5 INDIRECT EFFECTS AND CUMULATIVE IMPACTS

5.1 INTRODUCTION

MassDOT's stated purpose of the South Coast Rail project is to more fully meet the existing and future demand for public transportation between Fall River/New Bedford and Boston, Massachusetts to enhance regional mobility, while supporting smart growth planning and development strategies in affected communities.

The South Coast region includes 31 Massachusetts communities with a combined population of approximately 740,000. The regional population is projected to grow to more than 928,000 by 2035, making the South Coast one of the fastest growing regions of the state. As documented in the *South Coast Rail Economic and Land Use Corridor Plan*[1] (Corridor Plan), the South Coast Rail project is anticipated to result in economic benefits and growth in jobs and households within the South Coast region. While these changes are economically beneficial, induced growth is likely to affect land use and other resources. MassDOT has therefore incorporated smart growth planning into the project to provide communities with the opportunity to organize new growth and direct it away from sensitive areas of ecological value. The region envisions a future with renewed and expanded urban centers, new walkable neighborhoods, and natural areas that are preserved for future generations.

The following indirect effects and cumulative impacts analysis is consistent with the CEQ and other agency guidance documents, including:

- Considering Cumulative Effects Under the National Environmental Policy Act[2]
- Guidance on the Consideration of Past Actions in Cumulative Effects Analysis[3]
- Interim Guidance: Questions and Answers Regarding Indirect and Cumulative Impact Considerations in the NEPA Process[4]
- Consideration of Cumulative Impacts in EPA Review of NEPA Documents[5]

The indirect (or secondary) effects analysis is focused on induced household and employment growth that may result from increased transportation access in the South Coast region. The cumulative impact analysis evaluates changes within the study area as a result of past, present, and reasonably foreseeable future actions combined with the South Coast Rail project.

5.1.1 Regulatory Context and Definitions

The requirement to analyze the direct, indirect and cumulative impacts of proposed federal actions was established in the CEQ regulations implementing NEPA. This section summarizes key definitions and

[1] Goody Clancy 2009. South Coast Rail Economic Development and Land Use Corridor Plan. Goody Clancy: Boston, MA. June 2009.

[2] Council on Environmental Quality. 1997. *Considering Cumulative Effects Under the National Environmental Policy Act.* Executive Office of the President, Council on Environmental Quality: Washington, D.C. January 1997.

[3] Council on Environmental Quality. 2005. *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis.* , Executive Office of the President, Council on Environmental Quality: Washington, D.C. June 24, 2005.

[4] Federal Highway Administration. 2003. *Interim Guidance: Questions and Answers Regarding Indirect and Cumulative Impact Considerations in the NEPA Process*. US Department of Transportation, Federal Highway Administration: Washington, D.C. January 31, 2003.

[5] Environmental Protection Agency. 1999. *Consideration of Cumulative Impacts in EPA Review of NEPA Documents.* EPA 315-R-99-02. US Environmental Protection Agency, Office of Federal Activities: Washington, D.C. May 1999.

requirements related to indirect effects and cumulative impacts from the CEQ NEPA regulations, agency guidance documents, and court decisions. It should be noted that "effects" and "impacts" as used in the CEQ regulations are synonymous and can be positive or negative (40 CFR 1508.8).

5.1.1.1 Direct Effects

According to the CEQ's regulations implementing NEPA, direct effects are "caused by the action and occur at the same time and place" (40 CFR 1508.8). Direct effects are typically well understood and predictable. Examples of common direct effects for transportation projects include residential and business displacements, filling of wetlands to construct rail infrastructure, and removal of a historic structure.

5.1.1.2 Indirect Effects

Indirect effects "are caused by the action and are later in time and/or farther removed in distance, but are still reasonably foreseeable." Indirect effects "may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). The National Cooperative Highway Research Program's (NCHRP) *Report 466: Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects* identifies two primary types of indirect effects—induced growth (or growth influencing) and encroachment-alteration.

Induced growth type indirect effects are changes in the location and/or magnitude of future development attributed to changes in accessibility caused by the transportation project. Accessibility is the ease of movement from an origin (to all other places) or as a destination (from all other places). Transportation improvements change accessibility by reducing the time cost of travel between destinations. Changes in accessibility can affect the location decisions of residents and businesses if favorable economic, regulatory and infrastructure conditions are also supportive of new development. An example of an induced growth type indirect effect is commercial development occurring around a new rail station and the environmental impacts associated with this development. The transportation project is a necessary condition for this development to occur (by providing new or improved access), but is not a sufficient condition. In order for the development to occur, it also requires favorable conditions that may include:

- economic conditions that support development (e.g., markets, acceptable rate of return on investment in land purchase, design, construction, and other costs);
- zoning and other land use controls and policies suitable for the type of development suggested by market conditions;
- other infrastructure that supports development (e.g., water and sewer service); and
- amenities (e.g., good schools, access to recreational opportunities).

Encroachment-alteration indirect effects are physical, chemical or biological changes in the environment as a result of the project removed in time or distance from the direct effects. An example of an encroachment-alteration indirect effect would be a long-term decline in the viability of a population of a particular species as a result of habitat fragmentation caused by the project. Encroachment-alteration effects such as habitat fragmentation or changes in water quality are addressed in the resource-specific chapters of this FEIS/FEIR (e.g. Biodiversity, Wildlife and Vegetation, Water Resources, etc.).

Regardless of the type of indirect effect, case law has established that NEPA documents need to address indirect effects that are likely or probable.[6] Speculation on indirect effects that are merely possible is not required. In Sierra Club v Marsh 769 F. 2d 763 (1985), the Court set forth a three-part test to determine if a particular set of impacts is definite enough to take into account, or too speculative to warrant consideration:

- With what confidence can one say that the impacts are likely to occur?
- Can one describe them now with sufficient specificity to make their consideration useful?
- If the decision maker does not take them into account now, will the decision maker be able to take account of them before the agency is so firmly committed to the project that further environmental knowledge, as a practical matter, will prove irrelevant to the government's decision?

Where economic development is an explicit part of the project purpose, the indirect effects analysis should also consider the environmental effects of this development.

5.1.1.3 Cumulative Impacts

A cumulative impact is "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7). According to the FHWA's *Interim Guidance: Questions and Answers Regarding the Consideration of Indirect and Cumulative Impacts in the NEPA Process,*[7] cumulative impacts include the total of all impacts to a particular resource that have occurred, are occurring, and will likely occur as a result of any action or influence, including the direct and reasonably foreseeable indirect impacts of a proposed project.

Cumulative impact analysis is inherently resource-specific and frequently regional in scale. CEQ's *Considering Cumulative Effects under the National Environmental Policy Act* envisions cumulative impact analysis as a tool for evaluating the implications of project-level decisions on the status or health of regional resources. According to the USEPA, an adequate cumulative effects analysis of impacts that are due to past, present, and reasonably foreseeable future actions needs to consider the following factors: 1) whether the environment has been degraded, and if so, to what extent; 2) whether ongoing activities in the area are causing impacts; and 3) the trends for activities and impacts in the area.[8]

To determine what information is relevant to include in a cumulative impact analysis, sufficient scoping and research should reveal those actions that are "relevant to reasonably foreseeable significant adverse impacts" and are "essential to a reasoned choice among alternatives," and can be obtained without exorbitant cost.[9]

A cumulative impact analysis should identify:

[6] See NCHRP 25-25 Task 43 Legal Sufficiency Criteria for Adequate Indirect Effects and Cumulative Impacts Analysis as Related to NEPA Documents, 2008.

[7] Available online at: http://www.environment.fhwa.dot.gov/projdev/qaimpact.asp.

[8] USEPA. "Consideration of Cumulative Impacts in EPA Review of NEPA Documents," Office of Federal Activities (2252A). Document No. EPA 315-R-99-002. May, 1999.

[9] Connaughton, J.L., "Guidance on the Consideration of Past Actions in Cumulative Effects Analysis." Memorandum to Heads of Federal Agencies. June 24, 2005.

- the area in which the effects of the proposed project will be felt;
- the impacts that are expected in that area from the proposed project;
- other past, present, and reasonably foreseeable actions that have or are expected to have impacts in the area;
- the impacts or expected impacts from these other actions; and
- the overall impact that can be expected if the individual impacts are allowed to accumulate.

"Reasonably foreseeable future actions" for the purpose of cumulative impact analysis are probable or likely, not merely possible.

5.1.2 Massachusetts Environmental Policy Act Requirements

The MEPA regulations at 301 CMR 11.07(6) (h) require that an EIR evaluate the cumulative effects of a proposed project. The Secretary's Certificate on the ENF required that the DEIR include several specific analyses and information, listed below.

- The DEIR should present an analysis of the secondary and cumulative impacts, both positive and negative, related to induced growth in communities affected by the rail and bus alternatives, and explain how implementation of the Corridor Plan is expected to mitigate potential adverse impacts.
- Each of the alternatives should be evaluated under three different scenarios, including the full build with mitigation, i.e., implementation of the Corridor Plan. The full range of potential environmental impacts associated with implementation of this plan should be evaluated including impacts to biodiversity, wetlands, endangered species, air quality and greenhouse gas (GHG) emissions, transportation, municipal infrastructure, and water resources.
- The DEIR should define the study area for evaluation of secondary growth impacts and explain the rationale for the boundaries selected.
- The DEIR should discuss different scenarios for induced growth and explain how this has been incorporated in modeling for the alternatives analysis
- The DEIR should discuss different scenarios and include projections of where growth is expected to occur, and at what rate, under each of the alternatives.
- The DEIR should identify areas where sprawl may occur under certain alternatives and include mitigation plans to concentrate development and protect natural resources.
- The DEIR should evaluate the alternatives on the basis of other smart growth principles, including conservation of open space and use of existing infrastructure.
- The DEIR should discuss the trade-offs inherent in project alternatives, such as increased impacts on certain resources for environmental benefits in other areas.

- The DEIR should include details on specific mechanisms that will be used to ensure that the smart growth goals of the project will be realized, including funding commitments and mechanisms for conservation of PPAs and acquisition and development of PDAs.

- The DEIR should describe in detail how land use will be controlled and priority conservation areas permanently protected.

- The DEIR should clarify indicators and metrics to be used for evaluation of smart growth, and propose a long-term monitoring and evaluation plan.

- The DEIR should describe specific strategies and resources, including state funding commitments, to ensure successful implementation of the Corridor Plan.

- The DEIR should describe the tools and resources needed by individual communities to take advantage of the economic development potential of the proposed rail line in a manner that protects critical resources and is consistent with the Commonwealth's Sustainable Development Principles.

- The DEIR should also include information on any municipal land use or policy commitments that have been made.

- With respect to secondary growth impacts, each alternative should be analyzed under three different scenarios: (1) the baseline condition, which evaluates environmental conditions in the absence of the proposed rail under the assumption that current travel and development patterns continue and there are no changes in municipal zoning, (2) build without mitigation, which evaluates impacts, including induced growth, associated with each alternative in the absence of transit-oriented development (TOD), green building, zoning changes, transfer of development rights, wetlands restoration, habitat protection, or other mitigation measures, and (3) build with mitigation, which evaluates impacts associated with the alternatives assuming implementation of the Corridor Plan, TOD in and around the stations, habitat protection (including priority protection areas, PPAs) and other proposed mitigation.

- The DEIR should include an assessment of costs associated with implementation of the smart growth aspects of the project for each alternative, to fully understand the overall costs and rationale for selection of alternatives.

The Secretary's Certificate on the DEIR requested additional information on smart growth mitigation measures and the implementation of the Corridor Plan. This information is provided in Section 5.5.

5.1.3 Organization of this Chapter

Section 5.2 presents the methods used to assess indirect effects and cumulative impacts for each of the alternatives. Section 5.3 presents indirect effects assessment for the No-Build Alternative and the build alternatives under two scenarios—without smart growth measures, and with the implementation of the South Coast Rail Economic Development and Land Use Corridor Plan (the Plan). Section 5.3 also provides a description of the Plan and the smart growth measures that are included in the South Coast Rail alternatives. Section 5.4 provides an analysis of the cumulative impacts of the South Coast Rail alternatives on natural, social, cultural, and physical resources.

5.2 METHODOLOGY

5.2.1 Indirect Effects

This section identifies the methodology and assumptions for the analysis of indirect effects.

5.2.1.1 Introduction

Potential indirect effects (beneficial and adverse) of the Build Alternatives were evaluated with and without smart growth measures (including TOD). The Corridor Plan was the guiding land use development plan for this analysis. The Commonwealth provides a number of grant programs that support smart growth from economic development to land preservation. The Massachusetts Executive Office of EEA has developed a Smart Growth/Smart Energy Toolkit,[10] which includes tools, model bylaws, and other resources to help local planners control sprawl/encourage smart growth.

The analyses consider reasonably foreseeable indirect effects, from project initiation in 2016 through the planning period ending in 2035, from implementing the South Coast Rail project. Induced growth that would result from the Build Alternatives includes the creation of new residential development and jobs. In order to assess the indirect effects of this induced growth, two scenarios were developed to allocate growth in the South Coast region. The first scenario, Scenario 1, allocates induced growth under business as usual conditions, includes baseline conditions, and assumes that induced growth would occur in a traditional pattern.

The second scenario, Scenario 2, assumes that growth would be directed to Priority Development Areas (PDAs) and away from PPAs, based on the planning efforts of each municipality in the South Coast region. It includes the baseline growth, project-induced growth, and goals of the Corridor Plan. For some analyses, Scenario 2 was evaluated based on high and low levels of implementation of smart growth measures. The allocation of each growth scenario was then viewed in terms of its impact on natural, social, cultural, and physical resources as compared to the No-Build Alternative.

Each analysis relies on data provided in the Corridor Plan, information provided by the three regional planning agencies (RPAs) in the South Coast region, and information developed by MassDOT. The analysis identifies potential changes in land use, infrastructure requirements (water, sewer, etc.) under each scenario and the social and economic environment that would likely result from growth induced by the new transit system. Based on the anticipated changes in land use, potential impacts to selected environmental resources are estimated.

Each of the two build scenarios have been evaluated regionally for a range of potential impacts, based on the option with the largest projected ridership: the Stoughton Electric Alternative. The Whittenton Alternative was not evaluated, because its effects would be similar in magnitude and location to the Stoughton Electric Alternative. The indirect effects analysis in this FEIS/FEIR therefore assumes that these two alternatives are equivalent because the same level of induced growth distributed among the municipalities is expected.

[10] EOEEA. 2009. Available online at: http://www.mass.gov/?pageID=eoeeamodulechunk&L=1&L0=Home&sid=Eoeea&b=terminalcontent&f=eea_sgse_toolkit&csid=Eoeea. Accessed 27 May 2009.

5.2.1.2 Study Area

The study area for the indirect effects assessment is based on the area where induced growth would be likely to occur as a result of the South Coast Rail project (the "commuteshed"). The commuteshed includes the 31 Massachusetts communities in the Corridor Plan and four communities in southeastern Rhode Island that could potentially be served by a rail station in Fall River (Table 5.2-1). All communities are within a reasonable commuting distance of the proposed rail corridors and transit stations.

Table 5.2-1 Indirect Effects Study Area Municipalities

Regional Planning Agency	Municipalities	
Metropolitan Area Planning Council	*Canton*[1]	*Sharon*
	Foxborough	*Stoughton*
Old Colony Planning Council	*Bridgewater*	
	Easton	
	Stoughton[2]	
Southeast Regional Planning and Economic Development District	Acushnet	New Bedford
	Attleboro	*North Attleborough*
	Berkley	*Norton*
	Dartmouth	Raynham
	Dighton	Rehoboth
	Fairhaven	Rochester
	Fall River	Seekonk
	Freetown	Somerset
	Lakeville	Swansea
	Mansfield	Taunton
	Marion	Wareham
	Mattapoisett	Westport
	Middleborough	
Rhode Island	Bristol	Tiverton
	Portsmouth	Warren

1 Communities in italics are the "SCR 10" northern communities.
2 Stoughton is shared between Metropolitan Area Planning Council and Old Colony Planning Council.

5.2.1.3 No-Build (Enhanced Bus) Alternative

Conditions under the future No-Build Alternative (in 2035), based on the regional plans of the MAPC, the OCPC, and SRPEDD, have been developed to establish baseline conditions by which to assess the effects of the Build Alternatives under the scenarios discussed below. Smart growth measures already adopted by communities, irrespective of the South Coast Rail project, have also been incorporated in this baseline.

5.2.1.4 Scenario 1 – Indirect Effects without Smart Growth Measures

The analysis considers reasonably foreseeable indirect effects from implementing the South Coast Rail project without smart growth strategies, including TOD. Induced growth, both within immediate proximity of station areas and in nearby communities that are served by each station, has been estimated based on literature review and regional growth projections:

- Growth projections of jobs and households from SRPEDD, OCPC, and MAPC;
- Induced growth estimates of jobs and households from the Transportation Economic Development Impact System Model (TREDIS)[11] were projected by calculating the percentage of total 2030 Scenario 1 growth comprised by each municipality's 2030 No-Build Alternative and 2030 Scenario 1 growth projections, and applying the municipality-specific percentage from the 2035 No-Build Alternative to project 2035 Scenario 1 growth;
- Distribution of jobs and households in the region from the Corridor Plan and SRPEDD, MAPC, OCPC, and Regina Villa Associates; and
- Job growth projections were not previously available for Dartmouth and Wareham. Therefore the following assumptions were applied to calculate projected 2035 job growth in these municipalities. In order to arrive at projected 2035 job growth, the 2000 municipal population was multiplied by the average 2035 job growth per capita of nearby towns.

MassDOT has developed projections for induced growth in jobs and households broken down into three regions: Suffolk County/Cambridge, SCR 10[12] (the northern communities) and SCR 21[13] (the South Coast communities). Projections were also made for the four Rhode Island communities that are expected to have commuters utilizing the potential new transit service. This is growth that would not occur without the transit investment. In 2010, MassDOT prepared new regional projections of population and employment growth. The RPAs then updated their projections at the municipal level based on these revised figures.

Induced Jobs

The TREDIS model provides projections for new jobs according to the North American Industry Classification System (NAICS) employment classification system. Comparisons between the location quotients of the current distribution of jobs by consolidated NAICS job codes with the estimated distribution of the induced jobs allowed for projections to be made for the number and sub-regional geographic distribution of new jobs.

Data used to inform the allocation include:

- ridership data provided by the Central Transportation Planning Staff (CTPS) from the Boston Region Metropolitan Planning Organization, RPA demographic projections, and regional economic data sets;
- existing employment centers by sector: for example, the communities with the highest regional share of manufacturing jobs are expected to attract the majority of new manufacturing jobs;
- current trends: communities that have strong growth in particular job sectors are expected to continue attracting jobs from those sectors; and

[11] The Transportation Economic Development Impact System Model (TREDIS) is a web-based analysis system used to analyze planned transportation investments. The model works by utilizing a series of modules that compare project impacts and project benefits.

[12] SCR 10 communities: Attleboro, Bridgewater, Canton, Easton, Foxborough, Mansfield, North Attleborough, Norton, Sharon, and Stoughton.

[13] SCR 21 communities: New Bedford, Acushnet, Berkley, Dartmouth, Dighton, Fairhaven, Fall River, Freetown, Lakeville, Marion, Mattapoisett, Middleborough, Raynham, Rehoboth, Rochester, Seekonk, Somerset, Swansea, Taunton, Wareham, and Westport.

- zoning, infrastructure capacity, land availability, and transportation access: industrial parks and other job centers that have the appropriate zoning, infrastructure, and land available for expansion are likely to capture a significant share of this new growth.

To estimate the number of induced jobs under Scenario 1, total jobs were first projected by the model for the sub-regions and then distributed to the municipal level.

Unlike housing, which tends to be distributed more diffusely throughout the region, jobs are more strongly tied to existing job centers and less so to proposed station sites. Manufacturing jobs, for example will be clustered in industrial parks and other areas so zoned. Health occupations tend to congregate in hospitals and other medical campus settings. Consolidated NAICS job sector codes were used to group jobs into larger categories. For example, the NAICS codes between 541 and 551 were combined to create the Professional, Scientific, and Technical Services category—one of the sectors estimated to experience significant growth related to the restoration of transit service. A job share for each consolidated NAICS sector was then calculated for each city and town.

SRPEDD analyzed labor and workforce data for the consolidated job sectors for all communities between 2001 and 2008. An eight-year sector average was developed for each category for each municipality. These data reveal which communities have clusters of industry and, because it is an average over the eight-year time period, smooths out any anomalous years and captures recent trends. The eight-year jobs sector average by community was used to allocate the induced jobs in SCR 10 and SCR 21 communities.

To incorporate the expected influence of the transportation routes, a normative scoring system was used to take into account the relative influence the route alternative is likely to have on a given municipality. This system was developed by a working team consisting of the RPAs and project consultants. A community designated as likely to be strongly influenced, moderately influenced, or to experience limited influence. Communities were designated as strongly influenced if they would contain a new station or if the access to transportation service is improved. Moderate influence designations went to communities likely to experience less significant influence—those that are reasonably close to greatly expanded service or those communities that would see modest improvements in service. Finally, communities were assigned to limited influence if little or no change is expected to existing transportation service or if they are remotely located from new service.

Fifty percent of the induced jobs assigned to the communities that would experience a limited influence were then reassigned equally to the strongly influenced communities. The limited influence communities are the farthest away from the service improvements and would have the least benefit from transit improvements. On the other hand, the strongly influenced communities are expected to see more housing development and job opportunities as a result of the South Coast Rail project.

Because the TREDIS model's study area did not include any communities in Rhode Island, an estimate of the induced job growth for the Rhode Island communities was made by calculating the proportional growth the communities' Massachusetts neighbors would receive. Bristol and Portsmouth were assigned the same growth rate as Swansea; Tiverton to Westport; and Warren to Seekonk.

Induced Households

Similar to the effects on job creation, expanded and improved transportation access would increase the potential for new households to locate in the region. Some households are likely to be attracted to new

employment opportunities. Other households would be attracted to the relatively less expensive housing markets farther south of the Greater Boston area. Expected household growth for each of the alternatives was calculated by the Economic Development Research Group, Inc. A summary report, including a description of their methodology, is included in Appendix 5.2-A.

Factors considered in allocating induced households included:

- Ridership origination. Using ridership data produced by CTPS, areas that are now within a 20-minute drive of new stations are expected to generate new households. Communities within the northern portion of the corridor are already within a 20-minute commute to the stations of the Old Colony Line to the east and the Northeast Corridor to the west. Induced growth in this geography is more likely to be concentrated closer to new transit stations.

- Service time. Train and bus service times double in frequency north of the Southern Triangle (in Taunton).

- Housing costs. Housing costs generally decrease south of Mansfield providing more opportunity for home ownership and larger homes.

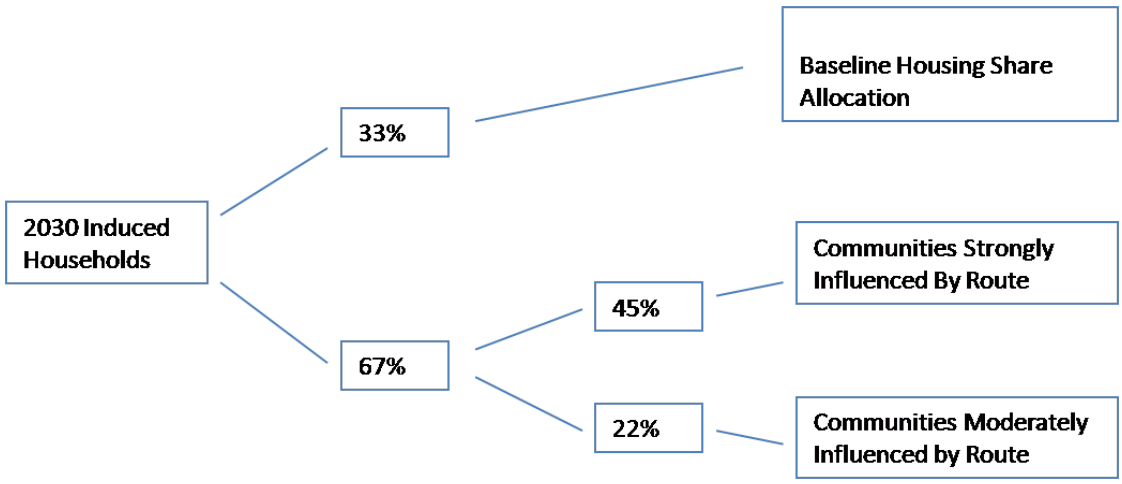
- Employment center midpoints. Large concentrations of jobs are found in Greater Boston, Providence, Fall River, New Bedford, Taunton, and Attleboro. Households with two workers often seek to live in the midpoint for the two commutes.

- Population concentration and growth trends. New household locations are likely to follow existing growth trends and are less likely to be absorbed into communities approaching build out.

- Zoning, infrastructure and land availability. The availability of land zoned for residential development and infrastructure capacity to support new development are other important factors. Some communities have zoning and capacity for additional multifamily units, while the more semi-rural communities are zoned for large lots and rely on private wells and septic tanks for wastewater disposal.

An expert team of RPA representatives and project consultants arrived at a general agreement at a working session on August 26, 2009, on how to use household concentrations over time to capture trends in housing location throughout the South Coast region. Similar to the jobs allocation, it uses a normative assessment of how likely each community is to be affected by the various transportation routes. Communities were designated as likely to be strongly influenced, moderately influenced, or to experience limited influence.

The following flowchart illustrates how households were allocated under Scenario 1.



