differ from commercial motor vehicles in their response to DSFS installations.

The remaining error term e_i is defined as $e_i \sim N(0, v_i)$, meaning that the residual error is normally distributed with a mean of zero and a standard deviation of v_i; this standard deviation v_i is directly computed in the effect size calculation. The quantity v_i becomes important in the model fitting process, giving greater weight to studies that have a lower variability in the response, due to a large sample size, a low standard deviation in the speeds, or a combination of the two.

For each of the 13 hypotheses tested, a similar structure of models was used. Establishing which fixed and random effect variables could be used depended on data availability. At a minimum, the statistical analysis always included a term for study, nested within publication ID. Safety focus and vehicle type were included as random effects in nearly all models. Posted speed and distance from DSFS (fixed effects) were available for only a subset of the hypothesis tests.

This analysis allows results to be presented on the overall effectiveness of DSFS in reducing speeds for a particular hypothesis, for example the overall effect of DSFS activation when comparing speeds measured at the DSFS sign during activation of the DSFS to speeds measured at the site of the DSFS sign prior to sign installation (hypothesis H1B). In addition to this overall measure of speed reduction, this analysis will further allow reporting of how much the posted speed drives the speed reduction, how much the speed reduction differs for passenger cars versus commercial vehicles, and how much the speed reduction differs for school zones, work zones, rural-to-urban transition zones, or other safety focus areas. The combination of several hypotheses tested and several moderating variables should assist traffic safety practitioners in determining where and when to deploy DSFS for maximum effect, and the size of the speed reduction they can expect to observe.

All of the effect size calculations and calculations of sample standard deviation were carried out in the meta-analysis package *metafor* (Viechtbauer, 2010) using the statistical programming language *R* (R Core Team, 2016). In R, the model is written as follows.

Effect.size ~ posted.speed + distance.from.sign + (1|safety.focus) + (1|vehicle.type) + (1|PublicationID/StudyID)

The term (1| safety.focus) means that there is a random effect for safety focus site. The term (1|PublicationID/StudyID) means that a lower level factor, in this case StudyID, appears only within a particular level of an upper level factor, in this case PublicationID. Functions for calculating normalized effect sizes (e.g., H1A) were written using the *metafor* functions as a foundation. Hypothesis testing was carried out using the linear mixed-effect model package *lme4* (Bates et al., 2015). The effect size calculations in *metafor* have been validated against results provided by the software packages Stata, SAS, and SPSS; the results from these other packages either agreed completely or fell within a margin of error expected when using numerical

methods. The results of *metafor* effect size calculations and analyses have also been validated against textbook examples.

4.4. Results

4.4.1. Summary of data

The literature review identified 43 publications with data appropriate for a quantitative meta-analysis. From these publications, 57 studies were included, with 204 sites at which the effectiveness of DSFS was evaluated (Table 4). By assessing the availability of the appropriate data (mean, *SD*, and *N*) within sites at the appropriate locations, the number of publications, studies, and sites available for testing each hypothesis can be calculated. This shows that hypothesis H1, the effect of DSFS activation at the site of the sign, is the most commonly studied design, followed by H2, the effect of DSFS activation downstream of the sign. Hypothesis H3, the effect of DSFS following deactivation of the sign, was rarely studied, with only three publications providing sufficient data for a meta-analysis. Note that these values differ from the literature review vote count analysis, which only required for inclusion in the vote count that studies report the significance of the result, not necessarily that the studies report the underlying data for a meta-analysis.

Table 4. Summary of the number of publications, studies, and individual sites with data for each the 13 hypotheses.

Hypothesis	Publications	Studies	Sites
H1A	12	22	81
H1B	18	36	186
H1C	14	28	123
H2A	9	18	85
H2B	9	18	85
H2C	9	18	85
H2A'	9	18	85
H2C'	9	18	85
H3A	2	3	8
H3B	3	5	8
H3C	2	3	4
H3A'	2	3	4
H3B'	3	5	8

The actual number of sample units available for each hypothesis test was greater than the number of sites in some cases, if studies separately investigated different vehicle types, for example. If some sites had insufficient data to carry out the statistical test (for example, lacking standard deviations reported), then the number of sample units was less than the number of sites in some cases. The mean difference in speeds *(MD*), variance (*Var*), and number of sample units (*N*) for each of the thirteen hypotheses are presented in Table 5. To be clear, these are not the changes in

speeds as estimated by the meta-analysis. Rather, these are the numerators of the effect size (*ES*) calculations referred to in Section 4.3.2. These numerators we refer to as *MD*.

