

Which Came First, People or Pollution? Assessing the Disparate Siting and Post-Siting Demographic Change Hypotheses of Environmental Injustice

SUPPLEMENT TO ERL521204

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Overview

These supplementary materials include details of the data sources used to identify and map commercial hazardous waste treatment, storage, and disposal facilities (TSDFs) used in this study (erl521204). Also included is a description of the spatial and analytic techniques and demographic variables used to assess racial and socioeconomic disparities associated with TSDFs locations at or near the time of siting and post-siting demographic changes. That detailed description of methods employed is followed by extended results, which include a series of figures showing socioeconomic disparities associated with TSDFs locations at or near the time of siting and post-siting changes in socioeconomic conditions in TSDFs host neighborhoods (Figures 3-5). These findings parallel the results shown in Figure 1 that show disparities in percentages of people of color at the time of siting and disproportionate post-siting changes in minority percentages.

Detailed Description of Methods

Identifying the Universe of Facilities and Mapping Facility Locations

Commercial TSDFs were identified from information provided by various public and private databases. These included: (1) the U.S. Environmental Protection Agency's (EPA) *Biennial Reporting System* (BRS); (2) EPA's *Resource Conservation and Recovery Information System* (RCRIS); (3) EPA's *Envirofacts Data Warehouse*; and (4) the *Environmental Services Directory* (ESD) (U.S. EPA 2003; U.S. Bureau of the Census 1993; U.S. EPA 2001, 2001/2002; Environmental Information Ltd. 2001/2002).

These databases were used to develop an initial list of commercial hazardous waste TSDFs in the U.S. that were subject to the permitting process under Subtitle C of the Resource Conservation and Recovery Act (RCRA) to receive hazardous waste from off-site sources in 1999 (the time data for the 2000 Census were being collected). Our selection criteria required that the facility: (1) was a legally permitted hazardous waste facility, i.e., a TSDF; (2) accepted hazardous waste from third parties for pay; and (3) operated in 1999 (closed facilities were not included). We used Geographic Information Systems (GIS) to initially geocode facility addresses and map facility locations (Environmental Systems Research Institute 2000; GeoLytics 2000).

Because the various databases included conflicting, incomplete, or outdated information, we contacted by phone owners and operators of all facilities on our initial list to determine the current operating and regulatory status of the facilities and verify their locations mapped in GIS. If owners or operators could not be contacted, state and federal regulatory agencies were contacted to verify facility information pertaining to our selection criteria. On the basis of information received, facilities that did not meet the selection criteria were removed from our list; and mapped facility locations were adjusted if necessary to match actual facility locations (e.g., rather than parent company or business office locations, which were sometimes erroneously reported as the actual facility addresses in the various databases). By rigorously applying these verification procedures and selection criteria, we identified a total of 319 facilities sited between 1966 and 1995 to include in the universe of TSDFs we examined.

Facility Siting Dates

Although some of the aforementioned databases provided dates that some facilities were sited, facility owners and operators assisted in confirming, and in many cases establishing, siting dates, i.e., years facilities began operating. Table 2 shows the number and percentage of facilities sited within each five-year interval with the time period of the study.

Table 2: Commercial Hazardous Waste Facilities by Period of Siting

Period of Siting	# of TSDFs	% of Total
1966 to 1970	26	8.2%
1971 to 1975	55	17.2%
1976 to 1980	88	27.6%
1981 to 1985	68	21.3%
1986 to 1990	58	18.2%
1991 to 1995	24	7.5%
Total	319	100.0%

Demographic Analyses

To assess patterns of disparate siting, the demographic characteristics of the host neighborhoods of each of the cohorts of facilities were examined at or near the time the facilities were sited. Since until recently the Census has been conducted only once every decade, the demographic characteristics of the Census year closest to the siting dates of the cohorts of facilities were examined. To assess patterns of post-siting demographic change, the demographic characteristics of the neighborhoods for each of the cohorts of facilities were examined at each subsequent Census year up to 2000. We also examined the demographic characteristics of the host neighborhood of the various cohorts of facilities in all prior Census years (beginning at 1970) to examine demographic changes *before* siting.

Areal apportionment and 50% areal containment distance-based methods (see discussion above and Mohai and Saha, 2006, 2007, and under review) were used to determine the demographic characteristics of circular host neighborhoods within 3.0 kilometers of TSDF locations. A GIS software (ArcView GIS Version 3.2) and 1970, 1980, 1990, and 2000 digitized Census tracts boundaries (shapefiles) were used to define circular-shaped host neighborhoods within 3.0 kilometers (approximately 1.8 miles) of the TSDF locations (GeoLytics 2000, 2001a, 2001b; Wessex 1995). This distance is within the range of distances used in prior studies and within which health, economic and other quality of life impacts have been found to exist (Mohai and Saha 2007).

For the longitudinal analyses, the areal apportionment method was used to determine demographic characteristics of the circular host neighborhoods around the TSDF locations. Census tracts hosting or adjacent to the TSDF were used as the building block units in applying the areal apportionment method.¹ However, because tracts were not delineated for locations of facilities in non-metropolitan areas for the 1970 and 1980 Censuses (i.e., Census data were not reported at the tract level in non-metropolitan areas), the next largest Census geography for which data were reported in those years (counties, county subdivisions, minor civil divisions, and places) and the areal apportionment method were used to estimate the demographic characteristics of the circular host neighborhoods around those facilities. This allowed us to include non-metropolitan facilities along with metropolitan ones in our longitudinal analyses of the nation's TSDFs.

Multivariate statistical analyses were used to assess the relative importance of racial and socioeconomic characteristics of nearby Census tracts in predicting the siting of new hazardous waste TSDFs at each of the Census years, 1970, 1980, and 1990. For these statistical analyses, the 50% areal containment method was used. However, because TSDFs in untraced areas in the 1970 and 1980 Censuses for which alternate geographic units, such as counties and county subdivisions, were too large to apply the 50% areal containment method, non-metropolitan facilities were excluded from the multivariate analyses for these years. This resulted in excluding 3 TSDFs sited between 1966 and 1970, 12 TSDFs sited between 1971 and 1975, 7 TSDFs sited between 1976 and 1980, and 3 TSDFs sited between 1981 and 1985.

