



Traffic Signal Design Manual

ORIGINATOR Director, Bureau of Highway Operations		7-1-5
CHAPTER 7	Sequence of Operations	
SECTION 1	General	
SUBJECT 5	Sequence Chart Layout	

The Sequence of Operations Chart is intended to illustrate the display of all traffic signal indications from the beginning of a specific phase including yellow and all red intervals. In addition, the chart also illustrates the pedestrian displays at an intersection, if applicable.

The Sequence of Operations Chart is separated into NEMA phase designations as discussed in TSDM Subject 7-1-2. The complexity of the chart is dependent on the actual number of signal phases required for a specific design. On a simple intersection configuration it *may* mean that only two or three phases will be used; with more complex intersections, all eight phases *may* be used. In developing the Sequence of Operations Chart, the relationship among head number designations, signal head displays, and vehicular and pedestrian phases must be maintained. This allows the Sequence Chart illustration to correlate with the actual signal plan.

Prior to setting up the Sequence Chart, the designer *should* establish which phases are to be used. Vehicular movements are defined through the use of an arrow and pedestrian movements indicated by an arrow with half an arrowhead. Those phases, which are not to be utilized, *should* be designated "NOT USED" and all corresponding information for that phase left blank in the Sequence Chart.

Once the phases to be used are established, the corresponding signal head(s) number(s) need to be designated. The head(s) number(s) associated with specific phases *should* then be inserted into (beside the corresponding phase number) the column labeled "HEAD NUMBERS." The last step is to indicate the actual display for each signal head during each specific phase. All phases utilized must be evaluated and the corresponding signal displays for each head number determined.

During development of the Sequence Chart, certain guidelines *should* be applied. These are as follows:

1. The typical display for the arrow indications under a protected/permitted left turn (five section heads are utilized here) when operating under the protected condition is a green arrow assigning right of way, a yellow arrow clearance, and a "-" symbol representing phase termination. At the end of the yellow arrow, right-of-way assignment is controlled by the corresponding through movement indications.

If the protected left-turn phase times concurrently with the adjacent through movement (i.e. phases 1 and 6), phase 1 indicates a green arrow concurrent with a green ball indication on phase 6. This is provided for in the Conflict Chart (Chart 1).

2. The normal display for a five-section traffic signal controlling a right turn is the red ball associated with the through movement displayed concurrently with a green right arrow. The remainder of the time, the right turn is controlled by the balls associated with the through movement of that approach. The green ball and green arrow **shall** not be displayed concurrently for right turns.

If separate right-turn signal heads are installed (i.e. three-section heads), only the green arrow indication *should* be displayed in the overlap condition to assign right of way.

3. Under flashing conditions pedestrian heads **shall** be blank, and all signal heads **shall** flash in accordance with the Sequence of Operations Chart.

Under each phase, the first column, designated R/W, refers to the displays for each signal head at the start of a specific phase. The heads- that correspond to the specific phase will be shown with the proper green or "Walk" indication. All other heads *should* be shown with the proper red or "Don't Walk" indication.

After the start-up displays are completed for a. specific phase, then the corresponding clearance intervals *should* be filled in. The clearance columns must also correspond to the information provided in a supplemental chart, typically called "CHART 1," that relates concurrent and conflicting movements among all phases. Attention *should* be given, also, to designating the proper pedestrian clearance indications which are typically referenced by a note below the Sequence Chart.

The supplemental chart mentioned above identifies which phases can and cannot be serviced concurrently. Figure 1 shows the Sequence of Operations Chart, notes, and Chart 1. Refer to TSDM Subject 5-5-1, Sample Plan Sheets for an illustrated sample of sequence of operations charts.

