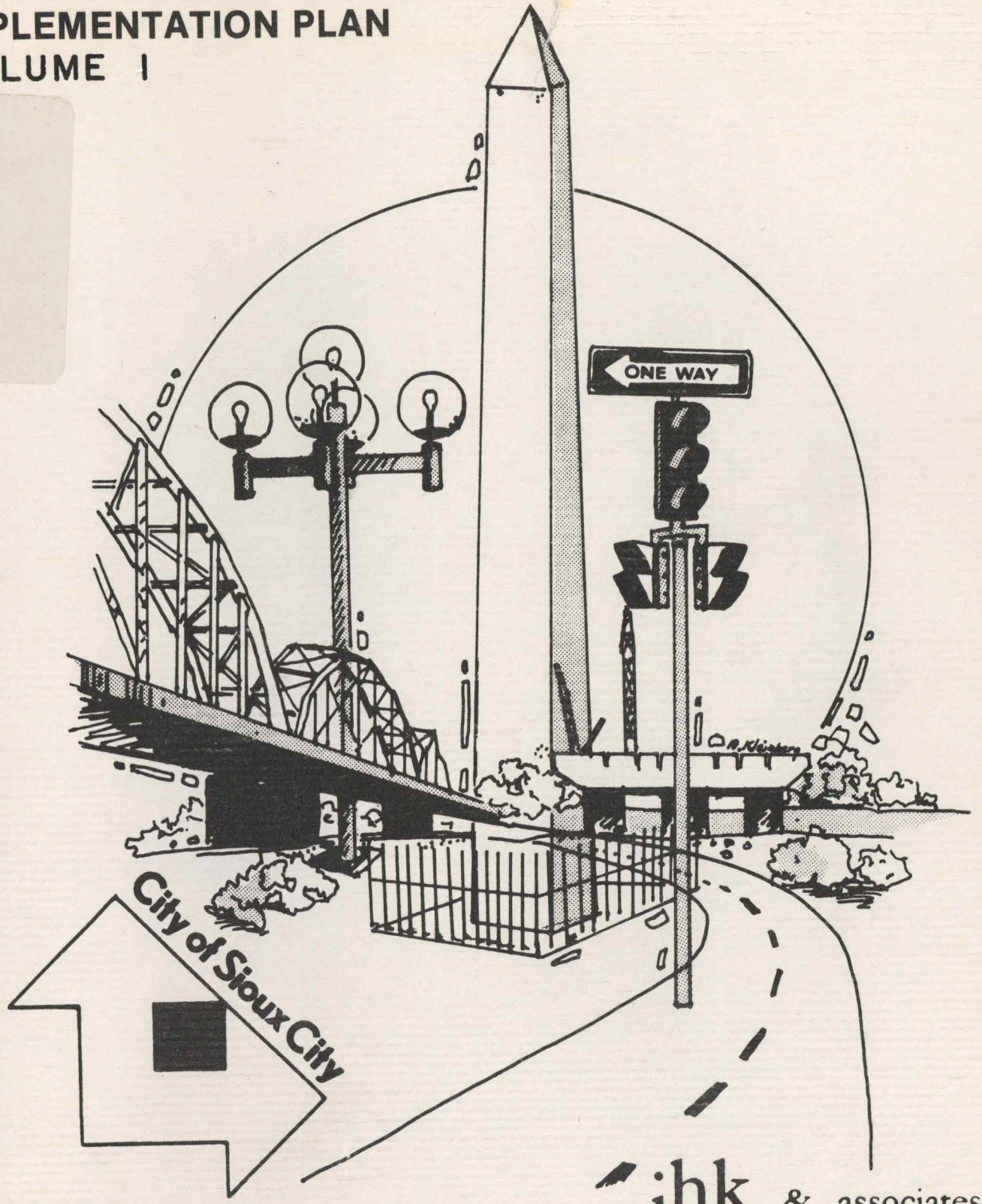
Study

sioux city

TRAFFIC SIGNAL SYSTEM

IMPLEMENTATION PLAN

VOLUME I



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SIOUX CITY SIGNAL SYSTEM
IMPLEMENTATION PLAN

VOLUME I

GENERAL GUIDELINES

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I. INTRODUCTION

Recognizing that improvements in motorist safety and transportation efficiency have been realized in some cities through improved signal system operation, Sioux City undertook a study to determine if similar improvements were feasible. The objectives of the study were to determine deficiencies in the existing signal system and to define the modernization to the system necessary to provide the level of operation required to meet the transportation objectives of the City. Based on an analysis of existing and future conditions, the study determined that the signal system control requirements to meet existing and future conditions greatly exceeded the capabilities of the existing system. It was further determined that the most cost-effective approach was to implement an areawide traffic control system utilizing state-of-the-art computer technology. The analysis, findings, and recommendations of this study are documented in the Sioux City Signal System Evaluation Study Final Report dated November 1977.

To refine the concepts developed during the feasibility study and to formalize a program for implementing the recommended traffic control system, a subsequent study was undertaken by the City. This study, funded by the Governor's Highway Safety Program, had as its objective the development of a detailed system description and an implementation plan sufficiently comprehensive to permit staged procurement of the system as funds became available. In this study, designated as Phase II, major items such as computer hardware, application software, and the communications network were to be developed at a level of detail to permit rapid development of construction documents.

This report presents a summary of the major products developed during the Phase II study. The report is organized as follows:

- System Functions - This section presents an overview of the operational capabilities to be provided by the

improved system. This includes a definition of the final system size and a description of the major master hardware components.

- Implementation Program - This section presents a description of how the project can be implemented in stages and a schedule of activities that would be required to construct the first project stage.
- Acceptance Testing - This section presents the various tests that will be required to insure proper operation of equipment and software furnished.
- Training - This section presents an overview of the initial training required for continued operation of the system.
- Installation Detail - This section presents typical construction installation details.

Detailed technical specifications for the procurement of the computer and peripheral equipment, communications equipment, and controller hardware is contained in a separate volume.

II. SYSTEM FUNCTIONS

To provide the transition from the conceptual description of the recommended system presented in the feasibility study to a detailed system design, an outline of functional requirements was developed. As it was anticipated that system implementation would be staged, and to insure that the system could be expanded as required, determining the system size was an important element in developing the functional outline. To permit proper sizing of the communications network and to permit easy updating of the map display, an analysis was performed to determine the probable location of new signals within the life expectancy of the system. These locations, together with the existing signals, were used to define the final system configuration and are shown in Appendix A.

SYSTEM FUNCTIONAL REQUIREMENTS

From the system configuration defined above and based on the findings of the signal system feasibility study, the functional requirements of the system were defined. The following presents in outline form the basic requirements to be provided by the modernized system.

Maximum System Size

The computer, mass storage, and software installed initially shall be sized to accomodate the following without the addition of equipment or software modifications:

° Intersections	180
° System Detectors	200
° Intersection Detectors	250
° Permanent Count Stations	20
° Fire Route Select Panels	12
° Auditorium Events Panel	1
° Maintenance Test Terminal	1
° Sections	30

In addition, the central communications equipment housing, power supply, and interconnecting cable between the communications equipment and the computer shall be installed initially to accommodate the above. All communications cable installed shall also be sized accordingly.

Controller Operation

Computer control shall provide for the following types of controller operation:

- Pretimed - Operation of electromechanical controllers, designated as Type P controllers, to be achieved by computer control of the controller camshaft. Controllers to be limited to Eagle Signal Co. EF 20 or EF 70 controllers.
- Actuated - Operation of actuated controllers to be achieved by computer issued hold, yield, and force-off commands. Controller equipment shall consist of solid-state devices conforming to NEMA Standards Publication No. TS 1-1976 and subsequent revisions. There shall be provisions for operating single ring controllers to provide 2 to 4 sequentially timed phases, designated as Type S controllers, and dual-ring controllers to provide 2 to 8 sequentially and concurrently timed phases, designated as Type D controllers. The decisions as to whether a force-off command is to be issued shall be determined by the computer by comparing the phase being displayed to the phase to be terminated. If there is a match, a force-off command will be issued; if they are different, a force-off command will be suppressed. There shall be provisions to independently control the phase duration of each ring of a Type D controller.

Sections

There shall be provisions to subdivide the system into 1 to 30 discrete areas of control designated as sections. There shall be provisions to assign from 1 to 180 intersections to a section. Assignment shall be accomplished by data base input. Dynamic reallocation of a signal from one section to another is not required.

Timing Plans

There shall be provisions for 31 timing plans for each section. Each timing plan shall be unique and shall consist of user-specified values of cycle length, split, and offset for each intersection. Cycle length shall be variable from 40 to 255 seconds in one second increments. Split and offset shall be variable in one second or one percent increments. The cycle length generation clocks shall be common to all sections.

Timing Plan Selection

There shall be provisions to select timing plans by operator, by time-of-day, and by traffic responsive operation. The following priorities shall apply with the lowest numerical value shown having the highest priority.

Priority Number	Criteria Class
1	Operator request for a signal
2	Operator request for a section
3	Operator request for the system
4	Time-of-day/day-of-week override for a signal
5	Time-of-day/day-of-week override for a section
6	Time-of-day/day-of-week override for the system
7	Traffic responsive criteria for a section
8	Time-of-day/day-of-week backup for a signal
9	Time-of-day/day-of-week backup for a section
10	Time-of-day/day-of-week backup for the system

Traffic Responsive Selection Criteria

The traffic responsive timing plan selection criteria (TRSP) shall consist of either a "pattern matching" procedure using volume and speed or shall conform to the Urban Traffic Control System (UTCS) procedure using volume and weighted occupancy. In addition, the TRSP procedure shall provide for the following:

- The procedure shall select timing plans for each section independently at a frequency not to exceed five minutes.
- Timing plan hysteresis to be provided by a user-specified minimum time criteria and by comparison to a minimum traffic performance change threshold function.
- Eligiblity of specific plans for selection to be determined on a time-of-day/day-of-week schedule.
- System detector assignment for TRSP be user-specified for each section on a time-of-day/day-of-week basis.
- Failures of system detectors assigned for TRSP to be automatically compensated for, except that TRSP to be disabled if the number of failed detectors exceeds a specified number defined by section.
- TRSP to be enabled or terminated by operator request or time-of-day/day-of-week schedule.

Transition

The change from off-line to on-line operation or the change from one timing plan to another shall be performed by means of a smooth transition. The transition timing plans shall be computed individually for each signal and shall be

performed by the "shortest method" by either expanding or contracting the transition cycle length.

Critical Intersection Control

There shall be critical intersection control (CIC) provisions to alter the cycle split of a signal based on information provided from system detectors located on each approach of the intersection. The procedure shall provide for the following.

- When enabled, CIC shall not become active until traffic parameters exceed a user-specified threshold.
- All system detectors assigned shall be operable.
- The split computation shall be performed on a cycle-by-cycle basis and shall be smoothed.
- There shall be provisions to compute the split for up to four signal phases.

Auditorium Events

There shall be provisions to permit time-of-day/day-of-week selection of user-defined plans to accommodate events at the City Auditorium. The procedure shall provide for the following.

- Requests are temporary, i.e., a new schedule shall be user-specified each week.
- Ability to schedule any timing plan.
- Ability to assign signals without section constraints.
- Plan selection procedure and plan duration to have highest priority except that it can be overridden by the operator.
- Begin time and end time of the timing plan to be specified in the schedule.

- Ability to start the timing plan earlier or later than that scheduled by a request entered through an Autidotirum Panel. In this case, the duration of the plan shall remain as scheduled.

Fire Route Preempt

There shall be provisions for preempting signals along predefined routes for fire apparatus. The procedure shall provide for the following:

- Ability to select from 1 to 10 routes from each station.
- Route selection to be performed from up to 12 stations.
- Request to be made by a push button request.
- Confirmation to be provided to requesting station as follows:
  a) Traffic control system is on-line;
  b) Preempt request is being processed for all signals along the route; or,
  c) One or more signals along the route will not preempt as requested; or,
  d) A previous fire route has been requested that conflicts with the current request.
- Routes shall be specified through user-defined input with provisions for up to 15 signals per route.
- The preempt display at Type P controllers is to be accomplished by the computer advancing the controller to the preempt interval(s) and holding the controller at this position for a user-specified time interval. Type S and Type D controllers are to be preempted by computer command and external logic at the controller to cause the desired preempt display.

Remote Flash

There shall be provisions to remotely select flashing operation of any signal. The change from stop-and-go to flashing operation or from flashing to stop-and-go operation shall be accomplished by operator request or by time-of-day/day-of-week schedule.

Standby

The system shall provide standby operation (i.e., computer failure, major communications failure, etc.) equal to the existing system operation. When a signal is off-line, all signal timing will be performed locally by the controller. Vehicle actuated (Type S and Type D) controllers will operate in an "isolated mode" responding to local traffic demand.

Coordinated standby operation of pretimed (Type P) controllers will be accomplished as follows. A standby master will provide a 48 volt DC output, to be transmitted to each Type P controller over a dedicated, electrically common, traffic control cable pair. The transmitted signal will be on continuously, except for two seconds once each cycle. This off-period will act as the synchronization impulse, or "zero reference point", in the same method as a standard pretimed signal system.

Permanent Count Station

There shall be provisions to permit data collection from up to twenty permanent count stations. Each count station will consist of one to four system detectors. Any system detector shall be assignable to any or all count stations by user-specified input parameters. The following data shall be provided for each detector and for each permanent count station, for a total of all detectors assigned to the station:

- 15-minute volume totals,
- Hourly totals, and
- Daily totals.

Display Map

The system shall provide for the operation of a display map. The map will act on requests from a map control panel. The map will display the status and operation of each intersection and system detector within the system. Each intersection display will consist of two, single color, independently controlled lamps. Either lamp, but not both, may be "on" or both may be "off", depending on the display request and the representative condition. Each detector display will consist of a single color, independently controlled lamp.

The operation of the map is to be structured within three functional categories: Section configuration, status, and lamp test.

Section configuration requests will result in a display to indicate all controllers and/or detectors that are currently assigned to the section specified by the position of the thumb-wheel on the map panel.

Lamp test requests shall cause all lamps of the color specified to be illuminated.

Status displays shall be provided, as requested, to indicate the status of each intersection and system detector. The controller status indications shall include: Main Street Green, On-Line, Standby, Failed, Flash, Preempt, and CIC. Detector status requests shall include an indication of the current status of all system detectors (on-line and failed) and an indication of detectors which are over or under traffic performance threshold values assigned by the user on the map panel thumbwheel switches.

Selectable Reports

Current reports shall be generated in response to specific requests entered at the console CRT, at a remote operations terminal, or in the activity scheduler.

It shall be possible to retrieve any and all user-specified input parameters including all entries in the activity scheduler. In addition, it shall be possible to obtain a single item of input data without observing other items of the same or related classifications.

It shall also be possible to obtain current status reports on the total system, one or more intersections, one or more detectors, the communications network, and special function devices. In addition, two current activity reports shall be provided, upon request, indicating the current signal timing plan for any intersection, and a comparison of actual controller operation to the intended operation specified in the timing plan.

A series of reports shall be provided, on request, for any or all detectors, intersections, or sections, for the following measure of traffic flow:

- Volume
- Occupancy
- Average Speed
- Stops and delay data
- Various parameters used for CIC and timing plan selection.

Data Logging

The system shall provide the means to create a record of system events, detector activity, and controller activity, simultaneously on request. In general, the data logging will be performed on magnetic tape, and the procedure shall permit background or off-line processing of data.

The information to be logged includes system events, such as automatic messages, timing plan and status changes, and parameter changes; detector activity; permanent count station data; controller activity; and calculated values for CIC and timing plan selection.

Data Base Management

The data base shall be accessible by the console CRT, the card reader, and the tape drive. The modification or addition of individual parameters shall be accomplished without interrupting the traffic control function of the system.

Automatic Messages

Various activities performed by the system generate automatic messages. Each message shall provide a unique, concise English language and decimal number description of the situation being reported. It shall be possible to preprogram the output device(s) assigned to present the messages.

Activity Scheduler

The activity scheduler shall provide the means to schedule by time-of-day/day-of-week all user-generated requests. The system shall initiate the appropriate action when the current time-of-day/day-of-week is the same as the corresponding execution time specified by a user entered request for the action in the activity scheduler.

Direct operator requests shall override all conflicting requests in the activity scheduler and shall remain in effect until cancelled by a second operator request.

Reports Scheduler

A reports scheduler shall provide the means to schedule by time-of-day/day-of-week user generated requests for reports. The reports scheduler need not be part of the activity scheduler; however, all requirements for the activity scheduler apply to the reports scheduler.

Monitoring and Testing

The system shall automatically monitor and test the operation of all field hardware including controllers, detectors,

communications, and special function devices. The inputs to the monitoring and testing procedures shall consist of timing plan parameters, expected equipment operation parameters, and observed equipment operation as determined from the equipment monitor messages. The output from the procedure, when an error is detected, shall include corrective actions, identifying failed units, automatically determining status of units, and generating error and failure messages.

The various hardware components at any particular time shall be categorized depending on the results of automatic monitoring and testing procedures or operator action including scheduled activities. The specific monitoring and testing performed by the procedure shall vary automatically according to operational status.

Central Control Equipment

A partial description of the equipment required for the central control of the traffic signal system is given below. The equipment includes the computer and its related displays, input/output devices, and maintenance related items.

The processor furnished shall have a minimum word size of 16 bits, and a minimum memory of 64,000 - 8 bit bytes. A minimum of 8000 bytes shall be provided for non-specified user background processing and at least 25 percent of the total memory and cycle time at the maximum configuration shall be available for future tests. The maximum memory cycle time shall be one microsecond or less.

In addition, the processor shall have a watchdog timer to stop operation when the computer experiences an unrecoverable error; a crystal controlled real-time clock; and a control panel with input switches and processor function displays. The processor shall be capable of an automatic restart after a power failure.

An external digital clock with a battery backup displaying numerically the month, date, and time in hours, minutes, and seconds, shall be provided. This clock shall be read by the traffic applications program on start-up or restart after power failure.

Two removable disk drives shall be provided. Each disk drive shall provide, as a minimum, 8 million bytes of addressable storage.

One magnetic tape drive, capable of reading or writing on nine tracks with 800 8-bit characters per inch, shall be provided. A card reader, with a speed of 300 cards per minute, shall also be provided.

An impact type line printer with a rated output of 300 lines per minute shall be provided. Each line shall have 132 print positions and the printer shall be adjustable to accept 8-1/2 inch to 14-7/8 inch fanfold paper. A heavy duty teletypewriter dedicated to the operating system but assignable to the traffic applications program shall also be provided.

A display map and map control panel for graphic representation of the status signal system shall be provided. The map displays are to be selected through operator request entered by various pushbuttons and thumbwheel switches. The map shall show, upon request, the following status for each intersection:

- Main Street Green
- On-Line
- Standby
- Failed
- Flash
- Preempted
- CIC

In addition, system detector status is to be shown on the map. The map shall show, upon request, the following:

- On-Line
- Off-Line
- Over/Under a requested volume, occupancy, or speed threshold

The map control panel shall also have controls for a lamp and legend test, which checks the operation of all indicators.

A traffic engineering console is required to provide a working area for the system operator, and a stable platform for the CRT terminal, the console printer, and the map control panel.

A keypunch machine is to be provided for preparation of Hollerith type punch cards.

Test controllers including a housing and displays are to be provided in the control center. Three test controllers shall be provided: one pretimed, one single-ring actuated, and one dual-ring actuated (Type P, Type S, and Type D respectively). Display panels, portraying typical intersection geometrics, pedestrian and vehicle movements, and vehicle and pedestrian detectors, if used, will be provided for each test controller type. Each controller shall operate identically to those used for intersection control. The test controller/display assembly shall be furnished with devices to permit simulated system detector inputs to the computer. There shall be provisions for simulating six system detectors, each of which will be manually adjustable to vary the count and detector "on" time.

At the city signal maintenance shop, a maintenance test terminal shall be installed. As a minimum, the terminal will include a CRT, a CRT input keyboard, communications equipment, three controller communications units and harnesses for the three controller types, display panels, and other devices necessary for operation by the computer system.

III. IMPLEMENTATION PROGRAM

Implementation of the entire Sioux City traffic control system as a single project may not be possible within short term funding limitations. However, a comprehensive program for staged implementation has been developed to permit the critical elements of the system to be installed initially with system expansion performed as funding becomes available. To assure integrated operation of the various system components and to maximize the benefit to the public for each project stage, it is necessary to configure the various project stages within a rational framework. The following presents a discussion of project staging, the communications network, and a typical implementation schedule.

PROJECT STAGING

The first project phase is defined as a complete and operational system limited only by the number of signalized intersections and the extent of the communications network. As a minimum, this phase must include the computer and peripheral equipment, the traffic applications software, and a sufficient portion of the communications network to operate a minimum number of intersections. This initial stage of system implementation must provide substantial benefit to the motoring public and permit all aspects of the system to be thoroughly tested prior to subsequent stage implementation. Construction work which can be easily accomplished by city staff as a part of the capital improvement program should be considered as part of subsequent phases.

All subsequent implementation phases must represent an integral improvement project that increases the size of the system with a minimum amount of disruption to signal system operation. As a criteria, each project should be configured so that it will enhance traffic operations and complement subsequent construction projects.

To permit the extent of the initial and subsequent implementation project phases to be defined, the total system was subdivided such that each intersection grouping represented a minimum implementation project size to be considered. These were then prioritized to define project stages. Thus, the initial project phase, as a minimum, would consist of those intersections defined in Stage One. Stages, however, can be and should be, whenever possible, combined into larger implementation projects if funding is available.

To define the project stages and establish the priority rating, each signalized intersection was investigated to categorize them in terms of traffic characteristics, physical conditions, and interaction between signals. The following are the major factors considered during the development of project staging and priority rating.

- Traffic Volume - Signals with high traffic volumes were given a higher rating than signals having low volumes.
- Impact On Area Strategy - Signals that have substantial impact on the overall traffic control strategy were given a high priority. Signals in this category include those whose primary purpose is to establish platoons, signals located at major traffic generators, etc.
- Network Geometrics or Physical Conditions - A high priority was given to signals whose spacing is conducive to good traffic progression. This includes signals where a good platoon discipline exists and system operation could assist in maintaining these desirable traffic characteristics.
- Accident Experience - High accident locations were given a high priority.

- Equipment Condition - Intersections with unreliable signal controller equipment were given higher priority than signals with equipment presently providing reliable operation.
- Intersection Geometrics - Locations requiring physical improvements to correct geometric deficiencies were given a lower priority than those where no geometric improvements are required. Examples are 27th & Pierce, Lakeport & Morningside, and Dace & Floyd.
- Intersection/Area Conflicts - Intersections where system implementation could adversely affect an unimproved area of the system (e.g., boundary disturbances) were given a lower priority or were grouped with adjacent signals having a higher priority.
- Predicted Land Use - Intersections which are predicted to have substantial changes in traffic characteristics due to major development or growth were given a higher priority to permit required system operation.
- Existing System - Signals presently operating in an existing control system that generally satisfy the area traffic control requirements were given a lower priority.

Most future signal locations and intersections presently scheduled for signal upgrading as part of a programmed roadway improvement project were not considered in the configuration of the various implementation stages. Therefore, it is recommended that a policy be established which would require that all new signalized intersections be constructed with all necessary provisions for incorporation into the system. All equipment, including controller and communications hardware, must be installed to permit system pickup when communications connections are provided.

