Attachment 2.E

Available Roadway Improvement Plans

Route 128 Add-A-Lane
(Final Design)

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

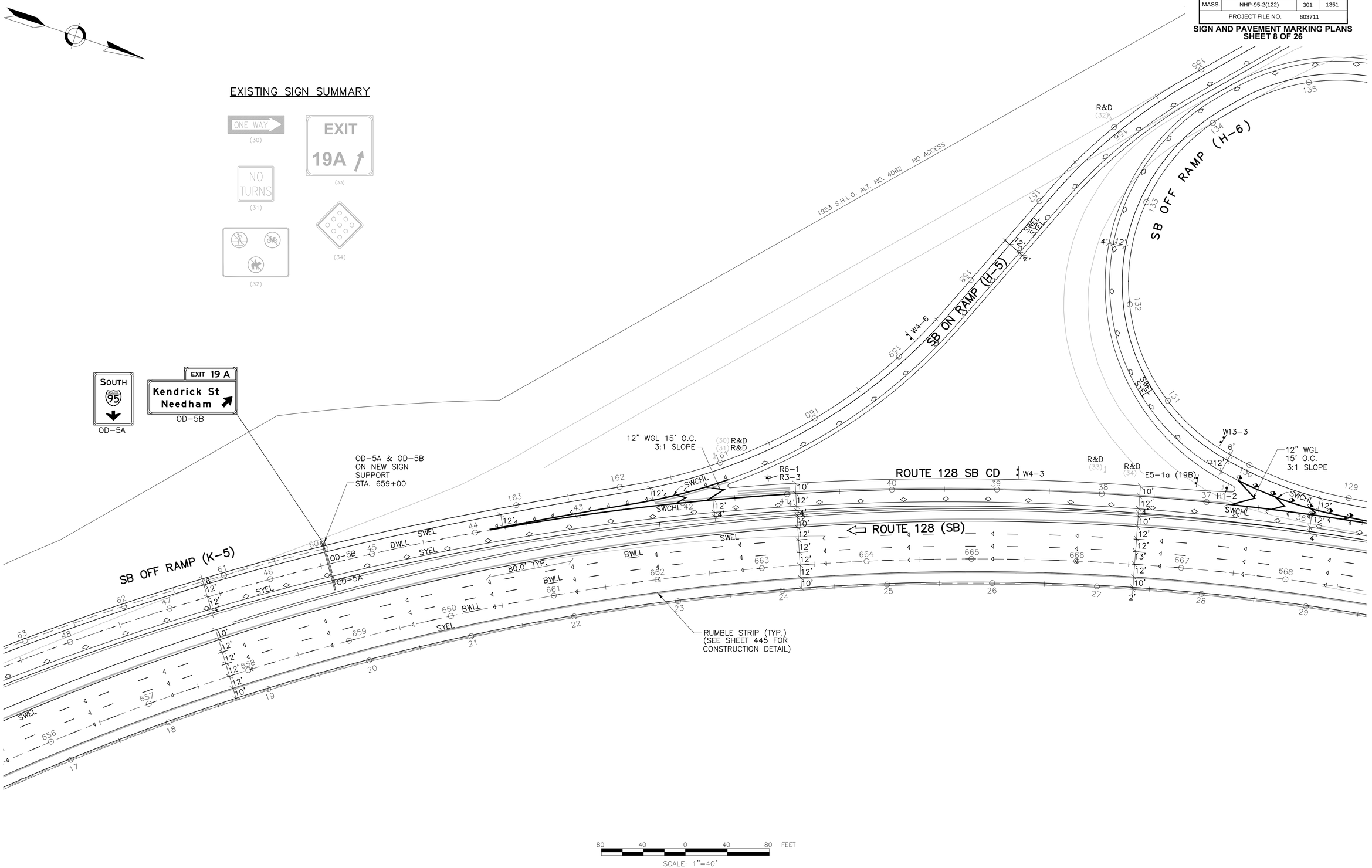
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	301	1351
	PROJECT FILE NO. 603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 8 OF 26

CONT. ON SHEET 300

CONT. ON SHEET 302

EXISTING SIGN SUMMARY



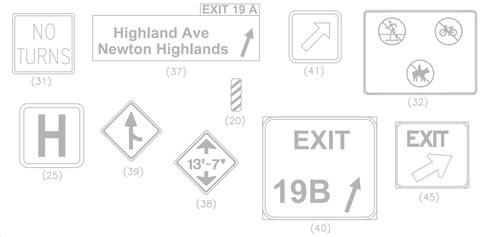
Jacobs - C:\Users\tvalencia\appdata\local\temp\AcPublish_6936\261-278 Signing&Pavement Marking Plan.dwg, January 14, 2014

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	302	1351
PROJECT FILE NO.	603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 9 OF 26

EXISTING SIGN SUMMARY



CONT. ON SHEET 301

CONT. ON SHEET 305

1980 S.H.L.O. ALT. NO. 6460

1953 S.H.L.O. ALT. NO. 4062 NO ACCESS

SB OFF RAMP (H-7)

SB ON RAMP (H-8)

W3-2

HIGHLAND AVENUE

(SEE HIGHLAND AVENUE SIGNING AND PAVEMENT MARKING SHEETS)

EXIT 19 A
Kendrick St
Needham
1/4 MILE
OD-8A

EXIT 19 B
Highland Ave
Newton
Highlands
OD-8B

OD-8A & OD-8B ON NEW SIGN SUPPORT STA. 673+14

OD-9A & OD-9B ON NEW SIGN SUPPORT STA. 680+68

12" WGL 15' O.C. 3:1 SLOPE

RUMBLE STRIP (TYP.) (SEE SHEET 445 FOR CONSTRUCTION DETAIL)

ROUTE 128 (SB)

RTE. 128 SB CD ROAD

R4-5D

R6-1 R3-3

W4-3

W4-6

E5-1a(19C)

W13-3

H1-2

SCALE: 1"=40'

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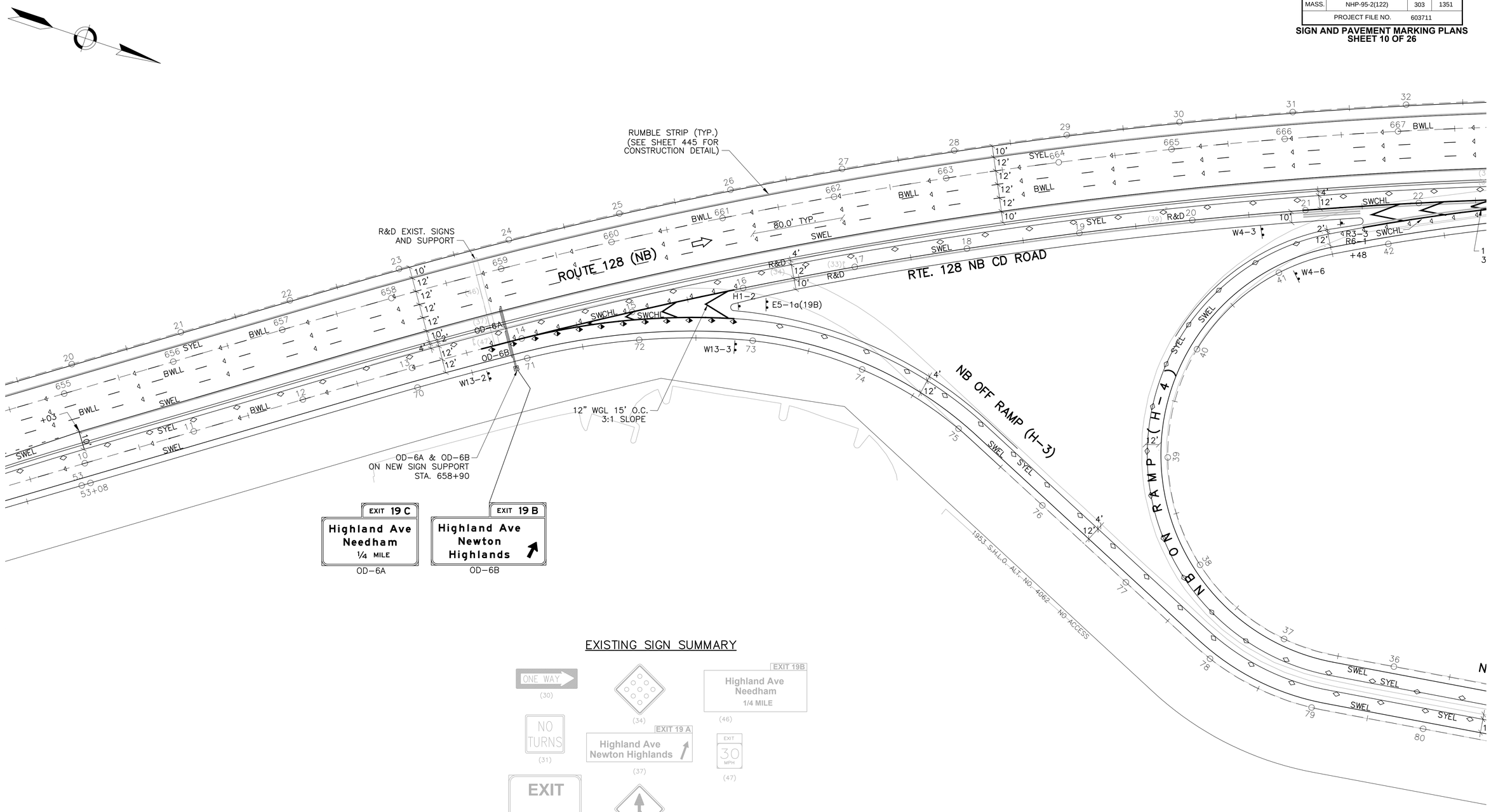
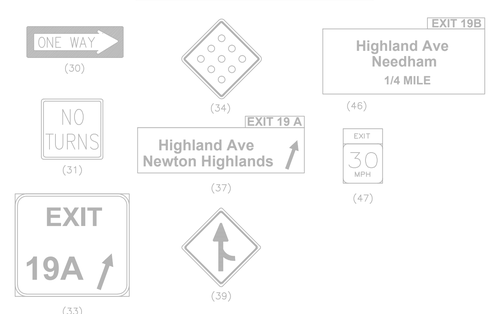
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	303	1351
PROJECT FILE NO.	603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 10 OF 26

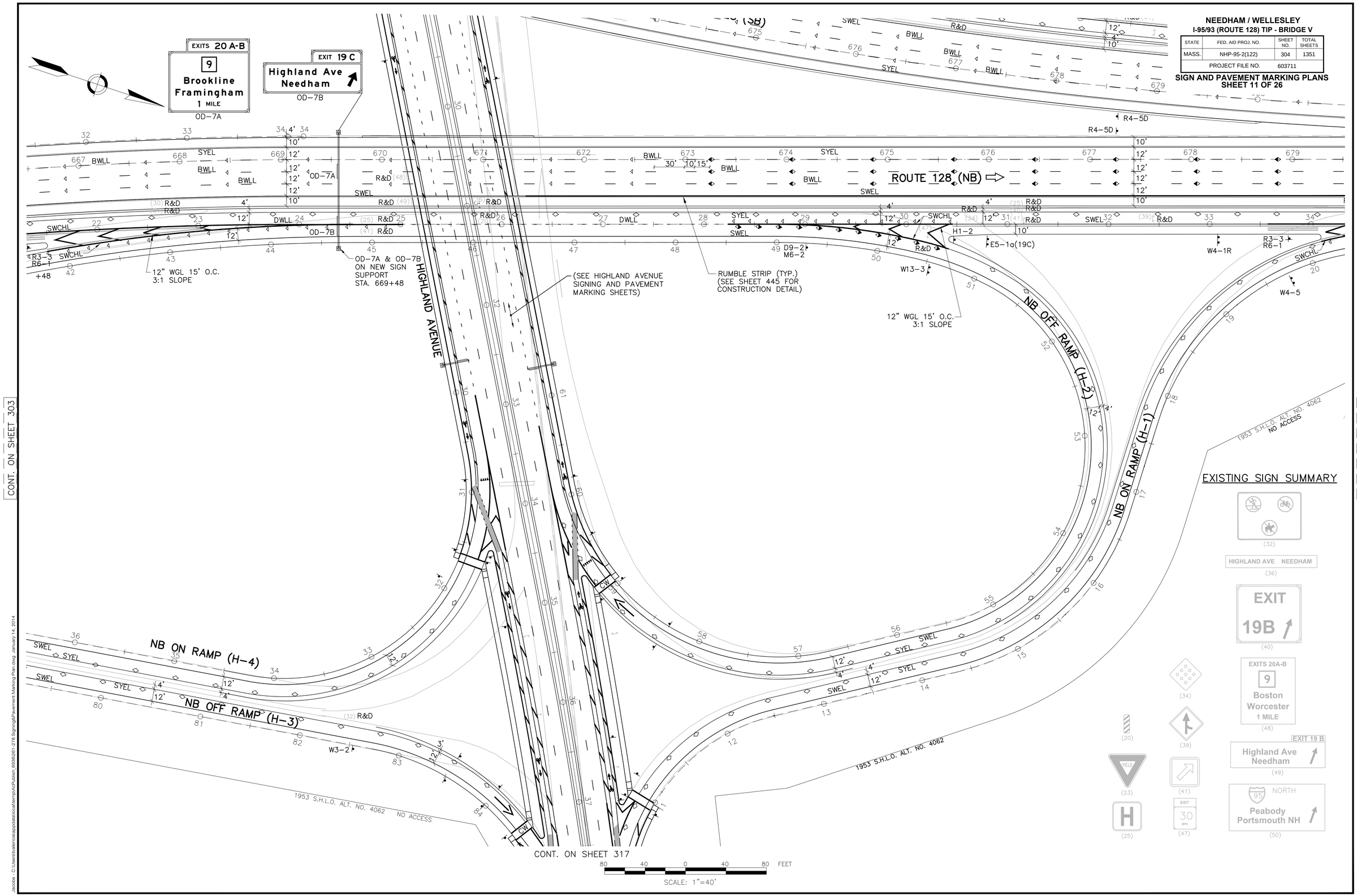


EXISTING SIGN SUMMARY



80 40 0 40 80 FEET
SCALE: 1"=40'

Jacobs - C:\Users\valencia\appdata\local\temp\AcPublish_6936\261-278 Signing&Pavement Marking Plan.dwg January 14, 2014



NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V
STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS
MASS. | NHP-95-2(122) | 304 | 1351
PROJECT FILE NO. 603711
SIGN AND PAVEMENT MARKING PLANS
SHEET 11 OF 26
EXITS 20 A-B
9
Brookline
Framingham
1 MILE
OD-7A
EXIT 19 C
Highland Ave
Needham
OD-7B
ROUTE 128 (NB)
HIGHLAND AVENUE
NB OFF RAMP (H-2)
NB ON RAMP (H-1)
NB ON RAMP (H-4)
NB OFF RAMP (H-3)
12" WGL 15' O.C.
3:1 SLOPE
OD-7A & OD-7B
ON NEW SIGN
SUPPORT
STA. 669+48
(SEE HIGHLAND AVENUE
SIGNING AND PAVEMENT
MARKING SHEETS)
RUMBLE STRIP (TYP.)
(SEE SHEET 445 FOR
CONSTRUCTION DETAIL)
1953 S.H.L.O. ALT. NO. 4062
NO ACCESS
CONT. ON SHEET 303
CONT. ON SHEET 305
CONT. ON SHEET 317
EXISTING SIGN SUMMARY
HIGHLAND AVE NEEDHAM
EXIT
19B
EXITS 20A-B
9
Boston
Worcester
1 MILE
EXIT 19 B
Highland Ave
Needham
NORTH
Peabody
Portsmouth NH
SCALE: 1"=40'
FEET

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	305	1351
	PROJECT FILE NO. 603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 12 OF 26

CONT. ON SHEET 302
CONT. ON SHEET 304
CONT. ON SHEET 306

OD-9A & OD-9B ON NEW SIGN SUPPORT STA. 680+68

EXIT 19 B
Highland Ave
Newton Highlands
1/4 MILE
OD-9A

EXIT 19 C
Highland Ave
Needham
OD-9B

E5-1a(19C)
12" WGL 15' O.C.
3:1 SLOPE
W13-3
H1-2
D9-2
M6-2
NO ACCESS
ACCESS FOR RAILROAD
1953 S.H.L.O. ALT. NO. 4062 NO ACCESS
RUMBLE STRIP (TYP.)
(SEE SHEET 445 FOR CONSTRUCTION DETAIL)
SOUTH 95 MILE 36
MM36
12" WGL 15' O.C.
3:1 SLOPE
ROUTE 128 (SB)
ROUTE 128 (NB)
SWCHL
BWLL
SWEL
SYEL
DWLL
R&D
R&R
R3-3
R6-1
W4-1R
W4-5
W4-6
M3-1
M1-1 (95)
M1-5 (128)
NORTH 95 MILE 36
1953 S.H.L.O. ALT. NO. 4062 NO ACCESS

EXISTING SIGN SUMMARY

(20)
(30) ONE WAY
EXIT 19 B Highland Ave Needham (49)
EXIT 19 A Highland Ave Newton Highlands 1/4 MILE (22)
(31) NO TURNS
NORTH (54)
STATE LAW SPEEDING FINES DOUBLED IN WORK ZONES (68)
YIELD (23)
128 (43)
14'-3" (67)
SPONSOR A HIGHWAY NEXT 2 MILES Needham Bank (69)

80 40 0 40 80 FEET
SCALE: 1"=40'

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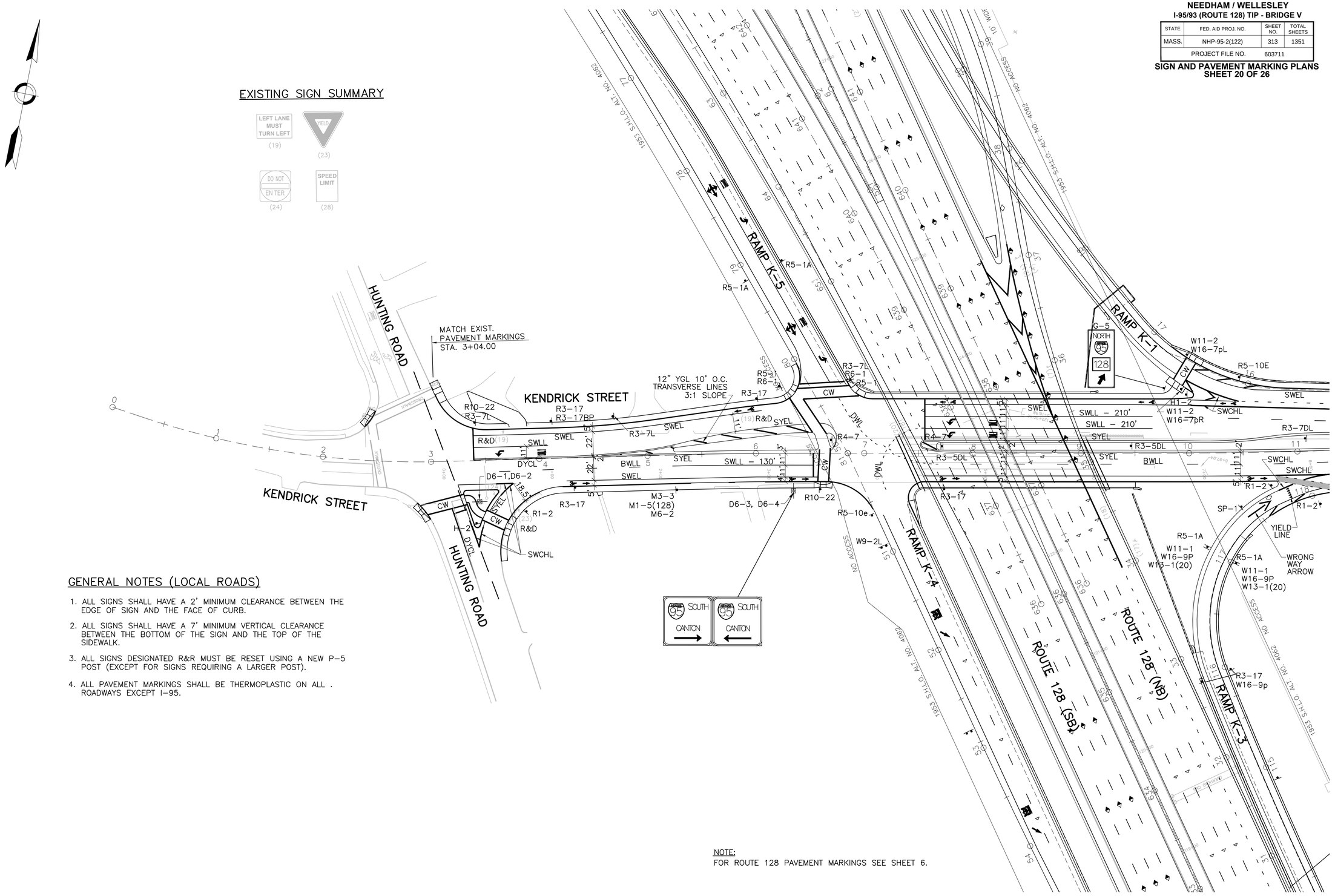
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	313	1351
PROJECT FILE NO.	603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 20 OF 26

EXISTING SIGN SUMMARY



GENERAL NOTES (LOCAL ROADS)

1. ALL SIGNS SHALL HAVE A 2' MINIMUM CLEARANCE BETWEEN THE EDGE OF SIGN AND THE FACE OF CURB.
2. ALL SIGNS SHALL HAVE A 7' MINIMUM VERTICAL CLEARANCE BETWEEN THE BOTTOM OF THE SIGN AND THE TOP OF THE SIDEWALK.
3. ALL SIGNS DESIGNATED R&R MUST BE RESET USING A NEW P-5 POST (EXCEPT FOR SIGNS REQUIRING A LARGER POST).
4. ALL PAVEMENT MARKINGS SHALL BE THERMOPLASTIC ON ALL . ROADWAYS EXCEPT I-95.

