Title

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ABSTRACT

In the past ten years, integrated land use and transportation modeling has received considerable attention in the scholarly literature. This academic interest is slowly yielding practical applications. Many metropolitan planning organizations (MPOs) and state departments of transportation are beginning to implement these types of models for the first time. While many improvements have been made to these models, and the value of these improvements should not be understated, much work still remains. One of the most challenging problems in land use modeling is how floorspace (buildings) is built and occupied. The purpose of this paper is twofold: first, to draw attention to insufficiencies in the representation of floorspace developer behavior—particularly as it applies to large, urban-edge projects—within current integrated land use and transportation models and, second, to determine the necessity of explicitly accounting for such projects within these models. The Sacramento MEPLAN model will be used together with historical development records to demonstrate and test these assertions. Single large developments are modeled with a common year of development, size, and location. Among the findings, large developments are fairly common in the Sacramento region and make up a considerable amount of floorspace development in absolute terms, large basic sector developments have more of an impact and are therefore more important to explicitly account for than are large non-basic sector developments. A single large basic sector development modeled in a 20 year forecast has a significant impact on zonal outputs. Recommendations are put forward regarding the use of this research in practical modeling exercises.

Large Developments, Spatial Uncertainty, and Integrated Land Use and Transportation Modeling

INTRODUCTION

In the past ten years, integrated land use and transportation modeling has received considerable attention in the scholarly literature (see *1-3*, and literature cited therein, for example). This academic interest is slowly yielding practical applications. Many metropolitan planning organizations (MPOs) and state departments of transportation are beginning to implement these types of models for the first time. These models are being used to evaluate a broad range of policies, from the economic implications of different bridge construction sequencing scenarios in the state of Oregon to analysis of regionwide growth scenarios in Sacramento, California (*4* and *5* respectively).

While many improvements have been made to these models, and the value of these improvements should not be understated, much work still remains. One of the most challenging problems in land use modeling is how floorspace (buildings) is built and occupied. The purpose of this paper is twofold: first, to draw attention to insufficiencies in the representation of floorspace developer behavior—particularly as it applies to large, urban-edge projects—within current integrated land use and transportation models and, second, to determine the necessity of explicitly accounting for such projects within these models. The Sacramento MEPLAN model will be used together with historical development records to demonstrate and test these assertions. Two questions specifically will be tested. First, would explicitly accounting for large developments have an impact on model outputs? And second, do different types of large developments have different impacts on model outputs (i.e. are some types of large developments more critical to account for than others)?

Large real estate construction projects are a concern to land and transport planners for several reasons. First, these projects require a large amount of land and typically locate on the urban fringe. This can lead to increased development pressures on surrounding land—including the possible development of “edge cities” (*6 and 7*). Second, different types of floorspace have different impacts on the land market and, by consequence, the direction of urban growth. For example, a large corporate campus may draw more subsequent development than an auto mall or animal containment facility. This differential draw could be for a variety of reasons (e.g. agglomeration economies, nuisance, etc.). Third, these projects, together with the subsequent development they draw, increase demand on the nearby travel networks. Fourth, land use policies and constraints are often relaxed for large developments. Cities and counties often seek to attract large developments (especially basic industry) with free or reduced-cost infrastructure, and tax abatements. These policy choices could be aided by a better understanding of how large developments impact cities and regions in both the short and long term. In other words, at least conceptually, it is important to explicitly account for large developments in the urban modeling process. To date, the value of including large developments in integrated land use and transportation models has never been examined or tested.

The remainder of this paper will proceed as follows. First, a conceptual discussion will present some background on developers, firm location, and how these are represented within current integrated land use models. Next, background will be provided on the case study area selected for this study. This will be followed by the model, scenario tests were preformed and results from those model runs. The final section will discuss the findings from this study and what they mean for the field of integrated land use and transportation modeling.

CONCEPTUAL DISCUSSION

Large Developments and Industrial Location

Developer decisions (where, when, and what to develop) are different from the location decisions of firms. Floorspace developers build floorspace according to predicted demand, which may or may not be realized. This creates the supply of floorspace in the region. Firms and households then select locations within the subset of built, available floorspace types appropriate to their use. In some instances, these decisions are made jointly. For example, a large firm may develop its own floorspace. It is important to consider these processes separately and to understand the factors that affect each, including how they relate to each other.