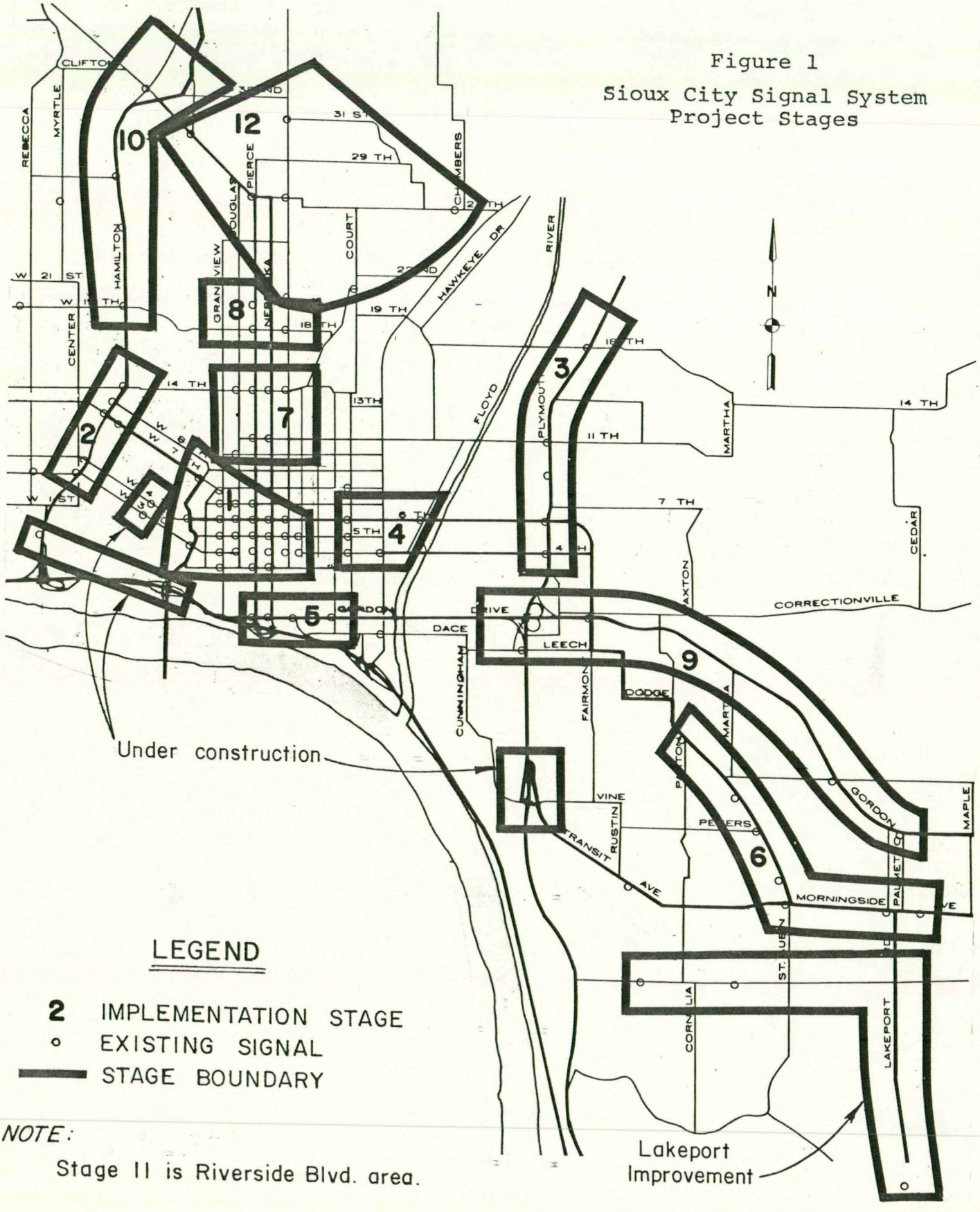
Stage Descriptions

Twelve project stages were developed and a priority establish for each based on the previously discussed factors. Figure 1 shows the intersection groups associated with each stage. The signalized intersections included in each stage are listed in Appendix B. The following is a brief description of each stage and general comments regarding its priority rating.

- Stage One - The Stage One project consists of 28 signalized locations within the Central Business District (CBD) of the City. This portion of the City was selected to receive the highest priority due to the importance of the area within the context of the long-range goals of the City and due to the inability of the existing traffic control system to meet current traffic conditions. The timely installation of a modernized traffic control system in this area is especially needed to accommodate urban redevelopment within the CBD and to coincide with the completion of a new river crossing and free-way interchange.
- Stage Two - The Stage Two project consists of signals located on Hamilton Blvd. from West 3rd Street to West 14th Street. These intersections received a high priority due to traffic volumes, inability of the existing system to adequately control present traffic conditions, and the benefit expected to be realized by the motoring public by improved signal operation. The Tri-View intersection, which is also part of this Subsystem, should be incorporated into the system in conjunction with construction of the Hamilton/Pearl Street Connector.

Figure 1

Sioux City Signal System
Project Stages



NOTE:

Stage 11 is Riverside Blvd. area.

- Stage Three - The Stage Three project consists of five signalized intersections on Lewis Blvd. from 4th Street to 18th Street. These signals received a high priority due to high traffic volumes, the condition of existing control equipment, and the good platoon discipline observed on this facility.
- Stage Four - The Stage Four project consists of five signalized intersections east of the CBD area. The project priority of these signals was established relatively high in order to maintain east-west CBD traffic platoons and to enhance the Stages One and Three projects. The marginal condition of the existing traffic control equipment also contributed to the high priority rating.
- Stage Five - The Stage Five project consists of four signalized intersections on Gordon Drive south of the CBD area. These intersections received a high priority due to high accident experience and due to the need to coordinate north-south and east-west traffic flows.
- Stage Six - The Stage Six project consists of seven signalized intersections on Morningside Drive, including the intersection of Morningside Drive and Paxton. This signal should be moved to a location south of the intersection to operate as a mid-block pedestrian signal. This project priority was established based on the arterial characteristics of the roadway and the anticipated construction of a major shopping center located south of Morningside Drive. Unreliable controller equipment and the inabilities of existing equipment at selected locations to provide needed operation also affected the priority.

The rating of this project may require re-examination if the proposed interloop project is implemented earlier than expected. Revised traffic characteristics and additional signalized locations could substantially revise the priority.

- Stage Seven - The Stage Seven project consists of seven signalized intersections in the Central Subsystem on, and to the south of, 14th Street. The priority was established to provide coordinated north/south traffic movements from the CBD (Stage One).
- Stage Eight - The Stage Eight project consists of four signalized intersections on 18th and 20th Streets in the northern part of the Central Subsystem. The project priority was established to complement the Stage Seven project. Reliability of existing control equipment confirmed the project priority.
- Stage Nine - The Stage Nine project consists of five signalized intersections on Lewis Blvd. and Gordon Drive. The project priority was established based on traffic volumes and geometric conditions that indicate good progression at relatively high speeds can be achieved.
- Stage Ten - The Stage Ten project consists of six signalized intersections on Hamilton Blvd. from West 19th Street to Stone Park Blvd. Although this arterial experiences heavy traffic volumes, the relatively low project priority was established due to the system capabilities provided by completion of the Hamilton Blvd. improvement project.
- Stage Eleven - The Stage Eleven project consists of four signalized intersections on Riverside Drive.

Although these signals are closely spaced and generally meet the criteria for system operation, the project priority was based on the remote location relative to the rest of the system.

- Stage Twelve - The Stage Twelve project consists of the signalized intersections in the North Central Subsystem and one location on Stone Park Blvd. This project priority was established due to low signal density in the area. The relative priority may require reexamination, however, if signal density increases more than anticipated in the near future.

In conjunction with the projects described above, other opportunities to expand the system will occur. The following is a description of complementary work that can be performed to implement the total system:

- A major effort will be required to install an area-wide, city-owned communications network. This task is both costly and time consuming but should be continually pursued in conjunction with other projects.
- Intersections not presently signalized should be equipped with traffic signal control equipment when installed to permit them to be easily incorporated into the system.
- The Lakeport Street traffic signals should be incorporated into the system when the Lakeport Improvement Project is constructed.
- The intersections on Transit Avenue at the Lewis Blvd. ramps should be incorporated into the system in conjunction with the Lewis Blvd. construction project.
- The signalized intersections at Helen and Glass Streets on Transit Avenue should be included in the project staging as part of Stage Thirteen as soon as additional traffic signals are installed along that arterial.

- Traffic signals installed at the connection of the Combination Bridge and the Hamilton-Pearl Connector should be incorporated in the initial system as soon as roadway and bridge construction is completed.
- Signalized intersections outside, but near the subsystem boundaries, should be incorporated in the system if other intersections are signalized that increase the signal density.
- The traffic signals in South Sioux City should be interconnected with the Sioux City Traffic Control System when the Combination Bridge construction is completed and agreements can be formalized between the various jurisdictions.

COMMUNICATIONS NETWORK

The communications network necessary to interconnect the traffic signals and the computer is a key component of the traffic control system. The cost associated with this network, both initially and amortized over a period of years, constitutes a major portion of the overall construction cost. For this reason, the design of the communications network requires extensive work by the design engineer along with cooperation of representatives of the City, utility companies, and many others to assure that the most cost-effective network is selected.

Communications System Description

The communications system selected for Sioux City is a full-duplex, four wire (two pair) electrical circuit using time-division multiplexing for data transmission. Dedicated city-owned cable will be installed along with connections to dedicated unconditioned telephone lines conforming to Bell Type 3002 channels. The system will provide a two-way exchange of data between the controller and computer, for the control and monitoring of equipment in the field. Other functions provided

by the communications include, a one-way exchange of data to synchronize intersection controller operation when the computer is not in direct control and a two-way voice communications between signalized intersections and the computer site.

The hardware required includes controller interface and communications units installed at each intersection, a communications terminal panel at the computer site, a master communications unit at the computer site and all the associated cabling to interconnect the components. The controller interface and communications unit and the master communications unit serve as counterparts to each other to receive and transmit data messages, to detect message errors, and to provide interface with other equipment.

Communications Media

The ultimate communications media to be used in the Sioux City Traffic Control System is a city-owned cable network. Due to anticipated limited funds in the initial stages of implementation, a combination of city-owned cable and telephone lines leased from Northwestern Bell Telephone will be utilized. However, the final cable network was defined as part of this project to provide a detailed plan for installing the cable system. The following is a brief description of the design process.

A tentative city-owned cable routing and sizing schematic was defined assuming installation in existing areaways and/or conduits in the Central Business District and overhead installation on existing utility poles throughout the remainder of the City. Representatives from the City and the utility companies then jointly reviewed the routing to identify the magnitude of conflicts with existing facilities and to define alternate routes to minimize the conflicts. Construction details and procedures were also identified at this time and approved by all parties.

Next, preliminary construction cost estimates were prepared and compared to available funding. As it was apparent

that the entire cable system could not be constructed initially, alternate implementation plans were developed and analyzed. From this analysis the following communications implementation plan was developed:

- The initial implementation project would include a city-owned cable network in the Central Business District. The cable would be installed in existing areaways or conduits supplemented by the installation of new conduit.
- Existing interconnect cable and/or conduit would be used along Hamilton Blvd.
- Leased telephone lines would be used to communicate with controller equipment in all areas.

This approach permits a large number of intersections to be initially controlled by the computer with a minimum amount of construction costs. The leased lines are intended to be temporary and should be replaced with city-owned cable as soon as possible. This approach will also permit the city to reduce total construction costs as it will allow installing cable in conjunction with other construction projects.

Based on previous activities, the routing of the total cable network was finalized and a detailed field review was conducted by the design engineer, city staff and representatives from the utility companies. Conflicts which prohibited conformance to minimum clearance requirements were discussed and utility relocation responsibilities were identified. The utility companies were then able to estimate and schedule their work requirements to coincide with the system implementation project.

The ultimate cable routing of the city-owned cable network was finalized in an Implementation Plan and is shown in Appendix C. The relocation work shown was identified during May 1978. Prior to constructing any portion of the network, a detailed review of the routing should be performed. The traffic

engineer and representatives of the utility companies should conduct this review to identify any revisions required to the Implementation Plan due to changed conditions. Additions or upgrading of utility lines occur continuously and may substantially impact the routing. Although revisions of routing or relocation requirements may occur, they should be accommodated within the overall plan.

SYSTEM DETECTORS

The location of system detectors will greatly affect the traffic surveillance capabilities of the system. When properly located, they provide meaningful data for use by traffic responsive routines and for the computation of system performance indicators. When improperly located, however, they are essentially useless.

As system detectors are relatively costly, a careful investigation of potential location was performed. Candidate system detector locations were identified based on guidelines presented in the FHWA research report entitled Locating Detectors for Advanced Traffic Control Strategies. Each of these candidate locations was then investigated, using traffic flow data developed during the System Feasibility Study, to determine those locations that provided a good indicator of traffic characteristics throughout the day. Those that did not meet this criteria, e.g. A.M. and P.M. traffic volumes are similar, were eliminated.

The resulting system detector locations are shown in Figure 2. These were further categorized to identify locations that should be installed initially with the installation of the remaining locations to be performed after the system has been operational. This will provide valuable user experience to permit a more concise determination as to whether adjustments in the proposed detector locations are required.

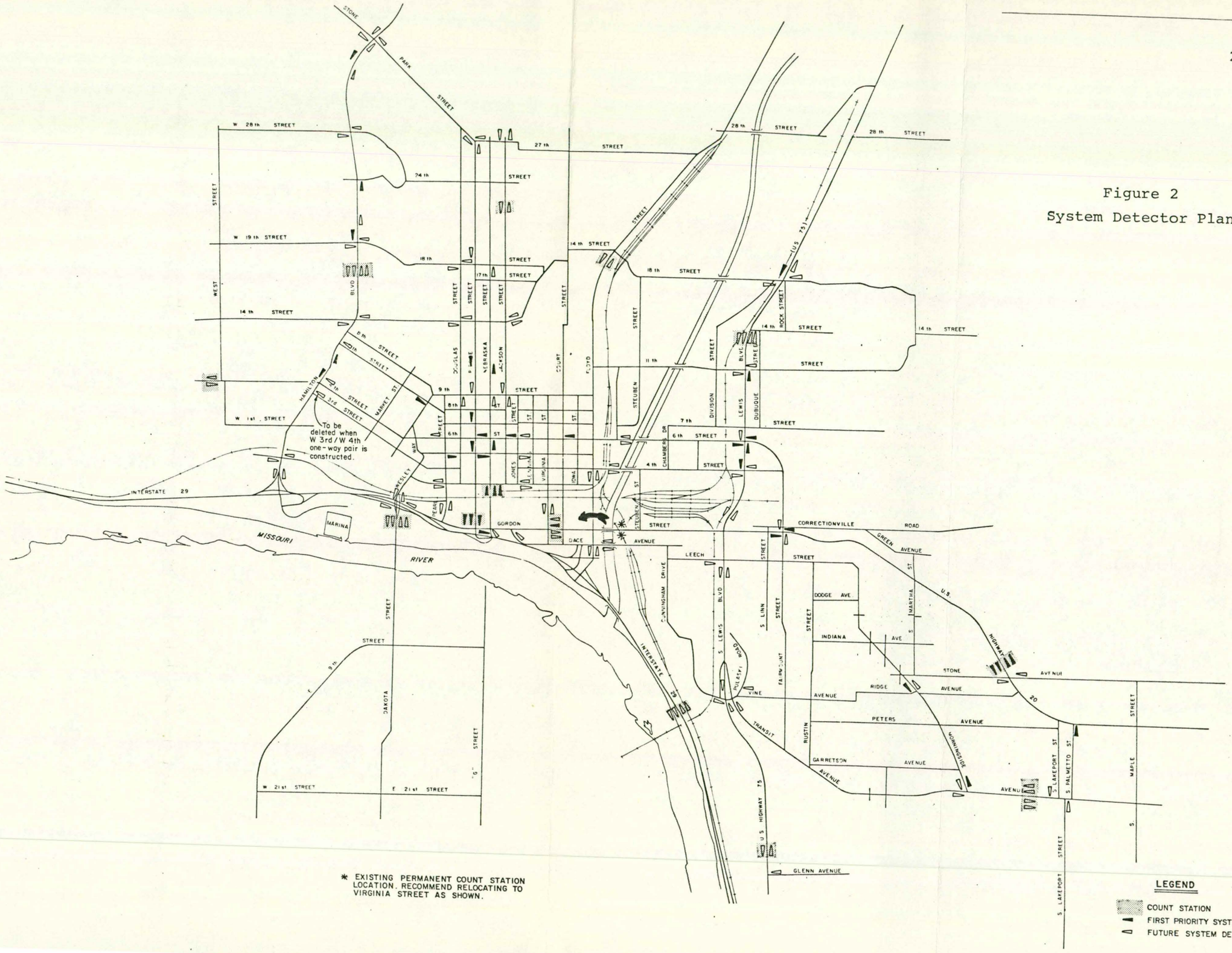


Figure 2
System Detector Plan

TYPICAL IMPLEMENTATION SCHEDULE

It was assumed that this project would consist of the installation of 60 to 70 intersections and a city-owned communications cable network within the CBD. Communications to the remaining intersections would be performed by telephone lines.

A typical implementation schedule for construction of the first phase of the project has been developed as a guideline to identify major activities, responsibilities, and time constraints. As with any project schedule, continual review and adjustments to the time schedule will be required for proper project control.

The project implementation schedule has been divided into Preconstruction Activities, those tasks necessary to solicit bids from qualified contractors; and System Implementation Activities, those activities necessary to construct the system.

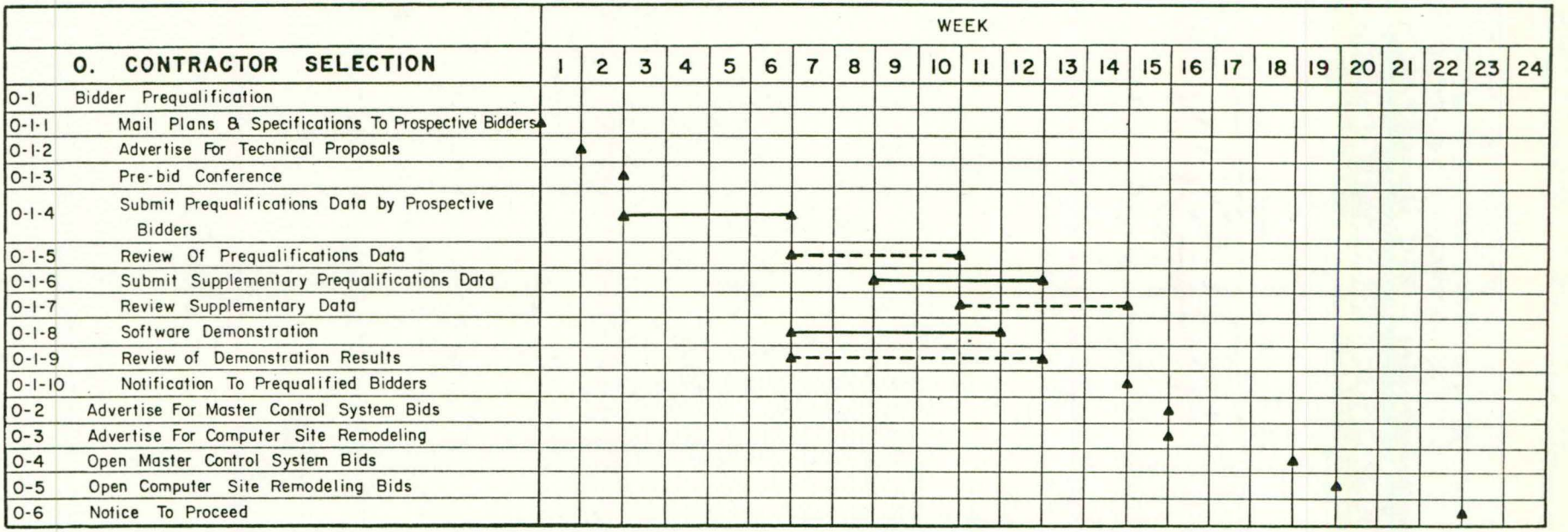
Preconstruction Activities

The implementation of a computerized traffic control system is a complex undertaking. It requires combining capabilities in computer integration, application software development, electrical construction, and overall project management. As those are diverse areas of expertise, many contractors may not be able to combine the necessary resources to successfully undertake a project of this complexity. Therefore, a process is necessary to prequalify bidders to minimize the risks to Sioux City by establishing a qualified bidders list based on prior experience.

A series of tasks are proposed as preconstruction activities to insure that only qualified contractors are permitted to bid on the project. These activities include advertising, bidder prequalifications, bid preparation, bid opening and review, and the awarding of the contract. A graphic summary of the preconstruction activities and time requirements is shown in Figure 3.

Figure 3

Phase A Implementation Schedule
Pre-Construction Activities



▲ START / END
——— TASK PERFORMED BY PROSPECTIVE BIDDERS
- - - - TASK PERFORMED BY CITY / CONSULTANT

The following is a brief description of the major preconstruction activities.

Bidder Prequalification

The prospective contractors must prequalify as acceptable prior to Advertise for Bids. The tasks required for this prequalification are:

- The City will mail plan sets and copies of the Special Provisions to prospective bidders who have shown interest in similar projects.
- The City will then request prequalification material from prospective bidders. This material will include a technical proposal, an experience statement, and financial information from prospective bidders. This information is a first step in the advertising and award procedures.
- Prior to submission of the prequalification material, the City will arrange for a prebid conference between the City and Prospective Bidders to discuss plans, specifications, and other project related information.
- Prospective Bidders submit technical proposals and prequalification statements to the City.
- The City will review the prequalifications data submitted by Prospective Bidders. If more information is necessary, the City will notify the individual contractors.
- If requested above, the Prospective Bidders will submit supplementary prequalifications data.
- The City will review any supplementary data submitted as requested.
- The Contractor will demonstrate the functions of the proposed Traffic Applications Software package to the City.

- The City will review the results of the above demonstration.
- The City will identify acceptable bidders and will officially notify those that have met the pre-qualifications requirements.

Advertise for Master Control System Bids

The City will advertise to invite prequalified bidders to bid on the Master Control System.

Advertise for Computer Site Remodeling

The City will advertise for bids for the remodeling and preparation of the computer site.

Open Master Control System Bids

The City will open and review all bids for the Master Control System.

Open Computer Site Remodeling Bids

The City will open and review all bids for the remodeling of the Computer Site.

Notice to Proceed

Upon review of all bids, the City will issue a Notice to Proceed to the qualified low bidders for the Master Control System and the Computer Site Remodeling.

Construction Activities

A detailed implementation schedule for the initial implementation project has been developed to provide a guidance in scheduling other activities. The major implementation activities have been listed with estimated time requirements and agency responsibilities. Figure 4 is a summary of these activities.

Figure 4

Phase A Implementation Schedule
Construction Activities

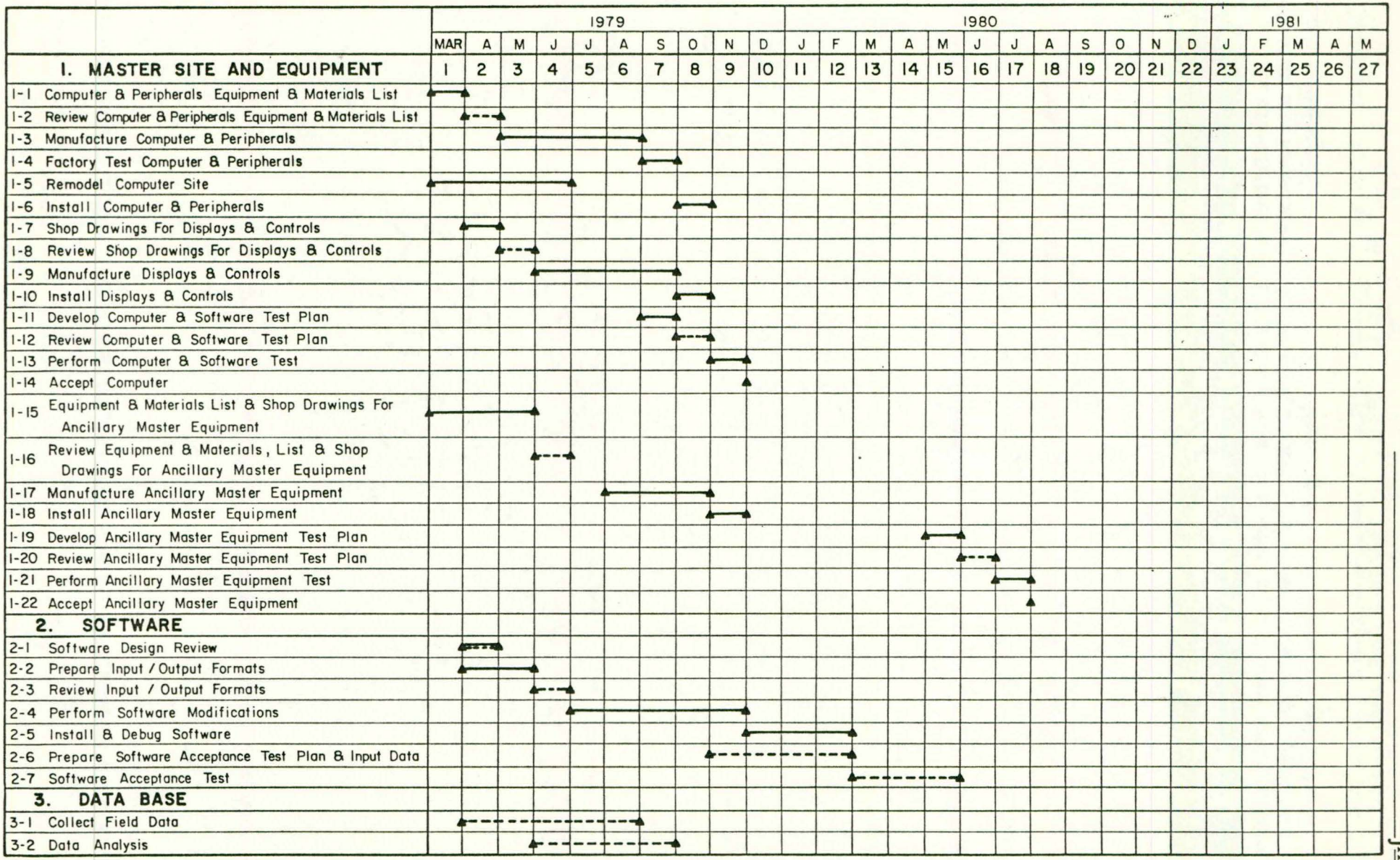


Figure 4 (Continued)