Demographic data from the 1970, 1980, 1990, and 2000 Censuses used in our analyses were obtained from various CD-ROM and other compilations that included a combination of long form and short form data (SF1 and SF3) (GeoLytics 2001a; U.S. Bureau of the Census 1984;

¹ Although Census tract boundaries at a given location may change from one Census year to the next, Mohai and Saha (2007) found that the areal apportionment method produces remarkably consistent and reliable estimates of the demographic characteristics within a circular buffer around a given point location regardless of differences in the sizes and shapes of the building block units used to derive the demographic characteristics within the buffer.

Wessex 1994; GeoLytics 2002). Data from each Census from 1970 to 2000 were used to create the following race and ethnicity variables: percent white, percent black or African American, percent Asian/Pacific Islander, and percent Hispanic or Latino. However, Census Bureau definitions for some race and ethnicity variables were not always consistent from decade to decade. Thus, we constructed these variables to be as comparable across the various Censuses as possible.² Census data from 1970 to 2000 were also used to create the following socioeconomic variables: mean owner-occupied housing (“property”) value; percent of persons 25 years old and over with a four-year college degree; percent of persons 16 years old and over employed in executive, managerial, or professional (“professional/managerial”) occupations; and percent employed in precision production or labor (“precision production/labor”) occupations. These socioeconomic variables were comparable across the various censuses despite some definitional changes in the occupational variables that reflect a changing economy and labor market.

As result of these changes, the Census Bureau occupation sub-categories that were combined for the occupation variables differed slightly among the various censuses. For example, for the 1970 Census there the main occupational categories used to construct the percent employed in professional/managerial occupation, include: 1) professional, technical, and kindred workers; and (2) managers and administrators; whereas for the 1990 Census, the corresponding categories included: 1) executive, administrative, and managerial occupations; and (2) professional specialty occupations. There were similar definitional changes for the main categories used for the precision production/labor variable: for 1970, the main occupational categories used included: 1) craftsmen and kindred workers; 2) operatives, except transport; (3)

² Note that the Census Bureau did not count the Asian/Pacific Islander population in 1970 at the census tract level (U.S. Bureau of the Census 1970; also see Massey and Denton 1987), so percentages for this racial group are not included in our analysis for 1970 but are for subsequent Censuses (1980, 1990, and 2000). Also, the Census Bureau also did not define or tabulate the Hispanic category until the 1990 Census. However, we followed the lead of prior studies (see, for example, Oakes, Anderton, and Anderson 1996) and used Spanish origin tabulations in 1970 and 1980 to define our own Hispanic or Latino variable for those years.

transportation equipment operatives; and (4) laborers, except farm. For 1990, the corresponding categories included: 1) precision, production, craft, and repair; 2) machine operators, assemblers, or inspectors; 3) transportation and material moving operators; and 4) handlers, equipment cleaners, helpers, and operators.

Census Variable Definitions, 1970, 1980, 1990 and 2000

1970 Census (Fourth Count Population Summary Tape, unless indicated)

Percent black or African American: Number of “Negros” (Table 105, Race, Category 2) divided by number of persons with race reported (Categories 1-3).

Percent Hispanic: Number of persons classified in any of the five Spanish categories of the question on “origin or descent” (Table 24, Spanish Indicators, Category 1) divided by number of persons with race reported (Table 105, Categories 1-3).

Percent white: Table 105, Category 1), divided by number of persons with race reported.

Mean property value: Aggregate value of owner occupied housing units for which values were tabulated (Housing Summary Tape, Table 1, Category 1) divided number of owner-occupied housing units for which value was tabulated (Table 52, Value, Occupancy Status, and Race of Head, Categories 1-11), expressed in thousands of dollars.

Percent with a (four-year) college degree: Sum of persons 25 years old and over with a four-year college degree (Table 114, Categories 9 and 10) divided by number of persons 25 years and over (Categories 1-10).

Percent employed in executive, management or professional occupations: Sum of persons 16 years old and over employed, (1) as professional, technical, and kindred workers, or (2) as managers and administrators (Table 58, Employed Population 16 Years Old and Over by Occupation, Categories 1-11), divided by number of employed persons 16 years old and over (Categories 1-42).

Percent employed in precision, production or labor occupations: Sum of persons 16 years old and over employed as, (1) craftsmen and kindred workers, or as (2) operatives, except transport, (3) transportation equipment operatives, or (4) laborers, except farm (Table 58, Categories 18-32), divided by number of employed persons 16 years old and over.

1980 Census (Data are from Summary Tape File, STF, 3)

Percent black or African American: Number of blacks (Table 17, Category 2) divided by number of persons (Table 1, Category 1).

Percent Hispanic: Sum of Mexicans, Puerto Ricans, Cubans and “Other Spanish” (Table 13, Spanish Origin and Race, Categories 2-5) divided by number of persons.

Percent Asian/Pacific Islander: Number of Japanese, Chinese, Filipinos, Koreans, Asian Indians, Vietnamese, Hawaiians, Guamanians, Samoans and Other Asians or Pacific Islanders (Table 12, Categories 6-15) divided by number of persons.

Percent white: Table 12, Category 1, divided by total number of persons of any race.

Mean property value: Aggregate value of owner-occupied non-condominium housing units in 1979 (Table 140) times 250 divided by number of owner-occupied housing units (Table 138, Mortgage Status and Year Householder Moved into Unit, Categories 1-5), expressed in thousands of dollars.

Percent with a (four-year) college degree: number of persons with a four-year college degree (Table 48, Race by Years of School Completed, Category 5) divided by number of persons 25 years old and over (Categories 1-5).

Percent employed in executive, management or professional occupations: Sum of persons 16 years old and over employed in, (1) executive, administrative and managerial, or (2) professional specialty occupations (Table 66, Occupation, Categories 1 and 2), divided by the number of employed persons 16 year old and over (Categories 1-13).

