
TRAFFIC ANALYSIS
PROGRAM AND
CIRCULATION PLAN

Town of Concord
Concord, Massachusetts

March, 1987

Vanasse Hangen Brustlin, Inc.

FINAL SUMMARY REPORT

TOWN OF CONCORD
TRAFFIC ANALYSIS PROGRAM
AND CIRCULATION PLAN

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INTRODUCTION

This Final Summary Report summarizes the Townwide Traffic Analysis study conducted for the Town of Concord by Vanasse Hangen Brustlin, Inc. It represents the culmination of a comprehensive study of the Town's traffic problems, summarizing existing deficiencies, projecting future traffic growth and developing a set of specific recommendations for physical and management improvements.

A set of three previous Technical Memoranda describe the three phases of the study in considerable detail, defining each of the tasks conducted. The first memorandum describes the initial task of data inventory and presents an analysis of existing conditions. Using available data, supplemented by field counts and observations, existing deficiencies in the Town's roadway network are identified. The second memorandum describes the MinUTP computer model used to simulate traffic flow on the existing network and to test changes in future travel patterns based on anticipated development in Concord and surrounding communities, as well as possible alternative network modifications.

The third memorandum projected traffic growth to 1995, analyzed travel patterns on the existing roadways and five alternative networks, and presented a set of recommended traffic improvements throughout the Town. Each improvement was evaluated with regard to its effectiveness, cost, implementation feasibility, priority and impact on the surrounding area. This Final Summary Report briefly describes the procedures followed, the results, and the recommendations. For more information and specific information on the study, the three previous memoranda should be consulted.

SUMMARY OF EXISTING CONDITIONS

The following represent the key findings of the Townwide traffic study which ultimately led to the development of the set of recommended improvements:

Traffic

- o Concord's roadway network is predominantly radial in nature with local streets radiating out from the Center of Town. Route 2, which effectively provides a bypass of the Center of Town in an east-west orientation, carries the highest volumes measured in Town (40,800 vehicles per day (vpd)).
- o Traffic growth on Route 2 has been considerable. Over the 1974-1984 period, average daily traffic volumes increased by 34 percent for an average annual increase of approximately 3 percent.
- o Other major roadways include Main Street (Route 62), Lowell Road, Old Bedford Road (Route 62), Elm Street (Route 2A), Cambridge Turnpike, Commonwealth Avenue and Lexington Road, all of which carry in excess of 7,000 vpd.

Roadway Operations

- o Traffic operational analyses indicated that while all of the seven (7) Town maintained signalized intersections are operating at good levels of service, most of the state maintained signals on Route 2 are operating near or at capacity, resulting in excessive queuing and long delays.

- o Key problem areas identified as contributing to traffic congestion and poor mobility include:

- Route 2 and its signalized intersections
- Monument Square and its approach roadways
- The Main Street commercial area
- West Concord Center

In addition, there are numerous collectors and arterial streets which are in poor physical condition or have one or more design deficiencies. The most notably deficient streets include:

- Barrett's Mill Road
- Virginia Road
- Strawberry Hill Road
- Old Road to Nine Acre Corner
- Monument Street

Land Use

- o Land use throughout the Town consists primarily of low density residential. Three commercial areas exist: (1) along Main Street (Milldam area), (2) along Thoreau Street and Sudbury Road (Depot area) and (3) in West Concord along Main Street and Commonwealth Avenue. Industrial activity is predominant in the Baker Avenue area at the northeast corner of Town (Virginia Road) and at the southwest corner (along Route 62).

Safety

- o An average of 322 accidents per year was reported on Town roads during the 1980-85 period. In addition, an average of 378 accidents has been reported annually on Route 2.

- o The highest accident location in Concord is the Route 2 rotary, which averaged 100 accidents per year. The highest accident location not on Route 2 is the Main Street/Baker Avenue intersection, which experienced an average of 14 accidents per year.

Details of these findings are presented in the Task 1 Memorandum, Data Inventory/Existing Conditions Analysis.

TRAFFIC MODEL DEVELOPMENT

The second task of this study involved the development of a microcomputer-based traffic planning model for simulating morning and afternoon peak period travel within the Town. The COMSIS MinUTP microcomputer transportation planning package, which operates on an IBM PC (or compatible) was used in the development of this traffic model. This model incorporates all of the needed capabilities that are part of the traditional urban transportation planning process including highway network building, impedance matrix development, trip generation, trip distribution, and trip assignment. A detailed description of the model is provided in the Task 2 Memorandum, Traffic Model Development.

The Concord traffic model development was based, in part, on the Hanscom Area Traffic Study (HATS), performed by the Central Transportation Planning Staff (CTPS). The CTPS subarea study was concerned with the traffic problems located in the area around Hanscom Air Field, including the communities of Bedford, Concord, Lexington, and Lincoln. The computerized highway network and base trip tables from this study provided the starting point for the Concord traffic model development.

The steps required in developing the Concord traffic model included the definition of the study area and traffic zone system. This was followed by development of the base year highway network and trip tables. The trip tables are matrices of trip volumes between the various internal and external zones. The volume of trips originating in, or destined to, a particular zone is a function of the amount of land use activity in the zone, in particular the number of households and employment. After assignment of the trip tables to the network, comparisons of the estimated traffic volumes were made to actual traffic count data collected in Task 1 of this study. After successful

replication of the existing Concord travel patterns, the traffic model was utilized to develop future year travel demands and to test alternative highway improvement projects as described in the next section.

ANALYSIS OF FUTURE CONDITIONS

Using the MinUTP computer traffic model, projections of 1995 travel demands were generated for both local traffic within Concord and regional through traffic. Once the projections were made, an analysis of the expected traffic volume impacts was conducted to determine growth trends and to develop an understanding of intersection deficiencies at key locations in the Town. This topic is discussed in detail in the Task 3 Technical Memorandum entitled "Circulation Plan."

Land use projections for 1995 were developed in conjunction with the Town's Planning Department. An estimated 772 dwelling units and approximately 1.1 million square feet of new commercial/institutional space (representing approximately 4,500 new employees) has been projected. While this growth is significant, it is expected to occur at a slower rate than that exhibited over the 1970-1980 period.

In terms of traffic volume increases expected by 1995, the model results indicate that the greatest traffic impacts are expected to occur along Route 2, with most of this growth generated by developments outside of Concord. On the local street system, several other trends were identified. The streets expected to carry much of the increased traffic are Keyes Road, Main Street, Sudbury Road, Thoreau Street and Lexington Road. Monument Square, because it serves as the focal point of several radial streets, is expected to experience a 27 percent increase in total entering traffic during the evening peak.

An analysis of the operation of the signalized intersections in Concord indicated that many of the locations now operating at acceptable levels of service will decline to Level of Service "E" or "F" conditions. The result will be increased congestion,

longer delays and an increased likelihood that some drivers may seek alternate routes to avoid the most heavily congested locations. This can result in the creation of new negative traffic volume impacts on currently unaffected residential streets.

The worst traffic problems in Concord are now, and will continue to be, along Route 2. The majority of the traffic volume increases will occur along Route 2, however much of the growth on Town roads appears attributable to the commercial and residential growth projected throughout the community. Clearly, this magnitude of new traffic growth will exacerbate the already congested conditions on Route 2, on Town roadways, and in Monument Square.

In addition to analyzing the impact of 1995 travel demand on existing roadways, five roadway improvement alternatives were studied by applying the model to the 1995 land use and traffic data. The five networks tested and the resultant impact on traffic volumes are summarized below:

- o Alternative 1 - Upgrade Route 2 to a four-lane, limited access roadway with grade-separated intersections and frontage roads. This alternative would result in a substantial diversion of traffic from local roadways to Route 2.
- o Alternative 2 - Route 2 improved by coordinating the existing signals but making no changes in current access points. Minor diversions of traffic from local roadways to Route 2 are projected and probably would not result in significant improvement in conditions on local roadways, although it would help drivers along Route 2.