The mean differences in speed are noted for decreases in speed due to activation of the sign, at the site of the DSFS (H1B, 2.99 mph decrease). For the downstream activation effects, the largest mean effect size was for the downstream effect calculated relative to speeds upstream of the DSFS (H2C, 6.98 mph decrease). As expected, when measured with respect to the speed at the DSFS during activation, the downstream speeds were faster (H2A', H2B'). Finally, deactivation effects were heterogeneous depending on what hypothesis was tested, but had high effect sizes for the reduction in speed between upstream and adjacent sites, following DSFS removal (H3C, 9.44 mph decrease). Again, as expected, when measured with respect to the speed at the DSFS during activation, there was an increase in speeds at the DSFS after deactivation (H3A', H3C').

Taken together, these results indicate that DSFS installations were consistently effective in reducing driver speeds at the DSFS, typically by 2 to 4 mph for passenger cars. Speeds generally increased downstream of DSFS installations when measured with respect to upstream speeds, indicating that the effect of the DSFS on driver behavior is not confined to just vehicles adjacent to the DSFS. Following removal of the DSFS, the few studies available indicated that vehicle speeds at the former site of the DSFS remained lower than prior to the installation when the speeds at the DSFS were measured with respect to the upstream speeds, giving evidence for a halo effect following removal of temporary DSFS installations.

A final caveat is in order. The mean differences in Table 5 are calculated at the level of a sample unit. The definition of a sample unit varies by hypothesis, and may include a single site measured at two points in time (e.g., H1B), two sites measured at the same time (H1C), or two sites, each measured at two points in time (H1A and other normalized effect sizes).

*Table 5. Summary of mean difference in speeds (*MD*, in mph) across the 13 hypotheses tested, with variance (*Var*) and sample size (N) indicated. These values represent average effect sizes, without accounting for publication-specific features. Statistical modeling of effect sizes follows below.*

Hypothesis Category	Hypothesis	*MD*	*Var*	N
H1: Activation	H1A	-2.73	1.88	72
	H1B	-2.99	0.89	249
	H1C	-2.73	2.00	49
H2: Downstream	H2A	-1.15	1.21	35
	H2B	-2.57	0.59	162
	H2C	-6.98	0.02	4
	H2A'	2.65	1.06	67
	H2C'	7.21	0.41	40
H3: Deactivation	H3A	-0.40	0.01	2
	H3B	-0.68	0.61	20
	H3C	-9.44	0.07	4
	H3A'	2.60	0.01	2
	H3B'	1.89	0.37	82

The sections below go beyond the above and employ statistical models to account for the differences between publications, studies within publications, vehicle types, and safety focal points. Further analysis was carried out, where possible, to address the effect on speed reductions both of the posted speed and of the distance between DSFS and measured speed.

4.4.2. H1: Activation hypothesis

As described in detail in Section 3.4, the three versions of the activation hypothesis H1 all rely on a measurement of vehicle speeds at the site of the DSFS, but use different baseline comparisons. The simplest, H1B, compares vehicle speeds at the site of the sign between the time before activation and during activation. H1A calculates a similar value, for the difference between activation timing (before and during), normalized to the same difference upstream of the DSFS. H1C compares speeds at the DSFS to speeds upstream, at the same time. Across all three activation hypothesis tests, statistically significant reductions in speed were observed.

4.4.2.1. H1A: Activation effect at DSFS, normalized relative to upstream

Overall, the decrease in speed attributed to DSFS, normalized by upstream location, is 2.84 mph, a significant effect ($p = 0.004$). For the vehicle type grouping variable, cars demonstrated a slowing effect 0.22 mph greater than that of trucks. Of the studies that specifically identified the safety focus, the largest reduction in the estimated speed was noted in school zones (-3.21 mph). When carrying out the statistical analysis of these effect sizes, 72 sites were available. Neither posted speed nor distance from sign location were significant predictors of the decrease in speed.

