Coastal Zone Management Program

EAST LYME (TOWN OF)

Nuclear Energy Generation Impact Study

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Town of East Lyme

NUCLEAR ENERGY GENERATION IMPACT STUDY

FINAL REPORT

U.S. DEPARTMENT OF COMMERCE NOAA
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SUMMARY

This study investigates the social and economic impacts of the Millstone Nuclear Power Station, located in Waterford, CT, on the neighboring Town of East Lyme. Direct and indirect effects on population growth, housing, employment, and income are evaluated. Effects on the public sector in terms of the cost and quality of municipal services and the revenues available to support them are also analyzed. Lastly, consideration is given to potential environmental effects.

Private Sector Effects: The average daily workforce at the operational Millstone Units I and II is approximately 1,300, and some 3,750 workers are presently employed in the construction of Unit III. Following completion of Unit III in 1986, the construction workforce will disappear, but the average daily workforce involved in operations and maintenance will rise to approximately 1,860. This force will be supplemented by 1,100 temporary workers during refueling shutdowns.

It is estimated that 137 of the present permanent Millstone I and II employees reside in East Lyme. Including workers' families, Millstone I and II are responsible for an estimated 350 residents, or 2.5 percent of the Town's 1980 population. The majority of these families are believed to have located in East Lyme at the time of employment at Millstone and are thus in-migrants. Start-up of Millstone III will add an estimated 140 Millstone-related residents. Families of permanently-employed Millstone workers now residing in East Lyme have incomes equal to or above the Town-wide average and are thus likely to occupy housing similar in type and cost to the Town-wide averages. It is therefore concluded that the permanent Millstone workforce has not had (and will not have in the future) a significant impact on population growth or housing in East Lyme.

The Millstone III construction workforce is made up primarily of workers who were resident in the Southeastern Connecticut region prior to employment at Millstone and others who commute long distances from outside the region. The available evidence indicates that roughly 20 percent of the present peak workforce of 3,750 have temporarily relocated to the region. These transient workers are typically either unmarried or married but with families remaining at a permanent residence outside the region. The largest source of temporary housing for these workers in East Lyme is winter rental of beach community housing. No evidence was found to indicate that the housing demand created by Millstone construction workers has displaced permanent residents or affected the rate of apartment development in the Town.

The secondary economic effect of Millstone on East Lyme and the Southeastern Connecticut region was estimated through the use of employment and income multipliers. Primarily as a result of purchases of goods and services by Millstone employees, the power station is estimated to have created approximately 50 service-sector jobs and $4.4 million in additional annual income in East Lyme. Start-up of Millstone III will eventually create about 20 more secondary jobs and $1.8 million in annual income in the Town. However, a negative economic stimulus for East Lyme and other towns in the region is created by a competitive advantage granted the Town of Waterford: Millstone property tax payments allow Waterford to maintain property tax rates that are much lower than surrounding towns while simultaneously improving its infrastructure, thus encouraging business and industry to locate in Waterford.

Public Sector Effects: The study utilizes a fiscal impact methodology to determine whether the presence of Millstone results in increased costs to East Lyme in the provision of public services and whether these increased

costs are balanced by the receipt of additional revenues. The only identified service that East Lyme provides directly to the Millstone complex is the Town's participation in the regional radiological emergency preparedness system. The bulk of costs for planning, training, and equipment directly in support of radiological emergency preparedness are paid directly or reimbursed to the Town by either Northeast Utilities or the Federal Emergency Management Agency. However, the Town has received no assistance for establishment or operation of its Emergency Operations and Communications Center, which enhances the Town's capability for coping with all types of emergencies, including radiological.

The primary source of municipal costs resulting from Millstone is the provision of public services to resident Millstone employees and their families. Based on income data, the housing profile analysis, and the number of Millstone-related children enrolled in the East Lyme schools, it is concluded that permanent Millstone employees and their families pay property taxes to the Town that are in excess of the cost of providing municipal services to them and that they therefore represent a net financial benefit to the Town.

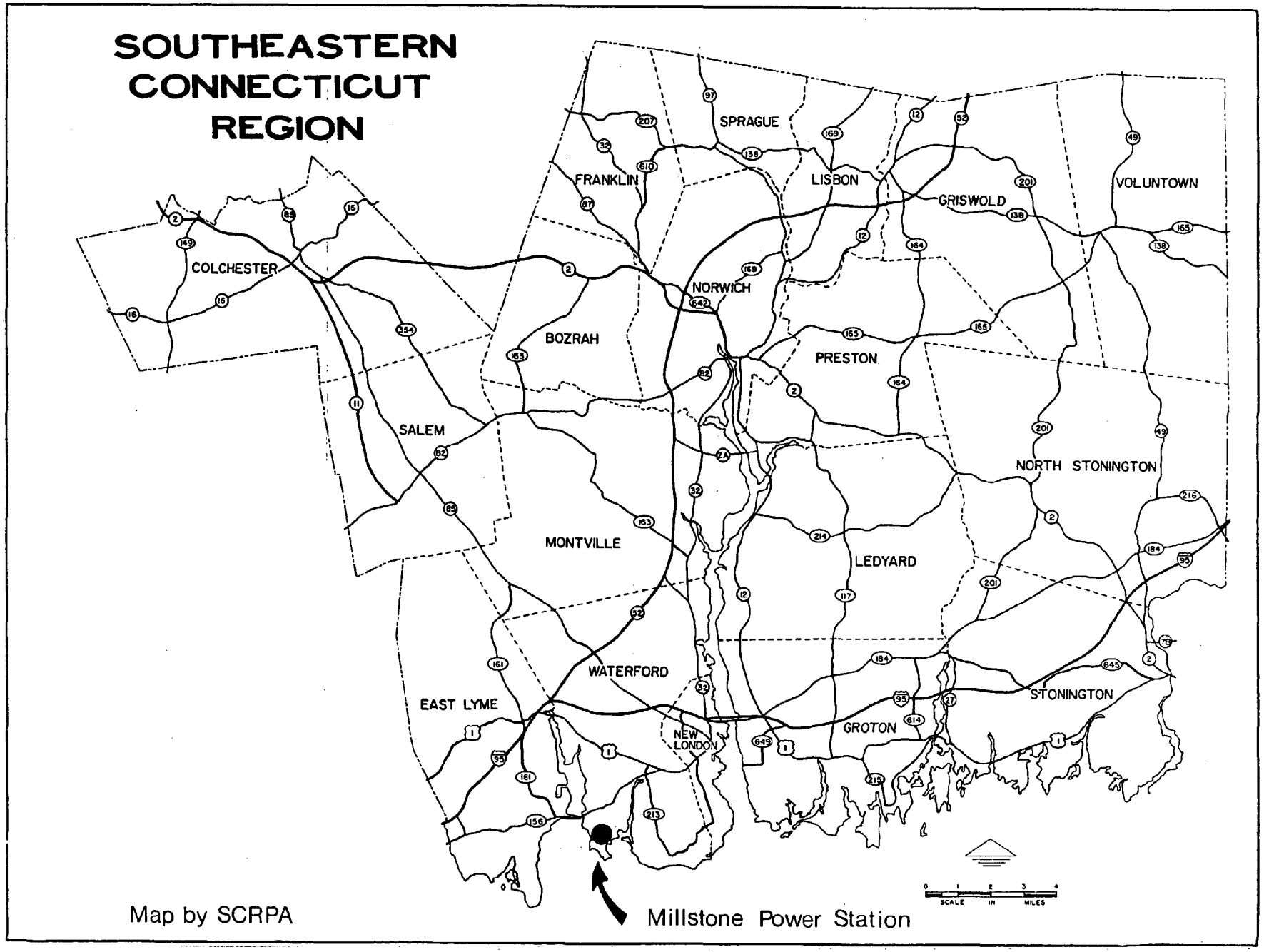
Municipal costs for services to resident construction workers and their families are estimated at roughly $300,000 per year, the majority of which is believed to be attributable to workers who are long-term residents of the Town. Transient workers who are residing temporarily in East Lyme while employed at Millstone III typically do not bring school-age children with them and therefore do not generate large municipal expenditures on an average per-worker basis. It was not possible to estimate the level of tax revenues attributable to construction workers, and thus the net financial effect on the Town of these residents is not known.

Public sector impacts may also be manifested in the form of additional demands on public facilities resulting in a deterioration in service quality. This is the case in regard to Millstone's effect on East Lyme's transportation system. Traffic is, by a wide margin, the most significant impact on the Town documented by this study. The traffic analysis demonstrates that serious congestion exists on Routes 156 and 161 during the morning and evening rush hours and finds that Millstone-generated traffic is a primary cause of this congestion, particularly in downtown Niantic. Identified problem areas include: the signalized intersections of Route 156 and Route 161, Route 161 and East Pattagansett/Roxbury Roads, and Route 161 and I-95; the commercial areas of Main Street/Pennsylvania Avenue and Route 161 south of I-95; and the use of Smith Avenue and connecting residential streets as through routes to avoid the Route 156/161 intersection. Substantial relief, particularly in downtown Niantic during the peak hours, will result from the removal of construction-related traffic with completion of Millstone III. However, the combined effects of general traffic growth and Millstone III operating personnel traffic will result in daily volumes by 1990 that are significantly higher than those experienced in 1981, prior to the Unit III construction workforce peak.

Therefore, a number of roadway and traffic control improvements are either necessary at the present time or will be needed by 1990 to accomodate projected traffic volumes. The highest priority improvement identified in the study is the upgrading of the Route156/Route 161 intersection in downtown Niantic. Improvements recommended at this location include the replacement of the existing signals with fully-actuated equipment and the widening of the last 200 feet of Route 161 to allow installation of an additional southbound lane into the intersection. The availability of dedicated southbound lanes for both left

and right turns together with signal equipment providing variable timing depending on the direction and volume of flow at various times of the day (rather than the present fixed timing), will substantially increase the capacity of this intersection. Other priority improvements include: reworking the internal circulation of the Niantic Village Shopping Center parking areas; construction of northbound left-turn lanes on Route 161 at East Pattagansett and Roxbury Roads; selective widening of Route 161 for installation of northbound left-turn lanes in areas with numerous commercial driveways; and roadway widening to 4 lanes on Route 161 between the eastbound and westbound access ramps to I-95, with associated signaling improvements.

Environmental Effects: Finally, the study reviews and characterizes existing research on the effects of Millstone in the areas of low-level radiation and the marine environment.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NEW LONDON
GROTON
STONINGTON
SCALE IN MILES
Map by SCRPA
Millstone Power Station

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INTRODUCTION

This study was carried out under contract to the Town of East Lyme, Connecticut utilizing funds granted to the Town by the Connecticut Office of Policy and Management under the Coastal Energy Impact Program of the U.S. Department of Commerce. The study objective is to investigate the socio-economic impacts of the Millstone Nuclear Power Station on East Lyme. The Millstone Nuclear Power Station consists of two reactors presently operating and a third under construction and scheduled to go into commercial operation in 1986. Millstone is located in the Town of Waterford, East Lyme's neighbor to the east.

Consistent with State law, the power station's owner, Northeast Utilities, pays all property taxes attributable to Millstone to the Town of Waterford; these payments represented just under 74 percent of Waterford's total local property tax revenues in 1982.

In accordance with the study scope, the primary hypotheses to be tested by this study are: (1) that East Lyme is, and will continue to be, subject to social, economic, and environmental impacts caused by the presence of the Millstone Power Station; and (2) that East Lyme is inequitably burdened by these impacts because the Town has not received additional revenues or other benefits to ameliorate them. To the extent that impacts are identified, the scope of work calls for recommendations as to how these impacts can be mitigated.

The organization of the study is such that the effects of Millstone on the private sector are investigated first, in such areas as population growth, housing, employment, and income. Section II evaluates impacts on the public sector, considering effects on the cost and quality of municipal services and the revenues available to sup-

port them. Finally, consideration is given to potential environmental effects in such areas as the marine environment and low-level radiation.

It should be noted that the analysis of traffic impacts and the recommendations for transportation facility improvements to mitigate those impacts was conducted under subcontract by Storch Engineers of Wethersfield, CT.

The Coastal Management Steering Committee, a group of volunteer East Lyme citizens appointed by the Selectmen, assisted in the study effort by reviewing and offering direction on the scope of the study, the decision to commit substantial study resources to investigation of traffic impacts, and the draft report. Administration of the grant contract was provided by First Selectman Richard Lougee. The members of the Steering Committee are:

Robert DeSanto
Barbara Brown
William Mountzoures
Christopher Mullaney
Elizabeth Murphy
Edward Neilan
F. Kent Sistare, Ex-Officio.

PRIVATE SECTOR EFFECTS

Virtually all of the private-sector and public-sector effects of the Millstone complex on East Lyme derive, either directly or indirectly, from the facility's workforce. The place of residence and family composition of these workers determine population impacts and effects on the cost of municipal services. These factors plus level of income and term of employment affect the local housing market and the retail and service economy. The number of employees and their journey to work patterns alter traffic levels on local roadways, potentially affecting the adequacy of transportation facilities.

I.A. Facility Employment

The Millstone workforce may be divided into 4 distinct categories: permanent, temporary (non-outage), temporary (outage), and construction. The number of workers in each of these categories presently employed at Millstone is shown in Table 1, as are the corresponding levels for the post-1986 period (when construction of Unit III has ended and the unit is in operation). Permanent personnel are those Northeast Utilities employees assigned to Millstone on a long-term basis. The majority of these workers are operations personnel, involved with the day-to-day operation and maintenance of the generating stations. This group presently numbers 532 and will rise to 930 as Unit III is brought on line. "Other NUSCO" are permanent Northeast Utilities employees assigned to such non-operational functions as production test, ongoing facility upgrading (betterment), training, and the environmental lab. In the case of current employment, this group also includes NUSCO personnel who are presently supervising Millstone III construction activity but will remain assigned to Unit III after start-up. This accounts for the fact that the size of the group will fall from the present 335 to 277

Table 1: Current and Projected Post-1986 Employment:

Millstone Nuclear Power Station

	1983	Post-1986
Permanently Assigned Personnel		
Operations	532	930
Other NUSCO	335	277
	867	1,207
Temporary Personnel (Non-Outage)	435	653
Average Daily Workforce (Non-Outage)	1,302	1,860
Temporary Personnel (Outage)	1,100	1,100
Average Daily Workforce (Single Outage)	2,402	2,960
Worst-Case Daily Workforce (Dual Outages)		4,010
Construction	3,750	0

Source: Northeast Utilities (January, 1983)

people after 1986.

The "temporary (non-outage)" category consists primarily of employees of firms contracted by NUSCO for specific betterment projects and for site security. In addition, there are a limited number of NUSCO employees on temporary assignment at Millstone at any time. The number of workers indicated in Table 1 (435 in 1983, 653 in 1986) is representative of the size of the temporary workforce at the site during periods when all units are operating. Therefore, the average daily workforce during such periods is 1,302 at present and will be 1,860 after completion of Millstone III.

During periodic refueling outages, an additional labor force of 1,100 workers are needed per unit. Refueling of each unit must be carried out at roughly 21 month intervals and generally requires 8-10 weeks to complete. (Inspections undertaken while the unit is out of operation may reveal additional work to be done; in these cases, the shutdown period may be extended.) Thus, as can be seen in Figure 1, a scheduled outage will be in effect approximately 40 percent of the time after 1986, and during these outages, the average daily workforce will expand to 2,960. Unscheduled outages can also occur; historically, Units I and II have experienced approximately 2 unscheduled outages per year. Generally, these shutdowns are of short duration and involve a relatively small additional workforce. Finally, it is conceivable that 2 of the 3 units could be out of service for refueling simultaneously. Under this worst-case situation, an estimated 4,010 persons could be working at the site.

The fourth Millstone employment category consists of construction workers involved in the building of Unit III. The construction workforce presently numbers 3,750; it will gradually diminish to approximately 400 as the plant nears completion in 1986 and to zero by the end of the first year of operation.

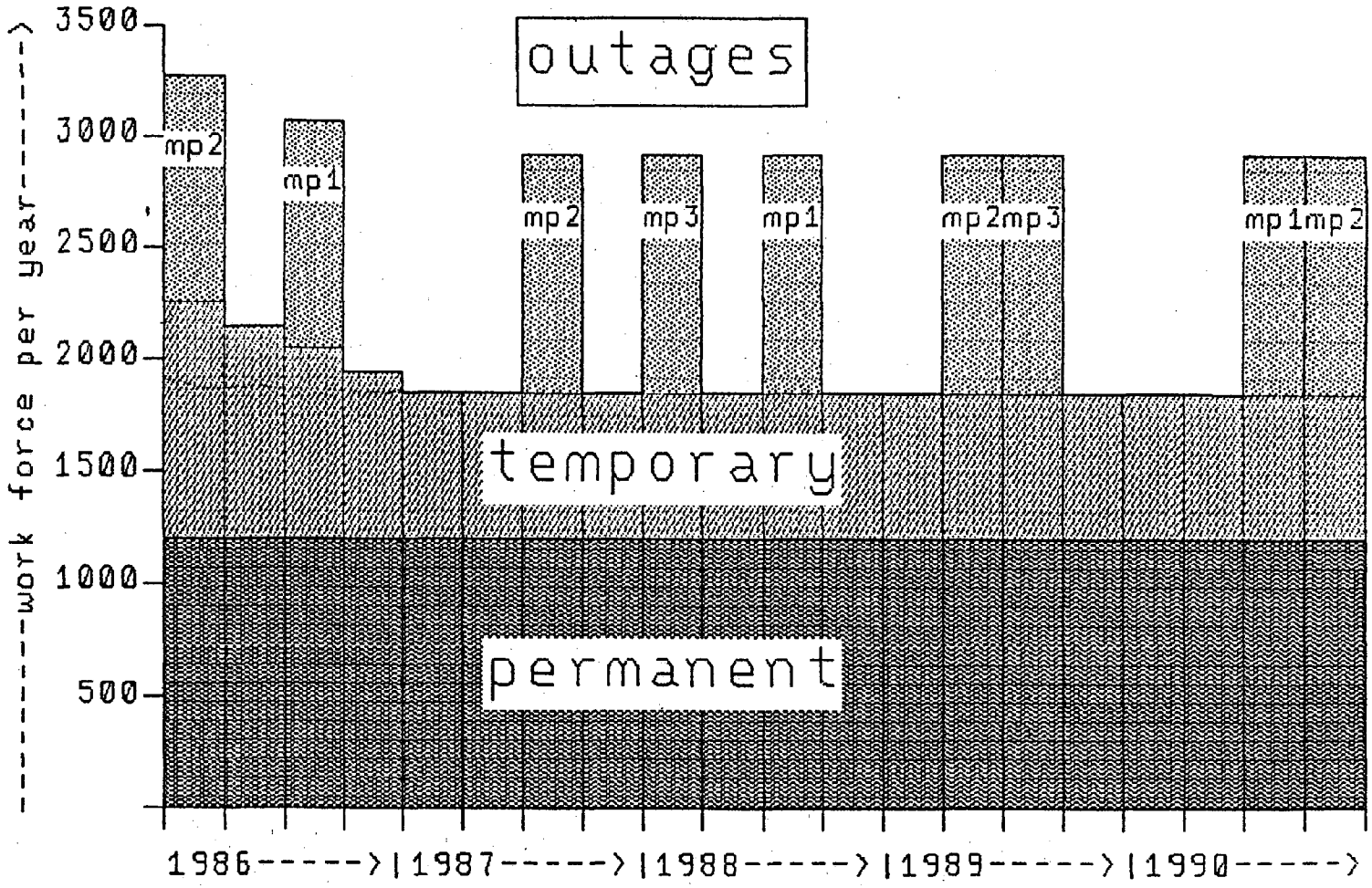


Figure 1. Anticipated fuel outage schedule and workforce at Millstone Point after 1986.

I.B. Demographic Effects

The effects of Millstone on East Lyme's population are a function of the number of Millstone workers in each of the 4 workforce categories who now reside or will reside in the Town, and the family composition of those workers. Also, a number of these workers may have been residents of the Town prior to being employed at Millstone; only workers and their families moving to East Lyme upon employment at Millstone will cause population increase. The level of this in-migration varies dramatically between the 4 workforce categories because of the unique characteristics of each in such factors as: length of employment, housing preference (and the location of housing meeting such preferences), willingness to commute long distances, and the degree to which the regional workforce can satisfy Millstone's particular skill and experience requirements.