- o Alternative 3 - Roadway reconstruction, including resurfacing and improving alignments, along all deficient Town maintained roadways. Generally the model results indicated no significant diversions in traffic.

- o Alternative 4 - Circulation changes and parking restrictions in Town Center and signalization of key intersections. Removal of parking and the provision of an additional through lane along Main Street results in the diversion of through trips to the Center of Town, increasing traffic through this area.

- o Alternative 5 - Addition of new connector roadway between Baker Avenue and Commonwealth Avenue south of MCI-Concord. This would divert traffic from Commonwealth Avenue and Main Street in West Concord and Route 2 between Elm Street and Main Street to the new connector. The effect is localized primarily in West Concord.

Additional alternative roadway networks and land use scenarios can be tested by Town staff on the model installed on Town owned computer equipment. Technical Memorandum 3 - Circulation Plan - discusses the analysis alternatives in considerable detail.

RECOMMENDATIONS

Based on the analysis of existing and projected 1995 conditions, input received at several public meetings held during the study, objectives set forth by the Long Range Plan Committee, and sound traffic engineering practice, a series of specific recommendations were developed. These recommendations deal with both traffic operations improvements and policy considerations, including development impact assessment, demand reduction measures, design standards, and truck routings.

Traffic Operation Improvements

In development of the recommended traffic operations improvements, several types of improvements were considered, including intersection upgrading, roadway improvements, circulation changes and pedestrian improvements. The recommended improvements primarily include measures for intersection upgrading, such as adding approach lanes, improving signal control, and changing curb space management to restrict parking and loading at peak times. The recommended intersection improvements cover three areas: Route 2; local intersections outside the Town Center; and the Town Center area including Monument Square.

The Route 2 intersection improvements are confined to relatively short-term improvements designed to enhance movement along intersecting local roadways. Detailed analysis of the long-term improvement needs for Route 2 traffic was beyond the scope of this study, however, it is generally recognized that a major upgrade including grade-separated intersections will be required to improve Route 2 operations. Analysis of such an improvement with the Concord model indicates substantial diversions of traffic from local roadways to Route 2 which would lead to improved conditions on local roadways.

Table 1 outlines the intersection improvements recommended as a result of this study. Included in Table 1 are construction cost estimates and priorities. Cost estimates are for construction only and do not include the cost of any land acquisitions which may be necessary. Priorities are listed as high, moderate and low, with the highest priority given to safety-related improvements and other lower-cost improvements which will provide the most significant improvements in operations at local intersections. Figure 1 shows the location of the improvements and conceptual plans for each improvement are presented in the Appendix.

Policy Recommendations

In addition to the roadway improvements described above, a series of policy recommendations were made:

- o Development Impact Assessment - All new developments and redevelopments of mid- to large-size should be required to undertake a study of their anticipated traffic impacts on the Town's roadways. Developments which are shown to have significant impacts should be required to contribute to providing related traffic improvements.

- o Demand Reduction Measures - The traffic impact of existing or future commercial development within the Town can be lessened somewhat through measures which reduce the amount of traffic generated by these uses. Demand reduction measures which would be applicable in Concord are ridesharing and alternative work schedules. Ridesharing refers to encouraging commuters to ride in vehicles with other commuters, such as in carpools and vanpools, rather than driving to work alone. Alternative work schedules reduce peak hour demands by shifting travel to non-peak

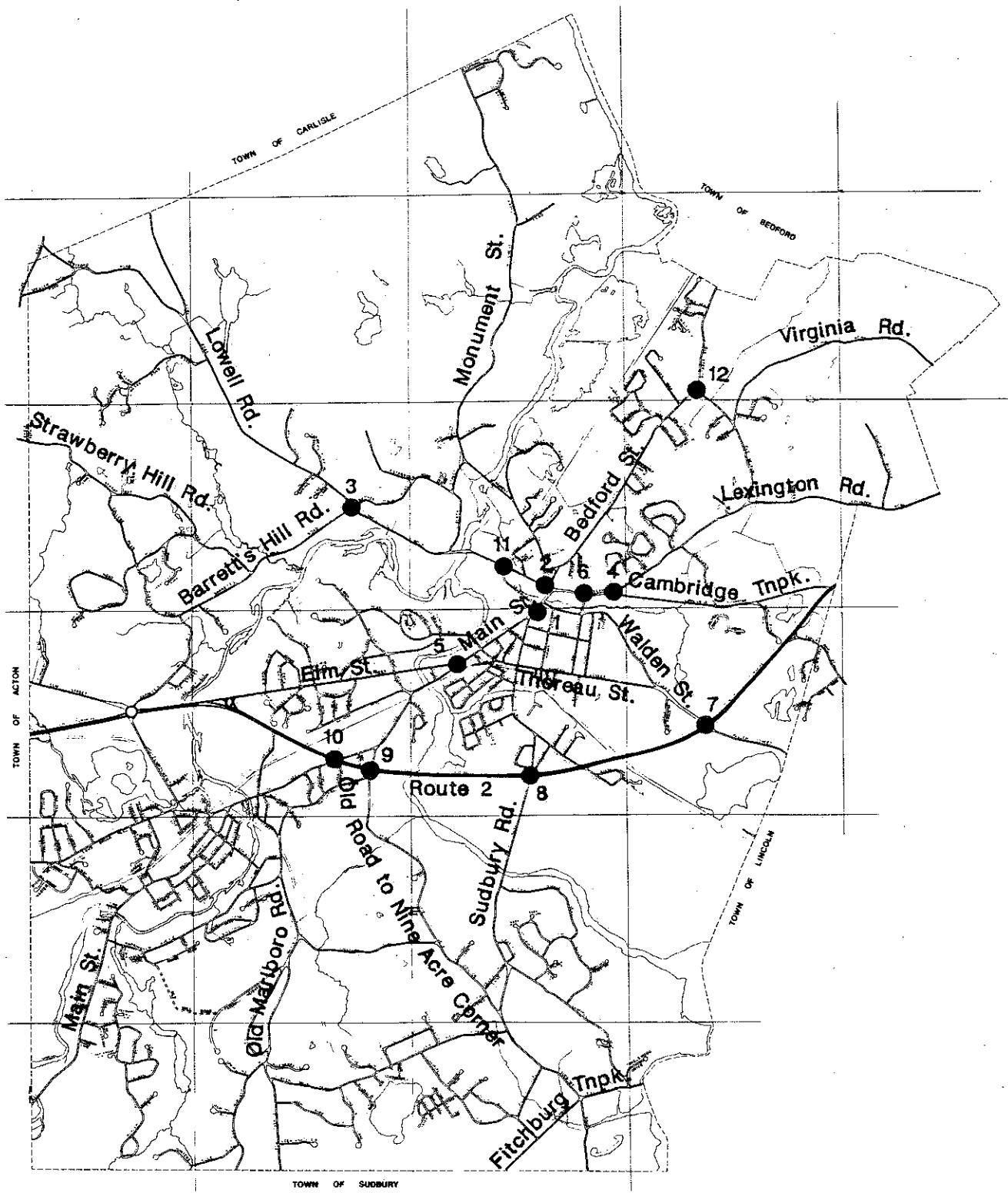
TABLE 1
RECOMMENDED ROADWAY IMPROVEMENTS

Location	Description	Construction Cost Estimate
<u>Highest Priority</u>		
1 Main Street Short-Term	Peak hour parking restrictions to provide additional approach lanes at Keyes Road and Sudbury Road.	No Construction Required
Main St. Long-Term	Realign Keyes Road to intersect Main St. at Sudbury Rd. and signalize intersection.	\$360,000
2 Monument Sq.	Parking restrictions and peak period police officer control.	\$10,000-\$20,000
3 Barrett's Mill Rd./Lowell Rd./Barnes Hill Rd.	Removal of sight obstructions and improved signing.	\$5,000-\$10,000
4 Lexington Rd./Cambridge Tpke.	Replace Y-type intersection with T-type intersection.	\$50,000-\$65,000
<u>Moderate Priority</u>		
4 Lexington Rd./Cambridge Tpke.	Install traffic signal, modify channelization.	\$75,000-\$85,000
5 Main St./Elm St.	Install traffic signal, minor geometry changes.	\$75,000-\$100,000
6 Lexington Rd./Heywood St.	Replace triangular island with T-type configuration.	\$15,000
7 Route 2/ Walden St.	Provide one through, one left-turn, and a channelized right-turn lane on northbound Walden Street approach.	\$25,000-\$30,000

NOTE: Location number refers to Figure 1.