NOTE:
FOR ROUTE 128 PAVEMENT MARKINGS SEE SHEET 6.

80 40 0 40 80 FEET
SCALE: 1"=40'

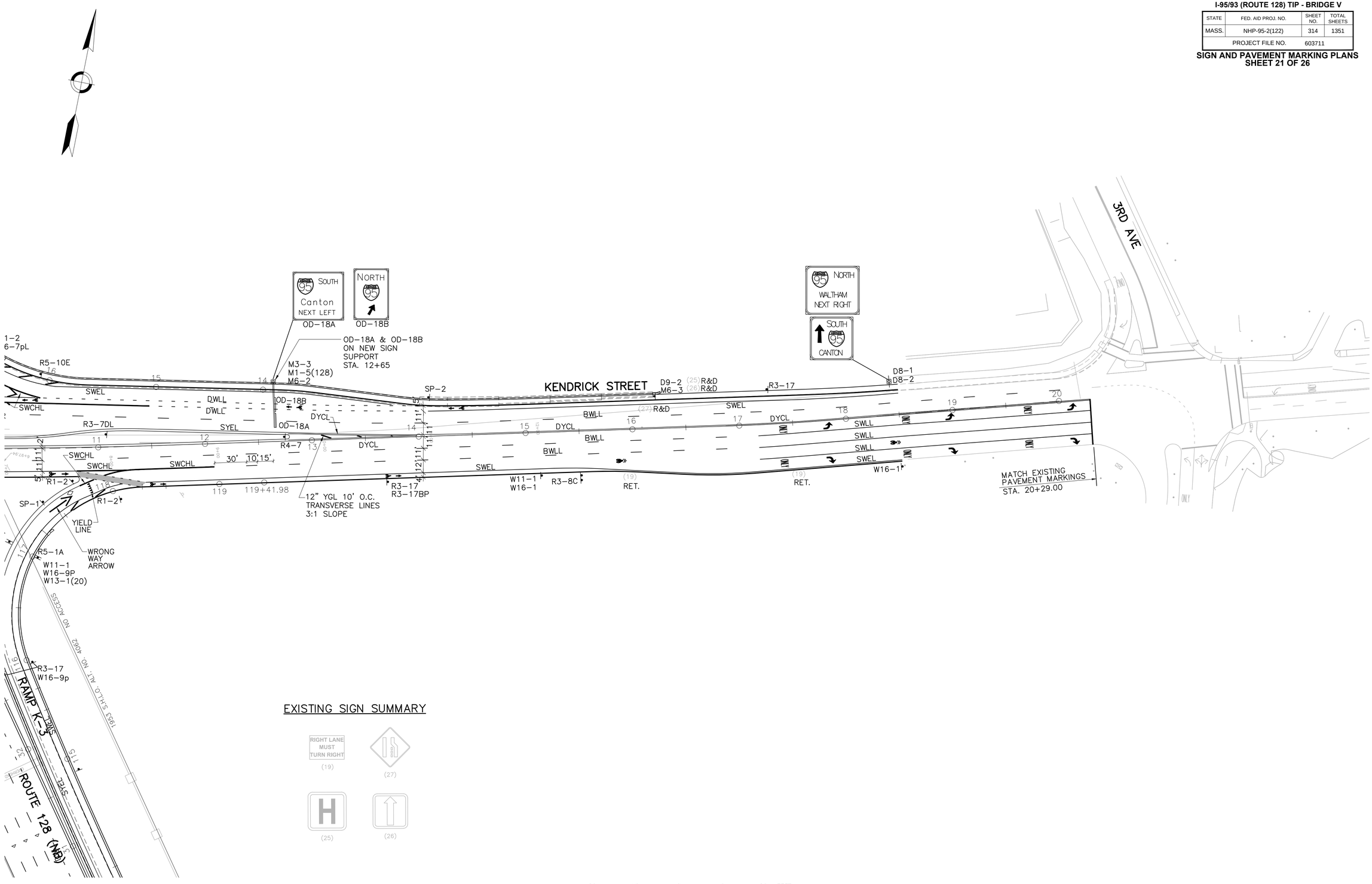
CONT. ON SHEET 314

Jacobs - C:\pwworking\rail\highland.awe\dms360432\61-278 Signing&Pavement Marking Plan.dwg January 13, 2014

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	314	1351
PROJECT FILE NO.		603711	

SIGN AND PAVEMENT MARKING PLANS
SHEET 21 OF 26



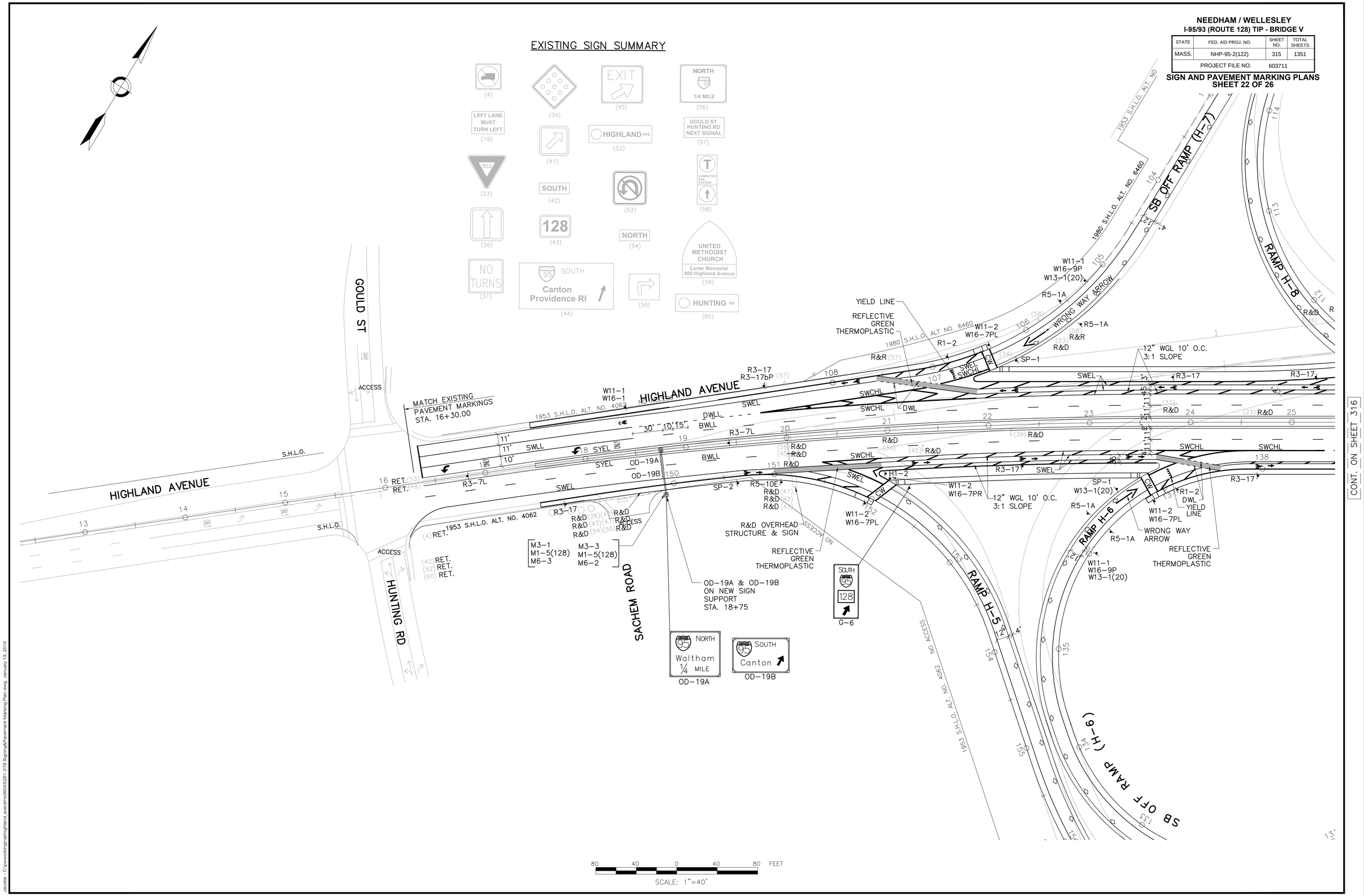
CONT. ON SHEET 313

Jacobs - C:\pwworking\nal\highland_ave\dms36043\261-278 Signing&Pavement Marking Plan.dwg January 13, 2014

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	315	1351
PROJECT FILE NO.		603711	

SIGN AND PAVEMENT MARKING PLANS
SHEET 22 OF 26



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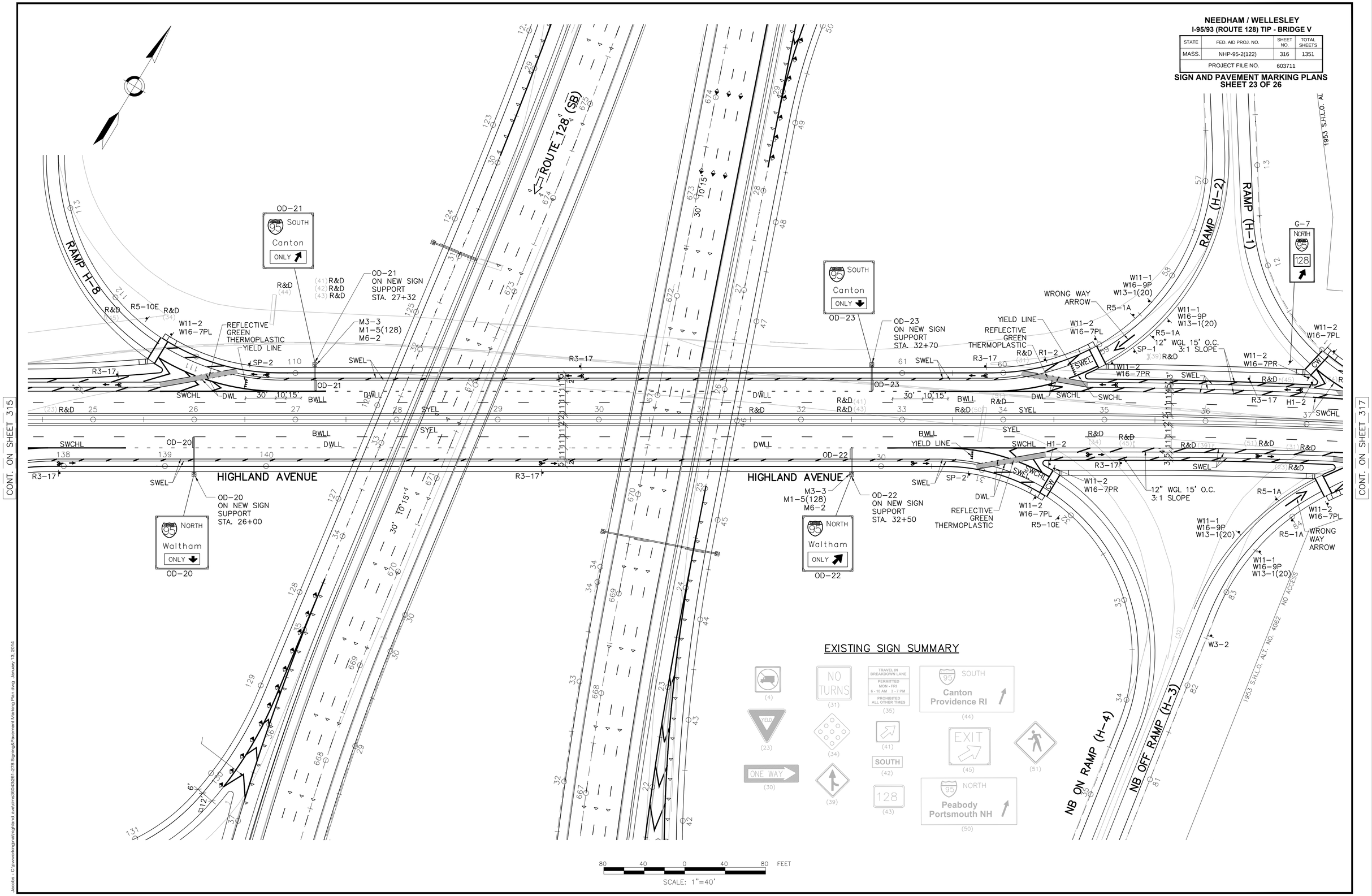
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	316	1351
PROJECT FILE NO.		603711	

SIGN AND PAVEMENT MARKING PLANS
SHEET 23 OF 26



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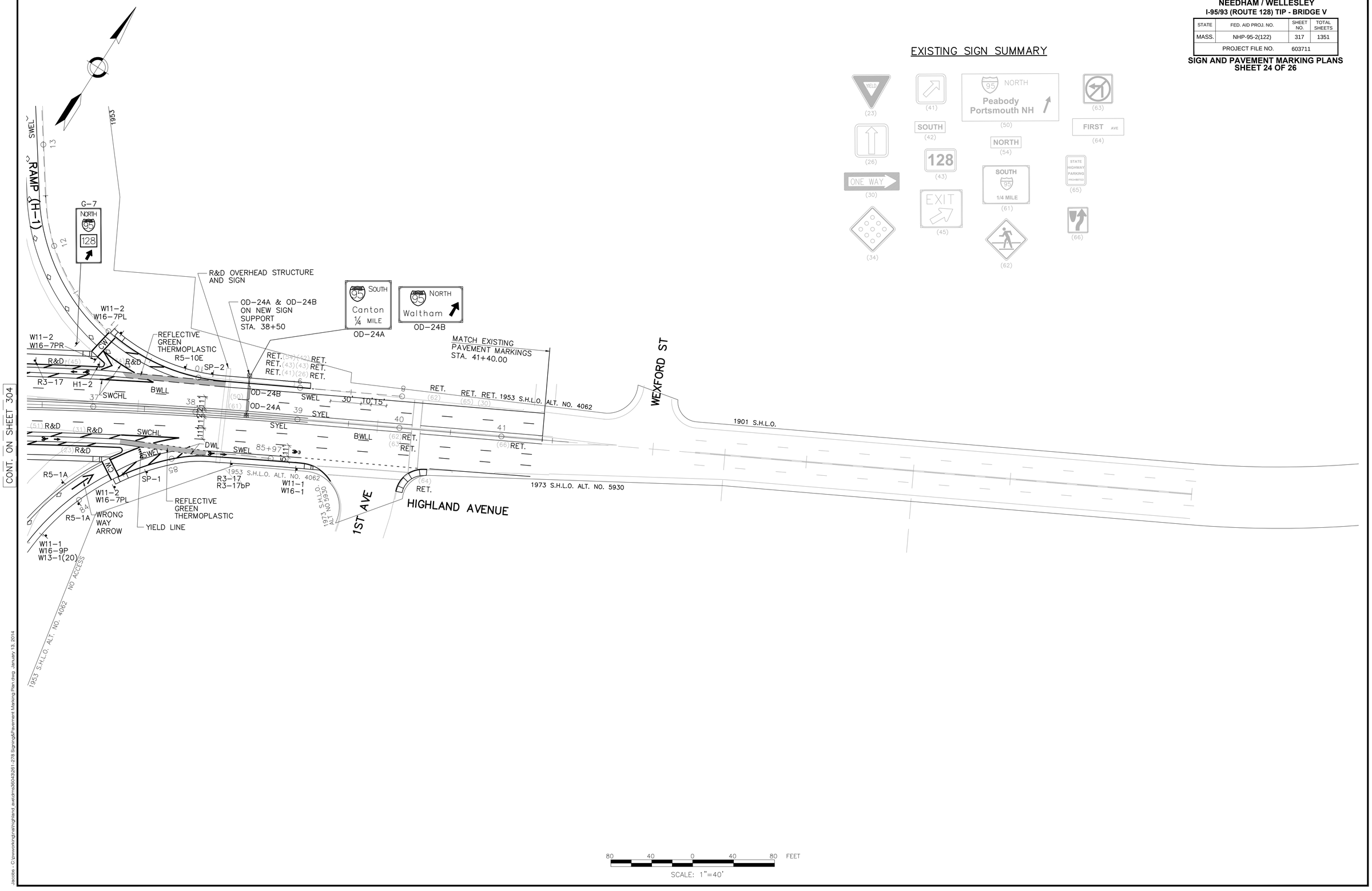
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	317	1351
PROJECT FILE NO.	603711		

SIGN AND PAVEMENT MARKING PLANS
SHEET 24 OF 26

EXISTING SIGN SUMMARY



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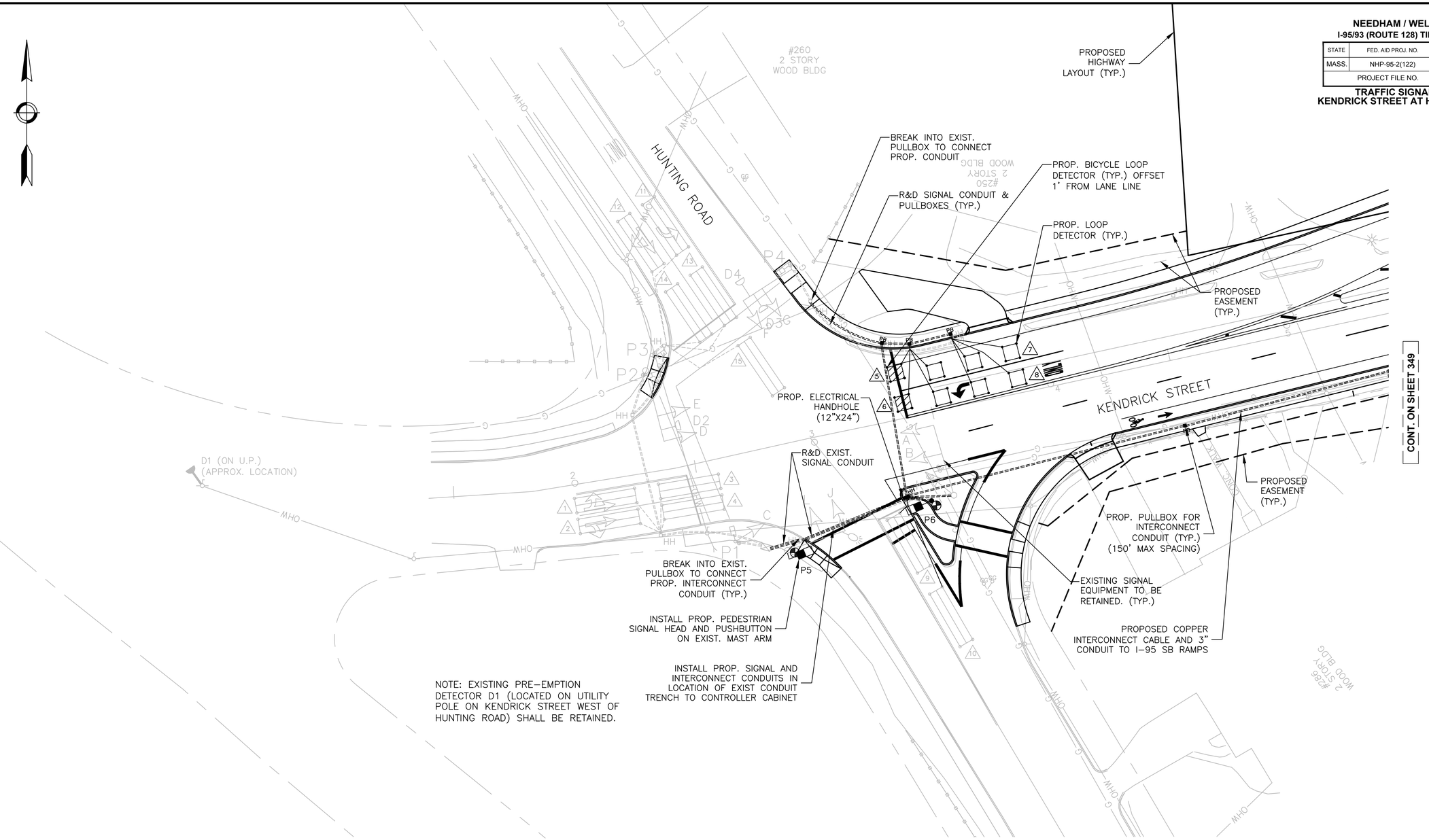
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

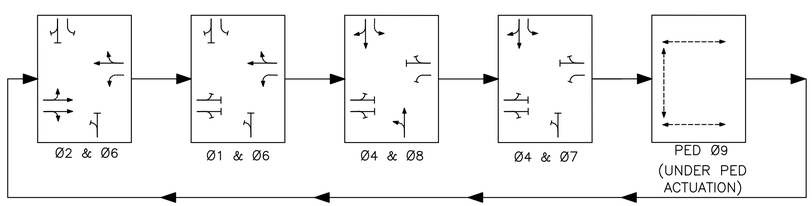
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	347	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL PLAN
KENDRICK STREET AT HUNTING ROAD

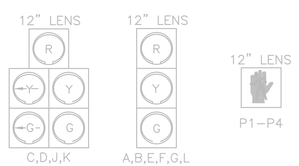


NOTE: EXISTING PRE-EMPTION DETECTOR D1 (LOCATED ON UTILITY POLE ON KENDRICK STREET WEST OF HUNTING ROAD) SHALL BE RETAINED.