Permanent Workforce: Permanent employees can be expected to reside predominantly within a commuting range of 30 minutes (15-20 miles) with higher concentrations in the towns immediately surrounding the facility. A Northeast Utilities survey of the current operations staff at Millstone found 84 persons residing in East Lyme out of a total complement of 532. Factoring this sample up to include other permanent employees, the total number of permanently-assigned Millstone workers living in East Lyme is estimated at 137. Based on 1980 Census averages for the marital status and family composition of East Lyme's over-18 population, as modified by age profile and school enrollment data specific to Millstone-employee families (see Section II-B), it is estimated that permanent Millstone employees and their families residing in East Lyme number approximately 350 people, or 2.5 percent of the Town's 1980 population. Data is not available to document what proportion of these people are in-migrants and therefore represent Millstone-induced population growth. It seems reasonable to assume that the majority of engineers

Table 2: Estimated Direct Population Impact on East Lyme of Permanent Millstone Employees

	Prior to 1983	1983 to 1986
Number of Employees Residing in East Lyme	137	191
Family Members of Employees	213	299
TOTAL	350	490
In-Migrants (.75 rate assumed)	263	368
East Lyme Total Population (1980, projected 1990)*	13,870	14,860

* Sources: 1980 U.S. Census
1990 Projection by Southeastern Connecticut Regional Planning Agency

and technicians (and their families) are in-migrants since the skills required are not readily available and the nuclear power industry's primary recruitment sources seem to be experienced personnel from nuclear plants elsewhere in the country and ex-Navy personnel with experience in nuclear ships and submarines. Requirements for more common work skills such as clerical and building maintenance workers, on the other hand, are more likely to have been filled by existing residents. One measure of the scale of Millstone's impact on the population of East Lyme may be derived by assuming that as many as 75 percent of all present Millstone employees are in-migrants. At this rate, Millstone-induced in-migration would have constituted less than 10 percent of the population growth experienced by the Town in the 1970-1980 decade. Thus it can be concluded that, although Millstone has contributed to East Lyme's rapid population growth, that contribution has been modest in both absolute and relative terms.

Start-up of Unit III will add 340 permanent employees to the Millstone workforce. If the proportion of these employees choosing to reside in East Lyme and their family composition follows past experience, the Town would gain an additional 140 Millstone-related residents. Again assuming a 75 percent in-migration rate, this would translate to 105 persons, or 10 percent of the Southeastern Connecticut Regional Planning Agency's 1980-1990 population growth projection for East Lyme.

Construction Workforce: Construction workers are much less likely to relocate to East Lyme and other communities surrounding Millstone than are permanent employees. A large number of case studies on the local effects of powerplant construction (including nuclear plants) have documented that the rate of construction-worker migration to the region surrounding the work site depends primarily on the location of the plant in relation to population centers, the avail-

ability of the required skills in the regional workforce, and the willingness of construction workers to commute long distances.[1] The availability and cost of housing near the site has a lesser effect on the rate of migration to the region but is critical in determining where in the region the in-migrants elect to live.

Construction of a nuclear powerplant may last from 5 to over 10 years. However, shifts are taking place throughout this period in the mix of crafts needed in the workforce. Therefore, individual workers are not likely to be employed over the entire construction term. Additionally in the case of Millstone III, management decisions related to financing and demand factors have resulted in wide swings in workforce levels, reinforcing the short-term nature of the construction employment. From a level of about 1,300 late in 1979, the Unit III workforce was cut to half that number in 1980 as the completion date was put back to 1986. Through 1981 employment was around the 1,000 level, then rose to over 2,500 in the fall of 1982, and reached its 3,750 peak in 1983. Because of this short-term employment outlook, construction workers will tolerate commuting distances up to 60 miles or 1½ hours one-way rather than relocate closer to the job site; this is particularly true of workers with families. This willingness to commute long distances increases the size of the region from which workers can be drawn; in the case of Millstone, it brings the site within commuting range of the Hartford, New Haven, and Providence metropolitan areas. Another factor limiting in-migration is the presence of an indigenous labor force with experience in nuclear powerplant construction developed in the building of Units I and II. Finally, hiring practices assure that jobs are made available first to members of the union locals within whose territory the site lies. The majority of crafts needed for construction of Millstone III are represented by union halls in Groton, New London, and Norwich, with the

remainder located in New Haven or Hartford. Only when the labor pools of these locals and affiliated locals elsewhere in the State are exhausted will jobs be made available to workers in other states.

Past studies of powerplant construction at locations near metropolitan areas or locations possessing an indigenous workforce with applicable experience, have estimated in-migration at 5-20 percent of the total workforce.[2] The available evidence indicates that the upper end of this range would hold true in the case of Millstone III at the present employment peak. A post-construction study commissioned by the Nuclear Regulatory Commission found that little in-migration took place during the construction of Millstone Units I and II because the state labor unions were generally able to fulfill the contractor's labor requirements.[3] However, since Millstone III is a larger plant presently working on an accelerated completion schedule, the present Unit III construction force is at least 1,000 workers larger than either the Unit I or II peak. Northeast Utilities acknowledges that, at times during the construction of Unit III, the number of workers required has exceeded the capacity of the local unions, Counts taken in March 1983 at the Millstone access road at the end of the day shift also suggest an approximate 20 percent in-migration rate. These counts revealed that 81 percent of the workers departed in vehicles with Connecticut plates. Some of the 19 percent in out-of-state vehicles were no doubt commuters (in particular, 4 busloads of commuters from the Providence,RI area), but these may well be balanced by riders in Connecticut-licensed cars who have temporarily relocated from the western part of the state.

As pointed out above, in-migrant construction workers will be distributed throughout the region of the work site; they will choose a place of residence primarily on the basis of proximity to the site and the cost and availability of

suitable quarters. Therefore the population impact of Millstone construction on East Lyme will depend on housing factors (discussed in Section I.C below) and on the family composition of the in-migrants. Based on interviews with local real estate agents, as well as supporting evidence on school enrollments of construction worker children (Section II.B), it is clear that the great majority of in-migrant construction workers are not moving in with families, and that they intend to live in the area only until their employment at Millstone ends. These workers are either unmarried or (more typically) are men with families who have stayed home at a permanent residence while the worker temporarily relocates closer to the job site. These latter workers often maintain a permanent residence within weekend commuting distance and are thus resident in East Lyme only 5 days per week. From the available indicators, a rough estimate of the total number of Millstone construction workers who are temporarily residing in East Lyme would be in the range of 250 to 350. The total Millstone III-related population in East Lyme also includes workers and their families who were resident in the Town prior to being employed at Millstone. These workers, being permanent residents, are likely to be married and to have average family sizes roughly equivalent to Town-wide averages. Again utilizing data on the level of school enrollment by children of Millstone construction workers, the total number of Millstone contruction-related residents (temporary and permanent) may be estimated to range from 750 to 850.

Temporary Workforce: The final 2 worker categories, non-outage and outage-period temporary workers, have no permanent effect on East Lyme's population. The great majority of these workers are employees of contractors brought in to perform specific short-term construction or maintenance tasks. The time needed to complete these tasks (for instance, 2 to 3 months for a refueling shutdown) is much

too short to justify relocation. Furthermore, without the drain on the regional worker pool caused by Millstone III's labor requirements, the trade unions are capable of satisfying temporary craft labor needs entirely with Connecticut-resident workers.

I.C Housing Effects

Millstone employees and their families moving to East Lyme, either permanently or temporarily, will of course require housing. The issues of concern for this study are whether the resultant increase in housing demand affects the cost or availability of housing by driving up rents, increasing the pace of residential development, or altering the type of housing being constructed. The housing choices of Millstone workers moving to East Lyme are a function of 3 factors: (1) the permanent or temporary nature of their employment; (2) the availability of housing fitting their needs within the existing housing stock; and (3) income levels.

Permanent Workforce: Permanent employees should display the same housing preferences as the general population; that is, they would tend to be purchasers of single-family housing to the extent allowed by their income level. Those unable to afford their own homes would be long-term renters of apartments and houses. Given this preference as to housing type, the choice of a location will typically result from a balancing of: cost (that is, price differentials for equivalent housing among the towns in the region), accessibility (primarily to the workplace), and locational amenities (such as being near the ocean or the perception of a quality school system). For this study, cost alone is considered an adequate indicator of all 3 factors because: (1) locational amenities can be assumed to be reflected in sales prices and rents; (2) East Lyme housing costs should already reflect a premium for workplace proximity because

of the Town's accessibility to the region's employment centers in New London and Groton. Therefore, housing choice in this case should be driven directly by income.

East Lyme's housing costs are the highest in the Southeastern Connecticut region. The 1980 Census documented a median value for owner-occupied dwellings of $64,500 compared to a regional median of $53,900. Twenty-two percent of these houses were valued at $80,000 or more in 1980 vs. a regional percentage of 12.6 percent. Rents were also the region's highest at a $264 median compared to $211 for the region as a whole. Not surprisingly, East Lyme also has the Southeastern Connecticut region's highest income levels. Median income in East Lyme was $25,446 per family in 1979; it is estimated that this figure has risen to $33,350 by mid-1983. (This estimate was obtained by inflating the 1979 figure by 7 percent per year, compounded. This yielded a 4-year total increase of 31 percent, slightly below the 35 percent rise in the Consumer Price Index over the same period.)

To enable a comparison of these Town-wide income levels with those of Millstone-related families, Northeast Utilities provided income data for the 867 permanent workers presently employed at Millstone. As of March 1983, the median income of these workers was $26,663. It is necessary to convert this income-per-employee figure into income per family for comparability with the Town-wide median family income figure. This conversion consists of estimating the number of Millstone-related families with more than one wage-earner and adding the estimated income of these additional wage-earners to the Millstone-derived income. Based on Census data for New London County and discounting families without any workers (e.g. retirees), 37 percent of all families have one wage-earner and 63 percent have two or more. Women in the workforce (full and part time) earned, on average, 35 percent of the income earned by men. If it

is assumed for the purpose of estimation that all Millstone employees are men and are the primary wage-earners in their families, an estimated median family income for Millstone-related families of $32,573 is derived, compared to the estimated Town-wide median of $33,350. This is considered a conservative estimate for the following reasons: (1) the calculation does not account for any Millstone-related families who may have more than 2 wage-earners; (2) some of the Millstone workers (e.g. clerical personnel) are likely not to be the highest wage-earner in their families; and (3) the estimate assumes that the incomes of Millstone-related families residing in East Lyme are no different from the median for all Millstone-related families; however, it is likely given the cost of housing in East Lyme that the East Lyme residents' incomes are generally above the median. Thus it can be conservatively estimated that there is no significant difference in income between the Millstone-related families living in East Lyme and the Town-wide average, and it is likely that the Millstone-related families have higher than average incomes.

Since, as noted above, housing choice is related directly to income, it is expected that the housing occupied by permanent Millstone employees is similar in type and cost to the Town-wide averages with slightly more than three-quarters owning their own homes and the remainder renting. (Millstone workers may display a slightly higher rate of rentals because the Millstone workforce is somewhat younger than the average head-of-household age for the Town.) Second, it should be recalled that the number of dwelling units occupied by Millstone-related families is small, representing only 7 percent of the new dwelling units developed in East Lyme in the 1970-1980 decade. Therefore, it is concluded that the permanent Millstone workforce has had no significant impact on the pace of residential development, the mix of housing types, or the cost of housing in East

Lyme. Nor should the addition of an estimated 54 more families leading up to the Unit III start-up date cause any significant future impact.

Construction Workforce: Determining the effect of Unit III construction workers on housing in East Lyme is difficult because estimation of the number of construction workers relocating to the Town is subject to error. As discussed in Section I.B, this derives from the dual uncertainties as to the level of in-migration to the region and the distribution of this in-migration among the towns in the region. Therefore the analysis is based upon evaluation of the available data on rental housing stock in East Lyme and regionally, supplemented by information provided by realtors and rental agents.

In 1980 there were a total of 1,177 rental units in East Lyme; 691 of these were in multi-family structures and the remainder were single-family houses. The percentage of rental units to total occupied dwellings was 23 percent, slightly less than the average for Southeastern Connecticut region suburban towns but well below the 38 percent figure for the region as a whole. Further, the number of rental units in East Lyme was only 6.7 percent of the total available in a selected group of towns nearest Millstone (East Lyme, Groton, Montville, New London, and Waterford). Finally, only 64 units were vacant and for rent in the spring of 1980, a time when Millstone III employment was under 1,000. This vacancy rate of 4 percent is very close to a fully-occupied condition, since normal turnover typically accounts for a 3 percent vacancy rate in rentals. The 64 vacant units in East Lyme compared to a total of 995 vacancies among the 5 selected towns. Therefore the rental housing stock in East Lyme prior to the Millstone III construction workforce build-up could be characterized as small on a regional basis and almost fully occupied. In short, the data indicate little capacity to accomodate a influx of workers seeking temporary

housing. As will be seen however, a unique aspect of East Lyme's rental housing stock has allowed a greater number of Millstone III workers to find housing in the Town than would be suggested solely by the Census data.

Interviews with realtors and rental agents indicate that the great majority of Millstone construction workers are seeking "bachelor" quarters, often with one or more roommates. Whether unmarried, or married with a family remaining at a permanent residence elsewhere, they require temporary housing and intend to move on to another construction site when their (often indeterminant) period of employment at Millstone ends. Although earning high wages and often sharing rent with roommates, their rental budgets are, in the majority of cases, limited by the need to maintain their permanent family residence.

Realtors in East Lyme report that they usually have no rental vacancies available for Millstone workers, particularly since the staffing-up began over a year ago. A major owner-operator of large apartment complexes in a number of area towns is able to accomodate only a small percentage of Millstone applicants; they report 50 to 100 Millstone workers living in their buildings on short-term leases. Realtors express the belief that, having filled the limited available rental space in the towns surrounding Millstone, workers are looking farther afield, to Norwich and beyond. In addition to rental apartments and houses, costruction workers utilize rooming houses and residential hotels; motels, however, are apparently not patronized heavily because of high cost and lack of cooking facilities. Use of travel trailers and RVs in recreational trailer camps is not uncommon, especially in the milder seasons.

All this would suggest a very limited number of Millstone construction workers renting in East Lyme. However, East Lyme is unusual among area towns in having a substantial stock of beach community homes that are rented on a

seasonal basis. These houses are rented on an 8-to-10 month term through the winter months and are then either occupied by their owners or re-rented to another party at much higher rates through the summer season. The primary rental agent for these houses estimates that there are approximately 200 such properties in the beach communities and that a substantial number are rented to Millstone III workers; he estimates 200 workers are housed in this manner. Up to 3 or 4 workers share one house at an average rent of $450 plus utilities. However since they cannot afford the summer rates, occupancy by Millstone workers drops to near zero in the summer, and other accomodations must be found. It is on the basis of these beach area rentals, plus limited space in residential hotels, rooming houses, and apartments, that the prior estimated range of 250 to 350 for transient Millstone construction workers living in East Lyme is made.

There is no evidence that the in-migration of Millstone construction workers has displaced prior permanent residents or that the housing demand created by them has affected the rate of apartment development in the Town. For any significant displacement to take place, Millstone workers would have to be competing for the same housing units occupied by permanent residents. As was discussed above, there was virtually no slack in the East Lyme rental market even before the major Millstone workforce build-up. Therefore, rents should have already reflected an undersupply of rental housing. Further, landlords would not be expected to increase rents markedly in order to replace long-term tenants with Millstone workers because they would face much higher turnover rates as well as the risk of a major cut in the Millstone workforce. Second, Millstone workers are renting temporary housing (such as winter beach houses and rooming houses) that would not be considered suitable by long-term residents. These units would either be rented to other transients seeking short-term accomodations or would remain vacant

if the Millstone-generated housing demand were not present. (It is significant in terms of temporary population effects and related municipal costs to note that the East Lyme beach community off-season rental units have apparently been consistently fully rented over recent years, irrespective of Millstone construction workforce levels. One rental agent indicated that there are always more applicants for temporary housing in the Town than rental units available. He attributes this to construction, training, and other activities related to the Navy Submarine Base and Electric Boat in Groton.) As to the potential for stimulating increased apartment development, building permits issued in the Town over the past 5 years show no such response. This is not unexpected given the short-term nature of the employment increase associated with the Unit III construction and the general awareness of this fact among developers.

Temporary Workforce: Consistent with the location characteristics discussed in Section I.B, non-outage and outage period temporary employees would not be expected to have any effect on housing in East Lyme. As noted, union locals will be able to supply all labor requirements for refueling, backfits, and major maintenance subsequent to Unit III start-up. Refueling outages occuring during the Unit III construction peak will cause temporary relocation to the region because Unit III construction needs have depleted the regional labor supply. However, it is doubtful that any significant number of these refueling personnel are able to find housing in East Lyme because Unit III workers have exhausted the supply.

I.D. Secondary Employment and Income Effects

The Millstone complex is, in economic terms, a basic industry; that is, the facility manufactures a product (electricity) for export from the region. All basic industries create some level of secondary employment and income in the

service sector of the local economy. Secondary jobs are created as a result of local purchases of goods and services by the industry and local purchases by its employees. The ratio of industry employees to secondary (or service) employees is termed the economic base multiplier.

Research on a number of powerplants documents that plants do not make significant purchases of local goods and services because of the highly specialized nature of their material and service needs.[4] Purchases tend to be limited to consumables such as office supplies. Therefore, the secondary job and income effects of Millstone will depend primarily on purchases by the facility's employees and their families. These "local" purchases will be made throughout the region, a portion of them in East Lyme. The powerplant studies cited above have found employment multipliers for operating employees to fall in the range of 0.4 to 0.8, depending on the regional economy. That is, 0.4 to 0.8 service jobs have been created for each operational job at the powerplant. The higher end of this range is representative of plant locations similar to Millstone's; that is, near or within a metropolitan area. The secondary employment impact of construction jobs is much less in percentage terms (typically less than a 0.2 ratio) for two reasons. First, construction workers and their families will make most of their purchases near their residence rather than near the work site. Thus the greater the proportion of commuting construction workers, the longer the commuting distance, and the greater the number of temporary residents sending most of their paycheck back to their family's permanent residence, the lower the secondary employment effect in the vicinity of the plant will be. Second, local businesses supplying goods and services will typically choose not to invest in expansion, anticipating a downturn in volume when the construction period ends.

Permanent Workforce: An employment multiplier of 0.91

has been calculated for New London County based on 1980 and 1981 Bureau of the Census figures (Table 3). A number of "best judgement" divisions of the Census figures between basic and service sectors were necessary to arrive at this multiplier; for instance, it is known that tourism is a major industry in Southeastern Connecticut, but the Census data does not distinguish between restaurant and recreational service employees whose jobs can be attributed to tourism and those supported by the expenditures of local residents. In any case, a number of assignment variations were tested, and these did not alter the multiplier by more than plus or minus 0.1; therefore, the 0.91 multiplier is believed to be quite accurate.

Thus, the 867 permanent jobs presently produced by Millstone are estimated to have generated an additional 789 jobs throughout the region, and the increase of 340 new permanent employees with the start-up of Millstone III will create another 309 jobs in the regional service sector. It is difficult to assign the location of these jobs or the residence of the job-holders because the available town-specific Census data is 13 years old. However, this data suggests that the distribution will approximate the regional distribution of population. On this basis, it can be roughly estimated that Millstone has been responsible for the creation of 48 jobs in East Lyme and 19 more jobs will be generated by Unit III.