Because household growth estimates are broken into the two SCR sub-regions, the allocation at the municipal level was undertaken for the SCR 10 and SCR 21 communities separately. First, each municipality's share of the households in 2010 was calculated based on U.S. Census data. Second, each municipality's share of projected growth in households from 2010-2035 was calculated. These two shares were averaged to create a baseline housing share that captures existing housing concentrations and projected growth in households. One-third (33 percent) of the induced households were allocated according to this baseline share. This part of the allocation depends on existing and projected regional housing characteristics and not on any specific alternative. The remaining two-thirds (67 percent) were allocated according to the expected influence of the Build Alternatives. This process takes into account residential development opportunities in some communities within easy drive-time distances of the new stations. At the same time, this approach discounts the expected impacts for the communities farther away from a particular route.

Each community was assigned a designation of strongly influenced, moderately influenced, or limited influence for each of the Build Alternatives. The RPAs and project consultants assigned these values to South Coast study area municipalities. Communities were designated as strongly influenced if they would contain a new station or if the access to transportation service is improved. Moderate influence designations went to communities likely to experience less significant impacts—those that are reasonably close to greatly expanded service or those communities that would see modest improvements in service. Finally, communities were assigned to limited influence if little or no change is expected due to local transportation service or if they are remotely located from new service. The remaining two-thirds of the households were allocated based on these designations—45 percent of the original total went to the strongly influenced communities and the remaining 22 percent of the original total were allocated to the moderately influenced communities. Previously, 33 percent of the households were allocated according to the baseline share, which results in a 100 percent allocation of households.

An estimate of the induced household growth for the Rhode Island communities was made by calculating the proportional growth the communities' Massachusetts neighbors would receive. Bristol

and Portsmouth were assigned the same growth rate as Swansea; Tiverton to Westport; and Warren to Seekonk.

5.2.1.5 Scenario 2 – Indirect Effects with Smart Growth Measures

The Corridor Plan outlines a future of more sustainable development patterns across the South Coast region. This smart growth plan envisions housing and jobs clustered in areas appropriate for development, while preserving important natural resource lands such as fields, forests, farmland, and wetlands. Outcomes of the Corridor Plan would include the creation of new multifamily housing developments and neighborhoods of tightly clustered single family homes in closer proximity to transportation options and mixed use centers that contain professional offices, retail stores, restaurants, and employment opportunities. Denser, mixed use development patterns would yield measurable benefits for the environment. Local governments can support the smart growth vision by altering current zoning laws to permit denser development and streamline permitting requirements. The Commonwealth supports smart growth efforts through grant programs and technical advice. Information on its Smart Growth/Smart Energy Program can be found at http://www.mass.gov/envir/smart_growth_toolkit/. USEPA also as programs supporting smart growth, see: http://www.epa.gov/dced/index.htm. The Corridor Plan identifies PDAs and PPAs, capturing the strongest candidates for development and preservation, as shown on the Corridor Map (Figure 5-1). The goals outlined on this map can be realized through coordinated state investments and local actions, such as rezoning and regulatory changes.

As part of the environmental review process the impacts of the No-Build Alternative were compared to the Build Alternatives. There are many potential smart growth scenarios that could unfold through 2035. It is impossible to predict with any certainty the future development or preservation outcomes for particular PPAs. However, it is possible to explore one theoretical smart growth scenario for the purposes of comparing the impacts between the No-Build and Build Alternatives. Any such exercise necessarily requires a series of assumptions to be made regarding the type and location of future growth. The following assumptions were made before constructing the smart growth model:

- Infrastructure constraints will be overcome within reason; the Commonwealth help will support infrastructure investments to realize more compact development;
- Local rezoning can be expected to occur for PDAs to accommodate higher levels of development and different permitted uses; and
- A greater mix of multifamily and smaller-lot single-family units will be developed under the smart growth scenario.

This analysis considers the reasonably foreseeable indirect effects of the South Coast Rail project with smart growth strategies (i.e., measures that MassDOT can implement and/or growth management strategies that are anticipated to be adopted by study area municipalities by 2035). It was assumed that proposed stations are designed to optimize TOD opportunities with the full range of smart growth measures as provided in the Corridor Plan and regional long-range plans.

The smart growth scenario includes all projected baseline (No-Build) and induced growth in jobs and households across the South Coast region. A working group of consultants and planners from the three RPAs constructed this theoretical model with the assistance of Geographic Information Systems (GIS) mapping techniques and ground-truthing by regional planners.

Under the smart growth scenario, jobs were allocated by the RPAs into traffic analysis zones (TAZs) based on the share of jobs projected in 2035. This allocation will permit future impact analyses of the induced jobs in the context of traffic and GHG emissions. Growth was redistributed using the process described in this section.

At the heart of the Corridor Plan is the Corridor Map, which identifies appropriate places for development and preservation (PDAs and PPAs). The smart growth model uses these districts as the base geographies for the reallocation of housing and jobs. All state-endorsed PDAs were designated to receive a portion of the reallocation, as were some regionally identified PDAs. Regional PDAs were included in the model if they were particularly well suited for smart growth development, such as downtowns. If a community did not have a state-endorsed PDA, the RPA included a regional priority area from the community that, in their professional judgment, represented the strongest opportunity for smart growth development.

The literature examining smart growth policies and planning has shown that approximately 30 percent of households[14] are attracted to the characteristics that comprise smart growth development—chiefly, compact, mixed-use development, and proximity to public transit, among other benefits. Originally, MassDOT proposed to reallocate 30 percent of the projected growth from the PPAs and Neutral Areas into PDAs. Reflecting the proposed state and local smart growth actions as identified in the Corridor Plan focus on the priority areas, the 30 percent reallocation assumption was modified to reflect this more nuanced approach to development and preservation activities. The working assumption is to shift 50 percent of the current predicted growth (baseline plus induced) of households and jobs in PPAs and 25 percent of the current predicted growth (baseline plus induced) of households and jobs in the neutral areas to the PDAs. This actually results in slightly less than the original 30 percent reallocation because less growth has been projected for the outlying protection areas.

Figure 5-2 illustrates how households and jobs were allocated under Scenario 2. The following "rules" were used in the Scenario 2 re-allocations:

- Acres of developable land were calculated for the PDAs.
- Only PDAs that have potential for residential or mixed-use development were considered for the reallocation of households and PDAs that are solely residential did not receive any reallocated jobs.
- The RPA current trends projections from 2010 to 2035 include households at the TAZ level. For each TAZ that falls outside a PDA, 30 percent of the projected growth from 2010 to 2035 under the No-Build scenario was redirected to the PDAs.
- A TAZ was considered within a PDA if 50 percent or more of its land area falls within the PDA border.
- If a municipality cannot hold projected growth in its PDA, a transfer was made to another PDA. The first transfer was intra-municipal. New households were shifted from non-PDA TAZs to the PDAs within a municipal boundary.

[14] Leinberger, C.B. *The Option of Urbanism: Investing in a New American Dream*. Washington, DC: Island Press, 2008. p. 92-101.

Figure 5-2 Household and Job Allocation Model under Scenario 2

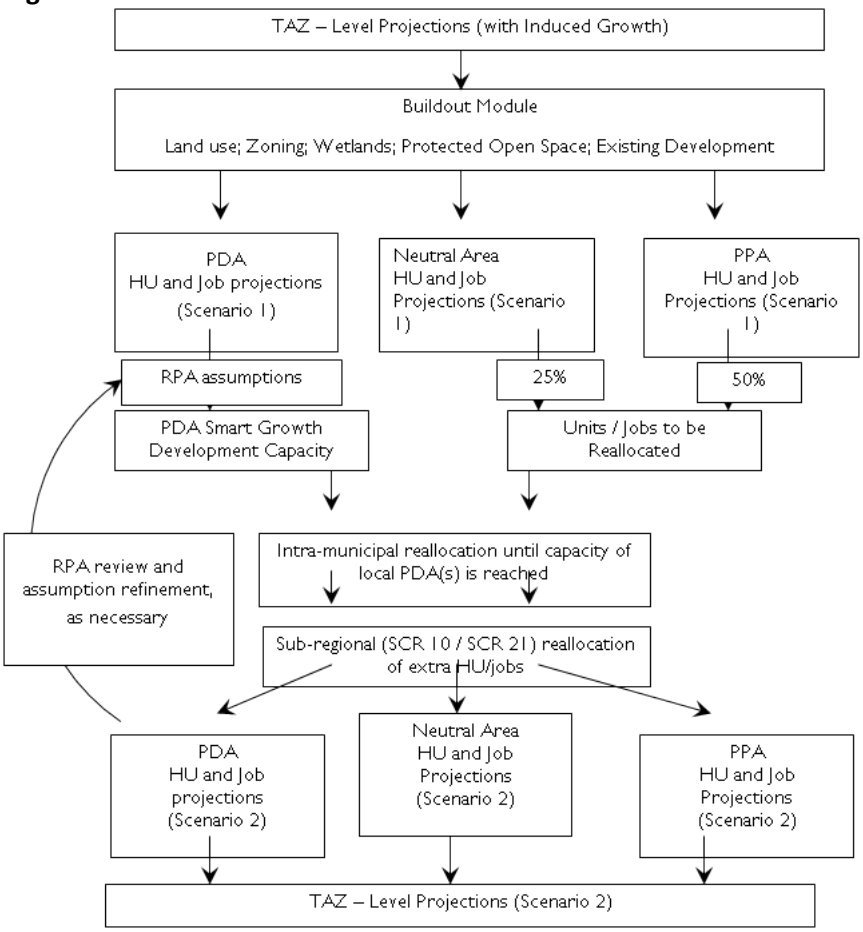


Table 5.2-2 Metrics Used to Evaluate Environmental Impacts of Induced Growth (per household)

	Metric[1]			
Resource	Scenario 1: No Smart Growth	Scenario 2: Smart Growth (high scenario)	Scenario 2: Smart Growth (low scenario)	Sources
GHG Emissions	11.83 tpy	-	11.83 tpy	eQUEST
Land Conversion[2]	0.56 acre	0.39 acre	0.44 acre	Losing Ground and American Journal of Public Health
Loss of Farmland[3]	0.13 acre	0.091 acre	0.10 acre	Losing Ground and American Journal of Public Health
Loss of Forest Land[4]	0.30 acre	0.21 acre	0.24 acre	Losing Ground and American Journal of Public Health
Loss of Wetland	7.35 sf	5.15 sf	5.81 sf	MassGIS
Biodiversity Impact	3:1 ratio	2.10:1 ratio	2.37:1 ratio	Losing Ground and American Journal of Public Health
Water Demand	162.5 gal	-	141.4 gal	MassDEP and USEPA[5]
Traffic	66 VMT/day	66 VMT/day	VMT/household/day	MPAC and MassGIS[6]

1 The number of households per community would be multiplied by this metric to estimate the potential future impacts, for each scenario.
2 These factors are averaged across the South Coast region. Community-specific factors are presented in Appendix 5.3-A.
3 These factors are averaged across the South Coast region. Community-specific factors are presented in Appendix 5.3-A.
4 These factors are averaged across the South Coast region. Community-specific factors are presented in Appendix 5.3-A.
5 U.S. Environmental Protection Agency. How to Conserve Water and Use it Effectively. http://www.epa.gov/nps/chap3.html (November 2009).
6 Conversion is based on municipality-specific factors prepared by MPAC, based on 16 million Registry of Motor Vehicles inspection records analyzed by MassGIS.

- Farmland. Future land development in the South Coast will likely involve the conversion of farmlands to residential and commercial uses. The Massachusetts Audubon Society's (MassAudubon) Losing Ground[15] study undertook an analysis of the conversion of farmland for new housing from 1999-2005 for the Commonwealth. This recent trend data provided an estimate of how much farmland might be consumed in each town as it absorbs new residential growth. A forecast was then made of the potential loss of farmland due to future development, based on development history and the size of a typical lot in each community in accordance with municipal zoning. Because similar data for relevant Rhode Island

[15] DeNormandie, J. (2009). *Losing Ground: Beyond the Footprint*. Lincoln, MA. Massachusetts Audubon Society.

communities was not readily available, an estimate of the potential loss of farmland there was made based on the experience of Massachusetts towns with similar residential densities.

- Wetlands. Residential housing development typically results in minor impacts to wetlands because of local, state, and federal legal protections. However, the construction of a subdivision might include new roadways, which could fill wetlands. In most cases, a developer would be required to mitigate the wetland loss by creating a wetland on another part of the property. To estimate the extent of wetland loss that could result from new residential growth, data were reviewed from a MassGIS analysis showing how land use changed between 1999 and 2005. Smart Growth developments, which are generally denser and feature multi-family housing, would reduce wetlands impacts. It is expected that the development of a typical housing unit would disturb 0.00017 acre of wetlands.

- Biodiversity. The potential effects of growth on biodiversity are difficult to quantify, but it is known that development destroys habitat and has a disruptive effect on ecological processes. The protection of land as open space is an important strategy. An assessment of the mixture of habitat and natural community types across a region provides insight into biodiversity. MassAudubon's Losing Ground report conducted an analysis of habitat fragmentation in USEPA ecoregions across Massachusetts. This analysis was used to estimate the direct and indirect impacts on biodiversity as a result of new development in the South Coast region. It is expected that for every 1 acre of development that 3 acres of biodiversity are impacted.

- Infrastructure. Residential housing growth will have a direct effect on communities' needs to supply or support water and wastewater infrastructure. MassDEP estimates that household water demand is approximately 65 gallons per person per day though demand does fluctuate by community. It was assumed that as new residential growth occurs, similar ratios of water and wastewater use per household will hold. Communities that rely on private wells and septic systems are not expected to bear new public costs for growth, but growth could still increase demands on constrained resources.

- Air Quality. Induced growth will result in the additional GHG emissions in the South Coast region. An analysis was conducted for a typical house constructed in the year 2035. The model provided estimated carbon dioxide emissions related a prospective home's electric and gas consumption. An analysis of the mobile source GHG emissions is presented based on a reallocation of population and employment to the TAZ level.

Assumptions for Scenario 2 (Future Growth Scenario with Smart Growth)

This scenario assumes that the measures outlined in Chapter 7 of the Corridor Plan: Implementation of the Corridor Plan are fully implemented by the state and study area municipalities. These measures have been adopted by the Development Cabinet of the administration and include implementation commitments from all Secretariats. Measures include strategic investments of discretionary state funding consistent with the Corridor Map, providing ongoing technical assistance to South Coast region municipalities to aid in changing local land use codes and regulations, creating a regional transfer of development rights (TDR) program, and capturing new tax revenues to balance state and local needs.

Strategic investments of discretionary state funding have been identified to encourage zoning and land use changes to support the Corridor Plan. Significant funding flows from the state to municipalities through a variety of grant and loan programs. By using the Corridor Plan priorities as the guide for these

investments, state agency investments will be better coordinated and will serve as an incentive that will prompt local actions consistent with the Corridor Plan. Technical assistance will be provided to expand affordable housing and economic development opportunities, open space preservation, and station area planning. A regional TDR program to steer growth into areas appropriate for development of PDAs and outside of PPAs will be created. The Commonwealth will help to support the Massachusetts Division of Fish and Wildlife's Eastern Box Turtle Conservation Plan by providing technical assistance to communities within critical areas for habitat protection. This assistance could include providing model conservation subdivision bylaws (cluster development or open space residential design bylaws) or transfer of development rights bylaws to protect critical habitat areas. Scenario 2 also includes implementing the Station Area Plans that are outlined in the Corridor Plan. TOD will cluster jobs and housing around the stations, creating new green neighborhoods. Table 5.2-3 provides a summary of build out anticipated in and around proposed transit stations.

Table 5.2-3 Station Area Development under Scenario 2

Station	Alternative	Residential (units)	Commercial (sf)
Battleship Cove	All	0	0
Dana Street	Whittenton	N/A	N/A
Easton Village	All	150-200	15,000 – 30,000
Fall River Depot	All	200	200,000
Freetown	All	200	25,000
King's Highway	All	350	250,000
North Easton	All	125	0
Raynham Place	All	400-600	90,000 – 200,000
Stoughton	All	300-350	10,000 – 25,000
Taunton	Stoughton	125-175	Complementary uses
Taunton Depot	All	150-200	0
Whale's Tooth	All	1,400	500,000

Source: Goody Clancy 2009. South Coast Rail Economic Development and Land Use Corridor Plan. Goody Clancy: Boston, MA. June 2009.
Note: The Dana Street station as part of the Whittenton Alternatives was not envisioned at the time the Corridor Plan was prepared.

Potential impacts on environmental resources that could be attributed to induced growth under the smart growth scenario in the study area include:

- Land Use. Development that is outlined in the Corridor Plan would be considered part of the smart growth scenario. It was assumed that compact, mixed-use, and infill housing development is expected to account for approximately 30 percent of induced growth, which is expected to reduce new land development by approximately 21 percent[16] for the low scenario and 30 percent for the high scenario. It is anticipated that communities which support the development of dense multi-family, clustered single-family housing, and transit-orientated development and utilize other smart growth incentives could reduce land use impacts up to 30 percent and achieve the high scenario. The low scenario entails a sizeable improvement over traditional growth patterns, but assumes that not all communities will implement smart growth policies enumerated in the Corridor Plan.

[16] Burchell, R.W. and S. Mukherj. (2003). Conventional Development Versus Managed Growth: The Costs of Sprawl. *American Journal of Public Health*, 93 (9), 1537.

- Farmland. Under the smart growth allocation, it is estimated that 21 percent fewer acres of agricultural land would be converted for development.

- Wetlands. Smart growth development, which is generally denser and features clustered and multi-family housing, would reduce wetlands impacts by an estimated 21 percent per a previous study.

- Biodiversity. To estimate how compact development patterns would reduce impacts on biodiversity, it was assumed that a 21 percent reduction in land consumption for development would have a commensurate benefit in land to support biodiversity in the South Coast region.

- Infrastructure. Smart growth development patterns are expected to reduce the consumption of water for use outdoors. However, multi-family and clustered housing are built on smaller lots and would have smaller lawns for watering and fewer paved areas to wash. It is estimated that smart growth would reduce household water consumption by approximately 13 percent.

- Air Quality. The model provided estimated carbon dioxide emissions related a prospective home's electric and gas consumption.

5.2.2 Cumulative Impacts

This section describes the methodology used to evaluate the cumulative impacts of the South Coast Rail project.

5.2.2.1 Introduction

The South Coast Rail project is anticipated to result in direct or indirect, adverse and/or beneficial effects to a range of resources, as described in Chapter 4. Additional effects may result from induced growth, as described in the indirect effects portion of this chapter. Some of the minor or major effects of the South Coast Rail project may when combined with the effects of other past, present, or future actions result in substantive impacts to environmental or social (human) resources. These combined effects are referred to as cumulative impacts and are further discussed in this section.

5.2.2.2 Methodology

Cumulative impacts of the Build Alternatives under both Scenarios 1 and 2 were analyzed as compared to the No-Build Alternative. The evaluation was conducted for a selected set of resources within certain temporal and spatial boundaries, in reference to historical trends or affects from specific other projects, and that are (for the most part) regulated by various governmental agencies.

Resources Evaluated

Chapter 4 describes the potential direct and indirect encroachment-alteration effects of the South Coast Rail project for a broad range of resources, including environmental (e.g., air, water), ecosystems (e.g., biodiversity, wetlands), and human environment (e.g., historical and archaeological resources, economics). Some resources are expected to be little affected by the Build Alternatives; others may be substantively affected positively or negatively, either directly or indirectly. Some resources have experienced substantial historical impact from other projects or human activity, may experience substantial future impact from other projects or activities, or are of specific interest to decision-makers, regulators, and residents of the South Coast region. A cumulative impacts evaluation of certain

resources was also required by the MEPA Certificate on the ENF. The cumulative impacts evaluation focuses on air quality, biodiversity, economy, land use, protected open space, threatened and endangered species, water quality, and wetlands. Other resources evaluated in Chapter 4 did not meet the selection criteria, are expected to be little affected by the Build Alternatives, and/or do not hold specific interest to stakeholders.

Temporal and Spatial Boundaries

The cumulative impacts analysis defines a time frame and geographic range for the evaluation, and takes into account changes from other projects within this time frame that contribute to cumulative impacts on the resources listed above. Historical impacts have been evaluated for two time periods:

- For most resources, prior changes have been evaluated for the period 1990 to 2008. The year 1990 was selected as the starting date because this is a prior census year, it was in the midst of a period of economic downturn, and it establishes a reasonable baseline condition.

- Some resources have been evaluated over a longer time period where useful data are available. For example, prior impacts to wetlands have been evaluated to 1983, the year that the Massachusetts Wetlands Protection Act (WPA) regulations were established. MassAudubon has published a series of reports documenting changes in land use from 1981.

Current impacts have been evaluated based on 2008/2009 conditions, taking into consideration publication delays for the availability of the most recent data. Future impacts have been evaluated to 2035, the horizon year of the South Coast Rail project.

Spatial boundaries for the analyses varied by resource according to the specific characteristics of the resource, regulatory jurisdictions, and the availability of meaningful data.

- **Land Use**—Land use was evaluated at the local (municipal) and regional levels.

- **Air Quality**—The air quality of the South Coast region is strongly influenced by predominant winds from the southwest and west, bringing air pollutants from upwind states Connecticut, Rhode Island, and New York.[17] Based on regulatory agency jurisdictions and reporting conventions, the three counties within the South Coast Rail study area (Bristol, Norfolk, and Plymouth) are considered to constitute the airshed.

- **Biodiversity**—Biodiversity was evaluated at the ecosystem level (the Bristol Lowlands Ecoregion), considering the biotic communities present in the South Coast region but using the geographic boundaries of the 31 South Coast communities.

- **Economy**—The economy was evaluated at three levels: local (municipal), regional (South Coast Rail study area), and state.

- **Protected Open Space**—Protected open space was evaluated at the local and regional levels.

[17] DEP. 2008. *Final Massachusetts State Implementation Plan to Demonstrate Attainment of the National Ambient Air Quality Standard for Ozone*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection: Boston.

- **Threatened and Endangered Species**—Threatened and endangered species were evaluated at the ecosystem level, but also considering the range of each identified species.
- **Water Quality**—This resource was evaluated at the watershed level.
- **Wetlands**—Wetlands were evaluated at the watershed level when useful data were available. State or regional data were used for historical perspective.

Trends and Reasonably Foreseeable Future Actions

The analysis used readily available data sources for past and future changes, including the MassAudubon *Losing Ground* report series, EEA data and publications, MassDEP wetland change mapping, federal and state agency major permit applications, and other readily available resources. For each resource, the analysis took into consideration:

- Past changes to the selected resources that resulted from development trends or major projects within the study area such as:
  - Fall River Airport closure,
  - Amtrak electrification,
  - New Bedford Wastewater Treatment Plant remediation,
  - Freetown industrial development, and
  - Great Woods development.
- Future changes to the selected resources from anticipated growth based on historic or recent trends, or specific projects, including all reasonably foreseeable projects (i.e., those that are undergoing or have completed major environmental permitting actions or MEPA and/or NEPA reviews), such as:
  - Fall River Executive Park,
  - Route 24 Exit 8A,
  - New Bedford Airport safety improvements,
  - Mashpee Wampanoag Casino, and
  - Other proposed developments.

Regional transportation planning was taken into consideration to the greatest extent possible. The most current regional plan covers the period from 2013 to 2016, and is mostly composed of road and bridge resurfacing and reconditioning projects.[18]

[18] Southeastern Massachusetts Metropolitan Planning Organization. 2009. *FFY 2013-2016 Transportation Improvement Program*. Prepared by the Southeastern Regional Planning and Economic Development District: Taunton, MA.

None of the projects in the plan include new road construction. Although several are identified as congestion relief projects, and specifically reference air quality improvements, quantified impacts to the resources evaluated in this cumulative impacts analysis are not provided. Some projects, identified as "congressional earmarks waiting for project approval and full funding" are also listed, and include projects such as Route 79 Improvements in Fall River and highway interchange and freight rail improvements throughout the South Coast region. It also identifies the relocation of Route 79 in Fall River to create a 4-land urban boulevard with a landscaped median and improved access to developable areas along the waterfront. Similar improvements are identified for Route 18 in New Bedford. Potential impacts associated with these projects are incorporated in the general resource trends described in the cumulative impact assessment.

Although not a "reasonably foreseeable future action" in the traditional sense of cumulative impacts analysis, the possible effects of climate change on resources such as biodiversity, threatened and endangered species, and wetlands has been taken into consideration to the extent possible.

The cumulative impacts evaluation analyzes the past and future changes to the selected resources from development trends and other specific projects within the resource-specific study areas, together with the added impacts of the South Coast Rail alternatives for each alternative and for the two scenarios.

Federal, state, or local governmental agencies regulate most of the resources evaluated for cumulative impacts. The regulatory programs drive many of the trends for improving resource values (e.g., air quality, water quality, and wetlands area) and are therefore important in determining resource impacts of the South Coast Rail and other regional projects. Regulatory programs typically prohibit impacts except as authorized by a permit, are charged with reviewing permit applications, and, generally, only authorize activities that provide the least impact to the resource while still meeting the proposed project's purpose and need. For this cumulative impacts evaluation, existing permitted facilities and proposed actions indicate the current and likely future impacts to the resources.

The agencies responsible for administering these programs are typically charged with managing the resources on a project-by-project basis but in the context of the common good. For example, the federal government has a "no net loss" policy on wetlands; project proponents seeking permits to fill wetland areas are commonly required to offset losses by replacing filled wetlands at a negotiated ratio, such as 2:1 or 3:1. These replacement ratios recognize the inherent unpredictability in creating or restoring replacement wetlands that offset the wetland functions from the project-specific loss, as well as the necessary passage of time between establishing adequate wetland hydrology, and succession to vegetative stability and ultimately functional maturity. This passage of time is particularly lengthy for forested wetlands. Thus, certain regulated resources can experience improvements, rather than degradations, over time.