PREFERENTIAL PHASING SEQUENCE



EXISTING SIGNAL HEAD DATA



Jacobs - I:\eng\Y0451011=Rt 128PSE\Plan\0347-0358 Signals.dwg, January 08, 2014

SEQUENCE AND TIMING

			ø1			ø2			ø4			ø6			ø7			ø8			ø9				PREEMPT øA–D1			PREEMPT øB–D2			PREEMPT øC–D3			PREEMPT øD–D4		
STREET	DIRECTION	HOUSINGS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	FLASH OPER.	13	14	15	16	17	18	16	17	18	16	17	18
KENDRICK STREET	E.B.	A,B	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	FY	G	Y	R	R	R	R	R	R	R	R	R	R
KENDRICK STREET	W.B.	C,D	R/~~G~~	R/~~Y~~	R	R	R	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	FY	R	R	R	G/~~G~~	Y/~~Y~~	R	R	R	R	R	R	R
KENDRICK STREET	W.B.	E	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	FY	R	R	R	G	Y	R	R	R	R	R	R	R
HUNTING ROAD	N.B.	F,G	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	FR	R	R	R	R	R	R	G	Y	R	R	R	R
HUNTING ROAD	S.B.	J,K	R	R	R	R	R	R	G	Y	R	R	R	R	R/~~G~~	R/~~Y~~	R	R	R	R	R	R	R	FR	R	R	R	R	R	R	R	R	R	~~G~~/G	~~Y~~/Y	R
HUNTING ROAD	S.B.	L	R	R	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	FR	R	R	R	R	R	R	R	R	R	G	Y	R
PEDESTRIAN	ALL	P1 – P6	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	W	FDW	DW	OUT	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW
TIMING IN SECONDS																																				
MINIMUM INTERVAL			7			10			10			10			7			10						EMERGENCY ONLY	*			*			*			*		
VEHICLE EXTENSION			2			2			2			2			2			2																		
MAXIMUM I		FREE	10			28			27			16			10			15																		
MAXIMUM II		COORDINATED	8			43			48			56			7			36																		
YELLOW AND RED CLEARANCE				4	1		4	1		4	1		4	1		4	1		4	1						4	1		4	1		4	1		4	1
WALK																					7															
PEDESTRIAN CLEARANCE																						15	3													
RECALL				OFF			SOFT			OFF			SOFT			OFF			OFF			OFF				–			–			–			–		
MEMORY				NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			LOCK				–			–			–			–		

NOTE: FLASHING OPERATION PER MUTCD SECTIONS 4D.28–4D.31.

* HOLD ON INPUT PLUS 10 SECONDS (20 SEC MINIMUM/120 SEC MAXIMUM)

DETECTOR DATA

DETECTOR NO.	NO. SECTION/ SIZE	NO. OF TURNS	CALL DELAY (SEC)	CALL PHASE	SWITCH+EXTEND PHASE	MODE	LOOP CONNECTION
1	1–6'X25'	TYPE Q	0	ø2	–	PRESENCE	–
2	1–6'X25'	TYPE Q	0	ø2	–	PRESENCE	–
3	1–6'X25'	TYPE Q	0	ø2	–	PRESENCE	–
4	1–6'X25'	TYPE Q	0	ø2	–	PRESENCE	–
5	1–6'X6'	TYPE D–2	0	ø6	–	PRESENCE/ BICYCLE	–
6	1–6'X6'	TYPE D–2	0	ø6	ø1	PRESENCE/ BICYCLE	–
7	3–6'X6'	3	0	ø6	–	PRESENCE	SERIES
8	3–6'X6'	3	0	ø6	ø1	PRESENCE	SERIES
9	1–6'X25'	TYPE Q	0	ø8	–	PRESENCE	–
10	1–6'X25'	TYPE Q	0	ø8	–	PRESENCE	–
11	1–6'X25'	TYPE Q	0	ø7	–	PRESENCE	–
12	1–6'X25'	TYPE Q	0	ø4	–	PRESENCE	–
13	1–6'X25'	TYPE Q	0	ø7	–	PRESENCE	–
14	1–6'X25'	TYPE Q	0	ø4	–	PRESENCE	–

LIST OF MAJOR ITEMS REQUIRED

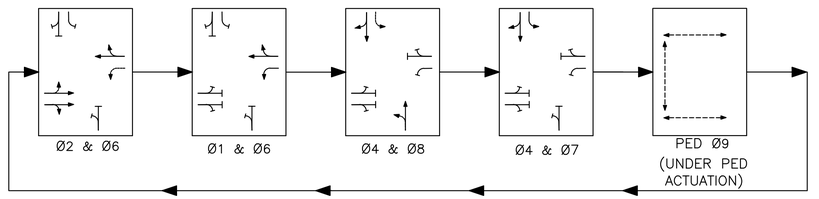
PAY ITEM	QUANTITY	DESCRIPTION
816.03	1	CONNECTION TO INTERCONNECT SYSTEM
	8	WIRE LOOP DETECTOR – SIZE VARIES
	2	DUAL CHANNEL LOOP DETECTOR AMPLIFIER (RACK MOUNTED)
	1	TRAFFIC SIGNAL POST AND BASE STANDARD– 8'
	2	PEDESTRIAN PUSH BUTTON DETECTORS (APS–CAPABLE)
	2	PEDESTRIAN SIGNAL HEAD, SINGLE SECTION, LED, 12" LENS
811.31	3	PULL BOX – 12" x 12"
811.22	1	ELECTRIC HANDHOLE – 12" x 24"

PLUS NECESSARY DUCT, CABLE, LABOR, MISCELLANEOUS MATERIAL AND EQUIPMENT TO COMPLETE THE INSTALLATION AND PROVIDE AN OPERATING TRAFFIC CONTROL SIGNAL.

EMERGENCY PRE–EMPTION NOTES:

1. THE EMERGENCY BEACON SHALL CONSIST OF A FLASHING WHITE STROBE AND SHALL FLASH WHEN THE EMERGENCY VEHICLE HAS CONTROL OF THE INTERSECTION.
2. WHEN ACTIVATED BY AN EMERGENCY VEHICLE, THE SIGNAL SHALL TERMINATE ALL GREEN INDICATIONS IMMEDIATELY, FOLLOWED BY THE COMPLETE YELLOW AND RED CLEARANCE INTERVALS, ACCORDINGLY. THE GREEN INTERVAL FOR THE PRE–EMPTED PHASE SHALL THEN FOLLOW.
3. IF ADDITIONAL PRE–EMPTION PHASES ARE ACTIVATED WHILE IN PRE–EMPTION, THE ORIGINAL PRE–EMPTION PHASE SHALL TIME OUT BEFORE PROCEEDING TO THE NEXT PRE–EMPTION PHASE.
4. UPON COMPLETION OF PRE–EMPTION, IN RETURNING TO NORMAL OPERATION, ϕ2 AND ϕ6 SHALL FOLLOW.
5. IN EMERGENCY PRE–EMPTION, NO PRIORITY SHALL BE ESTABLISHED, PRE–EMPTION SHALL BE A "FIRST COME, FIRST SERVE" OPERATION.
6. EMERGENCY PRE–EMPTION SHALL OVERRIDE COORDINATION.

PREFERENTIAL PHASING SEQUENCE



NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	348	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL DATA
KENDRICK STREET AT HUNTING ROAD

DAILY AND WEEKLY PROGRAM

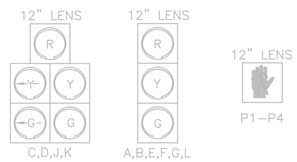
	MONDAY THRU FRIDAY	SATURDAY	SUNDAY
PLAN 1	5:30 AM– 10:00 AM	–	–
PLAN 2	3:00 PM– 7:00 PM	–	–
PLAN 3	10:00 AM– 3:00 PM	9:00 AM– 9:00 PM	10:00 AM– 7:00 PM
FREE OPERATION	ALL OTHER TIMES	ALL OTHER TIMES	ALL OTHER TIMES

COORDINATION DATA

(ALL ENTRIES IN SECONDS)

	PLAN 1	PLAN 2	PLAN 3
CYCLE LENGTH	130 SEC	125 SEC	100 SEC
OFFSET	123	116	87
ø2 & ø6	39	48	25
ø1 & ø6	13	13	12
ø4 & ø8	41	27	26
ø4 & ø7	12	12	12
PED ø9	25	25	25
COORDINATED PHASE	ø2 & ø6	ø2 & ø6	ø2 & ø6

EXISTING SIGNAL HEAD DATA



CONSTRUCTION NOTES:

1. RETAIN ALL EXISTING SIGNS UNLESS OTHERWISE NOTED.
2. PULLBOXES SHALL BE ADJACENT TO CURB UNLESS OTHERWISE NOTED.
3. SEE PAVEMENT MARKING AND SIGNING PLANS FOR DETAILED PAVEMENT MARKING AND SIGNING INFORMATION.
4. PAVEMENT MARKINGS (NOT SHOWN), WINDING DETAILS, AND R10–22 SIGN (NOT SHOWN) FOR BICYCLE DETECTORS SHALL CONFORM TO THE BICYCLE DETECTOR DETAIL SHEET. (SEE TRAFFIC SIGNAL DETAIL SHEET 9.)

SIGNAL NOTES:

1. EXISTING LOOP DETECTORS AT THE KENDRICK STREET WB APPROACH SHALL BE ABANDONED IN PLACE.
2. ALL OTHER SIGNAL EQUIPMENT AT THIS LOCATION SHALL BE RETAINED, UNLESS OTHERWISE NOTED.
3. STANDARD NEMA PHASING IN A DUAL RING CONFIGURATION SHALL BE USED.
4. SIGNAL TO OPERATE IN COORDINATION WITH PROPOSED SIGNAL AT I–95 SB RAMPS AND EXISTING SIGNAL AT THIRD AVENUE.
5. ONLY SIGNS TO BE MOUNTED ON SIGNAL EQUIPMENT ARE SHOWN ON THIS PLAN. SEE SIGN AND PAVEMENT MARKING PLANS FOR ALL OTHER SIGNS.
6. EACH LOOP DETECTOR GROUP SHALL BE CONNECTED TO A SINGLE LOOP AMPLIFIER CHANNEL.
7. ALL DETECTOR SETTINGS TO BE IMPLEMENTED AT THE CONTROLLER ONLY.
8. UNLESS OTHERWISE NOTED, LOOP DETECTORS SHALL BE PLACED IN THE CENTER OF THE LANE.
9. EXCLUSIVE PEDESTRIAN PHASE IS TO BE ACTIVATED BY PUSH BUTTON ONLY.

SEQUENCE & TIMING NOTES:

1. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT WILL NOT CHANGE DURING THE CLEARANCE INTERVAL.
2. IF THE ASSIGNED RIGHT–OF–WAY FOR ANY TRAFFIC MOVEMENT IS TO CHANGE DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATION FOR THAT TRAFFIC MOVEMENT WILL DISPLAY THE APPROPRIATE CLEARANCE INTERVALS.
3. THE RIGHT OF WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON–CONFLICTING PHASES.
4. IF CALLS EXIST ON ALL PHASES, THE ASSIGNMENT OF RIGHT OF WAY SHALL BE IN ACCORDANCE WITH THE PREFERENTIAL PHASE SEQUENCE.
5. FLASHING OPERATION IS FOR EMERGENCY ONLY. THE SIGNAL SHALL PROVIDE STOP AND GO OPERATION 24 HOURS DAILY.
6. Ø3 AND Ø5 SHALL NOT BE USED.
7. THE CONTRACTOR SHALL MONITOR TRAFFIC CONDITIONS DURING CONSTRUCTION AND ADJUST SIGNAL TIMINGS AT STUDY AREA INTERSECTIONS AS NECESSARY AND AS DIRECTED BY THE ENGINEER.

Jacobs - I:\engy\Y04510.11-Rt 128-PS&E\Plots\0347-0358 Signals.dwg, January 09, 2014

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	349	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL PLAN
KENDRICK STREET AT I-95 SB RAMPS

PROP. QUEUE DETECTOR (TO BE INSTALLED 1000' FROM STOP LINE AT RAMP K–5 STA. 70+26±)

W3–3 (TO BE INSTALLED 250' FROM STOP LINE)

6'X8'

6'X10'

PROP. 35' MAST ARM

PROP. ELECTRICAL CONNECTION (UNDERGROUND) TO EMH (PROP. BY OTHERS)

PROP. LOOP DETECTOR (TYP.)

PROP. VIDEO DETECTION CAMERA

PROP. BICYCLE LOOP DETECTOR OFFSET 1.5' FROM CURB

RAMP K–5

KENDRICK STREET

PROPOSED TAKING (TYP.)

6X60 DETECTION ZONE

R3–2

R10–15

R10–11a

35' M.A.

PROP. EMERGENCY PRE–EMPTION DETECTOR (TYP.)

PROPOSED COPPER INTERCONNECT CABLE AND 3" CONDUIT TO THIRD AVENUE

PROPOSED COPPER INTERCONNECT CABLE & 3" RGS CONDUIT MOUNTED ON BRIDGE DECK

PROP. PRE–EMPTION CONFIRMATION BEACON

PROP. 35' MAST ARM (INSTALLED ON CONCRETE WALL)

PROP. 3" SIGNAL AND INTERCONNECT CONDUITS (TYP.)

PROPOSED EASEMENT (TYP.)

PROP. ELECTRIC HANDHOLE (12"X24")

PROP. PULLBOX FOR INTERCONNECT CONDUIT (TYP.) (150' MAX SPACING)

PROP. SYSTEM MASTER AND LOCAL CONTROLLERS, CABINET, FOUNDATION, AND CONCRETE PAD

PROPOSED COPPER INTERCONNECT CABLE AND 3" CONDUIT TO HUNTING ROAD

RAMP K–4

CONT. ON SHEET 347

CONT. BELOW

SIGNAL HEAD DATA

12" LED LENS	12" LED LENS	12" LED LENS	12" LED LENS
B,G,H	C,D	A,E,F	P1–P6

NOTE: ALL PROPOSED SIGNAL HEADS SHALL HAVE TUNNEL VISORS AND 5" BACKPLATES.

PREFERENTIAL PHASING SEQUENCE

Ø1 & 6 — Ø2 & 6 — Ø4

CONT. ABOVE

PROPOSED LIMIT OF LAND TAKING (TYP.)

OHW

PROP. PULLBOX FOR INTERCONNECT CONDUIT (TYP.) (150' MAX SPACING)

KENDRICK STREET

PROPOSED COPPER INTERCONNECT CABLE AND 3" CONDUIT TO THIRD AVENUE

PROPOSED EASEMENT (TYP.)

20 0 20 40
SCALE IN FEET

CONT. ON SHEET 351

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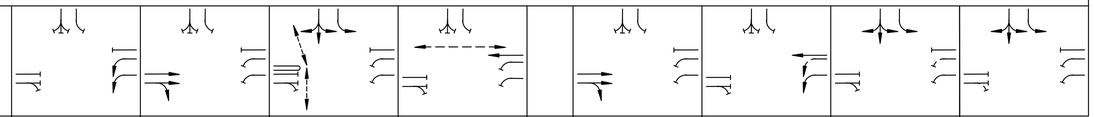
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	350	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL DATA
KENDRICK STREET AT I-95 SB RAMPS

SEQUENCE AND TIMING



			ø1			ø2			ø4			ø6			FLASH OPER.	PREEMPT øA–D1			PREEMPT øB–D2			PREEMPT øC–D3			PREEMPT øD–QUEUE		
STREET	DIRECTION	HOUSINGS	1	2	3	4	5	6	7	8	9	10	11	12		13	14	15	16	17	18	19	20	21	22	23	24
KENDRICK STREET	E.B.	A	R	R	R	↑	Y	R	R	R	R	R	R	R	FY	↑	Y	R	R	R	R	R	R	R	R	R	R
KENDRICK STREET	E.B.	B	R	R	R	G	Y	R	R	R	R	R	R	R	FY	G	Y	R	R	R	R	R	R	R	R	R	R
KENDRICK STREET	W.B.	C,D	~~G~~	~~Y~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~FR~~	~~R~~	~~R~~	~~R~~	~~G~~	~~Y~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~
KENDRICK STREET	W.B.	E,F	R	R	R	R	R	R	R	R	R	↑	Y	R	FY	R	R	R	↑	Y	R	R	R	R	R	R	R
RAMP K–5	S.B.	G,H	R	R	R	R	R	R	G	Y	R	R	R	R	FR	R	R	R	R	R	R	G	Y	R	G	Y	R
PEDESTRIAN	EB–WB	P1 – P2	DW	DW	DW	DW	DW	DW	DW	DW	DW	W/FDW	DW	DW	OUT	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW
PEDESTRIAN	WB–SB	P3 – P6	DW	DW	DW	DW	DW	DW	W/FDW	DW	DW	DW	DW	DW	OUT	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW
TIMING IN SECONDS																											
MINIMUM INTERVAL			7			10			7			10			EMERGENCY ONLY										30		
VEHICLE EXTENSION			2			2			2			2				*			*			*			0		
MAXIMUM I		FREE	11			38			33			49													30		
MAXIMUM II		COORDINATED	41			56			52			78													30		
YELLOW AND RED CLEARANCE				3	1		3	1		3	1		3	1			3	1		3	1		3	1		3	1
WALK									7			7															
PEDESTRIAN CLEARANCE									22	3	1	17	3	1													
RECALL			OFF			SOFT			OFF			SOFT				–			–			–			–		
MEMORY			NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK				–			–			–			–		

NOTE: FLASHING OPERATION PER MUTCD SECTION 4D.28–4D.31.

* HOLD ON INPUT PLUS 10 SECONDS (20 SEC MINIMUM/120 SEC MAXIMUM)

DAILY AND WEEKLY PROGRAM

	MONDAY THRU FRIDAY	SATURDAY	SUNDAY
PLAN 1	5:30 AM– 10:00 AM	–	–
PLAN 2	3:00 PM– 7:00 PM	–	–
PLAN 3	10:00 AM– 3:00 PM	9:00 AM– 9:00 PM	10:00 AM– 7:00 PM
FREE OPERATION	ALL OTHER TIMES	ALL OTHER TIMES	ALL OTHER TIMES

DETECTOR DATA

DETECTOR NO.	NO. SECTION/ SIZE	NO. OF TURNS	CALL DELAY (SEC)	CALL PHASE	SWITCH+EXTEND PHASE	MODE	LOOP CONNECTION
1	4–6'X6'	3	0	ø2	–	PRESENCE	SERIES/ PARALLEL
2	3–6'X6'	3	0	ø2	–	PRESENCE	SERIES/ PARALLEL
3	1–6'X6'	D–2	0	ø2	–	PRESENCE/ BICYCLE	–
4	VIDEO 6'X60'	–	0	ø1	ø6	PRESENCE	–
5	VIDEO 6'X60'	–	0	ø1	ø6	PRESENCE	–
6	VIDEO 6'X60'	–	0	ø6	–	PRESENCE	–
7	VIDEO 6'X60'	–	0	ø6	–	PRESENCE/ BICYCLE	–
8	4–6'X6'	3	0	ø4	–	PRESENCE	SERIES/ PARALLEL
9	2–6'X6', 1–6'X8', 1–6'X10'	3	0	ø4	–	PRESENCE	SERIES/ PARALLEL
10	1–6'X10'	3	10	QUEUE DETECTOR**	–	PRESENCE	–

LIST OF MAJOR ITEMS REQUIRED

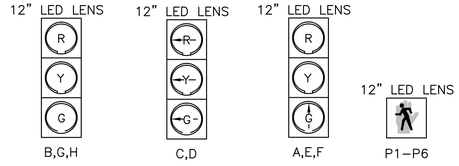
PAY ITEM	QUANTITY	DESCRIPTION
815.3	1	NEW TS2–TYPE 1 CONTROLLER, CABINET TYPE P, FOUNDATION AND CONCRETE PAD
	1	TS2–TYPE 1 CLOSED LOOP SYSTEM MASTER
	1	SERVICE CONNECTION (UNDERGROUND)
	16	WIRE LOOP DETECTOR – SIZE VARIES
	4	2–CHANNEL LOOP DETECTOR AMPLIFIER
	1	VIDEO DETECTION CAMERA
	1	VIDEO DETECTION SYSTEM PROCESSOR
	8	SIGNAL HEAD, 1–WAY, 3 SECTION, 12" LENSES
	6	PEDESTRIAN SIGNAL HEAD, SINGLE SECTION, LED, 12" LENS
	5	PEDESTRIAN PUSH BUTTON DETECTORS (APS–CAPABLE)
	3	35' TRAFFIC SIGNAL MAST ARM
	2	TRAFFIC SIGNAL POST AND BASE STANDARD – 8'
	3	OPTICOM – OPTICAL DETECTOR, UNDIRECTIONAL, SINGLE CHANNEL (700 SERIES)
	1	OPTICOM – 4 CHANNEL PHASE SELECTOR (700 SERIES)
	1	OPTICOM – CARD RACK (700 SERIES)
	1	EMERGENCY PREEMPTION CONFIRMATION BEACON (WHITE)
811.31	26	PULL BOX – 12" x 12"
811.22	1	ELECTRIC HANDHOLE – 12" x 24"

PLUS NECESSARY DUCT, CABLE, LABOR, MISCELLANEOUS MATERIAL AND EQUIPMENT TO COMPLETE THE INSTALLATION AND PROVIDE AN OPERATING TRAFFIC CONTROL SIGNAL.