Percent employed in precision, production or labor occupations: Sum of persons 16 years old and over employed, (1) in precision, production, craft, or repair occupations, (2) as machine operators, assemblers or inspectors, (3) in transportation and material moving occupations, or (4) as handlers, equipment cleaners, helpers or operators (Table 66, Categories 10-13), divided by number of employed persons 16 years old and over (Categories 1-13).

1990 Census (Data are from Summary File 3A unless indicated)

Percent black or African American: number of African Americans alone (Table P-8, Race, Category 2) divided by number of persons (Table P-1).

Percent Hispanic: number of persons of Hispanic origin (Table P-10) divided by number of persons.

Percent Asian/Pacific Islander: number of Asians or Pacific Islanders (Table P-8, Categories 6-24) divided by number of persons.

Percent white: Table 5, Category 1, divided by the total number of persons (Table 1).

Mean property value: Aggregate value of owner-occupied housing in 1989 (SF 1A; Table H-24) divided by number of owner-occupied housing units (Table H-25, Race of Householder, Categories 1-5), expressed in thousands of dollars.

Percent with a (four-year) college degree: number of persons 25 years old and over with a four-year college degree (Table P-57 Educational Attainment, Categories 6 and 7) divided by number of persons 25 years old and over (Categories 1-7).

Percent employed in executive, management or professional occupations: Sum of persons 16 years old and over employed in, (1) executive, administrative, and managerial, or (2) professional specialty occupations (Table P-78, Occupation, Categories 1 and 2), divided by number of employed persons 16 years old and over (Categories 1-13).

Percent employed in precision, production or labor occupations: Sum of persons 16 years old and over belonging employed: (1) in precision, production, craft, and repair, (2) as machine operators, assemblers, or inspectors, (3) as transportation and material moving operators, or (4) as handlers, equipment cleaners, helpers, and operators (Table P-78, Categories 10-13), divided by number of employed persons 16 years old and over.

2000 Census (Data are from Summary File 3A)

Percent black or African American: number of African Americans alone (Table P-6, Race, Category 3) divided by number of persons (Table P-1).

Percent Hispanic: number of persons of Hispanic origin (Table P-7, Hispanic or Latino by Race, Category 10) divided by number of persons.

Percent Asian/Pacific Islander: Sum of number of Asians alone and Native Hawaiian and Other Pacific Islanders alone (Table P-7, Categories 5 and 6), divided by number of persons.

Percent white: Table 6, Category 2 divided by Table 6, Category 1 (all person).

Mean property value: Aggregate value of owner-occupied housing in 1999 (Table H-81, Aggregate Value for Specified Owner-occupied Housing Units by Mortgage Status, Category 1) divided by number of specified owner-occupied housing units (Table H-80, Mortgage Status, Category 1), expressed in thousands of dollars.

Percent with a (four-year) college degree: number of persons 25 years old and over with a four-year college degree (Table P-37, Sex by Educational Attainment for the Population 25 Years and Over, Categories 15-18 and 32-35) divided by number of persons 25 years old and over.

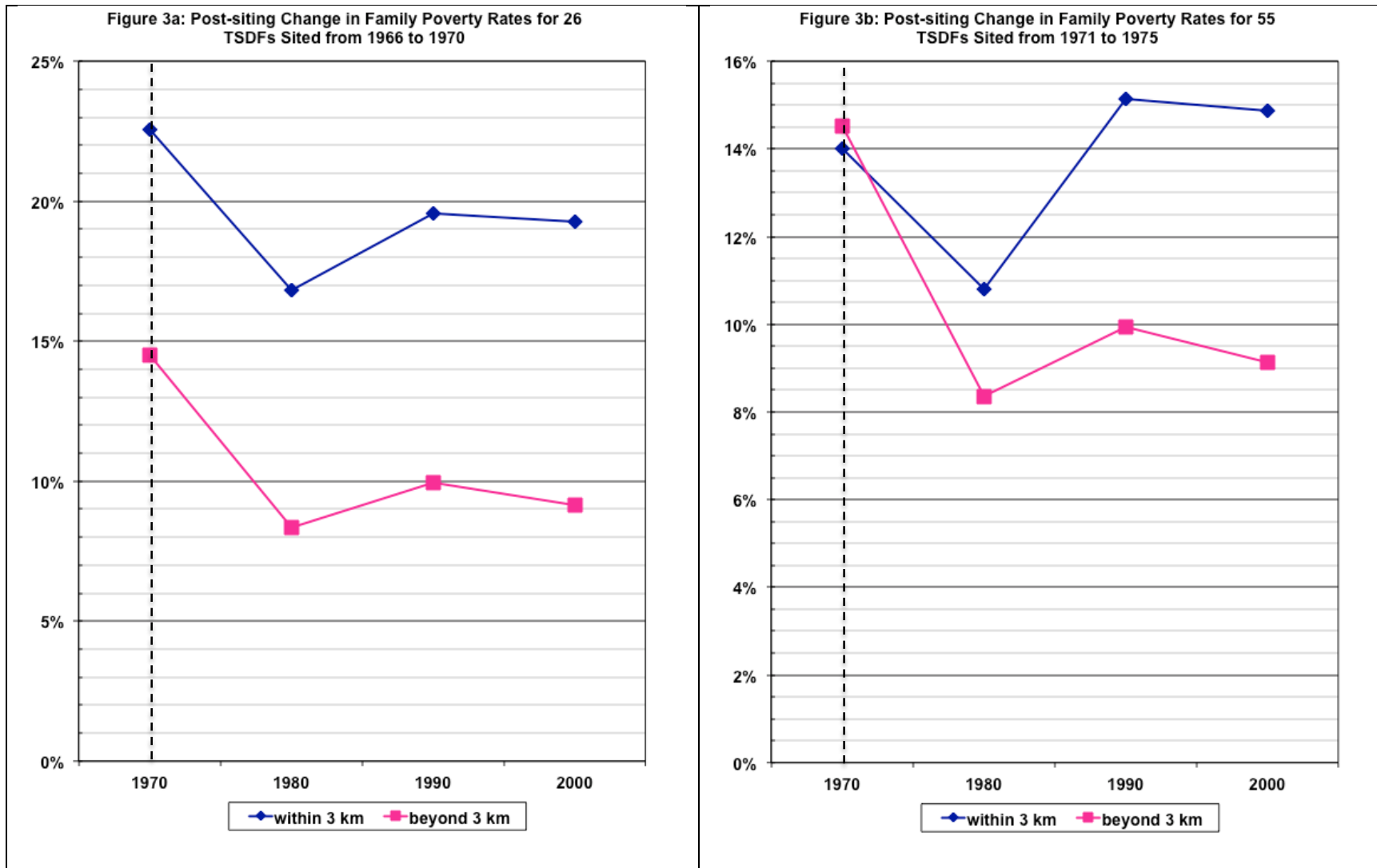
Percent employed in executive, management or professional occupations: number of persons employed in management, professional and related occupations (Table P-50, Sex by Occupation for Employed Civilian Population 16 Years and Over, Categories 3 and 50) divided by number of employed persons 16 years old and over (Categories 1-95).