5.3 DESCRIPTION OF IMPACT SCENARIOS

This section describes the three scenarios evaluated in this chapter: the No-Build Alternative and Scenarios 1 and 2 under the Build Alternatives. Tables 5.3-1 and 5.3-2 present the results of the allocation of induced households and jobs to the municipal level. These results are presented in Figures 5-3 through 5-7. This model was created as part of a theoretical exercise to demonstrate how development patterns could be shifted if the Commonwealth and local municipalities work together to further the goals of the Corridor Plan, in conjunction with local support in the form of zoning and permitting changes.

5.3.1 No-Build (Enhanced Bus) Alternative

This alternative assumes that growth in the South Coast region by 2035 occurs as projected by the three RPAs. These growth projections were developed in 2010 and are based on U.S. Census Bureau data, state requirements, economic trends, and local circumstances. The No-Build Alternative projects that the study area would gain 75,212 households by 2035, with the largest increases in Fall River (7,236), New Bedford (5,290), and Taunton (5,062). The smallest amount of household growth is projected for Marion (285) and Somerset (678).

Under the No-Build Alternative, significant job growth would be experienced throughout the South Coast region and is projected to be greatest in Dartmouth (5,191), Foxborough (4,558), Taunton (4,153), and Canton (3,369), among numerous others that are anticipated to increase their employment base by between 1,800 and 3,340 (Table 5.3-2). However, some municipalities are projected to experience a decrease in their employment base, most significantly in Attleboro (-2,751) and Fall River (-1,518). Overall, municipalities in the South Coast region are projected to add 37,864 new jobs by 2035.

5.3.2 Scenario 1 (Future Growth Scenario without Smart Growth)

Scenario 1 considers baseline growth of the No-Build Alternative plus induced growth from the Build Alternatives. It assumes that no additional smart growth measures would be implemented other than those already incorporated into municipal zoning or state planning.

Residential growth that would be introduced to the South Coast region as a result of the Build Alternatives under Scenario 1 is projected to total 2,804 households. The vast majority of these new households would be located in just a few municipalities: Fall River (533); New Bedford (449); Fairhaven (361); and Westport (205). All other municipalities in the South Coast region are projected to increase by less than 120 households with four communities anticipated to introduce fewer than 10 new households over the No-Build Alternative (Table 5.3-1).

Under Scenario 1, the Build Alternatives are projected to introduce or help retain 1,341 jobs in the South Coast region (Table 5.3-2). Some municipalities such as Attleboro, Fall River, and Fairhaven are projected to decrease their employment base by 2035 over the No-Build Alternative. However, under Scenario 1 of the Build Alternatives, it has been projected that approximately 257 jobs would be retained over the No-Build Alternative. Easton, New Bedford, and Taunton are projected to introduce an additional 137 to 147 new jobs under Scenario 1 of the Build Alternatives over the No-Build Alternative by 2035. The majority of municipalities in the South Coast region are projected to experience a change of less than 40 jobs over the No-Build Alternative.

5.3.3 Scenario 2 (Future Growth Scenario with Smart Growth)

Under Scenario 2, the distribution of the growth (induced and baseline) would shift to be concentrated in the PDAs. Induced growth would be concentrated around Foxborough (749), Fall River (393), New Bedford (334), and Bridgewater (265). Foxborough, Bridgewater, and Attleboro are projected to experience significant growth over the No-Build Alternative and Scenario 1 (Table 5.3-1). The Smart Growth scenario would shift growth (induced and baseline) out of rural communities and ten South Coast region municipalities are projected to experience negative household growth under Scenario 2 of the Build Alternatives. The most significant decline is projected for Westport with a decrease of 230 households by 2035. In total, projections indicate an increase of 2,802 households over the No-Build Alternative, slightly less than under Scenario 1.

Table 5.3-1 Projected Total Household Growth by Community (2035)

		Stoughton and Whittenton Alternatives			
		Scenario 1		Scenario 2	
Municipality	No-Build Alternative	Total Growth	Change from No-Build	Total Growth	Change from No-Build
Acushnet	965	992	27	1,006	41
Attleboro	2,906	2,920	14	3,108	202
Berkley	806	837	31	797	-9
Bridgewater	1,730	1,760	30	1,995	265
Canton	2,648	2,662	14	2,728	80
Dartmouth	3,705	3,772	67	3,717	12
Dighton	992	1,056	64	969	-23
Easton	1,262	1,287	25	1,406	144
Fairhaven	1,522	1,883	361	1,597	75
Fall River	7,236	7,769	533	7,629	393
Foxborough	1,515	1,524	9	2,264	749
Freetown	935	994	59	930	-5
Lakeville	1,433	1,462	29	1,378	-55
Mansfield	2,184	2,191	7	2,205	21
Marion	285	298	13	312	27
Mattapoisett	732	785	53	735	3
Middleborough	2,912	2,938	26	2,972	60
New Bedford	5,290	5,739	449	5,624	334
North	3,753	3,772	19	3,864	111
Norton	1,646	1,674	28	1,631	-15
Raynham	2,318	2,406	88	2,291	-27
Rehoboth	2,069	2,107	38	2,046	-23
Rochester	994	1,022	28	956	-38
Seekonk	1,302	1,315	13	1,330	28
Sharon	1,027	1,033	6	1,104	77
Somerset	678	714	36	718	40
Stoughton	2,267	2,339	72	2,423	156
Swansea	1,377	1,417	40	1,382	5
Taunton	5,062	5,177	115	5,214	152
Wareham	3,044	3,096	52	3,043	-1
Westport	3,419	3,624	205	3,189	-230
Bristol, RI	1,943	1,999	56	1,999	56
Portsmouth, RI	2,386	2,455	69	2,455	69
Tiverton, RI	1,976	2,095	119	2,095	119
Warren, RI	893	902	9	902	9
Total	75,212	78,016	2,804	78,014	2,802

Source: MAPC, OCPC, SRPEDD.

Projections indicate that approximately 1,339 new jobs would be introduced to South Coast region municipalities under Scenario 2. The vast majority of induced growth job would be concentrated in Foxborough which is projected to increase its employment base by 1,134 over the No-Build Alternative and 1,074 over Scenario 1 of the Build Alternatives. More than half of South Coast region municipalities are projected to lose some of their employment base by 2035 over the No-Build Alternative. However, projections indicate a decrease of between 15 and 113 jobs (Table 5.3-2).

5.3.4 Indirect Effects

This section describes potential environmental impacts that may result under the No-Build and Build Alternatives. This analysis presents a hypothetical comparison of the potential impacts and benefits of the South Coast Rail project. The metrics identified in this section are not anticipated to be exact predictions of indirect effects, but are intended to enable informed comparison and contrast between and among project alternatives.

Potential impacts are relatively similar under the No-Build Alternative and Scenario 1 of the Build Alternatives. Both generally assume that development would continue in a fashion similar to existing conditions and/or in accordance with municipal goals. However, smart growth measures would not be implemented. The low and high scenarios of Scenario 2 under the Build Alternatives assume that a certain amount of smart growth would be implemented to help contain sprawl and impacts to natural resources. Under the low and high scenarios, potential adverse environmental impacts from land development would be less than under the No-Build Alternative or Scenario 1.

Table 5.3-2 Projected Total Job Growth by Community (2035)

		Stoughton and Whittenton Alternatives			
		Scenario 1		Scenario 2	
Municipality	No-Build Alternative	Total Growth	Change from No-Build	Total Growth	Change from No-Build
Acushnet	-516	-505	11	-543	-27
Attleboro	-2,751	-2,704	47	-2,733	18
Berkley	173	182	9	142	-31
Bridgewater	1,829	1,851	22	2,128	299
Canton	3,369	3,413	44	3,406	37
Dartmouth	5,191	5,291	100	5,125	-66
Dighton	-45	-42	3	-79	-34
Easton	1,468	1,615	147	1,911	443
Fairhaven	-594	-578	16	-606	-12
Fall River	-1,518	-1,324	194	-1,482	36
Foxborough	4,558	4,618	60	5,692	1,134
Freetown	2,978	3,025	47	2,865	-113
Lakeville	990	1,007	17	923	-67
Mansfield	706	710	4	708	2
Marion	270	276	6	235	-35
Mattapoisett	97	99	2	64	-33
Middleborough	2,500	2,525	25	2,480	-20
New Bedford	1,261	1,402	141	1,311	50
North Attleborough	298	299	1	310	12
Norton	850	855	5	803	-47
Raynham	3,095	3,170	75	3,067	-28
Rehoboth	362	373	11	333	-29
Rochester	-151	-149	2	-180	-29
Seekonk	1,191	1,206	15	1,197	6
Sharon	134	137	3	119	-15
Somerset	708	743	35	682	-26
Stoughton	842	872	30	855	13
Swansea	601	612	11	565	-36
Taunton	4,153	4,290	137	4,154	1
Wareham	3,339	3,401	62	3,266	-73
Westport	451	473	22	423	-28
Bristol, RI	640	652	12	652	12
Portsmouth, RI	902	919	17	919	17
Tiverton, RI	249	254	5	254	5
Warren, RI	235	238	3	238	3
Total	37,865	39,206	1,341	39,204	1,339

Source: MAPC, OCPC, SRPEDD.

5.3.4.1 Land Use

Future development is anticipated to convert undeveloped land to developed areas, including residential, retail, commercial and industrial uses. This analysis evaluates the loss of undeveloped land that would occur by 2035 based on the projected increase in households, using the metrics identified in Table 5.2-2. Commercial, retail, and other land use types are not considered in the analysis. Table 5.3-3 presents the total number of acres that would be developed under the No-Build and Build Alternatives. Appendix 5.3-A identifies land use impacts in study area municipalities under the No-Build and Build Alternatives.

Table 5.3-3 Land Use Impacts by 2035 (Acres of Loss)

Alternative	Scenario 1	Scenario 2 (low)	Scenario 2 (high)
No-Build	38,892	38,892	38,892
Stoughton and Whittenton	40,184	31,631	27,995
Change from No-Build	+1,292	-7,261	-10,897

Municipalities across the South Coast region have different zoning regulations in place that dictate the density of future development. For example, Lakeville zoning regulations require an average of 1.23 acres per household while Canton requires only 0.14 acre per household. As a result, municipalities that are projected to increase the most significantly may require less land than municipalities where less development is anticipated. The low and high scenarios under Scenario 2 assume that growth would be concentrated around station areas and central business districts to support smart growth principles.

No-Build Alternative

The No-Build Alternative is anticipated to result in the loss of 38,892 acres of land for new residential development. The largest losses would occur in Westport (2,325), Taunton (2,278), Middleborough (2,184), and Dartmouth (2,119) while the smallest losses would occur in Marion (168), Somerset (271), and Canton (371). Twelve of the 35 municipalities in the study area would require between 1,000 and 2,000 acres to support projected residential development under the No-Build Alternative.

Scenario 1

Projected residential development under Scenario 1 is projected to require an additional 1,292 acres over the No-Build Alternative for a total of 40,184 acres. Similar to the No-Build Alternative, a significant share of the necessary land would be located in Dartmouth, Middleborough, Taunton, and Westport. Other municipalities that would now require more than 2,000 acres to support projected development under Scenario 1 but not the No-Build Alternative include Portsmouth, RI (2,038) and Rehoboth (2,023). Nineteen municipalities in the study area would require less than 1,000 acres to support projected residential development by 2035. Marion and Somerset would both require less than 300 acres to support projected residential growth.

Scenario 2

Under the low scenario, approximately 31,631 acres would be required to support projected residential development by 2035, a decrease of 7,261 acres over the No-Build Alternative. Twenty-three study area municipalities would require less than 1,000 acres to support projected residential growth. The six

municipalities that would require more than 2,000 acres to support projected residential development under the No-Build Alternative and Scenario 1 would require less than 2,000 acres under the low scenario of Scenario 2.

A total of 25 study area municipalities would require less than 1,000 acres to support projected residential development should smart growth measures be implemented to their fullest. A total of 27,995 acres would be needed to support projected residential development in 2035, a decrease of almost 11,000 acres from the No-Build Alternative and 3,636 acres from the low scenario of Scenario 2.

5.3.4.2 Forest Land

Forest land forms a major element of the South Coast region landscape and provides species habitat, recreation opportunities, and environmental benefits such as carbon sequestration. Forest land, unless protected by restrictions, is particularly vulnerable to development. Table 5.3-4 provides a summary of the total anticipated conversion of forest land to developed land by 2035 in the South Coast study area municipalities to help support projected residential development.

Land area that would be developed under the No-Build Alternative and Scenario 1 of the Build Alternatives assumes that current zoning regulations would continue without the implementation of smart growth measures. As a result, more forest land would need to be developed to help support projected residential growth than would be necessary under Scenario 2 which focuses on concentrated development based on smart growth principles. Appendix 5.3-A identifies forest land impacts in study area municipalities under the No-Build and Build Alternatives.

Table 5.3-4 Forest Land Impacts by 2035 (Acres of Loss)

Alternative	Scenario 1	Scenario 2 (low)	Scenario 2 (high)
No-Build	**19,965**	**19,965**	**19,965**
Stoughton and Whittenton	**20,584**	**16,169**	**14,403**
Change from No-Build	**619**	**-3,796**	**-5,562**

No-Build Alternative

The No-Build Alternative is anticipated to result in the loss of 19,965 acres of forest land to support projected residential development in study area municipalities. Four municipalities would experience a loss of more than 1,000 acres of forest land: Taunton (1,367); Middleborough (1,252); Dartmouth (1,074); and Westport (1,060). All other study area municipalities would require less than 900 acres of forest land to be converted to support projected residential development by 2035. The least amount of forest land to be converted for residential use would be in Marion (134) and Somerset (81).

Scenario 1

Under Scenario 1, approximately 20,584 acres of forest land would be converted to support projected residential development across study area municipalities, 619 more acres than under the No-Build Alternative. The same four municipalities as identified in the No-Build Alternative would require the conversion of more than 1,000 acres to support projected residential development in 2035. Fourteen study area municipalities would require the conversion of less than 500 acres of forest land to support projected residential development. Somerset and Canton would both require less than 200 acres of forest land.

Scenario 2

Under the low scenario, approximately 16,169 acres of forest land would be converted to support projected residential development across study area municipalities, a decrease of 4,415 acres over Scenario 1 and 3,796 acres over the No-Build Alternative. Only two municipalities would require the conversion of more than 1,000 acres of forest land to support projected residential development: Middleborough (1,010) and Taunton (1,095). Nine study area municipalities would require the conversion of less than 300 acres of forest land to support projected residential development.

Under the high scenario, no study area municipalities would require the conversion of more than 1,000 acres of forest land to support projected residential development by 2035. Eleven study area municipalities would experience the conversion of less than 300 acres to support such development, two more municipalities than under the low scenario. Under this scenario, which assumes that smart growth principles would be implemented to the greatest extent possible, approximately 5,562 acres less than under the No-Build Alternative and 6,181 acres less than under Scenario 1 of forest land would be converted to support projected residential development across the South Coast region.

5.3.4.3 Farmland

Farmland is a specific land use type that is of concern in the predominantly rural, agricultural communities of the South Coast region. Land that is held for farmland purposes provides economic benefits and a certain quality of life for people involved in farming activities. Farmland, unless protected by restrictions, is particularly vulnerable to development. Table 5.3-5 provides a summary of the total anticipated conversion of farmland to developed land by 2035 in study area municipalities to help support projected residential development. Appendix 5.3-A identifies farmland impacts in study area municipalities under the No-Build Alternative as well as Scenarios 1 and 2 of the Build Alternatives.

Table 5.3-5 Farmland Impacts by 2035 (Acres of Loss)

Alternative	Scenario 1	Scenario 2 (low)	Scenario 2 (high)
No-Build	9,907	9,907	9,907
Stoughton & Whittenton	10,249	7,903	7,142
Change from No-Build	342	-2,004	-2,765

No-Build Alternative

The No-Build Alternative is anticipated to result in the loss of 9,907 acres of farmland for new residential development. The largest losses would occur in Westport (1,060), Rehoboth (745), Middleborough (670), Portsmouth, RI (668), and Dartmouth (667). Twelve study area municipalities would experience the loss of less than 100 acres of farmland to support projected residential development.

Scenario 1

The loss farmland across the South Coast region to support projected residential development in 2035 under Scenario 1 would be similar to that experienced under the No-Build Alternative. Under the "business as usual" scenario, an additional 342 acres of farmland over the No-Build Alternative would be necessary to support projected residential development.

Scenario 2

Under the low scenario, approximately 2,000 fewer farmland acres would be converted to support projected residential development by 2035 than under the No-Build Alternative. A total of approximately 7,903 farmland acres would be converted for residential use. Twelve study area municipalities would require the conversion of less than 100 farmland acres to support this development. Land conversion in seven municipalities would represent the vast majority of converted farmland; four of which are located in Rhode Island.

Of all project alternatives, the high scenario would require the least amount of farmland to support projected residential development. Should smart growth measures be implemented to the greatest extent possible, as identified in the Corridor Plan, approximately 7,142 farmland acres would be converted to support projected residential growth. This is approximately 761 and 3,107 fewer farmland acres than under the low scenario and Scenario 1.

5.3.4.4 Wetlands

Although wetlands are stringently protected under local, state, and federal laws and regulations, these programs allow wetlands to be altered under certain circumstances, if proponents comply with relevant performance standards. Generally, small losses of wetlands are permissible if there are no practicable alternatives and compensatory mitigation is provided. This analysis assumes that there would be, on average, a small amount of direct wetland alteration for each new household; indirect impacts to wetlands that result from development and could possibly degrade their functions and values were not estimated.

USACE and USEPA have a policy of "no net loss" of wetland functions and values. Accordingly, this analysis assumes that projected wetland losses would be permittable and unavoidable consequences of secondary developments resulting from the South Coast Rail project, and that compensatory mitigation would be required and implemented to offset those wetland losses.

Table 5.3-6 provides a summary of the total anticipated loss of wetlands as a result of residential development by 2035. Appendix 5.3-A identifies wetland impacts in study area municipalities under the No-Build and Build Alternatives.

Table 5.3-6 Direct Wetland Impacts by 2035 (Acres of Loss)

Alternative	Scenario 1	Scenario 2 (low)	Scenario 2 (high)
No-Build	12.8	12.8	12.8
Stoughton and Whittenton	13.3	10.1	9.4
Change from No-Build	0.5	-2.7	-3.4

No-Build Alternative

The No-Build Alternative is anticipated to result in the loss of 12.8 wetlands acres to support new residential development. Only Fall River would experience the loss of more than one wetland acre. Twenty-eight study area municipalities are anticipated to lose 0.50 acre or less of wetland acres to support projected residential development by 2035.

Scenario 1

Under Scenario 1, an additional 0.50 wetland acre would be necessary to help support projected residential development over the No-Build Alternative. Because of the number of municipalities in the study area and small change from the No-Build to Scenario 1 of the Build Alternatives in terms of the acreage of wetlands necessary, the typical increase is significantly less than 0.1 acre. An additional 0.9 acre would be necessary to support projected residential development in Fall River by 2035.

Scenario 2

The low scenario would require approximately 2.7 fewer wetland acres to support projected residential development by 2035 than the No-Build Alternative. The implementation of smart growth measures would reduce wetland impacts by approximately 3.2 acres over Scenario 1, where development would continue as under existing conditions. Wetland impacts in Fall River would be less than 1 acre under the low scenario and required acreage would also decrease in all other study area municipalities.

Should smart growth measures be implemented to the fullest extent possible as identified in the Corridor Plan, wetland impacts would decrease to 9.4 acres, approximately 3.4 acres and 3.9 acres less than under the No-Build Alternative and low scenario, respectively. Many study area municipalities would experience less than 0.2 acre of wetland impacts should residential development be concentrated in PDAs and away from PPAs.

5.3.4.5 Biodiversity

New development is anticipated to result in the loss of biological diversity within the South Coast region by reducing the abundance of plants and animals. Development may affect plants and animals in both terrestrial and aquatic habitats through the direct loss of habitat, the creation of barriers to the movement of organisms, the reduction of habitat quality, and the reduction in the size of available habitats. The net results of these changes may reduce the size of populations, eliminate some populations, or potentially eliminate some species. These effects are directly correlated with the loss of natural undeveloped land, but also a result of new infrastructure (roads, utilities) required to support new development.

Table 5.3-7 provides a summary of the total biodiversity impacts anticipated by 2035 under each project alternative. Appendix 5.3-A identifies biodiversity impacts in study area municipalities under the No-Build and Build Alternatives.

Table 5.3-7 Biodiversity Impacts by 2035 (Acres with Decreased Value)

Alternative	Scenario 1	Scenario 2 (low)	Scenario 2 (high)
No-Build	116,675	116,675	116,675
Stoughton and Whittenton	120,551	74,967	58,706
Change from No-Build	3,876	-41,708	-57,969

No-Build Alternative

The No-Build Alternative is anticipated to affect biodiversity according to a 3:1 ratio. For every 1 acre of undeveloped land that is converted for development, there will be an impact on the biodiversity of an

additional 3 acres of land.[19] The greatest impacts on biodiversity would occur in communities where there is projected to be large amounts of new residential development. The No-Build Alternative would reduce the biodiversity value of an estimated 116,675 acres of land within the study area. Only Marion and Somerset are anticipated to have impacts that are less than 1,000 acres. Should residential development occur as projected, six municipalities would experience biodiversity impacts of between 5,900 and 7,000 acres: Dartmouth; Middleborough; Rehoboth; Taunton; Westport; and Portsmouth, Rhode Island.

Scenario 1

Under Scenario 1, the ratio of biodiversity impacts are anticipated to be the same as under the No-Build Alternative. Biodiversity impacts under Scenario 1 would increase by almost 4,000 acres than under the No-Build Alternative. Should residential development occur as anticipated, approximately 120,551 acres would experience biodiversity impacts.

Scenario 2

The low scenario assumes that the biodiversity impact ratio would decrease to 2.37:1 from the 3:1 ratio under the No-Build Alternative and Scenario 1 of the Build Alternatives. Under the low scenario, the implementation of smart growth measures would decrease biodiversity impacts by almost 42,000 acres over the No-Build Alternative. All study area municipalities would experience biodiversity impacts of less than 4,500 acres, a significant decrease than under the No-Build Alternative and Scenario 1. Six municipalities would experience biodiversity impacts of less than 1,000 acres, three of which are located closer to Boston and already experience significant development.

Assuming that smart growth measures are implemented to the greatest extent possible as identified in the Corridor Plan, the biodiversity impact ratio would decrease to 2.10:1. As a result, total biodiversity impacts would decrease even further than under the low scenario. Under the high scenario, approximately 58,706 acres would experience biodiversity impacts by 2035. This is slightly less than 58,000 acres less than under the No-Build Alternative. The high scenario would impact slightly less than 16,000 acres than under the low scenario. Significant reductions in biodiversity impacts would occur in municipalities where PDAs exist and/or TOD plans or other smart growth measures are in place or anticipated, such as Taunton, Stoughton, Rehoboth, Westport, and Portsmouth, Rhode Island.

5.3.4.6 Infrastructure

New development would place increased demand on municipal infrastructure, particularly water and sewer services. This section evaluates the increase demand for water resulting from projected residential growth in the South Coast region. Many study area municipalities rely on groundwater sources and impose water restrictions under most summer conditions due to limited supply. As a result, new development has the potential to place significant demand on water resources if appropriate measures are not put in place. Table 5.3-8 provides a summary of the change in water demand anticipated by 2035 under the No-Build and Build Alternatives.

[19] DeNormandie, J. (2009). *Losing Ground: Beyond the Footprint*. Lincoln, MA. Massachusetts Audubon Society.

Table 5.3-8 Water Demand by 2035 (Gallons per Household)

Alternative	Scenario 1	Scenario 2*
No-Build	12,221,993	12,221,993
Stoughton and Whittenton	12,677,600	11,029,902
Change from No-Build	455,607	-1,192,091

Note: Assumes that water demand will be almost the same under the low and high scenarios because the difference between the two is only two households.

No-Build Alternative

The No-Build Alternative is anticipated to continue current patterns of household water use. It assumes the current trend of 65 gallons per person per day would continue. Assuming there are 2.5 people per household, the average household's water consumption would be approximately 162.5 gallons per day (gpd). Should development continue as projected, water consumption under the No-Build Alternative is anticipated to total approximately 12,221,993 gpd by 2035. The more significant impacts on water demand will be borne by communities projected to increase notably over the next 20 years. New residential development is projected to be greatest in Fall River, New Bedford, and Taunton, therefore these communities would place the largest increased demand on water resources.

Scenario 1

Scenario 1 assumes the same water consumption patterns as under the No-Build Alternative. As a result, increased household development that is projected as a result of the Build Alternatives would place additional demand on water resources. The introduction of an additional 2,804 households would increase water demand by approximately 455,600 gpd over the No-Build Alternative by 2035.

Scenario 2

Under Scenario 2, smart growth measures for small lots, clustered single-family housing, or multifamily housing developments would have beneficial effects on water demand because there would be smaller lawns to water and fewer paved surfaces to keep clean. It is estimated that the average household's water consumption under this scenario would be approximately 141.4 gpd. Water demand under this scenario is anticipated to decrease by approximately 1,192,091 gpd and 1,647,698 gpd over Scenario 1 of the Build Alternatives and the No-Build Alternative, respectively. This represents a decrease of 13.0 percent and 9.9 percent.