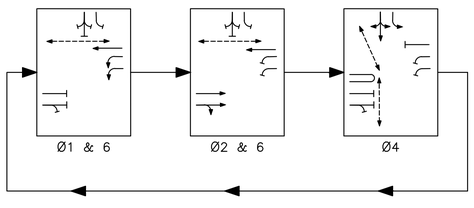
COORDINATION DATA
(ALL ENTRIES IN SECONDS)

	PLAN 1	PLAN 2	PLAN 3
CYCLE LENGTH	130 SEC	125 SEC	100 SEC
OFFSET	0	0	0
ø1 & ø6	14	45	11
ø2 & ø6	60	37	46
ø4	56	43	43
COORDINATED PHASE	ø2 & ø6	ø2 & ø6	ø2 & ø6

SIGNAL HEAD DATA



PREFERENTIAL PHASING SEQUENCE



**QUEUE DETECTOR NOTES:

1. A PRE–EMPTION CALL SHALL BE PLACED INTO THE CONTROLLER AFTER THE DELAY TIME ON THE QUEUE DETECTOR HAS TIMED OUT.
2. QUEUE DETECTOR PRE–EMPTION SHALL CAUSE THE CONTROLLER TO FORCE OFF PHASES CURRENTLY IN OPERATION AND SERVICE ø4.
3. PRE–EMPTION TIMING SHALL OPERATE AS SHOWN IN THE SEQUENCE AND TIMING CHART ON THIS SHEET.
4. UPON TERMINATION OF PRE–EMPTION, THE CONTROLLER SHALL RETURN TO NORMAL OPERATION BY SERVICING ø2 AND ø6.
5. THE CONTROLLER SHALL BE INITIALLY PROGRAMMED TO PROVIDE A MINIMUM RESERVICE TIME OF 2 MINUTES FOR QUEUE DETECTOR PRE–EMPTION.
6. EMERGENCY VEHICLE PRE–EMPTION SHALL OVERRIDE QUEUE DETECTOR PRE–EMPTION.

CONSTRUCTION NOTES:

1. RETAIN ALL EXISTING SIGNS UNLESS OTHERWISE NOTED.
2. PULLBOXES SHALL BE ADJACENT TO CURB UNLESS OTHERWISE NOTED.
3. SEE PAVEMENT MARKING AND SIGNING PLANS FOR DETAILED PAVEMENT MARKING AND SIGNING INFORMATION.
4. PAVEMENT MARKINGS (NOT SHOWN), WINDING DETAILS, AND R10–22 SIGN (NOT SHOWN) FOR BICYCLE DETECTORS SHALL CONFORM TO THE BICYCLE DETECTOR DETAIL SHEET. (SEE TRAFFIC SIGNAL DETAIL SHEET 9.)

SIGNAL NOTES:

1. STANDARD NEMA PHASING IN A DUAL RING CONFIGURATION SHALL BE USED.
2. SIGNAL TO OPERATE IN COORDINATION WITH EXISTING SIGNALS AT THIRD AVENUE AND HUNTING ROAD.
3. ONLY SIGNS TO BE MOUNTED ON SIGNAL EQUIPMENT ARE SHOWN ON THIS PLAN. SEE SIGN AND PAVEMENT MARKING PLANS FOR ALL OTHER SIGNS.
4. EACH LOOP DETECTOR GROUP SHALL BE CONNECTED TO A SINGLE LOOP AMPLIFIER CHANNEL.
5. ALL DETECTOR SETTINGS TO BE IMPLEMENTED AT THE CONTROLLER ONLY.
6. UNLESS OTHERWISE NOTED, LOOP DETECTORS SHALL BE PLACED IN THE CENTER OF THE LANE.

NOTE: ALL PROPOSED SIGNAL HEADS SHALL HAVE TUNNEL VISORS AND 5" BACKPLATES.

SEQUENCE & TIMING NOTES:

1. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT WILL NOT CHANGE DURING THE CLEARANCE INTERVAL.
2. IF THE ASSIGNED RIGHT–OF–WAY FOR ANY TRAFFIC MOVEMENT IS TO CHANGE DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATION FOR THAT TRAFFIC MOVEMENT WILL DISPLAY THE APPROPRIATE CLEARANCE INTERVALS.
3. THE RIGHT OF WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON–CONFLICTING PHASES.
4. IF CALLS EXIST ON ALL PHASES, THE ASSIGNMENT OF RIGHT OF WAY SHALL BE IN ACCORDANCE WITH THE PREFERENTIAL PHASE SEQUENCE.
5. FLASHING OPERATION IS FOR EMERGENCY ONLY. THE SIGNAL SHALL PROVIDE STOP AND GO OPERATION 24 HOURS DAILY.
6. ø3, ø5, ø7 AND ø8 SHALL NOT BE USED.
7. THE CONTRACTOR SHALL MONITOR TRAFFIC CONDITIONS DURING CONSTRUCTION AND ADJUST SIGNAL TIMINGS AT STUDY AREA INTERSECTIONS AS NECESSARY AND AS DIRECTED BY THE ENGINEER.

EMERGENCY PRE–EMPTION NOTES:

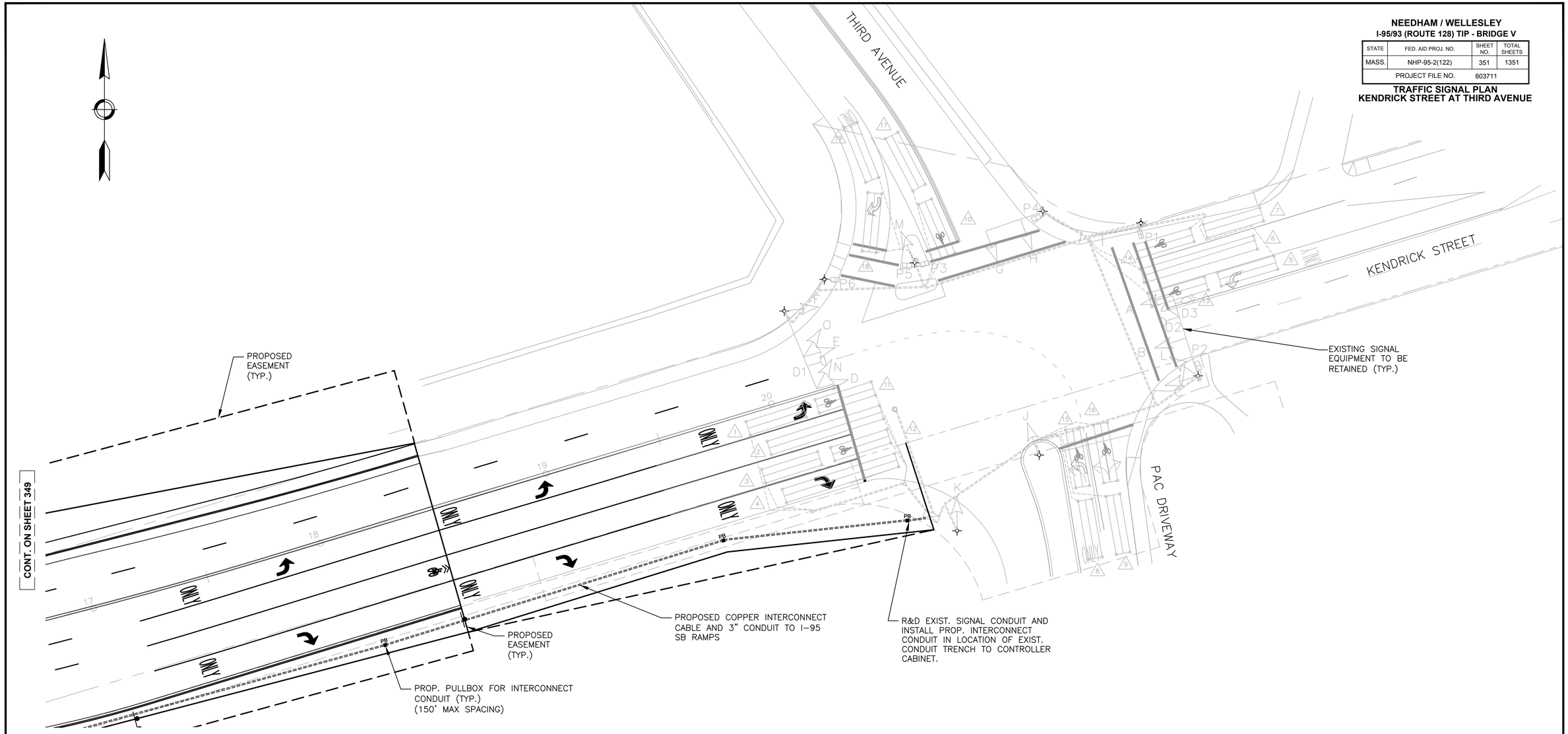
1. THE EMERGENCY BEACON SHALL CONSIST OF A FLASHING WHITE STROBE AND SHALL FLASH WHEN THE EMERGENCY VEHICLE HAS CONTROL OF THE INTERSECTION.
2. WHEN ACTIVATED BY AN EMERGENCY VEHICLE, THE SIGNAL SHALL TERMINATE ALL GREEN INDICATIONS IMMEDIATELY, FOLLOWED BY THE COMPLETE YELLOW AND RED CLEARANCE INTERVALS, ACCORDINGLY. THE GREEN INTERVAL FOR THE PRE–EMPTED PHASE SHALL THEN FOLLOW.
3. IF ADDITIONAL PRE–EMPTION PHASES ARE ACTIVATED WHILE IN PRE–EMPTION, THE ORIGINAL PRE–EMPTION PHASE SHALL TIME OUT BEFORE PROCEEDING TO THE NEXT PRE–EMPTION PHASE.
4. UPON COMPLETION OF PRE–EMPTION, IN RETURNING TO NORMAL OPERATION, ϕ2 AND ϕ6 SHALL FOLLOW.
5. IN EMERGENCY PRE–EMPTION, NO PRIORITY SHALL BE ESTABLISHED, PRE–EMPTION SHALL BE A "FIRST COME, FIRST SERVE" OPERATION.
6. EMERGENCY PRE–EMPTION SHALL OVERRIDE COORDINATION.

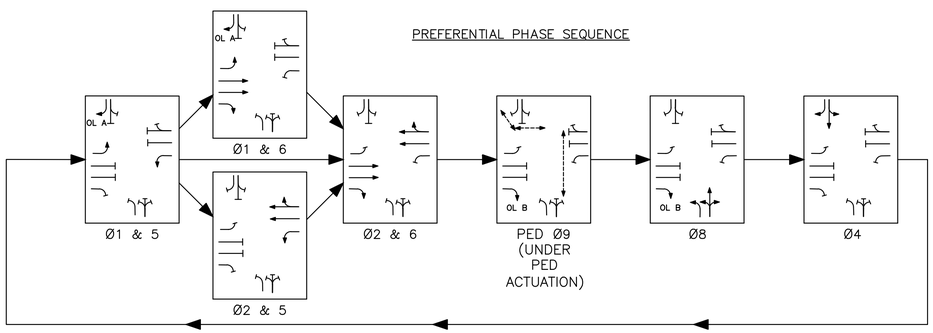
Jacobs - I:\engr\Y04510.11-Rt 128\PS&E\Prof\0347-0358 Signals.dwg, January 08, 2014

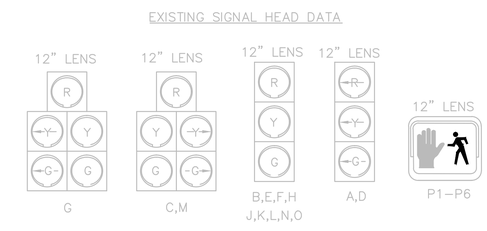
NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	351	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL PLAN
KENDRICK STREET AT THIRD AVENUE







Jacobs - I:\eng\Y04510.11=Rt 128\PS&E\Plot\0347-0358 Signals.dwg January 08, 2014

SEQUENCE AND TIMING

			OL A															OL B			OL B				PREEMPT ØA–D1			PREEMPT ØB–D2			PREEMPT ØC–D3		
			ø1			ø2			ø4			ø5			ø6			ø8			ø9													
STREET	DIRECTION	HOUSINGS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	FLASH OPER.	1	2	3	4	5	6	7	8	9
KENDRICK STREET	E.B.	A	~~G~~	~~Y~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~FR~~	R	R	R	~~G~~	~~Y~~	~~R~~	R	R	R
KENDRICK STREET	E.B.	B	R	R	R	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	R	R	R	FY	R	R	R	G	Y	R	R	R	R
KENDRICK STREET	E.B.	C	R	R	R	R	R	R	R	R	R	R	R	R	G	Y	R	R/~~G~~	R/~~Y~~	R	R/~~G~~	R/~~Y~~	R	FY	R	R	R	G/~~G~~	Y/~~Y~~	R	R	R	R
KENDRICK STREET	W.B.	D	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~G~~	~~Y~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~FR~~	~~G~~	~~Y~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~	~~R~~
KENDRICK STREET	W.B.	E,F	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	FY	G	Y	R	R	R	R	R	R	R
PAC DRIVEWAY	N.B.	G	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	~~G~~/G	~~Y~~/Y	R	R	R	R	FR	R	R	R	R	R	R	R	R	R
PAC DRIVEWAY	N.B.	H	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	G	Y	R	R	R	R	FR	R	R	R	R	R	R	R	R	R
THIRD AVENUE	S.B.	J,K,L	R	R	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	FR	R	R	R	R	R	R	G	Y	R
THIRD AVENUE	S.B.	M	R/~~G~~	R/~~Y~~	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	FR	R	R	R	R	R	R	G/~~G~~	Y/~~Y~~	R
THIRD AVENUE	S.B.	N,O	G	Y	R	R	R	R	G	Y	R	R	R	R	R	R	R	R	R	R	R	R	R	FR	R	R	R	R	R	R	G	Y	R
PEDESTRIAN	ALL	P1 – P6	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	W/FDW	DW	DW	OUT	DW	DW	DW	DW	DW	DW	DW	DW	DW
TIMING IN SECONDS																																	
MINIMUM INTERVAL			7			10			10			7			10			7			28												
VEHICLE EXTENSION			2			2			2			2			2			2			0												
MAXIMUM I		FREE	40			20			15			15			49			16			28												
MAXIMUM II		COORDINATED	46			42			11			8			62			10			28												
YELLOW AND RED CLEARANCE				4	1		4	1		4	1		4	1		4	1		4	1		4	1			4	1		4	1		4	1
WALK																					7/21	22											
PEDESTRIAN CLEARANCE																							4										
RECALL				OFF			SOFT			OFF			OFF			SOFT			OFF			OFF				–			–			–	
MEMORY				NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			NON–LOCK			LOCK				–			–			–	

NOTE: FLASHING OPERATION PER MUTCD SECTION 4D.28–4D.31.

* HOLD ON INPUT PLUS 10 SECONDS (20 SEC MINIMUM/120 SEC MAXIMUM)

EMERGENCY ONLY

NEEDHAM / WELLESLEY
I-95/93 (ROUTE 128) TIP - BRIDGE V

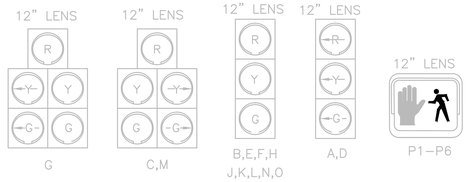
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	NHP-95-2(122)	352	1351
PROJECT FILE NO.	603711		

TRAFFIC SIGNAL DATA
KENDRICK STREET AT THIRD AVENUE

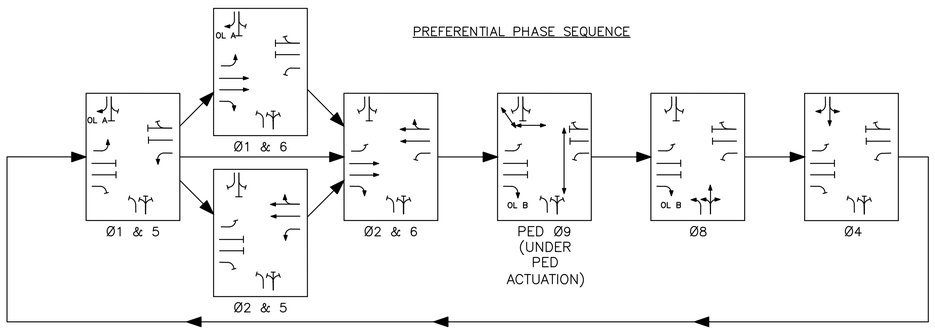
DAILY AND WEEKLY PROGRAM

	MONDAY THRU FRIDAY	SATURDAY	SUNDAY
PLAN 1	5:30 AM– 10:00 AM	–	–
PLAN 2	3:00 PM– 7:00 PM	–	–
PLAN 3	10:00 AM– 3:00 PM	9:00 AM– 9:00 PM	10:00 AM– 7:00 PM
FREE OPERATION	ALL OTHER TIMES	ALL OTHER TIMES	ALL OTHER TIMES

EXISTING SIGNAL HEAD DATA



PREFERENTIAL PHASE SEQUENCE



LIST OF MAJOR ITEMS REQUIRED

PAY ITEM	QUANTITY	DESCRIPTION
816.02	1	CONNECTION TO INTERCONNECT SYSTEM

PLUS NECESSARY DUCT, CABLE, LABOR, MISCELLANEOUS MATERIAL AND EQUIPMENT TO COMPLETE THE INSTALLATION AND PROVIDE AND OPERATING TRAFFIC CONTROL SYSTEM

COORDINATION DATA
(ALL ENTRIES IN SECONDS)

	PLAN 1	PLAN 2	PLAN 3
CYCLE LENGTH	130 SEC	125 SEC	100 SEC
OFFSET	67	55	39
ø1 & ø5	13	12	12
ø1 & ø6	29	9	6
ø2 & ø6	28	42	22
PED ø9	33	33	33
ø8	12	14	12
ø4	15	15	15
COORDINATED PHASE	ø2 & ø6	ø2 & ø6	ø2 & ø6

DETECTOR DATA

DETECTOR NO.	NO. SECTION/ SIZE	NO. OF TURNS	CALL DELAY (SEC)	CALL PHASE	SWITCH+EXTEND PHASE	MODE	LOOP CONNECTION
1	1–6'x25'	Q	0	ø1	–	PRESENCE/ BICYCLE	–
2	1–6'x50'	Q	0	ø6	–	PRESENCE/ BICYCLE	–
3	1–6'x25'	Q	0	ø6	–	PRESENCE/ BICYCLE	–
4	1–6'x50'	Q	5	ø6	ø8	PRESENCE/ BICYCLE	–
5	1–6'x25'	Q	0	ø5	–	PRESENCE/ BICYCLE	–
6	1–6'x50'	Q	0	ø2	–	PRESENCE/ BICYCLE	–
7	1–6'x25'	Q	5	ø2	–	PRESENCE/ BICYCLE	–
8	1–6'x25'	Q	0	ø8	–	PRESENCE/ BICYCLE	–
9	1–6'x25'	Q	5	ø8	–	PRESENCE/ BICYCLE	–
10	1–6'x25'	Q	0	ø4	–	PRESENCE/ BICYCLE	–
11	1–6'x25'	Q	0	ø1	–	PRESENCE/ BICYCLE	–
12	1–6'x25'	Q	0	ø6	–	PRESENCE/ BICYCLE	–
13	1–6'x25'	Q	0	ø5	–	PRESENCE/ BICYCLE	–
14	1–6'x25'	Q	5	ø2	–	PRESENCE/ BICYCLE	–
15	1–6'x25'	Q	0	ø8	–	PRESENCE/ BICYCLE	–
16	1–6'x25'	Q	5	ø8	–	PRESENCE/ BICYCLE	–
17	1–6'x25'	Q	0	ø4	–	PRESENCE/ BICYCLE	–
18	1–6'x25'	Q	5	ø4	ø1	PRESENCE/ BICYCLE	–
19	1–6'x25'	Q	5	ø4	ø1	PRESENCE/ BICYCLE	–

SIGNAL NOTES:

1. EXISTING SIGNAL EQUIPMENT AT THIS LOCATION SHALL BE RETAINED, UNLESS OTHERWISE NOTED.
2. STANDARD NEMA PHASING IN A DUAL RING CONFIGURATION SHALL BE USED.
3. SIGNAL TO OPERATE IN COORDINATION WITH PROPOSED SIGNAL AT I–95 SB RAMPS AND EXISTING SIGNAL AT HUNTING ROAD.
4. ONLY SIGNS TO BE MOUNTED ON SIGNAL EQUIPMENT ARE SHOWN ON THIS PLAN. SEE SIGN AND PAVEMENT MARKING PLANS FOR ALL OTHER SIGNS.
5. EACH LOOP DETECTOR GROUP SHALL BE CONNECTED TO A SINGLE LOOP AMPLIFIER CHANNEL.
6. ALL DETECTOR SETTINGS TO BE IMPLEMENTED AT THE CONTROLLER ONLY.
7. UNLESS OTHERWISE NOTED, LOOP DETECTORS SHALL BE PLACED IN THE CENTER OF THE LANE.
8. EXCLUSIVE PEDESTRIAN PHASE IS TO BE ACTIVATED BY PUSH BUTTON ONLY.