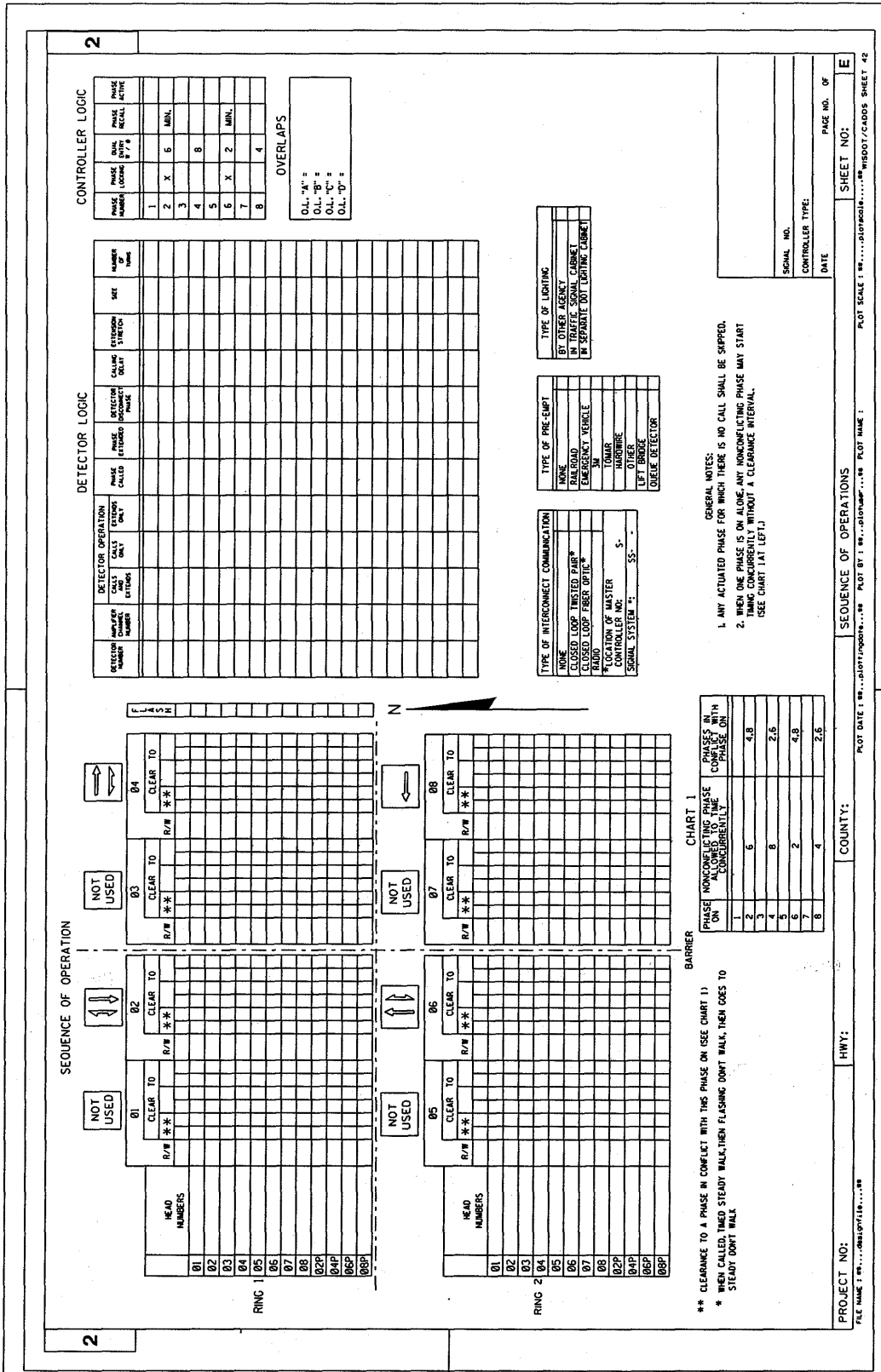


Figure 1
Blank Sequence of Operations Chart

Figures 2a and 2b illustrate a "T" intersection with one pedestrian crosswalk. Note that the mainline crosswalk is located on the right side of the intersection. This allows left-turning vehicles (from the stem of the "T") to proceed into the intersection without interfering with pedestrians. This location of the mainline crosswalk is recommended at "T" intersections especially when a left-arrow display is used for the stem approach. The possibility of traffic's blocking pedestrian head number 11 requires designers to thoroughly evaluate the location of the phase 2 near-right signal pole in regard to the crosswalk and stop line. The signal and pedestrian displays are shown and identified by simple numbers.

