SIGNAL PLAN REVIEW CHECKLIST

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Rev 5: 5/10/21

Project:		**Date:**	
State No.:			
Intersection:			

General:

- ❑ Traffic Signal Plans submitted to Bureau of Traffic at the 60% stage
- ❑ Sole Source items are proposed
  - ❑ Public Interest Finding (PIF) has been completed (Federal projects)
- ❑ Salvage materials in POW
  - ❑ All equipment should be salvaged and delivered to Bureau of Traffic during normal business hours
- ❑ East-West sun glare will be an issue
- ❑ General Notes included on the plan sheets

Geotechnical Report:

- ❑ Geotechnical engineering work has already been completed
  - ❑ If not, notes shall be added to the plan sheet(s) specifying that the contractor shall complete the geotechnical engineering work and submit the results to NHDOT
- ❑ Review report note on plans to determine if any additional requirements are necessary
  - ❑ Additional excavation, spread footing, etc.
- ❑ Boring symbol shown on plans where borings were located
- ❑ Test Borings table shall be provided on signal plan sheet:

Test Borings	
ID#	Station

Special Provisions:

- ❑ Include Supplemental 616 Specification that specifies structural requirements for traffic signal mast arms
- ❑ Spare detectors included
  - ❑ Amplifiers
    - ❑ Rack (preferred)
    - ❑ Shelf
- ❑ Power units included
- ❑ Entity responsible for electricity payment is confirmed
- ❑ Geotechnical information included in special provision
  - ❑ If non-typical: Special Provisions include specific notes for depth of foundation, etc.
- ❑ Correct mast arm information included
- ❑ ## Preemption emitters included in the Special Provision (*Temporary install only*)
- ❑ Salvage materials
  - ❑ All equipment should be salvaged and delivered to NHDOT Bureau of Traffic during normal business hours

Accessibility:

- ❑ ADA and PROWAG Guidelines have been followed

Utilities:

- ❑ All existing and proposed utilities and drainage are shown on the plans
  - ❑ Displayed in gray to avoid confusion
- ❑ Underground utility conflicts have been appropriately addressed
- ❑ Overhead utility conflicts have been appropriately addressed

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Permanent Lighting:

- ❑ Mast arm luminaire is mounted on vertical upright
- ❑ *General Note:* Permanent lighting shall consist of XXX (x) 250-Watt H.P.S. semi cut-off, Type 3 or approved equal mounted on a 12-foot bracket arm
- ❑ Wiring for lighting should not be installed within the same conduit as traffic signal wire and should not be run up the inside of the mast arm upright

Signal Plans:

- ❑ Scale: 1" = 20'
- ❑ North Arrow drawn on sheet(s)
- ❑ Construction Base Line(s) is included on each sheet with stationing labeled
- ❑ Existing signal items are shown on the plan sheet(s)
    - ❑ Conduit
    - ❑ Pullboxes
    - ❑ Mast Arms
    - ❑ Controller Cabinet
    - ❑ Meter Pedestal
- ❑ Proposed features shown on plans:
    - ❑ EP
    - ❑ TWs
    - ❑ Driveways
    - ❑ Curbs (Heavy line weight)
    - ❑ Lane Configuration
    - ❑ Pavement Markings (Lines, Arrows, and Legend)
    - ❑ Sidewalks and Curb Ramps
    - ❑ Retaining Walls
    - ❑ Guardrail
- ❑ Proposed Signal Items shown on plan sheet(s)
    - ❑ Power Source
    - ❑ Meter Pedestal
    - ❑ Loop Detectors
    - ❑ Controller Cabinet
    - ❑ Conduit
    - ❑ Pullboxes
        - ❑ Separate pullboxes for lighting
    - ❑ Mast Arm Length
    - ❑ Foundation Outline
- ❑ Right of Way lines are shown on the plan sheet(s)
- ❑ All roads labeled correctly
- ❑ Correct signal symbols are used
- ❑ Peak Hour Traffic Volumes included on plans
    - ❑ Opening Year Design Volume
    - ❑ AM & PM 10/20 Year Design Volumes
- ❑ Standard 8-Phase NEMA diagram included on plan sheet
- ❑ NHDOT Preferred Signal Phasing chart included on plan sheet
- ❑ General signal notes included on plan sheet
- ❑ 100 Amp meter bypass with pedestal and 30 amp breaker.