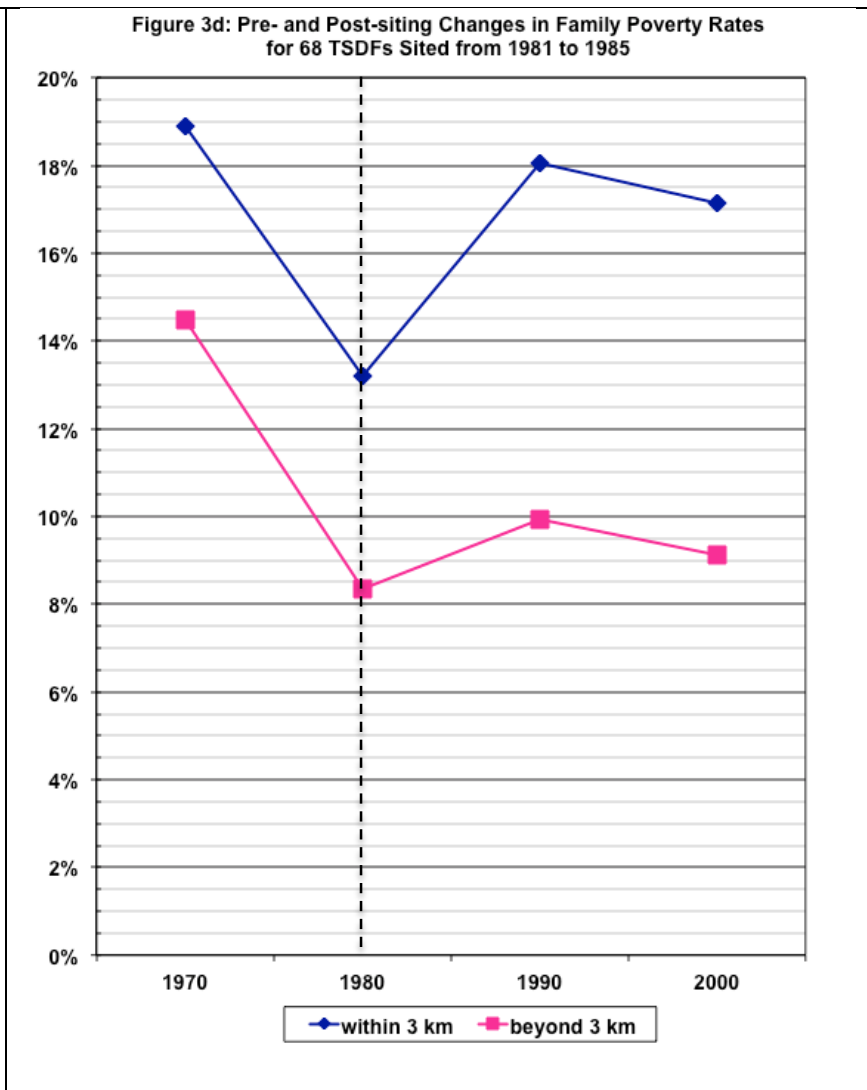
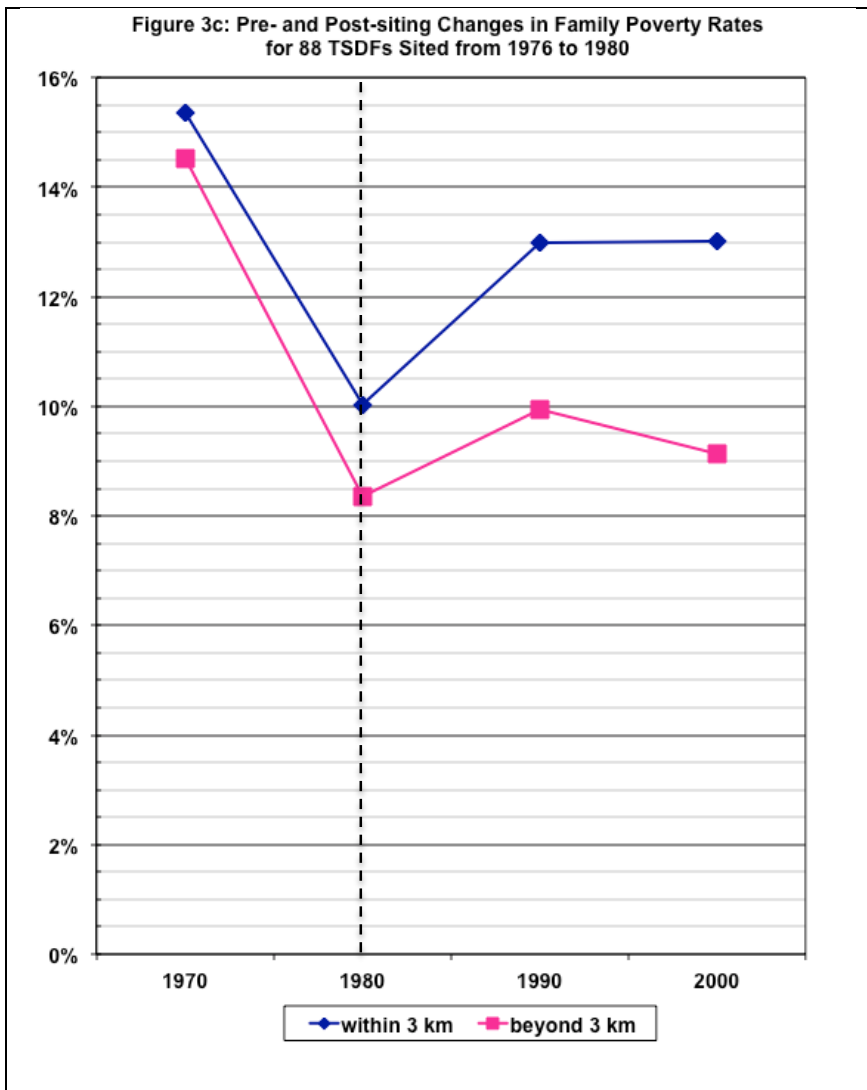
Percent employed in precision, production or labor occupations: Sum of number of persons employed persons in, (1) construction, extraction, and maintenance, or (2) production, transportation, and material moving occupations (Table P-50, Categories 35, 41, 82 and 88), divided by number of employed person 16 years old and over.