Also given in Table 3 is a regional income multiplier. This multiplier takes account not only of the number of service jobs created for each new job in basic industry, but also of the substantial difference in average annual wages between the basic and service sectors. Employing the income multiplier of 0.58 in concert with the 1983 median income for permanent Millstone workers of $26,663, the following additions to regional and local income generated by permanent employment at Millstone can be estimated (Table 4):

Table 3: Economic Base Multipliers: New London County, 1981

Basic Industry	Number of Employees
Mining	41
Manufacturing	35,694
Electrical Utility (for export)	800
Construction (facilities for industry)	944
Business Services (to industry)	1,000
Tourism Services	3,182
Military	12,791
Federal Government	5,462
TOTAL BASIC	59,914

Service Sector	
Agriculture	130
Construction (local)	943
Transportation	2,739
Wholesale Trade	2,752
Retail Trade (non-tourist)	12,335
Finance, Insurance, Real Estate	2,415
Local Services	14,853
Local Government	7,502
State Government	5,075
Self-Employed	5,339
Non-Classified	408
TOTAL SERVICE	54,491

Employment Multiplier

$$\frac{\text{TOTAL SERVICE}}{\text{TOTAL BASIC}} = \frac{54{,}491}{59{,}914} = 0.91$$

Income Multiplier

$$\frac{\text{Average per-job payroll (service)}}{\text{Average per-job payroll (basic)}} \times \text{Employment multiplier} =$$

$$\frac{\$11{,}838}{\$18{,}595} \times 0.91 = 0.58$$

Sources: U.S. Census, 1980 Census of Population and Housing
U.S. Census, 1981 County Business Patterns

Table 4: Regional and Local Income Impact of Permanent Millstone Employment

		Thousands
Regional		
Direct (Millstone I and II workers)		$23,117
Secondary		13,408
	TOTAL 1983	$36,525
Future Direct (Millstone III workers)		$ 9,065
Future Secondary		5,258
	TOTAL 1986	$50,848
East Lyme		
Direct (Millstone I and II workers)		$ 3,653
Secondary		804
	TOTAL 1983	$ 4,457
Future Direct (Millstone III workers)		$ 1,440
Future Secondary		315
	TOTAL 1986	$ 6,212

As an indicator of the relative scale of these additions, the $4.4 million estimated addition to 1983 local income represents approximately 3 percent of East Lyme's present total personal income.

Construction and Temporary Workforce: We have discussed the short-term nature of the construction workforce peak and the indication that housing units occupied by transient workers in East Lyme would be filled by other short-term residents if the Unit III construction were not taking place. For these reasons it is expected that in-migrant construction workers have generated little, if any, secondary job impact. It is likely that in-migrant construction workers have generated additional local income, primarily

through retail purchases, and the same can be said of temporary workers. However, there is no data available upon which to make an estimate of this income effect.

Distribution of Regional Economic Growth: A final impact of Millstone on employment and income is the power station's indirect effect on the distribution of economic activity within the region. Because Millstone has, in effect, quadrupled the property tax base of the Town, Waterford is able to maintain property tax rates far below those of neighboring towns, including East Lyme, while at the same time making major infrastructure improvements (such as a municipal sewer system). This combination gives Waterford a distinct competitive advantage over other towns in the region in attracting commercial and industrial development.

PUBLIC SECTOR EFFECTS

Having examined the effects of the Millstone complex on the private sector in East Lyme in the areas of employment, population, housing, and income, the second major topic of this study is an analysis of Millstone's effect on the public sector. Utilizing many of the findings on private sector effects, this analysis considers potential impacts on the services provided by government in East Lyme and on the cost of providing those services. The two central issues surrounding this analysis are:

(1) Does Millstone, directly or indirectly, result in increased costs to the Town in the provision of public services, and are these increased costs recompensed by the receipt of additional revenues?

(2) Does Millstone, directly or indirectly, place demands on the public service delivery system of such a magnitude that the quality of the services provided deteriorates?

The approach to addressing these issues consists of a fiscal impact analysis, in which the costs of providing the various categories of municipal services are determined, the portion of those costs attributable to the presence of the Millstone complex are estimated, and finally, any additional revenues attributable to Millstone are estimated and compared to costs. The fiscal impact analysis is then supplemented by an evaluation of specified service categories to detect impacts that may manifest themselves in the form of a deterioration in service quality rather than as increased cost; this approach was used most notably in the analysis of traffic impacts.

II.A. Induced Municipal Service Costs

Table 5 breaks down East Lyme's expenditures for 1982

Table 5: Town of East Lyme Municipal Expenditures; Fiscal Year 1982

	Salaries, Wages and Expenses	Percent of Total
Municipal Services		
Operating		
General Government	$ 954,059	8.7
Public Safety	615,418	5.6
Public Works	834,905	7.6
Health and Welfare	118,334	1.1
Recreation and Culture	317,700	2.9
Debt Service and Capital Outlay	544,456	5.0
	$3,384,872	30.9
Schools		
Operating	$7,112,312	65.0
Debt Service	445,919	4.1
	$7,558,231	69.1
TOTAL	$10,943,103	100.0

Source: Annual Report, Town of East Lyme, 1982.

into a number of major service categories, the primary division being that between costs for education and those for all other municipal services. This distinction will prove important with regard to the indirect impacts of Millstone because costs attributable to Millstone-related residents can be estimated on a per-capita basis for non-educational services, while costs for education will be estimated on the number of children of Millstone employees who are enrolled in Town schools. Table 6 documents the sources of revenue which supported East Lyme expenditures in 1982. Here it is important to distinguish between revenues that the Town raises through taxes and fees on its residents and revenues which come to the Town through intergovernmental transfers, primarily grants-in-aid from the State and Federal governments. These transfer payments will be deducted from total expenditures to arrive at per-capita and per-pupil direct costs to the Town in locally-generated dollars.

The only known service that East Lyme provides directly to the Millstone complex is in the area of disaster preparedness, which is discussed in Section II.E below. (Northeast Utilities does maintain a Millstone Information Center in Niantic, to which a small cost in direct services could be attributed. For the purposes of this study, it is assumed that tax revenues derived from this property meet the cost of the services provided.)

Therefore, the primary source of municipal costs resulting from Millstone will derive from the provision of public services to resident Millstone employees. To estimate these costs it is necessary initially to determine the proportion of total municipal costs (excluding education) that are attributable to the provision of services to residential properties. The steps in this process are shown in Table 7. Municipal expenditures attributable to commercial and industrial properties are derived

Table 6: Town of East Lyme Municipal Revenues; Fiscal Year 1982

	Amount	Percent of Total
Locally-Generated Revenue		
Taxes, Interest, and Lien Fees	$7,519,967	69.2
Liscenses, Permits, and Conveyances	149,667	1.4
Revenue from Use of Town Money	278,894	2.6
Other	65,103	0.5
LOCAL TOTAL	$8,013,631	73.7
Intergovernmental Transfers		
Town-Aid Road	$ 98,311	0.9
School Aid	2,066,634	19.0
Other State	198,805	1.8
STATE TOTAL	$2,363,750	21.7
Federal Revenue Sharing	$ 235,000	2.2
Education	22,000	0.2
FEDERAL TOTAL	$ 257,000	2.4
Tuition Payments from Other School Districts	$ 234,090	2.2
TOTAL REVENUE	$10,868,471	100.0

Source: Annual Report, Town of East Lyme, 1982 and supporting documentation.

Table 7: Residentially-Generated Per Capita Expenditure; Town of East Lyme, 1982

Total assessed real property value (RPV)	$322,059,620
Total assessed RPV for non-residential properties	$ 32,353,800
Number of taxable land parcels	6,536
Number of non-residential land parcels	247
Ratio of non-residential RPV to total RPV	0.10
Average assessed RPV per parcel	$ 49,275
Average assessed RPV per non-residential parcel	$ 130,987
Ratio of average non-residential RPV to average RPV	2.66
Coefficient to refine costs attributable to non-residential uses	1.5
Total municipal expenditures attributable to non-residential uses = $3,384,872 X 0.10 X 1.5	$ 507,731
Annual per capita costs for municipal services to residential properties = $\frac{\$3,384,872 - 507,731}{\text{estimated population of } 14,150}$	$ 203.33
Annual per capita expenditure of locally-generated revenues for municipal services to residential properties = $203.33 - 23.77	$ 179.56

Sources: Annual Report, Town of East Lyme, 1982
Grand List, 1981

by multiplying total non-educational expenditures times the percentage of the Town's grand list valuation that is represented by non-residential properties times a coefficient to account for a lower service cost per thousand of assessed valuation for non-residential properties.[5] The annual per-capita cost for municipal services to residential properties may then be calculated by subtracting non-residential costs from total non-educational expenditures and dividing the result by the population of the Town.

For fiscal 1982, the calculated per-capita cost for services to residential properties is $203.33. After accounting for intergovernmental transfers, a net per-capita cost of $179.56 is obtained; this figure represents the per-capita amount which must be generated by the Town through taxes and fees on residential properties in order to support the services provided. Thus the net cost to the Town of providing non-educational services to permanent Millstone employees and the members of their families (an estimated 350 persons) is $62,846. The comparable costs for construction workers, based on the rough estimates given in Section I.B, would be in the range of $45,000 to $63,000 for in-migrant temporary residents and in the range of $135,000 to $153,000 for all construction workers living in East Lyme (temporary in-migrants plus long-term residents).

II.B. Educational Costs

As is typical in the State of Connecticut, public school system costs are the dominant expenditure category in East Lyme's budget. Operation of the schools and debt service on educational facility bonds represent 69 percent of the Town's annual expenditures (Table 5). Even after discounting grants-in-aid and payments from other forms of State and Federal assistance (the great majority of which is for education), 65 percent of East Lyme's

locally-generated revenues are spent on education. Therefore, the number of school children of Millstone-employed parents and the degree to which their pupil-per-family ratio is above or below the Town average is of major importance in determining fiscal impact.

A survey of school system records indicating the place of employment of all pupils' parents was conducted in April 1983. This survey found 136 pupils with Millstone-employed parents, of a total East Lyme-resident enrollemnt of approximately 2,815. The listings of employer company names and at-work telephone numbers enabled the following categorization of these students: 49 are the children of permanent employees and 87 the children of Unit III construction workers or other temporary employees.

The enrollment figure for children of permanent employees indicates a substantial under-representation when compared to Town-wide averages. Based on 1983 enrollment and estimated population, the East Lyme average number of pupils per household is 0.58. At this average, the 137 permanent Millstone employees residing in East Lyme would be expected to have 79 children enrolled rather than the survey result of 49. The actual number may be somewhat higher than 49 due to potential inadequacies in the survey data. However, the primary cause for the lower-than-expected enrollment is the age profile of permanent Millstone employees. Northeast Utilities reports that the median age of these workers is 33, while the median age of all persons of working age (18-64) in the Town is 37.3 and the median age of all males of working age is 37.0 (1980 Census data). Because of this 4 year age difference, a greater-than-average number of Millstone employees are either not yet married, married but not yet parents, or parents of children who have not yet reached school age. The relative youth of Millstone employees also means that the group has a higher percentage of the persons who are af-

fecting general population trends by marrying later and having fewer chilren when they do marry.

As to the 87 pupils who are children of Millstone construction workers, the available evidence indicates that a large majority are the children of long-term residents rather than in-migrant temporary workers. This conclusion is supported by the information related above that the great majority of in-migrant construction workers seeking housing in East Lyme are without families and by the absence of any discernable response in school enrollments to the major swings in the size of the construction workforce that have occured over the last 5 years. An analysis of the 1980 Census break-down of East Lyme's population by age was carried out to determine the number of children who would enter the school system between 1980 and 1983 compared to the number who would graduate out of it. The excess of graduates over enrollees predicted by the data matched the actual East Lyme-resident enrollment decline between 1980 and 1983 almost exactly. This is a strong indication that the Millstone construction worker children presently enrolled were resident in the Town in 1980, when the construction workforce was below 1,000 and in-migration was believed to be limited.

East Lyme's 1982 expenditures for education averaged $2,464 per pupil. After deducting State and Federal aid for education, the net cost per pupil in locally-raised revenue was $1,783. Therefore, the annual cost to the Town to educate the children of permanent Millstone employees is estimated at $87,385, and the cost for children of construction workers is an estimated $155,153. Because East Lyme's school enrollment has been declining since 1975, the addition of Millstone-related children has not placed any strain on the capacity of the system's facilities.

II.C. Revenue/Cost Relationships

As we have seen from Sections II.A and II.B, the estimated cost to the Town to provide general municipal services to resident Millstone permanent employees is $62,846 and the cost to educate their children is estimated at $87,385, for a total of $150,231. The issue is whether this total cost is met by the tax revenues that the Town receives from these families. Local revenue from non-commercial-and-industrial sources is derived overwhelmingly from taxes on residential real property. Second, the conclusion was reached in Section I.C that there is no significant difference between permanently employed Millstone families and Town-wide averages in the type and cost of housing occupied. Therefore, the Town-wide average for residentially-generated revenue per household should be representative of the revenue derived from Millstone-related households. This per-household average in 1982 was $1,459.72, yielding estimated revenues from permanent Millstone-related households of $199,981. Thus it can be concluded that permanent Millstone-related residents as a group are a net financial benefit to the Town.

Tax receipts attributable to construction workers are much more difficult to estimate. The only data available which would offer an indication of tax receipts from rental housing utilized by in-migrant construction workers are average receipts per unit from apartment buildings ($280 per year in 1982). Assuming the Town-wide average for persons per rental unit of 2.2, average per person receipts for apartment dwellers would be $127. However, as has been discussed, the predominant housing type for in-migrant construction workers is single-family house rentals, which would be expected to yield substantially higher tax revenues per unit. Thus it is probable that tax receipts attributable to in-migrant construction workers

roughly equal the cost of non-educational services ($179 per person). To the degree that in-migrant construction workers are responsible for children in the school system, these workers would represent a net, though temporary, deficit to the Town.

Costs for services to construction workers and their families who are long-term residents of the Town cannot be attributed to Millstone since most would still reside in East Lyme if Unit III were not being built. Costs for services to these long-term residents are substantially higher than those for temporary in-migrants because the group is larger and is believed to account for the great majority of construction worker children enrolled in the school system. However, no estimate of this group's contribution to municipal revenues is possible because no data is available from which to construct an income or housing profile.

II.D. Transportation Impacts

The analysis of the public sector effects of Millstone has, to this point, focused on residentially-generated public service demands that result in increased service costs to the Town. A second form of potential impact is the creation of additional demand resulting in a deterioration in service quality. This type of impact often manifests itself in service areas dependent on substantial investments in capital facilities. Because of the capital costs required to improve these facilities so that the additional demands can be met, service quality may decline until the inadequacies are no longer tolerable. Traffic generated by Millstone is presently causing, and will continue to cause (to a lesser but still significant degree) this type of impact on East Lyme's transportation system. This study has found that traffic is, by a wide margin, the most significant impact of Millstone on the

Town.

Simple observation of traffic conditions in East Lyme during the morning and evening rush hours confirms that Millstone traffic is presently causing serious congestion, particularly on the two State routes (Routes 156 and 161) providing the primary access through the Town to the vicinity of the power station. Further, the traffic and roadway data available at the outset of the study indicated that certain segments of Routes 156 and 161 are rapidly approaching maximum capacity even without the addition of traffic attributable to the peak Millstone consruction force. Table 8 contains average daily traffic (ADT) volume counts taken by the Connecticut Department of Transportation (ConnDOT) for various segments of Routes 156 and 161 in 1971 and 1980. (It should be noted that the Millstone construction workforce was under 1,000 at the time of the 1980 counts, compared to 3,750 at present.) Also shown are Southeastern Connecticut Regional Planning Agency (SCRPA) projections for 1990 ADT over the same segments. The final column contains the calculated hourly capacity of each of the segments based on Level of Service E (unstable flow conditions). These capacities are derived by ConnDOT from a formula that accounts for such factors as the number of lanes and their width, degree of truck traffic and terrain, and generalized land use. To compare the average daily traffic figures to hourly capacity it is necessary to estimate the percentage of ADT occuring in the peak hour; ConnDOT uses a factor of 0.1 for urban roadways. A roadway segment may then be said to have reached capacity when 10 percent of the ADT equals or exceeds the hourly capacity value. Thus, the data in Table 8 indicates that Route 156 from East Pattagansett Road to the Niantic River Bridge will be near to or at capacity by 1990, and that Route 161 from Roxbury Road to the I-95 interchange has already reached capacity.

Table 8: Average Daily Traffic Volumes and Roadway Capacity for Route 156 and Route 161 Segments

	Average Daily Traffic*			Hourly
	1971	1980	1990	Capacity *
Route 156				
Rocky Neck Connector to East Pattagansett Road	6,500	7,300	8,760	1,215
East Pattagansett Road to Route 161	8,200	11,500	13,800	1,460
Route 161 to Niantic River Bridge	7,600	9,500	12,180	1,015-1,415
Niantic River Bridge to Route 213 (Waterford)	7,500	8,800	11,140	1,500
Route 161				
Route 156 to Roxbury Road	8,500	10,000	NA	1,415
Roxbury Road to I-95	10,200	14,500	17,940	1,415

* 1971 and 1980 ADTs are ConnDOT counts; 1990 ADTs are SCRPA projections; hourly capacities are ConnDOT computations.

Sources: SCRPA, Recommended Regional Transportation Plan, 1983
ConnDOT, Bureau of Highways, Traffic Volumes on State Roadways, 1971 and 1980.

It must be recognized, however, that these capacity calculations are based on rather simple formulas utilizing limited data; they are useful primarily as a general indicator of where capacity problems may exist. In order to develop reliable, site-specific traffic volumes and capacity values, it is necessary, through addtional traffic counts and direct observation, to account for a number of additional variables, including:

- directional movements and traffic signal performance at intersections: in urban locations the capacity of the intersections, rather than the capacity of the roadway links between them, is typically the limiting factor;
- actual peak hour volumes: the actual peak hour traffic volume may be substantially higher (or lower) than 10 percent of the ADT;
- the directional characteristics of the peak hour flows: the ConnDOT counts are bidirectional and thus cannot account for peak hour flows that are substantially higher in one direction than the other;
- the frictional effects of such factors as on-street parking, driveways, and pedestrian conflicts.

A further major consideration in evaluating the traffic impact of Millstone is that the majority of present Millstone traffic is construction-related and therefore temporary. In order to forecast future conditions, present-day construction traffic must be factored out and the additional permanent workforce assigned to Millstone III added.

Given the inadequacies of the existing data for the purposes of this study, it was decided to undertake a traffic engineering study which would:

- document the existing peak hour traffic volumes for Routes 156 and 161 and estimate the contribu-

tion of Millstone traffic to these volumes;

- project 1990 peak hour traffic volumes made up of 4 components: 1983 base traffic (without Millstone III construction traffic); 1983-1990 normal traffic growth; 1983-1990 Millstone permanent workforce growth; and Millstone refueling outage traffic;
- identify existing and anticipated problem areas and capacity deficiencies; and
- identify roadway and traffic control improvements necessary to accomodate projected 1990 peak hour traffic.

Storch Engineers of Wethersfield, CT was selected to conduct this study, which was carried out in June and July 1983.

Data Collection: After a review of the Southeastern Connecticut Regional Transportation Plan and the ADT data discussed above, all available additional count data was obtained from ConnDOT for Routes 156 and 161. It was determined that for traffic engineering purposes, considerably more data would be required, particularly with regard to specific time slots. Most counts for planning purposes are hourly, and ConnDOT counts are normally bi-directional. Such counts do not provide the specific information useful for determining street and intersection capacities. Accordingly, a counting program was undertaken which involved both manual and Automatic Traffic Recorder (ATR) counts. These counts were particularly directed at determining the impact on the street system of Niantic of traffic leaving the Millstone power station during the afternoon period. Manual and automatic counts were taken on several days at the intersection of the Millstone access road and Route 156, and ATR counts were taken at a number of locations along Route 156 to determine the dispersal of the Millstone traffic. Counts were taken at several locations on Route 161 to determine traffic flows on that

roadway. Traffic signal design and timing drawings for traffic signals at each of their locations on Route 161 were obtained from ConnDOT. Traffic count data taken by Storch Engineers as well as counts and signal drawings supplied by ConnDOT are all included in Appendix C.

Considerable additional information as to the number of day-shift personnel at Millstone was obtained from Northeast Utilities and similar information, including the actual number of employees present on the day the major count of existing traffic was taken, was obtained from the security officer in charge of the construction site of Millstone III. Simultaneously with obtaining counts and other data, traffic on Routes 156 and 161 was observed by trained traffic engineers to determine particular traffic problems and bottlenecks.

Traffic Projections: In order to develop the Millstone Nuclear Station contribution to projected 1990 traffic volumes, it was necessary to make an accurate determination of the elements of the present flow. There are three major elements to the flow of passenger vehicles to and from the Millstone site. First, there are those regular employees engaged in the day-to-day operation of Units I and II. While the station is manned by three shifts of personnel, the largest number are on the first, or day shift starting at 7:00 am and 7:30 am and leaving at 3:30 pm or 4:00 pm. Presently, there are about 580 permanent employees on the day shift. Second, there are those engaged in refueling during shut-down of one of the units. At the time of the traffic study, Millstone II was shut down for refueling, and there were approximately 600 day-shift workers involved in this effort. Third, there are the Millstone III construction workers, who will be present, but in decreasing number, through 1985. The present Millstone III workforce numbers 3,750, nearly all of whom are day-shift workers. The construction force starts at about the

same time as the regular employees but works a longer day (generally 9 hours) and leaves after 4:00 pm.