Fiber Optic Plans:

- ❑ Proposed 3-inch ITS interconnect conduit shown
- ❑ Fiber ITS Network diagram included in plans
- ❑ Fiber ITS system architecture included in plans
- ❑ Fiber optic detail sheets included in plans
- ❑ Fiber optic signs/bollards included in plans

Conduit:

- ❑ Signal conduit schedule is included – Schedule 40 & 80
  - ❑ Schedule 40 outside of roadway
  - ❑ Schedule 80 under roadway
- ❑ Maximum run between pullboxes:
  - ❑ 150-feet for signal cable
  - ❑ 300-feet for interconnect cable
- ❑ Separate conduit provided for lighting
  - ❑ Can be in same trench, but lighting wire should not be installed within signal conduit
- ❑ *General Notes:*
  - ❑ Pavement sawing for conduit and/or jacking pits (when required) shall be subsidiary to 616. Items
  - ❑ Replacement of pavement for conduit trenches and/or jacking pits will be paid under Item 403.12 or 403.99

Pull Boxes:

- ❑ 14” x 14” concrete pullboxes are included (standard)
  - ❑ Accommodate up to four (4) 3-inch conduits
  - ❑ 18” pullboxes required for more than four (4) 3-inch conduits
- ❑ Pullboxes provided for all transitions between Schedule 40 and Schedule 80 conduit
- ❑ No pullbox required between meter pedestal and controller cabinet *unless* distance is greater than 90-feet
- ❑ *General Note:* Existing concrete pull boxes labeled X shall be removed (subsidiary) and salvaged to the Bureau of Traffic. See the prosecution of work for contract names.
- ❑ Molded pull boxes for lighting

Mast Arms:

- ❑ All mast arms are oriented perpendicular to the roadway, unless otherwise noted
  - ❑ Angular offsets of mast arms are included (to nearest 5°)
- ❑ East-West mast arms include a signal on the vertical upright if sun glare will be an issue
- ❑ Correct offset from edge of pavement used
  - ❑ 10-feet from edge of pavement if no curb
  - ❑ 7-feet minimum behind curb or guardrail
- ❑ Mast arm length
  - ❑ Correct length labeled on plans
  - ❑ Length shown on plans matches length included in Special Provisions
- ❑ Necessary structure data is included in plans
- ❑ Traffic Signal Mast Arm Summary table is included on plans
  - ❑ Location Station and offset is included

Traffic Signal Mast Arm Test Boring Summary			
REF #	Location	Foundation Type	Boring #

Mast Arm Signs:

- ❑ Street names are spelled correctly
- ❑ Street name sign placement matches Special Provision 616.XXX
  - ❑ *Note*: Payment for street name signs falls under Item 616.XXX
- ❑ Signs are correct size
- ❑ R10-12 signs are installed where appropriate for Phases 2, 4, 6, and/or 8
  - ❑ *Note*: Payment falls under Item 616.XXX

Signal Heads:

- ❑ Signal head data
  - ❑ Correctly labeled with phase number
  - ❑ All necessary heads are included
  - ❑ Signal face is shown on the plans
- ❑ Signals are louvered
- ❑ Signals include backplate per **MUTCD Section 4D.12 page 20**
  - ❑ Backplate is 5-inches
  - ❑ Backplate is louvered
  - ❑ Backplate includes 2-inch fluorescent yellow retroreflective border (Type IX or XI sheeting) on outer perimeter
- ❑ Minimum height requirements met per **MUTCD Section 4D.15**
  - ❑ Vehicular signal heads – check heights against the cross section
    - ❑ Minimum 16-feet above roadway
    - ❑ Minimum 10-feet when mounted on vertical upright
  - ❑ Pedestrian signal heads
    - ❑ Minimum 8-feet
- ❑ Traffic Signal Placement falls within cone of vision per **MUTCD Figure 4D-4**
- ❑ Minimum sight distance for signal visibility is met per **MUTCD Table 4D-2**
  - ❑ Traffic signals are placed at least 40-feet from stop line
  - ❑ Traffic signals are no farther than 180-feet from stop line
- ❑ Number of signal heads on each approach meets guidelines presented in **MUTCD Section 4D.11**
  - ❑ One signal head per lane typically
- ❑ Left-turn heads are offset by 2-feet (if required)
- ❑ All lenses 12-inches
- ❑ Traffic signal heads match approved case study
- ❑ Pedestrian Heads
  - ❑ See **MUTCD Figure 4E-3, Page 501**
  - ❑ 16” x 18” heads
  - ❑ APS push buttons
  - ❑ 9” x 15” pedestrian sign included
- ❑ Signal heads should typically have a yellow body with a black face
  - ❑ Some municipalities use different colors—check to verify