5.3.4.7 Traffic

Future regional growth is anticipated to result in increased VMT. CTPS conducted regional travel demand modeling using the No-Build and Build Alternatives as inputs to the model. The model, which is based on the traditional four-step urban transportation planning process, uses 2010 as the base year and examines travel patterns on an average weekday for four time periods. It takes into consideration data on service frequency, routing, travel time, transit parking availability, and fares of all transit services as well as connectivity, length, speed, capacity, and tolls, among others associated with the roadway network. Traffic forecasts were then prepared based on the population and employment projections under the No-Build and Build Alternatives as presented in Tables 5.3-1 and 5.3-2. Table 5.3-9 provides a summary of the projected increase in vehicle miles and hours traveled under the No-Build and Build Alternatives in 2035.

Table 5.3-9 Vehicle Miles and Hours Traveled by 2035 (per day)

	Vehicle Miles Travelled (VMT)		Vehicle Hours Travelled (VHT)	
Alternative	Total	Difference from No-Build	Total	Difference from No-Build
No-Build	118,894,000		3,956,500	
Stoughton Electric	118,641,800	-252,200	3,944,200	-12,300
Whittenton Electric	118,696,500	-197,500	3,947,300	-9,200
Stoughton Diesel	118,654,800	-239,200	3,944,700	-11,800
Whittenton Diesel	118,708,500	-185,500	3,947,700	-8,800

No-Build Alternative

Under the No-Build Alternative, the South Coast region would experience substantial population and employment growth. This growth would result in increased VMT and VHT. Daily VMT in the region is projected to total approximately 11.89 million while daily VHT would increase to just under 4 million hours.

Stoughton Alternative

Under the Stoughton Electric Alternative, daily VMT would decrease by approximately 252,200 and 54,700 over the No-Build and Whittenton Alternatives, respectively. The Stoughton Electric Alternative would also reduce VHT the most significantly of the project alternatives. The model estimates that approximately 12,300 hours would be saved daily over the No-Build Alternative. Daily VHT would total approximately 3.94 million hours. Stoughton Diesel effects on traffic would be slightly less than Stoughton Electric (239,200 reduction in VMT and 11,800 reduction in VHT).

Whittenton Alternative

The Whittenton Electric Alternative would result in fewer VMT and VHT than the No-Build Alternative but not result in savings as significant as under the Stoughton Electric Alternative. A daily reduction of approximately 197,500 VMT would result from the operation of the Whittenton Electric Alternative over the No-Build Alternative. Daily VHT savings would be approximately 9,200 less than the No-Build Alternative, 3,100 fewer hours than under the Stoughton Electric Alternative. The model identifies longer travel times from New Bedford and Fall River up through Taunton as a cause of reduced demand at these stations. Vehicle miles may also increase as a result of people willing to bypass the slower segment of the Whittenton Alternative in Taunton in order to pick up the train north of the delay during the morning peak inbound commute period.

Whittenton Diesel effects on traffic would be slightly less than Whittenton Electric (185,500 reduction in VMT and 8,800 reduction in VHT).

5.3.4.8 Greenhouse Gas Emissions

Future regional growth is anticipated to result in increased emissions of regulated air quality pollutants from mobile and stationary sources, as well as increased GHG emissions (primarily CO_2). This analysis evaluates GHG emissions based on an average emission factor of 11.83 tons per year (tpy) per household and change in VMT.

GHG Emissions by Household

Although dispersed residential development under Scenario 1 can be contrasted with more compact, clustered development patterns anticipated under Scenario 2, emission factors specifically applicable to smart growth-style development were not available. This analysis therefore compares GHG emissions that may be expected from overall household growth, with the general assumption that there would be lower GHG emissions under Scenario 2 than under Scenario 1.

Regional GHG emissions would increase and reduced sequestration capacities would be experienced as undeveloped forests are cleared to accommodate new residential development with and without the South Coast Rail project. Various studies have attempted to quantify the role of forests in helping to sequester carbon from the atmosphere, but the analysis is complex and depends on multiple variables, many of which are poorly understood. The carbon sequestration capacity of individual tree species, the age of forests, the volume of trees cut down, and soil disturbance are a few examples of multiple factors that would affect carbon emissions in a certain area. Because it is very complex and not well understood, quantitative analysis of carbon sequestration was not undertaken for the South Coast Rail alternatives.

This analysis evaluates the increase in GHG emissions from residential sources that would occur by 2035 based on the anticipated increase in households, using the metrics identified in Table 5.1-2. A summary of this information is presented in Table 5.3-10 and described in greater detail in Appendix 5.3-A.

Table 5.3-10 Greenhouse Gas Emissions from Residential Development by 2035[1]

Alternative	Scenario 1	Scenario 2
No-Build	889,761	n/a
Stoughton and Whittenton	922,929	<922,929
Change from No-Build	33,168	<33,168

1 (CO_2 tons/year)

No-Build Alternative

For stationary sources of GHG emissions, current patterns of residential housing construction are expected to continue under the No-Build Alternative. Using the eQUEST model on a typical 2,000-square-foot (sf) house, estimated household GHG emissions are approximately 11.83 tpy. The No-Build Alternative is anticipated to result in an increase of 889,761 tpy of GHG emissions between 2000 and 2035. The projected increase in residential development in in Fall River, New Bedford, and Taunton would result in those communities having the greatest stationary source GHG emissions.

Scenario 1

Under Scenario 1, the Stoughton and Whittenton Alternatives are anticipated to indirectly result in an increase of 33,168 tpy in stationary source GHG emissions by 2035 over the No-Build Alternative, an increase of 4 percent. The largest GHG emissions would occur in Fall River, New Bedford, and Taunton.

Scenario 2

To estimate the change in stationary source GHG emissions from residential development, the eQUEST model was given an input of a prospective 1,500 sf home, one that might be found in a small lot or

multifamily housing development that is more likely to be introduced to study area municipalities should smart growth measures be in place. The model calculated the household GHG emissions to remain at 11.83 tpy despite the reduction in house size. As a result, the total stationary source GHG emissions are same for both scenarios.

GHG Emissions by VMT

This section provides an overview of estimated CO_2 emissions in 2035 that would result under each alternative from the change in VMT. Unlike the stationary source emission analysis above, this information is presented by alternative and for Scenario 1 only. As demonstrated in Table 5.3-11, the Stoughton Electric Alternative would result in the greatest reduction in CO_2 emissions over the No-Build Alternative. The operation of this alternative would result in the decrease of approximately 52,425 tons of CO_2 annually. The Whittenton Electric Alternative would result in a decrease of approximately 41,055 tons of CO_2 in comparison to the No-Build Alternative. The Stoughton Diesel Alternative would result in greater CO_2 reductions than the Whittenton Electric Alternative, but slightly less than the Stoughton Electric Alternative. The Whittenton Diesel would have the smallest effect on CO_2 emissions from automobile travel under Scenario 1. Although not quantified, the regional VMT and CO_2 emissions under Scenario 2 would be slightly less than the numbers presented for Scenario 1 (see discussion below for further assessment of Scenario 2).

Table 5.3-11 Greenhouse Gas Emissions from Regional Vehicle Miles Travelled by 2035, Scenario 1

	Vehicle Miles Travelled (VMT) (daily)		Carbon Dioxide (CO_2) tons/year	
Alternative	Total	Difference from No-Build	Total	Difference from No-Build
No-Build	118,894,000		24,714,942	
Stoughton Electric	118,641,800	-252,200	24,662,517	-52,425
Whittenton Electric	118,696,500	-197,500	24,673,887	-41,055
Stoughton Diesel	118,654,800	-239,200	24,665,218	-49,724
Whittenton Diesel	118,708,500	-185,500	24,676,380	-38,562

Note: VMT is anticipated to be slightly less under Scenario 2. Numbers reflect auto VMT only.

To provide some basis for comparing the effects of Scenario 1 and Scenario 2, a separate VMT analysis was conducted for the South Coast Rail communities (the regional model analysis includes most of eastern Massachusetts). The analysis used conversion factors (VMT per household per day) unique to each municipality based on projected increases in households. These municipality-specific factors were prepared by MAPC based on an analysis of 16 million Registry of Motor Vehicles inspection records. The per household VMT for each community included in this analysis includes local trips (schools, shopping, and jobs) rather than the long-distance commuting VMT that is evaluated in the regional assessment of the direct transportation effects of each alternative. Table 5.3-12 summarizes the results, with detailed tables with results for each community provided in Appendix 5.3-A.

Under the No-Build Alternative, the South Coast region would experience population growth and corresponding increases in VMT of 4,961,201 per day by 2035. The largest increases are expected in Fall River, Taunton, and Westport.

Table 5.3-12 Greenhouse Gas Emissions Increase from VMT in South Coast Rail Communities[1]

Alternative	Scenario 1	Scenario 2
No-Build	4,961,201	N/A
Stoughton and Whittenton	5,123,749	5,122,664
Change from No-Build	+162,548	+161,463

1 CO_2 tons/year

Under Scenario 1, induced growth would increase VMT by 5,123,749 per day by 2035; an increase of 162,549 more VMT per day than the No-Build Alternative. The largest increases are expected in Fall River, Taunton, and Westport.

Under Scenario 2, implementing Smart Growth measures is anticipated to shift some new development from the PPAs to targeted development areas, and to allow more dense residential and mixed-use development in the PDAs. Scenario 2 is anticipated to increase VMT by 5,122,664 per day by 2035. The largest increases are expected in Fall River, Middleborough, and Taunton. The Stoughton and Whittenton Alternatives under the Smart Growth scenario are anticipated to result in 1,805 less VMT per day than Scenario 1. Relative to the No-Build Alternative, Scenario 2 would increase VMT by 161,464 per day (3 percent).

5.3.4.9 Economic Effects

The economic analysis of the South Coast Rail project as reported in the Corridor Plan and Chapter 4.3, *Socioeconomics*, estimated the overall direct and indirect economic effects on the South Coast region as a result of implementing the Build Alternatives, based on the TREDIS model. Communities across the region can expect to benefit from additional tax revenues from growth, but they should also expect some infrastructure costs for roads, water, and wastewater systems. The following provides a qualitative assessment of potential economic effects associated with the South Coast Rail project.

No-Build Alternative

Under the No-Build Alternative it is projected that an additional 75,212 households and 37,865 jobs would be introduced to the South Coast region by 2035. Municipalities across the region would experience economic benefits in the form of additional property tax revenue, such benefits would be greater in those municipalities where growth is projected to be higher such as Fall River, New Bedford, and Taunton. However, the extent of additional tax revenue that is recognized from new residential development would also depend on municipal property tax rates – a determination that is beyond the scope of this project. Increased employment activity as a result of new residential development and job creation would also result in increased economic benefits, the extent to which would be recognized the most in areas where job growth is highest.

Scenario 1

Under Scenario 1 of the Build Alternatives, household and employment growth would continue as under existing conditions and would not include smart growth measures. An additional 2,804 households and 1,341 jobs are projected to be introduced to the South Coast region over the No-Build Alternative. Municipalities would recognize economic benefits as a result of increased property tax revenues and employment activity. Municipalities with the greatest projected growth and highest tax rates would recognize the greatest economic benefits as a result of such development. Municipalities where the greatest residential growth is projected over the No-Build Alternative include Fairhaven, Fall River, and

New Bedford. Easton, Taunton, and New Bedford are projected to experience the greatest job growth of study area municipalities. However, Scenario 1 would help retain 194 jobs in Fall River, one of the municipalities projected to experience significant job loss by 2035.

Scenario 2

Scenario 2 of the Build Alternatives assumes that smart growth measures would be implemented in accordance with the Corridor Plan and municipal objectives. Growth, both residential and employment, would be concentrated around PDAs and away from environmentally-sensitive areas (PPAs). While overall growth numbers (both residential and employment) is anticipated to occur on a similar scale under both Scenario 1 and Scenario 2, such development would be redistributed across the South Coast region differently than under Scenario 1.

Under Scenario 2, municipalities such as Stoughton, among others are projected to experience notable residential growth over Scenario 1 and the No-Build Alternative. As a result, these municipalities are anticipated to receive more in property taxes than they would under Scenario 1. Other municipalities such as Fall River, New Bedford, Lakeville, Raynham, and Westport, among others are projected to experience less residential development than under either the No-Build Alternative or Scenario 1. As a result, it is anticipated that these municipalities would experience less property tax revenue than under other alternatives.

Job growth is projected to be concentrated in Bridgewater, Easton, and Foxborough as compared to either the No-Build Alternative or Scenario 1. These municipalities, particularly Foxborough, would experience the greatest economic benefit of smart growth measures and increased employment. The majority of other municipalities are projected to experience a slight decrease in their employment base under Scenario 2 as compared to the No-Build Alternative and Scenario 1. Because projected employment loss represents such a small share of overall municipal employment, it is not anticipated that such a decrease would adversely affect tax revenues in a significant fashion as compared to the Bo-Build Alternative.

5.4 CUMULATIVE IMPACTS

This section describes the cumulative impacts of the South Coast Rail project on the following resources: air quality, biodiversity, economy, land use, protected open space, threatened and endangered species, water quality, and wetlands

5.4.1 Land Use

Land use in Massachusetts is directly regulated at the local level, typically through municipal zoning laws and ordinances. Although unique to each municipality, zoning laws commonly designate land usage (into categories such as residential, commercial, industrial, and open space) and development density (for different types of land use such as multi-family or single-family homes, and lot size). Indirect regulation from federal and state agencies derives from policies established by land management agencies responsible for federal- or state-owned property, as well as certain programs such as the federal Wild and Scenic River program (which protects designated waterways) and the state ACEC program. Additionally, traditional environmental media-oriented laws can function as *de facto* land use regulatory programs; new facilities with air emissions or wastewater discharges, for example, may not be permitted in certain locations if the project design cannot meet air quality or water quality standards or requirements.

Managing land use, and in particular motivating a change in land use, may be accomplished by financial or other incentives. Tax increment financing and TDR programs, potential components identified in the Corridor Plan, may be used by the state to motivate local land use change. To that end, the state has assisted each community in identifying PDAs and PPAs that would focus development in certain areas and limit it in others. These programs are intended to limit sprawl – a potential negative indirect effect of the South Coast Rail project.

This section evaluates the cumulative impacts of converting land from a natural state to developed land. Current land use within the South Coast region reflects the historical development of the area. Although much of the land is considered open space (forest, parks, farmland, or otherwise undeveloped land), no areas are completely undisturbed by human activity. Native Americans disturbed the natural environment prior to arrival of Europeans in the 1600s; forest fires were set to clear land and hunt for wildlife.[20] Development by European immigrants included establishing the villages that have grown into the communities currently present. Forests were cut for fuel and construction materials. Old growth forests (defined as having not been logged or disturbed for over 150 years) in the South Coast region are limited to 400 acres of the Acushnet Cedar Swamp, in which old-growth stands of Atlantic white cedar provide about 25 percent of the vegetative cover.[21] The industrial age concentrated development at locations with certain required resources (e.g., Fall River, where river flow powered mills) or convenient for transporting goods (e.g., New Bedford, with a protected harbor for seafaring). Agricultural land use also changed the landscape with forests cleared for crops.

As described in Chapter 4.14, *Biodiversity*, *Wildlife, and Vegetation*, a perspective of recent historical changes in land use is offered by the MassAudubon *Losing Ground* study series. The study was originally published in 1987, with new editions in 1999, 2003, and 2009. Each edition documents broad changes in land use over time. Although the study series provides a state-wide analysis, some aspects are community-specific or can be applied at the regional level.

The 1987 study[22] found that, statewide, open land developed for residential and commercial use between 1981 and 1986 totaled 103,000 acres (20,600 acres per year). The average growth in land development for that period was 2 percent per year. The 1999 study[23] analyzed land development in Massachusetts from 1971 to 1996 and found that the average annual rate of land conversion statewide had decreased from nearly 21,000 acres per year in the mid-1980s to just under 16,000 acres per year in the late 1990s. It further states that developed land has increased from 15.0 percent in 1972 to 23.8 percent in 1996.

Although the 1999 report does not provide community-specific data, the 31 South Coast study area communities in Massachusetts lie within areas characterized as under the greatest development pressure in the period from 1980 to 1996. The six northernmost communities in the South Coast region fell within a middle range of development with 36 to 60 acres developed per square mile of each municipality for that period. The thirteen communities in the central/southern portion varied considerably in newly developed acreage with Mansfield in the highest category of 102 to 169 acres developed per square mile. The twelve communities along the coast generally fell within the lowest ranges of newly developed land with only Fairhaven and Marion reaching the same middle range as the

[20] Jorgensen, N. 1978. *A Sierra Club Naturalist's Guide to Southeastern New England*. Sierra Club Books: San Francisco.

[21] Davis, M.B. 2008. *Old Growth in the East* (revised survey).Available on-line at http://www.primalnature.org/ogeast/survey.html. Accessed 6 October 2009.

[22] MassAudubon 1987. *Losing Ground: The Case for Land Conservation in Massachusetts*. Massachusetts Audubon Society: Lincoln, MA.

[23] MassAudubon 1999. *Losing Ground (Second Edition): An Analysis of Recent Rates and Patterns of Development and Their Effects on Open Space in Massachusetts*. Massachusetts Audubon Society: Lincoln, MA.

northern communities. These data suggest the greatest development pressures closest to the Boston metropolitan area, with decreasing development pressure (and some local variation) with increasing distance from Boston.

The 2003 study[24] focused on changes from 1985 to 1999 in forest and agricultural land use to residential and commercial development, and the hidden impacts of development. MassAudubon calculated an average visible (in aerial photographs) conversion of 40 acres per day of which 88 percent was attributable to new residential development.

According to the 2009 study,[25] natural land in 2005 for the 31 South Coast Study area municipalities in Massachusetts totaled 347,263 acres (an average of 11,202 acres per community). In the period from 1999 to 2005, 7,888 acres (2.2 percent of the 1999 total) in those 31 communities had been converted from natural land to developed land. The average annual natural-to-developed land conversion rate in the South Coast region was 1,315 acres. The conversion rate varies by community, generally according to zoning densities.

The Corridor Plan depicts current land uses for the entire South Coast region based on generalized community zoning.[26] Chapter 4.2, *Land Use, Zoning and Public Policy*, provides maps indicating land uses and zoning along each alternative alignment. These figures also show that residential zoning dominates the South Coast region (at varying degrees of density), although much of the land is actually undeveloped (see *Corridor Plan*, Figure 4-5). Concentrated residential, commercial, and industrial use occurs at the larger towns in the region: New Bedford, Fall River, Taunton, Attleboro, Mansfield, Stoughton, and Canton.

Differences in development density are also reflected, to some degree, in a north-to-south direction. The Corridor Plan's characterization of community's urban, suburban, or semi-rural character (see *Corridor Plan*, Figure 4-1) reflects this geographic trend, combined with the concentrated development at selected coastal communities.

Current and foreseeable projects as mentioned above are commonly located within or near the concentrated development of existing communities or along transportation corridors. Many of these projects consist of redevelopment of industrial property, such as the redevelopment of the Fall River Airport as the Fall River Commerce Park. This project generally does not constitute land use changes from undeveloped to developed land as most of the areas were previously disturbed.

One future project with a specific land use change, the proposed Route 24 Access Improvement Project, would convert 16.6 acres of forest (undeveloped) land to transportation use for a new interchange.[27] Numerous additional projects, at varying degrees of planning or speculation, are listed in the Corridor Plan as candidates for PDAs under Scenario 2.[28] Quantifiable land use conversions are not available for

[24] MassAudubon 2003. *Losing Ground: At What Cost? (Third Edition of the Losing Ground Series), Changes in Land Use and Their Impact on Habitat, Biodiversity, and Ecosystem Services in Massachusetts*. Massachusetts Audubon Society: Lincoln, MA.

[25] MassAudubon. 2009. *Losing Ground: Beyond the Footprint* website: http://www.massaudubon.org/losingground/. Accessed 5 October 2009.

[26] EOT. 2009. *South Coast Rail Economic Development and Land Use Corridor Plan.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. See Figure 4-6: South Coast Zoning.

[27] US DOT. 2009. Route 24, Fall River and Freetown, Massachusetts, Access Improvements Project,; Environmental Assessment, Draft Individual Section 4(f) Evaluation, and Final Environmental Impact Report. US Department of Transportation, Federal Highway Administration and Commonwealth of Massachusetts, Massachusetts Highway Department: Cambridge and Boston, MA.

[28] EOT. 2009. South Coast Rail Economic Development and Land Use Corridor Plan. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston.

all future projects. As noted in Table 5.4-1, the total area encompassed by the PDAs in the 31 South Coast study area municipalities in Massachusetts is 29,079 acres; it is not known what proportion of that area would be converted from undeveloped to developed land if each project was completed.

Table 5.4-1 PDAs and PPAs in the 31 South Coast Communities in Massachusetts

Community	Total Area (acres)	Priority Development Areas		Priority Protection Areas	
		Area (acres)	Percent	Area (acres)	Percent
Acushnet	12,064	44	0.36	591	4.90
Attleboro	17,815	2,024	11.36	26	0.15
Berkley	10,604	200	1.89	2,269	21.40
Bridgewater	18,179	1,460	8.03	3,323	18.28
Canton	12,487	1,256	10.06	3,683	29.49
Dartmouth	39,763	2,160	5.43	19,000	47.78
Dighton	14,268	30	0.21	1,631	11.43
Easton	18,709	1,195	6.39	7,499	40.08
Fairhaven	8,006	333	4.16	583	7.28
Fall River	24,756	1,912	7.72	533	2.15
Foxborough	13,342	1,120	8.39	2,235	16.75
Freetown	22,710	1,023	4.50	2,805	12.35
Lakeville	23,102	238	1.03	11,210	48.52
Mansfield	13,088	1,061	8.11	5,429	41.48
Marion	9,054	52	0.57	1,316	14.54
Mattapoisett	11,167	76	0.68	3,265	29.24
Middleborough	46,194	3,000	6.49	12,553	27.17
New Bedford	12,894	2,251	17.46	1,052	8.16
North Attleborough	12,418	899	7.24	1,632	13.14
Norton	18,724	333	1.78	10,234	54.66
Raynham	13,279	605	4.56	3,576	26.93
Rehoboth	30,371	215	0.71	3,226	10.62
Rochester	23,111	56	0.24	9,044	39.13
Seekonk	11,917	306	2.57	848	7.12
Sharon	15,626	153	0.98	2,780	17.79
Somerset	5,233	104	1.99	200	3.82
Stoughton	10,530	1,226	11.64	1,207	11.46
Swansea	14,834	490	3.30	2,047	13.80
Taunton	30,973	4,849	15.66	11,250	36.32
Wareham	23,951	242	1.01	6,904	28.83
Westport	33,068	166	0.50	7,807	23.61
TOTAL	572,237	29,079	5.08	139,758	24.42

Source: Corridor Plan, Figure 6-2 Corridor Map.

Based on the land use impacts presented in Table 5.3-3, approximately 38,892 acres of natural land would be converted to developed land by 2035 under the No-Build Alternative, representing approximately 11.2 percent of the 347,263 acres of natural land present in the South Coast region in

2005. Approximately 308,371 acres of natural land would remain in the South Coast region in 2035 under the No-Build Alternative.

Property acquisitions are used as a convenient indicator of direct land use impacts. The Stoughton Alternative would involve acquisition of 49.8 acres and the Whittenton Alternative would involve acquisition of 39.6 acres of undeveloped land. The greater land acquisition requirements for the Stoughton Alternative are in large part a result of a need to re-acquire the rail right-of-way between Route 138 and Winter Street in Raynham and Longmeadow Road in Taunton, which does not exist under the Whittenton Alternative. In addition to changes in ownership, both alternatives would convert undeveloped land (both in areas currently owned by MassDOT and in new property acquisitions) to transportation use as part of reactivation of rail service to abandoned corridors. Table 5.4-2 shows that the indirect effect on land use under Scenario 1 would be the conversion of 40,184 acres of undeveloped land to developed land, for a combined total of direct and indirect conversion of 40,234 acres for the Stoughton Alternative and 40,223 acres for the Whittenton Alternative. Combining historic trends in land use conversions, recent or reasonably foreseeable future actions, and the varying land conversions that would result from the Stoughton and Whittenton Alternatives, cumulative impacts of the South Coast Rail project to land use in 2035 are presented in Table 5.4-2.

Approximately 308,371 acres of natural land would remain in the South Coast region in 2035 under the No-Build Alternative. Under Scenario 1, approximately 307,029 acres of natural land would remain under the Stoughton Alternative and 307,040 acres would remain under the Whittenton Alternative. The difference between the Build Alternatives is negligible in a regional context and is due to the greater direct impact (land acquisition) requirements for the Stoughton Alternative noted above. However, it is important to note that direct land conversion (reactivation of rail corridors) would not be limited to the areas of property acquisitions (see Chapter 3 for description and mapping of areas where rail service would be reactivated under the Stoughton and Whittenton Alternatives). The additional loss of 1,331 to 1,342 acres from induced growth indirectly resulting from the Stoughton or Whittenton Alternatives plus direct land acquisition impacts under Scenario 1 would represent approximately 0.4 percent of the total natural land area.