Table 6. Summary of mixed effect model of hypothesis H1A, difference in speeds between DSFS before and at time of activation, normalized to the difference before and at time of activation upstream of the sign.

Predictor	**Estimated Reduction in speed**	**Std. Error**	**t value**
Overall Effect	-2.843	0.991	-2.869
Vehicle Type Effects:			
Unspecified	-2.90		
Car	-2.95		
Truck	-2.68		
Safety Focus Effects:			
Unspecified	-3.16		
Curved Section	-2.27		
School Zone	-3.21		
Signalized Intersection	-2.90		
Transition Zone	-2.79		
Work Zone	-2.73		

The reader will note that the estimated overall reduction in speeds that is reported in Table 6 (-2.84 mph) is not the same as the reduction in speeds that is reported in Table 5 (-2.73 mph, *MD*). That is because Table 5 shows directly calculated values using the sample means in the numerators of the equations in Section 4.3.2. The computations for the estimated overall reduction in speeds, on the other hand, show estimated values from the mixed effect models. If the data were perfectly balanced within each random effect, if random effects did not matter (no difference between the publications in the size of the effect), and if the sample sizes were the same across studies within publications, these would be identical values. However, because these conditions do not hold the differences in the mean speed (*MD*) reported in Table 5 will generally not equal the overall estimated reductions in mean speed reported in the tables summarizing meta-analysis models.

In summary, the above analysis shows that normalized speeds at the DSFS were reduced across all vehicle types when the DSFS was installed, providing strong evidence of the effectiveness of DSFS, even when accounting for the expected reductions in speed between locations upstream and adjacent to the site of the DSFS installation.

4.4.2.2. H1B: Activation effect at DSFS, relative to before

Calculations of the mean differences in speed for H1B, the decrease in speed at the site of the DSFS, show decreases in speed across all vehicle types and safety focal points. The statistical analysis of hypothesis H1B shows a highly significant decrease in speeds of -3.56 mph at the location adjacent to the sign (Table 7; $p < 0.001$). Within passenger cars, the decrease is even more pronounced with an estimated additional decrease of 0.58 mph. Thus, a 4.14 mph decrease is expected for passenger cars at DSFS locations. Mirroring the results in H1A, the reductions in speeds for trucks adjacent to the DSFS is more modest, with a speed reduction of 2.83 mph. Due

to the limited sample size, safety focus estimates were not able to be calculated; for further analyses where not all effects are reported, similar limitations on sample size apply.

Table 7. Summary of mixed effect model of hypothesis H1B, difference in speeds between DSFS before and at time of activation.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	-3.562	0.736	-4.843
Vehicle Type Effects:			
Unspecified	-3.72		
Car	-4.14		
Truck	-2.83		

4.4.2.3. H1C: Activation effect at DSFS, relative to upstream

The difference between speeds upstream and adjacent to DSFS during activation of the DSFS (measured at the same time) were surprisingly large, with an overall -8.62 mph (Table 8) decrease estimated (p = 0.008). The largest decreases were detected in several studies that did not differentiate by vehicle type (Hallmark, et al., 2007; Reddy et al., 2008; Roberts & Smaglik, 2012). Due to the limited sample size, safety focus and vehicle type estimates could not be calculated. The large decrease in speeds from upstream to adjacent sites can be attributed in particular to the studies of Hallmark et al. (2007), who studied the effect of DSFS installations at transition zones in rural communities, Gambatese and Jafarnejad (2015), and Reddy et al. (2008), who studied the effects of DSFS installations in work zones. Transition zones and work zones are places where the posted speed several miles upstream of the DSFS is likely to be much greater than the posted speed closer to the DSFS. Whether they would have observed such large reductions had the normalized version of the activation hypothesis (H1A) been evaluated is open to question for the reasons discussed above.