In order to survive economically non-residential developers must produce a product that is demanded by firms or "locators." Therefore, the factors that influence the location choice of firms also influence where developers want to build floorspace. Several of these factors redundantly appear in the industrial location literature: proximity to consumers and suppliers, general accessibility, proximity to complimentary activities (agglomeration economies), labor force availability, proximity to major transportation facilities (seen as having benefits beyond accessibility), etc. (see: 8-*11* and literature sited therein—this literature is also summarized in several texts: *12* and *13*).

Developers make a profit by maximizing the difference between construction costs (land and non-land costs) and expected returns in the form of rents and/or sales. Developers try to anticipate what the demand will be but are not always successful. Economic risk is involved and comes in at least two varieties, the inability to perfectly predict demand (resulting in unpurchase or unrented floorspace), and the inability to perfectly predict costs (e.g. unexpected environmental clean ups, finding endangered species on the property, etc.).

Firm location is typically analyzed using empirical data on where firms are currently located or have been in the past, usually measured as employees. For developer behavior, we are more interested in the buildings: where they are today, and what the urban setting was like when they were built. The data used in this study deal with building location, not firm location.

Model Representations

Models are necessary simplifications of reality. In model development, trade-offs are made between simplicity/practicality and the accuracy with which behavioral processes are represented. These tradeoffs are especially evident in the representation of floorspace developers and firm location in integrated land use and transportation modeling.

The current representation of developer processes in integrated models is not behaviorally accurate. In effect, individual zones, grid cells, or parcels make independent decisions as to whether or not to develop, what to develop (type of floorspace), and how much floorspace to build. This representation gives the appearance that the land itself is making the development decision. No true developer or landowner (owning multiple parcels, grid cells, or zones) exists in the models. Among other implications, this structure means that parcel assembly, for large projects, is not possible and, therefore, these types of development will not be accurately represented in the models.

The current representation of firms and their location choices in integrated models are equally inaccurate. Firms are not represented in these models. Rather, the models locate employees one at a time, with each employee making an independent location decision. There are functions in the models that serve to draw similar types of employees together, thus producing the appearance of firms, but movements are modeled on an employee-by-employee basis.

This current representation is a useful modeling technique that allows the model to "play the averages." If the model develops floorspace one parcel at a time, spatial errors can be assumed to be small. For employee location, these errors may cancel out at the regional level. In other words, error may be fairly evenly distributed throughout the region, thus serving to spatially diffuse errors rather than cluster them in a few locations. One reason for using the current representation of these processes is that it should serve to limit exposure to spatial uncertainty within the model. The concern over putting a regional shopping mall in the wrong part of town has led to the removal of its representation within the model. Testing the validity of this concern is one motivation for this paper.

Part of this concern stems from the idea that there can only be one official forecast. If only one forecast is used then it is reasonable to want to minimize exposure to large spatial errors. But, for policy analysis purposes and scenario testing there is no need to limit the comparisons to a single, official forecast. Uncertainty literature has urged the fields of land use and transportation modeling to move away from the use of point estimates (both as inputs and outputs) and to replace these with distributions obtained from multiple model runs under differing assumptions (*1, 14 and 15*). This same idea can be applied to spatial uncertainty. Alternative urban futures could be created within these models by varying the size, type, and location of large developments based upon probabilities obtained from observed data. This would allow the robustness of a policy to be tested across multiple urban futures. If combined with representations of input and parameter uncertainty this would produce the most thorough policy testing available with existing models.

CASE STUDY BACKGROUND

Sacramento is the capital of California and is located in California's Central Valley (roughly 85 miles northeast of the San Francisco Bay). In 2000 it had a regional population of roughly 1.9 million and forecasted an addition 1.7 million people by 2050. While the employment in the region is diverse, from computer chip and software companies to agriculture, the largest employer remains the State government. The rapid growth expected in this region has brought increased public attention to planning and modeling activities.