The character of each of these elements differs not only in time of departure from the plant but also in the average number of passengers per vehicle, with the construction forces averaging 1.7 passengers per vehicle and the regular plant employees probably averaging closer to 1.2 to 1.3 passengers per vehicle. The 1.7 figure for construction workers was calculated from the number of construction workers reporting on the day of the count versus the actual number of vehicles attributable to construction workers leaving. This 1.7 passengers per vehicle figure was the same obtained later from Mr. Newman, Security Officer at the construction site.

The present day-shift regular workforce at the Millstone I and Millstone II units is approximately 580, resulting in a traffic flow of approximately 500 vehicles. This workforce will, of course, increase when Millstone III becomes operational in 1986; the number could reach 1,300 during the start-up period but will drop back after that to a normal number of approximately 1,000 day-shift workers, resulting in 833 vehicles leaving during the afternoon peak.

As noted, Millstone II is presently being refueled, adding approximately 600 day-shift workers to the force at the site. This number will be representative of each future refueling. Using the 1.2 occupants per vehicle figure results in an estimate that 500 additional vehicles are presently leaving the site in the afternoon peak and will do so during each refueling period in any future year. The actual number of construction workers on the first shift on July 26 (the date of the final count on the access road) was 3,700, resulting in an existing additional flow of 2,150 vehicles. Thus the present total number of

vehicles departing the power station site during the afternoon peak is approximately 3,150.

It is clear from the above analysis that the contribution of Millstone to area traffic will be considerably lower in 1990 than at the present time. Summing 1,000 day-shift regular workers with a refueling crew of 600 on day shift indicates a total workforce during those hours of 1,600, resulting in 1,333 vehicles leaving the plant during the afternoon shift change. Millstone is, of course, not the only source of potential traffic growth in the area. Although traffic growth has been relatively slow over the last decade, it has been steady, and the trend may be expected to continue. The Regional Transportation Plan indicates an expected regional population gain of 5.6 percent over the 1980 to 1990 decade and a somewhat higher growth rate for East Lyme in the same period. Highway traffic in the region is expected to increase at a higher rate than population (2 percent per year). The average daily traffic volumes forecasted by SCRPA for Routes 156 and 161 in 1990 are shown in Table 8.

The Transportation Plan indicates congestion on Route 161 at several points, specifically the intersection of Route 161 and Route 156, the intersection of Route 161 and Pattagansett Road/ Roxbury Road, the intersection of Route 161 and Industrial Park Road, and the intersection of Route 161 and the I-95 ramps. Congestion on any roadway normally first manifests itself at intersections, and particularly at signalized intersections. It should be noted that each of the Transportation Plan's congestion locations is a signalized intersection. Observations made as part of this study generally confirm this insofar as Route 161 is concerned with certain additional business areas where, because of the narrowness of the roadway, left-turning movements into business driveways severely

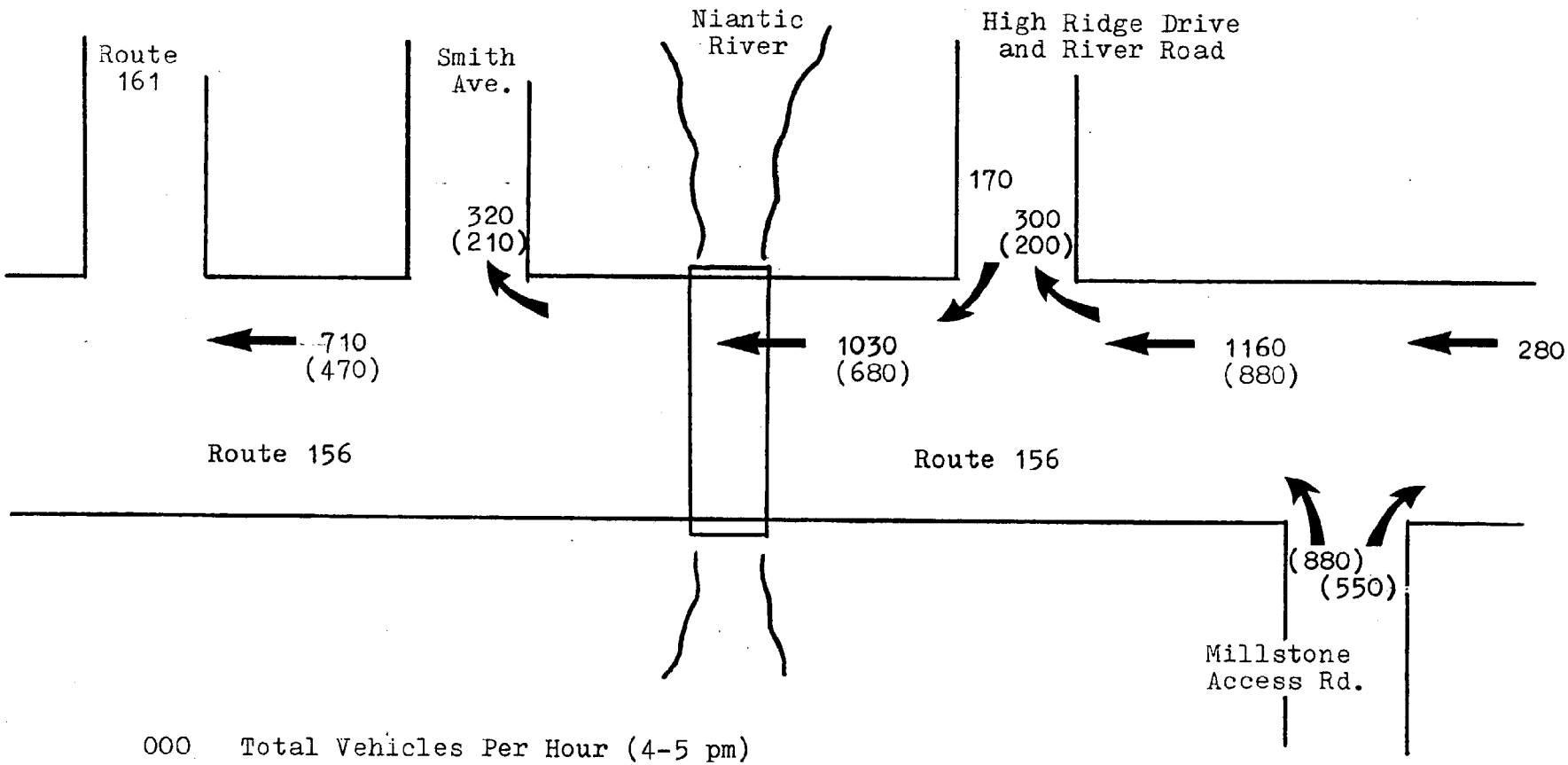
restrict through movement and thereby reduce roadway capacity.

On Route 156, roadway capacity is limited by the capacity of the intersection with Route 161. This is the intersection most heavily impacted by Millstone-generated traffic in the peak hour. Figure 2 is a schematic portrayal of the westbound peak-hour traffic flows on Route 156. Approximately 60 percent of the departing Millstone traffic turns west onto Route 156. A substantial number turn off Route 156 before crossing the Niantic River Bridge and travel north on River Road to gain access to the Boston Post Road and I-95. Of those crossing the river into Niantic, approximately one-third of the total westbound traffic (320 vehicles) detours onto Smith Avenue, the great majority in order to reach Route 161 northbound without passing through the Route 156/Route 161 intersection. This leaves approximately 710 vehicles entering the intersection with Route 161 in a westbound direction.

For intersections with signalization, capacities are calculated on the basis of various levels of service ranging from A to F. The levels of service are defined by the percentage of cars queued at an intersection approach during the peak hour that will clear the intersection on the next green phase. Thus in a free flow condition (Level of Service A), all cars stopped by a red light will clear through the intersection on the next green. At Level of Service C, generally considered a good urban condition during the peak hour, 3 cars in 10 will not be able to clear the intersection on the first green and will have to wait through another cycle. At Level of Service D, characterized as approaching unstable flow, 7 in 10 cars will be forced to wait through more than one cycle. Unstable traffic flow is reached at Level of Service E.

Calculations of capacity for the Route 156 intersection with Route 161 indicate that with the present signal

Figure 2: Peak-Hour Westbound Traffic Flow on Route 156



000 Total Vehicles Per Hour (4-5 pm)

(000) Millstone-Departing Vehicles Per Hour (4-5 pm)

operation, giving 21 seconds of green time each cycle to westbound Route 156 traffic, the capacity at Level of Service D, assuming equal distribution between through and right turn traffic from the two available westbound lanes, would be approximately 1,540 vehicles per hour of green (940 for the straight-through lane and 600 for the right-turn lane). The capacity at Level of Service D is then 22/60 x 1,540 or 565 vehicles per hour, considerably less than the 707 westbound vehicles entering the intersection that were counted during the peak hour. In fact, the present volume is slightly greater than the calculated capacity of 678 at Level of Service E. Figure 2 shows the number of vehicles entering the intersection which are attributed to Millstone traffic, the great proportion of which is construction-related. If the construction force traffic were eliminated, there would remain between 350 and 400 westbound vehicles entering the intersection in the peak hour. These would consist of the present non-Millstone traffic plus vehicles which would no longer divert to Smith Avenue because of the reduced congestion at the intersection. This number would be well below the Level of Service D capacity of 565.

From the above, it is clear that the present severe undercapacity problems on Route 156 are to a large degree the result of the construction force at the Millstone III project. Further, it appears that with the termination of construction there will be a reduction in the present Route 156 ADT of approximately 2,000. However, compared to the ConnDOT ADT count of 8,800 taken in 1981 (when the construction workforce numbered about 1,000), the reduction will be only about 500. Also, the reduction in construction traffic will be partially balanced by an increase in the operating force which may result in an ADT increase of 500 to 700 added to the anticipated area growth in general traffic of 2 percent per year. Deducting the 500 con-

struction-related ADT from the 8,800 counted in 1981 and adding 9 years of 2 percent growth gives a 1990 ADT of 9,920. The addition of 700 ADT from additional operating staff as a result of Millstone III going "on-line" indicates a total 1990 ADT of 10,620, or approximately 21 percent above the 1981 ADT. In other words, the combined effects of the additional Unit III workforce and general traffic growth will result in a 1990 ADT for Route 156 well above the levels experienced prior to the construction workforce peak of the last year. Fortunately, volumes in the peak hour should be somewhat reduced from 1983 levels because the general traffic growth component will be spread throughout the day.

Identified Problem Areas: The following observations, identifying problem locations, were made during the study:

Route 161 at I-95 Ramps, South to Society Road

Congestion was observed in both directions, probably due to the proximity of the two traffic lights and the narrowness of the roadway under I-95.

Route 161, Society Road to State Road

Moderate congestion was apparent at Roxbury Road and at Pattagansett Road, mainly due to left-turning traffic.

Route 161, State Road to Route 156

Back-up at shopping center entrances due to left turns affects Route 161 in this segment. The internal circulation at the Niantic Village Shopping Center aggravates the situation. The traffic signal at Route 156 causes back-up and the limited roadway width of Route 161 north of 156 heightens capacity problems. Long queues from the Route 156 signal create further problems at driveways.

Route 156, Columbus Avenue to Route 161 (Pennsylvania Ave.)

Westbound left turns in the vicinity of Columbus Avenue cause delays. Parking on both sides limits capacity. Driveways to commercial areas on both sides

with no turn lane limits capacity.

Route 156, Pennsylvania Avenue to Smith Avenue

The roadway is narrow except for a three-lane section near the intersection with Route 161. Driveways cause some capacity restriction.

Route 156, Smith Avenue to Niantic River Bridge

There are many driveways between Smith Avenue and the Bar, but most appear to be lightly used. The roadway lacks shoulders, and an eastbound vehicle breakdown would cause severe tie-ups.

Accident data obtained from ConnDOT revealed only one location in the study area being on the listing of high-frequency accident locations. This is the area of Route 156 between Methodist Street and Pennsylvania Avenue. However, this area is not high on the accident priority list, being ranked below the 500th location in the State.

Desirable and Required Improvements: Major attention has been given to traffic conditions during the afternoon period of combined commuter and business/commercial traffic. Certain problems were observed during morning commuter periods, but since these were generally for limited time periods and would be susceptible to the improvements being recommended because of the more severe afternoon capacity problems, they are not being treated separately.

The following recommendations are presented in the same order as the discussion of problem locations in the preceeding section. Each signalized location is circled on the map in Figure 3.

Route 161 at I-95 Ramps, South to Society Road

At the I-95 interchange, widening of the roadway between the ramps from the present 39 feet to 48 feet is recommended to provide four 11-foot lanes and 2-foot shoulders. This change can be accomodated in the 50-foot width of the underpass and will allow the establishment of de-

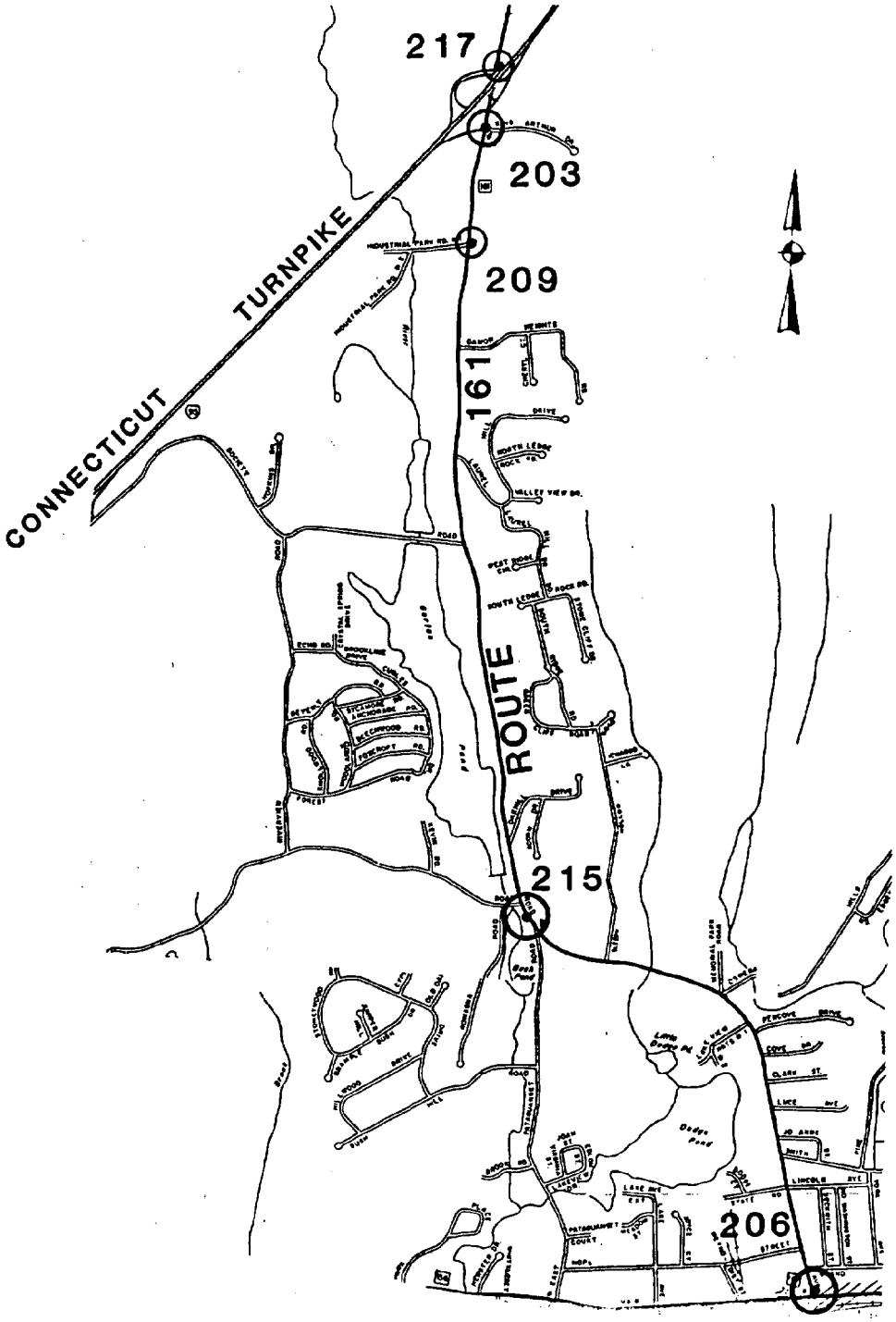


FIGURE 3

EAST LYME TRAFFIC STUDY	
LOCATION OF SIGNALIZED INTERSECTIONS ROUTE 161	SCALE: N/A DRAWN BY: A.J.K.
STORCH ENGINEERS — 161 MAIN STREET, WETHERSFIELD, CT 06109	CHECKED BY: L.M.R. DATE: AUG. 1983

fined left turn lanes which will not interfere with straight-through traffic on Route 161.

Presently, the signal at the eastbound ramps is full traffic actuated, and the signal at the westbound ramps is semi-traffic actuated and so coordinated with the full-actuated signal as to give a northbound clearout of traffic under the underpass. It is recommended that a check be made by ConnDOT signal technicians to determine if this signal is operating according to plans. If it is so operating, a traffic engineering check is recommended to determine if the two-directional heavy flow might be better accomodated by adjusting the northbound offset. It is also recommended that the controller vehicle periods at the full-actuated location be sharpened considerably from the 5 second settings shown on the plan. Settings of 3 to 3.5 seconds on the ramp and 4 seconds on Route 161 might be more appropriate. Also, the addition of a second magnetic detector on both approaches of Route 161, located approximately 70 feet from the stop bars, would permit still shorter vehicle periods along with a shorter initial period on Route 161 with an increase in operating efficiency at all times, but particularly during off-peak periods. At the Industrial Road intersection, the signal is full traffic actuated, and the width of the roadway should permit a dedicated exclusive left turn lane to avoid interference between northbound straight-through traffic on Route 161 and northbound vehicles turning left onto Industrial Park Road. No alteration in signal equipment or timing is deemed necessary.

Widening the entire section of roadway from the I-95 ramps to Society Road to 4 full lanes is recommended to accomodate the combination of through and turning traffic that exists. There are a number of commercial driveways throughout this area, all of which contribute to delays on Route 161 because of left-turning vehicles off the

roadway. Also, a safety concern has been expressed for school bus traffic departing the Society Road schools.

Route 161, Society Road to State Road

South of Society Road, Route 161 narrows to approximately 34 feet. The section of this roadway north of Roxbury Road, because of a lack of side friction, has adequate capacity to carry present and anticipated traffic. However, at the two intersections with Roxbury Road and Pattagansett Road, located as they are only about 350 feet apart, a capacity problem is created both because of their close proximity to one another and the lack of a northbound left turn lane at Roxbury Road.

Recommended is the widening of Route 161 on the east side to provide a through northbound lane and left turn lanes at both Pattagansett and Roxbury Roads. Also, the signal plan should be revised to shorten the vehicle period on Pattagansett and Roxbury Roads to 3 or 3.5 seconds, and detection and timing on Route 161 should be rearranged to better accomodate existing and anticipated peak traffic volumes (Figure 4).

South of Pattagansett Road, Route 161 further narrows to 32 feet and numerous side streets cause left turn interference problems. A widening to provide a curb-to-curb width of at least 36 feet is recommended with 40 feet a more desirable width. Increased width would permit a center left-turning lane which, again, would free up through traffic in both directions and reduce delay and congestion.