Supplementary Results

In our analyses, we found similar patterns to those for race and ethnicity when we examined socioeconomic conditions before during and after siting (Figures 3 to 5). Specifically, a) at the time of TSDF siting poverty rates within 3.0 km of TSDFs tended to be higher than in areas beyond 3.0 km while mean incomes tended to be lower; b) the disparities in poverty rates and mean incomes tended to widen after siting; but, c) these disparities around TSDF locations began widening before the TSDFs were sited. We found similar but much weaker patterns for property values. For example, for TSDFs sited between 1966 and 1980 we found small to nonexistent disparities in property values within and beyond the 3.0 km distances at the time of siting. In addition, for TSDFs sited between 1966 and 1970 and between 1976 and 1980 we found very little widening of disparities before or after siting.

Figure 3: Family Poverty Rates before, during and after TSDF Siting in 3 Km. Host Neighborhoods and Non-host Areas





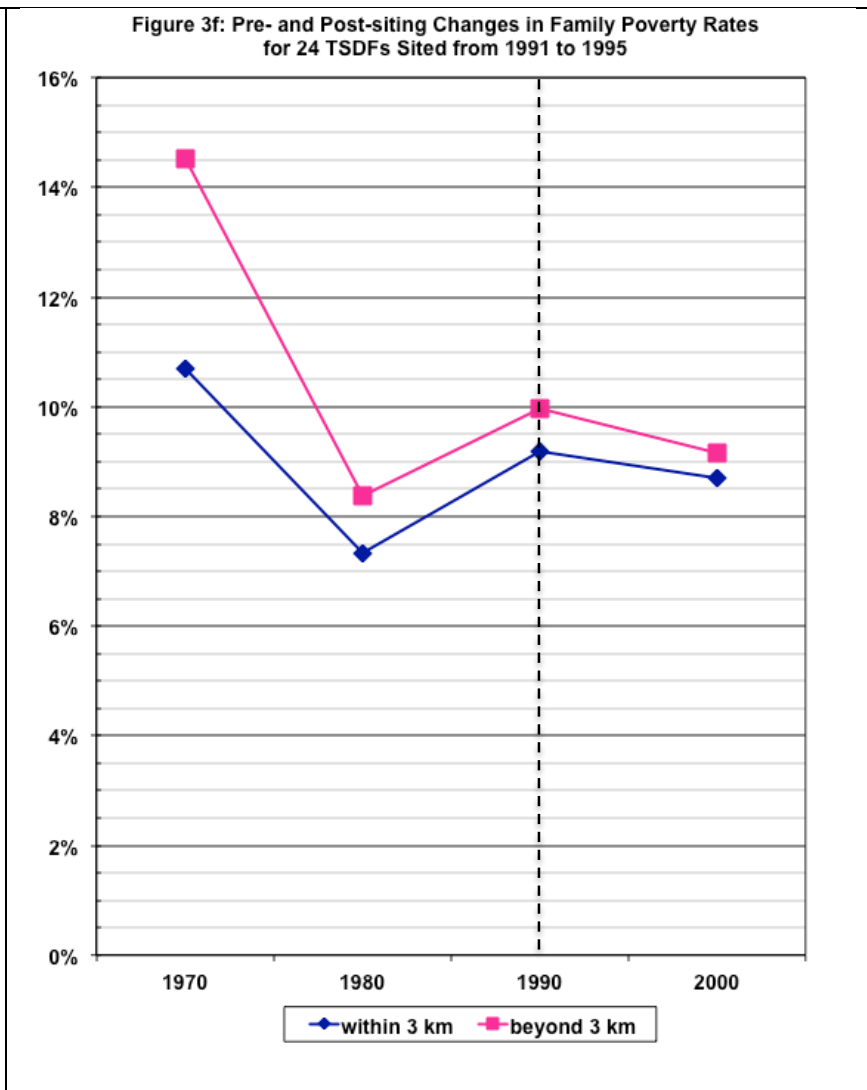
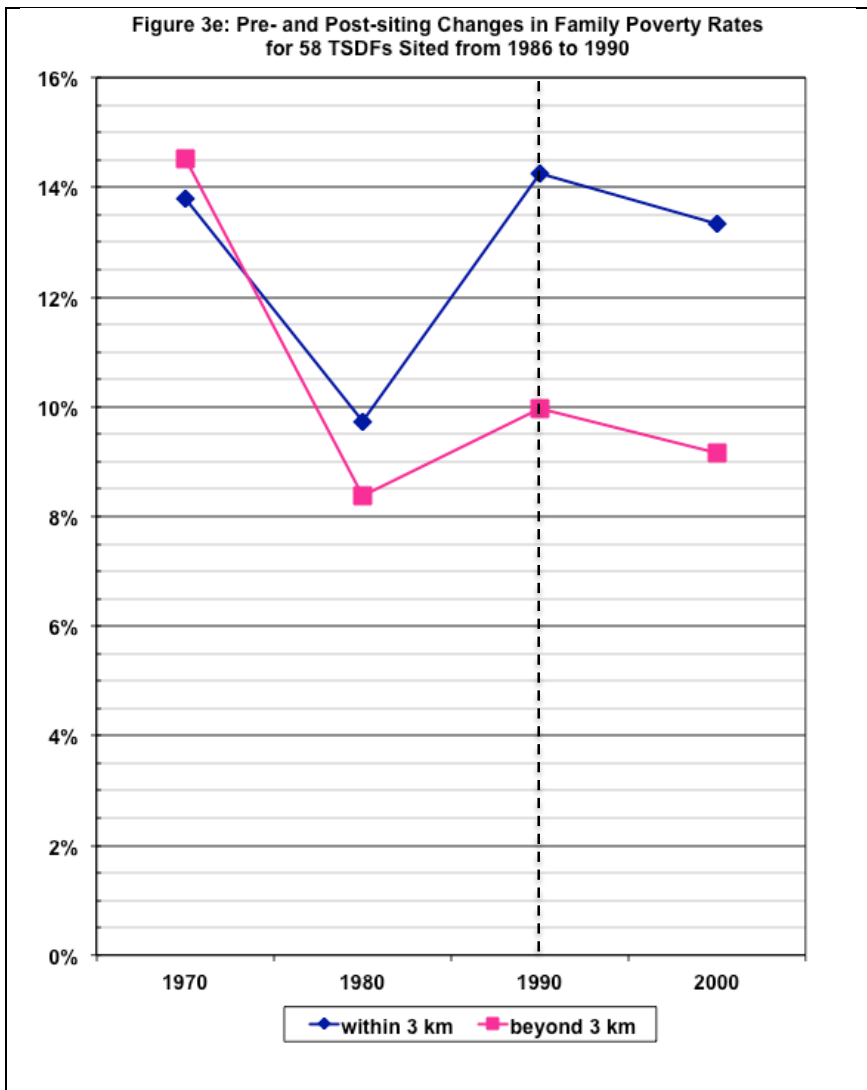
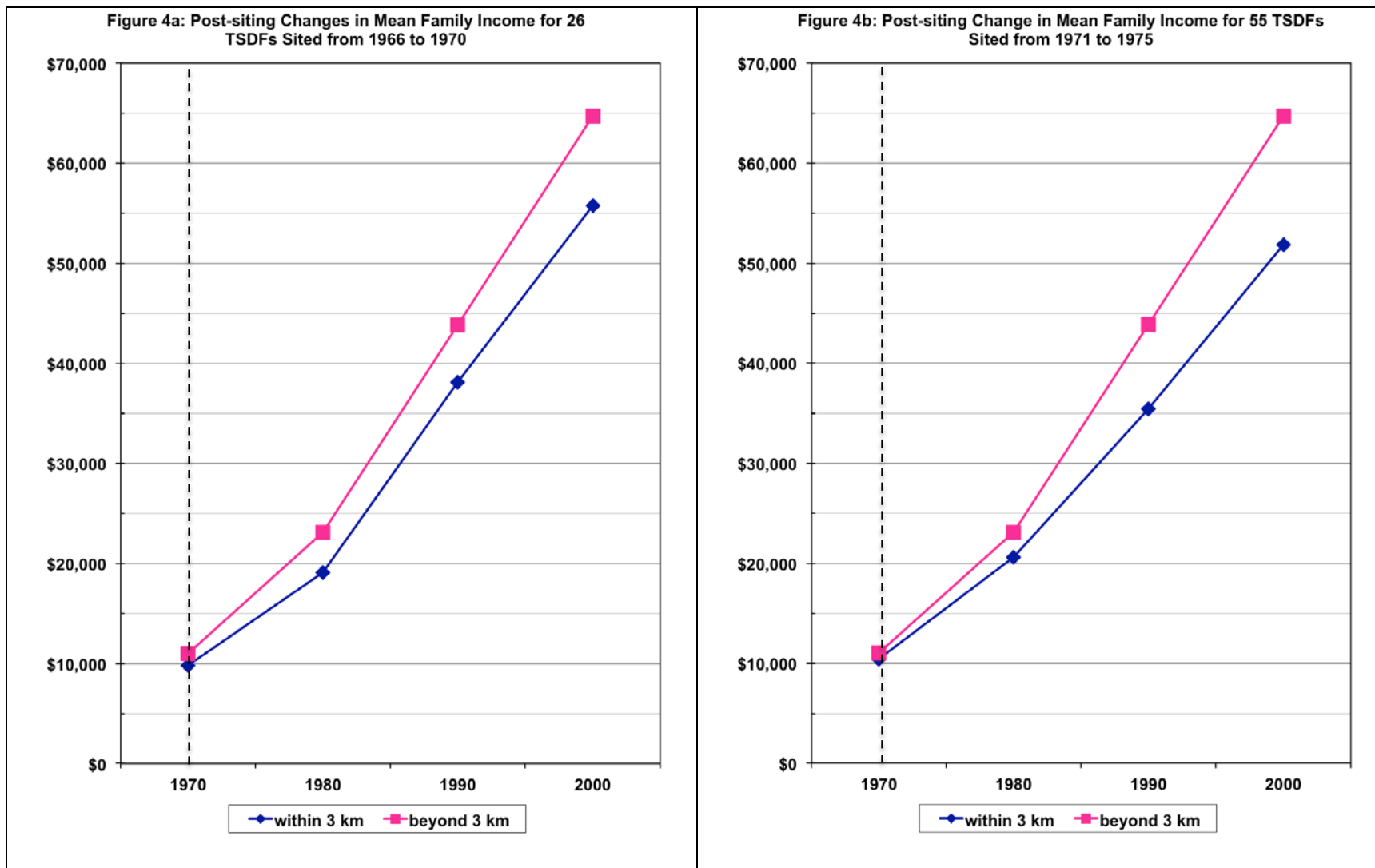
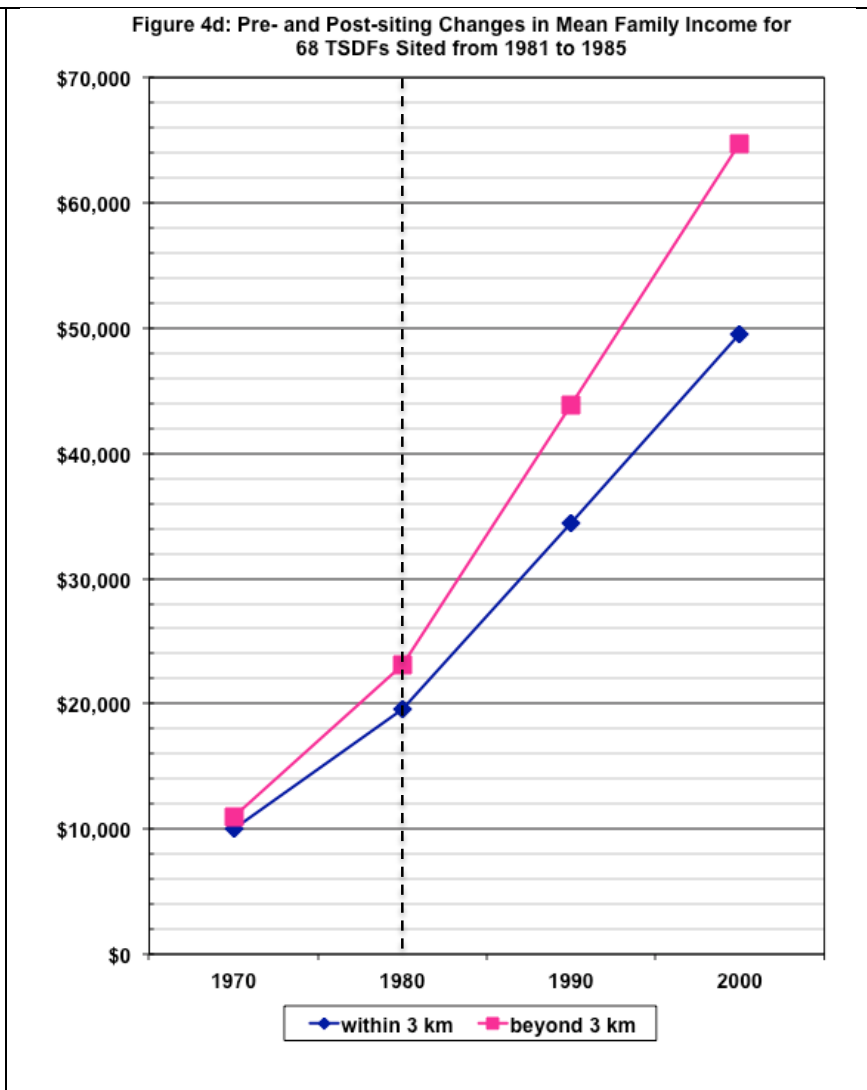
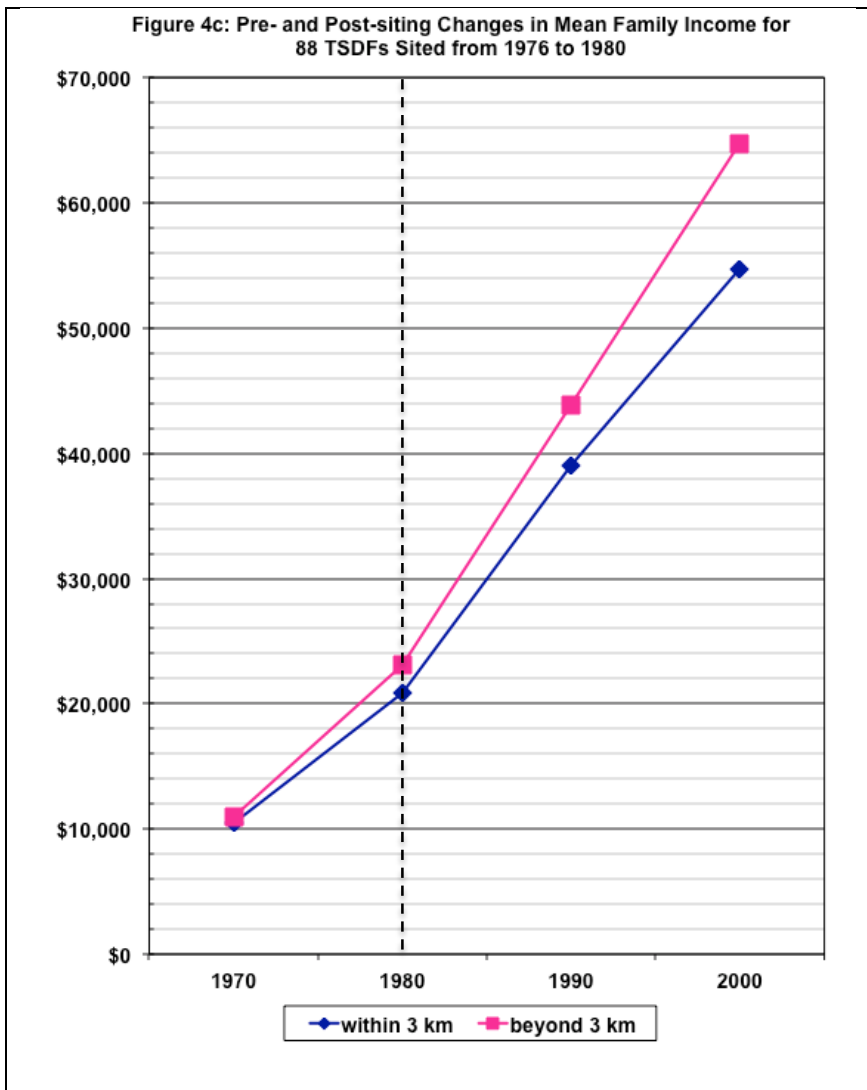