Phase A Implementation Schedule
Construction Activities

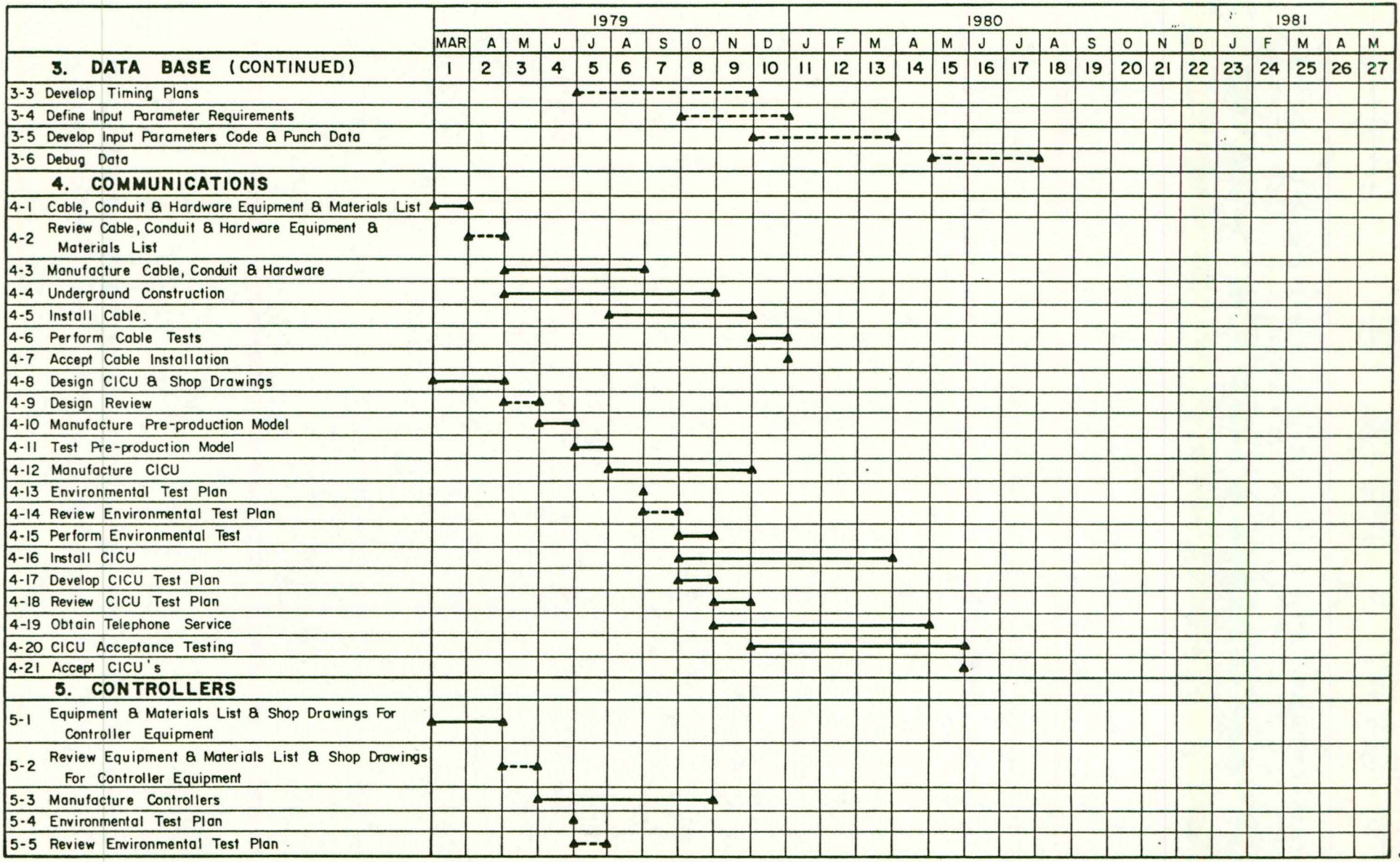
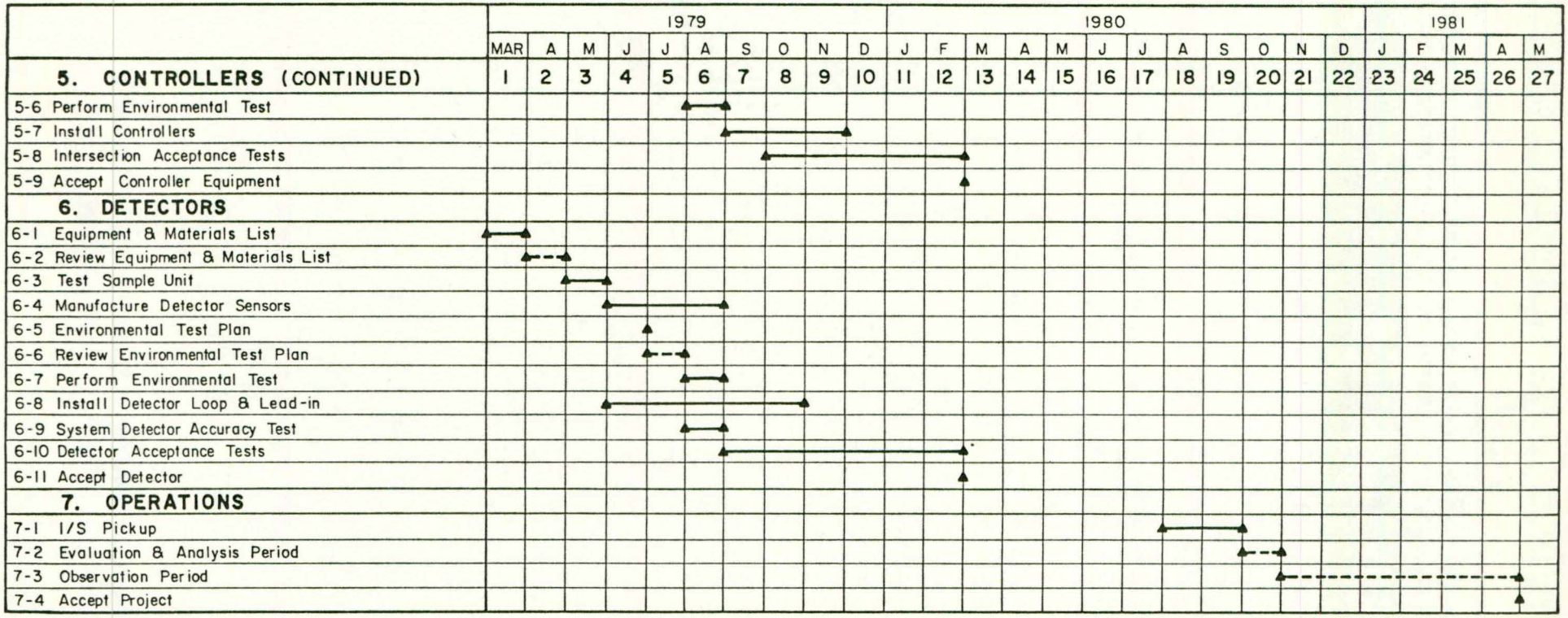


Figure 4 (Continued)

Phase A Implementation Schedule
Construction Activities



▲ START / END
——— TASK PERFORMED BY CONTRACTOR
- - - - TASK PERFORMED BY CITY / CONSULTANT

The following is a brief description of the major project implementation tasks required. The majority of the construction work will be performed by the contractor(s), with the City, and/or consultant(s) providing engineering support.

Master Site and Equipment

The tasks described in this element are the preparation and installation of those items of hardware related to the operation of the traffic signal system master computing facility. Essentially all elements that will be contained in the control center are included. The display, remote terminals, and remote panels are also considered as part of the master facility.

- Computer and Peripheral Equipment and Materials List - The Contractor will submit detailed descriptions of the proposed computer, peripheral equipment, and related materials to the City.
- Review Computer and Peripheral Equipment and Materials List - The list submitted by the Contractor will be reviewed by the City for sufficiency in meeting the system specifications.
- Manufacture Computer and Peripherals - The work under this task consists of the manufacturing or acquiring of the computer and peripheral equipment. The computer is defined as the central processing unit, its storage, and other related equipment. The peripheral equipment includes mass storage devices, input/output devices, and the computer interface units.
- Factory Test Computer and Peripherals - This task involves performing normal operational tests of the computer and peripheral equipment at the factory site. The City shall be advised of the date and form of the factory tests, so that its representatives can inspect the tests and test results.

- Remodel Computer Site - This task involves the modification and/or construction work required at the master site prior to installation of hardware.
- Install Computer and Peripherals - This task requires the Contractor to deliver and install the required master facility equipment including the computer and its peripherals.
- Shop Drawings for Displays and Controls - The Contractor shall submit shop drawings for the displays and controls including color samples, materials, and artwork.
- Review Shop Drawings for Displays and Controls - The City will review the shop drawings submitted by the Contractor and will give formal approval of the display design, including materials and presentation techniques.
- Manufacture Displays and Controls - The work under this task is the actual manufacture of the displays and controls.
- Install Displays and Controls - This task requires the Contractor to deliver and install the required displays and controls.
- Develop Computer and Software Test Plan - This task requires the Contractor to develop and submit a test plan for the acceptance testing of the computer and its basic software.
- Review Computer and Software Test Plan - The work under this task requires the City to review the submitted test plan and to make formal approval.
- Perform Computer and Software Test - The work under this task is the performance of the computer and software acceptance tests by the Contractor, in cooperation with the City. It is anticipated that certain elements

of the acceptance tests will have to be rerun. Retesting is generally considered as part of the basic acceptance test.

- Accept Computer - The work under this task is the acceptance of the computer, its peripherals, and the display and controls in place at the Master Site. This element will be one of the primary system milestones.
- Equipment and Materials List and Shop Drawings for Ancillary Master Equipment - The Contractor will submit detailed descriptions and shop drawings for all ancillary master equipment, including remote terminals, fire preemption panels, auditorium preemption panel, and standby master.
- Review Equipment and Materials List and Shop Drawings for Ancillary Master Equipment - The work under this task requires the City to review the Contractor's submittal for sufficiency in meeting the system specifications, and to issue formal approval.
- Manufacture Ancillary Master Equipment - This task involves the actual manufacture of the ancillary master equipment by the Contractor.
- Install Ancillary Master Equipment - This task requires the Contractor to deliver and install the required ancillary master equipment.
- Develop Ancillary Master Equipment Test Plan - The work under this task involves the development and submittal of a test plan for the acceptance testing of the ancillary master equipment.
- Review Ancillary Master Equipment Test Plan - The work under this task requires the City to review the submitted test plan and to make formal approval.

° Perform Ancillary Master Equipment Test - This task is the performance of the ancillary master equipment acceptance tests by the Contractor in cooperation with the City.

° Accept Ancillary Master Equipment - The work under this task is the acceptance of the ancillary master equipment by the City.

Software

This element requires the modification, preparation, installation, and debugging of the Traffic Applications Software. The work includes the design and incorporation of input/output formats, and testing of software functions.

° Software Design Review - This task requires the Contractor to prepare, in flow chart form, the modifications necessary to make the proposed software system conform to the specifications. The flow charts and any explanatory narrative shall be submitted to the City for review, to insure conformance with the intent of the functional specifications and to insure that the changes do not alter the desirable characteristics of the base program.

° Prepare Input/Output Formats - The work under this task requires the Contractor to prepare and submit detailed formats for all user-specified input data, and for all output messages and reports. The formats shall be prepared in cooperation with the City. The presentation of the formats for review should be in the form of sample input coding sheets and sample output printouts.

° Review Input/Output Formats - This task is the review of the input/output formats and if in conformance with the specifications and the requirements of the preceding task, to grant approval to the Contractor to incorporate the formats into the software system.

- Perform Software Modifications - The work under this task requires the Contractor to perform any and all modifications to the selected traffic applications software system so as to make it conform to the specifications.
- Install and Debug Software - This task involves the installation, normal testing, and debugging of the traffic applications software. Testing and debugging may be carried out at any computing facility chosen by the Contractor. The City shall be provided an opportunity to review results and progress throughout the task.
- Prepare Software Acceptance Test Plan and Input Data - The work under this task is the design by the City of detailed acceptance tests for the traffic applications software. The intent of the tests is to permit review of the overall system operation with predetermined test data before bringing intersections on-line. These tests will be carried out on the master facility computer. The tests will include pickup of the three test traffic signal controllers located at the master facility. The City will prepare the input data required for the tests.
- Software Acceptance Tests - This task consists of carrying out the tests described in the previous element. The tests are performed by the City with the cooperation of the Contractor. If all tests are completed successfully in accordance with the specifications, the City will notify the Contractor of the acceptance of the software. This would also be a major project milestone.

Data Base

The tasks under this element involve the preparation of the data base. This provides the computer with information about the system and its operation, such as signal phasing, timing plans, intersection locations, and other intersection and system parameters. Field studies, office data reduction, and data coding and punching are major factors in this element.

- Collect Field Data - This task requires the collection of field data for the data base. The City will develop forms, techniques, summary requirements, etc., for collection and summarizing of data. The City will also provide, train, and supervise the field crew.
- Data Analysis - The work under this task involves the tabulation, reduction, and office analysis of the data collected above.
- Develop Timing Plans - This task requires the preparation of timing plans for system operation.
- Define Input Parameter Requirements - This task consists of defining all input parameter requirements for both intersection and system control plans.
- Develop Input Parameters, and Code and Punch Data - This work task involves the determination of timing requirements for each intersection, as well as the parameters required for system plan and strategy selection. Several computer programs are available for use in this task. The task also includes the coding and transfer of required data to punched cards.
- Debug Data - This task involves the correction, updating, and debugging of the data base prepared above.

Communications

This element involves the preparation and installation of the communications network, including overhead and underground cable, conduit, pullboxes, communications interface and control units (CICU), and other necessary hardware. These tasks are necessary to implement the communications network from the computer to the local intersections.

- Cable, Conduit, and Hardware Equipment and Materials List - The Contractor will submit detailed descriptions of the proposed cables, conduit, and related hardware and materials to the City.
- Review Cable, Conduit, and Hardware Equipment and Materials List - The list submitted by the Contractor will be reviewed by the City for sufficiency in meeting the system specifications.
- Manufacture Cable, Conduit, and Hardware - This task involves the manufacture and/or acquisition of cables, conduit, and related hardware and delivery to the site.
- Underground Construction - This task is the construction of underground facilities such as buried conduit, pullboxes, risers, and conduit in areaways, for both communications and detector installation.
- Install Cable - This item is the installation of communications cable on overhead and in underground facilities.
- Perform Cable Tests - This task requires the Contractor to perform the required communications cable tests on the installed cable. The City will be present for all tests and when tests are completed, test results will be provided to the City.
- Accept Cable Installation - Upon completion of successful cable tests, the City will issue formal approval and acceptance of the cable installation.

- Design CICU and Shop Drawings - This task requires the Contractor to prepare and submit detailed designs and shop drawings for the proposed controller interface and communications unit (CICU) to the City for review.
- Design Review - The City will review the shop drawings submitted by the Contractor, to ensure sufficiency in meeting the system specifications. If a new design is acceptable, the City will give approval for the manufacture of a pre-production model.
- Manufacture Pre-Production Model - The detailed design recommended by the Contractor may include components not previously tested as part of a traffic signal system. It is anticipated, therefore, that up to three sample working models of the CICU will have to be prepared to demonstrate design sufficiency. Under this task, the Contractor would prepare the sample units. If the proposed design is already in production and has been used successfully elsewhere in a traffic signal system, two regular production models will be submitted for testing.
- Test Pre-Production Model - Under this task, the sample units would be tested in accordance with the approved test procedures. The testing will be sufficient to insure reliability and conformance to the specifications. The test will be carried out by the Contractor. After review and approval, the City will authorize production of the equipment.
- Manufacture CICU - This task involves the actual manufacture of the required CICU's for system operation.
- Submit Environmental Test Plan - This task requires the Contractor to develop and submit a test plan for the environmental testing of the CICU's.

- Review Environmental Test Plan - The City will review and, if acceptable, approve the CICU environmental test plan.
- Perform Environmental Test - The work under this task requires the Contractor to perform the approved CICU environmental tests. Test results will be presented to the City for review.
- Install CICU - This task involves the installation and cabinet modifications for each CICU.
- Develop CICU Test Plan - This task requires the Contractor to develop and submit an acceptance test plan for the CICUs.
- Review CICU Test Plan - The City will review and, if acceptable, approve the CICU acceptance test plan.
- Obtain Telephone Service - The Contractor will arrange for the connection of telephone service to the required intersections. The City will assist in contacts with the telephone company.
- CICU Acceptance Testing - The work under this task is the performance of the CICU acceptance tests by the Contractor in cooperation with the City. It is anticipated that certain elements of the acceptance tests will have to be rerun. Retesting is generally considered as part of the basic acceptance test.
- Accept CICUs - The work under this task is the acceptance of the CICUs in place, at all required locations. Acceptance is based on successful testing, with test results having been submitted to the City.

Controller Equipment

This element requires the procurement and installation of intersection controller equipment. The controller equipment includes controllers, cabinets, and related hardware including load relays and NEMA conflict monitors.

- Equipment and Materials List and Shop Drawings for Controller Equipment - The Contractor will submit detailed descriptions and shop drawings of the proposed controller equipment including controllers, cabinets and related hardware.
- Review Equipment and Materials List and Shop Drawings For Controller Equipment - The list and drawings submitted by the Contractor will be reviewed by the City for sufficiency in meeting system specifications.
- Manufacture Controllers - The work under this task consists of manufacturing or acquiring controller equipment. Since the authorized manufacturers were listed in the specifications and because controller delivery times have been unusually long lately, it is recommended that the Contractor order the controller equipment far prior to the above equipment list review.
- Submit Environmental Test Plan - This task requires the Contractor to develop and submit a test plan for the environmental testing of the controllers and related equipment.
- Review Environmental Test Plan - The City will review and, if acceptable, approve the controller environmental test plan.
- Perform Environmental Tests - The work under this task requires the Contractor to perform the approved controller environmental tests. Test results will be presented to the City for review.
- Install Controllers - The work under this task is to install controllers, cabinets and related hardware at the required field locations. The Contractor will coordinate his work with the City to best meet the City's needs.
- Intersection Acceptance Tests - This task requires the City to do the specified intersection acceptance tests.

Test results will be reviewed by the City.

- Accept Controller Equipment - The City will review the test results and, if satisfactory, will officially accept the controller equipment.

Detectors

The tasks under this element involve the procurement and installation of detector sensors and roadway loops. The work includes sawcutting, installing, and sealing roadway loops, installing lead-in cable, and the connection of detector sensor units. System detectors are tested for accuracy of operation in terms of volume counting and occupancy determination.

- Submit Equipment and Materials List - The Contractor will prepare and submit a detailed description of proposed detector units and related equipment and materials.
- Review Equipment and Materials List - The list submitted by the Contractor will be reviewed by the City for sufficiency in meeting system specifications.
- Test Sample Units - The Contractor will supply and test one sample detector unit of each type required. The results of these tests will be submitted to the City for review and approval.
- Manufacture Detector Sensors - The work under this task is the actual manufacture or acquisition of the detector sensors by the Contractor.
- Submit Environmental Test Plan - This task requires the Contractor to develop and submit a test plan for the environmental testing of the detector sensors.
- Review Test Plan - The City will review and, if acceptable, approve the detector sensor environmental test plan.

- Perform Environmental Test - The work under this task requires the Contractor to perform the approved detector sensor environmental tests. Test results will be presented to the City for review.
- Install Detector Loop and Lead-In - This task requires the Contractor to construct detector loops and to install lead-in cable in conduit.
- System Detector Accuracy Test - The Contractor is required, under this task, to check the accuracy of the system detectors in regards to occupancy and volume counts. Test results will be submitted to the City for review.
- Detector Acceptance Tests - This task requires the Contractor to perform the specified detector acceptance tests. The City will review test results.
- Accept Detectors - Upon review of satisfactory system detector accuracy tests and detector acceptance tests, the City will officially accept the detectors and installation.

Operations

The work under this element involves the testing and monitoring of the essentially complete traffic control system. It allows for fine tuning and adjustments to be made to eliminate minor operating problems.

- Intersection Pickup - The work under this task would be to bring the traffic signals under computer control. The Contractor will supply an intersection pickup schedule, requiring not more than six intersections to be picked up per day. The City will do the actual pickup testing of the intersections.
- Evaluation and Analysis Period - This task requires the City to evaluate and analyze the operation of the system. This will ensure that system goals have

been met and that required capabilities have been provided.

° Observation Period - During this task, the day-to-day, normal operation of the system is monitored by the City, and problems are brought to the Contractor's attention for repair.

° Accept Project - This is the final point in the project, the City will officially accept the project if all work has been completed satisfactorily. Final acceptance will mark the beginning of the six month guarantee period.

IV. ACCEPTANCE TESTING

Acceptance tests will be conducted on contractor supplied hardware and software to ensure conformance with system specifications. Successful acceptance testing of a system element must be performed before the City will accept the element.

It is anticipated that certain elements of the acceptance tests will have to be rerun. Retesting is generally considered as part of the basic acceptance test.

All acceptance testing will be performed as described herein. The following is a technical description of each test required for system acceptance.

DETECTOR ACCEPTANCE TEST

The following detector acceptance tests shall be conducted for all system and local detectors. All detector acceptance tests shall be conducted in the presence of the Engineer. The Contractor shall perform the tests and document the test results. When the tests are completed, whether successful or not, the test results documentation shall be furnished to the Engineer.

Megger Test

A 600 volt megger test shall be performed between each circuit and ground for each loop and lead-in cable circuit. The installation shall maintain a resistance to ground of not less than 10 megohms. Actual measured resistance shall be recorded.

Loop Circuit Test

Each loop and lead-in circuit shall be tested for continuity and resistance. Resistance shall not exceed four ohms. Actual measured resistance shall be recorded.

Power Interruption Test

Each detector shall be tested for power interruptions to assure that the sensor unit automatically retunes each channel as specified in these Special Provisions when power is restored. The results of this test shall be recorded.

Presence Time Test

Each channel shall be tested for presence time to assure that a vehicle will be detected for a minimum of 20 minutes using a test vehicle placed over the loop. The actual presence time measured shall be recorded.

COMMUNICATIONS CABLE ACCEPTANCE TEST

Communications cable acceptance testing shall be performed for each cable circuit at the master control room. Acceptance testing shall commence only when all terminations for each cable circuit are complete at both ends. During the communications cable tests, all transient suppression devices shall be disconnected. If any test is failed, repairs shall be made by the Contractor and the entire test series for that cable circuit shall be repeated.

Two tests shall be performed on each pair in the cable circuit; a continuity test and an insulation resistance test. All test equipment shall be at the master control room and all tests shall be conducted in the presence of the Engineer. The Contractor shall perform the tests and document the test results. When the tests are completed, whether successful or not, the test result documentation shall be provided to the Engineer. Both tests shall be conducted for all pairs in a cable circuit including spares and shall include all field terminations.

Continuity Test

The continuity test of each pair shall be made between the master control room and the field termination location. The measurements shall be made at the master control room and each pair shall show a resistance of not more than 10 ohms per 1,000 feet of conductor. The resistance of each pair shall be recorded.

Insulation Resistance Test

The insulation resistance shall be measured with all other connections to the conductor under test removed and all other conductors in the cable and the shield grounded. The measurement shall be made with a DC potential of not less than 360 volts, nor more than 550 volts, applied for one minute. Insulation resistance shall exceed 1,000 megohm-miles. The insulation resistance of each conductor shall be permanently recorded.

INTERSECTION ACCEPTANCE TEST

An intersection operation test shall be conducted and successfully completed prior to acceptance of each intersection. The test is designed to demonstrate that the field equipment installed at each intersection is installed properly and that all functions are in conformance with the Plans and Special Provisions. The detector acceptance tests for all local actuation detectors installed at the intersection shall have been successfully completed prior to initiating the intersection acceptance test.

The test shall be conducted in two parts. The first part shall be a visual final inspection of all intersection-related construction. The controller, local actuation detector, all cabinet accessories, and all cabinet wiring shall be complete and in-place. The cabinet shall include space for, and the wiring harness for, the controller interface and communications unit (CICU). It is not required that the CICU be installed for the test. All signal display hardware including, but not limited to, support structure, signal heads, pedestrian pushbuttons, conduit, junction boxes, etc. shall be complete and in-place. All intersection restoration work including, but not limited to, sidewalk, street, curb and gutter, grassed areas, etc. shall be completed. Only when the visual intersection inspection is acceptable to the Engineer shall the second part of the test commence.

The second part shall be a non-computer controlled functional test of the operation of the intersection. The Engineer shall set appropriate timings on the controller and adjust any local detectors for proper operation. The controller shall then be placed in operation. Type P controllers shall be tested for proper operation for 25 consecutive hours. Type S and Type D controllers shall be tested for proper operation for 168 consecutive hours. During the testing period, all equipment shall operate without failure of any type. The Engineer may adjust any timing during this period to fully test the functional operation of the equipment installed. If any failures are identified, the Contractor shall replace or repair the defective equipment within 24 hours of notofication by the Engineer. The test shall begin anew each time a failure is identified.