Route 161, State Road to Route 156 (Main Street)

This is an area of business and commercial use, and here again, left turns cause a major frictional problem. A particular problem exists at the Niantic Village Shopping Center, where lack of a good internal circulation pattern forces patrons looking for a parking space to leave the parking area, enter onto Route 161, and then re-enter the parking area in order to get a different parking aisle. Finally, at Route 156 the single southbound

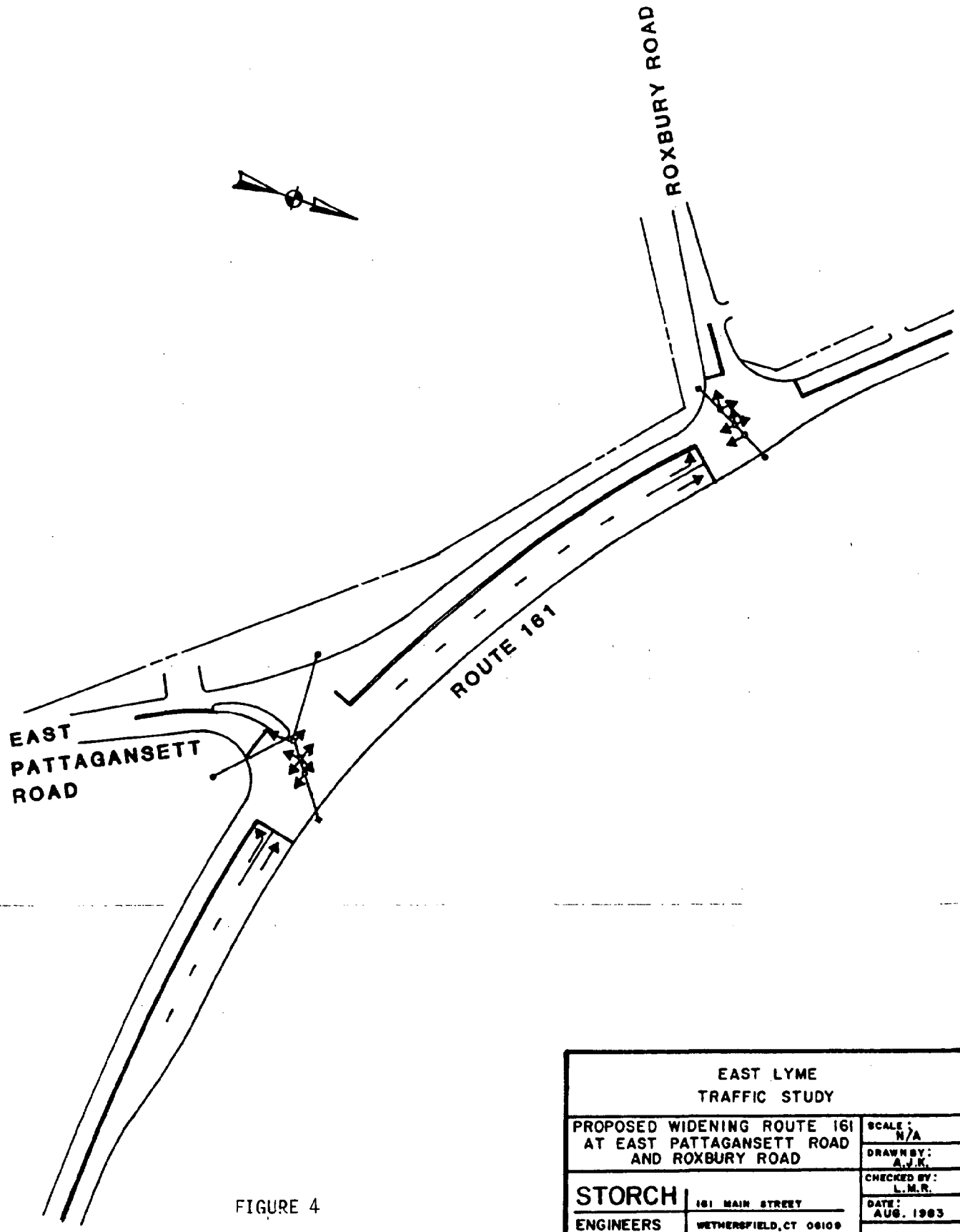


FIGURE 4

EAST LYME TRAFFIC STUDY	
PROPOSED WIDENING ROUTE 161 AT EAST PATTAGANSETT ROAD AND ROXBURY ROAD	SCALE: N/A DRAWN BY: A.J.K. CHECKED BY: L.M.R. DATE: AUG. 1983
STORCH ENGINEERS — 161 MAIN STREET, WETHERSFIELD, CT 06109	

lane limits southbound flow since right- and left-turning vehicles must use the same lane.

It is strongly recommended that Route 161 be widened throughout the entire distance from State Road to Route 156 in order to relieve each of the above traffic problems by increasing the capacity of Route 161. Particularly, a widening of the last 200 feet before the intersection with Route 156 would result in a material increase in the total capacity of this intersection (Figure 5).

Route 156 (Main Street), Columbus Avenue to Route 161

This section of Route 156 will be most difficult to improve because of the many businesses along this section that do not have off-street parking; to remove off-street parking would probably seriously damage their business. Also, because of restricted setbacks of properties, widening would be difficult.

Consideration should be given to restricting parking on the south side of Main Street during the morning peak period and on the north side during the afternoon peak. Such measures would increase street capacity materially and reduce accident probability. At the western end of this segment, somewhat more space is available, and provision of a left turn lane by widening Route 156 would reduce delays and congestion.

Route 156, Route 161 to the Niantic River Bridge

The present capacity deficiencies of Route 156 at its intersection with Route 161, particularly in the westbound direction would be improved by the recommended establishment of a second lane at the southbound Route 161 approach and associated signal improvements. This change would clear southbound traffic through the intersection more rapidly, thus allowing more green time for Route 156 vehicles. East of Route 161, the roadway can be considered substandard for the volume of traffic carried, but it does not appear to present a major bottleneck or be a

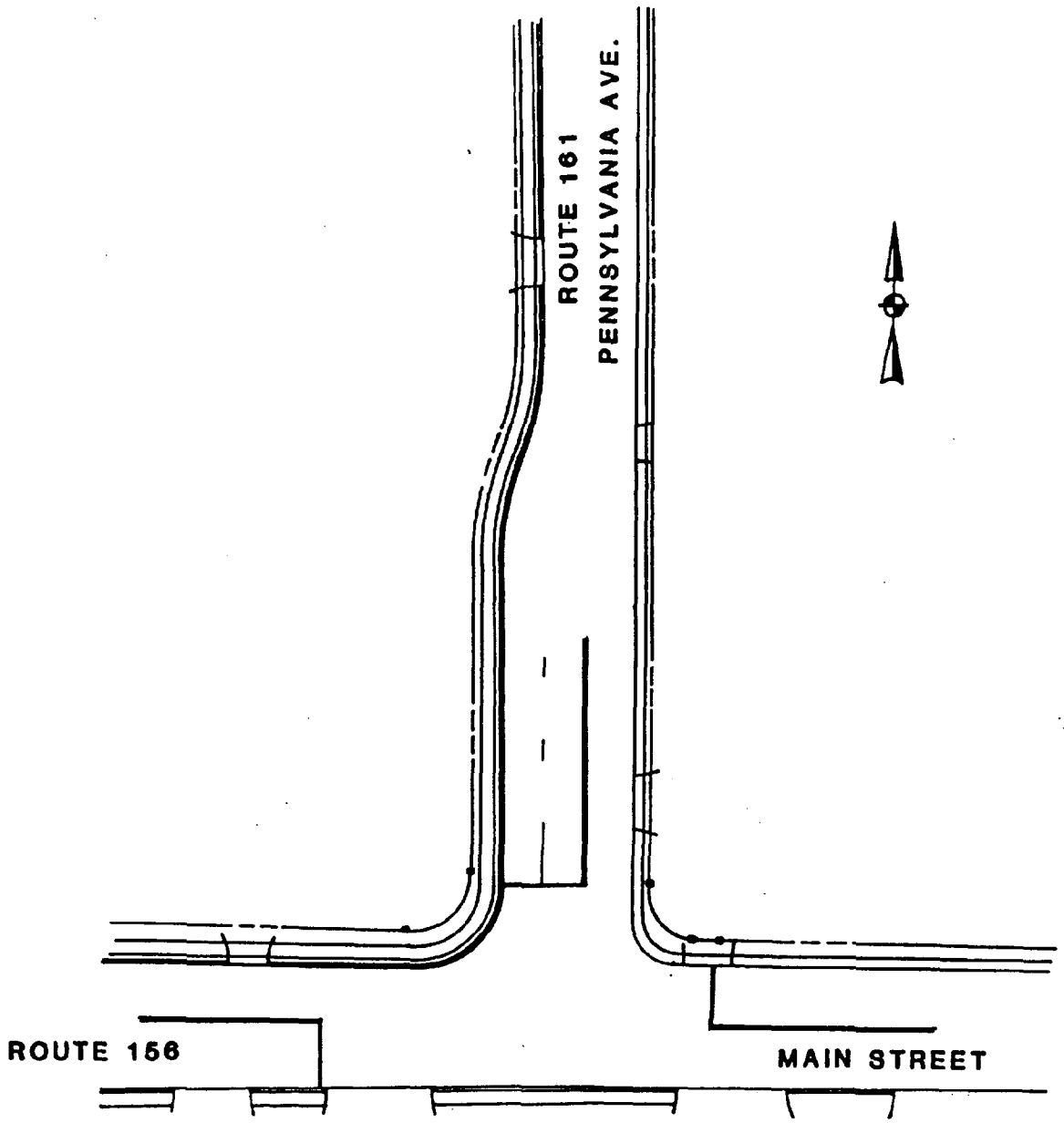


FIGURE 5

EAST LYME TRAFFIC STUDY	
PROPOSED WIDENING ROUTE 161 (PENNSYLVANIA AVE.) AT ROUTE 156 (MAIN ST.)	SCALE: N/A DRAWN BY: A.J.K. CHECKED BY: L.M.R.
STORCH ENGINEERS — 161 MAIN STREET, WETHERSFIELD, CT 06109	DATE: AUG. 1983

major accident location. Widening is recommended in the area where commercial properties line the north side of the road to provide an eastbound turning lane and also to provide space for a breakdown without disrupting opposing traffic. While these would be worthwhile improvements, they are deemed of lower priority than the intersectional improvements previously outlined.

Smith Avenue

While counts were not taken on Smith Avenue, afternoon diversion onto Smith Avenue by westbound vehicles was deduced by taking ATR westbound counts on Route 156 both to the east and west of Smith Avenue, the difference being the number of vehicles which entered Smith Avenue. Obviously, some of these vehicles were driven by residents of the area bounded by Routes 156 and 161, but most are believed to have re-entered Route 161 via Smith Street, Grand Street or Lincoln Avenue. During the period from 4:00 pm to 5:15 pm on July 15 (a Friday), 340 vehicles left the westbound stream on Route 156 at Smith Avenue. It is notable that as traffic increased, a disproportional percentage of vehicles left Route 156, indicating that the diversion was a function of the congestion at the traffic signal at Route 161. Increasing the capacity of that signal by installation of new full-actuated equipment with detectors on all approaches will substantially reduce the back-up on Route 156 from this intersection at peak periods and will thereby reduce the diversion through the residential area served by Smith Avenue. If the problem is intolerable to residents of Smith Avenue and adjoining streets, then restricting certain turns and making some sections of Smith Avenue and other residential streets one way could essentially prevent through traffic. Such actions would, however, of necessity increase total travel delays and also enforce restrictions on movements by area residents to which they may object.

II.E. Disaster Planning and Preparedness

The U.S. Nuclear Regulatory Commission sets requirements for planning and preparedness to assure that the public is protected in the event of a nuclear power plant accident. The utility, the State, and each of the communities within the Emergency Planning Zone (EPZ: a circular area of 10-mile radius around the power station) are required to have individual, though coordinated, plans. The utility's plan for the power station sets out the actions for which it is responsible and the measures it will take in a radiological emergency. These fall into 4 general categories: (1) notification of State and local officials within the EPZ via a radiopager system that an emergency is taking place; (2) assessment of the severity of the emergency, estimation of off-site radiation doses (utilizing on-site monitors, on-site meteorological equipment, and mobile monitoring teams), and communication of this information to State and local officials; (3) corrective actions to shut down the plant and control releases; and (4) actions directed toward the protection of the personnel on the plant site.

The State and local plans establish responsibilities and actions to be taken to protect the general public. Protective actions include: (1) controlling access by the public to the vicinity of the plant site; (2) notification of the public to take shelter and coordination of this activity; (3) controlling the use of food, water, milk, and livestock feed which may be contaminated; and (4) if necessary, ordering and directing the evacuation of the areas in the exposure pathway. Within each town, the chief elected official, assisted by the Civil Preparedness Director, has command responsibility for directing all protective actions in the town (unless the Governor declares a state of civil preparedness emergency). Town personnel involved with directing and coordinating the access control,

take shelter, and/or evacuation actions, as well as those with supporting roles in transportation, radiological monitoring, and health and social services, include the police, fire, highway, health, and water departments and the school system.

In order to assure that the plans are workable and the personnel involved are knowledgeable about their responsibilities, the Nuclear Regulatory Commission establishes requirements for training, drills, and exercises:

Training: Northeast Utilities is responsible for giving radiological orientation training to local personnel who may be required to come on site during an emergency. The local community is responsible for training its own personnel in their duties in carrying out protective actions assigned to the town.

Drills: Drills to verify the operation of communications systems linking the power station, the State, and the communities in the EPZ are required monthly. Annual drills are conducted for medical emergency and radiological testing teams.

Exercises: Exercises are full-scale enactments of a radiological emergency in which all personnel (utility, State, and local) are actively involved over a full day. An exercise at the Millstone station is required annually.

As can be imagined from the above description, substantial costs have been, and will continue to be incurred for developing and revising plans, carrying out training, drills, and exercises, and purchasing and maintaining communications and warning systems. Northeast Utilities absorbed a large share of the cost of establishing the present preparedness system. (Although Northeast Utilities participated with area towns in maintaining a preparedness system prior to 1980, in that year the Nuclear Regulatory Commission ordered new, more extensive plans and instal-

lation of public warning systems, with revocation of operating licenses as the ultimate penalty for non-compliance, but made no funds available to pay for the new requirements. In addition, the State of Connecticut had no funds available for these purposes.) Northeast Utilities reports that it expended $98,000 for preparation of local emergency plans and conducting training sessions for all 10 towns in the EPZ. Second, in 1981 the utility installed 18 emergency sirens in East Lyme at a total cost in labor and materials of $180,000 plus an additional $20,000 for conversion of 5 existing sirens and communications equipment. Northeast Utilities estimates that it will cost $160,000 annually for testing and maintenance of all 139 sirens in the Millstone warning system. It should be noted that these sirens can be used for notification of the public in natural disasters such as floods and hurricanes as well as radiological emergencies.

Preparedness costs to the Town of East Lyme may be divided between those incurred directly and exclusively in support of preparedness for a radiological emergency, and those which generally enhance preparedness for all types of emergencies. The Town is largely reimbursed for direct nuclear preparedness costs. The Federal Emergency Management Agency (FEMA) pays the full cost of communications equipment required for nuclear preparedness, such as portable two-way radios. This year the reimbursement will total just under $10,000. FEMA also reimburses 50 percent of the Town's costs for maintenance of its Office of Civil Preparedness. These costs consist of part-time salaries for the Civil Preparedness Director and a secretary, and office maintenance and supplies. Anticipated reimbursement in 1983 for these costs is $6,000. Finally, Northeast Utilities reimburses the full Town cost of its participation in exercises. The last full-scale exercise took place in March 1982, required 250 man-hours on the

part of East Lyme personnel, and was reimbursed in the amount of $1,982 by the State through a nuclear assessment fund to which Northeast Utilities is the sole contributor.

As to local expenditures which enhance preparedness for all types of emergencies (including radiological), the Town put into operation an Emergency Operations and Communications Center (EOC) in 1982 at a capital cost of $185,000. Operation of the EOC resulted in an increase in the annual expenditure for civil preparedness from $15,976 in fiscal 1982 to a budgeted $85,910 in fiscal 1983. The Civil Preparedness Director expressed the feeling that the presence of Millstone provided some of the impetus for construction of the EOC and that at least a portion of its operating costs should be shared by FEMA. Nevertheless, the Director believes that the Town presently has a first-class emergency operations system which it might not have without the presence of Millstone because civil preparedness would otherwise be a lower priority in the Town.

ENVIRONMENTAL EFFECTS

While emphasizing that the primary thrust of this study is the evaluation of the social and economic effects of Millstone on East Lyme, it is acknowledged that environmental effects also result from the normal operation of the power station. The two main areas of environmental concern related to operation of nuclear power plants are release of radiation to the environment and alteration of the marine environment resulting from the cooling process. In each case, experience at Millstone, and at nuclear power stations generally, has shown that very lengthy and expensive research efforts are necessary to attempt quantification of environmental effects. Even when such research efforts are undertaken, conclusive results satisfying all reviewers are often unattainable. Therefore, no original research was undertaken on environmental effects for this study. Rather, this section reviews and characterizes the existing research specific to Millstone.

III.A. Low-Level Radiation

Normal operation of the Millstone Power Station releases radiation to the environment in gaseous and liquid form. In addition, unplanned releases, generally liquid, occur periodically as a result of equipment malfunction or operator error. Finally, shipment of radioactive wastes from the plant site for burial out-of-state results in radiation doses along the shipping route.

A 1981 study by Northeast Utilities (Low-Level Radiation Health Effects Study for the Haddam Neck and Millstone Nuclear Power Facilities) documents releases in each of these categories for the first year of operation of Unit I through 1980. These data are then utilized as inputs to computer models which estimate radiation exposure off the plant site in terms of doses received by the

"maximum individual" and by the average individual within a 50-mile radius. (The "maximum individual" value is a measure of the upper bound of potential exposure, and no one individual can be expected to reach such a level.) The Northeast Utilities study computes the average annual radiation exposure from Units I and II at 10 millirem for the maximum individual and 0.14 millirem for the average individual within 50 miles. Since installation of an improved system for control of airborne releases from Unit I in 1978, the average annual doses are 0.3 and 0.003 millirem respectively.

In addtion to these computer model results, Northeast Utilities maintains a Millstone environmental monitoring program including 24 terrestrial stations for sampling and analysis of radiation levels in air particulates, groundwater, and milk, and 10 aquatic stations for sampling of seawater, bottom sediments, and various species of finfish and shellfish. The stations include certain "control" locations which are well removed from the plant site so that background levels can be determined. Also, the State maintains an independent, parallel sampling program providing data to the Nuclear Regulatory Commission for verification of the utility's sampling results.

The Northeast Utilities study compares the above estimated doses to other sources of radiation to which the general population is exposed. The average person in Connecticut receives an annual radiation dose of approximately 200 millirem. The largest single source (125 millirem annually) is naturally-occuring radiation (cosmic and terrestrial), and most of the remainder (72 millirem) comes from medical uses (X-rays). Thus the calculated annual average maximum individual radiation dose attributable to Millstone is approximately 5 percent of the annual dose commitment attributable to background and medical-use radiation. The average individual dose is less than 0.1 percent of background.

What this maximum 5 percent increase in radiation exposure may mean in terms of its effect on human health is the issue on which there is some scientific disagreement. The effects of high levels of exposure on the incidence of cancer and genetic defects are well known from studies of populations so exposed (including the survivors of the atomic bombings of Japan, uranium miners, and radiotherapy patients). The risk to human health from low levels of radiation is not known precisely and must be inferred from the knowledge of high-level effects. The majority of expert opinion seems to be that a linear model should be used to project the health effects of low-level radiation. This model states that the risk to human health from radiation exposure is directly proportional to the dose received; therefore, the risk from low levels of exposure can be extrapolated from the known effects of high exposures. However, some reseachers postulate that the health risks from low-level radiation are higher than would be predicted by the linear model.

A Health Systems Agency of Eastern Connecticut study (Report on Low-Level Radiation and Health Problems in Southeastern Connecticut) points to the difficulties inherent in studies of populations exposed to small increments of radiation. Because of these experimental difficulties, the only point on which there seems to be universal agreement is that the degree of health risk associated with low-level radiation has not been proven conclusively. Basing its calculations on the linear model, the Northeast Utilities study estimates that less than one potential excess cancer fatality could be expected as a result of radioactive effluents from the three Millstone units and the Haddam Neck facility during the operational lives of these plants. In the 50-mile areas around these facilities, approximately 470,000 people can be expected eventually to die of cancer from all causes.