Table 5.4-2 Cumulative Impacts to Land Use in 2035 (in acres)

Historical Trends Affecting Land Use	Trends and Current of Future Actions Affecting Land Use	Alternative	Land Use Conversion			
			Project Direct and Indirect Effects	Natural Land Remaining in 2035	Change from no-Build	% Change from No-Build
Land conversion for agricultural, residential, commercial, and industrial development	Average land conversion of 1,315 acres per year	No-Build	N/A	308,371	N/A	N/A
		Build Alternatives				
		Scenario 1				
		Stoughton	40,234	307,029	-1,342	-3%
		Whittenton	40,223	307,040	-1,331	-3%
		Scenario 2				
		Stoughton	28,005 to 31,681	315,582 to 319,258	-7,213 to -10,889	19% to 28%
		Whittenton	27,994 to 31,670	315,593 to 319,269	-7,232 to -10,898	19% to 28%

Under Scenario 2 low and high implementation of smart growth measures, approximately 315,582 and 319,258 acres of natural land would remain, respectively, for the Stoughton Alternative. For the Whittenton Alternative, 315,593 to 319,269 acres would remain. Approximately 7,213 to 10,898 fewer acres would be lost to development under Scenario 2 than under the No-Build Alternative, a decrease of up to 28 percent. The Build Alternatives would not result in substantial adverse cumulative impacts to land under Scenario 1 and Scenario 2 would substantively slow the rate of land conversion.

5.4.2 Protected Open Space

Publicly owned protected open spaces are regulated by the agency responsible for the property (whether federal, state, or local). Privately owned protected open spaces are not directly regulated by a governmental agency unless a deed restriction (such as a conservation agreement) is attached to the property. At all levels, conversion of publicly or privately owned protected open space to other uses is strongly regulated.

Through a variety of legal vehicles (such as actual ownership or conservation restrictions), public and private entities have protected open space from development throughout the state. In the period from 1999 and 2005, 109,863 acres of open space were newly protected from development.[29] In 2008, an additional 24,104 acres of land were protected by state action[30] and another 54,818 acres were protected in 2009.[31]

Data regarding the total area of recent protections to open space in the South Coast region were not readily available. Using the Commonwealth open space acquisition assumptions, protected open space would expand by 0.7 percent per year (14.7 percent overall), or about 383.7 acres per year (9,976 acres total), resulting in approximately 64,795 acres of protected open space in the South Coast study area municipalities in Massachusetts by 2035.

Under Scenario 1, approximately 64,794 acres of open space would remain under the Stoughton and Whittenton Alternatives. The additional loss of less than 0.66 acre of direct impacts from the Stoughton and Whittenton Electric Alternatives would represent approximately 0.001 percent of the total protected open space area in the South Coast region. Open space impacts for Scenario 2 are unknown but presumably greater than 0.66 acre; however, less open space would be lost to development under Scenario 2 than under the No-Build Alternative or Scenario 1 due to implementation of smart growth measures. The Build Alternatives would not result in substantial adverse cumulative impacts to open space under Scenario 1 and Scenario 2 would slow the rate of land conversion as compared to the No-Build Alternative.

The Corridor Plan identifies 72 PPAs but does not quantify the area of the PPAs nor specifically identify where candidate PPA sites would qualify for protection as public open space status under Article 97 of the Massachusetts Constitution. Although the implementation of smart growth measures of the Corridor Plan would orient growth away from PPAs, new protected open space would not be formally established under Scenario 2. Separate initiatives would be required to designate additional protected open space; however, it is not possible to accurately project the extent of any new protected open space that could be designated. Based on these factors, speculations on increases in protected open

[29] MassAudubon 2003. Losing Ground: At What Cost? (Third Edition of the Losing Ground Series), Changes in Land Use and Their Impact on Habitat, Biodiversity, and Ecosystem Services in Massachusetts. Massachusetts Audubon Society: Lincoln, MA.

[30] EEA. 2008. 2008 Land Protection Report. Executive Office of Energy and Environmental Affairs: Boston.

[31] MassGIS. 2009. Database on website: http://www.mass.gov/mgis/mapping.htm. Accessed on 7 October 2009.

space that may result from the establishment of PPAs do not meet the definition of "reasonably foreseeable projects" for a cumulative impacts analysis.

Combining historic trends of increasing protection of open space and the varying effects on protected open space that would result under the South Coast Rail project by 2035 are presented in Table 5.4-3.

Table 5.4-3 Cumulative Impacts to Protected Open Space in 2035 (in acres)

Historical Trends Affecting Open Space	Trends and Current or Future Actions Affecting Protected Open Space	Alternative	Protected Open Space			
			Project Direct and Indirect Effects	Protected Open Space in 2035	Change from No-Build	% Change from No-Build
State commitment to protect open space through acquisition, spending $50M per year	Open space protected at a rate of 383.7 acres per year	No-Build	N/A	64,795	N/A	N/A
		Build Alternatives				
		Scenario 1				
		Stoughton	0.66*	64,794	-0.66	<-1%
		Whittenton	0.66*	64,794	-0.66	<-1%
		Scenario 2				
		Stoughton	>0.66	>64,794	Unknown	Unknown
		Whittenton	>0.66	>64,794	Unknown	Unknown

Note: *0.66 acre for Stoughton and Whittenton Electric Alternatives. Impact is 0.16 acre for the Stoughton and Whittenton Diesel Alternatives.

5.4.3 Wetlands

Wetlands protection is closely related to the surface water quality laws and regulations mentioned above. Specifically, at the federal level, Section 404 of the CWA requires a Department of the Army permit for the discharge of dredged or fill material into waters of the United States, including adjacent wetlands. The Massachusetts WPA and WPA Regulations provide state protection. As mentioned above, a federal "no net loss" policy requires mitigation of wetland impacts. Only one community within the South Coast Rail study area, Westport, has registered wetlands within its boundary and has adopted restriction orders in compliance with the Coastal Wetlands Restriction Act or Inland Wetlands Restriction Act.

Wetlands in Massachusetts are currently protected at both the federal and state level.[32] Regulatory programs implementing the federal CWA, as administered by the Corps, are conducted in compliance with the national policy of "no net loss" of wetlands.[33] At the state level, the regulatory programs implementing the Massachusetts Clean Waters Act and the Massachusetts WPA, administered by MassDEP, provide similar wetlands protection. The USEPA notes that activities in upland areas outside of regulatory control may degrade wetlands quality, if not quantity.

Existing wetlands in the South Coast region reflect the long history of land use change described in Section 5.4.1. Wetland areas in Massachusetts in the 1780s totaled approximately 818,000 acres,

[32] Only one community (Westport) in the South Coast region has adopted wetland restriction orders in compliance with state laws, but all of the communities could do so.

[33] White House Office on Environmental Policy. 1993. Protecting America's Wetlands: A Fair, Flexible, and Effective Approach. Washington, DC.

representing about 15.5 percent of the state's 5,284,480 acres.[34] By the 1980s, the total wetland area decreased to approximately 588,486 acres, representing 11.1 percent of the total area of the state and a 28-percent decrease over the 200-year period. In 1992, this had further decreased to only 6 to 7 percent of total Commonwealth land.[35]

Wetlands loss rates, both in terms of the numbers of acres lost annually and percentage of total wetland area, have varied substantively over time. Losses can be attributed to several different types of conversions, which have also changed over time. The loss of 229,514 acres of wetlands in 200 years averaged nearly 1,150 acres per year, a 0.14 percent annual loss rate. In 1978, the U.S. Soil Conservation Service[36] estimated Massachusetts' annual wetland loss rate at 0.4 percent, and attributed the losses primarily to urbanization. Historically, the state has lost between 58 and 64 percent of its wetlands from conversion to agriculture, road construction, and other building projects.[37]

Recently, MassDEP initiated a wetlands loss mapping project, which includes a review of recent historical and current aerial photographs to more precisely identify wetland losses by comparing aerial photographs taken in 1990, 2001, and 2005. These losses include both legal[38] (permitted) and illegal (unpermitted) wetland loss. Wetlands lost by a permitted activity may have been mitigated by the project proponent through the creation of new wetlands. The mapping program cannot distinguish newly created wetlands from naturally existing wetlands. The values provided in the following summary are, therefore, conservative because they do not fully account for mitigated impacts. Because both the federal and state governments have "no net loss" policies for wetlands, legally "lost" wetlands have been mitigated at a replacement ratio of at least 1:1.

For the MassDEP Southeast Region (which includes the 31 South Coast Rail study area municipalities in Massachusetts), 545 acres of wetlands were lost from 1990 to 2001 (49 to 68 acres lost per year).[39] For the period from 2001 to 2005, 264 acres of wetlands were lost (66 acres per year) in the Southeast Region. These losses represent 62 percent of total wetland losses across the state during this time.[40] Currently, there are approximately 126,464 acres of wetlands in the 31 South Coast Rail study area municipalities located Massachusetts.[41] Conservatively assuming a consistent 66-acre-per-year loss rate,[42] 124,748 acres of wetlands would remain in 2035 (without considering mitigation under the state and federal "no net loss" requirements).

The wetlands loss mapping project allows for specific identification of conversion types, but data are not readily available at the regional level. Statewide, principal activities causing wetland loss varied. Table

[34] Dahl, T.E. 1990. *Wetlands Losses in the United States 1780's to 1980's.* U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 13pp.

[35] Tiner, R.W., D.B. Foulis, C. Nichols, S. Schaller, D. Petersen, K. Andersen, and J. Swords. 1998. Wetland Status and Recent Trends for the Neponset Watershed, Massachusetts (1977-1991).

[36] U.S. Department of Agriculture, Soil Conservation Service [now Natural Resources Conservation Service]. Referenced in "Natural Communities (from the Silvio O. Conte National Fish and Wildlife Refuge Final Action Plan and Environmental Impact Statement, October, 1995, U.S. Fish and Wildlife Service, Hadley, MA)."

[37] Tiner, R.W. and W. Zinni. 1988. Recent wetland trends in southeastern Massachusetts. US Fish and Wildlife Service. Newton Corner, MA.

[38] According to the DEP, legal losses "include permitted losses likely to have been replicated under permitting criteria. MassDEP is currently unable to identify replicated wetlands."

[39] DEP. 2009. *Wetlands PPA Summary and Workplan*. Commonwealth of Massachusetts, Department of Environmental Protection: Boston. Available at DEP website: http://www.mass.gov/dep/water/priorities/09wet.pdf. Accessed on 4 October 2009.

[40] DEP. 2008. The Environmental Progress Report FY 2008- Wetlands. Commonwealth of Massachusetts, Department of Environmental Protection: Boston. Website: http://www.mass.gov/dep/water/priorities/wlfy08.htm. Accessed 4 October 2008.

[41] MassGIS database: http://www.mass.gov/mgis/massgis.htm. Accessed 5 October 2009.

[42] This value is conservative because it represents the average annual loss in the DEP's Southeast Region, which is larger than the 31-community South Coast Rail study area.

5.4-4 identifies wetland losses attributed to 11 conversion types in 2004 and 2006. These data show a relative consistency of the percentage of wetland impacts attributable to residential development, at 22.5 percent in 2004 and 19.3 percent in 2006, for an average of 20.9 percent. Using this average and the average annual conversion rate of 66 acres per year in the MassDEP Southeast Region, approximately 13.8 acres of wetland loss per year can be attributed to residential development.

Table 5.4-4 Comparison of Statewide Wetland Conversion Types in 2004 and 2006

	Percentage of Total Conversion	
Wetlands Conversion Type	**2004**	**2006**
Agriculture	32.3	7.2
Commercial Development	18.7	12.5
Cranberry Bogs	(included in Agriculture)	9.6
Other	21.0	22.4
Gravel Operation	5.5	5.6
New Road	0.0	2.9
Dock or Pier	0.0	0.08
Residential Development	22.5	19.3
Transportation/Infrastructure	0.0	2.3
Clearing—unknown reason	0.0	16.4
Filling—unknown reason	0.0	1.6

Source: DEP. 2009. *Wetlands PPA Summary and Workplan*. Commonwealth of Massachusetts, Department of Environmental Protection: Boston.

It is not possible to define project-specific wetland losses that have or may occur from each of the recent or reasonably foreseeable activities evaluated in this chapter. Some projects have received or applied for wetland permits with the Corps and/or MassDEP, but there is not a clear indication of how recent wetland loss trends may change as a result of these and other projects. Lacking comprehensive project-specific data, it is reasonable to assume that the estimated 66 acres loss per year based on MassDEP recent data for the Southeastern Region would continue for the foreseeable future.

Chapter 4.16, *Wetlands*, concludes that direct permanent federal impacts to Waters of the U.S. under the electric versions of the Stoughton and Whittenton Alternatives would be 12.3 and 11.2 acres, respectively. Impacts of diesel alternatives would be slightly less than the electric alternatives. Based on regulatory requirements, these impacts would be mitigated at a 1:1, 2:1, or 3:1 ratio, depending upon the habitat type impacted. Therefore, direct wetlands impacts from the South Coast Rail project would not result in a net loss. As described in Chapter 4.16, 34.0 acres of wetlands are anticipated to be restored, replaced, or created to offset direct impacts of the Stoughton Alternatives and 31.0 of wetlands are anticipated to be restored, replaced, or created to offset direct impacts of the Whittenton Alternatives.

Under Scenario 1, wetland losses from induced growth are estimated to be 7.35 square feet per new household. This would decrease to between 5.15 to 5.81 square feet per new household with the implementation of smart growth measures under Scenario 2. Under Scenario 1, approximately 124,754 to 124,756 acres of wetlands would remain in 2035 under the Whittenton and Stoughton Alternatives, respectively. For Scenario 2 there would be a net increase of 9.5 to 12.0 acres, therefore approximately 124,757 to 124,760 acres of wetlands would remain in 2035, based on low to high implementation of smart growth measures under Scenario 2 of the Build Alternatives.

Table 5.4-5 provides an overview of direct and indirect effects and includes the consideration of mitigation measures to identify total wetland area in 2035 under the Build Alternatives. Mitigation for wetland losses indirectly resulting from the project are not included in this evaluation because mitigation ratios are unknown but would likely range from 1:1 to 3:1. It is assumed that mitigation would result in a replacement greater than 1:1 (e.g., no net loss); thus, there would be an increase in wetlands remaining in 2035 under the Build Alternatives as compared to the No-Build Alternative.

Table 5.4-5 Cumulative Impacts to Wetlands in 2035 (in acres)

			Wetlands			
Historical Trends Affecting Wetlands	**Trends and Current or Future Actions Affecting Wetlands**	**Alternative**	**Project Direct and Indirect Effects**	**Wetlands Remaining in 2035**	**Change from No-Build**	**% Change from No-Build**
Historical wetland loss; recent Federal and State wetland regulations	No net loss policy; mitigation (replacement) ratios from 1:1 to 3:1	No-Build	N/A	124,748	N/A	N/A
		Build Alternatives				
		Scenario 1				
		Stoughton	8.1	124,756	8.0	0.01%
		Whittenton	6.3	124,754	6.3	0.01%
		Scenario 2				
		Stoughton	11.3 to 12.0	124,759 to 124,760	11.3 to 12.0	0.01%
		Whittenton	9.5 to 10.2	124,757 to 124,758	9.5 to 10.2	0.01%

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5.4.4 Biodiversity

Biodiversity is not regulated by federal, state, or local agencies. However, evaluation of project impacts to biodiversity is typically a component of NEPA and MEPA analyses for federal and state agencies. This evaluation of the cumulative impacts to biodiversity is based, in part, on historical data from non-governmental sources rather than regulatory agency records.

Loss of biodiversity is linked to increases in land use: undeveloped land has higher biodiversity than developed land. Historical trends in land conversion, therefore, assist in understanding trends in loss of biodiversity. The Corridor Plan states that "more land had been developed in the South Coast region since 1960 than in the previous 340 years and that land development was occurring at 2.5 times the rate of population growth." At a more detailed level, the MassAudubon's *Losing Ground* report series includes an analysis of land use changes throughout Massachusetts from 1971, 1985, 1999, and 2005 data. The report notes that statewide 22 acres of natural land were developed per day during the period between 1999 and 2005, as compared to 40 acres per day between 1985 and 1999. Although land conversion is ongoing, the trend is of decreasing rates of conversion.

As described in Chapter 4.2, *Land Use*, and according to *Losing Ground*, natural (undeveloped) land in 2005 for the 31 South Coast communities in Massachusetts totaled 347,263 acres. In the period from 1999 to 2005, 7,888 acres (2.2 percent of the 1999 total) in those 31 communities had been converted from natural land to developed land. It is assumed that the natural-to-developed land conversion rates calculated by MassAudubon are likely to continue for the foreseeable future. Based on this rate, by 2035

approximately 39,450 acres of natural land would be converted to developed land. This is slightly greater than the amount of land conversion estimated under the No-Build Alternative (38,892 acres). Under the Build Alternatives, between 27,995 acres and 40,184 acres would be converted to support residential development by 2035 depending on which scenario is implemented (see Table 5.3-3). Assuming that natural land is developed as projected under the South Coast Rail project, between 307,079 acres and 319,268 acres of natural land would remain in 2035.

Several plots of land throughout the South Coast region have been set aside for conservation purposes, including the preservation of biological resources (see Chapter 4.10, *Open Space and ACEC*). One example would be the Southeastern Massachusetts Bioreserve (Bioreserve), a 13,600-acre area just east of Fall River, which was established to protect, restore, and enhance the biological diversity and ecological integrity of a large ecosystem representative of the region.[43] The Bioreserve comprises portions of the Freetown/Fall River State Forest, Acushnet Wildlife Management Area, watershed and conservation lands owned by the City of Fall River, and the former Acushnet Saw Mills property. The Bioreserve land is owned by the Commonwealth of Massachusetts, City of Fall River, and Trustees of Reservations. Lands for the Southeastern Massachusetts Bioreserve are still being acquired. There will be no economic development activities within the protected lands of the Bioreserve.

At least one recent project has specifically converted undeveloped to developed land, affecting biodiversity in the South Coast region. The golf course adjacent to the Great Woods Conservation Area in Mansfield converted 400 acres of forest land to developed land (landscaped golf course and appurtenant facilities).[44] Somewhat more historically, the construction of the numerous linear transportation facilities (surface streets, highways, and railroads) as well as utility corridors (aerial electric transmission lines and pipelines) from the late 1800s through the present time has fragmented the landscape, reducing biodiversity by segregating populations of low-mobility species by creating physical or psychological barriers to movement. Highway construction projects, such as I-195 and I-495, continued until the late 1900s.

Several reasonably foreseeable future actions could adversely impact biodiversity:

- Implementation of the Taunton Comprehensive Wastewater Management Plan may impact diadromous fish populations within the Taunton River and Three Mile River.[45]

- Numerous ongoing or anticipated developments throughout the South Coast region, as outlined in the Corridor Plan, will likely convert natural land to developed land. (Note, however, that many of these developments do not qualify as "reasonably foreseeable future actions" as defined above.)

As mentioned above, no new highway projects are currently anticipated in the South Coast region, therefore, biodiversity would not be impacted by any planned transportation improvements.

[43] Bioreserve Partners. 2009. Facts about the Southeastern Massachusetts Bioreserve. Green Futures website: http://www.greenfutures.org/projects/green/biofacts.html. Accessed 29 October 2009.

[44] Chase, H.B. Jr. 2009. Great Woods Today. Natural Resources Trust of Mansfield website: http://home.comcast.net/~nrtma/html/today.html. Accessed on 12 October 2009.

[45] EEA. 2009. Certificate of the Secretary of Energy and Environmental Affairs on the Notice of Project Change, Comprehensive Wastewater Management Plan (Winthrop Street, Davenport Terrace, Williams Street Sewer Extension). Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs: Boston.

Historic trends and current or future projects suggest that land development in the South Coast region is likely to continue for the foreseeable future. As discussed in MassAudubon's *Losing Ground* report series and reflected in the Corridor Plan, development generally propagates outward from the Boston metropolitan area, with a "sprawl frontier" of urban-character communities in the northern portion of the South Coast region and decreasing development density farther south into suburban and rural communities. Accordingly, there is a potential for greater conversion in the southernmost communities because the northernmost communities have already converted much of their land. Although the rate of conversion has slowed in recent years, the South Coast communities have not reached build-out. The South Coast region will likely experience continued loss of biodiversity correlated with land development in the foreseeable future irrespective of the South Coast Rail project.

In addition to these identifiable, specific human activity trends and projects, global warming may have local effects on biodiversity. Recent studies predict the effects of climate change in New England that could dramatically change the distribution of plant communities and some animal species. New England's average summer temperatures are anticipated to increase by 2 to 3°F by 2040, and by 6 to 14°F by the end of the century, resulting in a summer climate similar to that of North Carolina.[46] Winters are also predicted to be warmer, by 8 to 12^0F, with fewer snow-covered days. These changes are expected to be accompanied by longer growing seasons, increasing by 4 to 6 weeks by 2099.

These changes are predicted to affect the distribution of plant species, with most tree species shifting their range north by at least 300 miles. The effects are highly uncertain; however, Frumhoff et al. predict that Southeastern Massachusetts would likely retain the same dominant forest type.[47] Changes in plant distributions are likely to occur more slowly than for animals, as a result of the longer generation times, and that changes in vegetation are likely to be complex and result from a combination of the effects of changing temperature, precipitation, snow cover, and other factors.[48]

Sea level, which has been rising since the end of the last glaciations, is predicted to accelerate. Even in the absence of climate change, sea levels will be 6 inches higher by 2099. There is a range of predictions for the added effects of climate change, from 17 inches to more than 4 feet (assuming that the Greenland ice cap does not melt catastrophically). Sea level rise could result in the loss of much of New England's coastal salt marshes if sediment accretion does not keep pace with sea level rise and if topography and development at the current upland edges of salt marshes do not allow marshes to migrate landward.

Predictions for animal communities also suggest that some bird and mammal species could shift distributions northward as forest plant community composition and temperature extremes change. This is particularly the case for species whose present northern limit is linked to winter temperatures and snow cover. Warmer winters and less snow cover could allow these species to expand into New England. Other concerns with regard to wildlife habitat include changes in hydrography and increasing temperatures of stream waters, potentially affecting reproduction or survival of cold water fish, or changes in precipitation patterns that potentially alter the hydroperiod of vernal pools and affect reproductive success of obligate vernal pool amphibians. Vernal pools are particularly sensitive to change in precipitation and evapotranspiration rates. Climate change predictions of more episodic

[46] Frumhoff, P.C., J.J. McCarthy, J.M. Melillo, S.C. Moser, D.J. Wuebbles. 2007. *Confronting Climate Change in the U.S. Northeast: Science, Impacts, and Solutions.* Synthesis report of the Northeast Climate Impacts Assessment (NECIA), Cambridge MA: Union of Concerned Scientists. USC Publications

[47] Ibid.

[48] Bertin, R.I. 2008. Plant phenology and distribution in relation to recent climate change. J. Torrey Bot. Soc. 135: 126-146.

precipitation and increased evapotranspiration rates suggest that vernal pools would dry earlier in the year and stay dry longer.[49]

With these exceptions, plant and animal communities within the South Coast Rail study area are not anticipated to change substantially with projected climate change because these areas primarily support plant and animal communities with a more southern coastal plain distribution (the coastal plain extends from New Hampshire to Virginia), rather than the more vulnerable northern forest communities of northern New England. Salt marshes, cold-water fisheries, and vernal pools are the most vulnerable elements of the South Coast area.

The Stoughton and Whittenton alternatives would directly impact 11.2 to 12.3 acres of vegetated wetlands and 182 to 188 acres of upland wildlife habitat. Table 5.4-6 shows that the indirect effect on biodiversity from the Stoughton and Whittenton Alternatives under Scenario 1 would be the loss of 120,551 acres of habitat. The table compares combined historic trends in land conversion, recent or reasonably foreseeable future actions, and the range of land conversion that would result from the No-Build Alternative and under the two scenarios of the Stoughton and Whittenton Alternatives.

Table 5.4-6 Cumulative Biodiversity Impacts in 2035

Historical Trends affecting Biodiversity	Trends and Current or Future Actions Affecting	Alternative	Land Conversion (acres of reduced value)			
			Project Direct and Indirect Effects[1]	Natural Land Remaining in 2035	Change from No-Build	% Change from No-Build
40 acres per day land conversion; ecosystem fragmentation	22 acres per day land conversion; additional habitat degradation; climate change	No-Build	N/A	307,813	N/A	N/A
		Build Alternatives				
		Scenario 1				
		Stoughton	120,605	303,883	-3,933	-1%
		Whittenton	120,595	303,893	-3,920	-1%
		Scenario 2				
		Stoughton	58,760 to 75,021	349,467 to 365,728	+41,654 to +57,915	+14% to +19%
		Whittenton	58,750 to 75,011	349,477 to 365,738	+41,664 to +57,925	+14% to +19%

1 The four high-biodiversity habitat types (upland, wetland, vernal pool- wetland, and vernal pool- supporting upland) have been summed only to illustrate the area of land conversion; they are not of equivalent biodiversity value.

Approximately 307,813 acres of natural land would remain in the South Coast region in 2035 under the No-Build Alternative, after 116,675 acres of habitat loss. For the Stoughton Alternative under Scenario 1, approximately 303,883 acres of natural land would remain, after 120,605 acres of habitat loss. For Scenario 2, approximately 349,467 to 365,728 acres of natural land would remain, with low and high implementation of smart growth measures, respectively, after between 58,760 and 75,021 acres of habitat loss. The cumulative impacts of the Whittenton Alternative would be very similar to the Stoughton Alternative.

[49] Brooks, R.T. 2004. Weather-related effects on woodland vernal pool hydrology and hydroperiod. In *Wetlands.* (Vol. 24, No. 1, pp 104-114). The Society of Wetland Scientists.

Under Scenario 1, the Build Alternatives would result in approximately 1 percent more conversion of undeveloped land as compared to the No-Build Alternative. Under Scenario 2, the Build Alternatives would result in 14 to 19 percent less conversion of undeveloped land than the No-Build Alternative.