Sacramento has served as a test bed for integrated modeling in the United States for the past decade (*1*, *16* and *17*). With assistance from the University of California, Davis, the Sacramento Area Council of Governments (SACOG) has developed and tested the DRAM/EMPAL, TRANUS, and MEPLAN models, and is currently calibrating a PECAS model. The richness of the data and modeling experiences make Sacramento an ideal location for the study reported here.

In order to demonstrate the conceptual need to model large real estate developments, several types of data were gathered for this study. First, data on past large developments were gathered from city and county governments in the Sacramento region. In some cases, these data came from both the local building departments (in the form of building permit data) and planning departments for multi-building, large developments. These data were difficult to obtain and are not as robust as anticipated. Local record keeping ranges from meticulous to non-existent. Among those that had readily accessible data, several missing data points and incomplete records were identified.

Second, the Sacramento Business Journal produces an annual publication, the Top 25 Book of Lists (*18*), which, among other things, lists the 25 largest public construction projects and the 25 largest private construction projects for that year. After careful examination of these data they appear to capture all large projects for each year. These data were available for 2001 through 2004. Useful data provided include: the developer, the type of development (from which the use may be obtained), the size (in square feet), the location (by address), and the estimated construction cost in US dollars. In addition, the 2003 publication also included the 25 largest shopping centers in the region with similar data (size, location, year built, etc.) but went as far back as the early 1950s. Taken together, these data provide a reasonably good picture of the recent large development activity in this region.

[Insert Figure 1 about here]

Tables 1 and 2 summarize the data obtained from local governments and the Sacramento Business Journal for the years 2001 through 2004. While data were available beyond this point the data for the past 4 years was more complete and therefore better suited to provide probabilities of occurrence by type. The mixed-use projects reported in these tables were office/hotel/restaurant complexes that had a sufficient amount of each to classify them as mixed. In all other cases, the use was either singular or largely singular. The data were not always clear as to the use of each large project and it is possible that misclassifications occurred.

[Insert Table 1 about here]

Several things became apparent from these data. First, large developments are fairly common in this region. It was initially thought that million plus square foot developments would be scarce, perhaps one every five to ten years. Four, million plus square foot developments were found in four years of data. This is in addition to the numerous smaller large projects found in the data. In total, 71 large development (with greater than 100,000 square feet), representing nearly 23 million total square feet of developed floorspace were identified in four years of data. The preponderance of large developments in these data suggest that with enough years of data sufficient numbers may be obtained to calibrate probabilistic models of occurrence and location for these types of development. Second, all large developments took place in zones containing or adjacent to the region's interstate and state highways—see Figure 1. This strengthens the notion that accessibility is a key component in the development and location decisions for large projects. Third, local government policies make a difference. Notice the uneven distribution of large developments by geography (especially the west versus the north east). Yolo County, and particularly the City of Davis (the western part of the region), has strong growth controls. The difficulty of developing in this part of the region makes it less attractive compared to other locations with a more favorable policy stance toward growth, including large developments (e.g. Roseville in the northeast). Fourth, land availability is important. With the exception of the central part of the region, all large developments took place near the urban fringe and on previously undeveloped land. Finally, amenities play a role. The northeast and southeast benefit from proximity to the Sierra Nevadas. The proximity of outdoor recreation makes the eastern areas of the region attractive for firms to locate and by consequence, for developers to build. Together with the more pro-growth policy stance in these areas, this becomes a strong pull for large developments (note that roughly half of all large development square footage in this region from 2001 through 2004 was built in the northeast, near Interstate 80).

[Insert Table 2 about here]

IMPACTS OF LARGE DEVELOPMENTS IN INTEGRATED MODELING

Methods

While the historical development data demonstrate the reality of large real estate developments and the conceptual need to model them, only the model itself can tell us what impact large developments will have on model outputs. To evaluate the effects of explicitly accounting for large projects in integrated land use and transportation modeling and to isolate which types of projects have the largest impacts—and therefore are the most critical to account for—each type of project (or use category) observed in the data was manually input into the Sacramento MEPLAN model. Each project was given a consistent location (northern urban edge), size (one million square feet), and year of development (model year 2002.5). These were run individually and compared against a future base case scenario. By holding size, location, and year constant, impacts can be evaluated more easily and attributed directly to the type of development modeled (e.g. industrial, office, retail, etc.). In all cases, the model was run from a base year of 2000 to the year 2020, a typical planning horizon.