When both parts of the test are successfully completed, the intersection shall be accepted by the Engineer.

CENTRAL CONTROL EQUIPMENT ACCEPTANCE TEST

The central control equipment acceptance test shall begin seven days following the receipt by the Engineer of a written request from the Contractor to begin the test. The central control equipment acceptance test shall not begin until all master control room equipment has been installed and is fully operational. This equipment shall include the computer system, a real-time external clock, disk drives, magnetic tape drive, card reader, keypunch/verify machine, line printer, teletypewriter, display map and control console including cathode ray tube/keyboard terminal and printer, standby control unit, test controllers and housing, central communications equipment, and other central equipment.

Test Plan Submittal

The Contractor shall submit to the Engineer a test plan specification for the central control equipment acceptance test at least 30 days prior to the start of the test. The test plan

specification will be reviewed by the Engineer, who shall either approve or indicate changes that are required for approval within 10 days of receipt. The Contractor shall submit the revised test specification to the Engineer within ten days following receipt of the review of the initial test specification. If approved, the test may commence as specified; if rejected, the Engineer shall indicate changes that are required within ten days.

The test may commence at a time mutually agreed to by the Contractor and the Engineer as previously described, but not later than 30 days following receipt of written notification from the Engineer that the test plan is approved by the Engineer.

The test shall be executed on the basis of the approved specifications only. Only official representatives of the Contractor, the Engineer, FHWA, and Iowa DOT shall be permitted to attend the test. Both the Contractor and the Engineer are limited to four representatives.

Test Activities

Testing shall commence at 9:00 a.m. on the approved start date and may continue until completed or 12:00 noon at which time the testing shall be suspended. Testing shall resume at 2:00 p.m. and continue until completed or 5:00 p.m. at which time testing shall be suspended until the next day. The work day schedule as described above shall be repeated until all tests are performed. The Contractor shall conduct all tests in the presence of the Engineer.

Test Plan Contents

As a minimum, the test plan shall contain the following:

- Equipment Checkout Tests - Each system component shall be tested upon installation to verify operation on an individual basis. Tests shall include all major

functions of each piece of equipment. These tests shall include the diagnostic routines for the computer and peripherals.

° System Electrical Tests - These tests shall, as a minimum, provide electrical continuity and/or voltage tests for each conductor of each interface between system components.

° Computer Software Tests - The Contractor shall test each feature of the computer software after installation of the computer system. The Contractor shall verify that tests conform to specifications contained in the computer system documentation. These tests shall include a demonstration of the real-time, multi-programming operating system; the symbolic assembly program; the FORTRAN IV compiler, the mathematical subroutines, the utility programs; and the diagnostic program(s).

Two computer programs shall be written by the Contractor; one using the symbolic assembly compiler and one using the FORTRAN IV compiler. Both programs shall use at least two callable mathematic subroutines, at least one utility program, a scratch pad on disk, and store and recall data on magnetic tape. The program shall be input from the card reader and produce output on the line printer and the console CRT.

SOFTWARE ACCEPTANCE TEST

The software acceptance test shall begin within seven days following receipt by the Engineer of a written request from the Contractor to begin the software acceptance test. Software acceptance testing shall not begin until the computer acceptance testing has been successfully completed. The software acceptance test shall not be requested until all

Traffic Applications Software (TAS) as described in Traffic Control Functions of the Special Provisions is deemed by the Contractor to be fully operational.

The tests shall be conducted with the three test controllers in the master control room on-line. Prior to initiating the tests, the Contractor shall deliver the applications software documentation and the User's Manual to the Engineer to enable all functions of the TAS to be exercised.

The Contractor may have a maximum of three representatives to witness the testing. The Contractor's representatives, however, may only participate in the testing to the degree permitted by the Engineer. During any testing or retesting period, the Contractor shall make available a specialist with expertise in the TAS, a specialist with expertise in the communications system, and a specialist with expertise in the computer system within 24 hours of an oral request by the Engineer to the Contractor for the purpose of responding to questions. When the system is presented to the Engineer for testing or retesting, no changes to the TAS of any nature shall be permitted until the test has been terminated and the system is presented back to the Contractor.

Initial Test

The Engineer shall perform an extensive software acceptance test for an initial test period not to exceed 30 calendar days. If the software is found to be acceptable, the Contractor shall be notified in writing within 10 days following the end of the initial test period.

First Retest

If deviations and/or omissions from the Special Provisions are found during the initial test, the Contractor shall be notified in writing of the deviations and/or omissions from the Special Provisions within 10 calendar days following the end of the initial test period.

The Contractor shall make the necessary corrections to the TAS. When the corrections have been completed, the Contractor shall request a retest of the software in writing to the Engineer. The retest shall begin not earlier than 10 days following the end of the initial test period. The Engineer shall perform an extensive software acceptance test for a retest period not to exceed 30 calendar days. If the software is found to be acceptable, the Contractor shall be notified in writing within 10 days following the end of the retest period.

Subsequent Retest(s)

If deviations and/or omissions from the Special Provisions are found during the first retest, the Contractor shall be notified in writing of the deviations and/or omissions within 10 calendar days following the end of the retest. The Contractor shall make the necessary corrections to the TAS. When the corrections have been completed, the Contractor shall request a subsequent retest of the software in writing to the Engineer.

The Contractor shall bear the actual cost of each subsequent retest as defined herein. The actual cost includes the salary costs of FHWA, State, and City representatives, with a maximum of 20 man days; the cost of service of the Consultant, with a maximum of 20 man days; and all direct costs associated with having a State and FHWA representative and the Consultant on site for two weeks including, but not limited to; air fare, two round trips from the Consultant's base to the City coach class, automobile rental, housing and per diem. These costs shall be deducted from the payments due or charged to the withhold amount of the Contractor when the Project is terminated.

The subsequent retest shall not begin earlier than ten days following the end of the previous retest. The Engineer shall perform an extensive software acceptance test for a subsequent retest period not to exceed 21 calendar days. If the

TAS is found to be acceptable, the Contractor shall be notified in writing within ten days following the end of the subsequent retest. If deviations and/or omissions from the Special Provisions are found, subsequent retest(s) shall be scheduled.

ANCILLARY EQUIPMENT ACCEPTANCE TEST

All hardware equipment, including but not limited to, the maintenance test terminal, all remote devices, and the standby master shall be tested after the successful completion of the software acceptance test.

The tests shall be conducted by the Engineer after receipt of a written request for acceptance testing by the Contractor.

CONTROLLER INTERFACE AND COMMUNICATIONS UNIT (CICU) ACCEPTANCE TEST

Each CICU shall be tested prior to performing the Final Acceptance tests for the intersections. The test shall be performed by installing the CICU in the controller cabinet and inhibiting all outputs to the controller. The CICU shall be continuously operated for a 96 hour period and monitored for proper operation. Units failing to successfully complete the test will be rejected. The Contractor shall submit to the Engineer a test plan describing the procedures proposed to test and monitor all major functions and reliability of the CICU in accordance with the requirements of Test Plan Submittal.

FINAL ACCEPTANCE TEST

The final acceptance test shall consist of three sequential periods; intersection pickup, evaluation and analysis, and observation. When the requirements during each of the three periods have been met, the system shall be accepted. The requirements for each of the three periods are described below.

The Contractor shall make, and fully document, all modifications made to correct operations that are not in conformance to the Special Provisions.

The Engineer reserves the right to halt the test at any time, if in his sole judgement, errors or inconsistencies in the performance of any part of the system would lead to improper, inefficient, or unsafe operation of the traffic signals.

Intersection Pickup Period

The intersection pickup period shall commence not sooner than 45 days after the Software Acceptance Test is successfully completed. The Engineer shall be responsible for preparing the data base for the intersections. The pickup of an individual intersection shall occur only after the Intersection Acceptance Test and Controller Interface and Communications Unit (CICU) Acceptance Test for that intersection has been successfully completed.

The Contractor shall supply an intersection pickup schedule that requires not more than six intersections to be picked up per day. The Engineer shall perform the actual pickup testing of the intersections. Any intersection that does not respond to a pickup command shall be rescheduled for pickup the next day.

The Contractor shall be responsible for determining the reason why an intersection did not respond to a pickup command. It shall be the responsibility of the Contractor to correct any hardware or software malfunctions that caused a pickup failure. It is the responsibility of the Engineer to correct any data base errors that may have resulted in a pickup failure.

The pickup period shall continue until all intersections in the system have been picked up.

Evaluation and Analysis Period

The evaluation and analysis period shall commence when all intersections have been picked up and the Engineer has

received in writing a request from the Contractor to begin the test. There shall be at least seven days between the successful pickup of the final intersection and the beginning of the evaluation and analysis period. The evaluation and analysis period shall be at least 30 days in length.

During the evaluation and analysis period, the Engineer will be provided full access to the system in order to evaluate the system for conformance with the Special Provisions. During this period of time, the Contractor will be required to continue maintenance of the system and may perform any final clean-up, adjustments of the system, etc. that is necessary and shall cooperate with the Engineer such that evaluation and analysis of the completed system may continue unimpeded. During this period of evaluation and analysis, the Contractor shall redemonstrate any system function if requested and shall be available to answer any questions and offer explanations of the system as may be requested.

The Engineer will advise the Contractor in writing of any portions of the system that do not meet the requirements of the Special Provisions. The Contractor shall promptly make such modifications that may be required to bring the system in conformance with the Project requirements. If changes to the TAS are required, other than the change of data base, the 30 day evaluation and analysis period shall begin anew after the software changes are completed. If changes are required to any hardware unit or units that require a retro-fit, the 30 day evaluation and analysis period shall begin anew after the hardware changes are completed on all units.

During the evaluation and analysis period, the Contractor shall demonstrate that the equipment and all software furnished will provide a minimum of 25% spare memory and usable computer time while performing the traffic control functions described in these Special Provisions for 180 intersections, 200 system detectors, and 250 local detectors. This demonstration

shall be conducted with all intersections and detectors on-line and simulation of system loading of future intersections and detectors. The spare memory and usable computer time shall be demonstrated to the satisfaction of the Engineer as a necessary condition to completing the evaluation and analysis period.

Throughout the evaluation and analysis period, the system shall operate with no more than two percent intersection downtime. Percent intersection downtime is defined as 100 times the sum of the total time during which each intersection is failed divided by the sum of the total time that all intersections are scheduled to be on-line. If the percent downtime is greater than two percent, the Contractor shall be responsible for correcting the problem. After the problem has been corrected, the 30 day evaluation and analysis period shall begin anew.

Upon the determination by the Engineer that the system is in apparent conformance with the contract requirements, and upon written notice from the Engineer to the Contractor, the Observation Period shall commence.

Observation Period

Upon completion of the evaluation and analysis period, a 180 days Observation Period shall become effective. The Observation Period is to serve the purpose of full-scale operational testing of performance under day-to-day operating conditions. The Engineer shall be responsible for operating the system during the Observation Period. During the Observation Period, the system shall perform all functional operations specified in these Special Provisions for the control of traffic.

System or component failures occurring during this period shall be corrected by the Contractor. Equipment exhibiting excessive failure rates shall be improved through equipment modification or replacement. Excessive failure rates shall be considered to have occurred when the Contractor specified failure rates (MTBF) are exceeded by 20 percent.

Failure conditions or system operational conditions occurring during the Observation Period that require redesign of major system elements or total replacement of a major system element shall cause the count of time for the Observation Period to be discontinued until such time that the corrections have been made. The Observation Period time will commence upon correction of the condition and will continue for the duration of the remaining time of the Observation Period.

Final acceptance will occur at the successful completion of the 180 days Observation Period. Final acceptance shall mark the beginning of the six months guarantee period.

V. TRAINING

The completed traffic control system must be operated and maintained by city personnel. Therefore, the training of city forces is an important part of the overall project.

The Contractor will develop and administer six separate training programs in the installation, operation, and maintenance of the system. The six programs will concentrate on the following subjects:

a) Management
b) Computer Hardware and Software
c) System Operation
d) Hardware Maintenance
e) Traffic Applications Software
f) System Expansion Training

The system consultant will provide additional training to city staff on general system operation. Informal training by the consultant will provide the city staff with procedures for developing timing plans and control strategies, along with additional information on data reduction, system analysis, and the day-to-day operation of a computerized traffic control system.

TRAINING PROGRAM DESCRIPTIONS

The following brief description of each of the training programs includes the type of training, duration and description of attendees.

Management

The management program will consist of four presentations given at four month intervals during the project. The first program will give an overview of the project including construction schedules and a brief description of the major system components. Subsequent programs will give a progress report describing work accomplished to date and major areas of emphasis for the next

four months. A major element of the system will also be discussed. Each hour long program will be attended by both technical and non-technical personnel.

Computer Hardware and Software

The CPU manufacturer will provide a minimum of ten man-weeks of computer hardware maintenance and software training, at the manufacturer's facility. The courses will be part of the manufacturer's regular course offering or may be special courses if determined to be necessary by the City or their consultant.

The minimum course offering will include introductory and advanced assembly language programming, real-time FORTRAN programming, and CPU/peripheral maintenance to the board level.

System Operation

A five day program on system operation, for three to ten persons, will include system master equipment operation, the procedures for use of the traffic control software, and data base preparation.

The system master equipment operation sessions will cover the operating characteristics of all system master equipment. Topics will include:

- Equipment energization procedures;
- System start-up and shutdown;
- Utilization of operator controls;
- Detection of abnormal conditions;
- Emergency operating procedures;
- Selection and use of peripheral devices;
- Control of displays;
- Loading and unloading tapes and disks;
- Changing paper in the printers; and
- Troubleshooting and problem identification for devices which will not be maintained by city staff.

The remaining sessions will be an introduction to the traffic applications software procedures. All formats and procedures for the features and functions of the software will be covered, including user-supplied input handling, output interpretation and various operating commands. A draft version of the User's Manual will be used for this part of the program.

Hardware Maintenance

Six separate courses, each for from three to ten persons, will provide maintenance training directed towards a specific device. Two of the courses are related to controllers, discussing the functional operation, routine maintenance, and troubleshooting procedures for each type of controller. Extensive "hands-on" training will also be conducted. The training will be conducted on five consecutive days.

A three day course will be used to familiarize personnel with the CICU. Again considerable "hands-on" work will be done. Two additional days will be used for communications network training, teaching troubleshooting and repair procedures relating to the cable network.

Two days of training will cover the operation, maintenance, and troubleshooting of the map, map control panel, and remote panels. Modifications to the map will also be covered.

Detector training will take one day, and will cover operation, maintenance, and troubleshooting of detector sensor units, lead-in cable, and the loop itself.

Software Training

A five day program on software training will cover the operating of both the computer system software and the traffic applications software. The course will describe the function of all routines in the TAS as well as the procedures to execute a symbolic assembly program, a FORTRAN IV program, the utility program, and the diagnostic programs.

System Expansion Training

System expansion training will consist of the supervision of the addition of three actuated controllers and one system detector to the system by city staff. The City's work will include: installation of the CICU's, connection of communications lines in the field and at the central site; insertion of all necessary user-supplied input parameters into the data base including the communications line identification, timing plans, and system and local detector parameters; and other activities necessary to provide full and complete operation of the three locations. The Contractor will supply up to forty man-hours of time for supervision and to answer questions as required.

Informal Training

The Contractor and the consultant will be providing information to city staff throughout the construction phase. This information will be both general and detailed in nature to acquaint the staff with system operations, maintenance, and possible enhancements.

The training or exchange of information will be in the form of providing supervision and joint development of the various aspects of system timing, control strategies, data base parameters, operation procedures, maintenance operation, off-line programs and etc. No classroom training is presently envisioned, however, if deemed necessary it may be provided.

VI. TECHNICAL SPECIFICATIONS

Technical specifications are necessary to convey to the Contractor the City's desires and goals for the signal system. The specifications are a binding document that ensures that all the features, functions, and operating characteristics necessary for the designed system to operate are included in the finished project.

The specifications for the Sioux City Signal system will describe all contractor supplied hardware and computer software. The specifications for the computer and its related equipment, the Traffic Applications Software package, the system-wide communications network, and for traffic signal controllers were developed as part of the project and are contained in a separate volume. These four items cover the major components of the system and provide a basis for the uniformity of equipment in future implementation stages.

Other specifications not included as part of this project describe system and local detectors, construction requirements, test equipment, personnel training, system documentation, and administrative details.

The following is an outline of the administrative and technical specifications for the traffic control system.

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16.3	FURNISH AND INSTALL MAP DISPLAY AND MAP CONTROL PANEL
16.4	FURNISH AND INSTALL TRAFFIC ENGINEERING CONSOLE AND STORAGE CABINET
16.5	FURNISH AND INSTALL KEYPUNCH MACHINE
16.6	FURNISH AND INSTALL TEST CONTROLLERS, HOUSING, AND DISPLAYS
16.7	FURNISH AND INSTALL MAINTENANCE TEST TERMINALS
16.8	FURNISH AND INSTALL FIRE ROUTE SELECTION PANEL
16.9	FURNISH AND INSTALL AUDITORIUM SPECIAL EVENTS
16.10	FURNISH AND INSTALL STANDBY MASTER
16.11	FURNISH AND INSTALL CONTROL ROOM RADIO TRANSCEIVER
16.12	FURNISH AND INSTALL CENTRAL COMMUNICATIONS HARDWARE
16.13	FURNISH TEST EQUIPMENT
16.14	PROVIDE TRAINING
16.15	FURNISH DOCUMENTATION
16.16	FURNISH AND INSTALL DETECTOR SENSORS
16.17	FURNISH AND INSTALL DETECTOR ROADWAY LOOP
16.18	FURNISH AND INSTALL DETECTOR LEAD-IN CABLE
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16.20	FURNISH AND INSTALL PULLBOXES
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- 2.3.2 External Digital Clock
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- 2.4.1 Map Construction Requirements
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9.6 USER'S MANUAL

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VII. INSTALLATION DETAILS

Details of methods or materials required for construction are quite often difficult to describe in the specifications. To alleviate the possibility of misinterpretation of the required procedures or materials, detailed drawings were prepared showing the requirements. These drawings would be incorporated in the construction plans as typical details. A copy of these details is shown in Appendix D.

APPENDIX A
INTERSECTION IDENTIFICATION

Appendix A

Final System Configuration

Subarea	Inters. I. D.	Future	Location
Central Business District	CB1	X	Pearl @ Hamilton Conn.
	CB2	X	3rd @ Wesley Way
	CB3		3rd @ Pearl
	CB4	X	3rd @ Douglas
	CB5		3rd @ Pierce
	CB6		3rd @ Nebraska
	CB7		3rd @ Jackson
	CB8	X	3rd @ Jones
	CB9	X	3rd @ Virginia
	CB10		W. 3rd @ Wesley Way
	CB11		4th @ Pearl
	CB12		4th @ Douglas
	CB13		4th @ Pierce
	CB14		4th @ Nebraska
	CB15		4th @ Jackson
	CB16		4th @ Jones
	CB17		4th @ Court
	CB18		4th @ Floyd
	CB19	X	5th @ Wesley Way
	CB20		5th @ Pearl
	CB21		5th @ Douglas
	CB22		5th @ Pierce
	CB23		5th @ Nebraska
	CB24		5th @ Jackson
	CB25		5th @ Jones
	CB26		5th @ Court
	CB27		6th @ Wesley Way
	CB28		6th @ Pearl
	CB29		6th @ Douglas
	CB30		6th @ Pierce
	CB31		6th @ Nebraska
	CB32		6th @ Jackson
	CB33	X	6th @ Jones
	CB34		6th @ Court
	CB35		6th @ Hoeven
	CB36		7th @ Pearl
	CB37		7th @ Douglas
	CB38		7th @ Pierce
	CB39	X	7th @ Nebraska
	CB40		8th @ Pearl
	CB41	X	8th @ Pierce
	CB42	X	8th @ Nebraska
	CB43		8th @ Court
	CB44		W. 7th @ Perry
	CB45		W. 4th @ Market
	CB46		W. 3rd @ Market
Central	CE1		10th @ Douglas
	CE2		11th @ Pierce
	CE3		11th @ Nebraska
	CE4	X	11th @ Jackson
	CE5	X	11th @ Floyd
	CE6	X	13th @ Grandview
	CE7	X	13th @ Douglas
	CE8	X	13th @ Pierce
	CE9	X	13th @ Nebraska
	CE10	X	13th @ Jackson
	CE11		14th @ Douglas
	CE12		14th @ Pierce
	CE13		14th @ Nebraska
	CE14		14th @ Jackson
	CE15	X	18th @ Summit
	CE16	X	18th @ Grandview
	CE17	X	18th @ Douglas
	CE18		18th @ Pierce
	CE19	X	18th @ Nebraska
	CE20		18th @ Jackson
	CE21	X	19th @ Floyd
	CE22		20th @ Douglas
	CE23		20th @ Pierce
	CE24		20th @ Nebraska
	CE25		20/21st @ Jackson
	CE26		21st @ Court
	CE27	X	27th @ Court
	CE28		27th @ Chambers
North Central	CN1	X	24th @ Jackson
	CN2		27th @ Pierce
	CN3		27th @ Jackson
	CN4		31st @ Jackson
	CN5	X	32nd @ Jackson
	CN6	X	36th @ Jackson
	CN7	X	36th @ Cheyenne
	CN8	X	36th @ Dupont
Hamilton South	HS1		Hamilton @ TriView
	HS2		W. 3rd @ Hamilton
	HS3		W. 4th @ Hamilton
	HS4		W. 7th @ Hamilton
	HS5		W. 7th @ Omaha
	HS6		W. 8th @ Hamilton
	HS7		W. 14th @ Hamilton
	HS8		W. 3rd @ Isabella
Hamilton North	HN1		W. 19th @ Hamilton
	HN2		W. 24th @ Hamilton
	HN3		W. 28th @ Hamilton
	HN4		Hamilton @ Sunset S.
	HN5		Hamilton @ Sunset N
	HN6		Hamilton @ Stone Park
	HN7		McDonald @ Stone Park
	HN8		36th @ Hamilton
	HN9		W. 19th @ Center

Appendix A

Final System Configuration (Continued)

Subarea	Inters. I. D.	Future	Location
Gordon West	GW1		Gordon @ Pierce
	GW2		Gordon @ Nebraska
	GW3		Dace @ Gordon
	GW4		Gordon @ Virginia
	GW5	X	Court @ Gordon
	GW6		Dace @ Floyd
Gordon East	GE1		S. Fairmount @ Gordon
	GE2		Gordon @ S. Martha
	GE3		Gordon @ Stone Park
	GE4	X	Gordon @ S. Lakeport
	GE5		Gordon @ Palmetto
	GE6	X	Gordon @ Maple
	GE7	X	Gordon @ Outer Dr.
	GE8	X	S. Fairmount @ Leech
Lewis South	LS1	X	Cunningham @ Lewis NB
	LS2	X	Cunningham @ Lewis SB
	LS3	X	Cunningham @ Transit
Lewis Central	LC1		Cunningham @ Leech
	LC2		Leech @ Lewis
	LC3	X	Dace @ Lewis
	LC4	X	Gordon @ Lewis
	LC5		4th @ Lewis
	LC6		6th @ Lewis
Lewis North	LN1		9th @ Lewis
	LN2		11th @ Lewis
	LN3		18th @ Lewis
	LN4	X	28th @ Lewis
Morningside	MS1		Indiana @ Morningside
	MS2	X	Morningside @ Stone
	MS3		Morningside @ Ridge
	MS4		Morningside @ Peters
	MS5		Garrettson @ Morningside
	MS6		Helen @ Transit
	MS7		Glass @ Transit
	MS8		Morningside @ Transit
	MS9		Lakeport @ Morningside
	MS10		Cedar @ Morningside
Lakeport	LK1	X	Lakeport @ I-520
	LK2	X	Lakeport @ Lincolnshire
	LK3	X	Lakeport @ Sergeant
	LK4	X	Lakeport @ Lincoln
	LK5	X	Lincoln @ Sergeant
	LK6		Lakeport @ Mayhew
	LK7	X	Lakeport @ Sunnybrook
	LK8	X	Lakeport @ Lorraine
	LK9	X	Glenn @ Lakeport
	LK10	X	4th @ Lakeport

Subarea	Inters. I. D.	Future	Location
Glenn	GL1	X	Glenn @ Lewis
	GL2		Alice @ Glenn
	GL3		Glenn @ Martha
	GL4	X	Lewis @ Lincoln
Combination Bridge	BR1	X	Combination Bridge SW
	BR2	X	Combination Bridge SE
	BR3	X	Combination Bridge NW
	BR4	X	Combination Bridge NE
Riverside	RI1	X	W. 19th @ Riverside
	RI2		Riverside @ Wright
	RI3		Riverside @ Witcher
	RI4		Military @ Riverside
	RI5		Home @ Military
Outer Drive	OD1	X	Hamilton @ Outer
	OD2		Cheyenne @ Outer
	OD3	X	Indian Hills @ Outer
	OD4	X	Floyd @ Outer
	OD5	X	Lewis @ Outer
	OD6	X	28th @ Outer
Isolated	I101		W. 19th @ Rebecca
	I102		W. 26th @ Myrtle
	I201	X	Hwy. 520 @ Sunnybrook
	I202	X	Industrial @ Lewis
South Sioux	SS1		Dakota @ 6th
	SS2		Dakota @ 9th
	SS3		Dakota @ 13th
	SS4		Dakota @ 21st
	SS5		Dakota @ 23rd
	SS6		Dakota @ 29th
	SS7		Old Hwy. 20 @ US 77

APPENDIX B

INTERSECTION INPLEMENTATION BY STAGE

APPENDIX B

INTERSECTION IMPLEMENTATION BY STAGE

Stage 1		Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7	Stage 8	Stage 9	Stage 10	Stage 11	Stage 12
CB 3	CB23	HS2	LC5	CB17	GW1	MS1	CE1	CE18	LC2	HN1	RT1	HN7
CB5	CB24	HS3	LC6	CB18	GW2	MS3	CE2	CE20	GE1	HN2	RT2	CE24
CB6	CB25	HS4	LN1	CB26	GW3	MS4	CE3	CE22	GE2	HN3	RT3	CE25
CB7	CB27	HS5	LN2	CB34	GW4	MS5	CE11	CE23	GE3	HN4	RT4	CE26
CB10	CB28	HS6	LN3	CB35		MS8	CE12		GE5	HN5		CE28
CB11	CB29	HS7				MS9	CE13			HN6		CN2
CB12	CB30	CB45				MS10	CE14			HN7		CN3
CB13	CB31	CB46										CN4
CB14	CB32											
CB15	CB36											
CB16	CB37											
CB20	CB38											
CB21	CB40											
CB22	CB44											

NOTES:

1. Intersection groups do not include future signal locations.
2. The intersection groups shown without stage numbers shall be implemented as present or programmed roadway improvements are completed.
3. Intersections not included in stage boundaries shall be implemented when changes in traffic conditions warrant system operation.
4. Intersections MS9 and MS10 are not included in Phase A Project.
5. The existing signals on Transit at Glass and Helen Streets should be implemented when additional signals are constructed on Transit Ave.