TABLE 1 (Continued)
RECOMMENDED ROADWAY IMPROVEMENTS

<u>Location</u>	<u>Description</u>	<u>Construction Cost Estimate</u>
<u>Moderage Priority</u> (Continued)		
8 Route 2/ Sudbury Rd.	Provide one right-turn and one shared through/left-turn lane on northbound and southbound Sudbury Road approaches.	\$60,000-\$75,000
9 Route 2/Old Nine Acre Road to Nine Acre Corner	Provide one shared through/left-turn and one shared through/right-turn lane on southbound ORNAC approach.	\$25,000-\$30,000
10 Route 2/Main St. (Route 62)	Provide addition lane on Main Street westbound approach and one additional lane on the Main Street approach eastbound approach.	\$75,000
<u>Lowest Priority</u>		
11 Lowell Rd./ Keyes Rd.	Widen southbound approach to provide a separate right-turn lane.	\$15,000-\$20,000
12 Old Bedford Rd./ Bedford St.	Replace Y-type intersection with T-type intersection.	<u>\$45,000-\$50,000</u>
Total Cost of All Improvements		\$835,000-\$935,000



Proposed Roadway Improvement Locations

LEGEND:
Number refers to location
number in table 1.

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 Fig. 1

times through the use of staggered work hours, flexible work hours, and compressed work weeks. While these measures will not solve the Town's traffic problems, they will prove beneficial by reducing traffic generation in a limited way.

- o Design Standards - Technical Memorandum 3 presented a set of specific design criteria for town roads based primarily on several standard engineering references. These references provide guidelines on several elements to be considered when designing roadways, including facility type, design speed, design volume and design vehicle. It is also recommended that undesirable intersection geometry found at certain locations within the Town be modified. Specifically intersections with Y-type geometry should not be constructed in the future and existing intersections with such geometry should be redesigned as resources allow.

- o Truck Routing - Proper route signing should be maintained in order to keep trucks on designated routes. This involves the proper identification of truck routes and state route designations, especially at major intersections. As part of this study, no recommendation is made to change truck routes.

CONCLUSIONS

Based on traffic analysis results, field observations and discussions with local officials and others, several conclusions can be drawn relative to traffic in Concord:

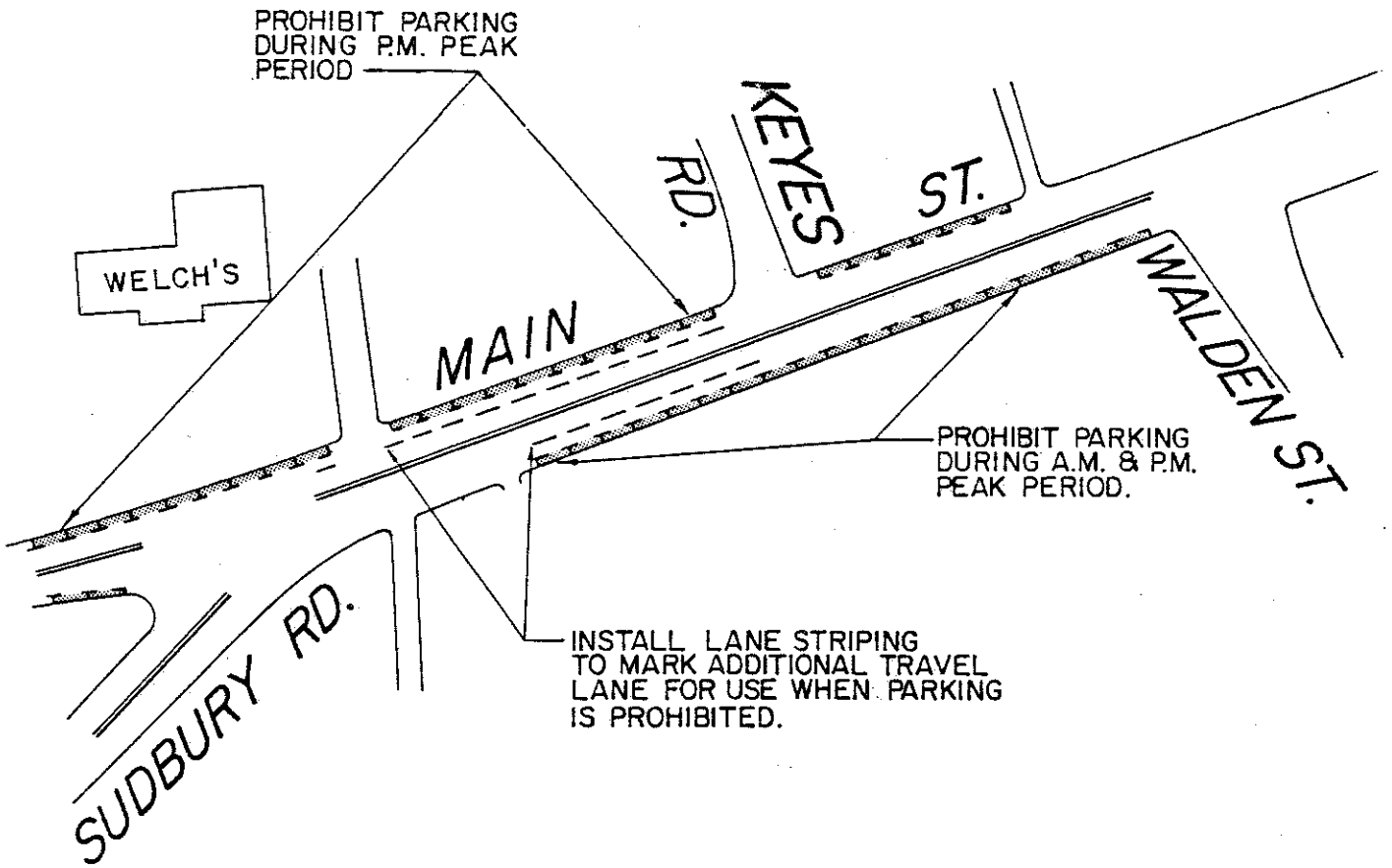
- o The Town has time to plan for future growth.
- o Future traffic increases will come mostly from growth outside Concord which will affect primarily Route 2 and to a lesser extent, Main Street (Route 62). Internal traffic growth on Town streets is likely to be much less pronounced.
- o The impact of external through traffic on local roadways because of diversions due to congestion can be minimized by means of traffic enhancements on the main commuter routes.
- o Concord is more in need of Transportation Systems Management (TSM) and safety-type improvements on its local streets and intersections rather than substantial new capacity from bypass roadways.
- o The Town itself will have to choose from among several alternative traffic improvement options at some locations studied. Trade-offs exist between enhancing traffic flow which may induce more traffic, and retaining the status quo which will discourage new trips but will not provide improved conditions.
- o Some trade-offs involve a choice between better traffic flow and reduced parking, or poor traffic operation while retaining existing on-street parking. It would be

preferable to seek additional off-street parking facilities as a replacement for any parking lost due to improvement plans.

- o Concord should continue to coordinate with the MDPW to obtain meaningful long-term improvements along Route 2. It can use the results of this study to highlight the worsening situation anticipated along Route 2.
- o Additional coordination efforts will also be necessary with neighboring communities. Cooperative programs involving demand reduction strategies would be beneficial to all by better managing traffic.