III.B. Marine Environment

The potential effects of Millstone on the marine environment are all related to the use of seawater for condenser cooling. Units I and II draw a total of 2,155 cubic feet per second of water from Niantic Bay, which after use, is discharged into Long Island Sound. (Unit III, when put in operation, will have a circulating flow of 2,000 cfs.) This circulation affects the marine environment in 3 ways. First, the cooling water is heated as it passes through the plant, increasing its temperature at discharge by 25°F; elevated temperatures in the discharge plume may alter the habitability of the area for certain species and force relocation to other, more suitable habitat. Second, finfish and macroinvertebrates (crabs, lobsters, squid) are impinged on the rotating screens that are installed at the cooling water intakes to prevent organisms and debris from being drawn into the cooling systems; impingement is fatal in the majority of cases, thereby reducing total populations. Third, small organisms (plankton) pass through the intake screens and are circulated through the cooling systems; this entrainment may cause mortality as organisms are subjected to elevated temperatures and mechanical damage. Mortality of ichthyoplankton (fish eggs and larvae) is of concern because of the loss of potential adults.

Northeast Utilities maintains an on-site environmental laboratory with a permanent staff of 30. The lab began studies of the waters surrounding Millstone in 1968, two years prior to the start-up of Unit I, and therefore has collected and analyzed data establishing trends over a 15-year period. The lab personnel carry out continuing sampling and analysis of impingement totals, plankton entrainment, intertidal habitat in the rocky shorefront around the plant (particularly important for detection of thermal pollution effects), benthic (bottom-dwelling)

organisms, fish ecology, and heavy metals. Special attention is given to the population dynamics of lobsters and winter flounder because of their value as commercial and recreational catches and because the Niantic River is a major spawning area for winter flounder.

In simplified terms, the methodology common to all of these studies is: to establish estimated populations through sampling and counts; to identify seasonal and annual trends in species density and relative composition, and differences due to location where appropriate; and to develop models and profiles which relate trends to naturally-occuring as well as plant-induced variables. The findings of these studies have led Northeast Utilities to conclude that the effects of operations at the Millstone Power Station since 1970 on the marine environment of the area have been negligible. Local fishermen have objected to the winter flounder sampling program in the Niantic River, concerned that the sampling itself results in flounder mortality and disruption of spawning; the utility maintains that the sampling is not detrimental to the flounder population.[6]

III.C. Air Quality, Noise, Aesthetics

No quantification of these potential impact areas was attempted; the general magnitude of their effects, however, can be characterized. Operation of the power station has no measurable effect on East Lyme in the areas of noise and air quality (emissions of hydrocarbons and particulates). In both cases, the levels produced are low, and potential effects on East Lyme are further reduced by the combination of distance and prevailing wind directions. Traffic generated by the power station inevitably results in increased levels of emissions along the roadways in East Lyme. The emissions increase would be expected to be greatest at intersections, particularly

the Route 156/Route 161 intersection, during peak traffic periods. However, these peaks are brief from an air quality standpoint, and the relatively open, shoreside location of the Main Street area should result in rapid dispersion of emissions.

The scale of the power station and its location on a peninsula make it a visually dominant feature in Niantic Bay. These factors, combined with the clearly industrial nature of the structures, are no doubt considered an aesthetic intrusion by residents of East Lyme, particularly those living on the eastern shorefront of Black Point and persons using the Town beach and park at McCook Point.

FOOTNOTES

1. Electric Power Research Institute, Socioeconomic Impacts of Power Plants, Section IV; Hendrickson, et al, Review of Existing Studies and Unresolved Problems Associated with Socio-Economic Impact of Nuclear Power Plants, pp. 2 and 13-14; Peelle, Socioeconomic Effects of Operating Reactors on Two Host Communities: A Case Study of Pilgrim and Millstone; Policy Research Associates, Socioeconomic Impacts: Nuclear Power Station Siting.

2. Electric Power Research Institute, pp. III-15 and V-1 to V-7; Hendrickson, p. 14.

3. Purdy, et al, A Post Licensing Study of Community Effects at Two Operating Nuclear Power Plants.

4. Electric Power Research Institute, pp. S-4 and V-7 to V-11; Bjornstad, Fiscal Impacts Associated with Power Reactor Siting: A Paired Case Study.

5. The coefficient utilized in this analysis is derived from Burchell and Listokin, The Fiscal Impact Handbook, pp. 31-32 and 122-125. Case studies have shown that: (1) the actual cost to provide municipal services to non-residential properties is less per thousand of assessed valuation than the cost of services to residential properties; and (2) the cost per thousand of assessed valuation for services to non-residential properties decreases as the average value of these properties rises. Thus, a coefficient is needed to avoid overstating the cost of services to non-residential properties, and the coefficient to be used in any particular case will vary according to the ratio of average non-residential value to average value for all properties.

6. New London Day, April 21, 1982, p. 16.

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_____. Radiological Emergency Response Plan for the Town of East Lyme. Effective date: March 1, 1983.

Appendix B: Potential Cost Impact of Evacuation

The study scope of work requests an evaluation of potential local costs in the event of a radiological emergency resulting in evacuation of the area. Assuming the evacuated area is effectively secured so that property losses from vandalism, looting, or fire do not occur, the components of potential cost are: municipal costs to provide emergency personnel; costs to individuals in lost income and extra living expense incurred during evacuation; and costs to business in lost sales and production.

Research conducted in the aftermath of the Three Mile Island accident (U.S. Nuclear Regulatory Commission, The Social and Economic Effects of the Accident at Three Mile Island) offers a perspective on potential losses. This study estimates that 144,000 of the 370,000 persons within 15 miles of the plant site evacuated the area for an average period of 5 days and incurred a total of approximately $15 million in lost income and evacuation expenses, or about $300 per household. Production and sales profit losses were estimated at $10 to $14 million. The study also concluded that economic "normalcy" returned almost immediately with the end of the emergency; no long-term disruption to the regional economy was discerned.

Municipal Costs: Table B.1 gives an estimate developed by East Lyme's Director of Civil Preparedness of the personnel, food, and fuel costs that would be incurred daily in responding to a radiological emergency. It should be noted that: (1) this $22,000 per day cost would be incurred in the event of any radiological emergency, not only in an emergency requiring evacuation; and (2) these costs would probably be reimbursed to the Town by the Federal Emergency Management Agency.

Individual Costs: If total evacuation of the Town is assumed, lost income (based on 1983 estimated median family

Table B.1

Town of East Lyme
Personnel Required in the Event of Civil Emergency

TOWN	Firemen - 5 fulltime @7.89/hr	39.45/hr
	60 parttime @ 5.26/hr	315.60/hr
	Police - 8 fulltime @7.89/hr	63.12/hr
	18 parttime @5.26/hr	94.68/hr
	Public Works - 15 @ 7.25/hr	108.75/hr
	Fire Marshal's Office - 2 @ 6.73/hr	13.46/hr
	Civil Preparedness - 2 @ 6.52/hr	13.04/hr
	Parks & Rec. - 2 @ 7.20/hr	14.40/hr
	Water - 3 @ 8.42/hr	25.26/hr
	Senior Bus - 1 @ 5.73/hr	5.73/hr
	Office Staff - 3 @ 6.79/hr	20.37/hr
	Communications Center - 2 @ 7.89/hr	15.78/hr
SCHOOL		
	Custodians - 8 @ 6.44/hr	51.52/hr
	Office Staff - 4 @ 7.02/hr	28.08/hr
	Bus Drivers - 19 @ 5.38/hr	102.22/hr
	TOTAL HOURLY COST	895.68/hr

Wages estimated at $1,000.00 per hours for the first 8 hours and $1,400.00 per hour at the overtime rate.

Estimated wages for the first 24-hour period	19,000.00
Food Costs for working personnel Food cost includes, food, wages and other expenses Food cost estimated at 1.25 per meal per person $250 per meal X 3 meals	730.00

NOTE: Additional costs for feeding the public would be estimated at the same rate providing evacuation centers are used for the general public. This cost cannot be estimated.

Fuel usage for evacuation	1,500.00
TOTAL PER DAY COST	22,145.68

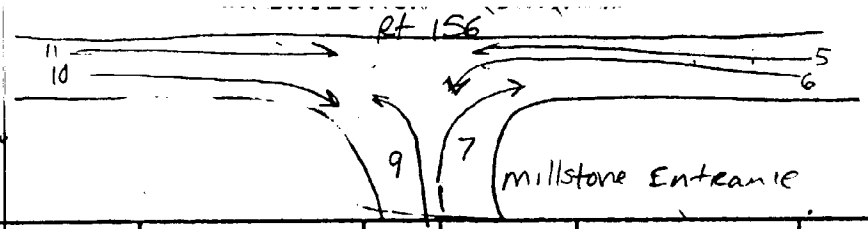
income and number of East Lyme households) would total approximately $649,000 per day. To this must be added extra expenses in food, lodging, and travel associated with evacuation. Based on the Three Mile Island study, $50 per day per household in extra expenses is estimated or approximately $243,000 in total. Thus, total daily costs to individuals could reach $900,000.

Business Costs: Costs to business would be in the form of lost income related to decreased sales and production. Given the relatively small scale of industry and wholesale trade in East Lyme, the primary losses would occur in the retail and service sectors. Here, daily losses of sales are estimated at roughly $270,000. However, net income lost would be the small percentage of this figure constituting profit margins on the lost sales. Assuming a 10 percent profit margin, roughly $27,000 would be lost daily in the retail and service sectors.

Thus, the total economic impact of a total evacuation of the Town could approach $1 million per day. No account has been taken in these estimates of the potential mitigation of impact that could occur through collections on insurance policies or receipt of public assistance payments.

TOWN NIANTIC

LOCATION Rt 156 and Millstone Entrance Intersection



DATE 7-26-83 WEEK DAY TUES

WEATHER Clear ROAD SURFACE

LENGTH BY

COMPUTED BY RF

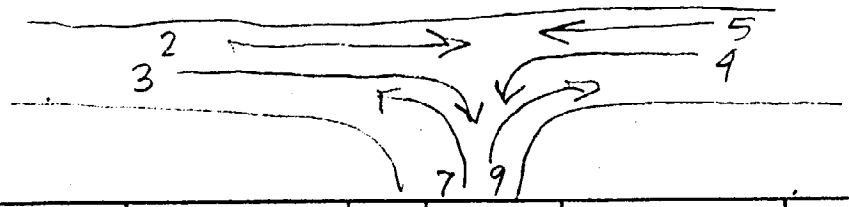
CHECKED BY 7/26/83 TUES.

ME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON – 12:15																
2:15 – 12:30																
2:30 – 12:45																
2:45 – 1:00																
OURLY TOTAL																
1:00 – 1:15																
1:15 – 1:30																
1:30 – 1:45																
1:45 – 2:00																
OURLY TOTAL																
2:00 – 2:15																
2:15 – 2:30																
2:30 – 2:45																
2:45 – 3:00																
OURLY TOTAL																
3:00 – 3:15						44	27	71	30		81	111	69	53		122
3:15 – 3:30						46	30	76	39		95	134	67	65		132
3:30 – 3:45						43	23	66	79		216	295	71	45		116
3:45 – 4:00						51	38	89	29		90	119	115	35		150
OURLY TOTAL						184	118	302	177		482	659	322	198		520
4:00 – 4:15						44	61	105	92		173	265	118	32		150
4:15 – 4:30						65	27	92	72		153	225	68	43		111
4:30 – 4:45						70	7	77	162		279	441	7	50		57
4:45 – 5:00						86	16	102	227		254	481	8	31		39
OURLY TOTAL			1124			265	111	376	553		859	1412	201	156		357
5:00 – 5:15																
5:15 – 5:30																
5:30 – 5:45																
5:45 – 6:00																
OURLY TOTAL																
RAND TOTAL						449	229	678	730		1341	2071	523	354		877

OWN NIANTIC

OCATION Milton Arnold

INTERSECTION DIAGRAM



DATE 7-28-83 WEEK DA THURS

WEATHER Clear ROAD SU

LENGTH _____ BY _____

COMPUTED BY RF

CHECKED BY 7/28/83 THURS.

ME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON - 12:15																
2:15 - 1230.																
2:30 - 12:45																
2:45 - 1:00																
OURLY TOTAL																
:00 - 1:15																
:15 - 1:30																
:30 - 1:45																
:45 - 2:00																
OURLY TOTAL																
2:00 - 2:15																
2:15 - 2:30																
2:30 - 2:45																
2:45 - 3:00																
OURLY TOTAL																
3:00 - 3:15																
3:15 - 3:30																
3:30 - 3:45																
3:45 - 4:00																
OURLY TOTAL																
4:00 - 4:15																
4:15 - 4:30																
4:30 - 4:45																
4:45 - 500																
OURLY TOTAL																
5:00 - 5:15		24	6	30	8	42		50	107		242	409				
5:15 - 5:30		67	22	89	14	74		88	147		138	285				
5:30 - 5:45		45	20	65	12	53		65	92		84	176				
5:45 - 600		65	19	84	18	56		74	59		33	92				
OURLY TOTAL		201	67	268	52	225		272	465		497	962				
RAND TOTAL		201	67	268	52	225		272	465		497	962				

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: Milltone Access Rd. Town: NIANTIC Tape # 282

Date: 7/26/83 W

Direction: NB Project #: 4582 Counter # 10

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE		7-26					
12-1 AM							
1-2 AM							
2-3 AM							
3-4 AM							
4-5 AM							
5-6 AM							
6-7 AM							
7-8 AM							
8-9 AM							
9-10 AM							
10-11 AM							
11-12 AM		98					
12-1 PM		223					
1-2 PM		230					
2-3 PM		116					
3-4 PM		154					
4-5 PM		568					
5-6 PM		1397					
6-7 PM							
7-8 PM							
8-9 PM							
9-10 PM							
10-11 PM							
11-12 PM							
AVG. & HIGH HRS							
24 HR TOTAL							

COMMENT:

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: 700' W of Millstone Entrance Light Rt 156 Town: Waterford Tape # 280

Date: 7/26/83 W

Direction: WB Project #: 4592 Counter # 5

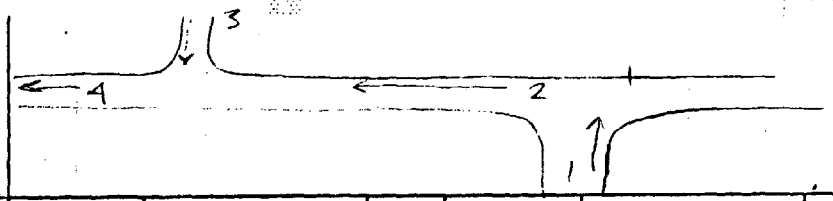
	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE		7-26					
12-1 AM							
1-2 AM							
2-3 AM							
3-4 AM							
4-5 AM							
5-6 AM							
6-7 AM							
7-8 AM							
8-9 AM							
9-10 AM							
10-11 AM							
11-12 AM		348					
12-1 PM		337					
1-2 PM		263					
2-3 PM		126					
3-4 PM		615					
4-5 PM		1163					
5-6 PM							
6-7 PM							
7-8 PM							
8-9 PM							
9-10 PM							
10-11 PM							
11-12 PM							
AVG. 8 HIGH HRS							
24 HR. TOTAL							

COMMENT:

OWN [illegible]

LOCATION Rt 156 (2,4)
[illegible] River Rd (3)
[illegible] Access Rd (1)

INTERSECTION DIAGRAM



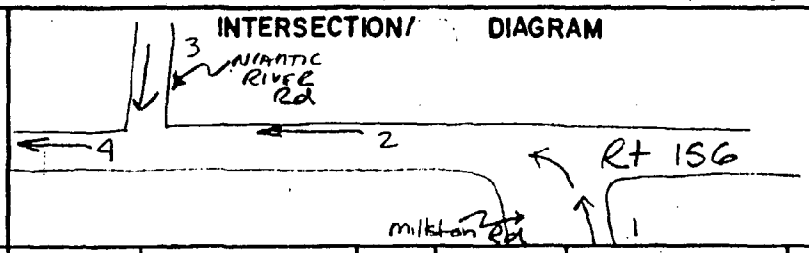
DATE [illegible] WEEKDAY
WEATHER [illegible] ROAD SURFACE
LENGTH _____ BY [illegible]
COMPUTED BY RF
CHECKED BY 7/26/83 TUES

TIME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON – 12:15	124	149	59	332	152											
12:15 – 12:30	30	65	28	98	73											
12:30 – 12:45	46	72	27	99	90											
12:45 – 1:00	30	51	25	106	69											
HOURLY TOTAL	230	337	139	706	384											
1:00 – 1:15	32	62	28	122	76											
1:15 – 1:30	20	61	32	113	84											
1:30 – 1:45	26	65	26	117	75											
1:45 – 2:00	38	75	22	135	81											
HOURLY TOTAL	106	263	108	477	316											
2:00 – 2:15	48	83	35	176	87											
2:15 – 2:30	35	21	26	82	79											
2:30 – 2:45	29	16	33	68	85											
2:45 – 3:00	42	16	40	88	58											
HOURLY TOTAL	260	126*	134	520	309											
3:00 – 3:15	105	50	35	190	112											
3:15 – 3:30	134	145	38	317	135											
3:30 – 3:45	307	271	46	624	202											
3:45 – 4:00	127	149	45	321	101											
HOURLY TOTAL	673	615	164	1452	550											
4:00 – 4:15	262	238	44	544	228											
4:15 – 4:30	186	218	38	442	174											
4:30 – 4:45	452	370	91	863	268											
4:45 – 5:00	497	337	43	877	291											
HOURLY TOTAL	1397	1163	166	2726	961											
5:00 – 5:15																
5:15 – 5:30																
5:30 – 5:45																
5:45 – 6:00																
HOURLY TOTAL																
GRAND TOTAL	2436	1678	711	4825	2520											

TOWN NIANTIC

LOCATION Rt 156 (2,4)
NIANTIC RIVER Rd (3)
Milklone Access Rd (1)

INTERSECTION/ DIAGRAM



DATE 7-26-83 WEEK D TUES
WEATHER CLEAR ROAD SURFACE
LENGTH BY
COMPUTED BY RF
CHECKED BY 7/26/83 TUES

TIME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
6AM - 6:15																
6:15 - 6:30																
6:30 - 6:45																
6:45 - 7:00																
HOURLY TOTAL																
7:00 - 7:15																
7:15 - 7:30																
7:30 - 7:45																
7:45 - 8:00																
HOURLY TOTAL																
8:00 - 8:15																
8:15 - 8:30																
8:30 - 8:45																
8:45 - 9:00																
HOURLY TOTAL																
9:00 - 9:15																
9:15 - 9:30																
9:30 - 9:45																
9:45 - 10:00																
HOURLY TOTAL																
10:00 - 10:15	27			27												
10:15 - 10:30	21	53		74												
10:30 - 10:45	28	47	23	98												
10:45 - 11:00	22	67	24	113	72			72								
HOURLY TOTAL	98	167	47	312	72			72								
11:00 - 11:15	33	79	29	141	57			57								
11:15 - 11:30	36	59	26	121	100			100								
11:30 - 11:45	52	92	28	172	83			83								
11:45 - 12NOON	103	118	38	259	66			66								
HOURLY TOTAL	224	348	169	740	306			306								
GRAND TOTAL	322	515	215	1052	378			578								

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: NIANTIC RIVER Rd Town: [illegible] Tape # 281

#100' N of AVER INTERSECTION Date: 7-26-83 W

Direction: NB Project #: 4582 Counter # 11

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE		7-26					
12-1 AM							
1-2 AM							
2-3 AM							
3-4 AM							
4-5 AM							
5-6 AM							
6-7 AM							
7-8 AM							
8-9 AM							
9-10 AM							
10-11 AM							
11-12 AM		121					
12-1 PM		139					
1-2 PM		108					
2-3 PM		134					
3-4 PM		164					
4-5 PM		167					
5-6 PM							
6-7 PM							
7-8 PM							
8-9 PM							
9-10 PM							
10-11 PM							
11-12 PM							
AVG. 8 HIGH HRS.							
24 HR. TOTAL							

COMMENT:

YEAR 1963 STA NO 175 1

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

(A)