The seven industry types represented in the large developments data (see Tables 1 and 2) plus a mixed-use case were modeled. Mixed-use is not a floorspace category within the Sacramento MEPLAN model. The mixed-use case was represented by a million-square-foot development with its floorspace evenly divided between office and retail (similar to the proportions observed in the data).

In MEPLAN each industry type has both basic (exporting) and non-basic (service) employees. Determining the share of basic and non-basic employees at each development was not feasible with these data. Judgment was used to determine which activity (basic or non-basic) the development likely dedicated the majority of its employees to and the total was assigned to the majority category (basic or non-basic).

One-million-square-foot office, retail, and government developments were manually input into the model twice, once with the appropriate number of basic sector employees assigned to them (making them basic sector developments/locators) and once as non-basic sector developments (with just the floorspace input into the model). Examples of each were in the data. Industry/manufacturing and mixed-use were run as basic sector developments/locators (floorspace with employees). Health and education were run as non-basic (just the floorspace). These decisions were made based upon what was found in the observed data.

The decision to add basic sector employees with the square footage was made based upon how the model represents these two phenomena. Floorspace is only categorized by industrial use in the model (e.g. retail, industrial, etc.); there is no basic or non-basic floorspace catagories. Both basic sector and non-basic sector office employees can occupy office floorspace, for example. The only way to truly model a large basic sector development was to manually assign basic sector employees to that floorspace. This means that the basic sector developments are really developer/locators or simply developments with tenants lined up before construction was completed. The structure of the MEPLAN model does not allow similar employee assignments for non-basic sector employees. For the large non-basic sector developments only the floorspace was manually input into the model and it was up to the location choice submodel to assign employees to it.

A zone on the northern urban fringe (North Natomas) was selected for these tests for several reasons. First, as can be seen in Table 3 this zone is fairly rural in the base year (2000) but projected to experience extreme growth in the next 20 years. Large developments will likely play a role in (or make up a share of) that growth. Second, the proximity of North Natomas to the downtown, Sacramento International Airport, and Sacramento River, combined with relatively lower land prices (compared with the east where most development has heretofore gone) will make this area attractive for future growth. The past five years have already seen large amounts of residential development in this area.

[Insert Table 3 about here]

The grossness of the MEPLAN zones (see Figure 1) means that the majority of the effect of a single large development will likely be contained within the zone where it is located. Therefore, in the result section (below) only the zone specific outputs are presented. A model with better spatial detail (small grid cells or parcels) might produce a more informative spreading of these impacts to neighboring land.

The MEPLAN Model

The most recent version of the Sacramento MEPLAN model was used for this study. This model is well documented (*17*, *19 and 20*), including its most recent updates (*5*). Put simply, MEPLAN is a quasi-dynamic model that allocates activities to zones and travel within and between zones via a travel network. By iterating a spatially disaggregate input-output (I/O) table (which includes households), MEPLAN generates all of the households (by three income types) and firms (11 types) within the region. The households and firms are then allocated to floorspace within the 81 zones (including 10 external) of the six-county SACOG model. The dollar flows between households and firms, firms and households, and between firms are converted into a demand for trips. These trips are then subject to mode choice and route choice. Location decisions, mode decisions, and route decisions are represented with a system of multinomial and nested logit models. The land use in year Y generates the demand for travel in that year. Travel disutilities are then fed back into the land use model, which uses those disutilities (together with floorspace prices) to affect location choices in year Y+1. The model is run in 2.5-year steps (e.g. 2000, 2002.5, 2005, etc.).

MEPLAN is based on Economic Base and Bid-Rent theories (*21* and *22* respectively). This means that basic sector developments are likely to have a larger impact than non-basic sector developments. A basic sector development draws both basic and non-basic employees and households. A non-basic development only draws non-basic employees and households. Both are carried out in the model in a typical iterated spatial input/output modeling fashion (with the noted exception that the I/O table includes households, which produce employees). MEPLAN assigns employees to zones based upon utility and represents the classic trade-offs between closeness to supplier versus closeness to consumers and between transportation costs and land costs (for exact mathematical expressions see *23*).