APPENDIX

Intersection Improvement Concept Plans



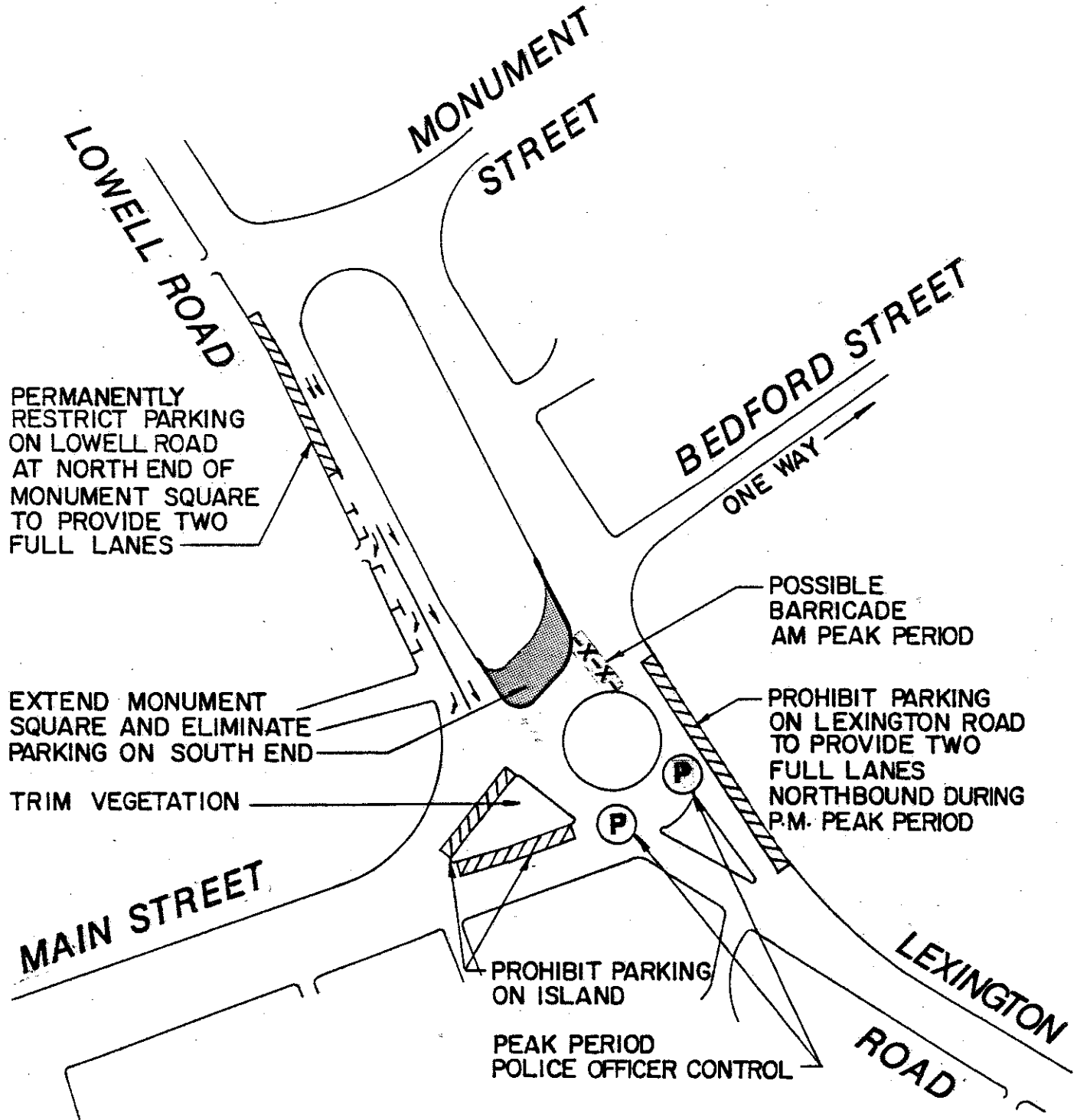
Main Street Short Term Proposed Roadway Improvements

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Not to Scale



Location 1



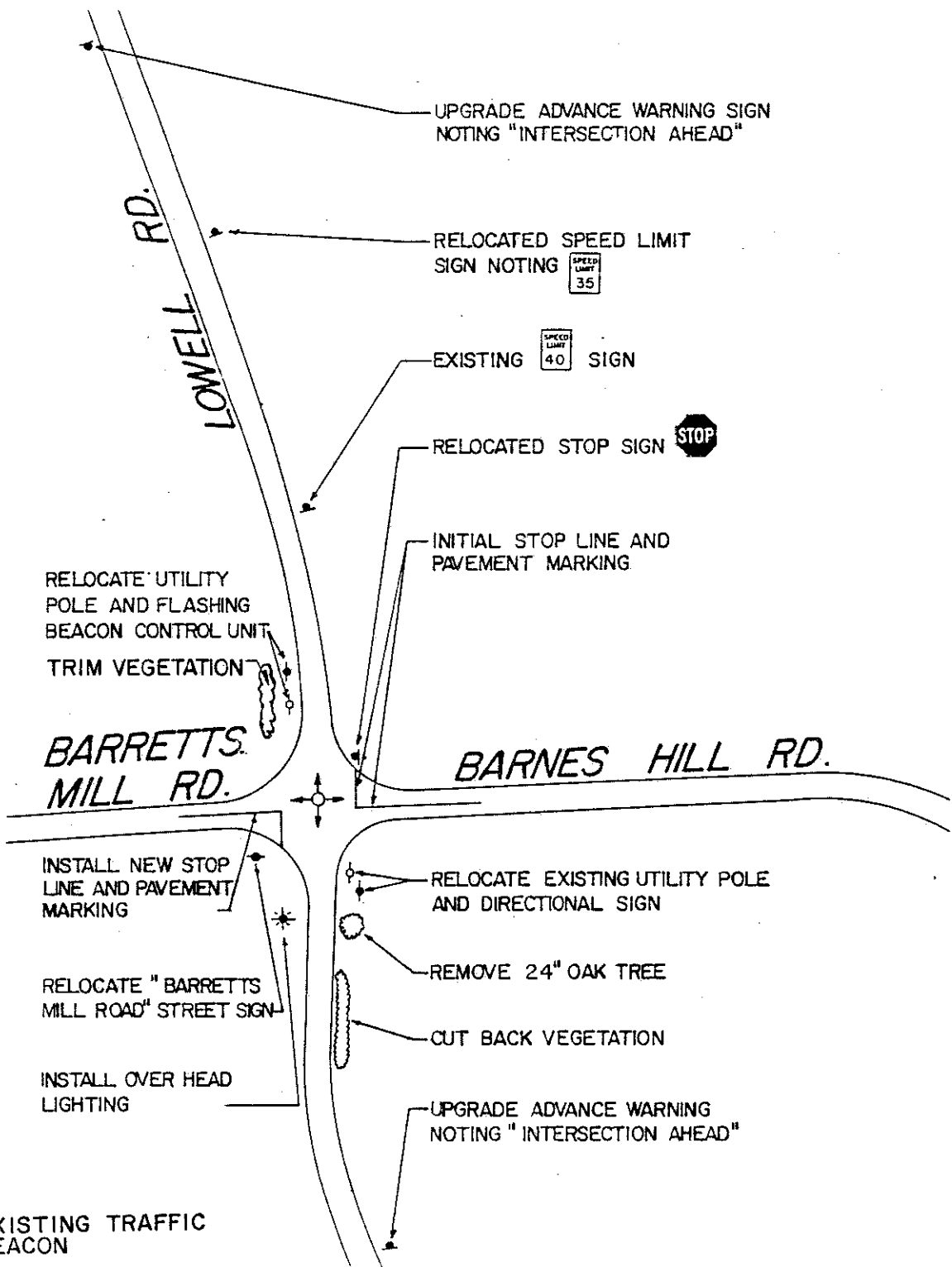
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Proposed Monument Square Improvements