TRAFFIC RECORDER DATA

TOWN OF Waterford ROUTE DIRECTION E

LOC U.S. 1 E.B. - N.W. of Niantic River Road

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	627	628	629	0	0	0
HOUR BEG							
MID	0	0	41	44	0	0	0
1A	0	0	18	23	0	0	0
2A	0	0	13	10	0	0	0
3A	0	0	19	15	0	0	0
4A	0	0	15	18	0	0	0
5A	0	0	167	170	0	0	0
6A	0	0	778	798	0	0	0
7A	0	502	495	0	0	0	0
8A	0	318	296	0	0	0	0
9A	0	281	269	0	0	0	0
10A	0	337	253	0	0	0	0
11A	0	346	301	0	0	0	0
12P	0	351	300	0	0	0	0
1P	0	350	280	0	0	0	0
2P	0	370	324	0	0	0	0
3P	0	483	428	0	0	0	0
4P	0	474	406	0	0	0	0
5P	0	436	342	0	0	0	0
6P	0	252	224	0	0	0	0
7P	0	232	190	0	0	0	0
8P	0	165	146	0	0	0	0
9P	0	118	114	0	0	0	0
10P	0	103	118	0	0	0	0
11P	0	66	65	0	0	0	0
TOT	0	5186	5624	1076	0	0	0

24HR 6237 MACHINE NO 221

YEAR 1963 STA NO 175 2

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

(B)

TRAFFIC RECORDER DATA

TOWN OF Waterford ROUTE DIRECTION W

LOC U.S. 1 W.B. - S.E. of Niantic River Road

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	627	628	629	0	0	0
HOUR BEG							
MID	0	0	40	46	0	0	0
1A	0	0	26	18	0	0	0
2A	0	0	18	27	0	0	0
3A	0	0	10	8	0	0	0
4A	0	0	10	9	0	0	0
5A	0	0	37	20	0	0	0
6A	0	0	101	117	0	0	0
7A	0	207	205	0	0	0	0
8A	0	226	205	0	0	0	0
9A	0	230	249	0	0	0	0
10A	0	248	247	0	0	0	0
11A	0	291	307	0	0	0	0
12P	0	332	334	0	0	0	0
1P	0	330	278	0	0	0	0
2P	0	366	327	0	0	0	0
3P	0	502	410	0	0	0	0
4P	0	684	589	0	0	0	0
5P	0	440	410	0	0	0	0
6P	0	310	220	0	0	0	0
7P	0	211	195	0	0	0	0
8P	0	194	159	0	0	0	0
9P	0	130	151	0	0	0	0
10P	0	71	93	0	0	0	0
11P	0	64	66	0	0	0	0
TOT	0	4836	4687	245	0	0	0

24HR 5078 MACHINE NO 224

YEAR 1983 STA NO 175 3

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

C

TRAFFIC RECORDER DATA

TOWN OF Waterford ROUTE DIRECTION N

LOC Niantic River Rd. N.B. - South of U.S. 1

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	627	628	629	0	0	0
HOUR BEG							
MID	0	0	20	16	0	0	0
1A	0	0	26	32	0	0	0
2A	0	0	84	82	0	0	0
3A	0	0	6	6	0	0	0
4A	0	0	9	7	0	0	0
5A	0	0	24	16	0	0	0
6A	0	0	112	113	0	0	0
7A	0	0	175	0	0	0	0
8A	0	141	150	0	0	0	0
9A	0	117	118	0	0	0	0
10A	0	107	114	0	0	0	0
11A	0	126	121	0	0	0	0
12P	0	147	165	0	0	0	0
1P	0	123	116	0	0	0	0
2P	0	146	121	0	0	0	0
3P	0	291	236	0	0	0	0
4P	0	411	316	0	0	0	0
5P	0	321	287	0	0	0	0
6P	0	153	146	0	0	0	0
7P	0	122	96	0	0	0	0
8P	0	54	60	0	0	0	0
9P	0	43	35	0	0	0	0
10P	0	40	36	0	0	0	0
11P	0	29	35	0	0	0	0
TOT	0	2371	2608	274	0	0	0

<4HR 2827 MACHINE NO 250

STORCH ENGINEERS

Location: RTE 156 (Waterford) Town: NIANTIC CONN Tape #

EAST of DRAW BRIDGE Date: 6-24-83 W

Direction: WESTBOUND Project #: 4587 Counter # 8

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE					6-24	6-25	
12-1 AM						164	
1-2 AM						198	
2-3 AM						256	
3-4 AM						35	
4-5 AM						24	
5-6 AM						47	
6-7 AM						96	
7-8 AM						149	
8-9 AM						200	
9-10 AM						296	
10-11 AM						335	
11-12 AM						373	
12-1 PM						494	
1-2 PM						400	
2-3 PM					271	339	
3-4 PM					467	569	
4-5 PM					1004	497	
5-6 PM					605		
6-7 PM					436		
7-8 PM					401		
8-9 PM					362		
9-10 PM					294		
10-11 PM					224		
11-12 PM					212		
AVG. 8 HIGH HRS							
24 HR TOTAL							

COMMENT:

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: Rt 156 600' E of Drawn BRIDGE

Town: MIAMITIC

Tape # [illegible]

Date: 7-26-83

W

Direction: WB

Project #: 4582

Counter # 8

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE	7-25	7-26	7-20				
12-1 AM							
1-2 AM							
2-3 AM							
3-4 AM							
4-5 AM							
5-6 AM							
6-7 AM							
7-8 AM							
8-9 AM							
9-10 AM							
10-11 AM							
11-12 AM		306					
12-1 PM		384					
1-2 PM		316					
2-3 PM		309					
3-4 PM		550					
4-5 PM		961					
5-6 PM		357					
6-7 PM							
7-8 PM							
8-9 PM							
9-10 PM							
10-11 PM							
11-12 PM							
AVG. 8 HIGH HRS							
24 HR. TOTAL							

COMMENT:

STORCH ENGINEERS

Location: RTE 156 JUST EAST OF SMITH AVE
Town: NIANTIC CONN
Tape #
Date: 6-24-83
W
Direction: WESTBOUND
Project #: 4587
Counter # 10

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE					6-24	6-25	
12-1 AM						171	
1-2 AM						193	
2-3 AM						265	
3-4 AM						35	
4-5 AM						30	
5-6 AM						63	
6-7 AM						122	
7-8 AM						171	
8-9 AM						264	
9-10 AM						349	
10-11 AM						397	
11-12 AM						441	
12-1 PM						539	
1-2 PM						479	
2-3 PM						415	
3-4 PM					414	632	
4-5 PM					433	597	
5-6 PM					502		
6-7 PM					1029		
7-8 PM					652		
8-9 PM					487		
9-10 PM					455		
10-11 PM					417		
11-12 PM					339		
AVG. & HIGH HRS							
24 HR TOTAL							

COMMENT:

STORCH ENGINEERS

Location: RTE 156 JUST WEST OF SMITH AVE

Town: NIANTIC CONN

Date: 6-24-83

Direction: WESTBOUND

Project #: 4582

Tape #

W

Counter # 5

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE					6-24	6-25	
12-1 AM						163	
1-2 AM						189	
2-3 AM						237	
3-4 AM						36	
4-5 AM						20	
5-6 AM						53	
6-7 AM						115	
7-8 AM						151	
8-9 AM						224	
9-10 AM						268	
10-11 AM						295	
11-12 AM						357	
12-1 PM						446	
1-2 PM					297	400	
2-3 PM					374	351	
3-4 PM					421	501	
4-5 PM					707	466	
5-6 PM					503		
6-7 PM					375		
7-8 PM					367		
8-9 PM					338		
9-10 PM					291		
10-11 PM					216		
11-12 PM					193		
AVG. 8 HIGH HRS							
24 HR TOTAL						6739	

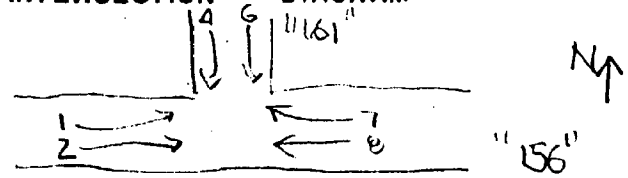
COMMENT:

PEAK HOUR PERCENTAGE 707/6739 = 10.5%

OWN ___ NIMITIC CONN

OCATION 161+156 INTERSECTION

INTERSECTION DIAGRAM



DATE 6-25 WEEK DA' SAT

WEATHER ___ ROAD SUR[illegible] ___

LENGTH ___ BY ___

COMPUTED BY D

CHECKED BY 6·25·83 SAT

ME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON – 12:15	74	58		132	53		43	96	30	71		101				
2:15 – 12:30	52	64		116	57		47	104	56	68		124				
:30 – 12:45	41	57		98	60		30	90	26	26		52				
2:45 – 1:00	55	58		113	45		47	92	30	68		98				
URLY TOTAL	222	237		459	215		167	382	142	233		375				
:00 – 1:15																
:15 – 1:30																
:30 – 1:45																
:45 – 2:00																
URLY TOTAL																
:00 – 2:15	66	64		130	45		47	92	22	56		78				
:15 – 2:30	70	65		135	66		32	98	23	46		69				
:30 – 2:45	54	67		121	57		46	103	34	69		103				
:45 – 3:00	62	58		120	59		37	96	36	32		68				
URLY TOTAL	252	254		506	227		162	389	115	203		318				
:00 – 3:15	52	81		133	44		52	96	60	89		149				
:15 – 3:30	62	67		129	42		45	87	29	50		79				
:30 – 3:45	50	61		111	36		44	80	29	118		147				
:45 – 4:00	59	60		119	36		34	70	32	70		102				
URLY TOTAL	223	269		492	158		175	333	150	327		477				
:00 – 4:15	55	56		111	54		33	87	42	74		116				
:15 – 4:30	54	61		115	46		39	85	25	50		75				
:30 – 4:45	59	60		119	55		30	85	36	83		119				
:45 – 5:00	52	68		120	44		32	76	30	71		101				
URLY TOTAL	220	245			199		134	333	133	278		411				
:00 – 5:15																
:15 – 5:30																
:30 – 5:45																
:45 – 6:00																
URLY TOTAL																
AND TOTAL																

YEAR 1981 STA NO 44 26

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

TRAFFIC RECORDER DATA

TOWN OF EAST LYME ROUTE 156 DIRECTION B

LOC WEST OF ROUTE 161

1981 ADT = 11300

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	0	0	909	910	0	0
HOUR BEG							
MID	0	0	0	0	69	0	0
1A	0	0	0	0	37	0	0
2A	0	0	0	0	24	0	0
3A	0	0	0	0	12	0	0
4A	0	0	0	0	19	0	0
5A	0	0	0	0	88	0	0
6A	0	0	0	0	324	0	0
7A	0	0	0	0	730	0	0
8A	0	0	0	325	495	0	0
9A	0	0	0	639	0	0	0
10A	0	0	0	727	0	0	0
11A	0	0	0	784	0	0	0
12P	0	0	0	891	0	0	0
1P	0	0	0	792	0	0	0
2P	0	0	0	851	0	0	0
3P	0	0	0	811	0	0	0
4P	0	0	0	1111	0	0	0
5P	0	0	0	905	0	0	0
6P	0	0	0	704	0	0	0
7P	0	0	0	678	0	0	0
8P	0	0	0	480	0	0	0
9P	0	0	0	346	0	0	0
10P	0	0	0	247	0	0	0
11P	0	0	0	147	0	0	0
TOT	0	0	0	10438	1798	0	0

24HR 11741 MACHINE NO 283

YEAR 1[illegible] STA NO 44 16

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

TRAFFIC RECORDER DATA

TOWN OF EAST LYME ROUTE 161 DIRECTION B

LOC NORTH OF ROUTE 156

1981 ADT = 7690

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	0	0	909	910	0	0
HOUR BEG							
MID	0	0	0	0	59	0	0
1A	0	0	0	0	28	0	0
2A	0	0	0	0	17	0	0
3A	0	0	0	0	6	0	0
4A	0	0	0	0	15	0	0
5A	0	0	0	0	56	0	0
6A	0	0	0	0	189	0	0
7A	0	0	0	419	432	0	0
8A	0	0	0	324	328	0	0
9A	0	0	0	467	451	0	0
10A	0	0	0	565	0	0	0
11A	0	0	0	572	0	0	0
12P	0	0	0	593	0	0	0
1P	0	0	0	597	0	0	0
2P	0	0	0	616	0	0	0
3P	0	0	0	541	0	0	0
4P	0	0	0	600	0	0	0
5P	0	0	0	536	0	0	0
6P	0	0	0	443	0	0	0
7P	0	0	0	489	0	0	0
8P	0	0	0	327	0	0	0
9P	0	0	0	227	0	0	0
10P	0	0	0	151	0	0	0
11P	0	0	0	106	0	0	0
TOT	0	0	0	7513	1581	0	0

[illegible] 1983 MACHINE NO 173

YEAR 1981 STA NO 44 [illegible]5

STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAYS
ENGINEERING DATA & INVENTORY SECTION

TRAFFIC RECORDER DATA

TOWN OF EAST LYME ROUTE 156 DIRECTION B

LOC EAST OF ROUTE 161

1981 ADT [illegible]

DAY	SUN	MON	TUES	WED	THUR	FRI	SAT
DATE	0	0	0	909	910	0	0
HOUR BEG							
MID	0	0	0	0	75	0	0
1A	0	0	0	0	44	0	0
2A	0	0	0	0	22	0	0
3A	0	0	0	0	9	0	0
4A	0	0	0	0	20	0	0
5A	0	0	0	0	111	0	0
6A	0	0	0	0	414	0	0
7A	0	0	0	849	872	0	0
8A	0	0	0	437	412	0	0
9A	0	0	0	464	430	0	0
10A	0	0	0	552	0	0	0
11A	0	0	0	606	0	0	0
12P	0	0	0	745	0	0	0
1P	0	0	0	619	0	0	0
2P	0	0	0	623	0	0	0
3P	0	0	0	760	0	0	0
4P	0	0	0	1033	0	0	0
5P	0	0	0	727	0	0	0
6P	0	0	0	615	0	0	0
7P	0	0	0	581	0	0	0
8P	0	0	0	353	0	0	0
9P	0	0	0	282	0	0	0
10P	0	0	0	217	0	0	0
11P	0	0	0	172	0	0	0
TOT	0	0	0	9595	2409	0	0

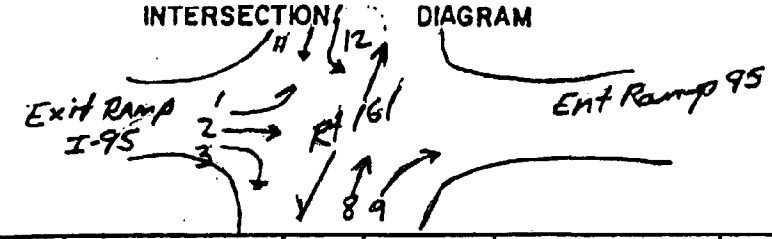
[illegible] MACHINE NO 187

Court Appeals High

TOWN East Lyme

LOCATION I-95 & Rt 161

INTERSECTION DIAGRAM



DATE 7-27-83 WEEK D THU

WEATHER Sun ROAD SURFACE

LENGTH _____ BY RF

COMPUTED BY _____

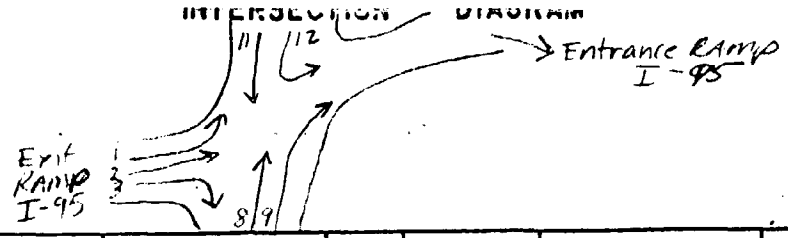
CHECKED BY 7/21/83 TMCA

TIME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
6AM - 6:15																
6:15 - 6:30																
6:30 - 6:45																
6:45 - 7:00																
HOURLY TOTAL																
7:00 - 7:15	10		17	27						50	101			72	3	
7:15 - 7:30	10		19	29						47	101			98	4	
7:30 - 7:45	7		12	19						71	134			119	7	
7:45 - 8:00	24		19	43						96	129			162	3	
HOURLY TOTAL	51		61	122						264	460	724		451	17	468
8:00 - 8:15	41		33	74						66	118			113	4	
8:15 - 8:30	20		9	29						70	92			127	2	
8:30 - 8:45	13		25	38						56	79			24	5	
8:45 - 9:00	14		24	38						70	70			153	4	
HOURLY TOTAL	88		91	179						262	359	621		517	15	532
9:00 - 9:15																
9:15 - 9:30																
9:30 - 9:45																
9:45 - 10:00																
HOURLY TOTAL																
10:00 - 10:15																
10:15 - 10:30																
10:30 - 10:45																
10:45 - 11:00																
HOURLY TOTAL																
11:00 - 11:15																
11:15 - 11:30																
11:30 - 11:45																
11:45 - 12NOON																
HOURLY TOTAL																
GRAND TOTAL	[illegible]		[illegible]							526	819	1345		[illegible]	[illegible]	[illegible]

TOWN EAST LYME

LOCATION I-95 E Rt 161

INTERSECTION DIAGRAM



DATE 7-20-83 WEEK DA

WEATHER ROAD SURFACE

LENGTH BY

COMPUTED BY

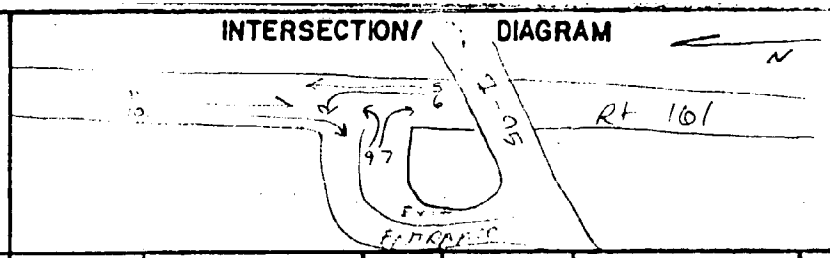
CHECKED BY 7/20/83 WED

ME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON – 12:15																
2:15 – 12:30																
2:30 – 12:45																
2:45 – 1:00																
OURLY TOTAL																
1:00 – 1:15																
1:15 – 1:30																
1:30 – 1:45																
1:45 – 2:00																
OURLY TOTAL																
2:00 – 2:15																
2:15 – 2:30																
2:30 – 2:45																
2:45 – 3:00																
OURLY TOTAL																
3:00 – 3:15																
3:15 – 3:30																
3:30 – 3:45																
3:45 – 4:00																
OURLY TOTAL																
4:00 – 4:15	22		28							132	88			207	7	
4:15 – 4:30	21		17							142	92			241	7	
4:30 – 4:45	27		16							146	90			250	6	
4:45 – 5:00	31		17							157	91			248	7	
OURLY TOTAL	101		78	179						577	361	938		949	27	985
5:00 – 5:15	22		25							128	78			200	4	
5:15 – 5:30	23		18							120	64			241	2	
5:30 – 5:45	15		22							[illegible]	57			200	2	
5:45 – 6:00	29		15							131	97			246	7	
OURLY TOTAL	89		80	169						490	326	816		967	16	983
RAND TOTAL	190		158	348						1067	687	1754		1943	43	1968

TOWN EAST LYME

LOCATION I-95 Rt 161 Interchange

INTERSECTION/ DIAGRAM



DATE 7-26-83 WEEK DAY Tues

WEATHER Clear ROAD SURFACE

LENGTH BY

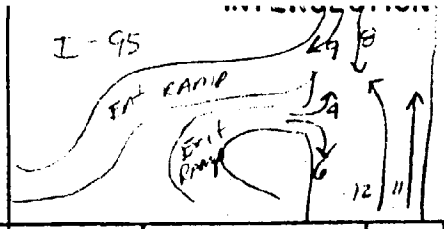
COMPUTED BY RF

CHECKED BY 7/26/83 TUES

TIME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
6AM – 6:15																
6:15 – 6:30																
6:30 – 6:45																
6:45 – 7:00																
HOURLY TOTAL																
7:00 – 7:15						43	8	51	26		0	26	16	66		
7:15 – 7:30						40	15	65	31		1	32	19	68		
7:30 – 7:45						64	8	72	28		2	30	9	61		
7:45 – 8:00						71	11	82	50		2	52	13	78		
HOURLY TOTAL						218	42	260	135		5	140	67	273		340
8:00 – 8:15						64	12	76	32		2	34	20	77		
8:15 – 8:30						69	10	79	42		2	44	17	71		
8:30 – 8:45						74	21	95	38		1	39	20	74		
8:45 – 9:00						79	20	99	37		6	43	17	89		
HOURLY TOTAL						286	53	339	149		11	160	74	311		385
9:00 – 9:15																
9:15 – 9:30																
9:30 – 9:45																
9:45 – 10:00																
HOURLY TOTAL																
10:00 – 10:15																
10:15 – 10:30																
10:30 – 10:45																
10:45 – 11:00																
HOURLY TOTAL																
11:00 – 11:15																
11:15 – 11:30																
11:30 – 11:45																
11:45 – 12 NOON																
HOURLY TOTAL																
GRAND TOTAL						504	95	599	184		16	200	141	584		725