Recent trends in land conversion and concomitant biodiversity loss described above in combination with the impacts from the Build Alternatives would:

- Under Scenario 1, result in little additional land conversion and habitat loss as compared to the No-Build Alternative, with resultant minimal impacts to biodiversity. A slight increase in the area of degraded habitat would also be realized in this scenario; or

- Under Scenario 2, contribute less to land conversion and habitat loss than the No-Build Alternative, with lower resultant impacts to biodiversity. Substantively less area of habitat would be degraded in this scenario.

5.4.5 Threatened and Endangered Species

Rare species are protected at the federal level by the US Fish & Wildlife Service, or the National Marine Fisheries Service, under the authority of the Endangered Species Act (ESA). At the state level, the Massachusetts Department of Fish and Wildlife (DFW) is responsible for administering the Natural Heritage and Endangered Species Program (NHESP) under the Massachusetts Endangered Species Act (MESA). Both classify rare species according to their risk of extinction, prohibit "take" of species except as authorized by permit (and usually requiring mitigation), and implement plans to assist in the recovery of those species.

Historical development of the South Coast region has impacted native plants and animals to the extent that some species are now rare and have received legal protection under state or federal law. Under MESA, an "Endangered" species is one that is in danger of extinction throughout all or a significant portion of its range within Massachusetts. A "Threatened" species is one that is likely to become endangered in Massachusetts in the foreseeable future. Species of Special Concern are those species where biological research has documented to have suffered a decline that could threaten the species if the decline continues unchecked, or those species that occur in such small numbers or with such a restricted distribution that they could easily become threatened within the Commonwealth. Similar definitions are used at the national level under ESA. Several state-listed rare species that are present in the South Coast region may be affected by the South Coast Rail project, as described in Chapter 4.15, *Threatened and Endangered Species*. No federally listed species would be affected by the South Coast Rail project. Table 5.4-7 identifies potentially impacted species and threats to each.

Historical and ongoing land development has converted natural land and altered wetlands and vernal pools, as described in Chapter 4.14, *Biodiversity*, *Wildlife, and Vegetation*; Chapter 4.2, *Land Use and Zoning*; and Chapter 4.16, *Wetlands*. A species now protected by either the ESA or MESA has been likely been adversely impacted by such historical activities. Federal and state laws, enacted in 1973 and 1990, respectively, now prohibit "take" of individuals and/or adverse impacts to their habitat except as permitted and usually with some mitigation requirement. Any major federal or state action (including providing funding or issuing a permit by an agency) requires analysis of impacts to listed species. Typically, projects adversely affecting listed species are not approved without a mitigation requirement. Project impacts to certain habitat types, such as wetlands and vernal pools, also typically require mitigation (for example, the "no net loss" policy for wetlands). However, some of the threats to listed species are not subject to ESA or MESA regulations.

Table 5.4-7 State-Listed Species Potentially Impacted by the South Coast Rail Project

Species	Listing Status	Threats
Marbled Salamander (*Ambystoma opacum*)	Threatened	Loss, degradation and fragmentation of both aquatic breeding pool habitat required for reproduction and terrestrial habitat needed for foraging, overwintering, growth and development to development and urbanization.
Blue-Spotted Salamander (*Ambystoma laterale*)	Species of Special Concern	Loss, degradation and fragmentation of both aquatic breeding pool habitat required for reproduction and terrestrial habitat needed for foraging, overwintering, growth and development to development and urbanization.
Wood Turtle (*Clemmys insculpta*)	Species of Special Concern	Hay-mowing operations, development of wooded stream banks, roadway casualties, incidental collection of specimens for pets, unnaturally inflated rates of predation in suburban and urban areas, forestry and agricultural activities, and pollution of streams.
Blanding's Turtle (*Emydoidea blandingii*)	Threatened	Habitat loss, degradation, and fragmentation (i.e., roads) driven by commercial and residential expansion. Other threats include illegal collection, unnaturally inflated rates of predation in suburban and urban areas, agricultural and forestry practices, and natural succession (i.e., loss of nesting habitat).
Eastern Box Turtle (*Terrapene carolina*)	Species of Special Concern	Habitat destruction resulting from residential and industrial development; road mortality; collection by individuals for pets; mowing of fields and early successional habitat during the active season; unnaturally inflated rates of predation in suburban and urban areas; disturbance of nest sites by ATVs; and genetic degradation due to the release of non-native (pet store) turtles.
Mocha Emerald (*Somatochlora linearis*)	Species of Special Concern	Stream damming or alteration; chemical pollution.
Hessel's Hairstreak (*Callophrys hesseli)*	Species of Special Concern	Habitat loss; suppression of disturbance (fire, flooding), or excessive deer browsing, preventing regeneration of Atlantic white cedar; hydrologic alteration; invasion by exotic plants; introduced generalist parasitoids; insecticide spraying
Pale Green Pinion Moth (*Lithophane viridipalle)*	Species of Special Concern	Habitat loss; hydrologic alteration; invasion by exotic plants; introduced generalist parasitoids; insecticide spraying; light pollution.
Water-Willow Stem Borer Moth (*Papaipema sulphurata)*	Species of Special Concern	Habitat loss; hydrologic alteration; invasion by exotic plants; introduced generalist parasitoids; insecticide spraying; light pollution.
Ringed Boghaunter (*Williamsonia lintneri)*	Endangered	Artificial changes in water level and various forms of pollution (such as agricultural and road runoff), septic system failure, insecticide spraying.
Long's Bulrush (*Scirpus longii*)	Threatened	Changes in the water quality and the natural fluctuating hydrologic regime of its habitat, invasion by exotic invasive plants, and exclusion of fire disturbance.

Source: NHESP Website: http://www.mass.gov/dfwele/dfw/nhesp/species_info/mesa_list/mesa_list.htm. Accessed 8 October 2009.

The New Bedford Airport Improvement Project is an example of an action in the South Coast region with potential impacts to protected species, particularly the eastern box turtle (*Terrapene carolina*) (Chapter 4.15, *Threatened and Endangered Species*). This project is required to obtain and comply with a Conservation and Management Permit to mitigate impacts to this species.

As described in Chapter 4.15, *Threatened and Endangered Species*, the South Coast Rail project would also include mitigation of direct or indirect effects to listed species' habitat, resulting in a net benefit to those species. Indirect effects from induced growth would be regulated by the ESA or MESA, and

relevant habitat protection laws for wetlands and vernal pools. Because of the overriding ESA and MESA regulations, there would be no difference in cumulative impacts to threatened or endangered species under the two scenarios even with full implementation of PPAs.

Several state-listed species could potentially experience cumulative adverse effects from the loss of habitat quality associated with habitat fragmentation from land development or climate change, as discussed in Chapter 4.14. Eastern box turtles and vernal pool species (marbled and blue-spotted salamanders [*Ambystoma opacum, A. laterale*], Blanding's turtles [*Emydoidea blandingii*]) could continue to decline as a result of these indirect effects.

In summary, federal and state laws and regulatory programs protect threatened or endangered species and certain habitat types. Regulatory protections prevent long-term adverse impacts to listed species. Because the MESA process requires net benefit measures for all projects, there would not be continued losses of listed species under the No-Build Alternative. As previously described, indirect effects on habitat quality and connectedness would be greater under Scenario 1 for the Build Alternatives, and would be reduced in Scenario 2 to levels below the No-Build Alternative.

5.4.6 Water Quality

Surface water quality is regulated by the USEPA under Section 402 of the CWA. Relevant CWA programs include the National Pollutant Discharge Elimination System (NPDES) (which regulates discharges of wastewater and storm water to certain surface water bodies), and the Total Maximum Daily Load program (regulating discharges of pollutants into certain water bodies with designated uses; this program has been delegated to DEP). Most construction-related discharges are subject to EPA's Construction General Permit, which requires a Stormwater Pollution Prevention Plan, among other requirements.

Surface water resources are protected at the state level under several laws and regulatory programs, including the Massachusetts Clean Waters Act (MCWA). Other applicable rules, regulations, and guidance include the Massachusetts Wetlands Protection Act and Wetlands Protection Act Regulations, Massachusetts Public Waterfront Act and Waterways Regulations, the Surface Water Quality Standards, the proposed Stormwater Management Regulations, and the Massachusetts Stormwater Management Handbook.

As with other physical resources (such as biodiversity and wetlands), water quality in the South Coast region has been adversely impacted by historical activities but increasingly stringent federal and state regulatory controls over the past several decades have resulted in substantive improvements. Many surface water bodies and groundwater resources have been classified for specific uses and are protected for those uses. Point source and non-point source discharges to surface water bodies are regulated, and special protections are afforded to either outstanding resource waters (those with exceptional values) or impaired waters (those that do not meet standards for their designated use). Groundwater supply protection areas have been similarly established to protect aquifers that are used for public water supplies. Chapter 4.17, *Water Resources*, provides a summary of the relevant regulatory programs and designations for each classified water resource in the South Coast Rail study area.

All potential sources of discharges to surface water bodies or groundwater resources must comply with relevant regulatory requirements. Accordingly, none of the reasonably foreseeable future actions listed above would result in a decrease of surface or groundwater quality.

The South Coast Rail project would not adversely impact water quality. The project would not require any process water discharges, and storm water discharges from the railroads, stations, or layover facilities would be managed in compliance with a Storm Water Pollution Prevention Plan (SWPPP) and state stormwater standards. With the required mitigation and drainage features in place, the Build Alternatives are not expected to contribute contaminants that would impair surface or groundwater resources (Chapter 4.17, *Water Resources*).

Development could indirectly affect water quality through nonpoint sources such as runoff from lawns (containing fertilizers, herbicides or pesticides). An increased number of septic systems in municipalities without sewer and wastewater treatment could also affect groundwater quality through the addition of nutrients, potentially increasing eutrophication in surface water bodies. As previously documented, there would be minor differences between the No-Build Alternative and the Build Alternatives under Scenario 1. Each of these could result in indirect effects to surface or groundwater quality. Although not quantifiable at this phase of project design, it is anticipated that land development under Scenario 2 would result in less pavement, due to cluster development, and less stormwater runoff than Scenario 1. Development in Scenario 2 is also anticipated to reduce lawn area, and would therefore have a slight reduction in potential indirect water quality effects. Therefore, Scenario 2 is anticipated to reduce cumulative water impacts over the No-Build Alternative and Scenario 1 of the Build Alternatives.

5.4.7 Air Quality

This section discusses the cumulative impacts of the South Coast Rail project to ambient air quality and GHG emissions. As discussed in Chapter 4.9, *Air Quality*, hazardous air pollutant emissions from mobile sources are not anticipated to be a substantial aspect of the South Coast Rail project and are therefore not discussed in this analysis.

Air quality in Massachusetts is regulated by the EPA within various programs of the federal Clean Air Act and by MassDEP under the Massachusetts Clean Air Act and the Global Warming Solutions Act. Certain projects must be evaluated for impacts to ambient air quality, GHG emissions, and hazardous air pollutant emissions. Controls or offsets of these emissions are often required as part of facility operating permits. States are required to develop and implement plans to improve ambient air quality when thresholds are exceeded for certain pollutants.

5.4.7.1 Ambient Air Quality

The existing ambient air quality in the South Coast region reflects past actions and regulatory controls. The USEPA regulates emissions of six "criteria pollutants" under the National Ambient Air Quality Standards (NAAQS) program.[50] The USEPA has designated all three South Coast counties (Bristol, Norfolk, and Plymouth)[51] as in non-attainment status for ozone NAAQS but in attainment status for all other criteria pollutants.[52] MassDEP has prepared a State Implementation Plan (SIP) describing how the

[50] USEPA. 2009. *Six Common Air Pollutants*. EPA website: http://www.epa.gov/air/urbanair. Accessed on 25 September 2009.
[51] The entire state does not meet the ozone NAAQS.
[52] USEPA. 2009. County Air Quality Report- Criteria Pollutants, Geographic Area: Massachusetts, Year: 2008. USEPA website: http://iaspub.epa.gov/airsdata/adaqs.summary?geotype=st&geocode=MA&geoinfo=st%7EMA%7EMassachusetts&year=2008&fld=county&fld=stabbr&fld=regn&rpp=25. Accessed on 25 September 2009.

ozone NAAQS will be met by the end of the 2009 monitoring season.[53] MassDEP projections were made with a model that takes into consideration state and county growth factors.

Air quality monitoring shows a recent trend of decreasing volatile organic compounds (VOCs) and nitrogen oxides (NO_x) emissions (in the presence of sunlight and heat, VOCs and NO_x react to form ozone). New federal rules on emissions and fuel standards for non-road mobile sources (such as locomotives), as well as regulations on numerous other source products, will contribute to these anticipated reductions.

The electrification of the Northeast Corridor reduced diesel locomotive usage, resulting in lower emissions of air pollutants, and likely beneficially impacting ambient air quality.

The construction of proposed industrial, business, or commercial parks in Fall River and Freetown, and at Great Woods in Mansfield would increase automobile traffic, resulting in more emissions of air pollutants than if these projects were not built. However, none of these projects would result in exceeding NAAQS. Even with these projects ambient air quality is expected improve over the current conditions due to increasing regulatory controls.[54] Although traffic would be increased, regulatory controls such as federal automobile emission standards and state vehicle inspection programs would reduce emissions.

The South Coast Rail project would not adversely impact ambient air quality. None of the alternatives would result in exceeding any of the NAAQS for the six criteria pollutants (Chapter 4.9, *Air Quality*). There is less than one-tenth percent variation in emissions between the alternatives, including either electric- or diesel-powered train options of the Build Alternatives.

Ambient air quality in 2035 would be improved over current conditions, even with the projected growth in the region, due to both regulatory controls and the reduced rate of growth in traffic that would result from use of the transit system. The South Coast Rail project is expected to beneficially impact air quality indirectly. Compared to the No-Build Alternative, vehicular movements (in terms of VMT) under the Build Alternatives would be reduced by up between 197,500 and 252,200 VMT daily, with resultant reduction in emissions of regulated air pollutants (see Table 5.3-9).[55]

There would be no significant difference in ambient air quality cumulative impacts under the No-Build and Build Alternatives.

5.4.7.2 Greenhouse Gases

GHG monitoring at the federal level has been conducted since 1990, and the U.S EPA recently initiated a program regulating GHGs for large sources.[56] The most recent data available are from 2007 and, compared to 1990 data, indicate that total national GHG emissions have increased by 17 percent over

[53] DEP. 2008. *Final Massachusetts State Implementation Plan to Demonstrate Attainment of the National Ambient Air Quality Standard for Ozone*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection: Boston.

[54] US DOT. 2009. Route 24, Fall River and Freetown, Massachusetts, Access Improvements Project,; Environmental Assessment, Draft Individual Section 4(f) Evaluation, and Final Environmental Impact Report. US Department of Transportation, Federal Highway Administration and Commonwealth of Massachusetts, Massachusetts Highway Department: Cambridge and Boston, MA.

[55] Ibid.

See in particular Table 5-1, Summary of 2030 Mesoscale (Regional) Air Quality Analysis for South Coast Rail Project.

[56] USEPA. 2009. Final Mandatory Reporting of Greenhouse Gases Rule. USEPA website: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html. Accessed on 25 September 2009.

those 17 years.[57] GHG emissions attributed to transportation sources principally from fossil fuel consumption increased 27 percent over the same time period (an average of 1.6 percent per year).

At the state level, GHG emissions in 1990 have been used as a baseline to establish projections to 2020.[58] GHG reduction targets are to be developed for each decade from 2020 to 2050,[59] beginning with a target between 10 and 25 percent reduction (as compared to 1990 levels) and culminating in at least an 80 percent reduction by 2050.[60] The 1990 data indicate that GHG emissions attributable to transportation sources were 28.9 million metric tons of carbon dioxide equivalent ($MMTCO_{2e}$). Lacking current state-specific data of GHG emissions but assuming that the nation-wide increase in transportation GHG emissions are similarly increasing at the state level, approximately 36.7 $MMTCO_{2e}$ were emitted by the transportation sector in Massachusetts in 2007. It is not possible to predict what either the regulatory limit for nor what the actual rate of GHG emissions may be in 2035.

The EPA's recent rule requiring reporting of GHG emissions applies to large GHG emission sources: facilities that emit more than 25,000 metric tons of carbon dioxide per year. Numerous other EPA regulatory programs are addressing greenhouse gas emissions from other sources, including vehicle emission standards for heavy-duty vehicles,[61] and standards for 2017-2025 model year cars and trucks adopted in 2012.[62]

The construction of proposed industrial, business, or commercial parks in Fall River, Freetown, and Mansfield will likely contribute GHGs into the atmosphere due to increased VMT. For example, the Crossroads at 24 project in Fall River is required to conduct mesoscale air quality analyses for VOC and NO_x emissions for compliance with MassDEP's Greenhouse Emissions Policy and Protocol. As with the ambient air quality, this project would result in GHG emissions but modeled air pollutant concentrations in the future (2035) are lower than current concentrations due to increasing regulatory controls.[63]

The South Coast Rail project would result in direct and indirect GHG emissions. Although all project alternatives (including the electric- or diesel-powered train options) would result in direct GHG emissions, the modeled emissions are less than would occur under the No-Build Alternative (Chapter 4.9, *Air Quality*). Automobile traffic (VMT) would be reduced, with resultant comparative reduction in GHG emissions (Chapter 4.9, *Air Quality, Table 4.9-20: Summary of the 2030 Mesoscale (Regional) Air Quality Analysis for the South Coast Rail Alternatives)*.

The South Coast Rail project would result in GHG emissions from induced growth. Table 5.4-8 compares the calculated direct and indirect transportation-related, as well as residential growth, 2035 GHG emissions for each alternative from the Business as Usual scenario.

[57] USEPA. 2009. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2007*. US Environmental Protection Agency: Washington, DC.

[58] DEP. 2009. *Statewide Greenhouse Gas Emission Level: 1990 Baseline and 2020 Business As Usual Projection*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection: Boston.

[59] MA DEP. 2009. *Air & Climate: Greenhouse Gases & Climate Change, What the State is Doing: Global Warming Solutions Act*. Website: http://www.mass.gov/dep/air/climate/index.htm#gwsa. Accessed 12 October 2009.

[60] DEP. 2009. *Statewide Greenhouse Gas Emission Level: 1990 Baseline and 2020 Business As Usual Projection*. Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, Department of Environmental Protection: Boston.

[61] Available online at: http://www.epa.gov/otaq/climate/regs-heavy-duty.htm.

[62] Available online at: http://www.epa.gov/otaq/climate/documents/420f12051.pdf

[63] US DOT. 2009. Route 24, Fall River and Freetown, Massachusetts, Access Improvements Project,; Environmental Assessment, Draft Individual Section 4(f) Evaluation, and Final Environmental Impact Report. U.S. Department of Transportation, Federal Highway Administration and Commonwealth of Massachusetts, Massachusetts Highway Department: Cambridge and Boston, MA.

The data suggest a very minor change from the No-Build Alternative in greenhouse gas emissions that would directly or indirectly result from the South Coast Rail project. Fewer miles would be traveled for all alternatives, offsetting the growth in the number of households for each alternative.

Table 5.4-8 Greenhouse Gas Emissions in 2035

Historical Trends affecting Greenhouse Gas Emissions	Trends and Current or Future Actions affecting Greenhouse Gas Emissions	Alternative	Greenhouse Gas Emissions (CO_2 tpy)			
			Project Direct and Indirect Effects	GHG Emissions in 2035	Change from No-Build	% Change from No-Build
Increasing greenhouse gas emissions	Decreasing greenhouse gas emissions due to new state and federal controls despite additional sources	No-Build	N/A	28,691,855	N/A	N/A
		Build Alternatives				
		Scenario 1				
		Stoughton	33,168	27,842,309	-849,546	2.9
		Whittenton	33,168	27,842,309	-849,546	2.9
		Scenario 2				
		Stoughton	<33,168	<27,842,309	>-849,546	>2.9
		Whittenton	<33,168	<27,842,309	>-849,546	>2.9

Note: Assumes 11.83 CO_2 tpy for all alternatives.

The cumulative impacts evaluation combines the historical activities, regulatory controls, and reasonably foreseeable future actions with the greenhouse gas emissions that are anticipated from the South Coast Rail project. As with ambient air quality, within Scenario 1 greenhouse gas emissions in 2035 would be improved over current conditions for all alternatives, even with the anticipated growth in the region, due to both the regulatory controls and the reduced rate of growth in traffic that would result from use of the transit system. It is not possible to predict the greenhouse gas emission level limits that may arise from the regulations mentioned above; it is only known that the limits will be some percentage lower than the 1990 emission levels. In any case, compared to the No-Build Alternative, automobile traffic (in terms of VMT) would be reduced, with resultant reduction in emissions of greenhouse gases, as presented in Chapter 4.9, *Air Quality, Table 4.9-20: Summary of the 2030 Mesoscale (Regional) Air Quality Analysis for the South Coast Rail Alternatives*. The increase in households would, of course, increase associated greenhouse gas emissions over the No-Build Alternative. In either case, however, greenhouse gas emissions will be cumulatively reduced because of the regulatory requirements to reduce greenhouse gas emissions as compared to 1990 levels.

Scenario 2 is anticipated to reduce greenhouse gas emissions but the reductions may not be measurable at the regional level. As shown in Table 5.2-2, there would be no measurable difference in greenhouse gas emissions by household within Scenario 2. The location of the sources would differ (i.e., concentrated in PDAs instead of dispersed throughout the region) but the total emissions from stationary sources would not. Sprawl would be reduced, as compared to Scenario 1, because development would be concentrated close to station sites and in PDAs, presumably resulting in less personal car use and therefore lower greenhouse gas emissions.[64]

[64] EOT. 2009. *Smart Energy/Smart Growth Toolkit: Transit-Oriented Development (TOD)*. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works website: http://www.mass.gov/envir/smart_growth_toolkit/pages/mod-tod.html. Accessed 25 September 2009.

As described in Section 5.3, forest clearing would likely reduce carbon sequestration, but cannot be quantified at this time. Changes in carbon sequestration would be proportional to the amount of land cleared for each alternative and scenario.

Combined with the improvements in greenhouse gas emissions required by regulatory standards described above, the cumulative impacts from the Build Alternatives would:

- Under Scenario 1, contribute additional GHG but, depending upon the alternative selected, at minimally lower or higher rates than the No-Build Alternative, or
- Under Scenario 2, also contribute additional GHG but, depending upon the alternative selected, at minimally lower or higher rates than the No-Build Alternative. The greenhouse gas emission source locations may vary, but the overall (regional) reduction as compared to the Business as Usual scenario may be immeasurable.

There would be no significant differences between the alternatives in the cumulative impacts to global climate change from greenhouse gas emissions.

5.4.8 Economy

The evaluation of potential project-induced impacts to economic conditions is typically a component of analyses conducted for federal and state agencies. Because governments are typically funded, in part, by taxes, tracking tax revenue streams often provides a good measure of the economy.

Local, state, and federal agencies monitor (measure) various economic metrics. As described in the Corridor Plan, the "South Coast rail alternatives will improve accessibility and mobility in the South Coast region, and these improvements are expected to stimulate additional business sales, jobs, household income, and state and local taxes beyond that forecast in the absence of such improvements."[65] This evaluation of the cumulative impacts to the economy that may result from the South Coast Rail project is based on projected impacts to households and population, economic activity and jobs, and tax revenues.

It is anticipated that economic impacts would be recognized at different locations across the South Coast region under Scenario 1 and Scenario 2 because the implementation of smart growth measures under Scenario 2 would distribute development differently than demonstrated under existing conditions and projected under Scenario 1.

5.4.8.1 Household Size and Population

As presented in Table 5.3-2, household growth in the South Coast region from 2000 to 2035 is anticipated to total 75,212 new households under the No-Build Alternative. Assuming an average household size of 2.5 persons, the resident population of the South Coast region would increase by approximately 188,031 persons by 2035 under the No-Build Alternative. Based on a regional population of approximately 740,000 in 20098, the South Coast region population would be approximately 928,031 in 2035 under the No-Build Alternative.

[65] EOT. 2009. *South Coast Rail Economic Development and Land Use Corridor Plan.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. See Chapter 5: Potential Economic Effects of South Coast Rail, and in particular Table 5-1: Economic Effects in 2030 of South Coast Rail (SCR) Rail Alternatives ($2007).

The Build Alternatives are projected to introduce an additional 2,802 to 2,804 households across the South Coast region by 2035. Assuming 2.5 people per household, this would result in an additional 7,005 to 7,010 people across the South Coast region over and above the No-Build Alternative. The incremental increase in population under the Build Alternatives represents less than 0.8 percent of the 2009 South Coast region population.

5.4.8.2 Jobs and Economic Activity

Extensive economic data characterizing the current economy are provided in the Corridor Plan.[66] Bristol County includes some three-quarters of the population and is almost entirely encompassed by the South Coast Rail study area (smaller portions of Plymouth and Norfolk counties are also within the project area). The employment base in Massachusetts grew by 53 percent between 1976 and 2006, while the Bristol County employment base grew by only 43 percent.[67] Seventy percent job growth was seen in Norfolk County and 109 percent in Plymouth County. The highest growth rates (statewide and in each county except Norfolk) were observed between 1981 and 1986, followed by negative growth (job loss) between 1986 and 1991.[68] With few exceptions, Bristol County experienced the least job growth (and greatest job loss) of the three South Coast counties over the 30-year period.

In the most recent period, total economic output in the South Coast Rail study area was over $50 billion in 2006, an increase of 18 percent from the 2001 output of $43 billion.[69] Grouping the broad range of industry sectors into four general types agricultural output represented 42.7 percent ($398 million), manufacturing represented 22.6 percent ($12 billion), services and trades represented 18.6 percent ($34 billion), and other production (mining, construction, and utilities) decreased represented 0.6 percent ($4 billion).