APPENDIX C

COMMUNICATIONS NETWORK IMPLEMENTATION PLAN

STATE OF IOWA

WOODBURY COUNTY

CITY OF SIOUX CITY

FEDERAL AID URBAN SYSTEMS

TRAFFIC CONTROL SYSTEM IMPLEMENTATION PLAN

THE IOWA STATE HIGHWAY COMMISSION STANDARD SPECIFICATIONS FOR CONSTRUCTION WORK SERIES OF 1977 SHALL APPLY TO WORK ON THIS PROJECT (PLUS CURRENT SUPPLEMENTAL SPECIFICATIONS AND SPECIAL PROVISIONS)

UTILITIES

UNDERGROUND UTILITIES SHOWN ON THESE PLANS ARE APPROXIMATE AND DO NOT ALWAYS REPRESENT THE EXACT NUMBER, LOCATION, OR ALIGNMENT OF EXISTING FACILITIES. THE CONTRACTOR SHALL CONTACT REPRESENTATIVE OF EACH UTILITY PRIOR TO COMMENCING ANY WORK TO DEFINE EXACT LOCATION OF THEIR EXISTING FACILITIES.

ELECTRIC	IOWA PUBLIC SERVICE	502 SIXTH ST. SIOUX CITY, IOWA
TELEPHONE	NORTHWESTERN BELL TELEPHONE	701 PIERCE ST. SIOUX CITY, IOWA
WATER & SEWER	CITY OF SIOUX CITY	CITY HALL SIOUX CITY, IOWA
GAS	IOWA PUBLIC SERVICE	502 SIXTH ST. SIOUX CITY, IOWA

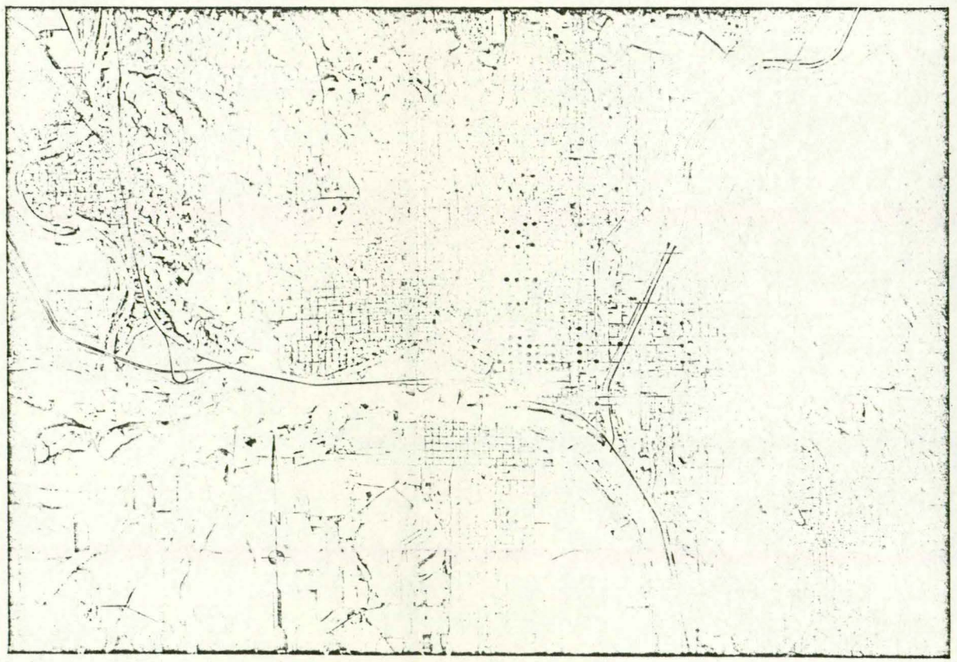
LEGEND

SYMBOLS

EXISTING	NEW	
		CONTROLLER
		AREAWAY
		PULL BOX
		PULL BOX IN AREAWAY
		METAL POLE
		WOOD POLE
		INTERCONNECT IN AREAWAY OR ON STRUCTURES
		OVERHEAD INTERCONNECT CABLE
		UNDERGROUND INTERCONNECT CONDUIT
		RAILROAD
	(CE13)	CONTROLLER IDENTIFICATION
	(CE 14)	FUTURE CONTROLLER IDENTIFICATION
	(A)	LOCATION IDENTIFICATION
		CURB

ABBREVIATIONS

UTILITIES	
IPS	IOWA POWER SERVICE
NWB	NORTHWESTERN BELL TELEPHONE
GENERAL	
PB	PULL BOX
ENCL.	ENCLOSURE
CONT.	CONTROLLER
CAB.	CONTROLLER CABINET
EXIST.	EXISTING
COND. ENT.	CONDUIT ENTRY TO EXISTING BASE (POLE, CONTROLLER, ETC.)
SIG.	SIGNAL
COND.	CONDUIT
CABLE	
CC CABLE	CONTROLLER COMMUNICATIONS ENTRY CABLE (6)
TC CABLE	TRAFFIC COMMUNICATIONS CABLE
O/U	OVERHEAD TO UNDERGROUND INSTALLATION
COMMUNICATIONS	
CC/TEL	CONTROLLER COMMUNICATIONS ENTRANCE CABLE CONNECTION TO IBT LOCATION
CC/TC	CONTROLLER COMMUNICATIONS ENTRANCE CABLE CONNECTION TO TC CABLE LOCATION
CC CABLE	COMMUNICATIONS CABLE (6 PR.) FROM MAIN CABLE, OR IBT, INTO CONTROLLER CABINET



LOCATION MAP

0 1/3 2/3 1 2 mile

INDEX OF SHEETS

PREPARED BY

jhk & associates

I HEREBY CERTIFY THAT THIS PLAN AND SPECIFICATION WAS PREPARED BY ME OR UNDER MY SUPERVISION AND THAT I AM DULY REGISTERED AS PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

SIGNED Morris J. Hanley DATE 4/28/78

P.E. 8600

APPROVED

CITY ENGINEER DATE

APPROVED

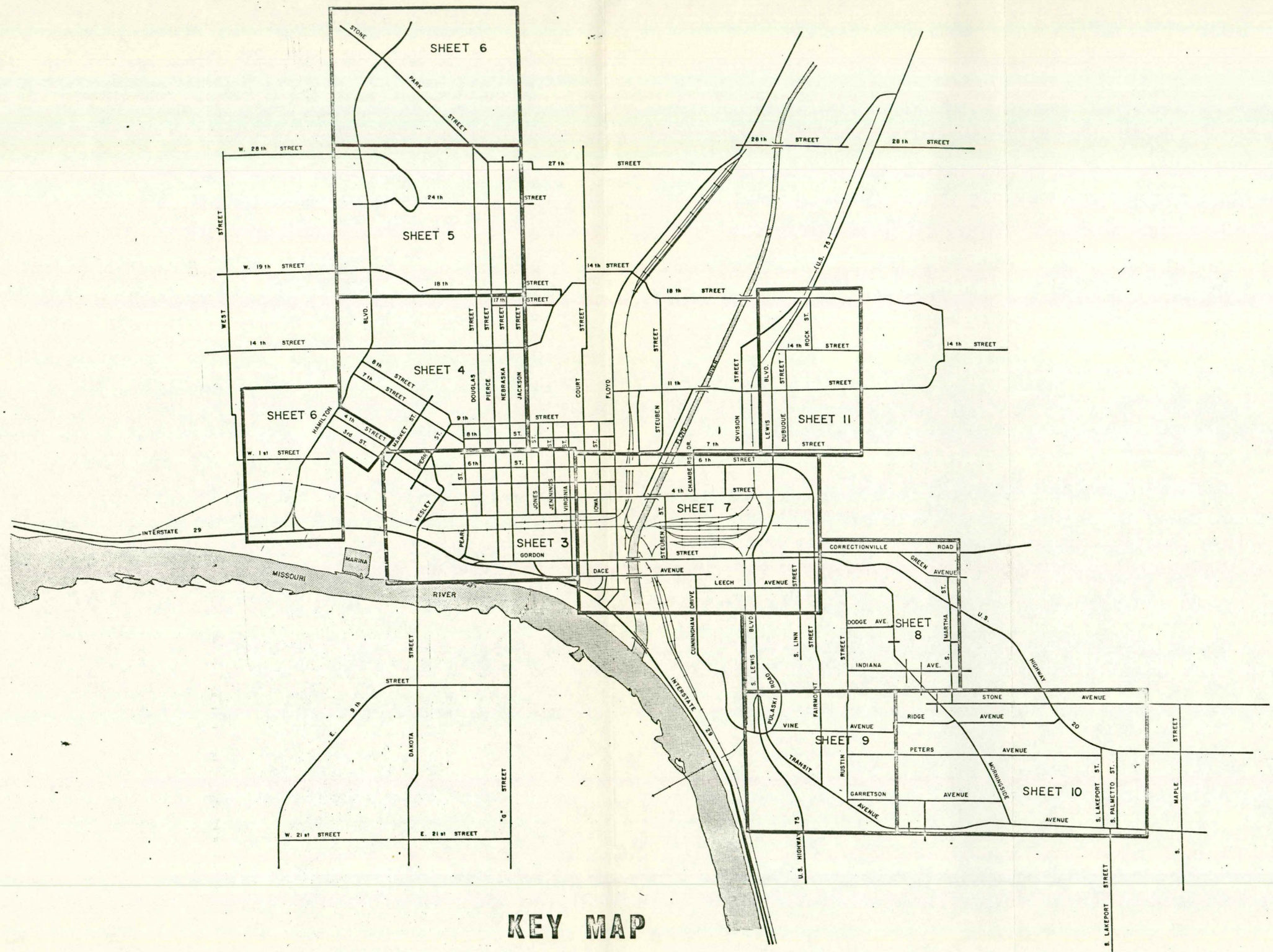
IOWA DEPARTMENT OF TRANSPORTATION DATE

DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
APPROVED

DIVISION ADMINISTRATOR DATE

WOODBURY COUNTY

WOODBURY COUNTY PROJECT NO. SHEET NO. 1


SHEET 6
SHEET 5
SHEET 4
SHEET 6
SHEET 3
GORDON
SHEET 7
SHEET 11
SHEET 8
SHEET 9
SHEET 10
STONE
PARK
STREET
W. 28th STREET
27th STREET
24th STREET
W. 19th STREET
18th STREET
14th STREET
WEST
BLVD
17th STREET
DOUGLAS
PIERCE
NEBRASKA
JACKSON
COURT
FLOYD
STEUBEN
8th STREET
7th STREET
HAMILTON
4th STREET
3rd ST
MARKET ST.
9th STREET
8th ST.
W. 1st STREET
6th ST.
PERRY ST.
WESLEY
PEARL
JONES
JENNINGS
VIRGINIA
IOWA
11th STREET
RIVER
ZOO DR.
7th
DIVISION
LEWIS
DUBUQUE
ROCK ST.
6th STREET
4th STREET
CHAMBERS DR.
INTERSTATE 29
MISSOURI
RIVER
MARINA
DACE AVENUE
LEECH AVENUE
DRIVE
CUNNINGHAM
CORRECTIONVILLE ROAD
GREEN AVENUE
DODGE AVE.
INDIANA AVE.
S. LINN
S. MARTHA
S. LEWIS BLVD
PULASKI ROAD
FAIRMONT
VINE AVENUE
RIDGE AVENUE
STONE AVENUE
PETERS AVENUE
GARRETSON AVENUE
TRANSIT
RUSTIN
MORNINGSIDE
S. LAKEPORT ST.
S. PALMETTO ST.
U.S. HIGHWAY 75
U.S. HIGHWAY 20
MAPLE
S.
S. LAKEPORT STREET
E. 9th STREET
DAKOTA
"O" STREET
W. 21st STREET
E. 21st STREET
INTERSTATE 29

KEY MAP

SEE SHEET 7

WEST STREET

SEE NOTE 1

Install CC cable (1-D 48) (1A new cond.)

CB45

WEST MARKET

4th STREET

SEE NOTE 1

CB46

CC/TC-1 (CB 45 & 46)

Install TC Cable in new riser & conduit.

3rd STREET

PERRY STREET

Install CC cables (CB 45 & 46) in new riser & conduit.

Install head guy

NWB drops to be remove by others (planned)

Install TC Cable below NWB cable crossing

IPS

SEE SHEET 5

7th STREET

6th STREET

5th STREET

4th STREET

3rd STREET

MAY STREET

SEE SHEET 4

WESLEY

WATER

PEARL

DOUGLAS

PIERCE

NEBRASKA

JACKSON

JONES

JENNINGS

VIRGINIA

MASTER SITE

Install TC cable

IPS

SEE SHEET 4

SEE SHEET 8

N

SEE NOTE 2 & 3

(PROPOSED ALIGNMENT)

HAMILTON / PEARL CONNECTOR

BR1

BR2

(PROPOSED ALIGNMENT)

SEE NOTE 2

BR4

BR3

U.S. 20

SEE NOTE 3

COMBINATION BRIDGE

MISSOURI RIVER

CC/TC-3 (GW1) GW1

Install TC cable.

GW2

CC/TC-3 (GW2) inside cont. cable

Exist. 2" PVC cond that was installed in 150' sections. Locate end of sections and install PB as required to form a continuous conduit run from GW 3 to GW4 Install TC Cable

CC/TC-3 (GW 3)

GW3

GORDON DRIVE

Install TC Cable

Exist. 4" fiber conduit

CC TC-3 (GW4)

GW4

(U.S. 20)

SEE NOTE 4

Install 2" cond., PB, and TC cable

I-29

DACE STREET

415

NOTES:

1. Signals at Market St. and W. 3rd. and at Market St. and W. 4 th. to be modernized by others.
2. Construction of signals (by others) on the new Combination Bridge intermediate level diamond interchange to include conduit and appurtenances for installation of TC cable. Also, final signal design may result in a single signal cont. in lieu of the four units shown.
3. Conduit to be installed (by others) on new Combination Bridge for future installation of TC cable to South Sioux City. Coordination of bridge and approach construction activities is required.
4. Signal at Gordon Dr. and Virginia St. to be modernized by others.

SEE SHEET 6

Use existing 18 pair TC cable

Remove exist. cable and install new TC Cable

Splice new TC Cable to exist. TC Cable

Install new cond. & PB and install TC cable.

Install PB to connect new cond. to exist. cond.

CC/TC-3 (HS7) in cont. cable

Install PB to connect new cond. to exist. cond.

Remove exist. cable and install TC cable

Install PB At exist PB location and construct cond. ent. to sig. pole.

CC/TC-2 (HS 6)

Install PB to connect new cond. to exist. cond.

Install new cond. & PB and install TC Cable

Install PB to connect new cond. to exist. cond.

CC/TC-3 (HS 4 & HS5) in cab.

Remove exist. cable and install CC Cable (HS 5)

Remove exist. cable and install TC Cable.

SEE SHEET 7

HS7 HS6 HS4 HS5

BLVD. HAMILTON STREET OMAHA Signal Shop

14 th STREET

W. 8 th STREET

W. 7th STREET

PERRY STREET

Install TC cable on pole line (new)

GRANDVIEW STREET

Install interconnect On two exist. 30' poles. (Do not use adjacent 50' poles)

Install comm. drop and encl. for future signals (CE 6 through CE 10)

Install TC Cable using stand-off on 3 poles to provide adequate clearance to buildings.

CE11 CE6 CE7 CE8 CE9 CE10 CE12 CE13 CE14

CC/TC-1 (CE11)

IPS

Install TC cable

CC/TC-1 (CE13)

CC/TC-1 (CE 12)

CC /TC-1 (CE 14)

Install head guy

17 th STREET

13 th STREET

STREET STREET STREET

Remove NWB cables (by others)

NWB/IPS

PIERCE NEBRASKA (PROPOSED JACKSON ALIGNMENT INNER LOOP)

SEE NOTE 2

Install TC Cable

Remove exist. signal cable and install TC Cable on 45' pole line

CC/TC-1 (CE 3)

CE2 CE3 CE4

IPS

11th STREET

Install comm. drop and encl. for future signal (CE 4)

DOUGLAS

CC/TC-1 (CE 2)

Install head guys

CE1

10 th STREET

Remove NWB Jackson St. (planned)

CC/TC-1 (CE 1)

9 th STREET

NWB / IPS

8 th STREET

Install comm. drop and encl. for future signals (CB41 & CB 42)

CB44 CB40 CB41 CB42

Install CC cable in exist. cond.

CC/TC-3 (CB 40 & CB 44) in cont. cable

Install cond. and CC cable (CB 44)

SEE NOTE 1

SEE SHEET 3

N

16554

NOTES:

1. Signal at W 7th St and Perry St to be modernized by others.
2. Conduit & TC cable to be installed by others along 13th St. from Grandview to Jackson as part of the inner loop signalization and improvement project (future) for signals CE 6, CE 7, CE 8, CE 9, & CE 10.

SEE SHEET 7

HN3 W. 28th STREET

CC/TC-2 (HN 3)

HN2 W. 24th STREET

CC/TC-2 (HN2)

BLVD.

HAMILTON

Use exist. TC cable & cond. along Hamilton Blvd. from Stone Park Blvd. to W. 14 St.

HN1 W. 19th STREET

CC/TC-2 (HN1)

SEE SHEET 5

SEE SHEET 7

Install PB, cond., and CC cable

Install head guys

CN2 27th STREET

CC/TC-1 (CN2)

Install drop for future signals CN 4, CN5, and CN6.

CN3

Install head guy

CC/TC-1 (CN 3)

Install head guys

Install PB, cond. and CC cable

Install pole guy

Install TC cable

Install guy

Install riser and cond. for O/U Cable installation to cross alley.

24th STREET

CN1

Install comm. drop and encl. for future signal (CN 1)

Install head guy

Install TC cable

DOUGLAS STREET

PIERCE STREET

NEBRASKA STREET

JACKSON STREET

21st STREET

Install PB, cond., and CC cable

Install head guy

Install cond. to exist. PB & install CC cable

CE22

CC/TC-1(CE 22)

Raise street light (by others)

CE23

20th STREET

CE/TC(CE 23)

Install TC cable

Do not attach cable

Lower NWB drop (by others)

Install cond. and CC cable

CE24

CC TC-1 (CE 24) raise street light (by others)

CE25

Install head guy

CC/TC-1 (CE 25)

Raise secondary cable (by others)

SUMMIT STREET

GRANDVIEW STREET

CE 15

Install comm. drop and encl. for future signals (CE 15, CE 16, CE 17)

CE 16

CE 17

Install head guy

CE 18

CC/TC-1 (CE18)

18th STREET

Install cond., PB and CC Cable

Install riser and cond. for O/U cable installation

Install comm. drop and encl. for future signal (CE 19)

CE 19

Install TC cable

CE 20

Install PB, cond., and CC cable

CC/TC-1 (CE 20)

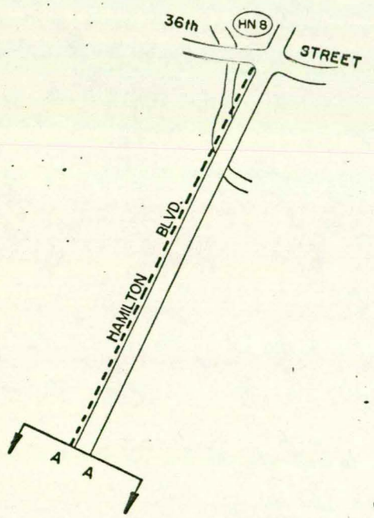
Install head guy

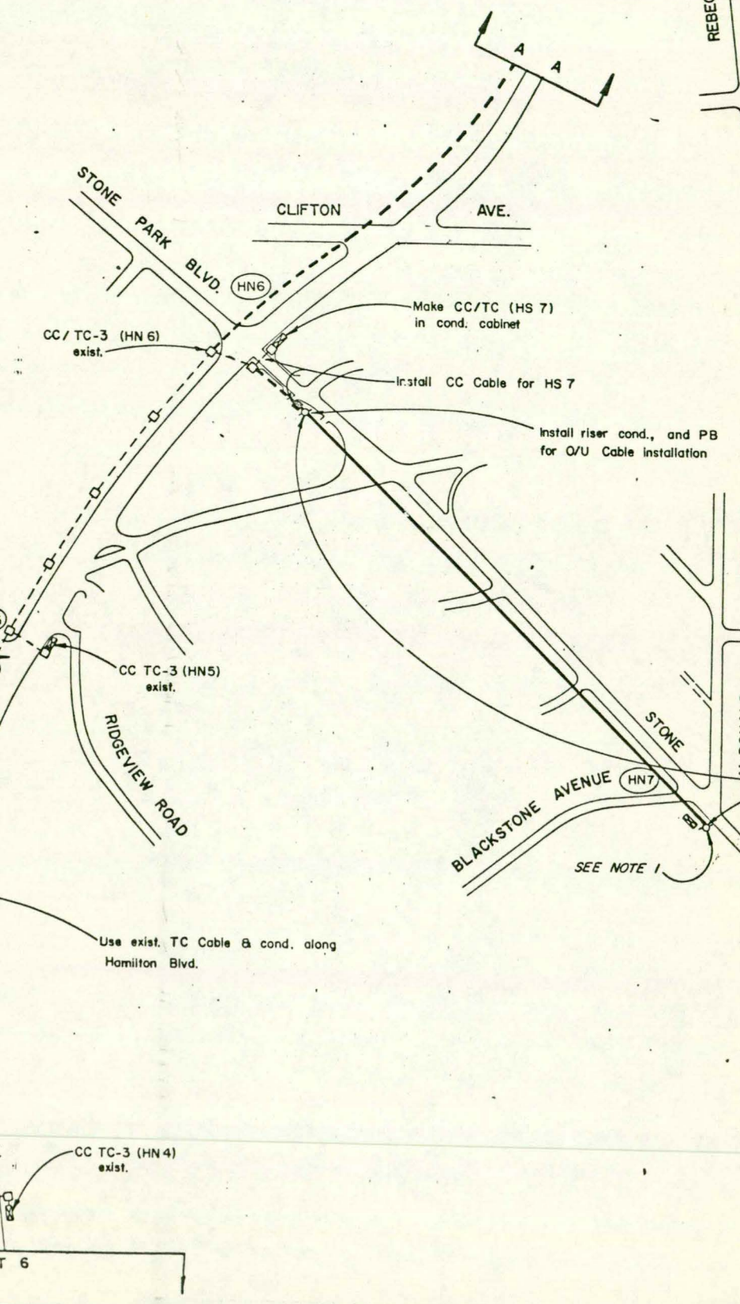
SEE SHEET 5

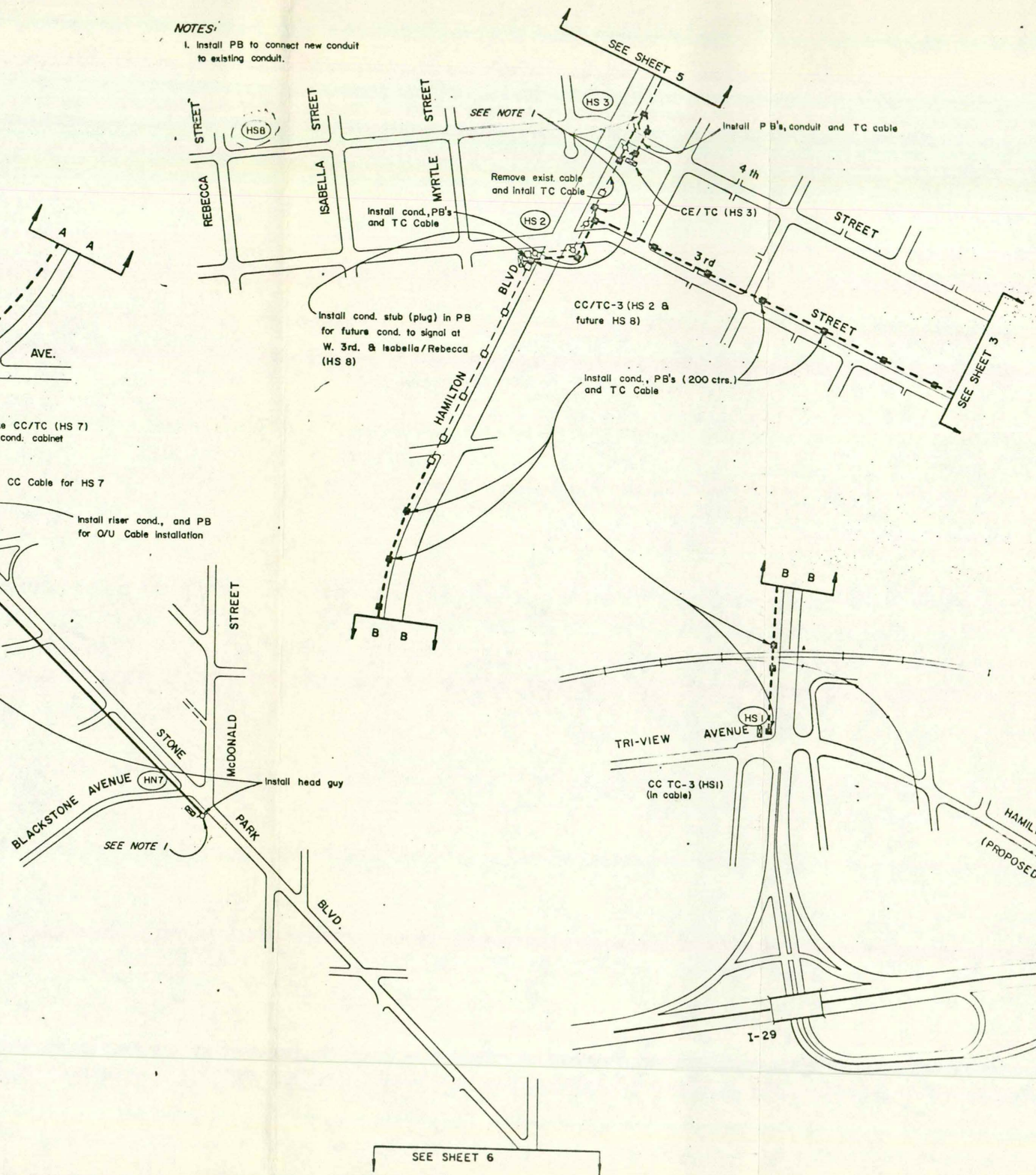
N

NOTES:

1. Install PB to connect new conduit to existing conduit.







SEE SHEET 12

CB34 Install guy

CC/TEL-1 (CB 35) CB35

6 th STREET

Install head guys

CC/TC-1 (LC6) 2

Install CC cable

CC/TC-1 (CB 34)

Install CC cable

Remove NWB cable

IPS

CB26

5 th IPS NWB STREET

Install TC cable

Install head guys.

Install cond., PB, and CC cable.

HOEVEN DRIVE

CHAMBERS DRIVE

PAVONIA STREET

LC6

N

CC TC-1 (CB 26)

Install head guy.

SEE NOTE 2

Lower NWB drop(by others)

Install CC cable

NWB

CC/TC-1 (CB 18)

Areaway to be filled as required

CB17

CC/TC-1(CB 17)

CB18

SEE NOTE 1

4 th STREET

IPS

CC/TC-1 (LC 5)

LC5

Conc. wall

SEE NOTE 3

Install TC cable

3 rd STREET

3rd STREET

Install guys.

Install side guys

Install head guy

SEE NOTE 1

FAIRMOUNT STREET

RIVER

Install TC cable

A

2 nd STREET

SEE SHEET 3

COURT BLVD.

FLOYD BLVD.

B

FLOYD

(U.S. 75)

LEWIS BLVD.

LC4

WESTCOTT STREET

Install cond., PB's, and TC cable along face of curb.

1st STREET

IPS

SEE SHEET 9

Install cond. stub (plug) and provide sufficient slack in TC cable for future CC cable splice. (GW 4)

GW5

SEE NOTE 4

SEE NOTE 3

Install riser up bridge pier to junction box.

Install TC cable

GORDON DRIVE (U. S. 20)

Install high impact plastic type C junction box.

SEE NOTE 5

C

D

SEE NOTE 1

Install high impact plastic Type A junction box.

Dead end messenger cable on bridge.

Install high impact plastic Type B junction box.

Install cond. stub (plug) and provide sufficient slack in cable for future CC cable splice (LC 3).

LC 3

Install cond., PBs, and TC cable.

Install guy

IPS

GW6

DACE AVENUE

Install head guys

Install cond. on underside of bridge

SEE SHEET 9

Notes:

1. Install riser, PB, and cond. for O/U cable installation.
2. Remove existing traffic cable on Court St. from 4th St. to 6th. St., on 5th St. from Court St. to Floyd Blvd. and Floyd Blvd. from 5th St. to 4th St.
3. Install PB, conduit riser and conduit bend and install cond. on bridge approach retaining wall. Pulling boxes to be installed at 200' ± centers.
4. Replace existing standoffs between locations A & B on west side of Floyd Bridge with new 4" x 6" creosote treated wooden standoffs. Install messenger cable on standoffs for aerial installation of TC cable. Cable shall maintain a 4" minimum clearance from bridge structure.
5. Install high impact plastic Type B junction box on bridge curb and install riser and PB for transition to buried conduit.

CC/TC-1(GW6)

Install head guy

Install fiber conduit from location C to D on back edge of bridge curb between railing and street light bases. Expansion joints to be installed at bridge beam supports. High impact plastic pulling boxes to be installed at 200' ± centers. Conduit to be secured to curb by stainless steel clamps and anchor bolts spaced no more than 10' apart.

CUNNINGHAM DR.

Install head guys.

LEECH AVENUE

LC 2

LC1

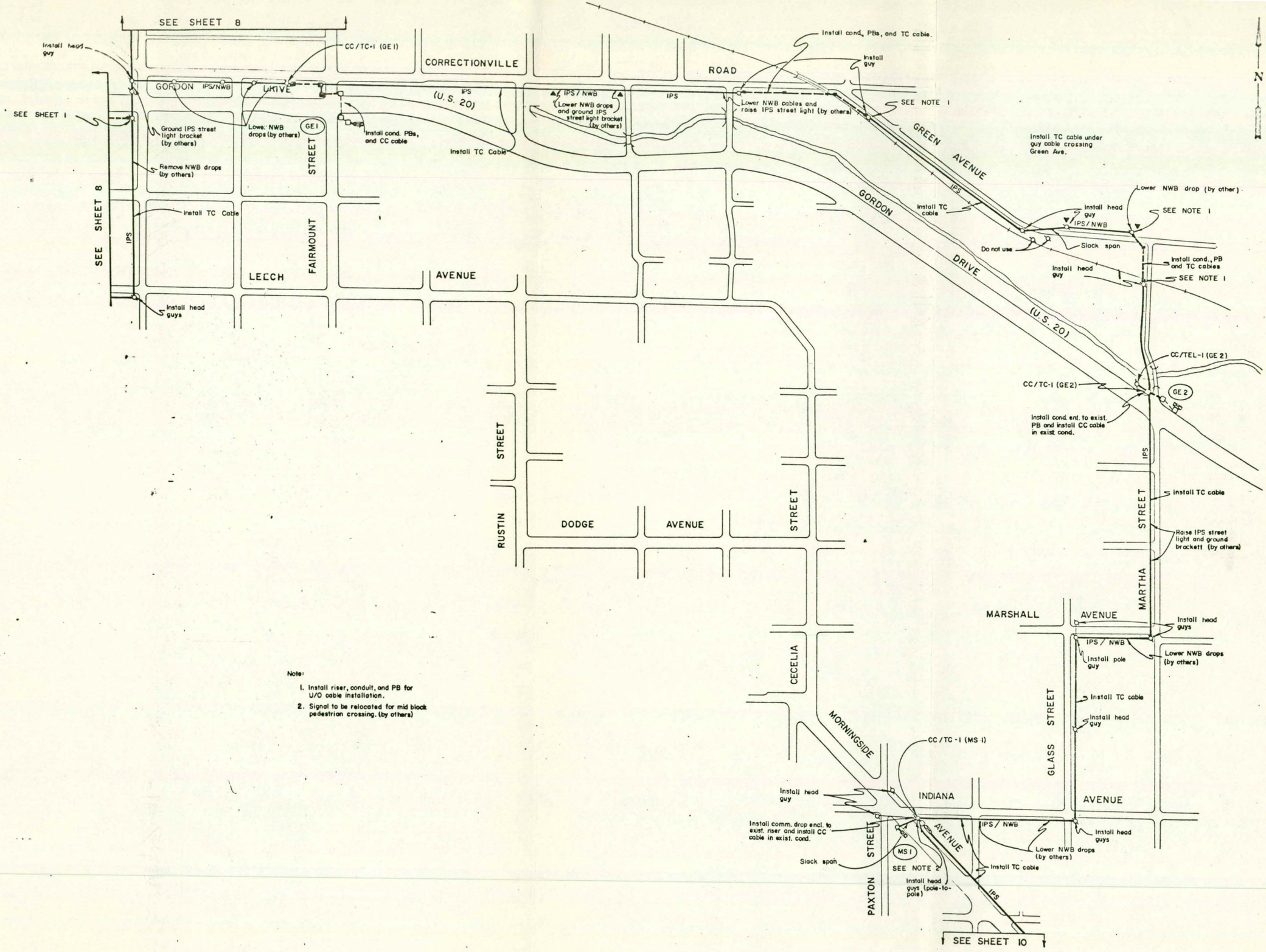
CC/TC-1 (LC1)

CC/TC-1 (LC 2)

IPS

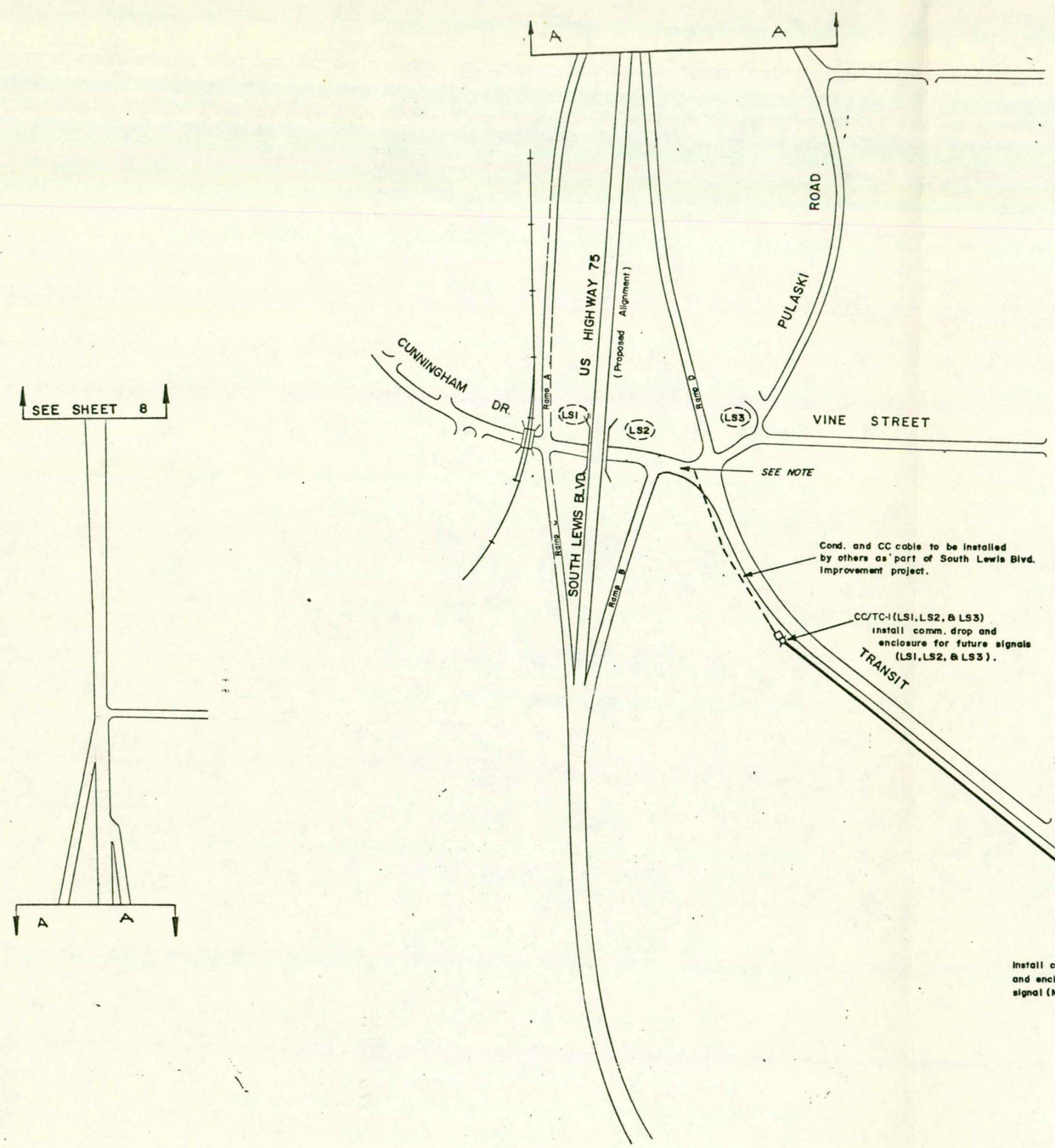
Signal at Leech Ave. and Lewis Blvd. to be modernized by others as part of the South Lewis Blvd. improvement project.

SEE SHEET 10



Note:

1. Install riser, conduit, and PB for U/O cable installation.
2. Signal to be relocated for mid block pedestrian crossing. (by others)



NOTES:

1. Signals at Cunningham and Lewis (ramp A & C), Cunningham and Lewis (ramp B), and Cunningham and Transit (Lewis ramp D) to be installed by others as part of the South Lewis Blvd. Improvement Project. Improvement project to be coordinated to include installation of conduit and CC cable along Transit Ave. to a point adjacent to IPS pole for connection to overhead TC cable.

SEE SHEET 9

Install guy

Install comm. drop and encl. for future signal (MS 2)

IPS

Install pole

MS 2

STONE AVENUE

Raise 7 IPS street lights along Stone Ave. to provide adequate clearance (by others)

IPS

CC/TC-1 (GE 3)
SEE NOTE 1

GE 3

CC/TC-1 (GE 3)
SEE NOTE 1

Install head guy

Install CC Cable in exist. cond.

GORDON DRIVE

Lower NWB cable

IPS

MS 3

RIDGE AVENUE

Install TC cable

CC/TC-1 (MS 3)

MORNINGSIDE AVENUE

GE 4

GE 5

(U.S. 20)

To GE 6 (Maple ST.)

Terminate CC cable for future signals (CC 4 & CC 5) in cab

Install cond. stub (plug) for future signals (GE 4 & GE 6)

CC/TC-1 (GE 4 through GE 6)

Install head guy

SEE NOTE 1

MS 4

PETERS AVENUE

CC/TC-1 (MS 4)

Raise IPS transformer (if necessary) to provide adequate clearance (by others)

IPS / NWB

Install TC cable

MS 5

GARRETSON AVENUE

CC/TC-1 (MS 5)

SEE NOTE 1

ORLEANS AVENUE

Install pole

Install head guys

CC/TC (MS 9)

Install CC cable

SEE NOTE 1

Install TC cable

MS 9

Raise IPS street light (by others)

Lower NWB drop (by others)

Install head guys

Install cond. and PB's

ORLEANS AVENUE

Install head guys

SEE NOTE 1

Install cond. and PB's

IPS / NWB

CC/TC-1 (MS 8)

Install CC cable

MS 8

NEWTON STREET

CORNELIA STREET

GLASS STREET

SOUTH ST. AUBIN STREET

PATTERSON STREET

LAKEPORT STREET

Terminate cable for 10 future signals (LK 1 through LK 10)

SEE NOTE 2

Proposed alignment

IPS / NWB

PALMETTO STREET

Remove NWB cables along alley (planned by others)

Install TC cable

Install pole and head guy

IPS

MS 11

Install pole guy

MS 10

SEE NOTE 1

CC/TC-1 (MS 11)

CEDAR

Install back guy

Install head guy

Install TC cable

SEE SHEET 11

TRANSIT

MORNINGSIDE AVENUE

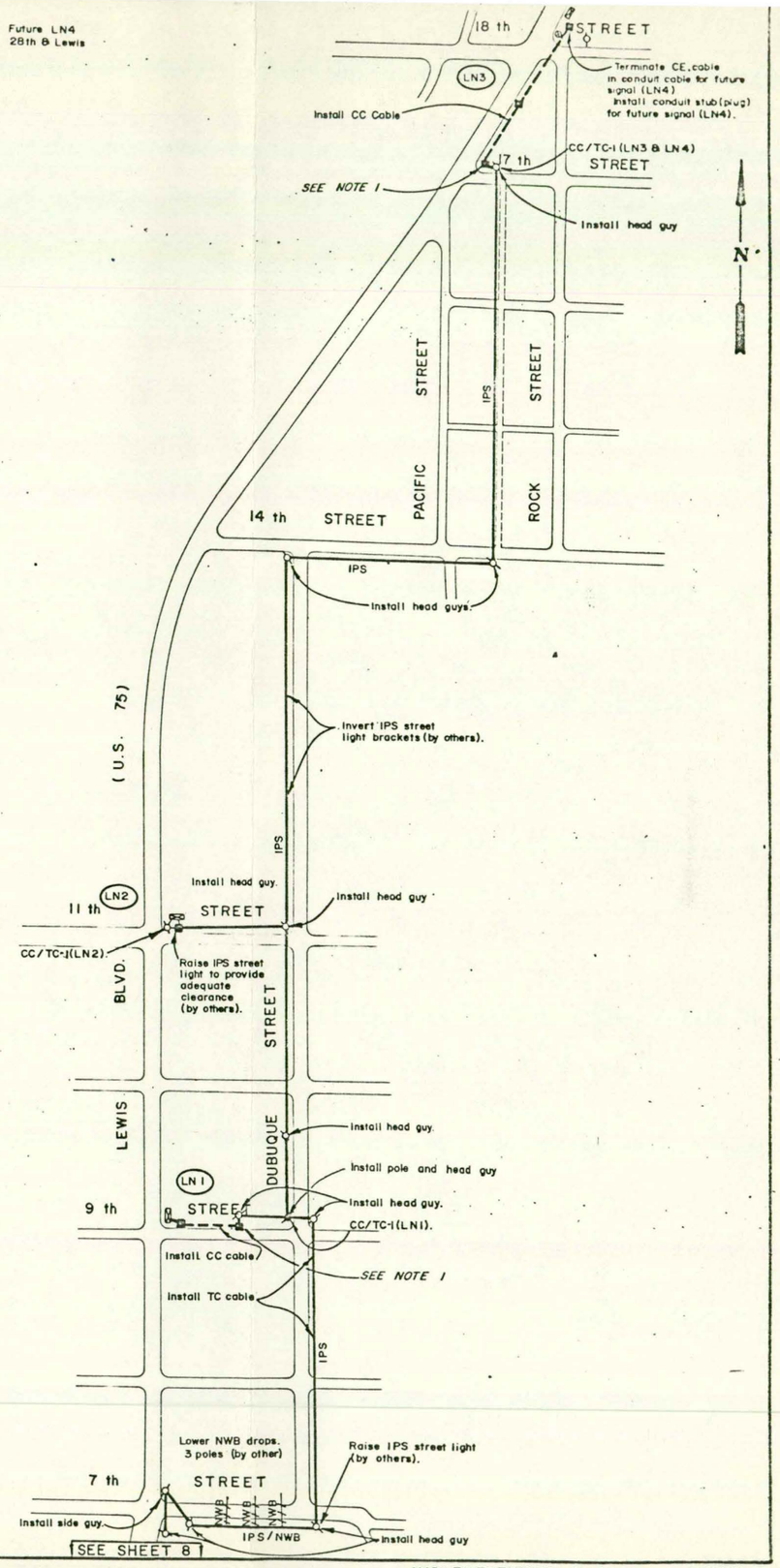
IPS

N

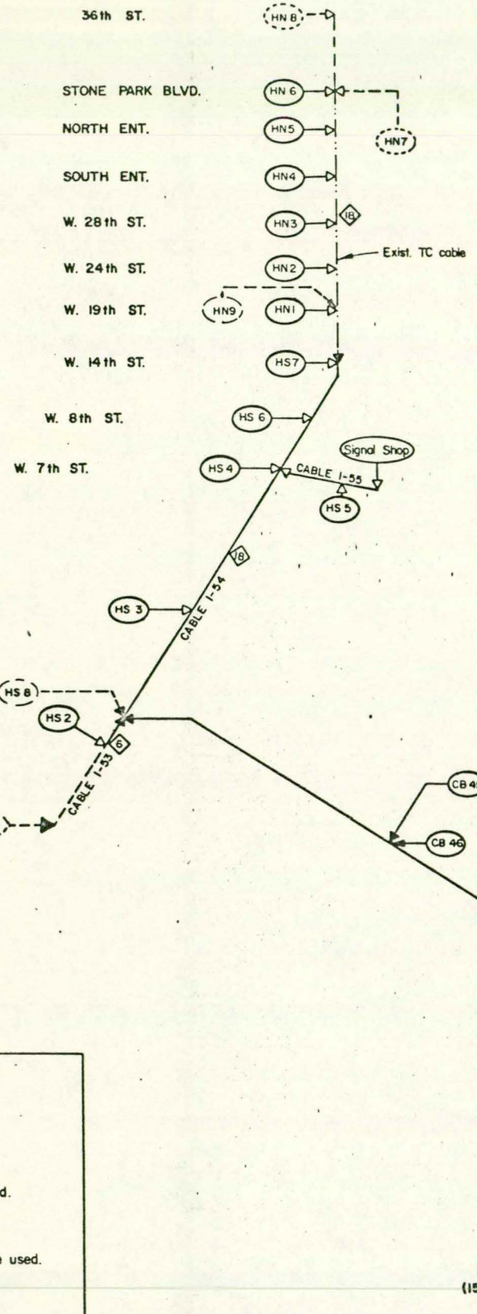
NOTES:

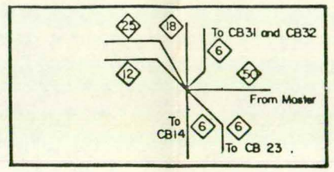
1. Install riser, PB, and cond. for U/O cable installation.
2. The proposed Lakeport improvement project includes realignment of Lakeport and Palmento Streets. Conduit, PB's, and other appurtenances required for cable installation to be constructed as part of this project.

Future LN4
28th & Lewis



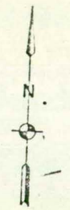
NOTES:
1. Install riser, cond., and PB for O/U cable installation.