SEQUENCE & TIMING NOTES:

1. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT WILL NOT CHANGE DURING THE CLEARANCE INTERVAL.
2. IF THE ASSIGNED RIGHT–OF–WAY FOR ANY TRAFFIC MOVEMENT IS TO CHANGE DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATION FOR THAT TRAFFIC MOVEMENT WILL DISPLAY THE APPROPRIATE CLEARANCE INTERVALS.
3. THE RIGHT OF WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON–CONFLICTING PHASES.
4. IF CALLS EXIST ON ALL PHASES, THE ASSIGNMENT OF RIGHT OF WAY SHALL BE IN ACCORDANCE WITH THE PREFERENTIAL PHASE SEQUENCE.
5. FLASHING OPERATION IS FOR EMERGENCY ONLY. THE SIGNAL SHALL PROVIDE STOP AND GO OPERATION 24 HOURS DAILY.
6. Ø3 AND Ø7 SHALL NOT BE USED.
7. THE CONTRACTOR SHALL MONITOR TRAFFIC CONDITIONS DURING CONSTRUCTION AND ADJUST SIGNAL TIMINGS AT STUDY AREA INTERSECTIONS AS NECESSARY AND AS DIRECTED BY THE ENGINEER.

EMERGENCY PRE–EMPTION NOTES:

1. THE EMERGENCY BEACON SHALL CONSIST OF A FLASHING WHITE STROBE AND SHALL FLASH WHEN THE EMERGENCY VEHICLE HAS CONTROL OF THE INTERSECTION.
2. WHEN ACTIVATED BY AN EMERGENCY VEHICLE, THE SIGNAL SHALL TERMINATE ALL GREEN INDICATIONS IMMEDIATELY, FOLLOWED BY THE COMPLETE YELLOW AND RED CLEARANCE INTERVALS, ACCORDINGLY. THE GREEN INTERVAL FOR THE PRE–EMPTED PHASE SHALL THEN FOLLOW.
3. IF ADDITIONAL PRE–EMPTION PHASES ARE ACTIVATED WHILE IN PRE–EMPTION, THE ORIGINAL PRE–EMPTION PHASE SHALL TIME OUT BEFORE PROCEEDING TO THE NEXT PRE–EMPTION PHASE.
4. UPON COMPLETION OF PRE–EMPTION, IN RETURNING TO NORMAL OPERATION, ϕ2 AND ϕ6 SHALL FOLLOW.
5. IN EMERGENCY PRE–EMPTION, NO PRIORITY SHALL BE ESTABLISHED, PRE–EMPTION SHALL BE A "FIRST COME, FIRST SERVE" OPERATION.
6. EMERGENCY PRE–EMPTION SHALL OVERRIDE COORDINATION.

Jacobs - I:\eng\Y0451011=Rt 128PSE\Port\0347-0358 Signals.dwg January 08, 2014

Highland Avenue/1st Avenue Improvements (25 percent Design)

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

PLAN AND PROFILE OF

INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

IN THE TOWN OF

NEEDHAM

NORFOLK COUNTY

FEDERAL AID PROJECT NO.

25% SUBMITTAL

NEEDHAM
INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

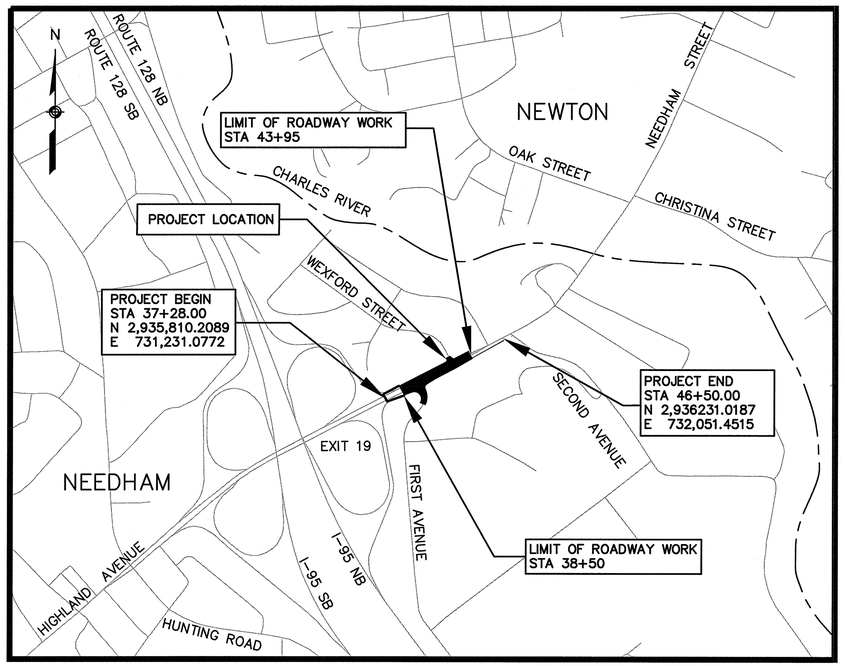
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	-	1	29
PROJECT FILE NO. 607889			

TITLE SHEET AND INDEX

THE MASSACHUSETTS HIGHWAY DEPARTMENT 1988 STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, SUPPLEMENTAL SPECIFICATIONS DATED JUNE 15, 2012, THE STANDARD SPECIAL PROVISIONS, THE 2012 CONSTRUCTION STANDARD DETAILS, THE 1996 TRAFFIC STANDARD DETAILS, THE 2009 "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" WITH MASSACHUSETTS AMENDMENTS, THE 1990 "STANDARD DRAWINGS FOR SIGNS AND SUPPORTS," THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK, WILL GOVERN.

INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET AND INDEX
2	LEGEND AND ABBREVIATIONS
3	GENERAL NOTES
4	KEY PLAN
5	TYPICAL SECTIONS
6-7	CONSTRUCTION PLANS
8-9	PROFILE
10-11	DRAINAGE AND UTILITY PLANS
12	TRAFFIC GENERAL NOTES AND LEGEND
13-14	SIGN AND PAVEMENT MARKING PLANS
15	TRAFFIC SIGN SUMMARY
16-19	TRAFFIC SIGNAL PLANS
20-23	TEMPORARY TRAFFIC CONTROL PLANS
24	CONSTRUCTION SIGN SUMMARY
25	CONSTRUCTION DETAILS
26-29	CROSS SECTIONS



0 500 1000 1500 2000

SCALE: 1" = 500'

LENGTH OF PROJECT = 922.006 FEET = 0.175 MILES

DESIGN DESIGNATION

	HIGHLAND AVENUE
DESIGN SPEED	35 MPH
ADT (2008)	35,500 VPD
ADT (2028)	31,100 VPD
K	7.60%
D	55% WB
T (PEAK HOUR)	1.10%
T (AVERAGE DAY)	4.0%
DHV	2,365
DDHV	1,445
FUNCTIONAL CLASS	URBAN MINOR ARTERIAL

6-2014	25% DESIGN	0
DATE	DESCRIPTION	REV #

FS&T PROJECT NO.			
QM-145U			
DES	----	CHK	MJH
DR	ABD	CHK	MJH
EST	----	CHK	----
ENGINEER IN CHARGE			

ENGINEERS
FST
Since 1914
FAY, SPOFFORD & THORNDIKE
5 BURLINGTON WOODS
BURLINGTON, MA 01803

MassDOT
Massachusetts Department of Transportation
Highway Division

RECOMMENDED FOR APPROVAL

CHIEF ENGINEER — DATE

DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR — DATE

APPROVED

HIGHWAY ADMINISTRATOR — DATE

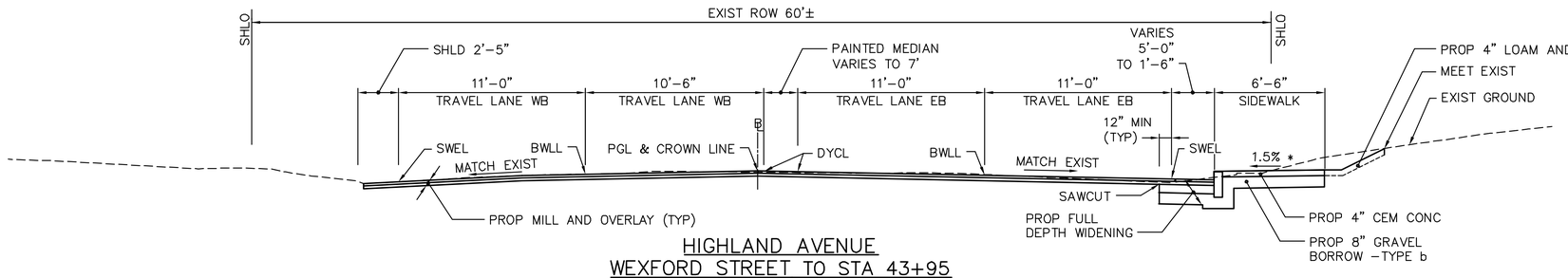
FILE NAME: T:\QM-145U Needham 1st Ave\Drawings\General Plans\01 TITLE.dwg LAYOUT NAME: TITLE PLOTTED: Monday, June 23, 2014 - 2:17pm USER: Dunkel_A

NEEDHAM

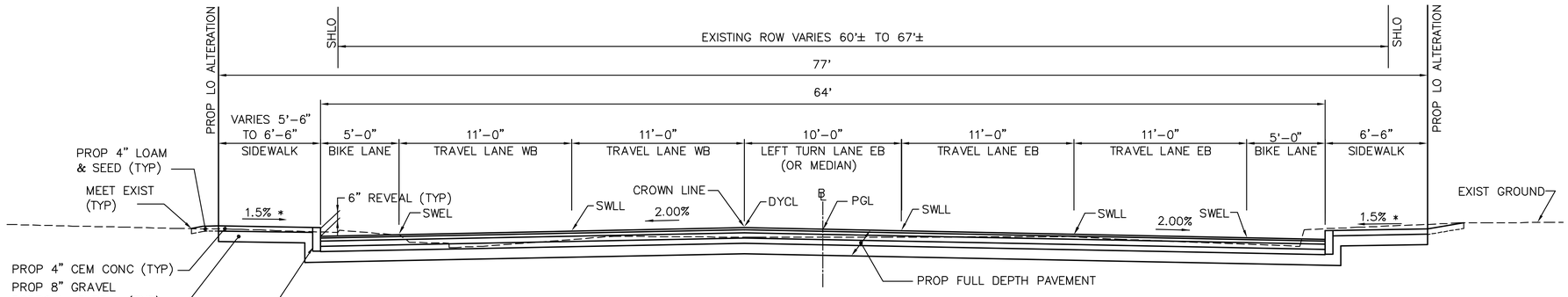
INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	5	29
PROJECT FILE NO. 607889			

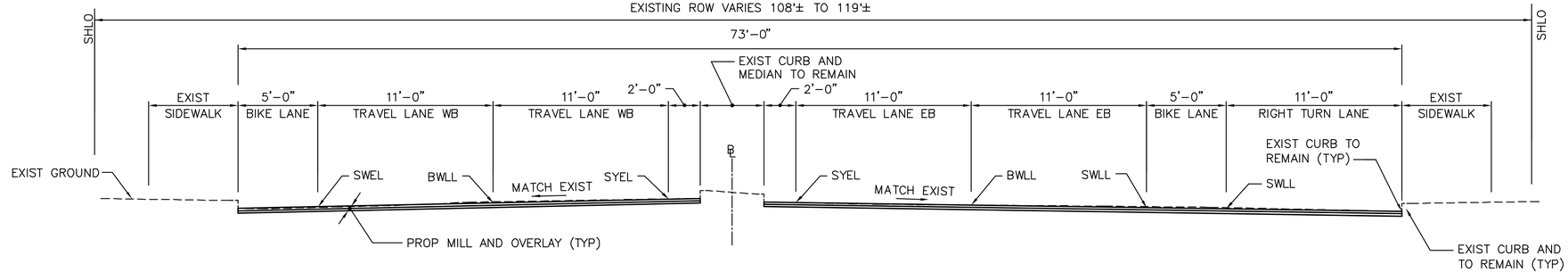
TYPICAL SECTIONS



HIGHLAND AVENUE
WEXFORD STREET TO STA 43+95
NOT TO SCALE



HIGHLAND AVENUE
FIRST AVENUE TO WEXFORD STREET
NOT TO SCALE



HIGHLAND AVENUE
WEST OF FIRST AVENUE
NOT TO SCALE

PAVEMENT NOTES:

MILL AND OVERLAY:

MILL: 4" DEPTH

SURFACE: 4" PLACED IN TWO LAYERS 1 1/2" SSC–9.5 OVER 2 1/2" SIC–19.0, EXISTING PAVEMENT TREATED WITH BITUMEN FOR TACK COAT (RS–1) AT 0.07 GAL/SY

FULL DEPTH PAVEMENT:

SURFACE: 4" HOT MIX ASPHALT PAVEMENT PLACED IN TWO LAYERS: 1 1/2" SSC–9.5 OVER 2 1/2" SIC–19.0,

BASE: 4" SBC–37.5, BITUMEN FOR TACK COAT (RS–1) AT 0.05 GAL/SY

SUBBASE: 4" DENSE GRADED CRUSHED STONE
8" GRAVEL BORROW – TYPE b

FOR FULL DEPTH WIDENING LESS THAN 4 FEET:

SURFACE: 4" HOT MIX ASPHALT PAVEMENT PLACED IN TWO LAYERS: 1 1/2" SSC–9.5 OVER 2 1/2" SIC–19.0,

BASE: 6" HES CEMENT CONCRETE

SUBBASE: 8" GRAVEL BORROW – TYPE b

CEMENT CONCRETE SIDEWALK:

SURFACE: 4" CEMENT CONCRETE AIR ENTRAINED, 4000 PSI, 3/4", 610 LBS

SUBBASE: 8" GRAVEL BORROW – TYPE b

CEMENT CONCRETE WHEELCHAIR RAMP:

SURFACE: 6" CEMENT CONCRETE AIR ENTRAINED, 4000 PSI, 3/4", 610 LBS

SUBBASE: 8" GRAVEL BORROW – TYPE b

CEMENT CONCRETE SIDEWALK AT DRIVEWAY:

SURFACE: 6" CEMENT CONCRETE AIR ENTRAINED, 4000 PSI, 3/4", 610 LBS

SUBBASE: 4" DENSE GRADED CRUSHED STONE
8" GRAVEL BORROW – TYPE b

HOT MIX ASPHALT DRIVEWAY:

SURFACE: 4 1/2" HOT MIX ASPHALT PAVEMENT PLACED IN TWO LAYERS: 1 1/2" SSC–9.5 OVER 3" SIC–19.0

SUBBASE: 4" DENSE GRADED CRUSHED STONE
8" GRAVEL BORROW – TYPE b

* TOLERANCE FOR CONSTRUCTION ±0.5%

FS&T PROJECT NO.			
QM–145U			
DES	PGM	CHK	MJH
DR	ABD	CHK	MJH
EST	----	CHK	----
ENGINEER IN CHARGE			

FILE NAME: T:\QM–145U Needham 1st Ave\Drawings\General Plans\TYPICALS.dwg LAYOUT NAME: Typ Sec PLOTTED: Monday, June 23, 2014 – 1:48pm USER: Dunkel_A

NEEDHAM

INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	13	29
PROJECT FILE NO. 607889			

SIGN AND PAVEMENT MARKING PLAN PART 1 OF 2

BEGIN PROJECT
NO 607889
STA 37+28.00
N 2,935,810.2089
E 731,231.0772

LIMIT OF ROADWAY WORK
STA 38+50±

I-95 NB ON-RAMP

ON SIGN BRIDGE

INTERSTATE 95 SOUTH
Canton
1/4 MILE
(RET)

INTERSTATE 95 NORT
Waltham
(RET)

STA 39+73.53 HIGHLAND AVENUE CONST BL =
STA 270+00.00 FIRST AVENUE CONST BL

ONE WAY
NO LEFT TURN
(R&D)

D3-1-1 (PBS)
(MOUNT ON MAST ARM)

PEDESTRIAN
NO LEFT TURN
(R&D)

RAISED MEDIAN

PEDESTRIAN
(R&D)

STATE HIGHWAY
PARKING PROHIBITED
(R&D)

SOUTH 128
ARROW
(RET)

NORTH 128
ARROW
(RET)

D3-1-2 (PBS)
(MOUNT ON
MAST ARM)

R3-5a
(MOUNT ON
MAST ARM)

MATCH EXIST PAVEMENT MARKINGS

SWLL
BWLL
SYEL
DWLL
DWLEX
SWEL
DYCL
YTL

R3-18
R4-7

R7-4

R3-17

CONT. ON
SH NO 14

HIGHLAND AVENUE

NO PARKING
(R&D)

R3-7R
R10-15

PEDESTRIAN
(R&D)

PROP HIGH FRICTION SURFACE
TREATMENT (GREEN COLORED-BETWEEN
WHITE LANE MARKINGS)

REMOVE EXIST PAVEMENT MARKINGS

NO PARKING
(RET)

NO PARKING
(RET)

I-95 NB OFF-RAMP

PC
+89.00

PCC
+13.27

PT
+87.62

LIMIT OF WORK
STA 271+63

FIRST AVENUE

R3-8(L-R)

R3-5a
(MOUNT ON MAST ARM)

R3-5R
(MOUNT ON MAST ARM)

D3-1-2 (PBS)
(MOUNT ON MAST ARM)

FIRST AVE (R&D)

STOP (R&D)

NO PARKING (RET)

R3-7L

R3-17
R3-17bP

NOTES:
1. FOR TRAFFIC LEGEND AND GENERAL NOTES, SEE SHEET NO 12.
2. FOR EXPLANATION OF SIGN IDENTIFICATION NUMBERS, SEE SHEET NO 15.
3. ALL EXISTING SIGNS TO BE REMOVED AND STACKED UNLESS OTHERWISE NOTED.

20 0 20 40
SCALE IN FEET

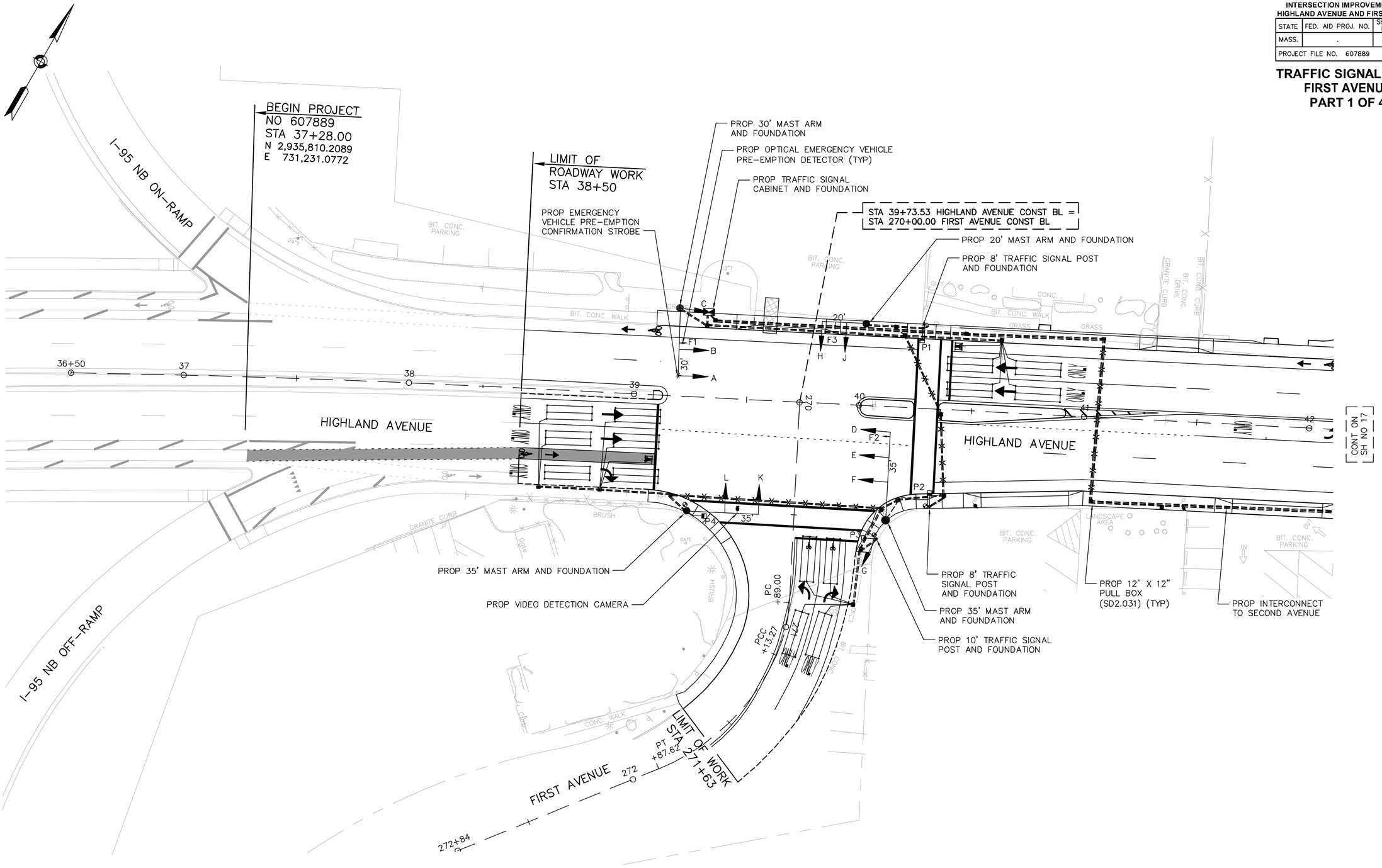
FS&T PROJECT NO.			
QM-145U			
DES	SEB	CHK	ATC
DR	SEB	CHK	ATC
EST	SEB	CHK	ATC
ENGINEER IN CHARGE			

FILE NAME: T:\QM-145U Needham 1st Ave\Drawings\General Plans\Sign Pvmt Mrk.dwg LAYOUT NAME: 05 - FIRST AVE PLOTTED: Monday, June 23, 2014 - 1:50pm USER: Dunkel_A

NEEDHAM
INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	16	29
PROJECT FILE NO. 607889			