Figures 3a and 3b illustrate a four-leg intersection with protected/permitted left-turn phasing for each approach. Signal displays are shown in the legend and coded in the plan based on NEMA through phase numbers for each approach.

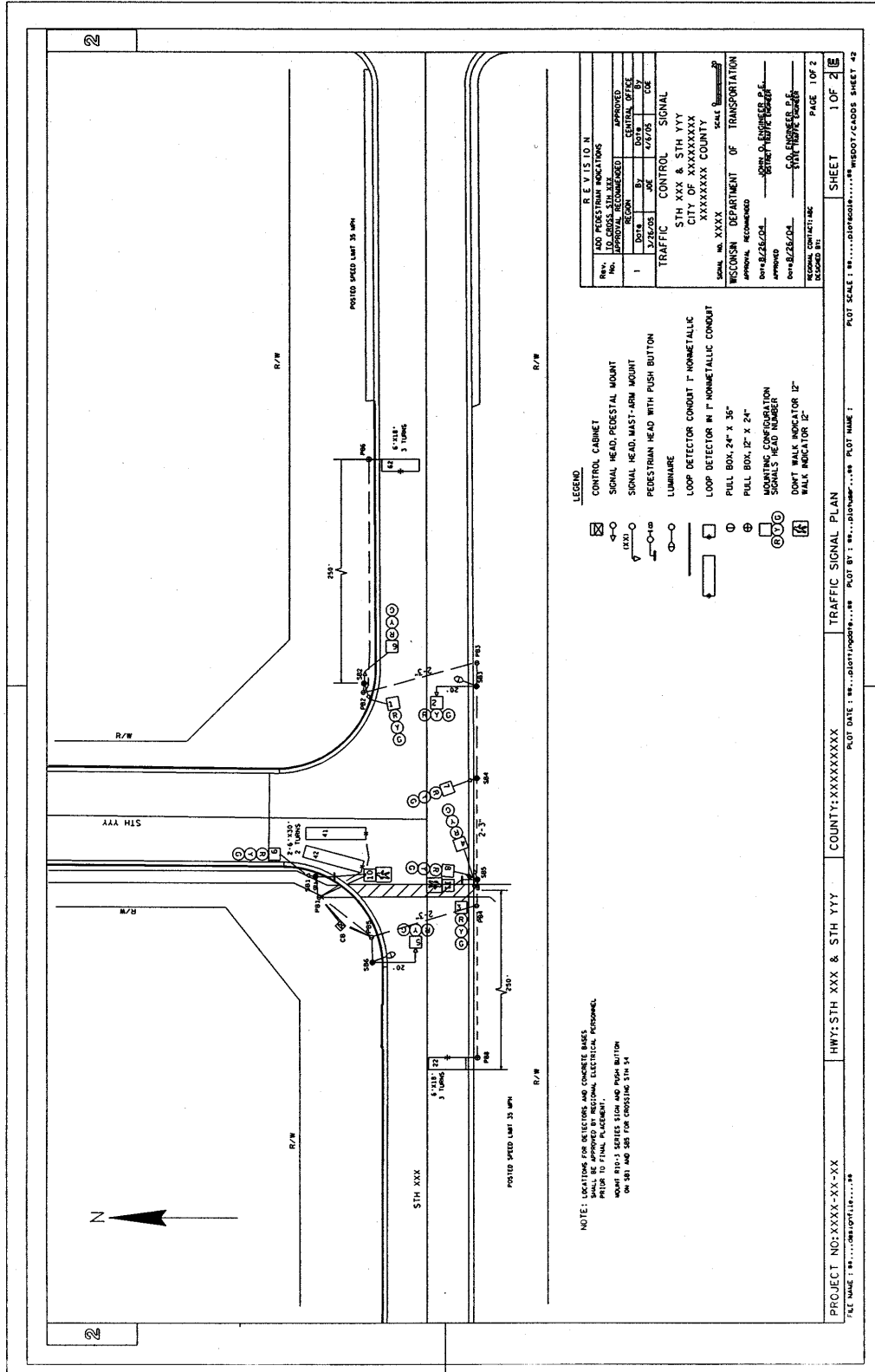


Figure 2a
"T" Intersection (3-phase operation)