While economic output gained on average, the South Coast region lost 2,839 jobs during this period to total 374,832 in 2006, a decrease of less than 1 percent.[70] The greatest number of job losses was realized in the manufacturing sector, down from 51,833 to 40,633. This represents a nearly 22 percent loss but compares with state (23 percent) and national (21 percent) losses in the manufacturing sector in the same period. Job growth in sectors such as amusement & recreation, lodging, eating & drinking, wholesale trade, and real estate helped offset the shrinking of the manufacturing sector. The Corridor Plan estimates that there are currently 380,000 jobs the South Coast region.[71]

A number of the reasonably foreseeable future activities, as well as some more speculative projects, would introduce new economic activity and job in the South Coast region:

[66] Ibid.

[67] Ibid. See in particular Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline.

[68] Ibid. See Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline, Figure 40: Employment Changes, 1976-2006.

[69] Ibid. See Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline, Table 25: Trends 2001-2006.

[70] Ibid. See Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline, Table 22: Employment Changes by Sector, 2001-2006.

[71] Ibid. See Chapter 5, Potential Economic Effects of the South Coast Rail.

- The proposed industrial, business, or commercial parks in Fall River and Freetown would increase business activity and add 11,000 jobs in these two communities[72] once the parks are occupied.

- Numerous other ongoing or anticipated developments throughout the South Coast, as outlined in the Corridor Plan,[73] are projected to increase business activity and add jobs in the region.

Many of these projects fall within the Southern Triangle portion of the South Coast Rail study area, therefore, the cumulative impacts would not differentiate between the Build Alternatives.

Historic and current data suggest that overall economic growth will continue in the South Coast region at a rate similar to the state as a whole. However, growth (or loss) will vary substantively between industries and communities and likely fluctuate during different time periods as a result of overall economic conditions. In general, economic activity is greatest in the northernmost communities (those closer to Boston) and communities already serviced by rail (such as the Northeast Corridor). Using the two geographic divisions described in the indirect effects analysis, the Corridor Plan predicts $52 billion in business activity in SCR 10 and $27 billion in SCR 21, for a total business output of $99 billion in 2030 under the No-Build Alternative.[74] The Corridor Plan does not analyze potential impacts in 2035.

Economic benefits would be recognized across the South Coast region during both the construction and operation of the Build Alternatives. Based upon the preliminary estimates of construction costs, the Corridor Plan states that "expenditures for labor and materials would generate construction period benefits of about 7,000 to 8,000 jobs, $1.4 to $1.8 billion in business output, and about $315 to $360 million in household income."[75] The Corridor Plan does not assign these impacts to individual communities or distinguish between the alternatives. By 2035, recognized economic benefits as a result of the South Coast Rail project are expected to contribute between $268 and $295 million in net new business output annually within the South Coast region and an additional $180 million to $192 million for the rest of the state.[76]

As described in Chapter 4.3, *Socioeconomics*, some job losses are anticipated as a result of business displacements to support the Build Alternatives, specifically at the Fall River Depot Station. The extent of such losses would depend on whether business owners relocate in the area. The size and number of businesses that would be displaced is not anticipated to affect overall municipal tax revenue in any significant way.

An additional 37,864 jobs would be introduced to the South Coast region by 2035 under the No-Build Alternative. This number is over and above the 380,000 estimated jobs in the Corridor Plan. Under Scenario 1 of the Build Alternatives, projections indicate an additional 1,341 jobs would be introduced to the South Coast region by 2035. Two fewer jobs would be introduced to the region under Scenario 2

[72] Pateakos, J. 2009. Grants for Executive Park to be unveiled. Herald News (April 3, 2009) website: http://www.heraldnews.com/homepage/x180623384/Grants-for-Executive-Park-to-be-unveiled. Accessed 13 October 2009.

[73] EOT. 2009. South Coast Rail Economic Development and Land Use Corridor Plan. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. See in particular Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline. See in particular Chapter 6: Elements of the Corridor Plan.

[74] EDR Group. 2009. Basic Economic Variables. Economic Data Research Group: Boston.

[75] Ibid. Pg.9.

[76] EOT. 2009. *South Coast Rail Economic Development and Land Use Corridor Plan.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. Pg. 9.

than Scenario 1. An additional 1,200 to 1,260 jobs are estimated to result from the South Coast Rail project but occur elsewhere in the state.

Similar to population projections, economic activity and the job market are not expected to change on the regional level with the implementation of smart growth initiatives under Scenario 2. Locally, businesses may choose sites close to stations or municipalities with implemented smart growth measures such as TOD as compared to those that do not. However, it is not possible to project such fine-scale economic activity changes under Scenario 2.

5.4.8.3 Tax Revenue

The Corridor Plan identifies per-capita property tax receipts for selected South Coast communities in 2006.[77] These data indicate that tax receipts for communities that currently do not have train service (Fall River, New Bedford, and Taunton) are lower than for communities that currently do have train service (Attleboro, Foxborough, and Sharon).

Potential direct economic impacts from the Build Alternatives are outlined in Chapter 4.3, *Socioeconomics*. The analysis concludes that direct property tax revenue losses as compared to the total property tax receipts in affected municipalities would be minimal. Property acquisitions (converting privately owned parcels to publicly owned, thereby eliminating the property tax generated) would be minimal, and few business or residential displacements would result from the Build Alternatives.

Indirectly, property values are expected to increase near station sites due to increased access to transit but decrease along the Build Alternative alignments due to increased noise levels from train operations. It is assumed that residential property values would increase by 5 to 25 percent for residences within 1 mile of new station sites and decrease by up to 20 percent within about 400 feet of the alignments or layover facilities. It is not possible to predict with any precision the property tax revenue changes that may result for each community.

The Corridor Plan indicates that, under Scenario 1, the Build Alternatives would indirectly generate between $16 million and $18 million in net new state taxes and $8.5 million to $9.5 million in net new local business property taxes each year by 2030 as compared to the No-Build Alternative.[78] The expected changes for the Build Alternatives are not attributed separately. The Rapid Bus Alternative would generate approximately 60 percent of these values. The estimated overall growth (forecast regional growth plus growth attracted to station sites and new induced growth) near rail stations would result in $62 million to $77 million in local property taxes.[79] The Corridor Plan provides estimates through 2030.

The implementation of smart growth measures under Scenario 2 is expected to change the location of economic impacts such as property tax revenue sources in some South Coast study area communities, but is not expected to change overall (regional) impacts as compared to Scenario 1.

[77] EOT. 2009. *South Coast Rail Economic Development and Land Use Corridor Plan.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. See Appendix E: Baseline Report: Economic Development and Land Use Conditions in the South Coast Region Today, Chapter IV Economic Development Baseline, Figure 36: Per Capita Property Tax Receipts (All) 2006.

[78] EOT. 2009. *South Coast Rail Economic Development and Land Use Corridor Plan.* Commonwealth of Massachusetts, Executive Office of Transportation and Public Works, and Executive Office of Housing and Economic Development. Prepared by Goody Clancy: Boston. See Chapter 5, Potential Economic Effects of South Coast Rail.

[79] Ibid. See in Table 5-2, Estimated Growth Near SCR Commuter Rail Stations by 2030.

5.4.8.4 Summary of Cumulative Economic Impacts

Combining the historic trends in the economy, recent or reasonably foreseeable future actions, and the varying effects on the economy that would result from the Build Alternatives, cumulative impacts of the South Coast Rail alternatives to the economy in 2035 for each alternative under the two scenarios are listed in Table 5.4-9.

The Build Alternatives would measurably benefit the economy in the South Coast region, with actual benefits at the municipal level distributed; the distribution of which would depend on whether smart growth measures are implemented. In all cases, the incremental addition of the project's economic benefit to the regional economy would be insubstantial; the cumulative effect of any of the alternatives would be a minimal change to any of the economic parameters.

Local effects would vary considerably, particularly in communities with transit stations. However, cumulative impacts even at the local level would be minimal because new residential development under the Build Alternatives would represent only a small fraction of total households in each municipality.

Table 5.4-9 Cumulative Impacts to the Economy in 2035

Historical Trend Affecting the Economy	Trends and Current or Future Actions Affecting the Economy	Economic Conditions in 2035				New Tax Receipts (2030)*	
		Alternative	Population	Jobs	Economic Activity (2030)*	Municipal	State
Recent growth in economic activity but slower growth in job market; geographic differences north-to-south	Global economic downturn; planned commercial and industrial developments in Southern Triangle 380,000 current jobs with 1.4 % per year growth	No-Build	928,031	417,864	$99B	N/A	N/A
		Build Alternatives					
		Scenario 1	935,041	419,205	$99.479B	$8.5-9.5M	$16-18M
		Scenario 2	935,036	419,203	$99.479B	$8.5-9.5M	$16-18M

* The Corridor Plan only includes projections through 2030.

5.4.9 SUMMARY OF CUMULATIVE IMPACTS

Table 5.4-10 summarizes the incremental changes to the evaluated resources from the South Coast Rail alternatives that, in combination with past activities or trends and other known current and future projects, would potentially result in a substantive cumulative effect. The comparison is provided for both scenarios for the three alternatives considered in this evaluation, in relationship to the status of these resources under the projected No-Build Alternative conditions in 2035. Because there is no substantive difference between the impacts from Build Alternatives' electric- or diesel-powered trains, these options are not included in this summary comparison.

Table 5.4-10 Summary of Incremental Cumulative Changes between Alternatives

	Resource					
	Land Use	**Wetlands**	**Biodiversity**	**Protected Open Space**	**Air Quality**	**Economy**
No-Build Alternative	Conversion of 1,315 acres per year	No net loss policy	22 acres of land converted per day	Protected at average rate of 383.7 acres per year	Trend of increasing GHG emissions counteracted by new regulatory requirements	Population: 928,031
	308,371 acres of undeveloped land remaining in 2035	Mitigation ratios of 1:1 to 3:1	116,675 acres of decreased habitat quality in 2035	64,795 acres of open space remaining in 2035	CO_2-equivalent emissions to be 80% of 1990 levels by 2050	Households: 75,212
		124,748 acres of wetlands remaining in 2035	307,813 acres of natural land remaining in 2035		28,691,855 tpy CO_2 emissions in 2035	Jobs: 417,864 Business Activity: $99B Tax Revenue: N/A
Stoughton Alternative Scenario 1	Conversion of 1,315 acres per year	No net loss policy	22 acres of land converted per day	Protected at average rate of 383.7 acres per year	Trend of increasing GHG emissions counteracted by new regulatory requirements	Population: 935,040
	307,030 acres of undeveloped land remaining in 2035	Mitigation ratios of 1:1 to 3:1	120,605 acres of decreased habitat quality in 2035	64,794 acres of open space remaining in 2035	CO_2-equivalent emissions to be 80% of 1990 levels by 2050	Households: 78,016
		124,756 acres of wetlands remaining in 2035	303,883 acres of natural land remaining in 2035		27,842,309 tpy CO_2 emissions in 2035	Jobs: 419,206 Business Activity: $99.5B| Tax Revenue: +$8.5-9.5M (municipal) +$16-18M (state)
Whittenton Alternative Scenario 1	Conversion of 1,315 acres per year	No net loss policy	22 acres of land converted per day	Protected at average rate of 383.7 acres per year	Trend of increasing GHG emissions counteracted by new regulatory requirements	Population: 935,040
	307,045 acres of undeveloped land remaining in 2035	Mitigation ratios of 1:1 to 3:1	120,595 acres of decreased habitat quality in 2035	64,795 acres of open space remaining in 2035	CO_2-equivalent emissions to be 80% of 1990 levels	Households: 78,016

	Resource					
	Land Use	**Wetlands**	**Biodiversity**	**Protected Open Space**	**Air Quality**	**Economy**
Stoughton Alternative Scenario 2					by 2050	
		124,754 acres of wetlands remaining in 2035	303,893 acres of natural land remaining in 2035		27,842,309 tpy CO_2 emissions in 2035	Jobs: 419,206 Business Activity: $99.5B Tax Revenue: +$8.5-9.5M (municipal) +$16-18M (state)
	Conversion of 1,315 acres per year	No net loss policy	22 acres of land converted per day	Protected at average rate of 383.7 acres per year	Trend of increasing GHG emissions counteracted by new regulatory requirements	Population: 935,040
	315,583 to 319,259 acres of undeveloped land remaining in 2035	Mitigation ratios of 1:1 to 3:1	58,760 to 75,021 acres of decreased habitat quality in 2035	>64,794 acres of open space remaining in 2035	CO_2-equivalent emissions to be 80% of 1990 levels by 2050	Households: 78,016
		124,759 to 124,760 acres of wetlands remaining in 2035	349,467 to 365,728 acres of natural land remaining in 2035		<27,842,309 tpy CO_2 emissions in 2035	Jobs: 419,206 Business Activity: $99.5B Tax Revenue: +$8.5-9.5M (municipal) +$16-18M (state)
Whittenton Alternative **Scenario 2**	Conversion of 1,315 acres per year	No net loss policy	22 acres of land converted per day	Protected at average rate of 383.7 acres per year	Trend of increasing GHG emissions counteracted by new regulatory requirements	Population: 935,040
	315,598 to 319,274 acres of undeveloped land remaining in 2035	Mitigation ratios of 1:1 to 3:1	58,750 to 75,011 acres of decreased habitat quality in 2035	>64,795 acres of open space remaining in 2035	CO_2-equivalent emissions to be 80% of 1990 levels by 2050	Households: 78,016

	Resource					
	Land Use	**Wetlands**	**Biodiversity**	**Protected Open Space**	**Air Quality**	**Economy**
		124,757 to 124,758 acres of wetlands remaining in 2035	349,477 to 365,738 acres of natural land remaining in 2035		<27,842,309 tpy CO_2 emissions in 2035	Jobs: 419,206 Business Activity: $99.5B Tax Revenue: +$8.5-9.5M (municipal) +$16-18M (state)

Table 5.4-10 shows that, in comparison to the No-Build Alternative, the Stoughton and Whittenton Alternatives would not have an adverse cumulative impact on the evaluated resources. There would be only minor differences in the cumulative effects of the Stoughton and Whittenton Alternatives, attributable to the minor differences in direct effects. For many resources, the cumulative impacts of Scenario 1 represent an insubstantial change from the conditions that would exist under the No-Build Alternative. In general, the cumulative effects of either alternative would be beneficial, depending on the extent of implementation of Smart Growth measures.

5.5 IMPLEMENTATION OF THE SOUTH COAST RAIL ECONOMIC DEVELOPMENT AND LAND USE CORRIDOR PLAN

This section of the FEIS/FEIR was prepared in response to comments on the DEIS/DEIR in regard to the South Coast Rail Long-Term Smart Growth Evaluation and Environmental Stewardship Plan. The Secretary's Certificate directed MassDOT to consult with the Interagency Coordinating Group (ICG) to develop a long-term evaluation and monitoring plan for the anticipated environmental and smart growth benefits of the South Coast Rail project. Specifically, the Secretary's Certificate stated that MassDOT should explore existing models and performance metrics used to evaluate the effectiveness of smart growth plans and environmental protection strategies, and include a summary in the FEIR of experience from other regions that may be useful to apply in the case of this project. In addition, the Secretary's Certificate directed MassDOT to work with the Massachusetts Executive Office of EEA, the ICG, RPAs, and local communities to develop evaluation indicators and metrics tailored to the South Coast Rail project. The Secretary's Certificate required the FEIR to propose a mechanism for periodic reporting out to the public and other agencies on MassDOT's progress in achieving smart growth and environmental goals of the project, including its commitments to protection of ecologically significant habitat.

This section provides MassDOT's literature review of smart growth monitoring and indicators/metrics, proposes a series of smart growth performance metrics appropriate for the South Coast Rail Corridor Plan and a method for reporting out on the performance metrics for the long-term term plan. Note that the implementation of the Corridor Plan is not required by the USACE.

5.5.1 Literature Review

As directed in the Secretary's Certificate on the DEIS/DEIR for the South Coast Rail project, existing plans smart growth and monitoring programs from across the United States were identified and reviewed for applicability to the proposed project. The purpose of the review was to identify metrics or indicators that may be used to evaluate implementation of the Corridor Plan with respect to PDAs, the PPAs, and the Station Areas. A total of five existing plans/programs were reviewed; three in depth including interviews, and two based on a review of existing, readily available materials. Detailed information on the plans/programs reviewed is provided in Appendix 5.5-A.

A significant difference between the plans and programs review and the South Coast Rail project is that there is no legislative mandate in Massachusetts that controls growth through the planning process. However, this does not mean that the goals and objectives of the Corridor Plan cannot be implemented; only that participation by the local communities would be voluntary rather than compulsory. Data collection to support the metrics and indicators would be accomplished through cooperation between state agencies, RPAs, and local governments.

A number of commonalities were evident in the literature review and subsequent interviews. Data were typically collected every two years. In the case of SANDAG's RCP monitoring, the SANDAG staff had begun by collecting and reporting data every year. Collecting and reporting on the RCP progress every year became an extremely staff- and time-intensive task prompting SANDAG to revise the reporting timeframe to every two years. As noted by other interviewees, reporting every year will not show any major trends. Change happens slowly and therefore, the performance metrics or evaluation indicators chosen should be descriptive without being overly complicated or too simplified. A number of well-developed metrics or indicators under a high level category may be needed to describe trends as illustrated by the large number of measures used by SANDAG and the PSRC for their VISION 2040.

Many of the metrics and indicators reviewed are simple metrics that could be reported with numbers. Others are more complex to report. Through the interviews completed, it was clear that metrics and indicators that reveal the performance trends without being too complex or overly simplistic are ideal. Similarly, data that are readily available is the simplest way to track metrics and indicators. The U.S. Census Bureau was often used due to the large amounts of data that are collected. In the case of the San Diego's Regional Comprehensive Plan and the Puget Sound Regional Council's VISION 2040 and Growing Transit Communities, the RPAs were the source of the data used to fulfill the metric or indicator. Other government agencies, and in very few cases, independent entities outside of the government, supplied data as well.

5.5.2 Performance Metrics

5.5.2.1 Methodology

To develop the performance metrics, MassDOT reviewed the *Corridor Plan*, the Secretary's Certificate and comments on the South Coast DEIS/DEIR relevant to smart growth, and Executive Order 525. Through internet searches, MassDOT identified regional plans and implementation reports/performance metrics that had similarities to the smart growth development goals envisioned for the South Coast region. Interviews were conducted with the RPAs charged with the implementation and reporting of performance metrics.

- Performance metrics were reviewed and prioritized using the following criteria:
- Performance metrics that were specifically identified in the Secretary's Certificate.
- Applicability of performance metrics to the smart growth goals and strategies identified in the *Corridor Plan*.
- Ease and availability of data for regular data collection. With a few exceptions, performance metrics with identifiable data sources were included such as U.S. Census data.
- Screening and the identification of additional performance metrics with the RPAs and state agencies that would be responsible for the tracking and monitoring component of this program.
- Screening and the identification of additional performance metrics from the ICG Smart Growth Working Group.

- Verification and alignment of performance metrics with data already collected under Executive Order 525 by state and RPAs.

- Directly or indirectly attributable to the successful implementation of the *Corridor Plan.*

After performance metrics were identified and refined, a plan for monitoring and reporting the metrics was drafted. The Evaluation Plan identifies the agencies responsible for data collection and reporting as well as recommendations on the distribution/reporting to the public to document Smart Growth progress within the South Coast region as a result of the implementation of the *Corridor Plan*.

The performance metrics identified in this Evaluation Plan are those that can be directly or indirectly attributable to the successful implementation of the *Corridor Plan* and not to the addition of South Coast Rail to the region. Performance metrics related to the South Coast Rail project as a whole were considered, but ultimately not included in the Evaluation Plan. For example, the potential economic benefits of the South Coast Rail project to the region are well-documented in the FEIS/FEIR and the project is projected to bring increased economic activity and access to new jobs. However, these economic benefits are not in themselves attributable to smart growth development and could be anticipated as a result of the South Coast Rail project with or without smart growth. The Evaluation Plan does include an employment-related performance metric but it is focused on TOD because it reports on the jobs within 0.5 mile of a transit station.

5.5.2.2 South Coast Rail Corridor Plan Performance Metrics

The performance metrics developed for the South Coast Rail project include metrics under a number of categories as described further below. According to the Secretary's Certificate, "the evaluation plan should include a monitoring component to assess the accuracy of impact projections and allow for mid-course corrections and adaptive strategies as needed." The performance metrics associated with impacts are Metrics 2 through 5 in Table 5.5-1.

EIS/EIR and General Metrics

According to the Secretary's Certificate, "the evaluation plan should include a monitoring component to assess the accuracy of impacts projections and allow for mid-course corrections and adaptive strategies as needed." These metrics assess impacts such as growth projections, as well as forestland, farmland and wetland impacts that were projected in the FEIR/FEIS for the business-as-usual and smart-growth scenarios with the actual impacts to these resources. The impacts associated with these scenarios would vary depending on the level of implementation of the *Corridor Plan*. The Evaluation Plan compares predicted impacts with actual impacts to assess the success of the *Corridor Plan*. MassDOT would collect data so that it may notify other state agencies and municipalities that have the ability to make "corrections and adaptive strategies" as required by the Secretary's Certificate.

Priority Development Area Metrics

PDA performance metrics are applicable to encouraging growth and higher density development in the 33 PDAs identified in the *Corridor Plan*. There is also one combined PDA/PPA. The PDAs are areas with the greatest capability or potential to accommodate new development, including downtowns, major job centers, and future South Coast Rail station areas. These metrics gauge the results of the *Corridor Plan* on PDAs, such as state investments in infrastructure with PDAs and development density within PDAs.

Transit Oriented Development Metrics

Transportation Oriented Development metrics are applicable to encouraging appropriate development, as well as bicycle and pedestrian infrastructure within the planned Station Areas and within up to 0.5 to 1 mile radius of the station. TOD emphasizes "compact, generally mixed-use development at or near transit stops whose design encourages walking and transit use."[80] The boundary for a TOD district is generally defined to be within 0.25 to 0.5 mile of the Transit Station.[81] The South Coast Rail metrics for TOD are generally defined as within 0.5 mile of a station.

Conservation and Priority Preservation Area Metrics

The Conservation and PPA Metrics are applicable to monitoring the permanent preservation of land within the 72 PPAs (in addition, there is one combined PDA/PPA). PPAs include land or environmental resources that are not permanently protected but are worthy of increased levels of protection through planning, regulation, conservation or acquisition.

Social Equity Metrics

These metrics would be used to monitor the social equity benefits of the *Corridor Plan*. The *Corridor Plan* specifically mentions the Chapter 40B and inclusionary zoning as possible tools that municipalities can use to implement housing-related regulatory policies to direct development towards PDAs. The performance metrics are focused on the provision and planning of affordable housing within PDAs and station areas because it is assumed that the availability of affordable housing near station areas will result in increased access to jobs, medical care, and educational opportunities for low to medium income households. In addition, the provision of affordable housing will also help to moderate the effects of gentrification close to station areas. It should be noted that these metrics are focused on the success of the Corridor Plan to advance social equity, and not on the effects of new public transit services which are also expected to provide benefits to under-served minority and low-income populations.

5.5.2.3 Performance Metrics Data Collection

Performance metric data sources should be readily available data and, if possible, data that is already routinely collected. As such, the data sources for the South Coast Rail performance metrics include the South Coast municipalities, the U.S. Census Bureau, the Massachusetts Executive Office of Administration and Finance (A&F) Database, and the MassGIS. Executive Order 525, which directed state agencies to make infrastructure and land protection investments consistent with the priority areas identified on the Corridor Map of the *Corridor Plan*, directed the Massachusetts Office of Administration and Finance to develop a web-based tracking tool, the Administration and Finance Database, which would track state agency investment in the South Coast region related to the goals identified in the *Corridor Plan*. Finally, MassGIS data has readily available state-wide GIS data that can be used in GIS-based analyses to document changes throughout the South Coast region.

While the majority of the performance metrics are available through reliable and regularly updated data sources, there are a number of exceptions to these including:

- Metric 2 - Actual and predicted loss of farmland by community;

[80] Commonwealth of Massachusetts. South Coast Rail Economic Development and Land Use Corridor Plan. June 2009.

[81] Transit Cooperative Research Program. Transit-Oriented Development and Joint Development in the United States: A Literature Review. Number 52. October 2002.

- Metric 3 - Actual and predicted loss of wetlands by community; and
- Metric 4 - Actual and predicted loss of forestland by community.

There data were specifically requested by MEPA. Data for these metrics would be provided by MassGIS, however, the last updated GIS data were provided in 2004. Although it is not known when the GIS data would be updated, these metrics are included in the anticipation that the data would become available at some point during the 20-year monitoring period.

In addition to the MassGIS data, the VMT data, jobs, and housing and transportation affordability metrics are not currently regularly available for the South Coast region. These metrics include:

- Metric 5 - VMT for entire South Coast Region;
- Metric 21 - VMT per capita within 1 mile of station;
- Metric 22 - Total jobs within a 0.5 mile of station; and
- Metric 31 - Percent of household income spent on housing and transportation within 0.5 mile of station compared to region.

MAPC is currently working on a project to estimate annual mileage for every vehicle in the state, based on odometer readings during annual safety inspections, and to geocode the vehicles based on their registration address, and estimate fuel consumption and associated cost for each vehicle based on the mileage and EPA fuel efficiency ratings. The final product will be a "VMT Atlas." MAPC has noted that these data could be available for the South Coast region and for station areas but that funding is not yet available to update the data on a regular basis.