TRAFFIC SIGNAL PLAN
FIRST AVENUE
PART 1 OF 4



SCALE IN FEET: 20 0 20 40

FS&T PROJECT NO.			
QM-145U			
DES	ATC	CHK	FAM
DR	SEB	CHK	ATC
EST	SEB	CHK	ATC
ENGINEER IN CHARGE			

FILE NAME: T:\QM-145U Needham 1st Ave\Drawings\General Plans\Traff Signal.dwg LAYOUT NAME: FIRST PLOTTED: Monday, June 23, 2014 - 1:50pm USER: Dunkel_A

NEEDHAM
INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	18	29
PROJECT FILE NO. 607889			

TRAFFIC SIGNAL PLAN
FIRST AVENUE
PART 3 OF 4

SEQUENCE AND TIMING FOR FULLY-ACTUATED TRAFFIC SIGNAL CONTROL

STREET	DIR	HOUSING	NOT USED	ø1			ø2			NOT USED	ø3			ø4			NOT USED	ø5			ø6			NOT USED	ø7			ø8			NOT USED	ø9			FLASHING OPERATION
HIGHLAND AVE	SB	A					Ĝ	Ŷ	R					R	R	R					R	R	R					R	R	R				(Y)
HIGHLAND AVE	NB	B,C					G	Y	R					R	R	R					R	R	R					R	R	R				(Y)
HIGHLAND AVE	SB	D					R	R	R					R	R	R					Ĝ	Ŷ	R					R	R	R				(Y)
HIGHLAND AVE	NB	E					R	R	R					R	R	R					G	Y	R					R	R	R				(Y)
HIGHLAND AVE	NB	F					R	R	R					R	R	R					G	Y	R					R/G>	R/Y>	R				(Y)
FIRST AVE	WB	G,J					R	R	R					R	R	R					R	R	R					G	Y	R				(R)
FIRST AVE	WB	H					R	R	R					R	R	R					R	R	R					<G/G	Y	R				(R)
DRIVEWAY	EB	H					R	R	R					<G/G	Y	R					R	R	R					R	R	R				(R)
DRIVEWAY	EB	J					R	R	R					G	Y	R					R	R	R					R	R	R				(R)
PEDESTRIAN		P1-P2					DW	DW	DW					W	FDW	DW					DW	DW	DW					DW	DW	DW				OUT
PEDESTRIAN		P3-P4					W	FDW	DW					DW	DW	DW					DW	DW	DW					DW	DW	DW				OUT
INTERVALS (IN SECONDS)	MINIMUM GREEN						10							4							10							6						EMERGENCY ONLY
	EXTENSION INTERVAL						2							2							2							2						
	MAXIMUM I						50							28							50							20						
	MAXIMUM II						50							28							50							30						
	CLEARANCE INTERVAL							3.5	1.5						3	3						3.5	1.5						3	3				
	"WALK" INTERVAL						7							7																			
	PED CLEARANCE INTERVAL							21	2						21	3																		
DETECTOR MEMORY							NON-LOCK							NON-LOCK							NON-LOCK							NON-LOCK						
RECALL SWITCH							SOFT							OFF							SOFT							OFF						

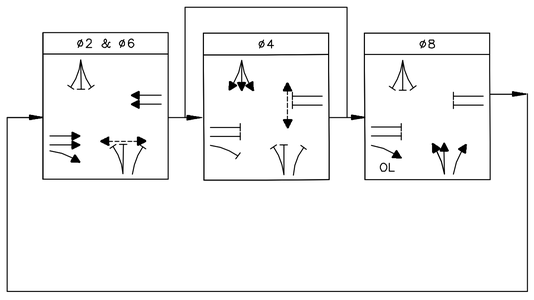
EMERGENCY PRE-EMPTION

STREET	DIR	HOUSING	øF1			øF2			øF3		
HIGHLAND AVE	SB	A	Ĝ	Ŷ	R	R	R	R	R	R	R
HIGHLAND AVE	NB	B,C	G	Y	R	R	R	R	R	R	R
HIGHLAND AVE	SB	D	R	R	R	Ĝ	Ŷ	R	R	R	R
HIGHLAND AVE	NB	E	R	R	R	G	Y	R	R	R	R
HIGHLAND AVE	NB	F	R	R	R	G	Y	R	R	R	R
FIRST AVE	WB	G,J	R	R	R	R	R	R	G	Y	R
FIRST AVE	WB	H	R	R	R	R	R	R	<G/G	Y	R
DRIVEWAY	EB	H	R	R	R	R	R	R	R	R	R
DRIVEWAY	EB	J	R	R	R	R	R	R	R	R	R
PEDESTRIAN		P1-P2	DW	DW	DW	DW	DW	DW	DW	DW	DW
PEDESTRIAN		P3-P4	DW	DW	DW	DW	DW	DW	DW	DW	DW
INTERVALS (IN SECONDS)	MINIMUM GREEN		6			6			6		
	EXTENSION INTERVAL										
	MAXIMUM I										
	MAXIMUM II										
	CLEARANCE INTERVAL			3.5	1.5		3.5	1.5		3	3
	"WALK" INTERVAL										
	PED CLEARANCE INTERVAL										

TECHNICAL NOTES

1. ANY PHASE NOT CALLED WILL BE SKIPPED. SIGNAL INDICATION WILL NOT CHANGE IF THE ASSIGNED RIGHT OF WAY DOES NOT CHANGE DURING THE NEXT PHASE CALLED.
2. THE RIGHT OF WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON-CONFLICTING PHASES. IF CALLS EXIST ON ALL PHASES, THE RIGHT OF WAY SHALL BE ASSIGNED IN ACCORDANCE WITH THE PREFERENTIAL PHASING SEQUENCE.
3. FLASHING OPERATION PER M.U.T.C.D. SECTION 4D.28 THROUGH SECTION 4D.31
4. MAX I = NORMAL OPERATION
   MAX II = MON-FRI, 3PM - 7PM

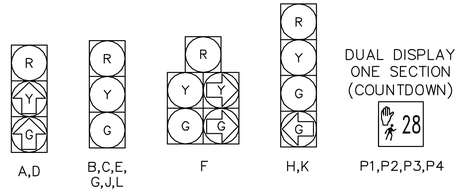
PREFERENTIAL PHASING DIAGRAM



VEHICLE MOVEMENT

PEDESTRIAN MOVEMENT - ON PED ACTUATION

SIGNAL FACES



1. ALL TRAFFIC SIGNAL HEADS SHALL BE EQUIPPED WITH ±5" LOUVERED BACKPLATES WITH RETROREFLECTIVE BORDER (YELLOW).
2. ALL SIGNAL HEADS SHALL BE EQUIPPED WITH L.E.D. MODULES WITH 12" LENSES AND BE EQUIPPED WITH CAP VISORS.
3. ALL PEDESTRIAN INDICATIONS SHALL BE 16" COUNTDOWN L.E.D. AND BE EQUIPPED WITH SUN CAP VISORS.

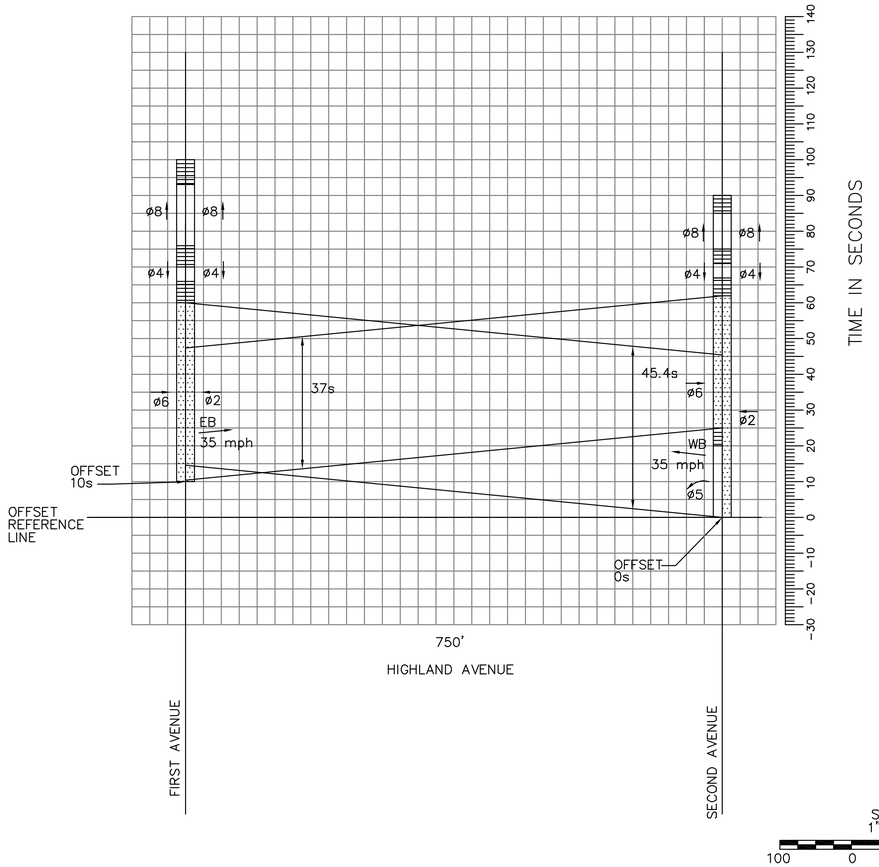
FS&T PROJECT NO.			
QM-145U			
DES	ATC	CHK	FAM
DR	SEB	CHK	ATC
EST	SEB	CHK	ATC
ENGINEER IN CHARGE			

NEEDHAM
INTERSECTION IMPROVEMENTS AT HIGHLAND AVENUE AND FIRST AVENUE

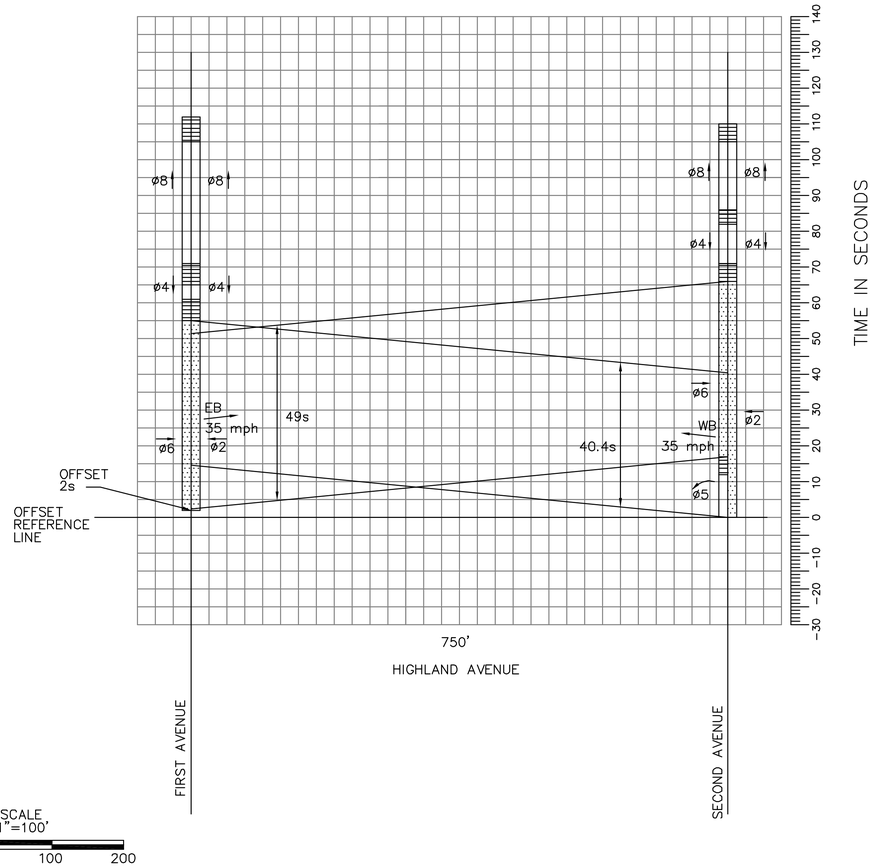
STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	19	29
PROJECT FILE NO. 607889			

TRAFFIC SIGNAL PLAN FIRST AVENUE COORDINATION DATA PART 4 OF 4

PLAN 1 WEEKDAY MORNING PEAK HOUR
HIGHLAND AVENUE
90 SECOND CYCLE



PLAN 2 WEEKDAY EVENING PEAK HOUR
HIGHLAND AVENUE
110 SECOND CYCLE



SCALE
1"=100'
100 0 100 200

LEGEND

- COORDINATED PHASE(S) GREEN TIME
- NON-COORDINATED PHASE(S) GREEN TIME
- CLEARANCE TIME (YELLOW + RED)
- PHASE MOVEMENT
- INTERSECTION-INTERSECTION COORDINATION BAND

HIGHLAND AVENUE
AT FIRST AVENUE
COORDINATION DATA
(ALL ENTRIES IN SECONDS)

	PLAN 1	PLAN 2
CYCLE LENGTH	90	110
OFFSET	70	78
SPLIT ø2&ø6	56 (42)	59 (45)
SPLIT ø4	10 (24)	10 (24)
SPLIT ø8	24	41
COORDINATED PHASE	ø2&ø6	ø2&ø6

HIGHLAND AVENUE
AT SECOND AVENUE
COORDINATION DATA
(ALL ENTRIES IN SECONDS)

	PLAN 1	PLAN 2
CYCLE LENGTH	90	110
OFFSET	0	0
SPLIT ø2&ø5	25	17
SPLIT ø2&ø6	42	54
SPLIT ø4	8	15
SPLIT ø8	15	24
COORDINATED PHASE	ø2&ø6	ø2&ø6

NOTES:

1. ALL OFFSETS REFERENCED TO THE BEGINNING OF GREEN OF THE COORDINATED PHASES.
2. TIMINGS IN PARENTHESES REPRESENT SPLITS WITH PEDESTRIAN PHASE

DAILY & WEEKLY COORDINATION PROGRAM

	MONDAY THRU FRIDAY	SATURDAY	SUNDAY
PLAN 1 90" CYCLE	0600-1000	-	-
PLAN 2 110" CYCLE	1500-1900	-	-
FREE OPERATION	0000-0600 1000-1500 1900-2400	0000-2400	0000-2400
FLASH OPERATION	-	-	-

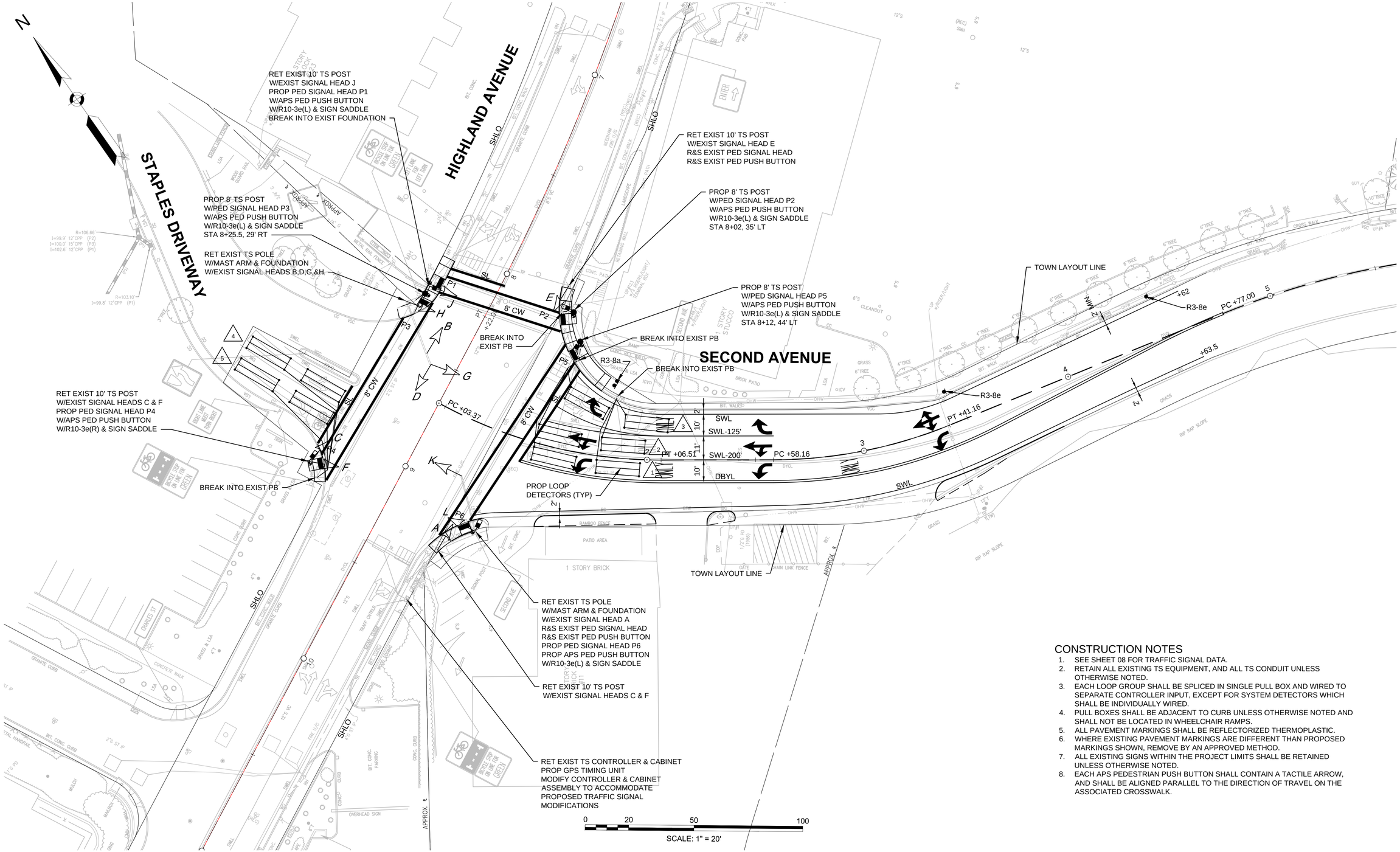
FS&T PROJECT NO.			
QM-145U			
DES	SEB	CHK	ATC
DR	SEB	CHK	ATC
EST	SEB	CHK	ATC
ENGINEER IN CHARGE			

FILE NAME: T:\QM-145U Needham 1st Ave\Drawings\General Plans\Traff Signal.dwg LAYOUT NAME: COORD PLOTTED: Monday, June 23, 2014 - 1:51pm USER: Dunkel_A

Highland Avenue/2nd Avenue
Town of Needham's Concept Plan

NEEDHAM
HIGHLAND AVE. AT SECOND AVE.
TRAFFIC PLANS
SHEET 07 OF 18

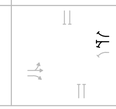
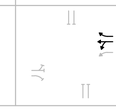
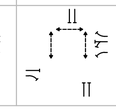
1257002-TSIG.DWG Plotted on 22-Dec-2014 9:26 AM



CONSTRUCTION NOTES

1. SEE SHEET 08 FOR TRAFFIC SIGNAL DATA.
2. RETAIN ALL EXISTING TS EQUIPMENT, AND ALL TS CONDUIT UNLESS OTHERWISE NOTED.
3. EACH LOOP GROUP SHALL BE SPLICED IN SINGLE PULL BOX AND WIRED TO SEPARATE CONTROLLER INPUT, EXCEPT FOR SYSTEM DETECTORS WHICH SHALL BE INDIVIDUALLY WIRED.
4. PULL BOXES SHALL BE ADJACENT TO CURB UNLESS OTHERWISE NOTED AND SHALL NOT BE LOCATED IN WHEELCHAIR RAMPS.
5. ALL PAVEMENT MARKINGS SHALL BE REFLECTORIZED THERMOPLASTIC.
6. WHERE EXISTING PAVEMENT MARKINGS ARE DIFFERENT THAN PROPOSED MARKINGS SHOWN, REMOVE BY AN APPROVED METHOD.
7. ALL EXISTING SIGNS WITHIN THE PROJECT LIMITS SHALL BE RETAINED UNLESS OTHERWISE NOTED.
8. EACH APS PEDESTRIAN PUSH BUTTON SHALL CONTAIN A TACTILE ARROW, AND SHALL BE ALIGNED PARALLEL TO THE DIRECTION OF TRAVEL ON THE ASSOCIATED CROSSWALK.