Emergency Preemption:

- ❑ Included in design
- ❑ *General Notes:*
  - ❑ Location of emergency vehicle preemption receivers are to be determined in the field by the Contractor, Engineer, and the Town of _____ Fire Department.
  - ❑ Preemption signal shall be served on a first come – first serve basis.
  - ❑ Minimum Green Time and normal vehicle clearance times shall be provided on phases that are to be terminated by preemption demand.
  - ❑ Emergency preemption shall override coordination.
  - ❑ No overlaps shall operate during emergency preemption calls.
- ❑ Correctly labeled
- ❑ ## Preemption emitters included in the Special Provision (Temporary install only)
- ❑ Compatibility has been verified with local fire/police/ambulance services
- ❑ Emergency Preemption Table included

EMERGENCY PREEMPTION	
PREEMPT 1	CALLS Ø1 & Ø6
PREEMPT 2	CALLS Ø2 & Ø5
PREEMPT 3	CALLS Ø3 & Ø8
PREEMPT 4	CALLS Ø4 & Ø7

Signal Timing:

- ❑ Vehicular Clearance Intervals are calculated based on NCHRP Report 731
- ❑ The below captures NCHRP Report 731 however see this excel sheet an easier check,
- ❑ All Clearance Interval values should be rounded up to the nearest whole number
  - ❑ ***Exception: Yellow clearance for 40 mph shall be 4.5 seconds***
- ❑ Green time shall be rounded to the nearest 5 seconds
- ❑ Red clearance shall not exceed 6 seconds
  - ❑ ***Exception: Alternating one lane, 2-way temporary traffic control***

- ❑ **Yellow Clearance Interval**
  - ❑ $Y = \max\left[\left(t + \frac{1.47V}{2a+6\ \ .4gG}\right), 4\right]$
    - ❑ t = 1 second (Perception Reaction Time)
    - ❑ a = 10 ft/sec^2 (acceleration)
    - ❑ V = 85th percentile speed
      - ❑ If unavailable, use posted Speed Limit minus 5mph for left-turn movements and posted Speed Limit plus 7mph for all other movements.
    - ❑ g = approach grade (percent, negative for downgrade)
- ❑ **Red Clearance Interval:**
  - ❑ $R = \max\left[\left(\frac{W+L}{1.47V} - 1\right), 2\right]$
    - ❑ W = Width of intersection, measured from the back edge of the approaching movement stop line to the far side of the intersection as defined by the extension of the curb line or outside edge of the farthest travel lane (ft)
    - ❑ L = 20 ft (average length of vehicle)
    - ❑ V = 85th percentile speed
      - ❑ If unavailable, use 20mph for left-turn movements and posted Speed Limit plus 7mph for all other movements.

- ❑ **Pedestrian Signal Timing**
  - ❑ Most intersections will follow **MUTCD Figure 4E-2** for Pedestrian Signal Timing
  - ❑ Leading Pedestrian Interval (LPI)
    - ❑ Typically 7 seconds: Time should be long enough to fully establish pedestrian presence in road
  - ❑ Walk = 7 Seconds unless pedestrian volumes are expected to support lower value
    - ❑ 4 Seconds is the minimum value
  - ❑ Pedestrian Clearance Interval
    - ❑ $PCI = \frac{Distance}{Speed}$ (in seconds)
    - ❑ Distance is measured in feet from top of curb ramp to opposite curb
    - ❑ Speed used is 3.5 ft/sec
  - ❑ Pedestrian Buffer Interval
    - ❑ Concurrent Phasing: Buffer Interval is equal to the Yellow Change Interval
    - ❑ Exclusive Phasing: Buffer Interval is 3 seconds
  - ❑ Pedestrian Red Clearance is equal to 0 seconds