Table 8. Summary of mixed effect model of hypothesis H1C, difference in speeds between DSFS upstream and adjacent to the sign.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	-8.615	3.254	-2.647
Publication ID Effects:			
Gambatese et al. (2015)	-10.41		
Hallmark et al. (2007)	-15.60		
Reddy et al. (2008)	-13.60		
Roberts et al. (2012)	-2.96		
Tribbett et al. (2000)	-0.50		

4.4.3. H2: Downstream Hypothesis

After drivers move past the DSFS installation, the extent to which speeds increase again is an important point to consider. Those speeds can be measured either with respect to the upstream DSFS or the adjacent DSFS. When the upstream speed was the baseline, a reduction in speed downstream of the DSFS was estimated to occur and, consistent with the previous analyses, the smallest estimated reduction was seen with the normalized measure (-0.94 mph, H2A, versus -5.44 mph, H2B). Note that there was not enough information to estimate this reduction for H2C. However, perhaps not surprisingly, when the adjacent speed was the baseline, an increase in speed downstream of the DSFS was measured. Again, the effect was more moderate when a normalized index was used (2.51 mph, H2A') than when a simple comparison was used (4.17 mph, H2C').

4.4.3.1. H2A: Downstream effect normalized, relative to upstream

As for the activation hypothesis, a normalized difference in speeds can be calculated to address the downstream effect. Similar to H1A, where the differences in speeds upstream of and adjacent to the DSFS were calculated normalized to the timing of DSFS activation, H2A calculates a difference between the upstream and downstream sites, normalized by the timing of activation.

The statistical analysis of this hypothesis shows a modest trend for speed to decrease, when normalized, of only 0.94 mph. The reduction was not statistically significant ($p = 0.148$). In this case, sufficient variation at the grouping level was only available for safety focus. Of the two safety focal points included where the studies identified the location, work zones showed a stronger decrease (-1.37 mph) than did curves (-0.78). This same order was observed in the test of H1A.

Table 9. Summary of mixed effect model of hypothesis H2A.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	-0.942	0.652	-1.445
Safety Focus Effects:			
Unspecified	-0.68		
Horizontal curve	-0.78		
Work zone	-1.37		

4.4.3.2. H2B: Downstream effect, relative to before

There were decreases in the estimated speed downstream of the DSFS (measured before and during activation) across all vehicle types and locations. The statistical analysis of hypothesis H2B shows a large decrease in speeds of 5.44 mph downstream of DSFS installations, a trend however that was not statistically significant. ($p = 0.099$). This trend was quite similar across vehicle types, with only slightly larger decreases observed for passenger cars of 5.55 mph. Though slight, the direction of the changes is consistent with what was observed for passenger cars and trucks in the evaluation of the activation hypothesis. These large decreases should be interpreted with caution, as very large downstream differences were detected in Fontaine et al. (2001), which analyzed effects of DSFS installations in work zones in Texas.

Table 10. Summary of mixed effect model of hypothesis H2B, difference in speeds downstream of DSFS sites, before and at time of activation.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	-5.439	3.304	-1.646
Vehicle Type Effects:			
Unspecified	-5.44		
Car	-5.55		
Truck	-5.33		

4.4.3.3. H2C: Downstream effect, relative to upstream

The downstream effect of DSFS can be further analyzed by focusing on just the time during the DSFS activation. Comparing speeds detected downstream of the DSFS to speeds upstream of the DSFS is the focus of hypothesis H2C. Here, an insufficient number of studies were conducted either to carry out a breakdown of DSFS effectiveness by vehicle type or safety focus, or to employ the full statistical model. However, the overall effect can be assessed using the mean differences. In this case a decrease of -6.98 mph was observed in the mean speeds (Table 5).

4.4.3.4. H2A': Downstream effect normalized, relative to adjacent

As with H2A, which normalized the difference by comparing upstream and downstream speeds, before and during DSFS activation, H2A' examines the adjacent and downstream speeds, both before and during DSFS activation. Compared to H2A, the difference is now that the reference level is adjacent to the DSFS; therefore, the relative speed difference may be expected to be a positive value, as vehicles accelerate following the DSFS.

Consistent with this, it is clear from Bertucci (2006) that passenger cars accelerate after passing the DSFS. There is an overall estimated increase in speeds of 2.51 mph ($p = 0.002$), which is nearly equal to the estimated decrease in speeds between the upstream and adjacent sensors detected by the normalized metric of H1A of 2.84 mph. If the same studies had been used to evaluate H1A, H2A and H2A', then the difference observed in H2A (-0.94 mph) should be equal to the net change in speed as measured by H1A (-2.84) and H2A' (2.51 mph), or -0.33 mph. But of course, they are not the same studies. Still, the similarity of the two estimates (-0.94 mph versus -0.33 mph) is evidence that the combined (H2A) and separate (H1A, H2A') evaluations are yielding roughly the same value of the normalized decrease in speed between the upstream and downstream sensors.