1257002-TSIG.DWG Plotted on 22-Dec-2014 9:27 AM

ø1	ø2	ø3	ø4	ø5	ø6	ø7	ø8	ø9*	
									

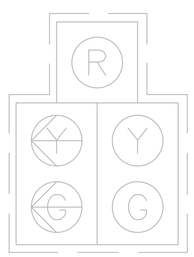
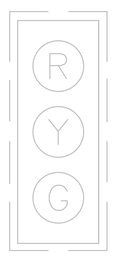
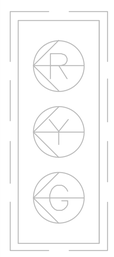
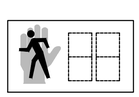
SEQUENCE AND TIMING FOR FULLY ACTUATED CONTROL

APPROACH	DIRECTION	HOUSING	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	FLASH
HIGHLAND AVENUE	WB	A,B				G	Y	R				R	R	R	G	Y	R	R	R	R				R	R	R	R	R	R	FY
HIGHLAND AVENUE	WB	C				G	Y	R				R	R	R	G	Y	R	R	R	R				R	R	R	R	R	R	FY
HIGHLAND AVENUE	EB	D,E				R	R	R				R	R	R	R	R	R	G	Y	R				R	R	R	R	R	R	FY
SECOND AVENUE	NB	F,G				R	R	R				R	R	R	R	R	R	R	R	R				G	Y	R	R	R	R	FR
SECOND AVENUE	NB	H,J				R	R	R				R	R	R	R	R	R	R	R	R				G	Y	R	R	R	R	FR
STAPLES DRIVEWAY	SB	K				R	R	R				G	Y	R	R	R	R	R	R	R				R	R	R	R	R	R	FR
STAPLES DRIVEWAY	SB	L				R	R	R				G	Y	R	R	R	R	R	R	R				R	R	R	R	R	R	FR
PEDESTRIAN X–ING	EB–WB	P1–P2				DW	DW	DW				DW	DW	DW	DW	DW	DW	DW	DW	DW				DW	DW	DW	W/FDW	DW	DW	OUT
PEDESTRIAN X–ING	NB–SB	P3–P4				DW	DW	DW				DW	DW	DW	DW	DW	DW	DW	DW	DW				DW	DW	DW	W/FDW	DW	DW	OUT
PEDESTRIAN X–ING	NB–SB	P5–P6				DW	DW	DW				DW	DW	DW	DW	DW	DW	DW	DW	DW				DW	DW	DW	W/FDW	DW	DW	OUT
TIMING IN SECONDS																														
MINIMUM GREEN (INITIAL)						15						6			4			15						6			–			CONFLICT FLASH OPERATION ONLY
PASSAGE TIME (VEHICLE)						2						2			2			2						3			–			
MAXIMUM 1						25						10			10			35						18			–			
MAXIMUM 2						42						10			7			35						30			–			
MAXIMUM 3						32						10			6			30						18			–			
YELLOW CLEARANCE							4						4			3			4						4			4		
RED CLEARANCE								1.5						1			2.5			2						1.5			1	
PEDESTRIAN WALK																											6			
PEDESTRIAN CLEARANCE																											24			
DETECTOR MEMORY						NON–LOCK						NON–LOCK			NON–LOCK			NON–LOCK						NON–LOCK						
RECALL						MIN						OFF			OFF			MIN						OFF						

COORDINATION DATA				COORDINATION PHASE SPLIT TIMES								
CYCLE NO.	PATTERN	CYCLE	OFFSET	ø1	ø2	ø3	ø4	ø5	ø6	ø7	ø8	ø9
MODE				COORD ø								

NOTES:
1. AUTOMATIC FLASHING OPERATION PER 2009 M.U.T.C.D., AS AMENDED.
2. *UPON PEDESTRIAN PUSH BUTTON ACTUATION
3. MAXIMUM 1 = NORMAL OPERATION
4. MAXIMUM 2 = 4:00 PM – 6:00 PM, MON–FRI
5. MAXIMUM 3 = NOT USED
6. STOP AND GO OPERATION FOR 24 HOURS PER DAY. FLASHING OPERATION FOR EMERGENCY ONLY.
7. DURING THE PEDESTRIAN INTERVAL FLASHING DON'T WALK OPERATION SHALL NOT BE IN EFFECT.

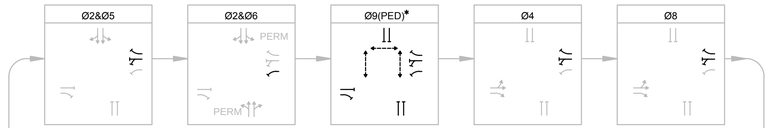
SIGNAL HEAD DATA

A,B,K	C,D,E,H,J,L	F,G	P1,P2,P3,P4,P5,P6
			 W/COUNTDOWN TIMER (L.E.D.)

SEQUENCE & TIMING NOTES:

1. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO REMAIN IN EFFECT DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATIONS FOR THAT TRAFFIC MOVEMENT WILL NOT CHANGE DURING THE CLEARANCE INTERVAL.
2. THE RIGHT OF WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON-CONFLICTING PHASES.
3. IF CALLS EXIST ON ALL PHASES, THE ASSIGNMENT OF RIGHT OF WAY SHALL BE IN ACCORDANCE WITH THE PREFERENTIAL PHASE SEQUENCE.
4. IF THE ASSIGNED RIGHT OF WAY FOR ANY TRAFFIC MOVEMENT IS TO CHANGE DURING THE NEXT CALLED PHASE, THE SIGNAL INDICATION FOR THAT MOVEMENT WILL DISPLAY THE APPROPRIATE CLEARANCE INTERVALS.

PREFERENTIAL PHASE SEQUENCE



* UPON PEDESTRIAN PUSH BUTTON ACTUATION

LOOP DETECTOR DATA

DETECTOR NO.	NO. SECTION/ SIZE	NO. OF TURNS	OPERATIONS	DELAY /EXT	CALL PHASE	LOOP CONNECTION
1	2-6'X20' QUADRUPOLE	2-4-2	PRESENCE	5 SEC DELAY	Ø8	SERIES
2	2-6'X20' QUADRUPOLE	2-4-2	PRESENCE	0	Ø8	SERIES
3	2-6'X20' QUADRUPOLE	2-4-2	PRESENCE	0	Ø8	SERIES
4	2-6'X20' QUADRUPOLE	2-4-2	PRESENCE	0	Ø4	SERIES
5	2-6'X20' QUADRUPOLE	2-4-2	PRESENCE	0	Ø4	SERIES

NOTE: DELAY AND EXTENSION TIMINGS SHALL BE PROGRAMMED IN THE LOOP DETECTOR

LIST OF MAJOR ITEMS REQUIRED

HIGHLAND AVENUE AT SECOND AVENUE/STAPLE DRIVEWAY

PAY ITEM	QUANTITY	DESCRIPTION
SECTION 12.2.20b (816.01)	1	MODIFY EXIST TS CONTROLLER AND CABINET ASSEMBLY (SEE NOTE 1)
	3	TS POST 8' STANDARD INCL. FOUNDATION
	6	PEDESTRIAN SIGNAL HEAD (L.E.D.)
	5	APS PEDESTRIAN PUSH BUTTON W/R10-3e(L) AND SIGN SADDLE
	1	APS PEDESTRIAN PUSH BUTTON W/R10-3e(R) AND SIGN SADDLE
	2	2-CHANNEL SHELF LOOP DETECTOR AMPLIFIER W/DELAY AND EXTENSION
	10	WIRE LOOP DETECTOR
	1	GPS SYNCH UNIT (SEE NOTE 1)
	1	MAINTAIN EXISTING SERVICE CONNECTION
SECTION 12.2.20d (804.3)	20 FT	3 INCH ELECTRICAL CONDUIT (TYPE NM)

PLUS NECESSARY DUCT, CABLE, LABOR, MISCELLANEOUS MATERIAL AND EQUIPMENT TO COMPLETE THE INSTALLATION AND PROVIDE AN OPERATING TRAFFIC CONTROL SIGNAL.

NOTE:
1. THE EXISTING CONTROLLER IS AN NEMA TS-1 , LMD8000 UNIT. THE PROPOSED GPS SYSTEM CAN BE INTERCONNECTED TO THE CONTROLLER VIA A CONTACT CLOSURE INPUT ON THE "D" CONNECTOR. AS AN ALTERNATIVE, THE CONTROLLER CAN BE REPLACED AND THE PROPOSED GPS SYSTEM CAN BE INTERCONNECTED TO THE SERIAL PORT ON THE NEW CONTROLLER. THE NEW CONTROLLER SHALL BE PROGRAMMED SUPPORT ALL EXISTING TIMING AND CONTROL FUNCTIONS.

TRAFFIC SIGN SUMMARY

IDENTIFI-CATION NUMBER	SIZE OF SIGN		TEXT	TEXT DIMENSIONS (INCHES)			NUMBER OF SIGNS REQUIRED		COLOR		POST SIZE AND NUMBER REQUIRED	UNIT AREA (S.F.)	AREA IN SQUARE FEET
	WIDTH	HEIGHT		LETTER HEIGHT	VERTICAL SPACING	ARROW RTE. MKR.		BACK-GROUND	LEGEND	BORDER			
R3-8a	48"	30"		SEE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS			1	WHITE	BLACK	BLACK	P5-2	10.00	10.00
R3-8e	30"	30"					2	WHITE	BLACK	BLACK	P5-2	6.25	12.50

NOTES:
1. SEE FHWA "STANDARD HIGHWAY SIGNS, 2004 EDITION" FOR TEXT DIMENSIONS, AS AMENDED; THE MASSDOT DEPARTMENT SIGN LISTINGS 1993 EDITION, AS AMENDED; AND THE TOWN OF CARVER STANDARD SPECIFICATIONS AND DETAILS.
2. ALL PROPOSED REGULATORY AND WARNING SIGNS SHALL BE 0.08" ALUMINUM WITH HIGH INTENSITY PRISMATIC REFLECTIVE SHEETING.

Highland Avenue Corridor Improvements (25 Percent Design)

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	01	145
PROJECT FILE NO. 606635			

TITLE SHEET AND INDEX

PLAN AND PROFILE OF

HIGHLAND AVENUE / NEEDHAM STREET / BRIDGE NO. N-04-002=N-12-002

OVER THE CHARLES RIVER CORRIDOR PROJECT

IN THE MUNICIPALITIES OF

NEEDHAM AND NEWTON

NORFOLK COUNTY AND MIDDLESEX COUNTY

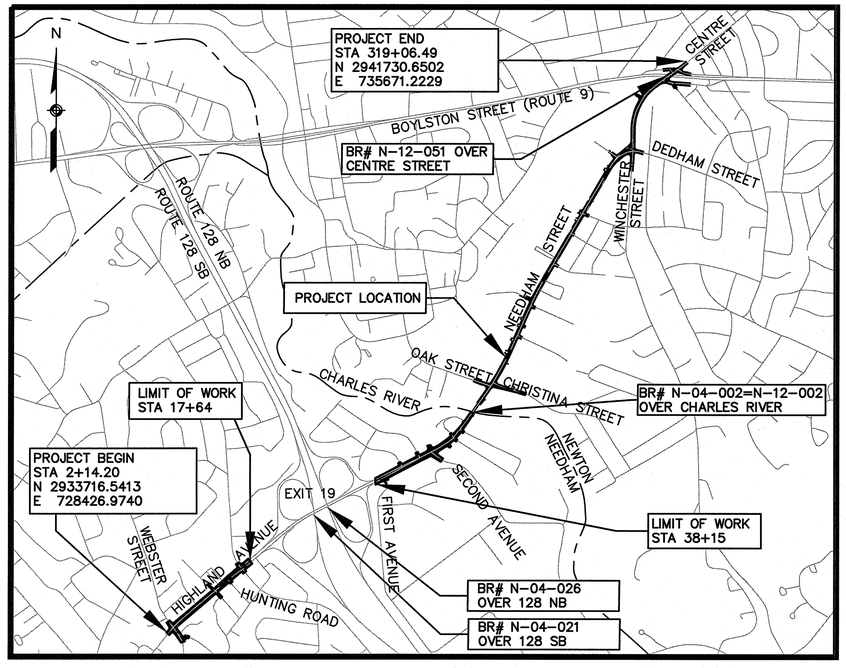
FEDERAL AID PROJECT NO.

25% SUBMITTAL

THE MASSACHUSETTS HIGHWAY DEPARTMENT 1988 STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, SUPPLEMENTAL SPECIFICATIONS DATED JUNE 15, 2012, THE STANDARD SPECIAL PROVISIONS, THE 2012 CONSTRUCTION STANDARD DETAILS, THE 1996 TRAFFIC STANDARD DETAILS, THE 2009 "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS" WITH MASSACHUSETTS AMENDMENTS, THE 1990 "STANDARD DRAWINGS FOR SIGNS AND SUPPORTS," THE 1968 STANDARD DRAWINGS FOR TRAFFIC SIGNALS AND HIGHWAY LIGHTING, AND THE LATEST EDITION OF THE AMERICAN STANDARD FOR NURSERY STOCK, WILL GOVERN.

INDEX

SHEET NO.	DESCRIPTION
1	TITLE SHEET AND INDEX
2	LEGEND AND ABBREVIATIONS
3	GENERAL NOTES
4	KEY PLAN
05-12	TYPICAL SECTIONS
13-32	CONSTRUCTION PLANS
33-61	PROFILES
62-81	DRAINAGE & UTILITY PLANS
82	TRAFFIC GENERAL NOTES & LEGEND
83-102	SIGN AND PAVEMENT MARKING PLANS
103-106	TRAFFIC SIGN SUMMARY
107-124	TRAFFIC SIGNAL PLANS
125-132	TEMPORARY TRAFFIC CONTROL PLANS
133-136	CONSTRUCTION DETAILS
137-145	CRITICAL CROSS SECTIONS



0 1000 2000 3000 4000

SCALE: 1" = 1000'

LENGTH OF PROJECT = 9,473.88 FEET = 1.794 MILES

DESIGN DESIGNATION

	HIGHLAND AVENUE WESTERN SEGMENT	HIGHLAND AVENUE EASTERN SEGMENT	NEEDHAM STREET WINCHESTER AVENUE
DESIGN SPEED	35 MPH	35 MPH	35 MPH
ADT (2008)	23,700 VPD	34,100 VPD	36,300 VPD
ADT (2028)	26,400 VPD	34,000 VPD	40,870 VPD
K	7.40%	8.10%	6.9%
D	50% EB/WB	55% WB	50
T (PEAK HOUR)	2.10%	1.50%	1.7%
T (AVERAGE DAY)	2.3%	4.0%	1.8%
DHV	1,765	2,775	2,820
DDHV	1,060	1,830	1,440
FUNCTIONAL CLASS	URBAN PRINCIPAL ARTERIAL	URBAN MINOR ARTERIAL	URBAN MINOR ARTERIAL

12-2013	25% DESIGN	0
DATE	DESCRIPTION	REV #

FS&T PROJECT NO.			
QM-167			
DES	–	CHK	MJH
DR	ABD	CHK	MJH
EST	–	CHK	–
ENGINEER IN CHARGE			

ENGINEERS
FST Since 1956
FAY, SPOFFORD & THORNDIKE
5 BURLINGTON WOODS
BURLINGTON, MA 01803

massDOT Massachusetts Department of Transportation Highway Division

RECOMMENDED FOR APPROVAL

CHIEF ENGINEER DATE

DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR DATE

APPROVED

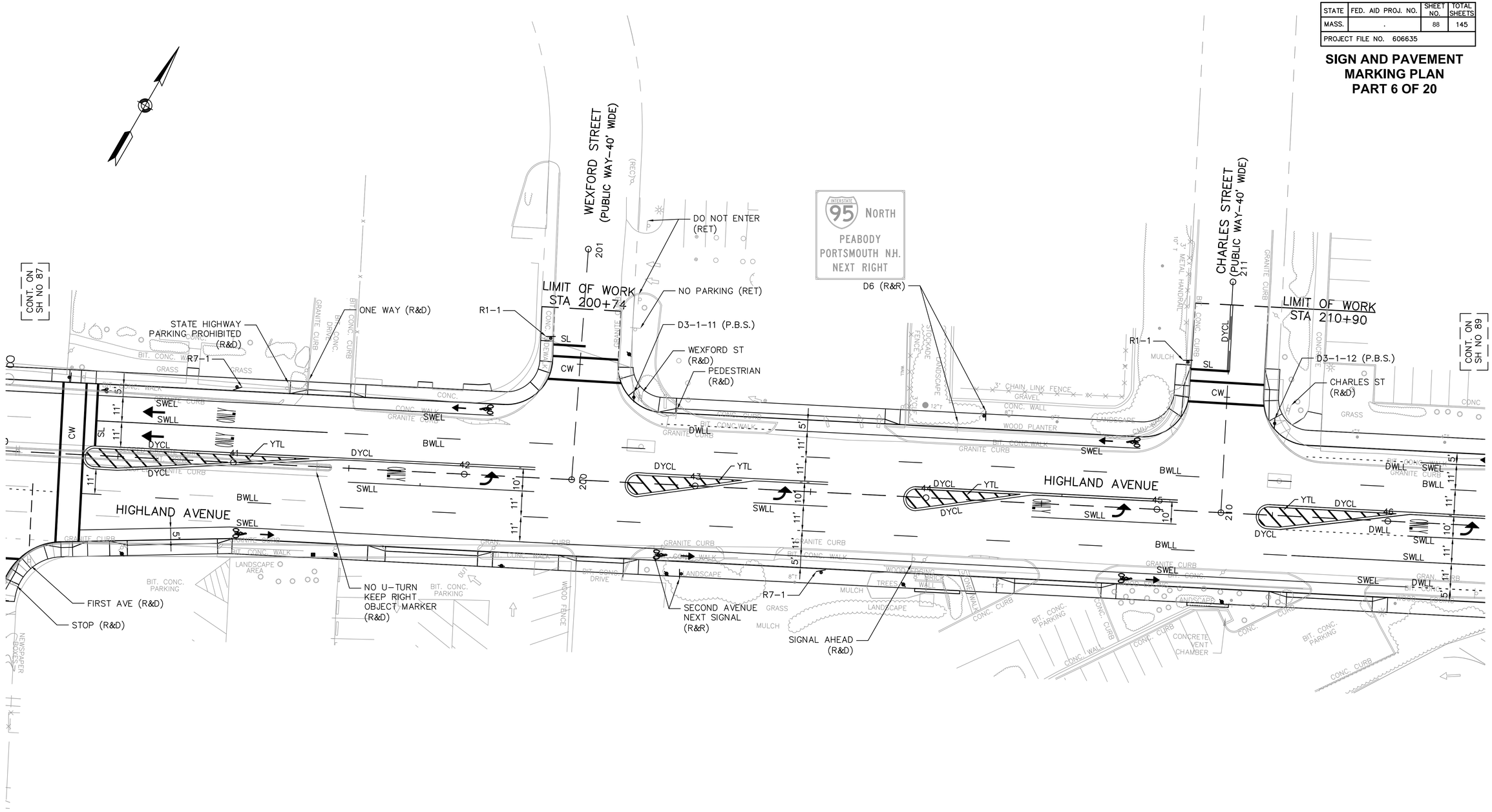
HIGHWAY ADMINISTRATOR DATE

FILE NAME: T:\QM-167 Needham Newton Corr\CADD\05 Highway\01 TITLE.dwg LAYOUT NAME: TITLE PLOTTED: Monday, December 23, 2013 – 3:41pm USER: Dunkel_A

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	88	145
PROJECT FILE NO. 606635			

SIGN AND PAVEMENT MARKING PLAN PART 6 OF 20



NOTES:
1. FOR TRAFFIC LEGEND AND GENERAL NOTES, SEE SHEET NO 82.
2. FOR EXPLANATION OF SIGN IDENTIFICATION NUMBERS, SEE SHEET NO 103–106.
3. ALL EXISTING SIGNS TO BE REMOVED AND STACKED UNLESS OTHERWISE NOTED.

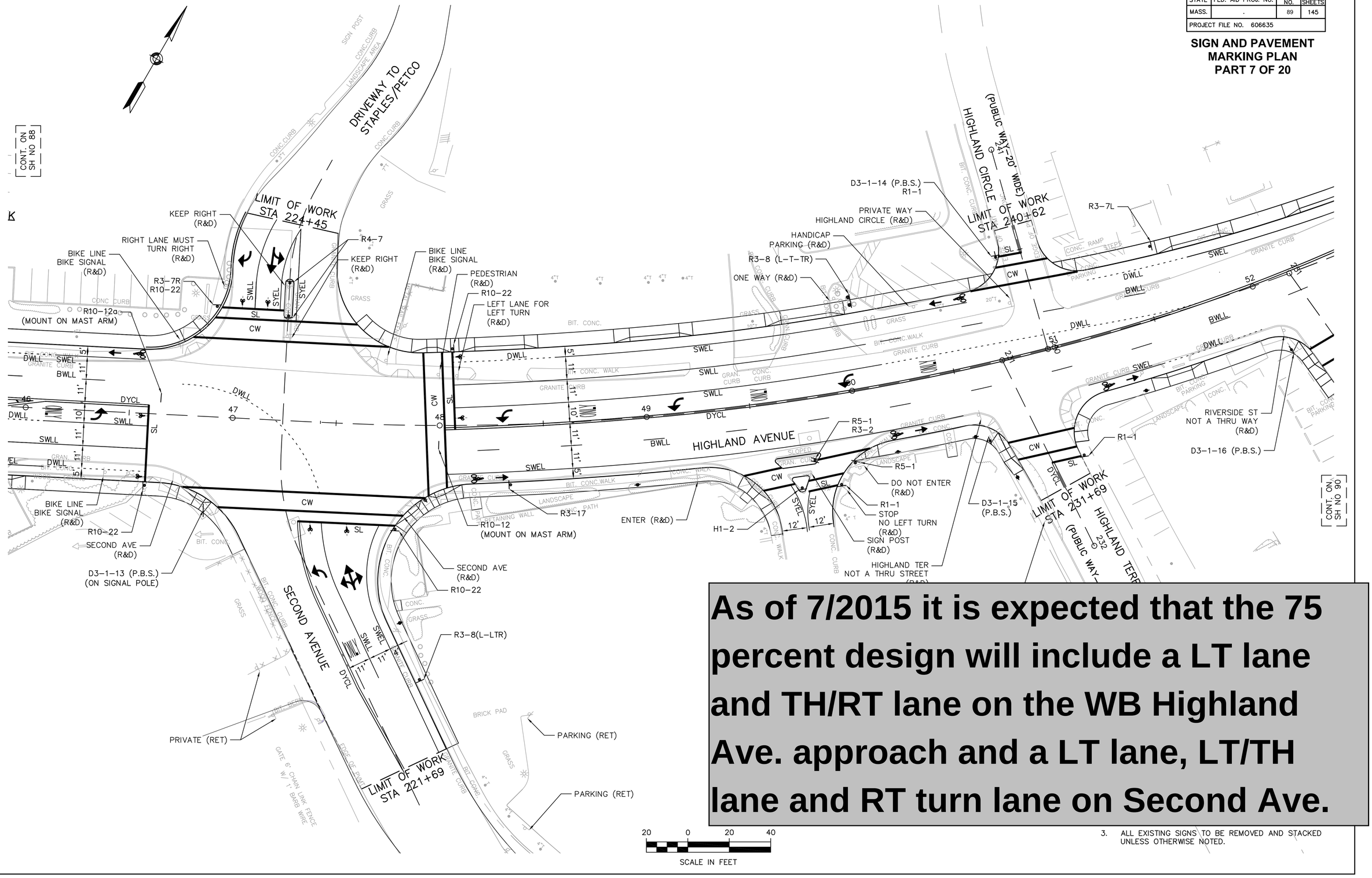
20 0 20 40
SCALE IN FEET

FS&T PROJECT NO.			
QM–167			
DES	–	CHK	–
DR	–	CHK	–
EST	–	CHK	–
ENGINEER IN CHARGE			

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	89	145
PROJECT FILE NO. 606635			

SIGN AND PAVEMENT MARKING PLAN PART 7 OF 20



As of 7/2015 it is expected that the 75 percent design will include a LT lane and TH/RT lane on the WB Highland Ave. approach and a LT lane, LT/TH lane and RT turn lane on Second Ave.