The Future Base Case

The Base Case represents a relatively unconstrained land use scenario. This land use scenario was derived from the local general plans of the cities and counties in this region. In 2000, over 800,000 vacant acres are zoned for development. By 2050 only roughly 250,000 of these have been developed (leaving more than a half million vacant acres zoned for development). This allows households and employees to locate almost wherever they want. The travel networks consist of the current network (as it was in 2000) with incremental additions in the years 2005 and 2015. These travel networks were obtained directly from the travel demand model currently being employed by SACOG.

Results

The effects of modeling the various types of large developments in North Natomas (the subject zone) can be seen in Table 4. One of the more striking findings is that the secondary growth impacts of the large basic sector office development are larger than its primary impacts. In other words, 5,000 employees were manual input into the model along with the floorspace, by 2020, an additional 6,291 employees (not present in the future base case model run) were drawn to the zone from elsewhere in the region. The drawing effect, or secondary growth impacts from the large office development are actually larger than the development itself. In all other cases, the drawing effect was either equal to or smaller than the size of the initial project, as expected. This is a key finding and demonstrates the differential drawing abilities of different types of large developments, within the MEPLAN model.

Further, the impact appears to be non-linear. The basic sector mixed-use development, which is half retail and half office, had a lower than expected impact on zonal outputs given the magnitude of impacts produced by the basic sector, million square foot office and retail projects. The nature of the non-linearity of these relationships cannot be known from this research. One data point is insufficient to draw conclusions from and further study is needed with multiple sizes of projects to clearly demonstrate this phenomenon.

[Insert Table 4 about here]

The primary and secondary growth impacts of the modeled large developments impacted the distribution of trips. As can be seen in Table 4, the large basic sector office development caused an increase of roughly 32% in trips attracted to the subject zone. This caused the corresponding link volumes (associated with this zone) to increase as well—particularly the arterials, as the major highways were already heavily congested in 2020. This redistribution of trips can be attributed directly to the presence of the manually added large developments, the employees (in the basic sector cases) that were input with them, and the employees that were subsequently drawn to the zone. Trip generation by household income class and by employee type is fixed in MEPLAN. Therefore, the regionwide number and type of trips did not change in the model.

Only modest impacts were expected from this exercise. These large, manually-imposed developments represent only a small portion of the total employment growth in the region for the model year 2002.5 and an even smaller percentage of the total employment growth experienced across all 20 years covered by the model. Further, given the preponderance of million-plus square-foot developments in the historical data it was initially believed that numbers equal to those found in the data would be needed to produce significant differences in the model's outputs. The large shifts in employment and trip activity in the zone caused by a single basic sector development were a bit surprising, especially considering the amount of growth this zone was going to experience anyway (see Table 3).

Two "big picture" findings become evident from Table 4. First, it is clear that within this model, the location of basic sector industry plays a major role in the location decisions of other types of commercial activities. This creates a path dependency within the model. It appears that where basic sector employment goes other types of employment will follow. Care needs to be taken when calibrating the basic sector employee location submodel as this will have a strong influence on model outputs. Second, for the location and size modeled here, basic sector large developments have more of an impact—and are therefore more important to model explicitly—than non-basic sector large developments within the Sacramento MEPLAN framework.

The amount of growth experienced by the subject zone (North Natomas) in the Future Base Case is the most likely reason for why non-basic sector developments did not have a significant impact in 2020. If the zone was going to gain a million or more square feet of a particular development type anyway, then modeling it explicitly in 2002.5 is less critical for final-year analysis. If year-by-year outputs are of interest, then the timing of that growth becomes more vital to model. Also note that while the non-basic projects did not produce large impacts on zonal employment totals, they did impact the number and shares of some employee types within the zone. The large retail project, for example, produced 15% more retail employees in the out year than did the base case.

As discussed earlier, non-basic floorspace is developed in MEPLAN without the ability to explicitly assign employees to it. If zone "x" is unattractive to employees of a certain type, compared with other zones possessing available floorspace, then the floorspace in zone "x" will likely not be occupied. The million-square-foot health project, for example, failed to fill any of its floorspace. This was the only large project modeled that failed to do so. This finding is an artifact of the zonal characteristic for the selected zone.