Signal Phasing:

- ❑ If coordinated system: coordination data is provided within the plan set
- ❑ Correct phasing sequence used
  - ❑ Phase 1 = Major movement Northbound or Eastbound left-turn
  - ❑ Minor Approaches
    - ❑ Split Phasing: Phase 3 = Eastbound or Northbound & Phase 4 = Westbound or Southbound
    - ❑ Concurrent Phasing: Phase 8 = Eastbound or Northbound & Phase 4 = Westbound or Southbound
- ❑ Preferential phasing sequence diagram shown on plans
  - ❑ For permissive turns (flashing yellow arrow), product of the hourly left-turning volume and the opposing thru volume should be less than 100,000 (4-lane roadway) or 50,000 (2-lane roadway) per ITE guidance
- ❑ NEMA Ring-Barrier diagram shown on plan sheet(s)
- ❑ Pedestrian Phasing
  - ❑ Exclusive
  - ❑ Leading Pedestrian Interval (LPI)
  - ❑ Concurrent
- ❑ Signal Phasing Schedule included on traffic signal plan sheet

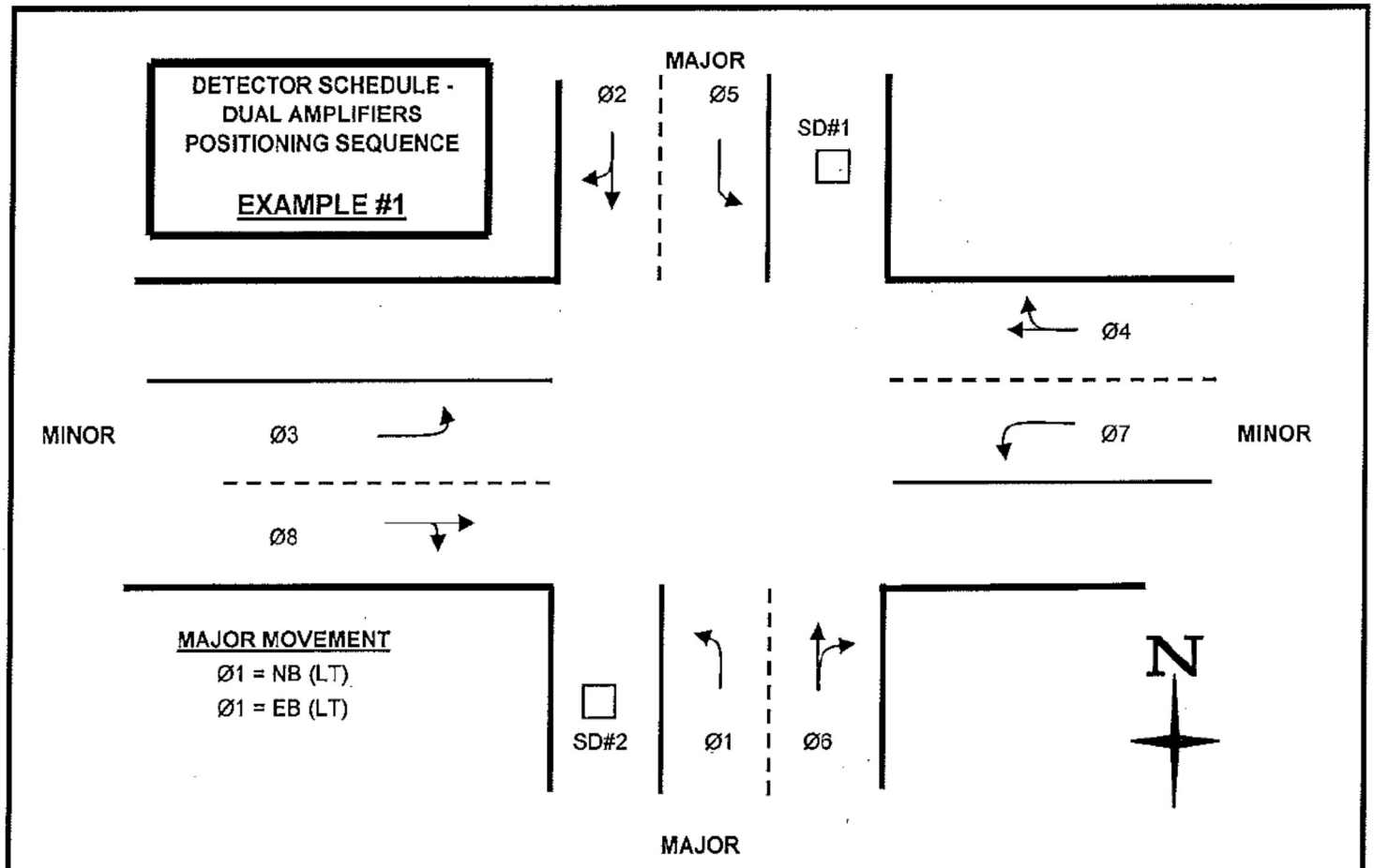
SIGNAL PHASING									
	Ø1	Ø2	Ø3	Ø4	Ø5	Ø6	Ø7	Ø8	Ø9
Timing in Seconds	NB or EB Left								
INITIAL INTERVAL									
VEHICLE EXTENSION									
MAXIMUM 1									
MAXIMUM II									
YELLOW									
ALL RED									
WALK/FLASH DON'T WALK									
RECALL									
DETECTOR									
FLASH	FR	FY	FR	FR	FR	FY	FR	FR	OFF