Not to Scale



Location 2



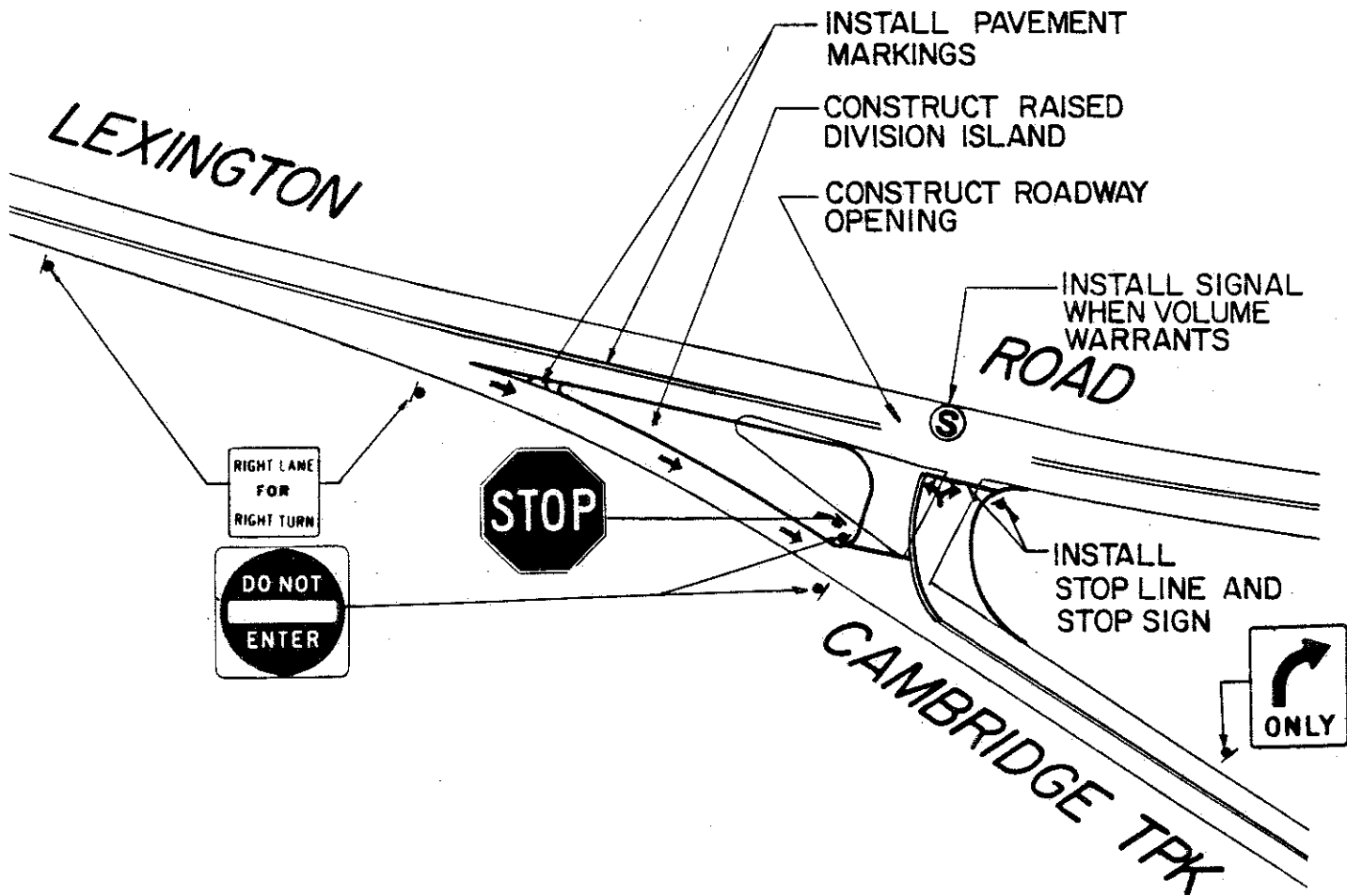
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Proposed Roadway Improvements

Not to Scale



Location 3



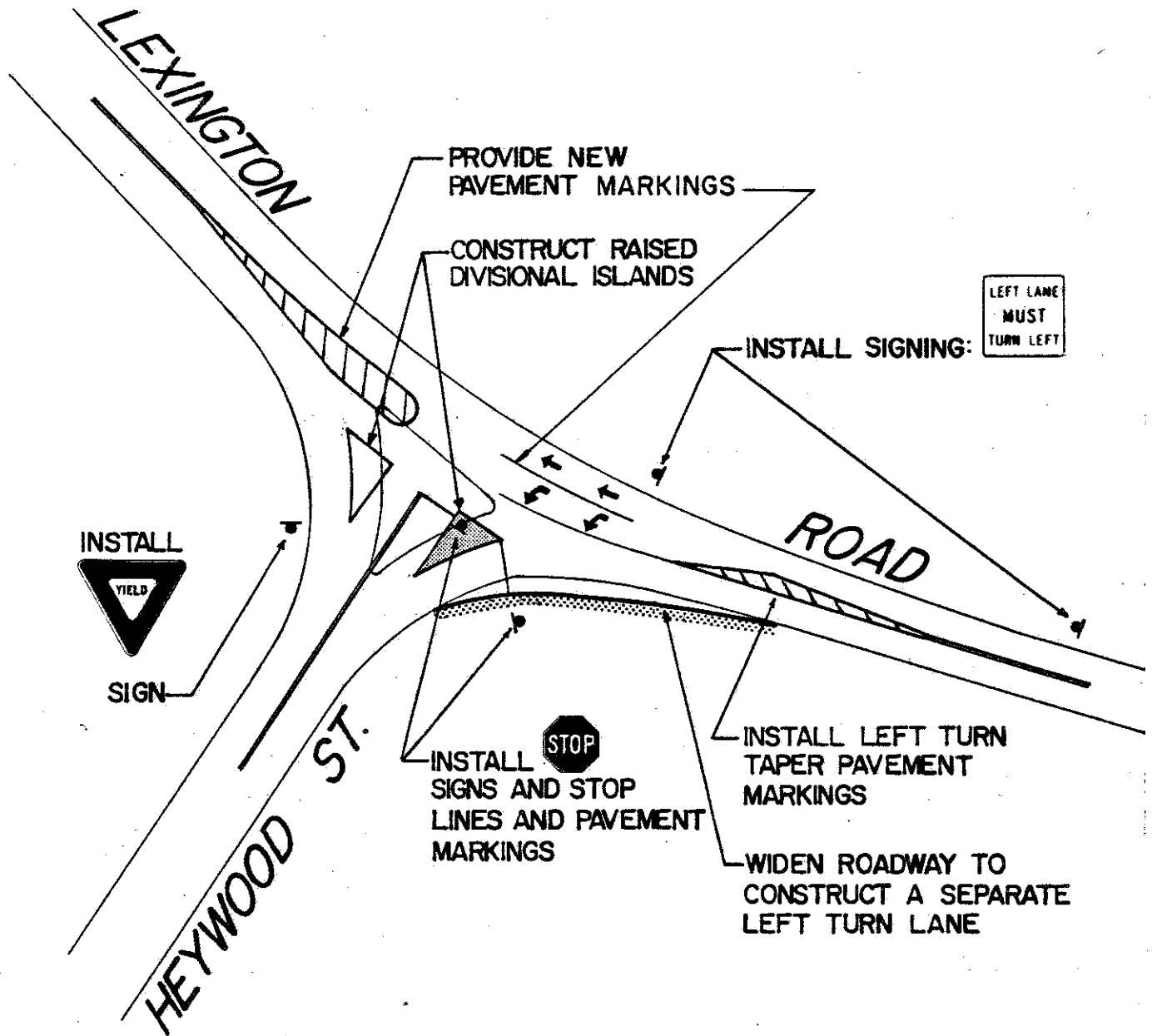
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Proposed Roadway Improvements