One final note is worth mentioning. Again, the difference between passenger cars and trucks is consistent with what has been observed before, trucks evidencing less of an effect of the DSFS than passenger cars both when approaching the DSFS (H1) and downstream of the DSFS (H2). Here, passenger cars show a 3.36 mph increase in speeds, whereas trucks show only a 2.34 mph increase in speeds.

Table 11. Summary of mixed effect model of hypothesis H2A', the normalized activation effect of DSFS, relative to sites adjacent to the DSFS.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	2.513	0.807	3.113
Vehicle Type Effects:			
Unspecified	1.84		
Passenger	3.36		
Truck	2.34		

4.4.3.5. H2C': Downstream effect, relative to adjacent

As with H2A' where the comparison involves the adjacent and downstream sensors, a substantial overall rebound in speeds was detected of 4.17 mph, though it was not statistically significant (p = 0.136). Note that this increase does not mean there is no net change in speeds downstream of the DSFS during activation. Recall there was a 6.98 mph decrease in speeds at the downstream location relative to the upstream location (H2C). Due to sample size limitations, the safety focus could not be included in the statistical model, with the effects of vehicle type and study within publication retained. No statistically significant variation was detected for vehicle types, though again passenger cars were observed to have a larger rebound in speeds (8.31 mph) than trucks (7.42 mph). The largest rebound in speeds among the studies was from the work Hajbabai et al. (2011), which evaluated the effect of speed photo-radar enforcement along with DSFS installations in work zones.

Table 12. Summary of mixed effect model of hypothesis H2C'.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	4.165	2.791	1.492
Publication ID Effects:			
Hajbabai et al. (2011)	8.22		
Reddy et al. (2008)	3.40		
Roberts et al. (2012)	0.87		

4.4.4. H3: Deactivation Hypothesis

DSFS installations are not always permanent. For temporary installations as test cases, for instance in transition zones, the installation would be removed. Interest would then center on whether the speed reduction observed during the activation of the DSFS was still observed after the DSFS had been removed. There was not enough information to obtain the estimates from the statistical model to derive an overall picture of the effect of deactivation on estimated speed. Therefore, the discussion below relies on the mean differences (Table 5).

As is true for the normalized activation effect (H1A) and the normalized downstream effect relative to the upstream location (H2A), the normalized deactivation effect with respect to the time period before the installation of the DSFS (-0.40 mph, H3A) was smaller than either the

comparison of the mean speeds at the adjacent DSFS before activation and after deactivation (-0.68 mph, H3B) or the comparison of the mean speeds upstream and adjacent to the DSFS after deactivation (-9.44 mph, H3C, Table 5). Moreover, as is true for the normalized downstream effect with respect to the time period when the DSFS was activated (H2B'), the normalized deactivation effect with respect to the time period when the DSFS was activated led to an increase in speeds (2.60 mph, H3A'). The different effects (H3A and H3A') on speeds of deactivation can easily be explained given that the decrease in speeds at the DSFS after deactivation is measured with respect to the upstream sensors before activation whereas the increase in speeds at the DSFS after deactivation is measured with respect to the sensors at the DSFS during activation. Unfortunately, there were not enough observations to compare normalized estimates to unnormalized estimates (i.e., H3A with H3B and H3C or H3A' with H3B').

4.4.4.1. H3A: Deactivation effect normalized, relative to before

Comparing the speeds upstream and adjacent to the site of the DSFS as in H1C is one direct measure of the effectiveness of DSFS. H3A tests the effectiveness of the DSFS after the sign is removed, by carrying out that comparison before installation and after removal of the DSFS at the DSFS, normalizing by the speeds upstream before installation and after removal of the DSFS. This comparison allows examination of how much drivers slowdown in anticipation of the DSFS, even after the sign is removed.