3. ALL EXISTING SIGNS TO BE REMOVED AND STACKED UNLESS OTHERWISE NOTED.

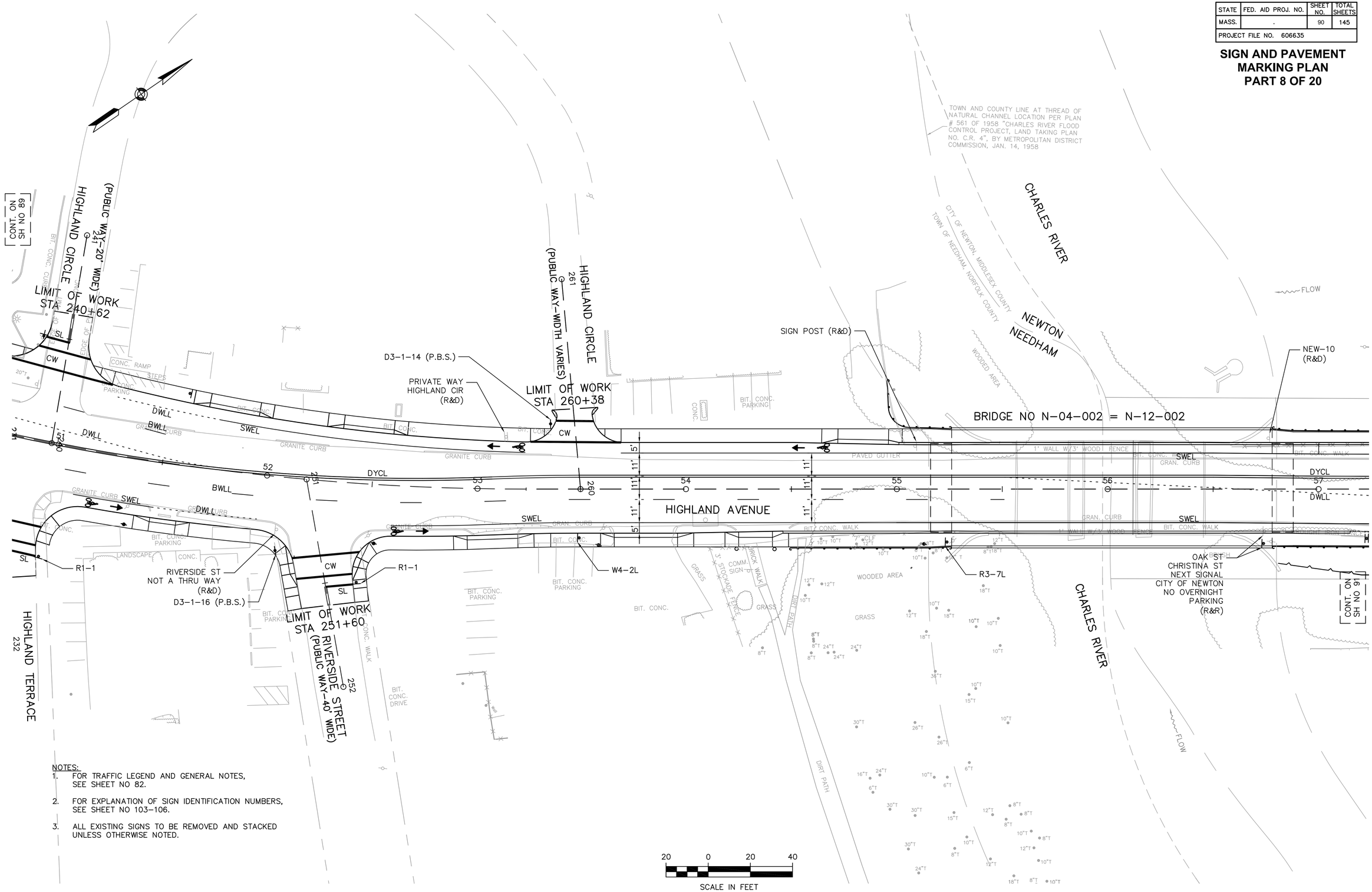
FS&T PROJECT NO.			
QM-167			
DES	–	CHK	–
DR	–	CHK	–
EST	–	CHK	–
ENGINEER IN CHARGE			

FILE NAME: T:\QM-167 Needham Newton Corr\CADD\05 Highway\33 Sign Pavmt Mrkng.dwg LAYOUT NAME: 07 – SECOND AVE. PLOTTED: Monday, December 23, 2013 – 4:00pm USER: DunkelL_A

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	90	145
PROJECT FILE NO. 606635			

SIGN AND PAVEMENT MARKING PLAN PART 8 OF 20



NOTES:

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2. FOR EXPLANATION OF SIGN IDENTIFICATION NUMBERS, SEE SHEET NO 103–106.
3. ALL EXISTING SIGNS TO BE REMOVED AND STACKED UNLESS OTHERWISE NOTED.

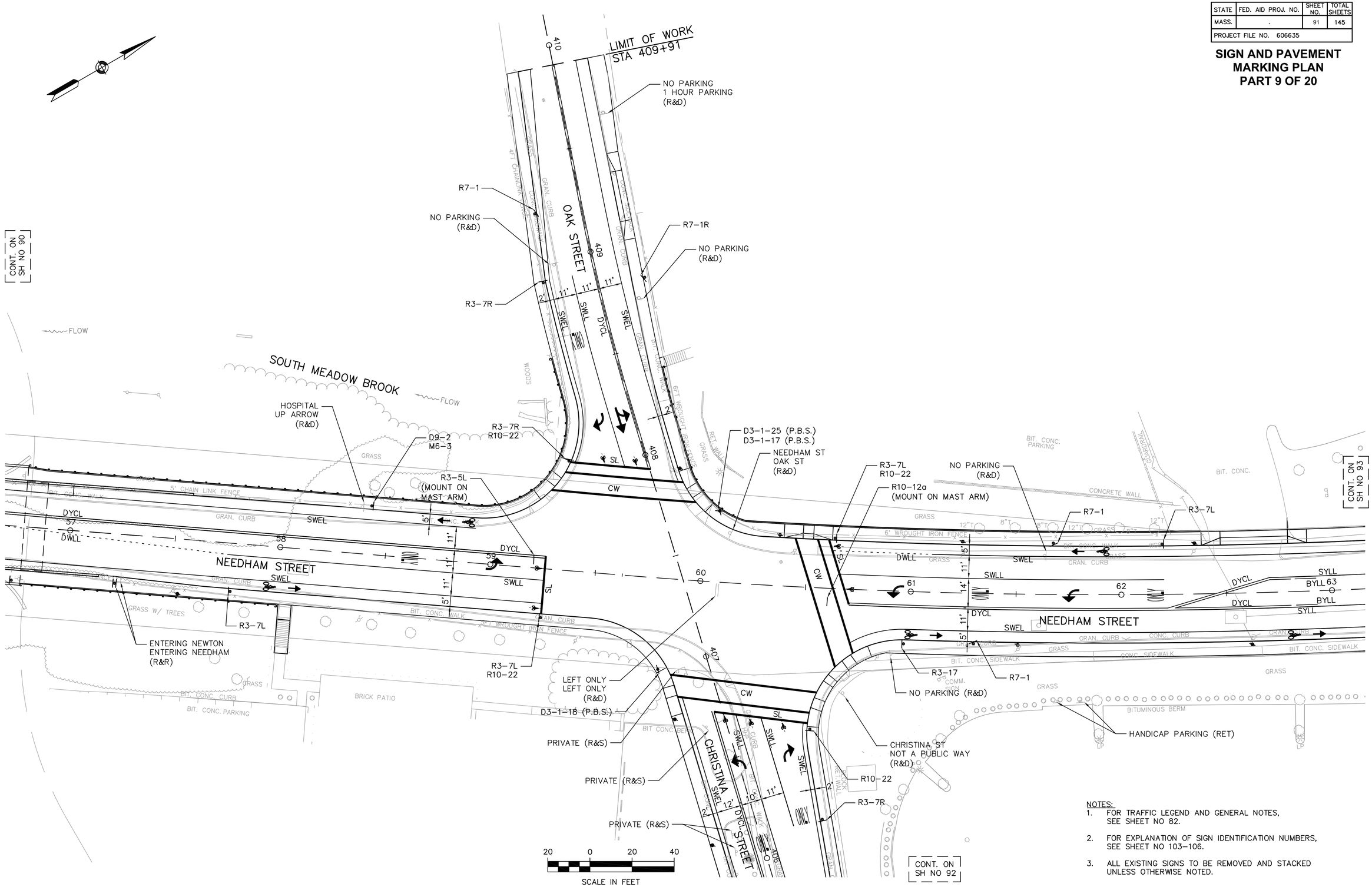
20 0 20 40
SCALE IN FEET

FS&T PROJECT NO.			
QM–167			
DES	–	CHK	–
DR	–	CHK	–
EST	–	CHK	–
ENGINEER IN CHARGE			

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	91	145
PROJECT FILE NO. 606635			

SIGN AND PAVEMENT MARKING PLAN PART 9 OF 20



NOTES:
1. FOR TRAFFIC LEGEND AND GENERAL NOTES, SEE SHEET NO 82.
2. FOR EXPLANATION OF SIGN IDENTIFICATION NUMBERS, SEE SHEET NO 103–106.
3. ALL EXISTING SIGNS TO BE REMOVED AND STACKED UNLESS OTHERWISE NOTED.

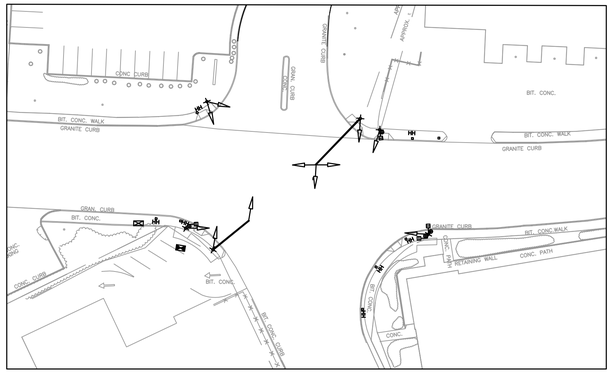
FS&T PROJECT NO.			
QM–167			
DES	–	CHK	–
DR	–	CHK	–
EST	–	CHK	–
ENGINEER IN CHARGE			

FILE NAME: T:\QM–167 Needham Newton Corr\CADD\05 Highway\33 Sign Pavmt Mrkng.dwg LAYOUT NAME: 09 – CHRISTINA PLOTTED: Monday, December 23, 2013 – 4:01pm USER: Dunkel_A

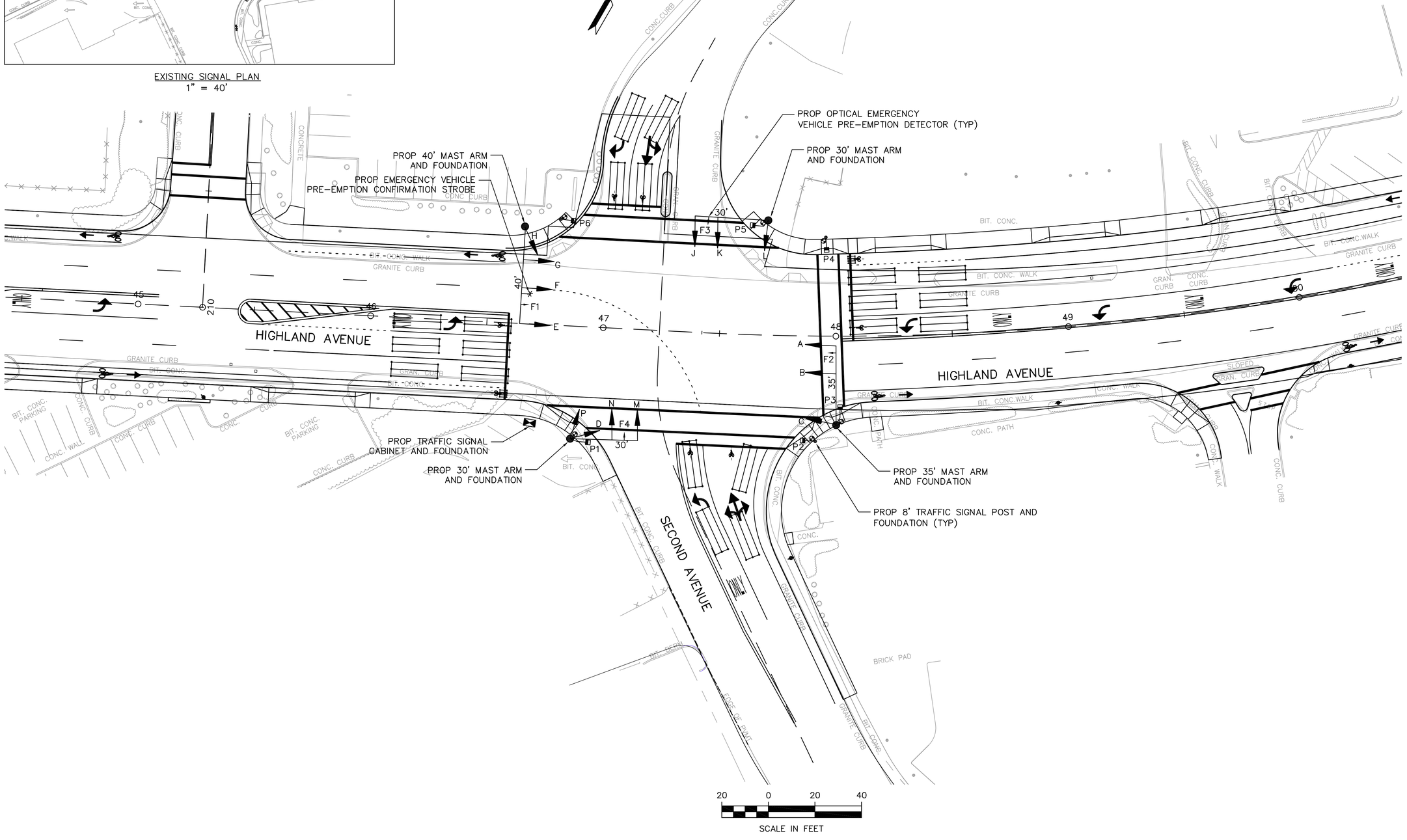
NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	113	145
PROJECT FILE NO. 606635			

TRAFFIC SIGNAL PLANS
LOCATION 4
SECOND AVENUE
SHEET 1 OF 2
NEEDHAM



EXISTING SIGNAL PLAN
1" = 40'



FS&T PROJECT NO.			
QM-167			
DES	—	CHK	—
DR	—	CHK	—
EST	—	CHK	—
ENGINEER IN CHARGE			

NEEDHAM / NEWTON
HIGHLAND AVENUE / NEEDHAM STREET

STATE	FED. AID PROJ. NO.	SHEET NO.	TOTAL SHEETS
MASS.	.	114	145
PROJECT FILE NO. 606635			

TRAFFIC SIGNAL PLANS
LOCATION 4
SECOND AVENUE
SHEET 2 OF 2
NEEDHAM

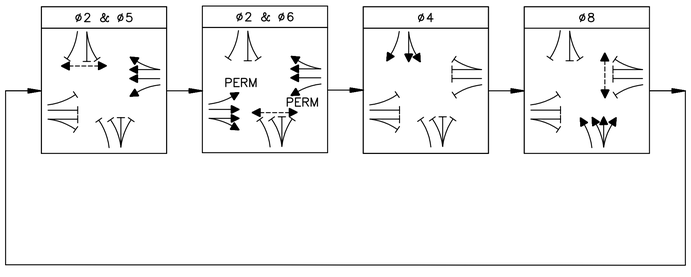
SEQUENCE AND TIMING FOR FULLY-ACTUATED TRAFFIC SIGNAL CONTROL

STREET	DIR	HOUSING	NOT USED ø1	ø2	NOT USED ø3	ø4	ø5	ø6	NOT USED ø7	ø8	NOT USED ø9	FLASHING OPERATION
HIGHLAND AVE	NB	A,B,C		R R R		R R R	R R R	G Y R		R R R		(Y)
HIGHLAND AVE	SB	D,E		<FY <Y <R		<R <R <R	<G <Y/<FY <R	<R <R <R		<R <R <R		(R)
HIGHLAND AVE	SB	F,G		G Y R		R R R	R R R	R R R		R R R		(Y)
SECOND AVE	WB	H,J		R R R		R R R	R R R	R R R		<G/G Y R		(R)
SECOND AVE	WB	K,L		R R R		R R R	R R R	R R R		G Y R		(R)
STAPLES DRWY	EB	M,N,P		R R R		G Y R	R R R	R R R		R R R		(R)
PEDESTRIAN		P1-P2		DW DW DW		DW DW DW	DW DW DW	W FDW DW		DW DW DW		OUT
PEDESTRIAN		P3-P4		DW DW DW		DW DW DW	DW DW DW	DW DW DW		W FDW DW		OUT
PEDESTRIAN		P5-P6		W FDW DW		DW DW DW	DW DW DW	DW DW DW		DW DW DW		OUT
INTERVALS (IN SECONDS) MINIMUM GREEN				15		4	4	15		10		EMERGENCY ONLY
EXTENSION INTERVAL				2		2	2	2		2		
MAXIMUM I				50		10	20	40		30		
MAXIMUM II				50		10	10	40		30		
CLEARANCE INTERVAL				4 2.5		3 3.5		4 2.5		3 3.5		
"WALK" INTERVAL				7				7		7		
PED CLEARANCE INTERVAL				22 2.5				29 2.5		19 3.5		
DETECTOR MEMORY				NON-LOCK		NON-LOCK		NON-LOCK		NON-LOCK		
RECALL SWITCH				SOFT		OFF		SOFT		OFF		

EMERGENCY PRE-EMPTION

ø F1	ø F2	ø F3	ø F4
R R R	G Y R	R R R	R R R
<G <Y <R	<R <R <R	<R <R <R	<R <R <R
G Y R	R R R	R R R	R R R
R R R	R R R	<G/G Y R	R R R
R R R	R R R	G Y R	R R R
R R R	R R R	R R R	G Y R
DW DW DW	DW DW DW	DW DW DW	DW DW DW
DW DW DW	DW DW DW	DW DW DW	DW DW DW
DW DW DW	DW DW DW	DW DW DW	DW DW DW
6	6	6	6
4 2.5	4 2.5	3 3.5	3 3.5

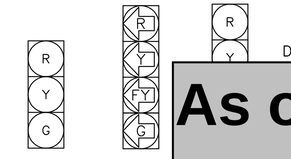
PREFERENTIAL PHASING DIAGRAM



VEHICLE MOVEMENT

PEDESTRIAN MOVEMENT – ON PED ACTUATION

SIGNAL FACES



1. ALL TRAFFIC SI
WITH ±5" LOUV
BORDER (YELLO
2. ALL SIGNAL HEA
L.E.D. MODULES
CAP VISORS.
3. ALL PEDESTRIAN
L.E.D. AND BE

TECHNICAL NOTES

1. ANY PHASE NOT CALLED WILL BE SKIPPED. SIGNAL INDICATION WILL NOT CHANGE IF THE ASSIGNED RIGHT OF WAY DOES NOT CHANGE DURING THE NEXT PHASE CALLED.
2. THE RIGHT-OF-WAY MAY BE ASSIGNED TO ANY PHASE OR ANY COMBINATION OF NON-CONFLICTING PHASES. IF CALLS EXIST ON ALL PHASES, THE RIGHT-OF-WAY SHALL BE ASSIGNED IN ACCORDANCE WITH THE PREFERENTIAL PHASING SEQUENCE.
3. FLASHING OPERATION PER M.U.T.C.D. SECTION 4D.28 THROUGH SECTION 4D.31
4. MAX I = NORMAL OPERATION

As of 7/2015 it is expected that the 75 percent design will include a LT lane and TH/RT lane on the WB Highland Ave. approach and a LT lane, LT/TH lane and RT turn lane on Second Ave. Therefore, it is expected that these timings will change.

FS&T PROJECT NO.			
QM-167			
DES	ATC	CHK	ATC
DR	SEB	CHK	ATC
EST	-	CHK	-
ENGINEER IN CHARGE			