Detection:

- ❑ Loops (preferred)
  - ❑ 6’ x 50’ quadrupole 2-4-2 loops (standard)
  - ❑ Loops extend 4-feet beyond stop bar
  - ❑ Loops placed in each lane on each approach to the intersection
  - ❑ *General Notes:*
    - ❑ Loop wire shall be brought back to the cabinet on separate lead-in cables.
    - ❑ Pavement sawing for Loops shall be subsidiary to 616.XX Items
- ❑ Video
- ❑ Advance Detection
  - ❑ **MUST** be included on all roadways where posted speed is 40mph or greater
  - ❑ 6’ x 6’ loops (typically)
  - ❑ Location of advance loops ahead of stop bar should be based on the posted speed as follows:

Speed (mph)	Distance (feet)
40	295
45	330
50	365
55	400

- ❑ Table for detector field measurements (ie resistance and inductance) included on the plan sheet(s)



DETECTOR SCHEDULE					
APPROACH			AMPLIFIERS		
STREET	DIRECTION	LANE	Ø	NO	CHANNEL
MAJOR	NORTH	LEFT	1	1	1
MAJOR	NORTH	THRU-RT	6	1	2
MAJOR	SOUTH	LEFT	5	2	1
MAJOR	SOUTH	THRU-RT	2	2	2
MINOR	EAST	LEFT	3	3	1
MINOR	EAST	THRU-RT	8	3	2
MINOR	WEST	LEFT	7	4	1
MINOR	WEST	THRU-RT	4	4	2
MAJOR	NORTH	THRU	SD#1	5	1
←		OPEN		→ 5	2
MAJOR	SOUTH	THRU	SD#2	6	1
←		OPEN		→ 6	2