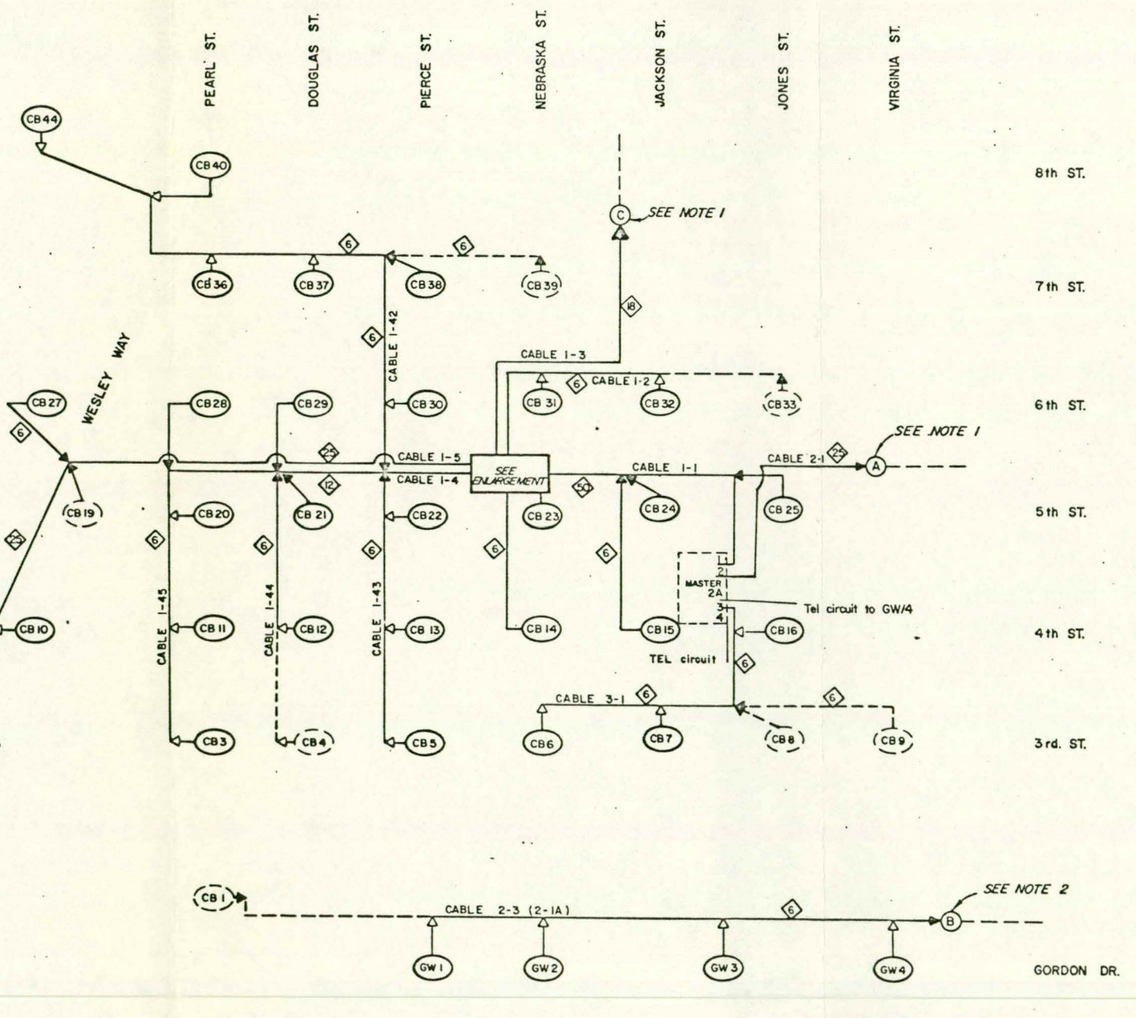




NOTES

1. Terminate TC cable in junction box on utility pole for future extension by others.
2. Terminate TC cable in junction box on utility pole for communications connection to NWB.

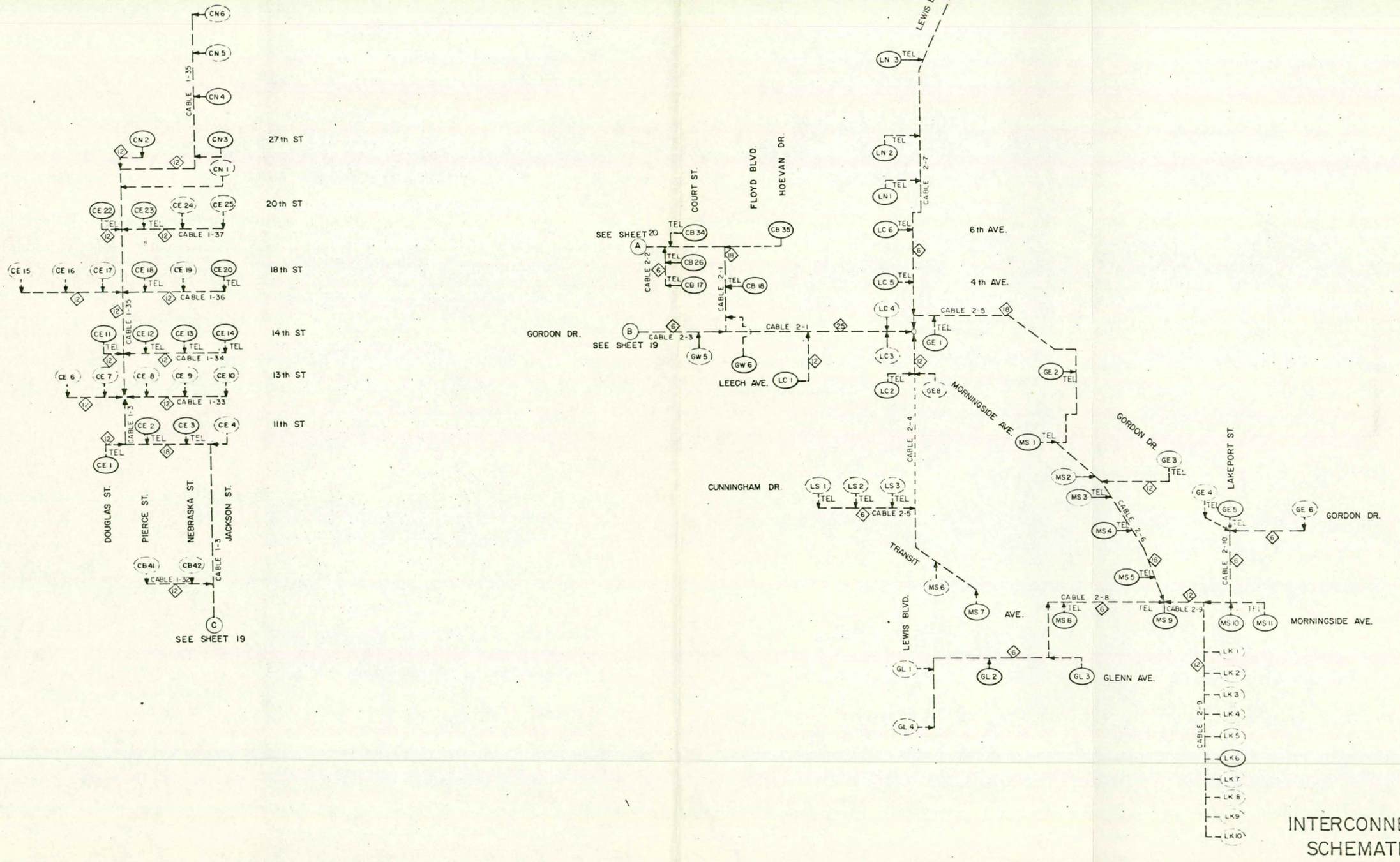




SCHEMATIC DIAGRAM

- (CE 15) Existing Signal
- (CE 16) Future Signal
- Traffic communications cable to be installed.
- Traffic communications cable (by others)
- Existing traffic communications cable to be used.
- Cable size (pairs)
- Junction box on pole or in pull box.
- Junction box in controller cabinet.
- CICU connection made by connection to a 6 pair CC cable to be installed between TC cable splice in junction box, Type 4 A or 5A pull box ,or splice enclosure and controller cabinet terminal.
- CICU connection made by connection to TC cable

INTERCONNECT SCHEMATIC

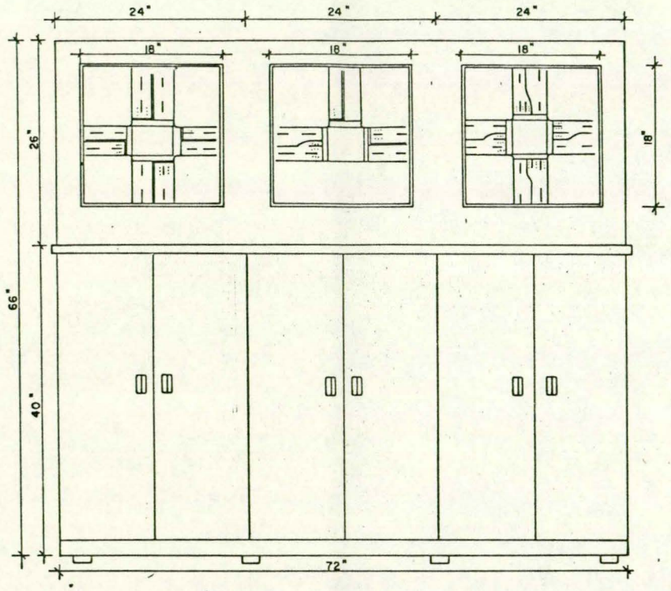

N
CN6
CN5
CN4
CN3
CN2
CN1
CABLE 1-35
27th ST
CE 22
CE 23
CE 24
CE 25
TEL
CABLE 1-37
20th ST
CE 15
CE 16
CE 17
CE 18
CE 19
CE 20
CABLE 1-36
18th ST
CE 11
CE 12
CE 13
CE 14
CABLE 1-34
14th ST
CE 6
CE 7
CE 8
CE 9
CE 10
CABLE 1-33
13th ST
CE 2
CE 3
CE 4
CE 1
CABLE 1-3
11th ST
DOUGLAS ST.
PIERCE ST.
NEBRASKA ST.
JACKSON ST.
CB41
CB42
CABLE 1-35
C
SEE SHEET 19
LN 4
LEWIS BLVD
LN 3
LN 2
LN1
CABLE 2-7
LC 6
6th AVE.
LC 5
4th AVE.
LC 4
CABLE 2-5
GE 1
LC3
LC2
GE8
GE 2
MORNINGSIDE AVE.
MS 1
GORDON DR.
GE 3
MS2
MS3
CABLE 2-6
MS4
GE 4
GE 5
GE 6
LAKEPORT ST
CABLE 2-10
MS5
MS 10
MS 11
MORNINGSIDE AVE.
CABLE 2-8
CABLE 2-9
MS 8
MS 9
LK 1
LK 2
LK 3
LK 4
LK 5
LK 6
LK 7
LK 8
LK9
LK10
CABLE 2-9
COURT ST.
FLOYD BLVD
HOEVAN DR.
SEE SHEET 20
A
CB 34
CB 35
CB 26
CB 17
CB 18
CABLE 2-2
CABLE 2-1
GORDON DR.
B
CABLE 2-3
SEE SHEET 19
GW 5
GW 6
LEECH AVE.
LC 1
CABLE 2-1
CABLE 2-4
CUNNINGHAM DR.
LS 1
LS 2
LS 3
CABLE 2-5
TRANSIT
MS 6
MS 7
AVE.
LEWIS BLVD.
GL 1
GL 2
GL 3
GL 4
GLENN AVE.
INTERCONNECT
SCHEMATIC

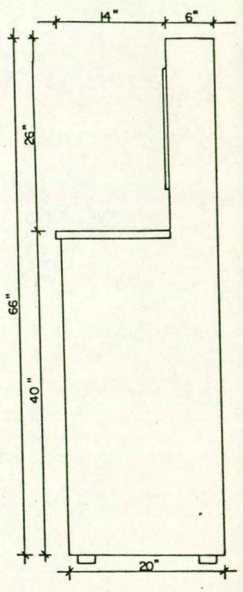
APPENDIX D
TYPICAL DETAILS

CABINET FOR TEST CONTROLLERS AND DISPLAYS

ALL DIMENSIONS ARE APPROXIMATE

FRONT VIEW →





STORAGE SHELVES

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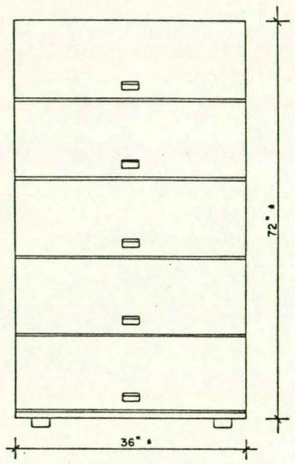
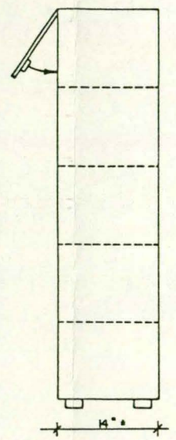
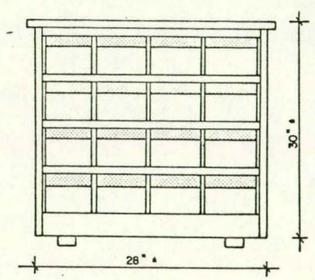
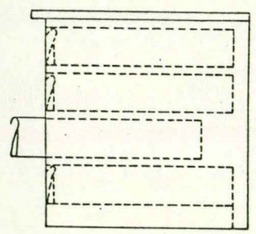




CARD FILE

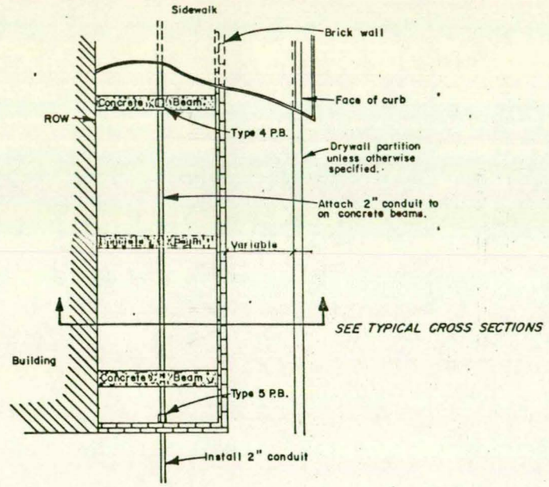
ALL DIMENSIONS ARE APPROXIMATE





DETAILS

VIEW A →

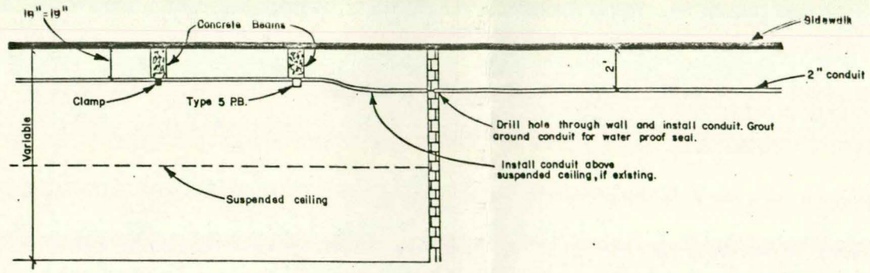


AREAWAY TYPICAL

GENERAL NOTES:

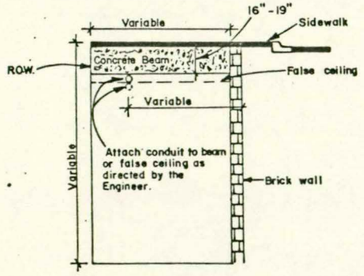
1. All work within areaways shall be coordinated with the Engineer and areaway tenant.
2. Conduit entrances to areaways shall be waterproof. Any see page problems shall be corrected by the contractor prior to final acceptance.
3. Work within areaways shall be performed with due regard for occupant safety. Work area shall be cleaned up of all debris and all material neatly stacked prior to end of workday.

PROFILES OF AREAWAYS

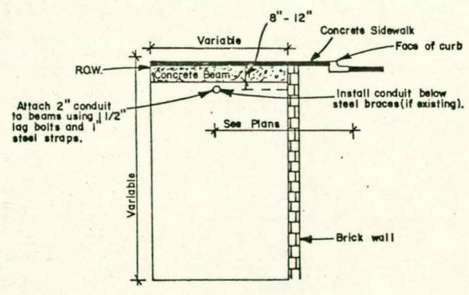


DETAIL A

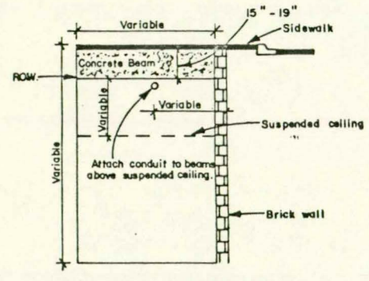
TYPICAL CROSS SECTIONS OF AREAWAYS



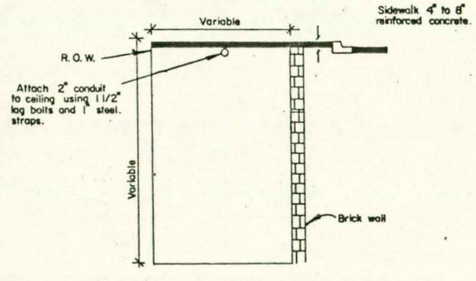
CROSS SECTION A



CROSS SECTION B

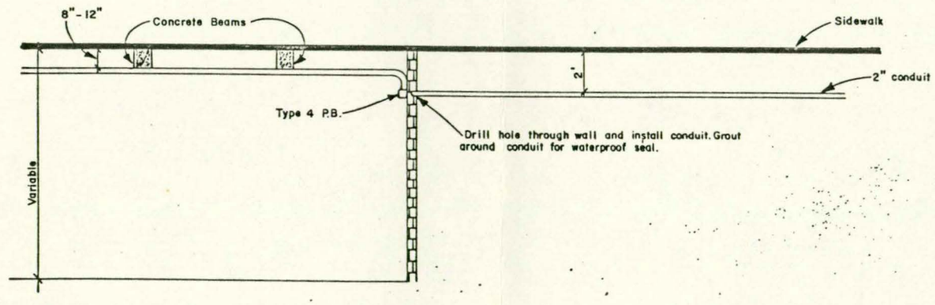


CROSS SECTION C

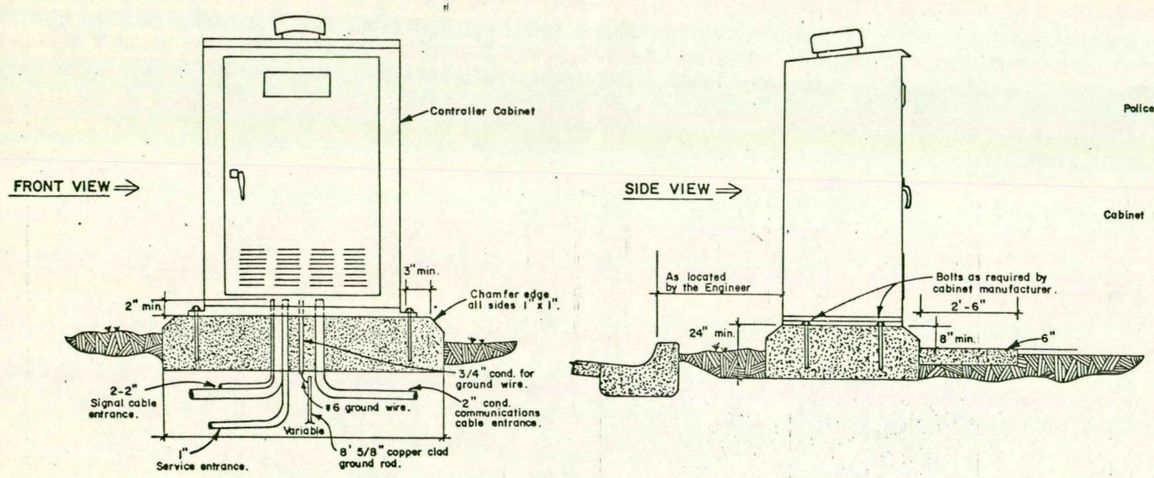


CROSS SECTION D

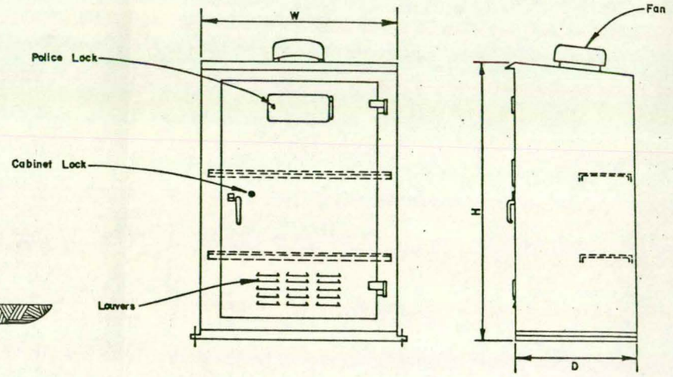
DETAIL B



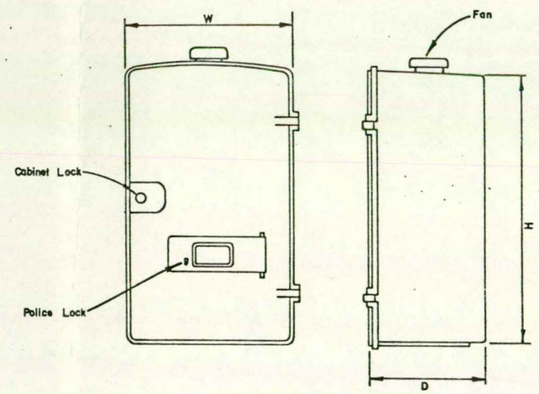
AREAWAY DETAILS



TYPE M-1 MOUNTING



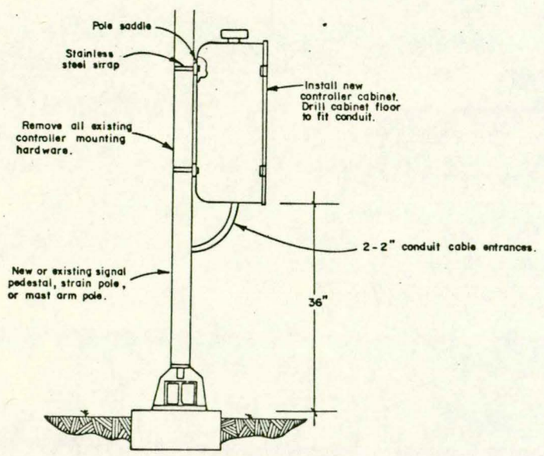
CONTROLLER CABINET
TYPE D



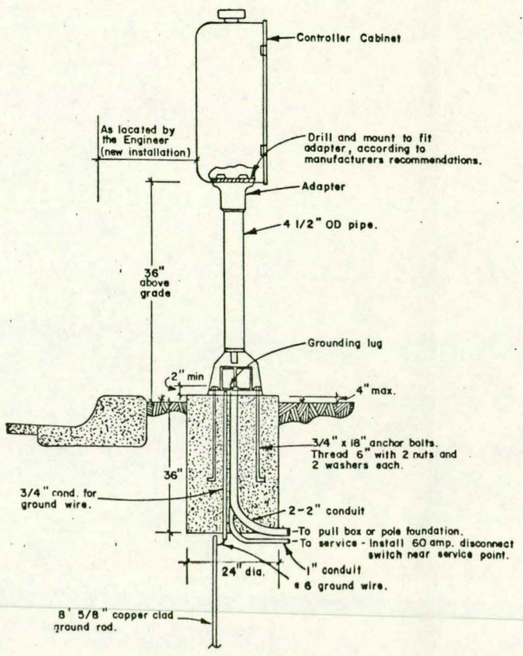
CONTROLLER CABINET
TYPE B AND C

CABINET SIZE

CAB'T. TYPE	H	W	D
B	33"	20"	14"
C	36"	22"	15"
D	48"	34"	17"