The small percentage shifts in households caused by the large basic sector developments was a bit puzzling at first. After careful examination of the model it was learned that the increases in employment consumed land and bid up the price of land in the zone. The combination of these together with the marginal increases in congestion (travel time delays) experienced by households in this zone resulting from the large developments are likely what caused the reductions in households observed in Table 4.

CONCLUSIONS

While the ability of sophisticated land use and transportation models to analyze policy alternatives is growing, much work remains. This paper has sought to identify an area of further improvement to these models, the explicit representation of developer decision processes for large developments. Historical data was used to demonstrate the preponderance of large developments in the Sacramento region (71 projects with more than 100,000 square feet of developed floorspace in only four years). The Sacramento MEPLAN model was used to isolate and demonstrate the impact that large developments have on model outputs. These impacts are significant in the case of basic sector projects.

Several things were demonstrated in particular. First, land and floorspace are often developed in large quantities for large projects. Few meaningful development decisions are made on a parcel-by-parcel basis. Second, the current representation is an artifact of two things, concern over spatial uncertainty, and the idea that there can be only one official forecast. Addressing the latter will create the latitude needed to address the former. Modeling multiple urban futures is one way to utilize spatial uncertainty in the policy analysis process to produce more robust policies. Third, explicitly accounting for large projects does impact model outputs. Large shifts in zonal employment and trip distributions were observed from a single large development imposed in an early model year. From this it can be concluded that representation of the projects in the numbers found in the historical data would yield substantial changes to the forecast. Finally, different types of development have different impacts. Large differences in impacts were observed across the various types of large developments, particularly between developments occupied by basic sector versus non-basic sector employees. Within the MEPLAN model, basic sector developments are more critical to account for than non-basic sector developments.

This study represents an initial inquiry into the effects of including large developments (large quantities of floorspace modeled as a unit) in integrated modeling and has several limitations. First, the selection of zone used in this study was fairly arbitrary. Had a different zone been chosen, it is possible that the results presented here would change. The size and type of that change, though not expected to be large, would depend upon the characteristics of the new zone and would affect different large development types differently. The case of the large health project failing to fill its floorspace is a good example of this. Had a zone been selected with more favorable characteristics for health employees this project would have likely filled its floorspace and had a larger impact overall (though not dissimilar from the other non-basic large developments that were successful in the selected zone). Second, only one size of development was manually input into the model. As evidenced by the lower than expected impacts from the mixed-use development, a non-linear relationship likely exists between project size and output deviations.

Recommendations were put forward earlier in this paper regarding how the findings from this study might be utilized by modelers. These recommendations are worth restating here. For policy analysis purposes, multiple model runs that include large developments should be undertaken. These multiple runs could be arrived at in a variety of ways, from expert judgment about where large developments are likely to go, to simple "what if" large development scenarios, or if sufficient historical data is available, modeling large developments with plausible amounts of uncertainty interjected into the probabilities of occurrence, type (use category), and location. This will allow a more robust testing of policy and planning alternatives across differing urban futures.

Another important issue mentioned, but not addressed by this research has to do with the employee location choice representation in current models. Few meaningful location decisions are made on an employee-by-employee basis. It is the movement of firms that really matters. Currently, firms and their location decisions are not explicitly modeled. Even if we explicitly account for large developments, according to the model, those developments will still be occupied or abandoned one employee at a time. This is not realistic and prevents us from being accurately representing large shifts in employment.

Further study is needed on the issues presented in this paper. Future work should focus on modeling multiple types of developments in a single model run, varying the size, year of development, and location of large developments within the model. The goal here is to gain an understanding of how integrated models respond to large developments and eventually to be able to estimate a model of developer choice for project-based floorspace construction. A parallel advance would be the development of a firm location choice model. These areas of research will do much to improve the conceptual validity of integrated land use and transportation forecasting models.

Large real estate developments play a role in the growth and shape of urban regions. This role needs to be explicitly represented within integrated models. Currently, even the most advanced models (such as UrbanSim and PECAS) do not represent large developments or firm location decisions explicitly. While the current methods may be a reasonable representation of small developments and small firms, they are insufficient for large projects and large firms, which are key determinants of overall growth patterns.