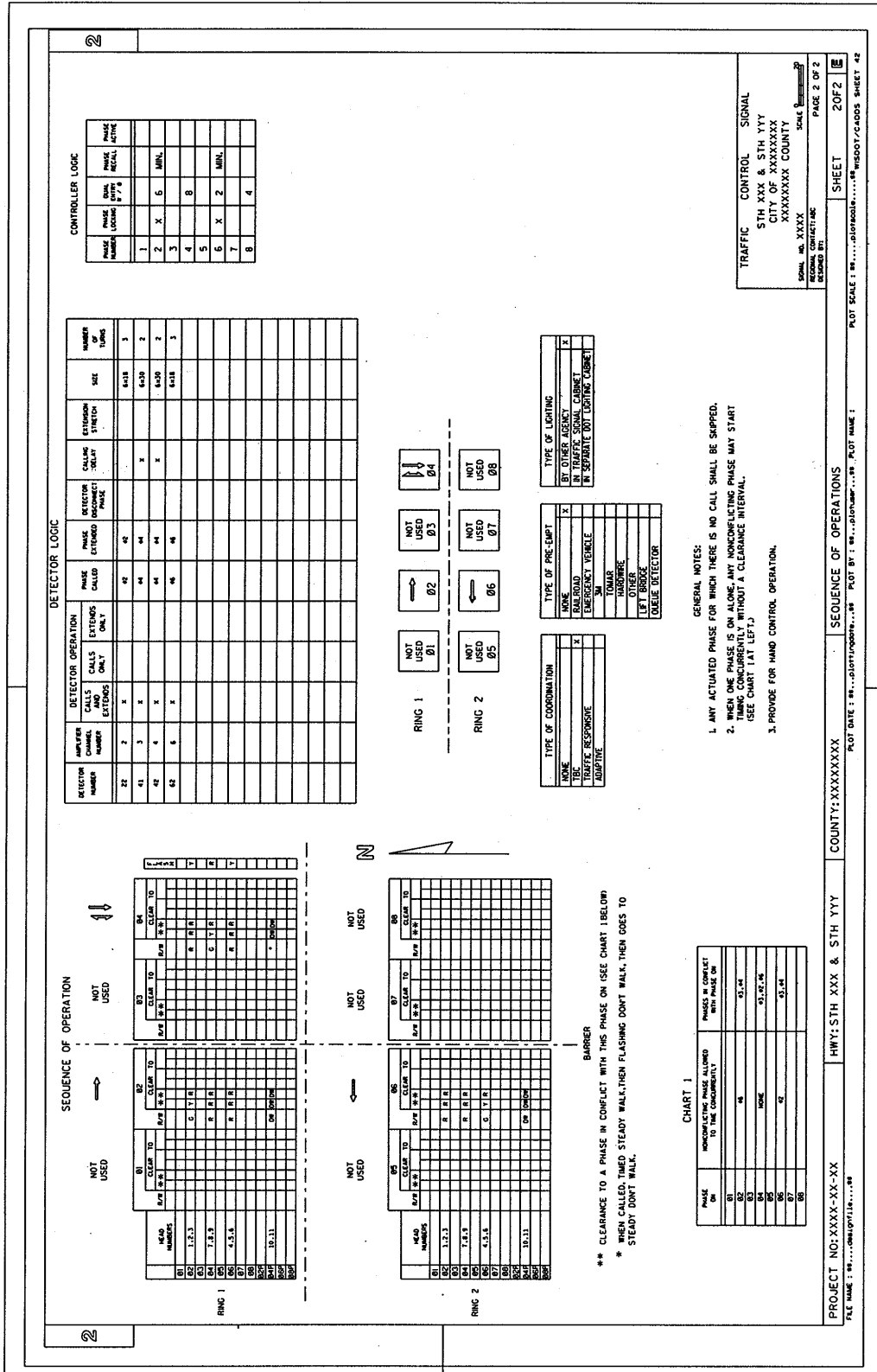


Figure 2b
 Sample Sequence of Operations Chart
 "T" Intersection (4-phase operation)