Metrics 22 and 31 are currently proposed to be collected through the Center for Neighborhood Technology's Transit Oriented Development Database (TOD database). CNT has developed the TOD database—a GIS platform that includes every fixed-guideway transit system in the United States and demographic and land use data for the half-mile radius around all 4,000 stations. This tool provides detailed information on the performance of TOD in metropolitan regions. The South Coast Region is not currently covered in the CTOD TOD database because these stations have not yet been constructed. Data collected for Metrics 22 and 31 using the TOD database are contingent on whether these stations and relevant data sources are added to the TOD database.

Although it is not confirmed that the data sources for these performance metrics would be regularly available, these metrics are included because there are no other readily available data sources for these metrics and they were noted to be of particular importance by the ICG Smart Growth Working Group.

Table 5.5-1 includes the proposed metric by title, the potential data sources, and suggested frequency of data collection based on the data source and ease of collection. These metrics were reviewed by the ICG Smart Growth Working Group (Executive Office of Housing and Urban Development, Massachusetts [EOHED], EPA, MassDEP, Executive Office of EEA, MEPA, USACE, and MassDOT) at meetings on April 26 and June 27, 2012, and revised based on the group's feedback.

Table 5.5-1 South Coast Rail Proposed Performance Metrics

Topic	Indicator	Data Source	Frequency of Data Collection
EIS/EIR and General Metrics	1. Actual and predicted growth in the number of households by community	American Community Survey 5-Year Estimates at the Block Group Level	3 year
	2. Actual and predicted loss of farmland by community	MassGIS (as available)	3 year
	3. Actual and predicted loss of wetlands by community[1]	Local Conservation Commission agents, MassGIS (as available) and baseline, business-as-usual, and smart-growth scenarios from FEIR/FEIS and MassGIS	3 year
	4. Actual and predicted loss of forestland by community	MassGIS (as available)	3 year
	5. Vehicle miles travelled (VMT) for entire South Coast Region	MAPC (as available)	3 year
	6. State technical assistance to communities to implement *Corridor Plan* in dollars and type by community	A&F Spreadsheet	Annual
	7. Transfer of Development Rights (TDR) projects by municipality	Municipality	3 year
Priority Development Area Metrics	8. Housing units per acre within PDAs versus new housing units per acre outside of PDAs	American Community Survey 5-Year Estimates at the Block Group Level3	3 year
	9. New commercial/industrial square footage meeting or exceeding 10,000 sq. ft. in the PDAS and Commercial /Industrial square footage meeting or exceeding 10,000 sq. ft. outside PDAs in the South Coast Region[1]	A& F Spreadsheet3	Annual
	10. Type of new housing units located in PDAs: multi-family versus single family	American Community Survey 5-Year Estimates at the Block Group Level 3	3 year
	11. Number of municipalities with zoning revisions and type of zoning revisions supporting PDAs	A&F Spreadsheet4	3 year
	12. Permitting changes, such as expedited permitting under Chapter 43D, within PDAs	A&F Spreadsheet4	Annual
	13. Direct state investments and funding in PDAs (dollars)	A&F Spreadsheet3	Annual
	14. New state buildings and office leases in PDAs	A&F Spreadsheet3	Annual

Topic	Indicator	Data Source	Frequency of Data Collection
Transit Oriented Development Metrics	15. Number of municipalities that have adopted specific station area plans or have specific station area plans under development (total by municipality)	Municipality3	3 year
	16. Number of municipalities adopting parking management strategies within 0.5 mile of station	Municipality3	3 year
	17. Amount of new bike lanes provided by municipality	MassDOT and/or municipality	3 year
	18. Household density within 0.5 mile of station	Decennial U.S. Census and/or building permit data from municipality	10 year for decennial Census; 3 year for building permit data
	19. Mode share of commute to work within 0.5 mile of station	American Community Survey 5-Year Estimates at the Block Group Level	3 year
	20. Number of buildings that are LEED-Certified, developments using green building strategies and LEED for Neighborhood development Certified neighborhoods within Station Areas	U.S. Green Building Council, MAPC, Municipality[3]	3 year
	21. Vehicle-miles traveled (VMT) per capita within 1 mile of station	MAPC (as available)3	3 year
	22. Total jobs within 0.5 mile of Station	CNT TOD Database (as available). http://toddata.cnt.org/ Data derived from LED Work Area Characteristics.	3 year
Conservation and Priority Preservation Area Metrics	23. Number of municipalities creating open space plans and/or revising zoning ordinances to support PPAs (conservation subdivision bylaws such as cluster development or open space residential design bylaws) and how	Municipality (A&F Spreadsheet)4	3 year
	24. Number of land preservation projects by community	Municipality (A&F Spreadsheet)	3 year
	25. Percent and acreage of PPAs permanently protected	Executive Office of EEA	Annual
	26. Percent and acreage of PPAs developed	Executive Office of EEA	Annual
	27. Land preservation investment in PPAs	Executive Office of EEA	Annual

5.5.3 Monitoring and Reporting Program

This section describes MassDOT's proposed monitoring program for the *Corridor Plan* including the responsibilities for each state agency and RPA. The reporting program is also described in this section.

5.5.3.1 Current Monitoring Program

Currently Executive Order 525, described in Appendix 5.5-A, mandates policy commitments made in the *Corridor Plan* for "Strategic Investments" by committing the Commonwealth to use its discretionary grant funds and its investments to target technical assistance and infrastructure investments to priority areas, to the maximum extent feasible. The state programs that are under the purview of the Executive Order 525 are identified below according to responsibilities.

EOHED:

- MassWorks Grants
- Chapter 43D Expedited Permitting
- Brownfields Revolving Fund

Executive Office of Administration and Finance (A&F)/Department of Revenue (DOR)

- Brownfields Tax Credit
- Historic Tax Credit

Department of Housing and Community Development (DHCD):

- Economic Development Fund (component of the Community Development Block Grant Program)
- Economic Development Incentive Program
- Chapter 40R smart growth districts
- Chapter 40B housing developments
- Rental Round Assistance
- Housing Development Incentive Program

Division of Capital Asset Management (DCAM):

- Construction of new state buildings and new office leases

Executive Office of Energy and Environmental Affairs (Executive Office of EEA):

- Gateway City Parks
- PARC (formerly, Urban Self-Help)

- LAND (formerly, Self-Help)
- Land preservation programs at the Department of Fish and Game, Department of Agricultural Resources (Agricultural Preservation Restriction Program), Department of Conservation and Recreation, and Department of Environmental Protection
- Conservation Restrictions
- State Revolving Fund- clean and drinking water projects

MassDOT:

- Transportation Improvement Program projects
- Accelerated Bridge Program
- Non-Federal Aid transportation projects

MassDOT/EOHED:

- South Coast Rail Technical Assistance Program

The Executive Order requires annual reporting by directing A&F to develop a retrospective analysis to measure the consistency of state investment commitments with the *Corridor Plan* in addition to web-based tracking tool.[82] Over 245 state investment commitments, made between Fiscal year 2009 and Fiscal year 2011 in the South Coast Region, were reviewed as part of A&F's retrospective analysis.

As noted in the *Retrospective Report*[83], agencies have undertaken the following implementation actions to ensure compliance:

- Developing a strategic plan, by agency, for implementing the Executive Order, which will include considerations and issues raised in this report;
- Collecting data to report the implementation of the Executive Order by agency, which will be summarized in an annual report;
- Seeking approval from other agencies for investments that are inconsistent with the *Corridor Plan* (for example, the Executive Office of EEA would need to justify an exception to the EO 525 for land conservation in a PDA); and
- Targeting technical assistance and infrastructure investments to priority areas, to the maximum extent feasible.

In addition to the *Retrospective Report* and web based tracking tool, the Executive Order also directed A&F to collect and report state investment commitments each year in the region. These commitments

[82] Available online at: http://www.mass.gov/hed/economic/eohed/pro/planning/southcoast/executive-order-525/.

[83] South Coast Rail Inter-Agency Working Group. State Investment in the South Coast Region and Implementation of the Corridor Plan: A Retrospective Analysis. February 23, 2012.

will be used to measure consistency with the *Corridor Plan.* The first annual analysis will be released in Fall 2012.

5.5.3.2 Proposed Monitoring Program

The following sections describe the proposed monitoring and data collection responsibilities of the RPAs and the state agencies as well as the data collection administration by MassDOT. The first year of data collection would commence during the first year of construction of South Coast Rail as a baseline. Annual data collection would occur annually for state agencies and every three years for regional planning for the next 20 years provided that data are available. The state agencies would collect data annually as most of the data they collect is already collected annually as directed by EO 525 through the A&F spreadsheet. The initial data collection would be a significant effort on the part of the RPAs and state agencies**.** Therefore, MassDOT would identify funding to offset the cost.

MassDOT will request data from the RPAs annually and from A&F annually, after the data tracking has been completed and finalized each year. The RPAs' role will be to collect the necessary data from the South Coast Rail communities and other data sources such as the U.S. Census to provide to MassDOT. The RPAs are better suited to collecting data from municipalities and U.S. Census sources because of their expertise in planning research methods and their working relationships with the respective municipalities. Where applicable, data collected from the RPAs for each metric would then be aggregated by MassDOT. Municipal data collected by each of the RPAs would need to be aggregated to provide one metric for all South Coast Rail communities where applicable; however, the performance metrics would also include the metric by individual municipality and/or station area where applicable.

5.5.3.3 Regional Planning Agencies

The three RPAs (SRPEDD, MAPC, and OCPC) would be responsible for collecting the metrics which describe the South Coast region communities.

As described above, data collection would be a relatively intensive effort during the three years following the start of construction. Following the first three years, data would be collected every three years. Most of the raw data would require further manipulation since these data are input at the community-wide scale and do not distinguish projects within PPAs, PDAs, or station areas. Funding would be available to offset the cost. The RPAs would be responsible for data collection for the 20 performance metrics including:

- Metric 1: Actual and predicted growth in the number of households by community
- Metric 5: VMT for entire South Coast Region (MAPC)
- Metric 7: TDR projects by municipality
- Metric 8: Housing units per acre within PDA versus housing units per acre outside PDAs
- Metric 9: New commercial/industrial square footage meeting or exceeding 10,000 square feet in the PDAS and Commercial /Industrial square footage meeting or exceeding 10,000 square feet outside PDAs in the South Coast Region
- Metric 10: Type of new housing units located in PDAs: multifamily vs. single-family

- Metric 11: Number of municipalities with zoning revisions and type of zoning supporting PDAs
- Metric 12: Permitting changes, such as expedited permitting under Chapter 43D, within PDAs
- Metric 15: Number of municipalities that have adopted specific station area plans or have specific station area plans under development (total and by municipality)
- Metric 16: Number of municipalities adopting parking management strategies within 0.5 mile of station
- Metric 17: Amount of new bike lanes provided by municipalities
- Metric 18: Household density within 0.5 mile of station
- Metric 19: Mode share of commute to work within 0.5 mile of station
- Metric 20: Number of buildings that are LEED-Certified, developments using green building strategies and LEED for Neighborhood development Certified neighborhoods within Station Areas
- Metric 21: VMT per capita within 1 mile of station
- Metric 22: Total jobs within 0.5 mile of station
- Metric 23: Number of municipalities creating open space plans and/or revising zoning ordinances to support PPAs (conservation subdivision bylaws such as cluster development or open space residential design bylaws) and how
- Metric 24: Number of land preservation projects by community
- Metric 30: Percent of households spending greater than 30 percent of income on housing within 1 mile of Station
- Metric 31: Percent of income spent on housing and transportation within 0.5 mile of Station compared to region

5.5.3.4 State Agencies

Four state agencies are responsible to collect data in support of the metrics listed below. Those agencies include A&F, Executive Office of EEA, EOHED, and DHCD. These data would be collected annually because the majority of the data is already being collected annually through the A&F Spreadsheet. The data collection responsibilities are listed according to the state agency responsible.

Administration and Finance:

- Metric 6: State technical assistance to communities to implement Corridor Plan in dollars and type by community
- Metric 13: Direct state investments and funding in PDAs

- Metric 14: New state buildings and office leases within PDAs

Executive Office of Energy and Environmental Affairs:

- Metric 25: Percent and acreage of PPAs permanently protected
- Metric 26: Percent and acreage of PPAs developed
- Metric 27: Land preservation investment in PPAs including conservation restrictions and PARC (Self-Help), Gateway City Parks, LAND (Self-Help), land preservation programs by Department of Fish and Game and Department of Agricultural Resources; and Drinking Water State revolving fund

Executive Office of Housing and Economic Development:

- Metric 28: Number of housing production plans or housing master plans by municipality

Department of Housing and Community Development:

- Metric 29: Investment commitments targeted to Chapter 40B developments within PDAs

Department of Transportation

- Metric 2: Actual and predicted loss of farm land by community
- Metric 3: Actual and predicted loss of wetlands by community
- Metric 4: Actual and predicted loss of forestland by community

5.5.3.5 Reporting

As part of the monitoring and reporting program, MassDOT would be responsible for the reporting of results of performance metrics evaluation. MassDOT would draft a report, which would be published on MassDOT's website. The first report would be published approximately four years after the commencement of South Coast Rail Service. Subsequent reports would be available every three years after this first report, for a maximum of 20 years. The first report would include data collected for the baseline year (the first year of construction of South Coast Rail) and data collected three years of data after the baseline data collection year. Each subsequent report would include the historical data, as well as show data from the additional reporting period. The reporting schedule would be as shown in Figure 5-8.

Figure 5-8 Proposed Smart Growth Evaluation Plan Reporting Schedule

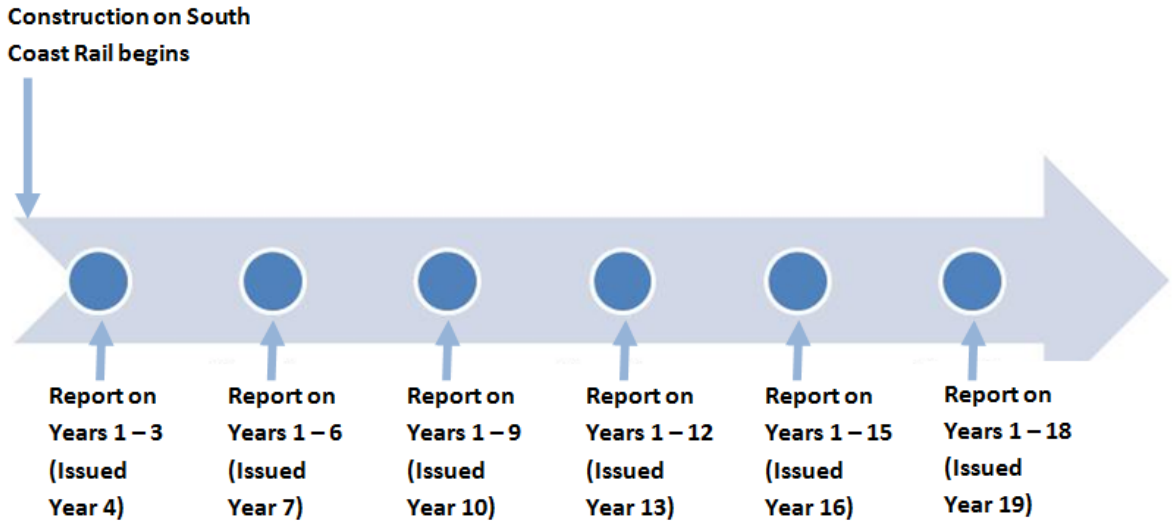


Table 5.5-2 demonstrates how each data point could be displayed (whether in a graph, chart, or table).

Table 5.5-2 Recommended Method of Reporting the Smart Growth Metrics to the Public on MassDOT's Website

Metric	Type	Representation	Additional Data Notes
1. Actual and predicted growth in the number of households by community	General	Table	Number of households per community for the reporting year compared to predicted. Total households would be reported in last row of table.
2. Actual and predicted loss of farm land by community	General	Table	Loss of acres of farmland by community for the reporting year compared to predicted. Total lost acreage would be on last row of table.
3. Actual and predicted loss of wetlands by community	General	Table	Loss of wetlands by community for the reporting year compared to predicted. Total wetland acreage lost would be on last row of table.
4. Actual and predicated loss of forest land by community	General	Table	Loss of forest land by community for the reporting year compared to predicted. Total forest land lost would be on last row of table.
5. VMT for entire South Coast region	General	Table	VMT for entire region for reporting year compared to what is predicted.
6. State technical assistance to communities to implement Corridor Plan in dollars and type by community	General	Table	Give dollar amount per community with a short description of project
7. Transfer of Development Rights project by community	General	Table	Description of each TDR project, including sending and receiving locations
8. Housing units per acre within PDA versus housing units per acre outside PDAs	PDA	Table	Table shows one row of data for housing units per acre within PDAs and one row showing housing units per acre outside PDA (the data is

Metric	Type	Representation	Additional Data Notes
			averaged for all municipalities)
9. New commercial/industrial square footage meeting or exceeding 10,000 sq. ft. in the PDAS and Commercial/ Industrial square footage meeting or exceeding 10,000 sq. ft. outside PDAs in the South Coast Region	PDA	Table	Table shows one row for data within PDA and one row for data outside PDA (the data is aggregated for all municipalities) for reporting year
10. Type of new housing units located in PDAs: multifamily vs. single-family	PDA	Table	Table shows one row for percent of multifamily and one row for single-family
11. Number of municipalities with zoning revisions and type of zoning supporting PDAs	PDA	Table	Number of municipalities with zoning revision in addition to a table which describes the type of zoning revisions by community. The table will also provide a column for the year that the zoning was adopted
12. Permitting changes, such as expedited permitting under Chapter 43D, within PDAs	PDA	Bar chart	Graph with one bar showing number of permitting changes (Chapter 43D) for PDA development and one bar showing percent of total expedited permitting changes for South Coast region
13. Direct state investments and funding in PDAs	PDA	Bar chart	Chart shows dollars in funding (y axis) by type of project (x axis) (MassWorks Infrastructure Program funding, Economic Development Fund, and Economic Development Incentive Fund, TIP projects, and Drinking Water State revolving fund)
14. New state buildings and office leases within PDAs	PDA	Table	Table has one line showing number of state buildings and number of office leases.
15. Number of municipalities that have adopted specific station area plans or have specific station area plans under development (total and by station area)	TOD	Table	Number and table showing specific area plans and status by station area
16. Number of municipalities adopting parking-management strategies within 0.5 mile of station	TOD	Graph	Number of municipalities.
17. Amount of new bike lanes provided by municipalities	TOD	Table	Table showing one column for number of new bike paths and one column for miles of new bike lanes (aggregate for all communities)
18. Household density within 0.5 mile of station	TOD	Table	Household density in number (average for all stations)
19. Mode share of commute to work within 0.5 mile of station	TOD	Table	Commute to work by mode (average for all stations) and by station

Metric	Type	Representation	Additional Data Notes
20. Number of buildings that are LEED-Certified, developments using green building strategies and LEED for Neighborhood development Certified neighborhoods within Station Areas (within 1 mile of station)	TOD	Table	Number of LEED buildings and green buildings within 1 mile of station by community
21. Vehicle miles traveled (VMT) per capita within 1 mile of station	TOD	Table	VMT within 1 mile of station (aggregate for all stations) and by station
22. Number of jobs within 1 mile of station	TOD	Table	Jobs within 1 mile of station (aggregate for all stations) and by station
23. Percent and acreage of PPAs that have been permanently protected	PPA	Table	Bar chart
24. Percent and acreage of PPAs developed	PPA	Table	Bar chart
25. Municipalities creating open space plans and/or revising zoning ordinances to support PPAs (conservation subdivision bylaws such as cluster development or open space residential design bylaws) and how	PPA	Table	List of zoning revisions supporting PPAs (by community and status and description of each zoning revision)
26. Land preservation investment including conservation restrictions and PARC (Self-Help), Gateway City Parks, LAND (Self-Help), land preservation programs by Department of Fish and Game and Department of Agricultural Resources; and Drinking Water State revolving fund	PPA	Bar chart	Financial investment in land preservation bar chart by year (x axis) and investment in dollars (y axis)
27. Number of land preservation projects by community and type	PPA	Table	Number of municipalities with land preservation projects in addition to a table which describes the land preservation project by community.
28. a) Number of housing production plans b) Number of housing master plans	Social Equity	Table	Table showing column of number of housing production plans and column of master plans (listing by community)
29. Investment commitments targeted to Chapter 40B developments within PDAs	Social Equity	Bar chart	Chart shows dollars in funding (y axis) by year (x axis) for 40B developments
30. Percent of households spending greater than 30 percent of income on housing	Social Equity	Table	Table shows percent of income spent on housing within 1 mile of station (average for all stations as well as by station)

Metric	Type	Representation	Additional Data Notes
within 1 mile of station			
31. Percent of household income spent on housing and transportation within 0.5 mile of station compared to region	Social Equity	Table	Table shows percent of income spent on housing and housing within 0.5 mile of station (average for all stations as well as by station and region)

Tables 5.5-3 and 5.5-4 and Figure 5-9 depict how data could be presented visually. Please note that these graphics are for illustrative purposes only and do not represent actual data.

Table 5.5-3 Sample Metric 4. Forest Land Impacts (in acres)

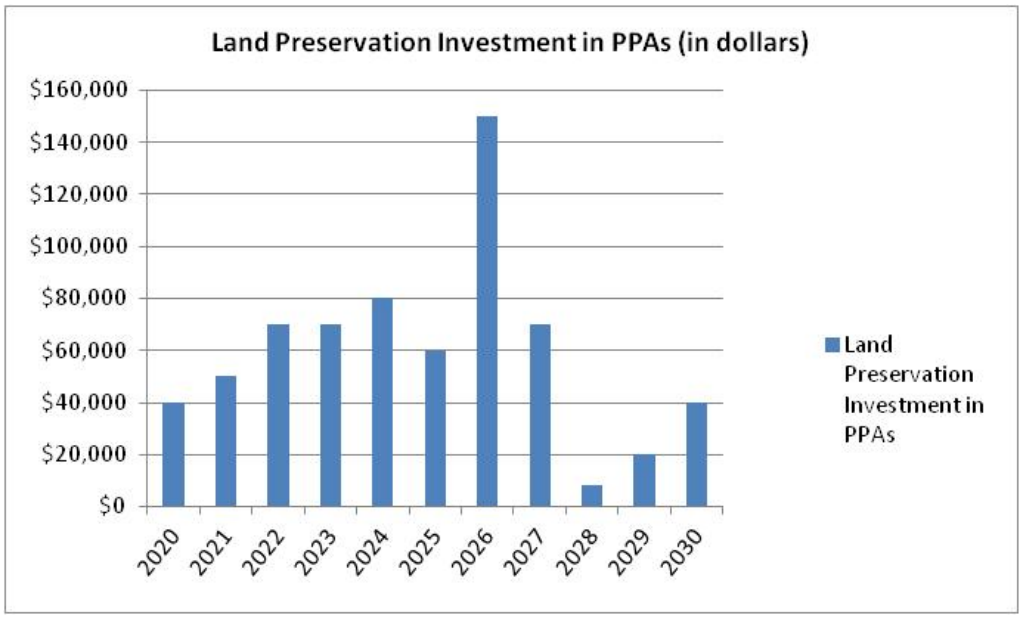
	Forest Land Impacts (in acres)	
Scenario	2020	2030
No-Build		23,736
Build without Smart Growth		24,311
Smart Growth Scenario		16,600
Actual Forest Land Impacts	10,000[1]	18,000[2]

Note: Actual Forest Land Impacts are cumulative total impacts since existing conditions data provided by MassGIS in 2005.
1 MassGIS, forest land data updated 2018.
2 MassGIS, forest land data updated 2029.

Table 5.5-4 Sample Metric 11 and Metric 15. SCR Zoning Revisions and Plans to Support PDAs and Station Areas.

Community	Zoning Ordinance Supporting PDAs and Station Areas	Year	Status
Acushnet	Town creating a 40R district, to encourage mixed-income housing within PDA.	2025	In progress.
Fall River	City developed TOD zoning adjacent to the Station Area.	2024	Adopted May 10, 2024.
Freetown	SRPEDD worked with the city to develop TOD zoning beginning in fall 2009.	2024	Adopted April 20, 2024.
New Bedford	Developed specific area plans for station-area TOD for the Whale's Tooth and King's Highway station sites.	2023	Adopted April 10, 2023.
Taunton	Began developing a 40R district within a PDA.	2023	On hold.

Figure 5-9 Sample Metric 26. Land Preservation Investment in PPAs



Note: Land Preservation includes conservation restrictions and PARC (Self-Help), Gateway City Parks, LAND (Self-Help), land preservation programs by Department of Fish and Game and Department of Agricultural Resources; and Drinking Water State revolving fund.

5.5.4 Agency Coordination

The Secretary's Certificate specifically requested that MassDOT form a Working Group devoted to the implementation of the Corridor Plan. To meet this requirement, MassDOT convened the ICG Smart Growth Working Group, a subset of the ICG and included representatives from EPA, EOHED, Executive Office of EEA, MassDEP, and the RPAs. The purpose of the ICG Smart Growth Working Group was to develop evaluation indicators and metrics. In addition to the meetings described below, MassDOT worked closely with EOHED and SRPEDD staff to develop the range of metrics. MassDOT convened a meeting on April 16, 2012 with the Working Group, to present proposed performance metrics. Following the April meeting, MassDOT refined the performance metrics based on the feedback at that meeting and subsequent coordination with the RPAs and EOHED. The Smart Growth Work Group met again on June 27, 2012. At this meeting, MassDOT proposed a monitoring and evaluation plan to assess the accuracy of impact projections and allow for mid-course corrections and adaptive strategies as needed and performance metrics to evaluate the effectiveness of smart growth plans and environmental protection strategies.