Not to Scale



Location 4



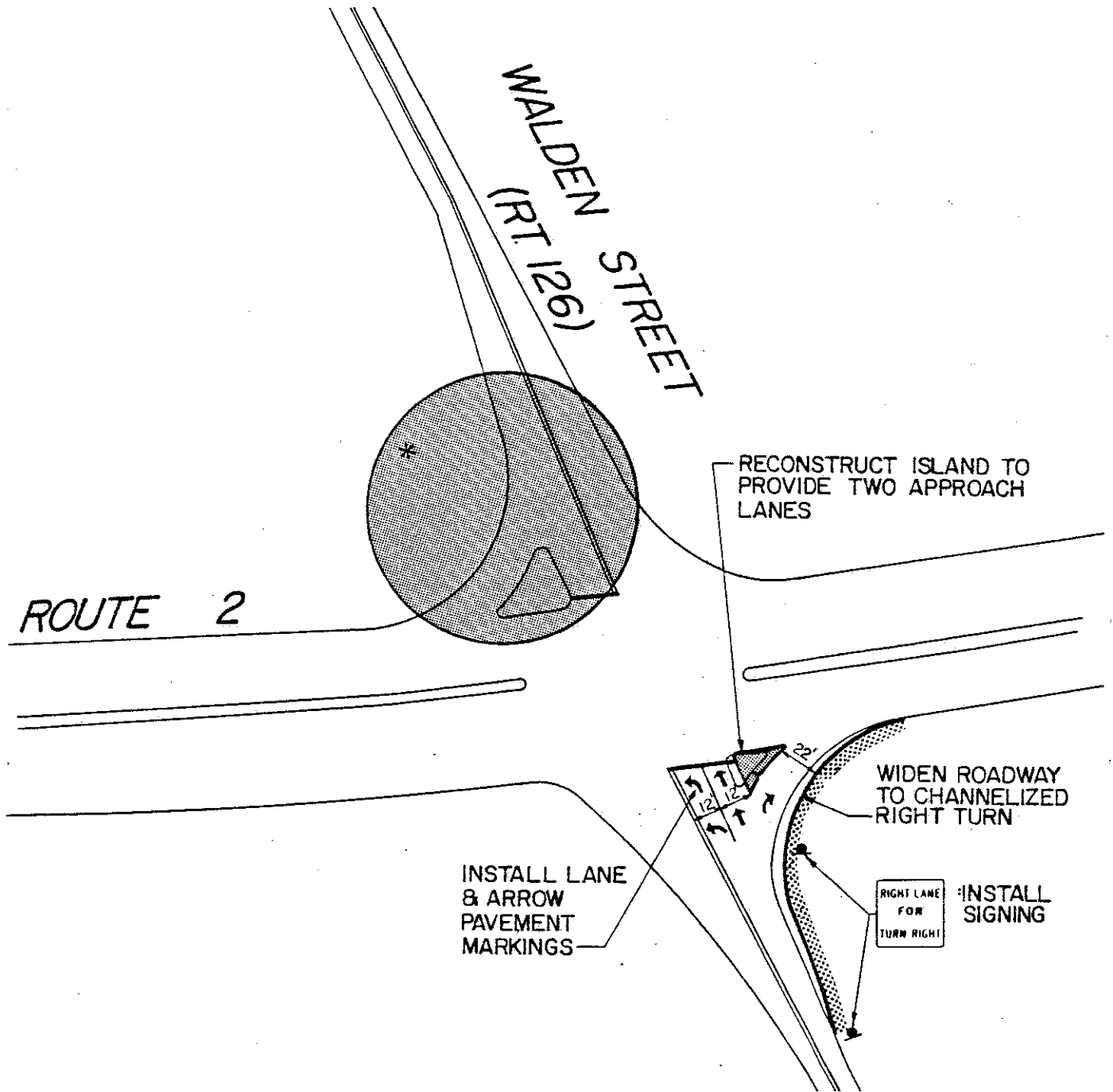
Proposed
Roadway
Improvements

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Not to Scale



Location 6



IMPROVEMENT BY
OTHERS

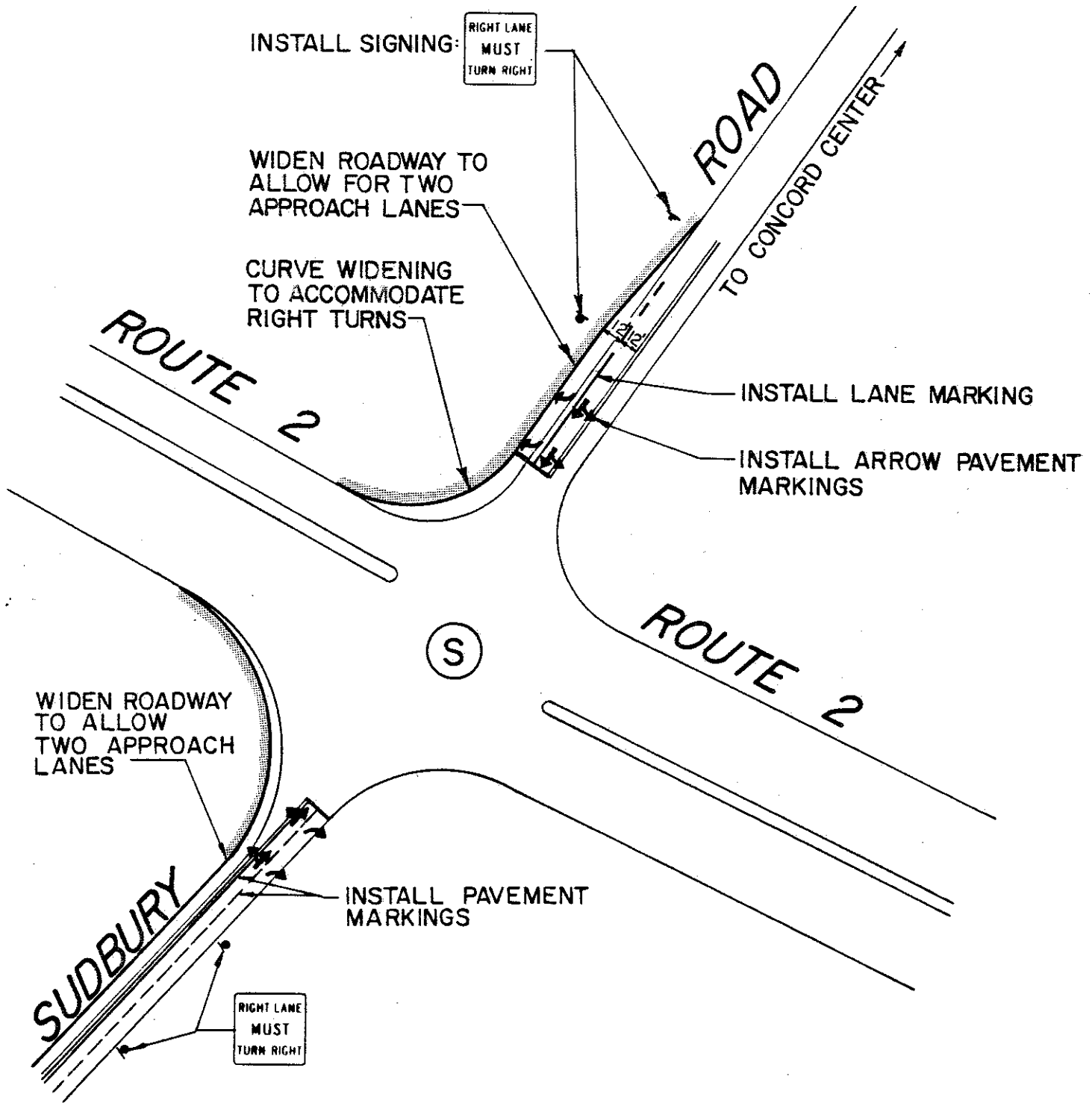
Proposed Roadway Improvements

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Not to Scale



Location 7



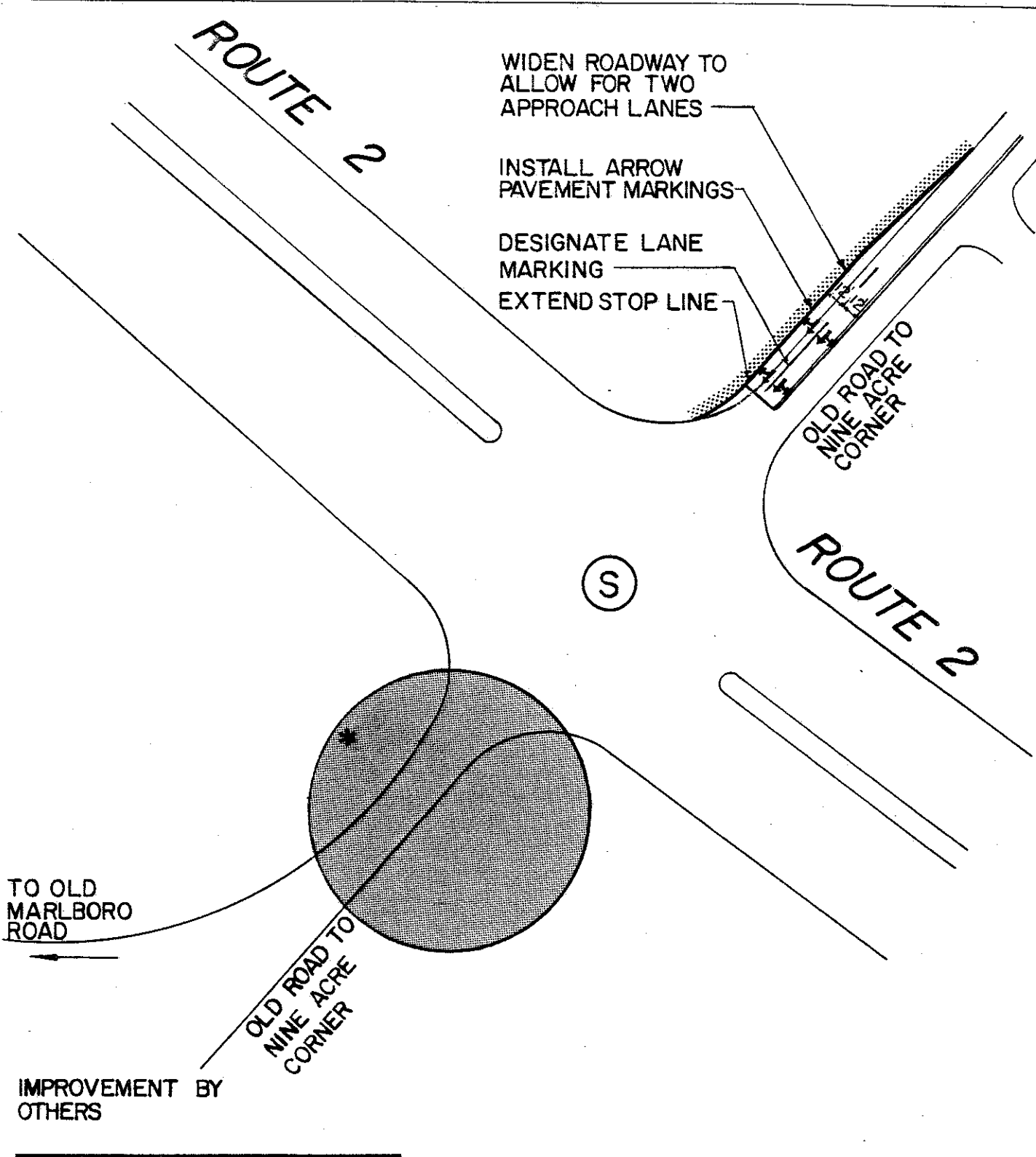