TOWN EAST LYME

LOCATION I 95 & Rt 161



DATE WEEK DA

WEATHER ROAD SURFACE

LENGTH BY

COMPUTED BY

CHECKED BY 7/21/83 THURS

TIME PERIODS	MOVEMENT NO. 1	2	3	15 MIN. TOTAL	MOVEMENT NO. 4	5	6	15 MIN. TOTAL	MOVEMENT NO. 7	8	9	15 MIN. TOTAL	MOVEMENT NO. 10	11	12	15 MIN. TOTAL
NOON – 12:15																
12:15 – 12:30																
12:30 – 12:45																
12:45 – 1:00																
HOURLY TOTAL																
1:00 – 1:15																
1:15 – 1:30																
1:30 – 1:45																
1:45 – 2:00																
HOURLY TOTAL																
2:00 – 2:15																
2:15 – 2:30																
2:30 – 2:45																
2:45 – 3:00																
HOURLY TOTAL																
3:00 – 3:15																
3:15 – 3:30																
3:30 – 3:45																
3:45 – 4:00																
HOURLY TOTAL																
4:00 – 4:15					6		70			146	20			126	34	
4:15 – 4:30					7		90			121	18			129	19	
4:30 – 4:45					9		117			127	17			[illegible]	27	
4:45 – 5:00					7		109			157	16			155	25	
HOURLY TOTAL					29		386	915		551	71	622		552	105	657
5:00 – 5:15					3		106			159	15			136	20	
5:15 – 5:30					2		108			147	16			57	29	
5:30 – 5:45					1		75			112	20			[illegible]	29	
5:45 – 6:00					4		68			121	28			112	18	
HOURLY TOTAL					10		357	367		539	79	618		417	[illegible]	517
GRAND TOTAL					39		743	782		1090	150	1240		1101	[illegible]	[illegible]

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: Rt 161 Town: EAST LYME Tape # 277

[illegible]00' S. of Light @ Indust. Pk Rd Date: W

Direction: SB Project #: 4582 Counter # 10

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE	7-25	7-26	7-20	7-21	7-22	7-23	7-24
12-1 AM	101	102		152	116	197	193
1-2 AM	40	57		64	66	135	134
2-3 AM	40	32		43	45	79	82
3-4 AM	12	21		35	28	53	61
4-5 AM	16	16		29	17	45	42
5-6 AM	97	121		147	136	119	57
6-7 AM	290	290		303	338	207	73
7-8 AM	393	357		368	389	193	124
8-9 AM	455	411		480	469	409	190
9-10 AM	501			530	526	613	288
10-11 AM	558			643	620	806	370
11-12 AM	612			737	742	861	483
12-1 PM	626			734	793	847	564
1-2 PM	681		593	620	666	667	637
2-3 PM	657		613	625	767	685	628
3-4 PM	704		717	718	797	643	584
4-5 PM	861		915	919	995	616	542
5-6 PM	746		933	894	959	552	491
6-7 PM	622		678	664	693	573	402
7-8 PM	528		580	564	652	555	439
8-9 PM	429		507	496	550	443	362
9-10 PM	346		407	446	456	423	334
10-11 PM	205		296	268	312	313	250
11-12 PM	180		193	153	256	214	[illegible]
AVG. 8 HIGH HRS.							
24 HR. TOTAL	9680			10652	11288	10238	7595

COMMENT:

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: EAST LYME Town: E LYME Tape # 276

Rt 161 South of Ind Pk Rd 1000' Date: 7-27-83 W

Direction: NB Project #: 4592 Counter # 5

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE	7-25	7-26	7-20	7-21	7-22	7-23	7-24
12-1 AM				81			
1-2 AM				72			
2-3 AM				98			
3-4 AM				29			
4-5 AM				8			
5-6 AM				73			
6-7 AM				378			
7-8 AM				639			
8-9 AM				148			
9-10 AM				543			
10-11 AM				533			
11-12 AM				560			
12-1 PM				610			
1-2 PM			610	556			
2-3 PM			605	Hose disconnected			
3-4 PM			622				
4-5 PM			847				
5-6 PM			715'				
6-7 PM			629				
7-8 PM			628				
8-9 PM			453				
9-10 PM			394				
10-11 PM			269				
11-12 PM			191				
AVG. 8 HIGH HRS.							
24 HR. TOTAL			9735				

COMMENT:

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: Industrial Park Rd Town: E LYME Tape #

250' W of Rt 161 EB Date: 7-27-83 W

Direction: EB Project #: 4582 Counter # 11

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE	7-25	7-26	7-20	7-21	7-22	7-23	7-24
12-1 AM	1	4		5	10	8	2
1-2 AM	2	1		0	0	0	0
2-3 AM	0	1		0	2	0	0
3-4 AM	0	1		0	1	0	0
4-5 AM	0	0		0	2	0	0
5-6 AM	0	0		1	0	1	0
6-7 AM	4	1		4	1	3	0
7-8 AM	18	9		10	11	4	0
8-9 AM	27	39		30	28	5	1
9-10 AM	30			33	39	7	0
10-11 AM	29			28	30	12	5
11-12 AM	37			28	28	10	3
12-1 PM	52		64	72	70	8	2
1-2 PM	26		30	37	24	5	1
2-3 PM	16		25	29	29	13	1
3-4 PM	72		62	61	68	4	1
4-5 PM	106		108	124	116	7	5
5-6 PM	39		44	39	34	3	1
6-7 PM	13		21	19	20	34	2
7-8 PM	14		26	22	5	4	2
8-9 PM	13		28	25	28	1	0
9-10 PM	4		1	4	1	1	0
10-11 PM	0		3	2	0	0	0
11-12 PM	1		0	0	0	0	0
AVG. 8 HIGH HRS.							
24 HR. TOTAL	492			543	547	130	26

COMMENT:

MACHINE COUNT SUMMARY

STORCH ENGINEERS

Location: INDUSTRIAL PARK RD 250' W of Rt 161 Town: East Lyme Tape # 278

Date: 7-27-83 W

Direction: W.B. Project #: 4582 Counter # 8

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
DATE	7-25	7-26	7-20	7-21	7-22	7-23	7-24
12-1 AM				6	3	1	
1-2 AM				2	3	0	
2-3 AM				0	0	0	
3-4 AM				0	1	0	
4-5 AM				2	1	0	
5-6 AM				3	1	0	
6-7 AM				61	69	4	
7-8 AM				101	116	11	
8-9 AM				51	36	7	
9-10 AM				32	33	10	
10-11 AM				31	30	12	
11-12 AM				30	36	4	
12-1 PM			66	77	68	4	
1-2 PM			39	50	34	1	
2-3 PM			42	41	35	9	
3-4 PM			50	63	58	3	
4-5 PM			51	38	46		
5-6 PM			28	32	25		
6-7 PM			16	26	11		
7-8 PM			10	8	6		
8-9 PM			18	15	8		
9-10 PM			4	4	0		
10-11 PM			7	3	0		
11-12 PM			2	0	0		
AVG. & HIGH HRS.			-				
24 HR. TOTAL			-	676	620		

COMMENT:

SEQUENCE & TIMING

	PHASE A						PHASE Bx, By						FLASHING OPERATION
	INIT	VEH	MAX #1	MAX #2	CL	CL	CL	INIT	VEH	MAX #1	MAX #2	CL	CL	
(SEC)	18	5	60	45	6	4	3.5	7	4	50	40	3	2	
NO.														
			G		G	A	R		R			R	R	FL. A
			G		G	A	R		R			R	R	FL. A
			G		G	A →	R →		R →			R →	R →	FL. A
			R		R	R	R		G			A	R	FL. A
			G		G	A	R		R			R	R	FL. A
			G		G	A	R		R			R	R	FL. A
			G		G	A	R		R			R	R	FL. A
			R		R	R	R		G			A	R	FL. A
SIGN	OFF													ON

PHASE "A" ON RECALL.

PHASE "Bx" TO CALL PHASE "By" AND VICE VERSA.

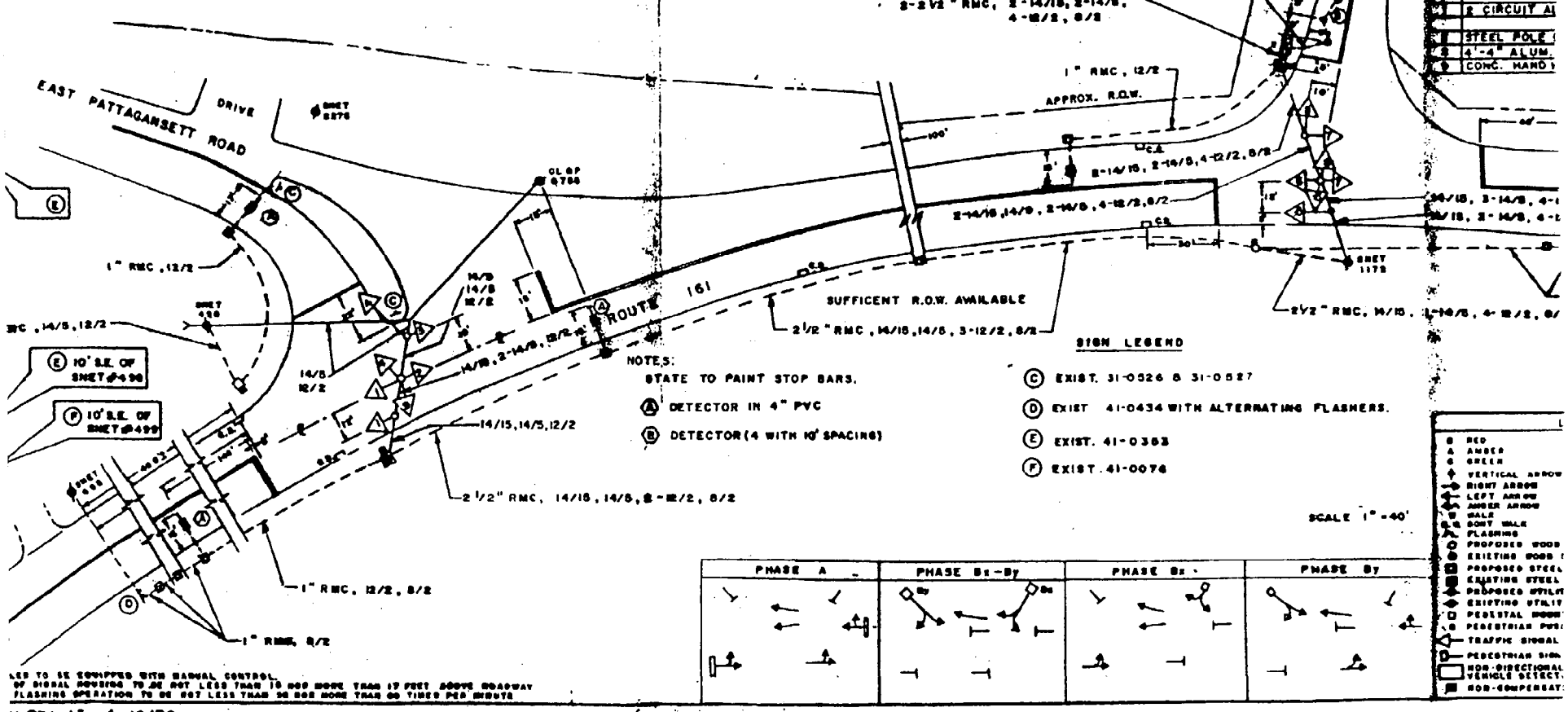
PHASE "Bx" AND "By" TO TIME CONCURRENTLY BUT INDEPENDENTLY.

(1) SPECIAL SIGN TO FLASH.

PEDESTRIAN ACTUATION TO RECEIVE 15" PHASE "Bx" OR PHASE "By" GREEN.

MAX. #2 TO OPERATE 6:30 A.M. TO 9:30 A.M. MON. THRU FRI.; MAX. 1 TO OPERATE ALL OTHER TIMES.

SIGNAL TO FLASH 10:00 P.M. TO 5:00 A.M. E.S.T.



NOTES:

STATE TO PAINT STOP BARS.

(A) DETECTOR IN 4" PVC

(B) DETECTOR (4 WITH 10' SPACING)

SIGN LEGEND

(C) EXIST. 31-0526 & 31-0527

(D) EXIST 41-0434 WITH ALTERNATING FLASHERS.

(E) EXIST. 41-0353

(F) EXIST. 41-0074

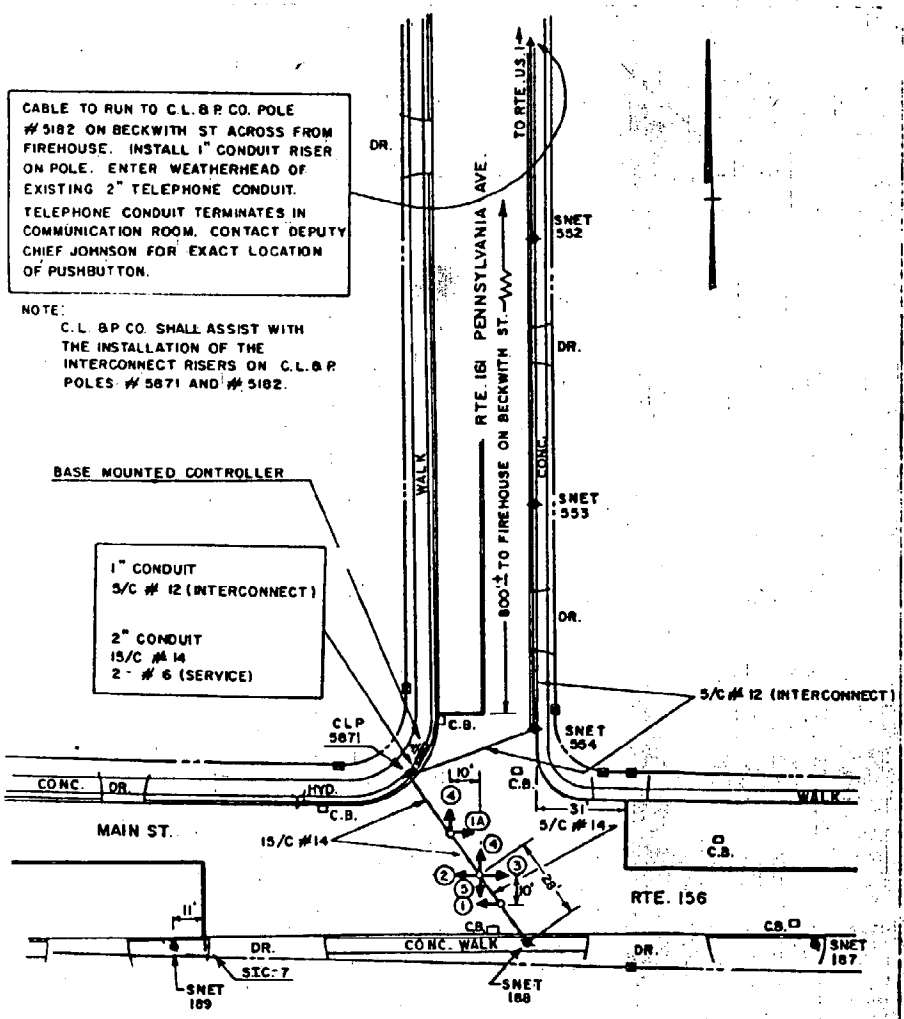
SCALE 1" = 40'

LES TO BE EQUIPPED WITH MANUAL CONTROL.
OF SIGNAL HOUSING TO BE NOT LESS THAN 10 NOR MORE THAN 17 FEET ABOVE ROADWAY
FLASHING OPERATION TO BE NOT LESS THAN 50 NOR MORE THAN 60 TIMES PER MINUTE

M TRA-13 ed 10/76

CABLE TO RUN TO C.L. & P. CO. POLE #5182 ON BECKWITH ST ACROSS FROM FIREHOUSE. INSTALL 1" CONDUIT RISER ON POLE. ENTER WEATHERHEAD OF EXISTING 2" TELEPHONE CONDUIT. TELEPHONE CONDUIT TERMINATES IN COMMUNICATION ROOM. CONTACT DEPUTY CHIEF JOHNSON FOR EXACT LOCATION OF PUSHBUTTON.

NOTE:
C.L. & P. CO. SHALL ASSIST WITH THE INSTALLATION OF THE INTERCONNECT RISERS ON C.L. & P. POLES #5871 AND #5182.



NOTE:
PAINT STOP BARS AS SHOWN.

TRAFFIC CONTROL SIGNAL

TOWN OF EAST LYME (NIANTIC)

INTER. OF ROUTE 156 AND ROUTE 161

FACE NO.	PHASE A			PHASE B		FL OPER	DELAY	FIRE PRE-EMPTION		
1A	R	G	A	R	R	FL. A		A	R	R
1	G	G	A	R	R	FL. A		A	R	R
2	← G	G	A	R	R	FL. A		A	R	R
3	R	G	A	R	R	FL. A		A	R	R
4	R	R	R	G	A	FL. R		A	G	A
5	R	R	R	G	A	FL. R		A	R	R
MIN. SET.	6"	10"	5"	10"	3"		5"	3"	10"	3"
MAX. SET.	15"	34"	5"	34"	5"		45"	5"	60"	5"
ACT. SET.	10"	21"	4"	22"	3"		20"	3"	50"	3"

OFFICE RECORD
REVISION #3

STC REPORT # 11106 11-16-65
PLAN NO. 3870 S SIGNAL REVISED 9-26-66
FIELD CHECKED 9-29-66 CTC
ADD DUAL HEADS, ADD TIMING RANGE AND FIRE PRE-EMPTION PHASE. REVISED ARTERY GREEN FROM 22" TO 21". REVISED ARTERY AMBER FROM 3" TO 4". SEE MEMO. DATED 5-23-60. STC APPROVED 6-21-60 FOR PAST RECORD.

REVISION #4 CRM 7-23-68
STC - REPORT # 14004 APPROVED 9-17-68
PERMIT NO. 4929-SR ISSUED 9-3-68
SIGNAL REVISED NOT REVISED
ADDED RIGHT ARROW ON FACE 1A.

REVISION #5 CRM 5-12-69
STC - REPORT # APPROVED
PERMIT NO. ISSUED
SIGNAL REVISED
FIELD CHECKED BY
REMOVED RIGHT ARROW ON FACE 1A.

EQUIPMENT REQUIRED

1 SINGLE DIAL FIXED TIME TWO PHASE TRAFFIC CONTROLLER WITH FIRE PRE-EMPTOR, BASE MOUNTED.

1 4 WAY-3,3,3,4 SECTION TRAFFIC SIGNAL

1 2 WAY-3 SECTION TRAFFIC SIGNAL

1 1 WAY-3 SECTION TRAFFIC SIGNAL. ALL TRAFFIC SIGNALS SPAN WIRE SUSPENDED

1 STANDARD SURFACE MOUNTED ENCLOSURE WITH MOMENTARY CONTACT PUSH BUTTON ASSEMBLY AND RED JEWEL LIGHT ASSEMBLY

DRIVEN GROUND
EXISTING POLE
PROPOSED POLE
SIGNAL HEAD
CONTROLLER
DETECTOR
PED PUSH BUTTON
CONDUIT & CABLE

E.C.E.	2-19-65
E.C.E.	3-23-65
P.A.S.	3-29-65
BJQ	6-7-65
RJM	6-9-65
M.C.F.	5-20-66
G.S.	5-25-66
D.P.M.	5-25-66
Amd	5-27-66

NOAA COASTAL SERVICES CENTER LIBRARY
3 6668 00001 6339