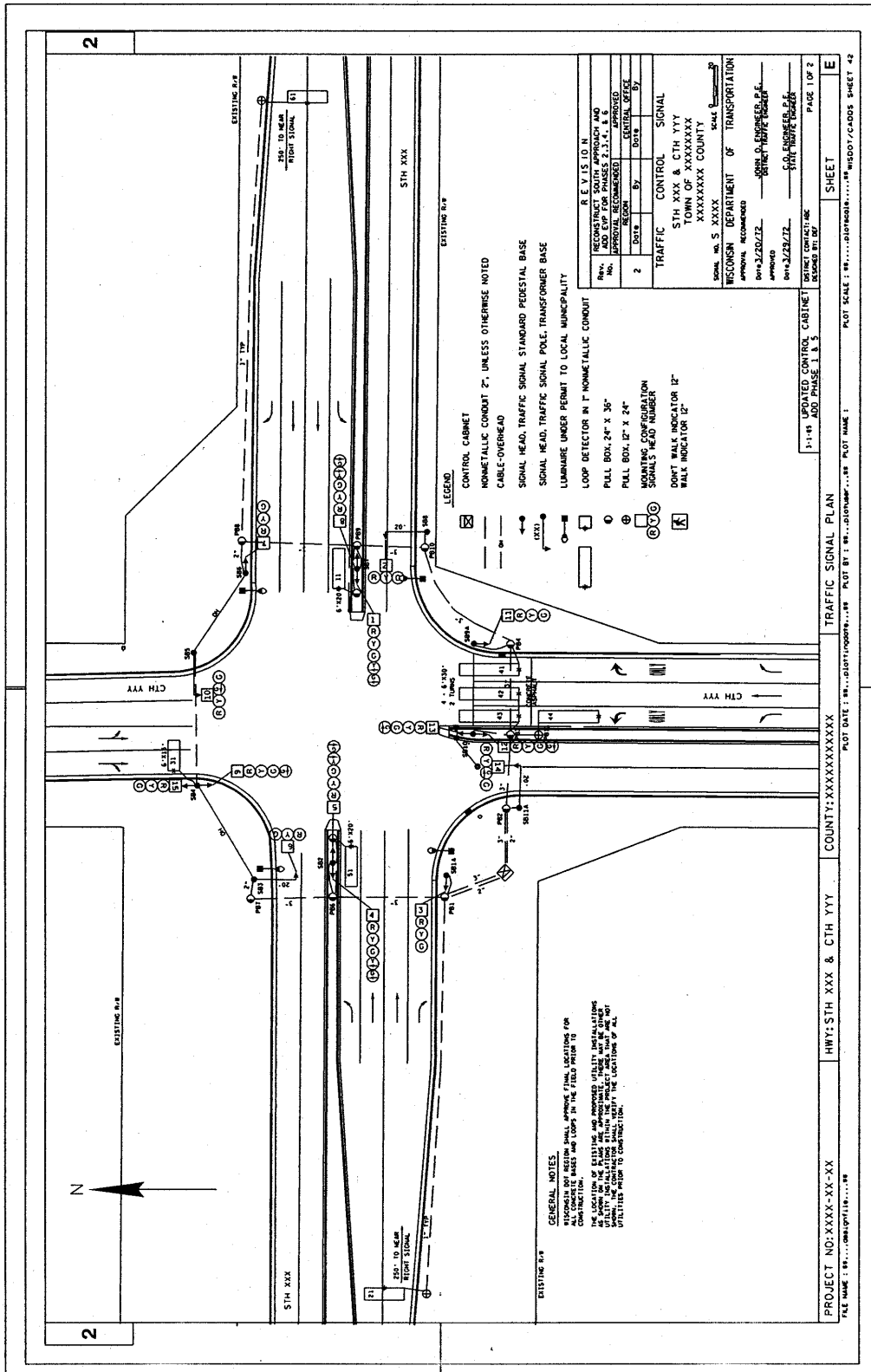


Figure 3a
4-legged intersection (split phase operation)