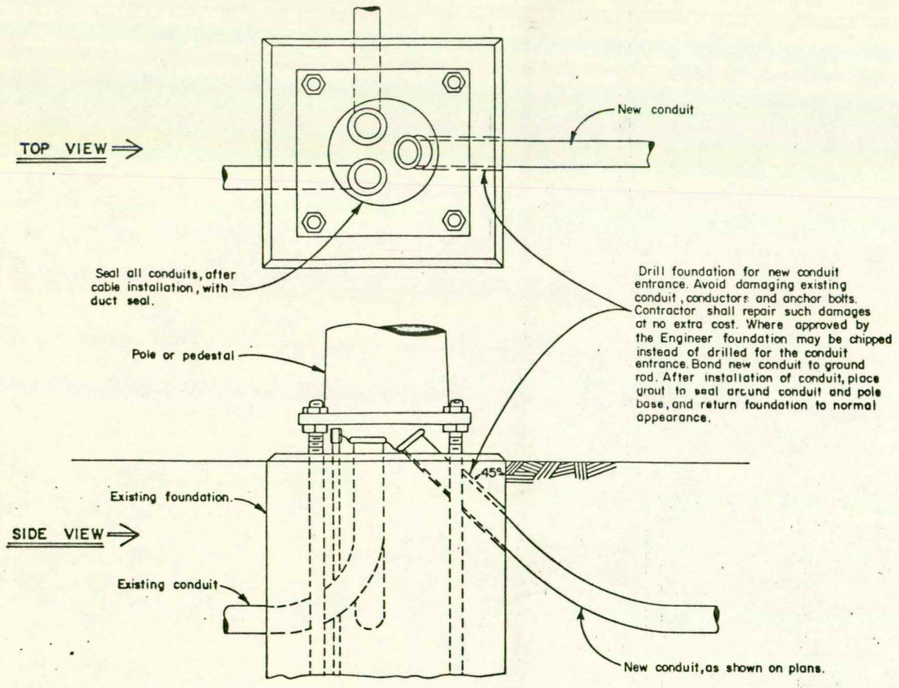
TYPE M-2 MOUNTING



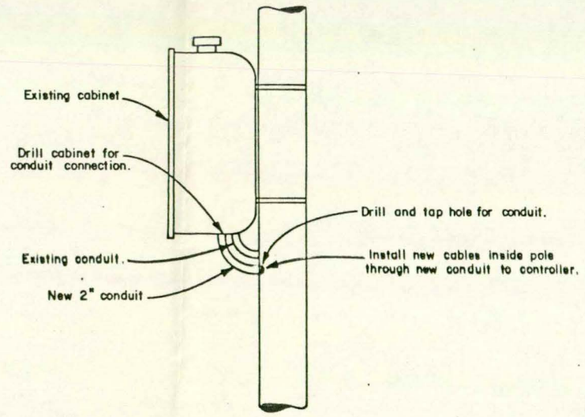
TYPE M-3 MOUNTING

CONTROLLER CABINET AND MOUNTING DETAILS

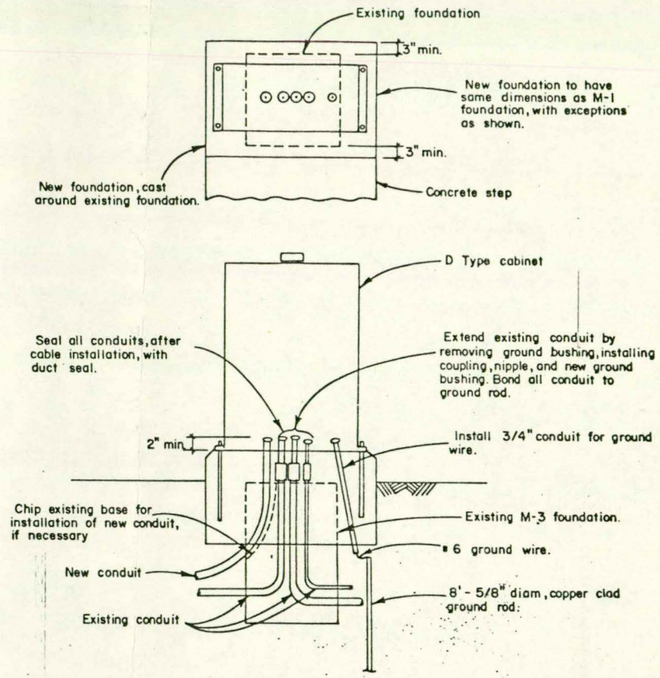
NEW CONDUIT INTO EXISTING POLE FOUNDATION (TYPICAL)



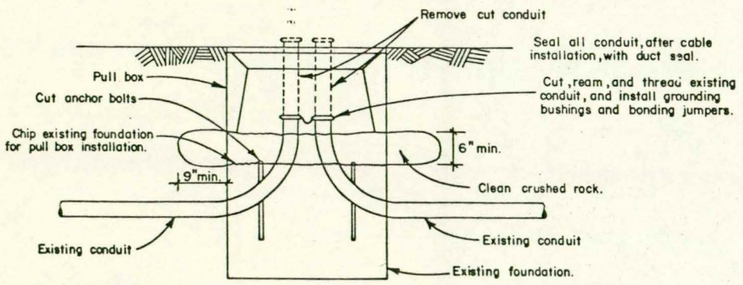
NEW CABLE ENTRANCE INTO EXISTING CABINET ON STEEL POLE



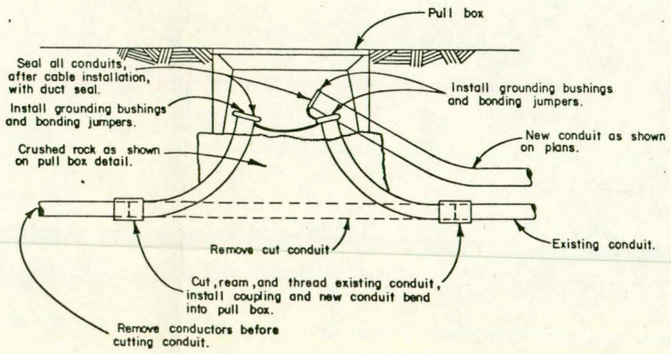
NEW M-1 CONTROLLER MOUNTING AT EXISTING M-3 MOUNTING LOCATION (TYPICAL)



NEW PULL BOX AT EXISTING POLE FOUNDATION (TYPICAL)

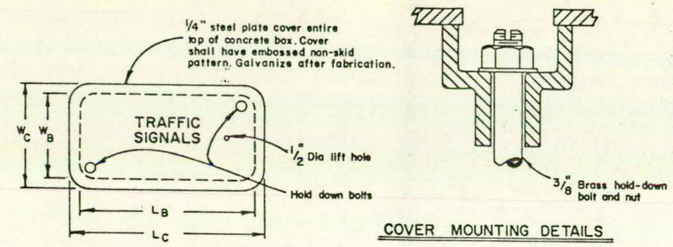


NEW PULL BOX IN EXISTING CONDUIT (TYPICAL)



DETAILS

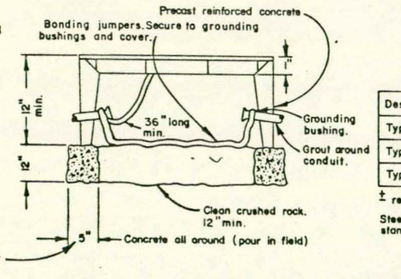
WOODBURY COUNTY	PROJECT NO.	STATE	FED. ROAD DIST. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS



COVER MOUNTING DETAILS

NOTES:

1. Pull box extensions shall be installed as required for splice enclosures, etc.
2. Top of pull box shall be flush with grade or top of curb except in unimproved areas. The box shall be placed with top 1 1/2" above surrounding grade.
3. Where applicable pull boxes shall be placed adjacent to back of curb or on side of foundation facing traffic.



Install only when pull box is located in roadway or other traveled area.

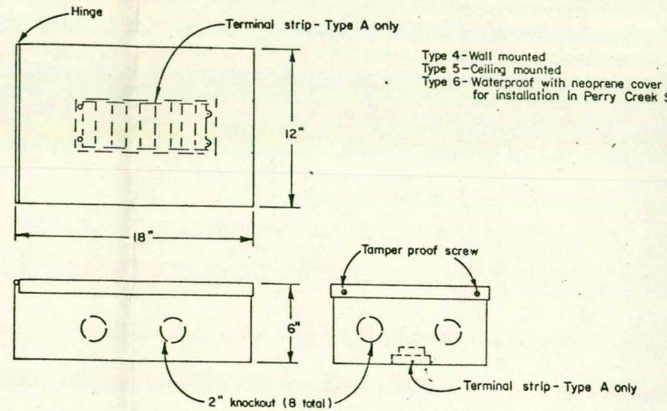
— TABLE OF DIMENSIONS —

Designation	L_C	L_B	W_C	W_B
Type 1	25" ±	21" ±	16" ±	12" ±
Type 2	35" ±	31" ±	22" ±	18" ±
Type 3	51" ±	49" ±	33" ±	31" ±

± refers to ± 1/2"

Steel reinforcing shall be as regularly used in the standard products of the manufacturer.

PULL BOX TYPES 1, 2, and 3



Type 4 - Wall mounted
Type 5 - Ceiling mounted
Type 6 - Waterproof with neoprene cover gasket for installation in Perry Creek Storm Drain.

Constructed from 14 gauge steel. Hot-dip galvanized after fabrication. Primer coat and two coats grey paint. Mounting holes (4) to be drilled in bottom. All dimensions approximate.

PULL BOX TYPES 4, 5, and 6

CC/TEL - 1 — Connection of CC cable to telephone circuit performed in a junction box. See detail below. CC cable shall run continuously from splice to terminal strip in controller cabinet.

CC/TC - 1 — A branch splice performed in a junction box or Type 4-6 PB See detail below. CC cable shall run continuously from splice to terminal strip in controller cabinet.

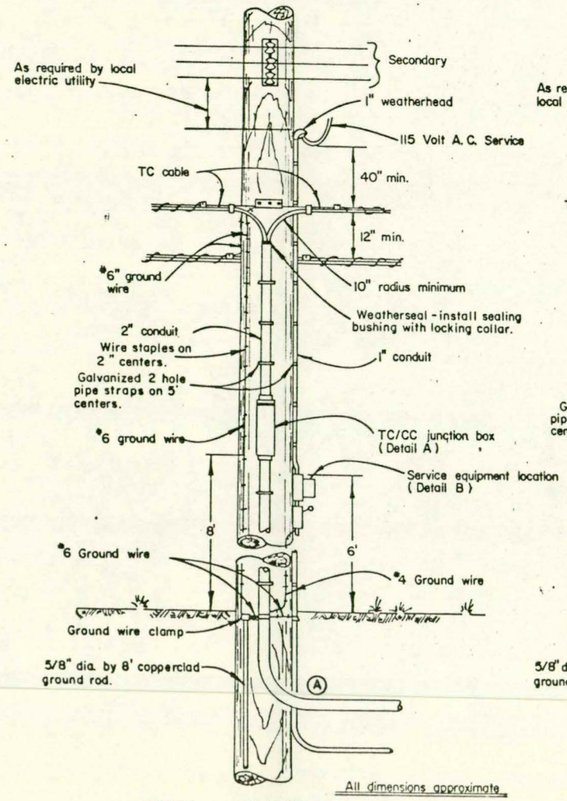
CC/TC - 2 — A branch splice in a pull box or manhole as shown on the plans. Splice shall be performed in a reenterable enclosure conforming to the requirements of the special provisions. CC cable shall run continuously from splice to terminal strip in controller cabinet.

CC/TC - 3 — TC cable is brought into controller cabinet or other enclosure. TC cable to be terminated (both ends) on terminal strip located in enclosure.

CC/TC - 4 — An overhead branch splice performed in a reenterable enclosure conforming to the requirements of the Special Provisions. CC cable shall run continuously from splice to terminal strip in controller cabinet.

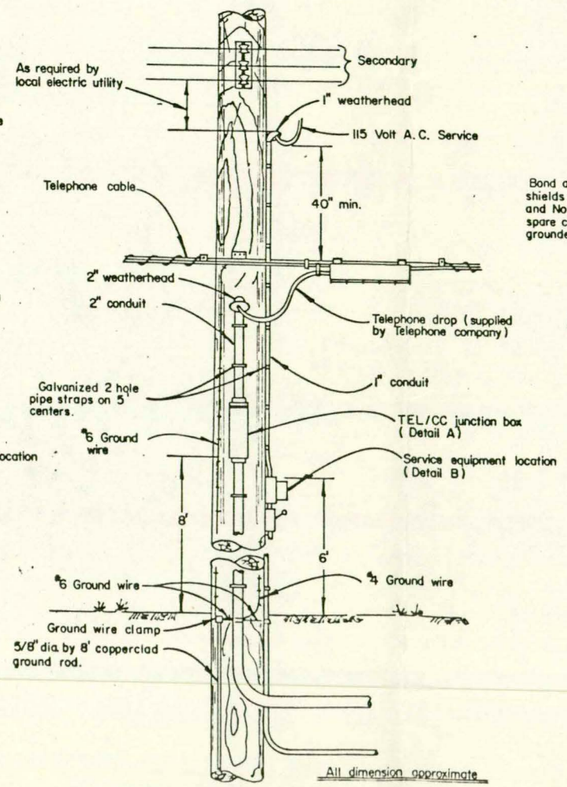
COMMUNICATIONS/CONTROLLER CONNECTION

PULL BOX DETAILS



All dimensions approximate

CC/TC-1 CONNECTION



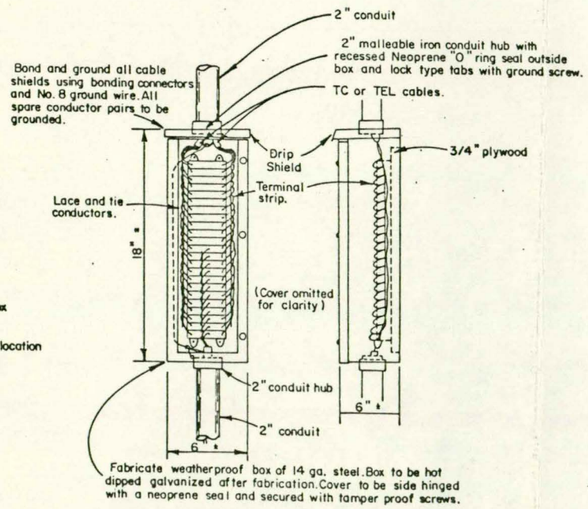
All dimension approximate

CC/TEL-1 CONNECTION

NOTE:

TC/CC junction box installed for future signal shall consist of a complete installation except that the CC cable shall not be installed and the conduit riser shall extend only to location (A) where it shall be sealed.

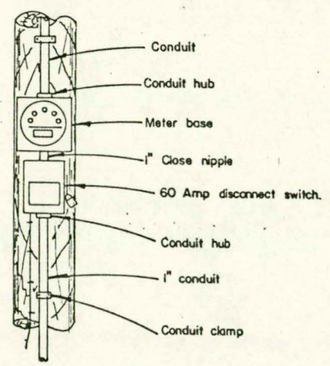
DETAIL A



CC/TC-1 or CC/TEL-1 JUNCTION BOX

All dimensions approximate

DETAIL B



Service Equipment Location

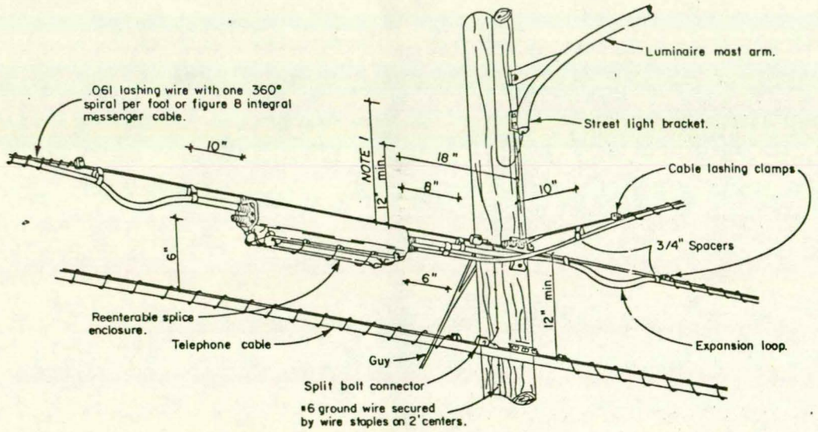
All dimensions approximate

CABLE AND SERVICE INSTALLATION DETAILS

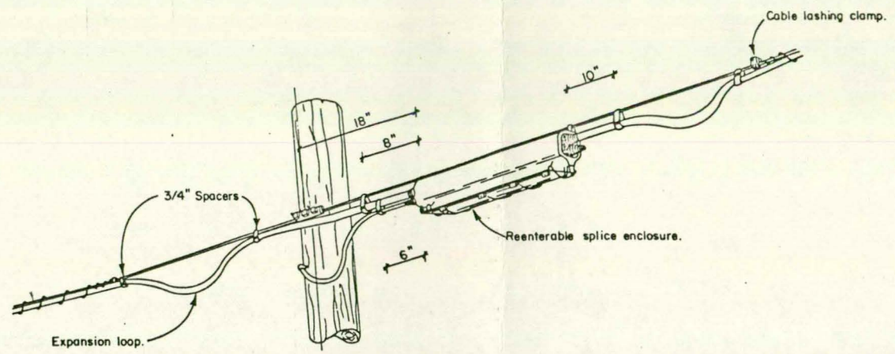
E:

" min. for ungrounded bracket. arance may be reduced to 4" grounded bracket except that er drip loop clearances must maintained. Bond TC messenger bracket ground.

BRANCH SPLICE - WOOD POLE

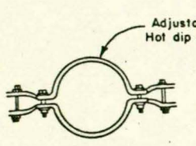


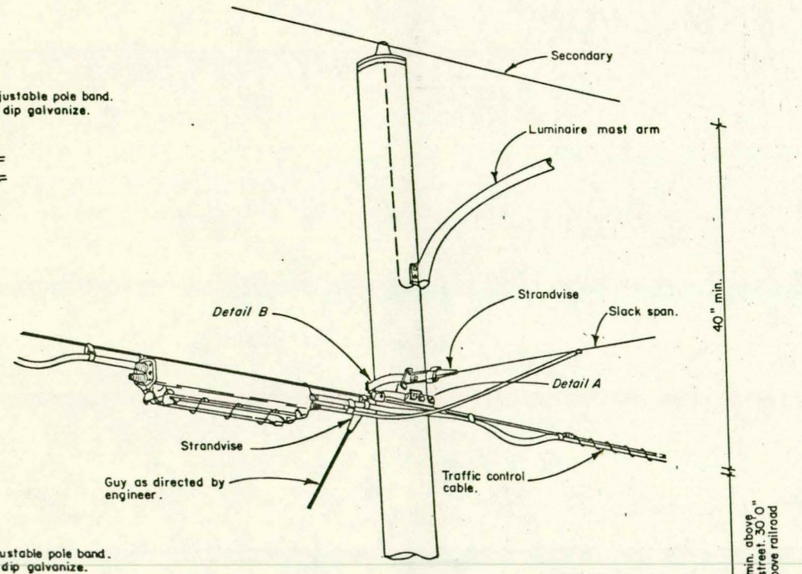
IN-LINE POLE SPLICE - WOOD POLE



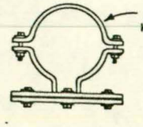
BRANCH SPLICE - STEEL OR ALUMINUM STREET LIGHT POLE

DETAIL B

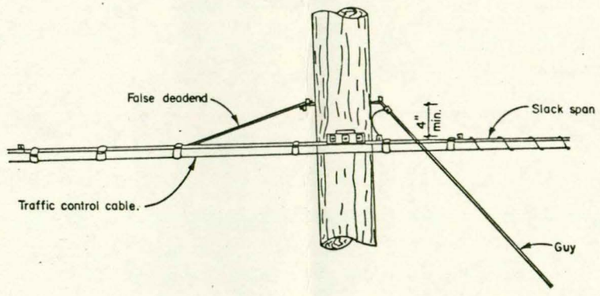




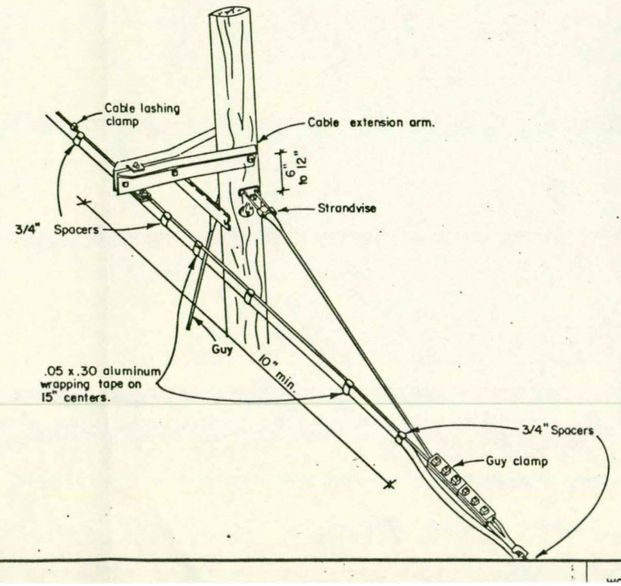
DETAIL A



FALSE DEAD-END AT SLACK SPAN



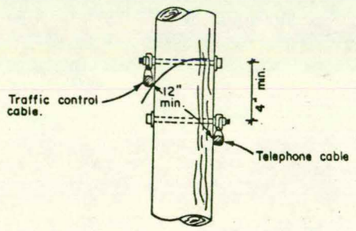
FALSE DEAD-END AT CABLE EXTENSION ARM



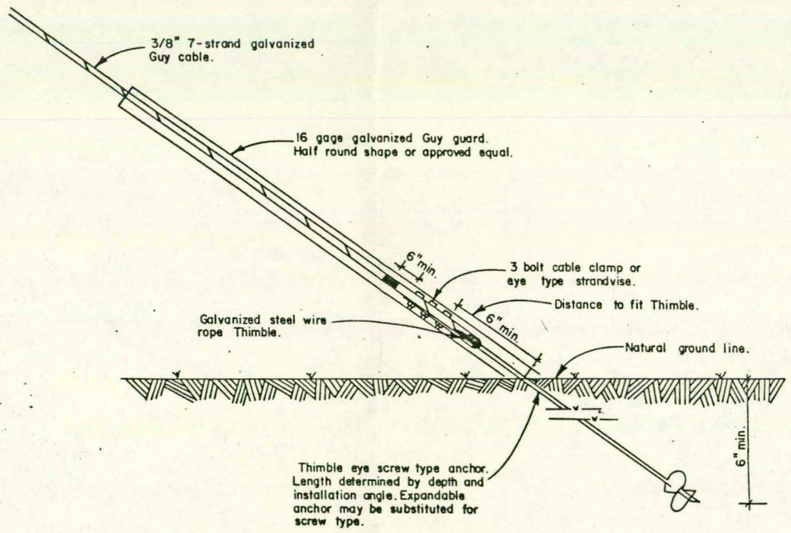
CABLE INSTALLATION DETAILS

WOODBURY COUNTY	PROJECT NO.	STATE	FED. ROAD DIST. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS

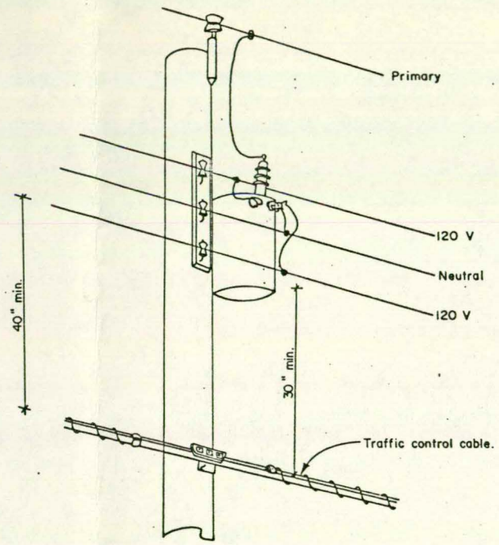
MINIMUM CLEARANCE TO TELEPHONE CABLE



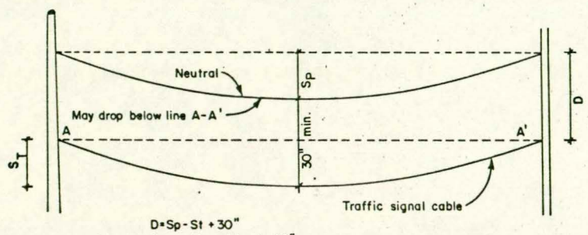
GUY ANCHOR ASSEMBLY



TRANSFORMER, REGULATOR, OR CAPACITOR CLEARANCE

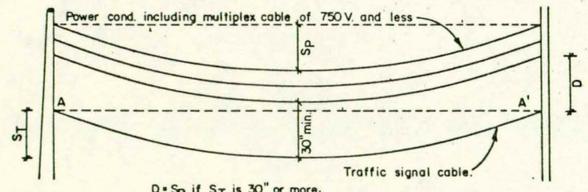


SPAN CLEARANCE



D = Sp - St + 30"
D must be at least 40"

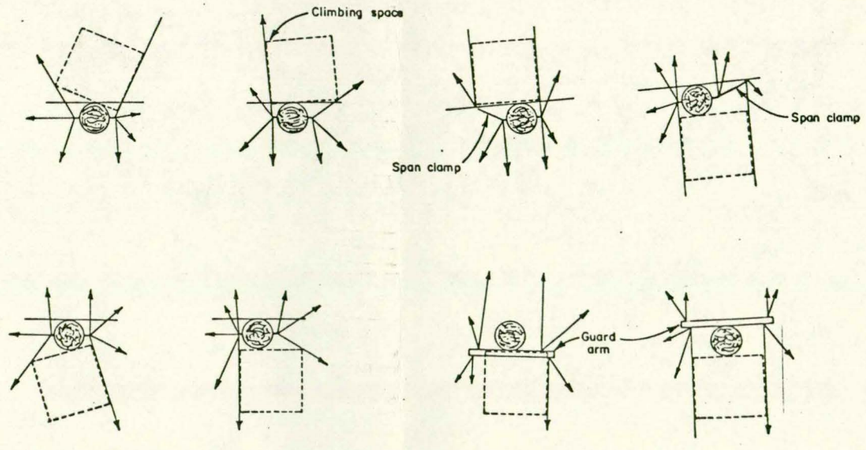
Grounded neutral associated with conductors of up to 22 KV (any span length)



D = Sp if S_T is 30" or more.
D = $S_P - S_T$ + 30" if S_T is less than 30".
D must be at least 40"
Spans over 150' - Power conductors must not be below line A-A'

Power conductors of 750 volts or less

CLIMBING SPACE



An unobstructed vertical climbing space consisting of an imaginary 30" square box extending at least 40" above and below the highest cable facility shall be provided. Traffic control cable, riser and junction box shall not be located within the climbing space. Techniques for maintaining the climbing space where drop wires are involved is shown above.

CABLE INSTALLATION DETAILS