No statistical analysis was possible for H3A, as only two sample units were available, from studies conducted in work zones in Arizona (Roberts & Smaglik, 2012). These 2 studies together show modest decreases in speeds (-0.04, Table 5).

4.4.4.2. H3B: Deactivation effect, relative to before

Directly comparing speeds at the site of the DSFS, before installation and after removal, is a simpler test of the halo effect of DSFS. In contrast to H3A, this test does not normalize for the difference in location upstream and adjacent, and only compares the speeds over time. Four publications provided data with which to test this hypothesis and showed that there was a decrease of approximately 2 mph that remained after DSFS removal. Given the small sample size, this effect is not statistically significant ($p = 0.273$). These effect sizes were similar across the three categories of safety focal points (pedestrian area, transition zone, work zone) where the focus was identified. The consistency of this halo effect is noteworthy, as it indicates a possible remaining benefit of DSFS installation even following removal.

Table 13. Summary of mixed effect model of hypothesis H3B.

Modeled Effect Sizes	**Estimate**	**Std. Error**	**t value**
Overall Effect	-2.077	1.895	-1.096
Safety Focus Effects:			
Unspecified	-1.89		
Pedestrian area	-2.12		
Transition zone	-2.12		
Work zone	-2.18		

4.4.4.3. H3C: Deactivation effect, relative to upstream

Focusing strictly on the period of time following DSFS removal, H3C examines the difference in speeds between sites upstream and adjacent to where the DSFS would be. In this study, only four sample units were available for this test, from two publications (Hallmark et al., 2007; Roberts & Smaglik, 2012). These results indicate a trend for speeds to decrease between these sites, but the results were limited by sample size and are not statistically significant ($p = 0.332$). The halo effect at transition zones (-19.14 mph) was much larger than this effect at work zones (0.16 mph). It is possible that work zones are much more visible from afar than are transition zones, thus, drivers are already slowing as they approach a work zone, but not as they approach a transition zone.

Table 14. Summary of mixed effect model of hypothesis H3C.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	-9.438	9.737	-0.969
Safety Focus Effects:			
Transition zone	-19.04		
Work zone	0.16		

4.4.4.4. H3A': Deactivation adjacent normalized, relative to during

To overcome the conceptual limitations of hypothesis H3C, it is possible to normalize by the difference upstream and adjacent during the period when the DSFS is installed. The calculated value now is the true difference in speeds following DSFS removal, after correcting for the expected difference when DSFS was installed. In this study, only two sample units were available, relying again on the work zone study of Roberts and Smaglik (2012). There was an increase in mean speeds (2.60 mph, Table 5), but it was not possible to test for statistical significance because insufficient data were available.

4.4.4.5. H3B': Deactivation effect, relative to during

The final test of the deactivation hypothesis is the test of how speeds at the site of the DSFS change between the time period when the sign was active and when it was removed. This hypothesis modifies H3B in using the time of DSFS activation as the reference speed, rather than the period before the DSFS was installed. H3B' can also be thought of as a mirror image to the activation hypothesis H1B, which compares speeds during DSFS activation with speeds before installation.

A modest rebound in speeds was detected, with predicted speeds increasing by 0.96 mph, but this was not statistically significant. While 82 sample units were available for this test, the overall rebound in speeds was close to zero for the five publications examined. This indicates that the speed reductions achieved when the DSFS was installed largely remained in effect even following the removal of the sign.

Table 15. Summary of mixed effect model of hypothesis H3B'.

Modeled Effect Sizes	Estimate	Std. Error	t value
Overall Effect	0.956	1.036	0.923
Publication ID Effects:			
Cruzado & Donnell (2009)	1.12		
Hallmark et al. (2007)	0.84		
Kamyab et al. (2002)	0.91		
Pesti & McCoy (2011)	1.11		
Roberts & Smaglik (2012)	0.80		