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TABLE 1: Summary of large developments (greater than 100,000 square feet) by size and use in the Sacramento Region from 2001 to 2004.

	100,000 to 200,000 sq.ft.	200,000 to 500,000 sq.ft.	500,000 to 1,000,000 sq.ft.	1,000,000 sq.ft. or more	Totals
Office					
number	9	8	1	2	20
total Sq.Ft.	1,246,409	2,153,698	632,482	3,681,000	7,713,589
Industrial					
number	4	1	0	0*	5
total Sq.Ft.	540,086	257,000	0	0*	797,086
Retail					
number	10	7	0	0*	17
total Sq.Ft.	1,548,735	2,177,382	0	0*	3,726,117
Health					
number	3	0	1	0	4
total Sq.Ft.	377,000	0	750,000	0	1,127,000
Education					
number	6	8	0	1	15
total Sq.Ft.	814,573	2,033,156	0	1,555,000	4,402,729
Government					
number	2	2	2	2	8
total Sq.Ft.	237,767	495,000	1,235,188	2,500,000	4,467,955
Mixed Use					
number	0	2	0	0	2
total Sq.Ft.	0	582,715	0	0	582,715
Totals					
number	34	28	4	5	71
total Sq.Ft.	4,764,570	7,698,951	2,617,670	7,736,000	22,817,191

*Note that while no million plus square foot retail or industrial projects took place between 2001 and 2004, two retail projects were built between 1995 and 1998, totaling 2,745,489 square feet and one industrial project, built in 1998, had 1,556,804 square feet.

TABLE 2: Geographic distribution of large development (greater than 100,000 square feet) by type, and proportions of large developments by type by area.

	North	South	North East	South East	West	Central City	Total Sq. Ft. by Industry type
Office:							
Number	1	1	11	5	1	1	7,713,589
(Percent)	(3)	(2)	(74)	(15)	(3)	(3)	(100)
Industrial:							
Number	1	0	4	0	0	0	797,086
(Percent)	(32)	(0)	(68)	(0)	(0)	(0)	(100)
Retail:							
Number	1	2	10	2	0	2	3,726,117
(Percent)	(7)	(10)	(50)	(15)	(.0)	(18)	(100)
Health:							
Number	0	1	2	1	0	0	1,127,000
(Percent)	(0)	(9)	(76)	(15)	(0)	(0)	(100)
Education:							
Number	2	5	1	1	6	0	4,402,729
(Percent)	(11)	(59)	(5)	(5)	(20)	(0)	(100)
Government:							
Number	1	0	1	2	0	4	4,467,955
(Percent)	(7)	(0)	(15)	(25)	(0)	(53)	(100)
Mixed—Office and Retail:							
Number	0	0	2	0	0	0	582,715
(Percent)	(0)	(0)	(100)	(0)	(0)	(0)	(100)
Total Sq.Ft. by Location	1,501,000	3,225,674	10,438,832	3,275,292	1,120,910	3,255,483	22,817,191

TABLE 3: Future Base Case growth in North Natomas Zone from 2000 to 2020

	Year 2000	Year 2020	Percent change
Households	706	36,494	5,069.15
Employees overall	5,549	19,288	247.62
Employees by type:			
Office	862	5,829	576.05
Industry	789	1,462	85.22
Retail	705	5,312	653.34
Health	0	0	.00
Education	123	3,047	2,382.89
Government	3,024	3,594.80	18.88

TABLE 4: Year 2020 Impacts in the North Natomas Zone from Individual Large Developments by Type, Built in 2002.5: Changes from Future Base Case

	Number of employees added manually	Resultant % change in households	Resultant % change in employees	Resultant % change in trips generated	Resultant % change in trips attracted
Basic sector:					
Office	5,000	-2.27	58.54	13.00	32.10
Industrial	3,831	-3.30	49.32	8.09	21.37
Retail	5,000	1.23	36.61	1.89	31.53
Government	5,000	-.85	41.70	3.87	21.47
Mixed-use	5,000	-1.12	28.04	3.96	18.55
Non-basic sector:					
Office	N/A	.23	3.76	1.14	2.31
Retail	N/A	4.43	4.33	3.64	4.52
Health	N/A	.14	-.06	0.10	0.11
Education	N/A	.20	-.09	-0.16	0.30
Government	N/A	.23	3.76	1.14	2.31
Base numbers for 2020:		36,494	19,288	43,451	1,177