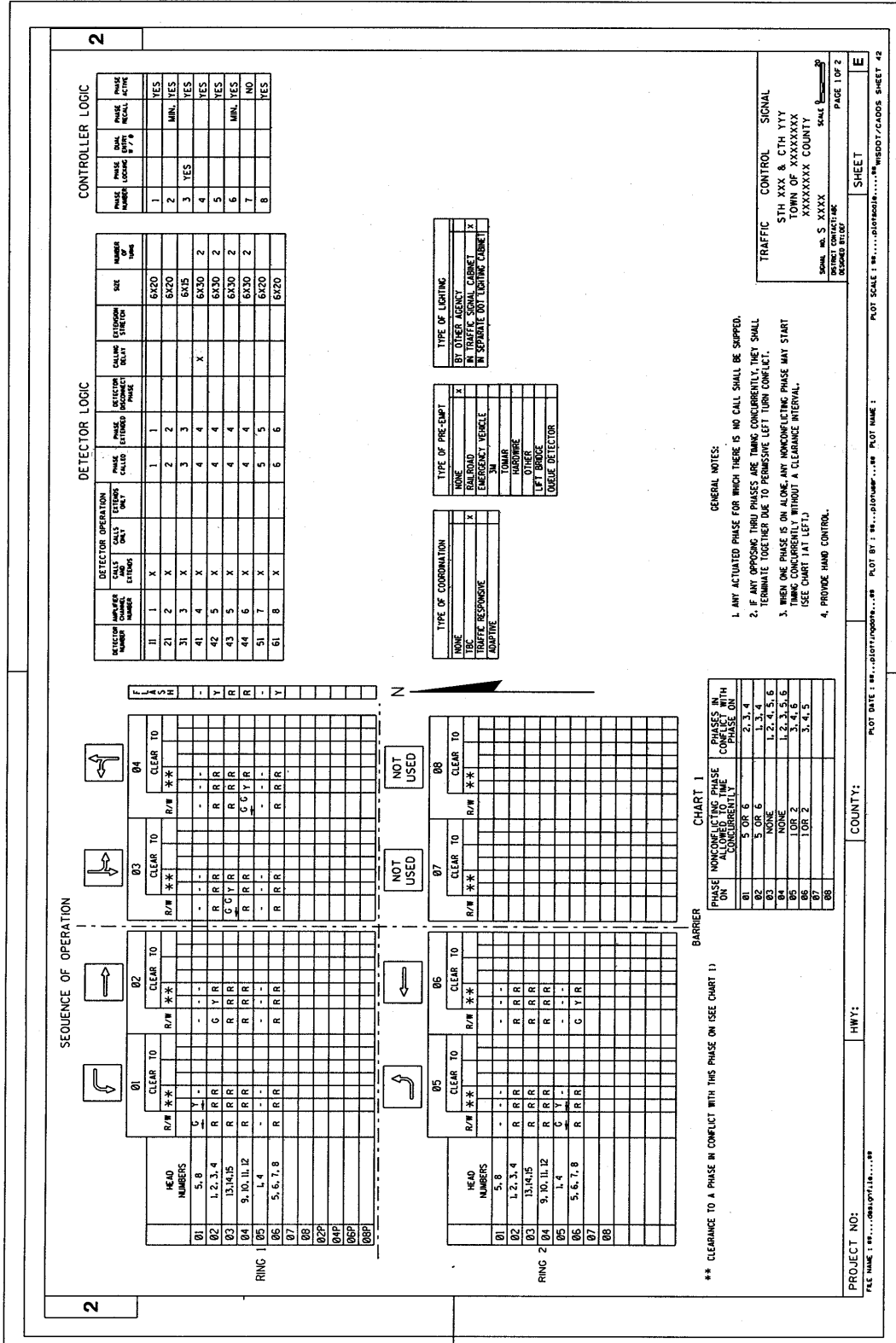


Figure 3b
Sequence of Operations Sheet
4-legged intersection (split phase operation)