4.5. Conclusions

The meta-analysis of DSFS effectiveness demonstrates that overall vehicle speeds are consistently slowed by DSFS installations, at the DSFS, downstream of the DSFS, and after the DSFS (relative to the speed before the DSFS was installed), most of these reductions being both practically and statistically significant. Having said this, there are two important caveats. First, the size of the reductions was smallest when the confounding factors were removed and the measures were normalized both with respect to time and place. The importance of this is that in order to compute the practical effect of a DSFS on the reduction in speed, traffic engineers can only accurately predict that effect using the normalized measure. The three tests of the activation hypothesis make clear why this is so important to recognize. The normalized test indicates an estimated reduction of -2.84 mph (H1A, Table 6). The evaluation of the speeds at the same place (adjacent to the DSFS) but at different times indicates an estimated reduction of -3.56 mph (H1B). And the evaluation at the same time but different places (H1C) indicate an even larger reduction in estimated speeds of -8.62 mph. Assuming cars are traveling 40 mph at the upstream sensor and 40 mph at the adjacent sensor before the DSFS are installed, H1A, H1B and H1C represent, respectively, 15 percent, 25 percent and 67 percent reductions in severe injuries caused by vehicle-pedestrian strikes (Tefft, 2011). In most any cost-benefit analysis, such variation will presumably greatly affect the cost-benefit ratio. The importance of using a measure of the reduction in speeds that can be truly attributed to the installation of a DSFS cannot be emphasized enough.

The second caveat is related to the first. Note that even for normalized hypotheses one needs to understand the baseline. For example, when looking at the normalized effect of the DSFS on speeds at the downstream sensor one finds both a reduction in estimated speeds (H2A, -0.94 mph, Table 6) and an increase in speeds (H2A', 2.51 mph). How can this be? The answer, as we discussed above, is that the baseline for one version of the downstream hypothesis is the upstream sensor (H2A) where one would expect a decrease in speeds after activation of the DSFS at the downstream sensor and the baseline for the other version of the downstream hypothesis is the sensor at the DSFS (H2A') where one would expect an increase in speeds at the downstream sensor.

We also want to comment on the difference between the reduction in speeds of passenger cars and trucks. Passenger cars were estimated to slow down by approximately 4 mph at the DSFS when it was active (H1B, Table 7), with effects persisting downstream (-5.15 mph, H2B, Table 10) and to some extent even after signs were removed (-0.68, H3B, Table 5). Trucks exhibited

smaller speed reductions in response to DSFS installations (e.g., H1A, Table 6). It would appear at first glance that truck drivers pay less attention to the DSFS than do passenger car drivers. However, this interpretation ignores the speed of the vehicles approaching the DSFS. Trucks are traveling more slowly than passenger cars on average. Therefore, the installation of a DSFS has a smaller effect on their vehicle speed as they approach a DSFS (assuming that they do not drop below the posted speed). Consistent with this we find that truck drivers increase their speed downstream of the DSFS slightly less than do passenger car drivers.

Finally, although the studies were not sufficient to support a strong argument to the effect that DSFS had the same effect across safety focal points, the evidence that we have collected suggests that this may indeed be the case (e.g., H1A, Table 6). An argument that such is the case might start with the assumption that drivers reduce their speed by a constant delta, regardless of the posted speed, when first seeing a DSFS. Thus, the fact that the DSFS might have been upstream of a school zone or of a curve could plausibly have not had an effect on the size of their reduction in speed. Having said that, the studies we had were too few to analyze whether the size of the reduction was a function of the difference between the posted speed and the actual speed of the driver.

There are a number of limitations of the current study that are deserving of comment. First, although not obvious from the above, in many cases we had to estimate the speeds from figures. Had the speeds been reported in tables, we would have used those exact values. However, when trying to estimate from a figure what the speeds are before and after installation, along with after deactivation, there are inevitable errors introduced. Second, there was an extraordinary variation in how far from the DSFS the sensors upstream, adjacent to, and downstream of the DSFS were located. To pretend that these distances were constant would mislead the reader. So, when we report adjacent speeds, upstream speeds, and downstream speeds the reader should realize that the sensors that were providing information on the speeds were not all located similarly with respect to a reference point. Unfortunately, although we painstakingly recorded this information for each study and each site, the were not enough observations to determine whether the distances were having the expected effect.

The above two limitations are by no means the only limitations. However, given that even modest reductions in vehicle speeds can have major benefits for public safety (Tefft, 2011) and given that reductions in speed were identified across all hypotheses that used as a baseline the time period before the installation of the DSFS, these results support installation of DSFS at locations where other traffic calming measures may be costly or difficult to implement.

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