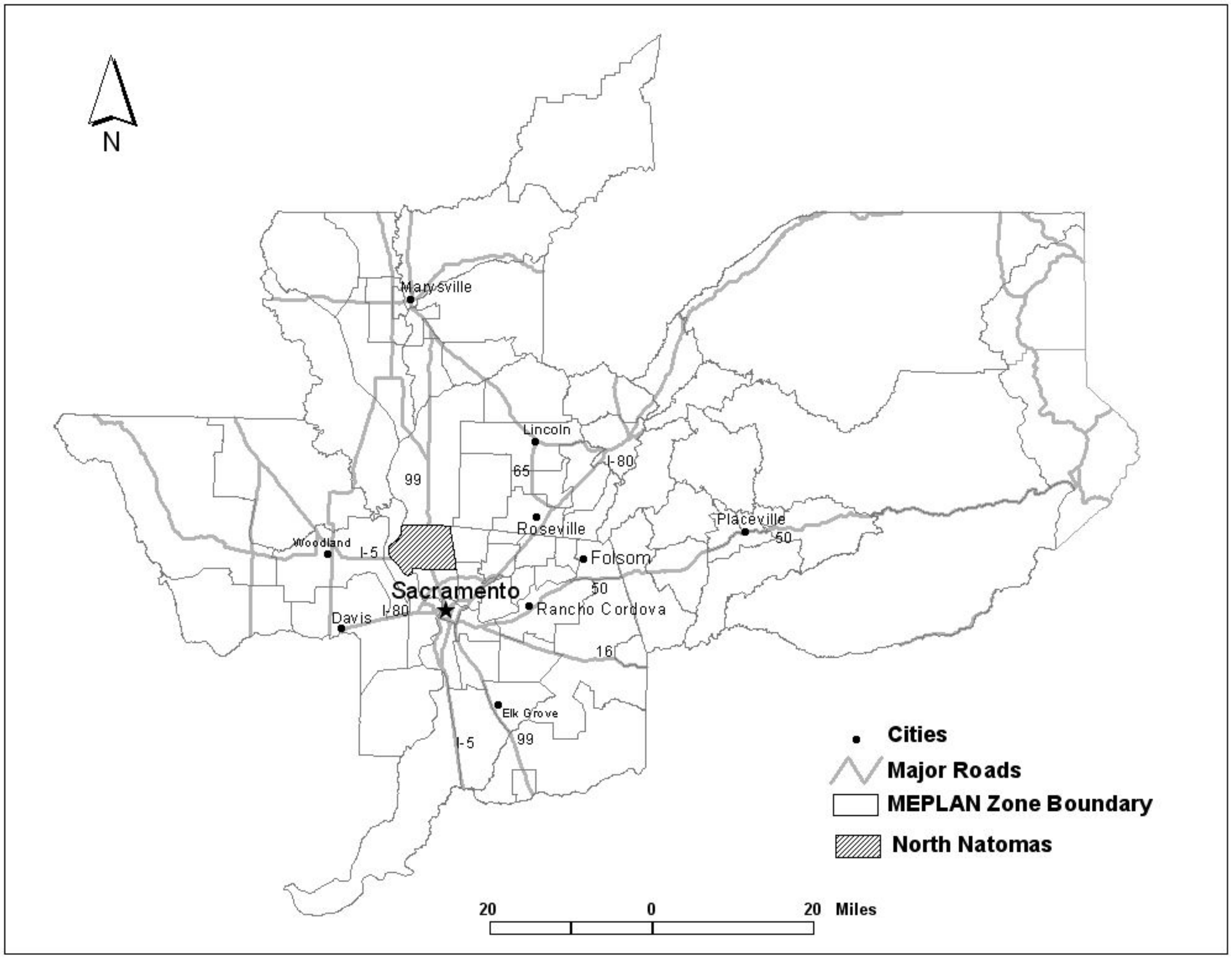

FIGURE 1 The Sacramento Region