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Proposed Roadway Improvements

Not to Scale



Location 8



TO OLD
MARLBORO
ROAD

OLD ROAD TO
NINE ACRE
CORNER

IMPROVEMENT BY
OTHERS

WIDEN ROADWAY TO
ALLOW FOR TWO
APPROACH LANES

INSTALL ARROW
PAVEMENT MARKINGS

DESIGNATE LANE
MARKING

EXTEND STOP LINE

OLD ROAD TO
NINE ACRE
CORNER

ROUTE 2

(S)

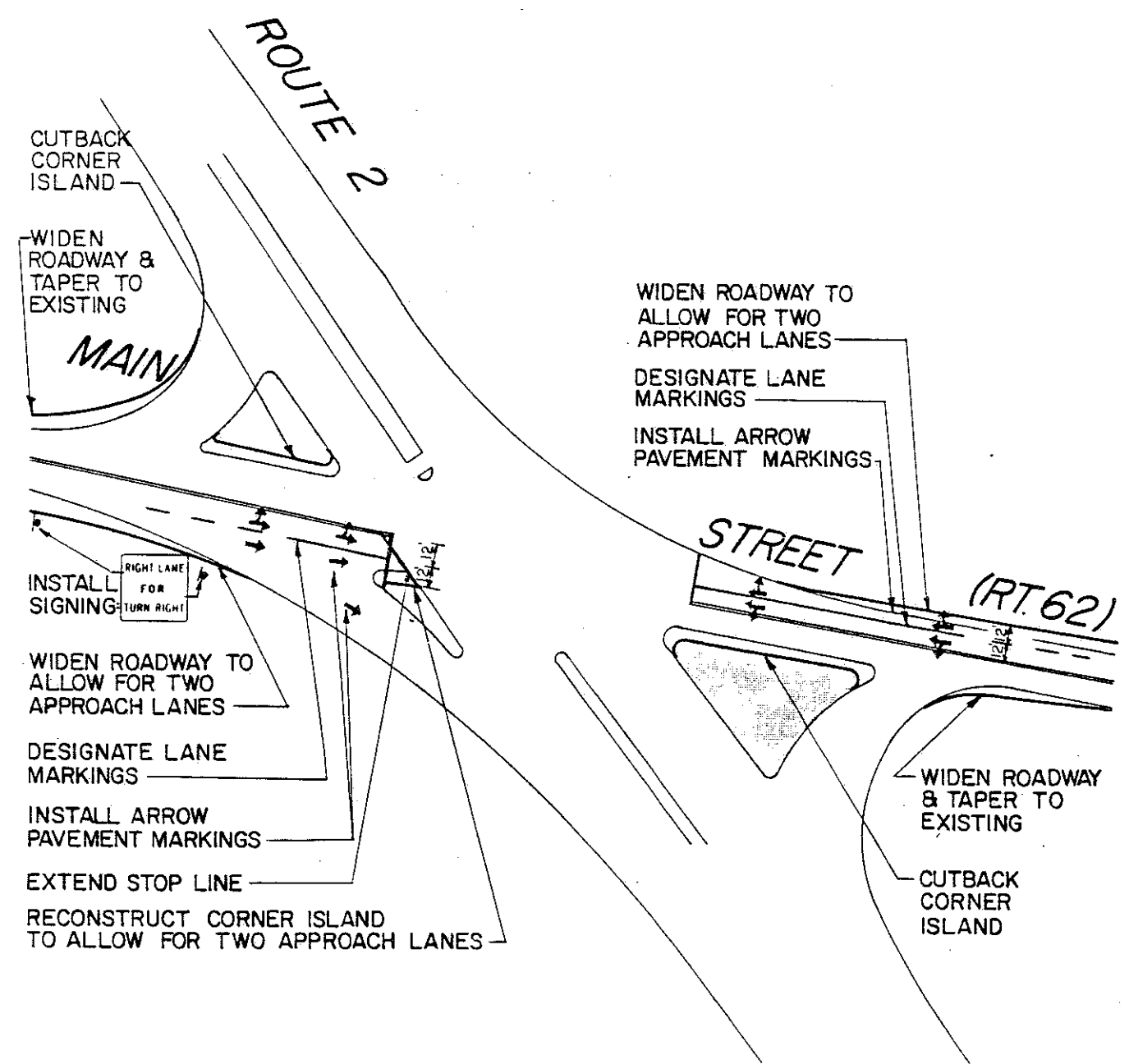
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Proposed Roadway Improvements