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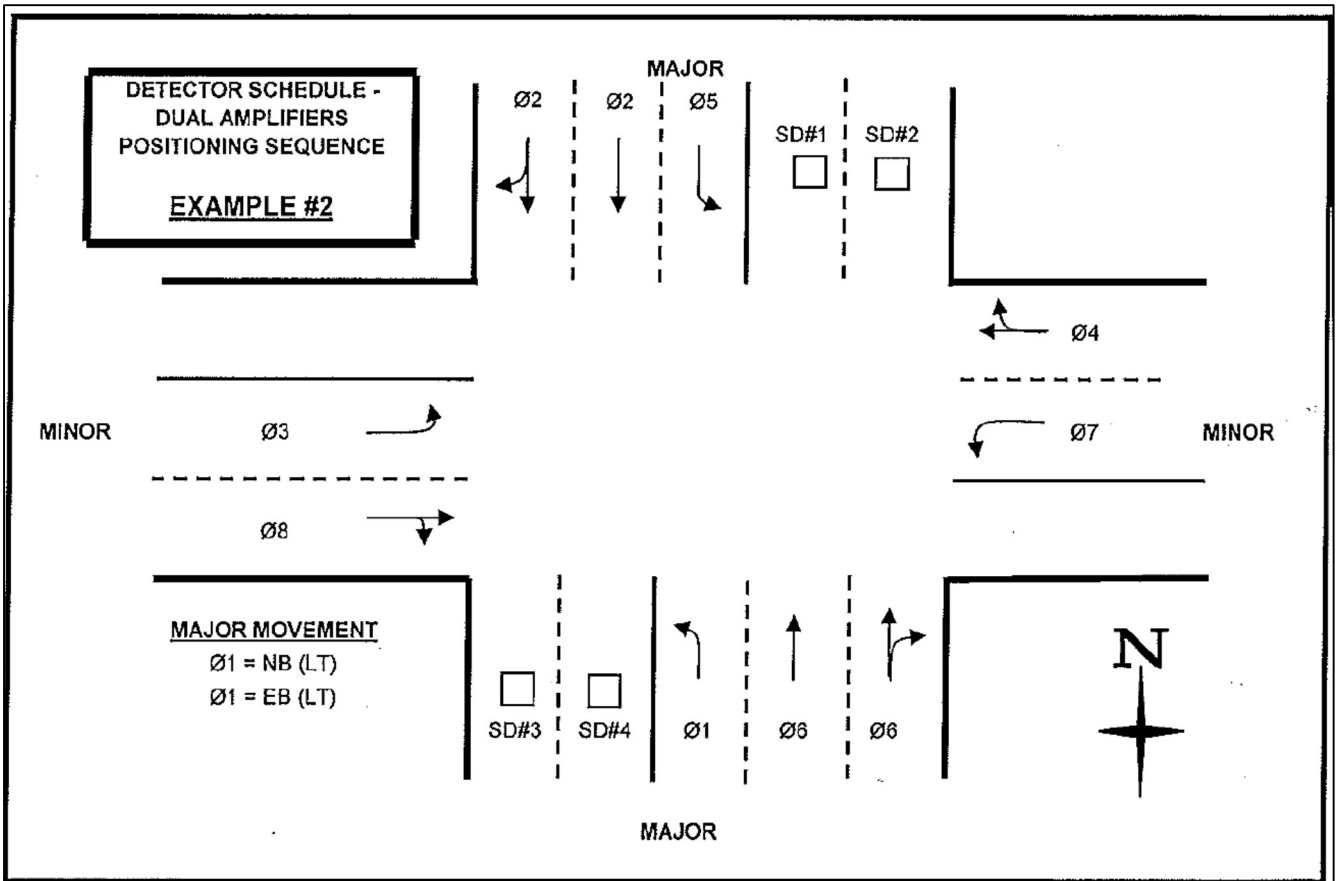

DETECTOR SCHEDULE

APPROACH			AMPLIFIERS		
STREET	DIRECTION	LANE	Ø	NO	CHANNEL
MAJOR	NORTH	LEFT	1	1	1
←		OPEN	→	1	2
MAJOR	NORTH	THRU	6	2	1
MAJOR	NORTH	THRU-RT	6	2	2
MAJOR	SOUTH	LEFT	5	3	1
←		OPEN	→	3	2
MAJOR	SOUTH	THRU	2	4	1
MAJOR	SOUTH	THRU-RT	2	4	2
MINOR	EAST	LEFT	3	5	1
MINOR	EAST	THRU-RT	8	5	2
MINOR	WEST	LEFT	7	6	1
MINOR	WEST	THRU-RT	4	6	2
MAJOR	NORTH	THRU	SD#1	7	1
MAJOR	NORTH	THRU	SD#2	7	2
MAJOR	SOUTH	THRU	SD#3	8	1
MAJOR	SOUTH	THRU	SD#4	8	2