Not to Scale



Location 9



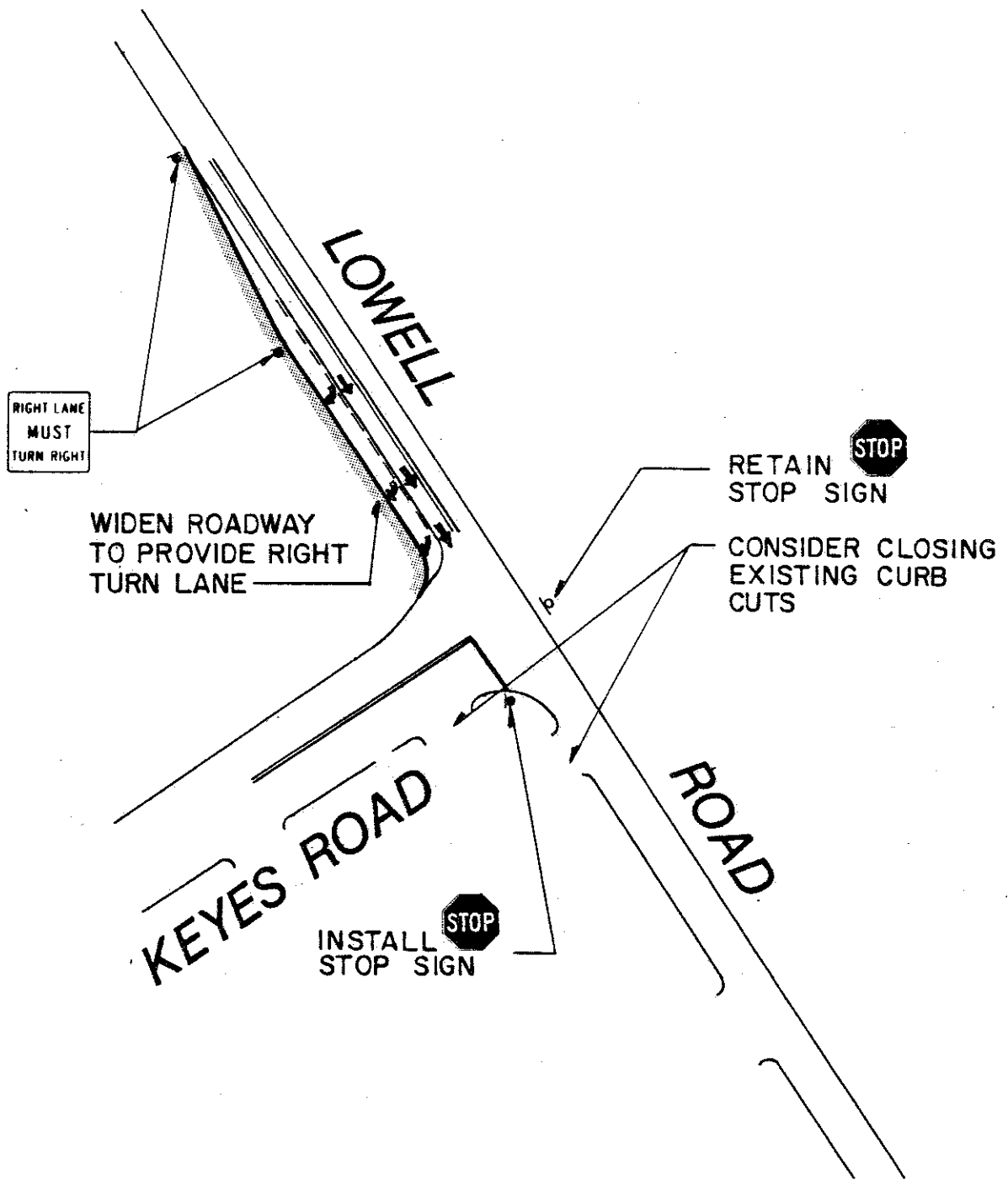
Proposed Roadway Improvements

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Not to Scale



Location 10



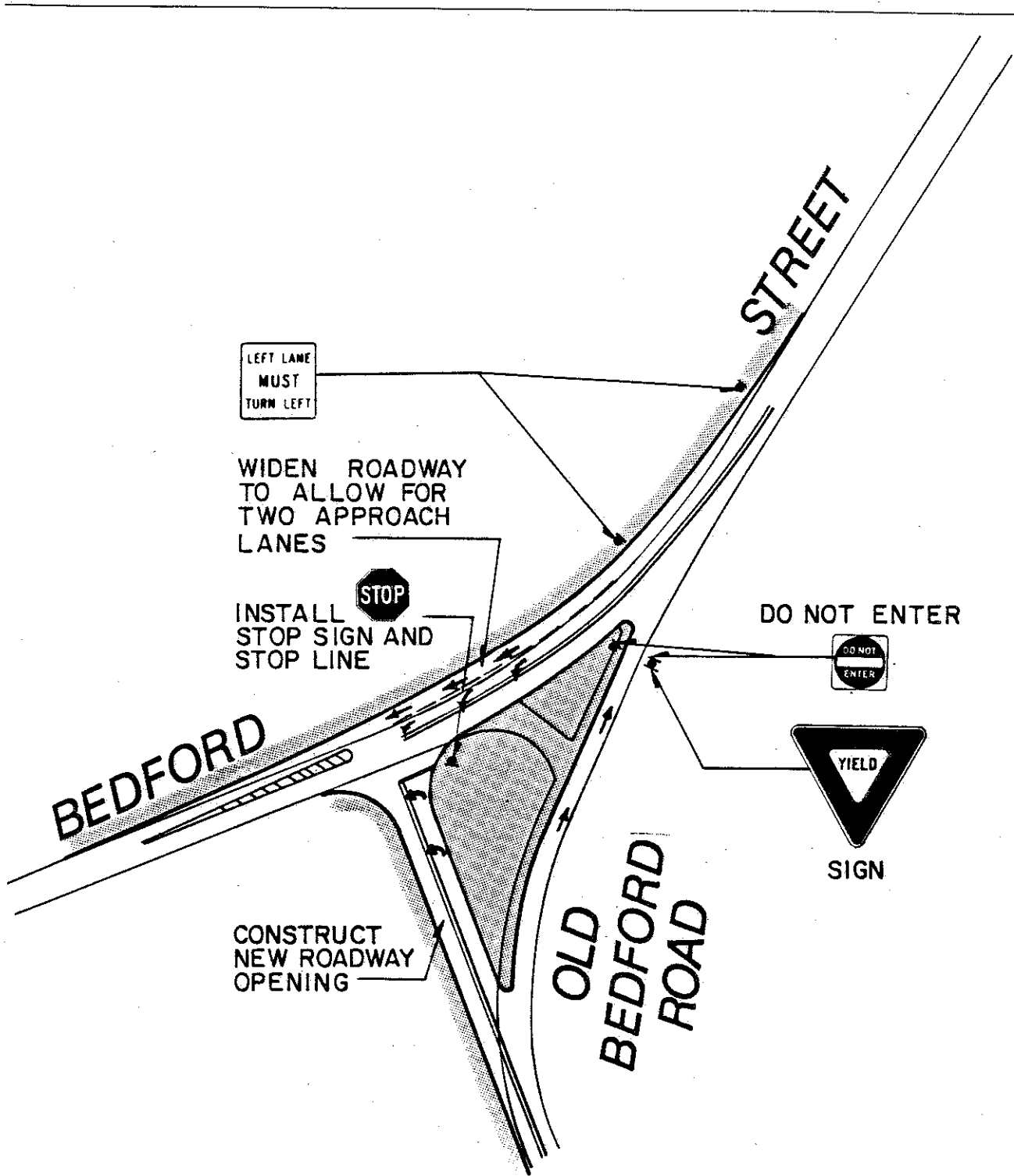
Proposed
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Not to Scale



Location 11



Proposed
Roadway
Improvements

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Not to Scale



Location 12