Figure 4: Mean Family Income before, during and after TSDF Siting in 3 Km. Host Neighborhoods and Non-host Areas





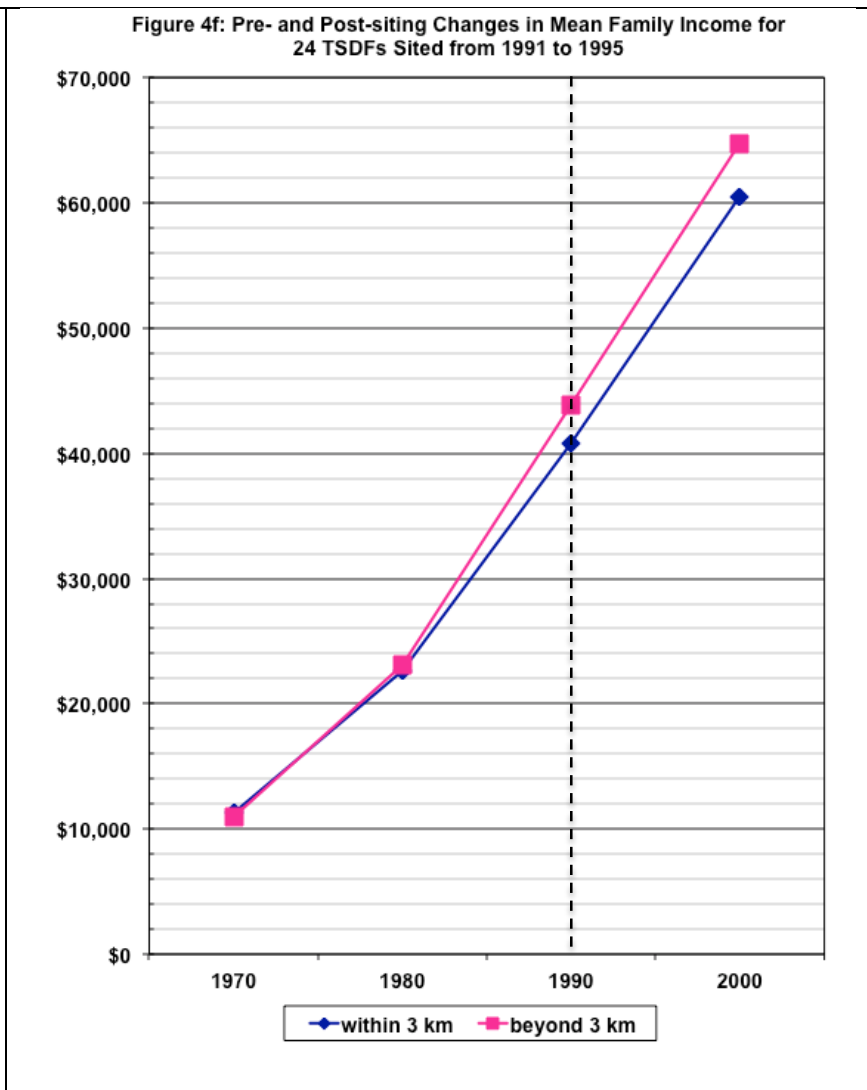
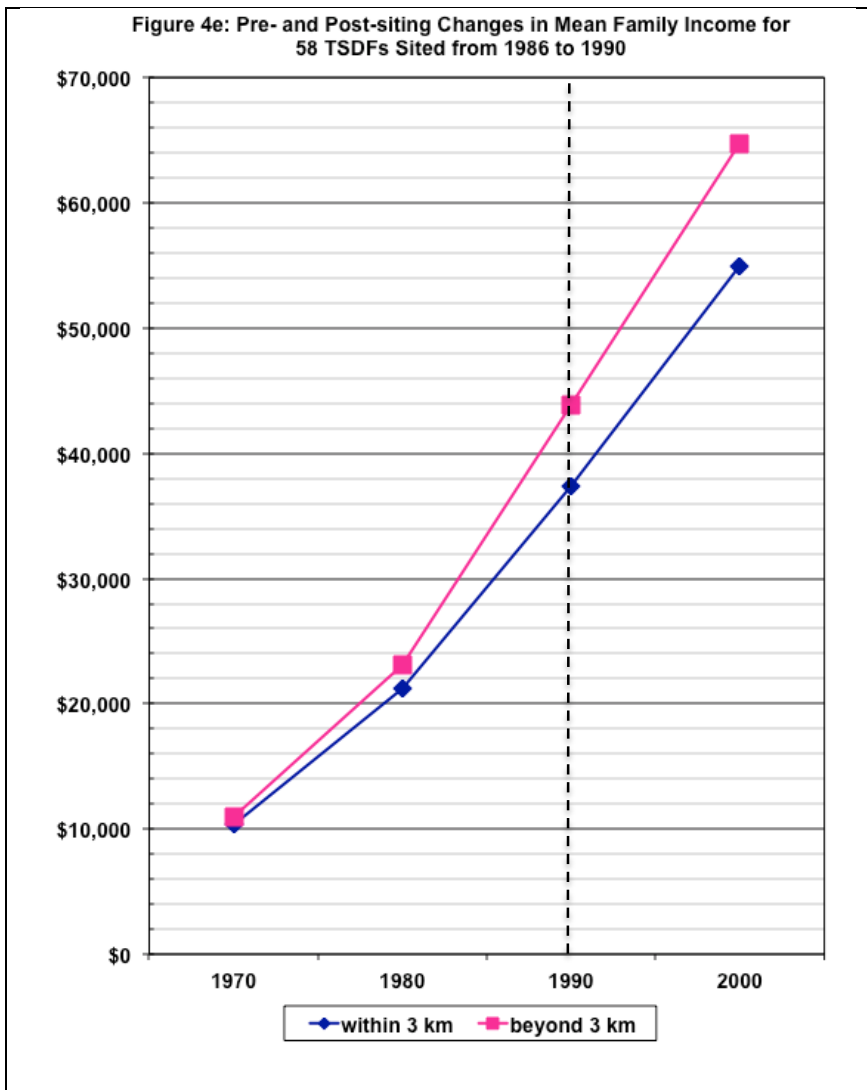
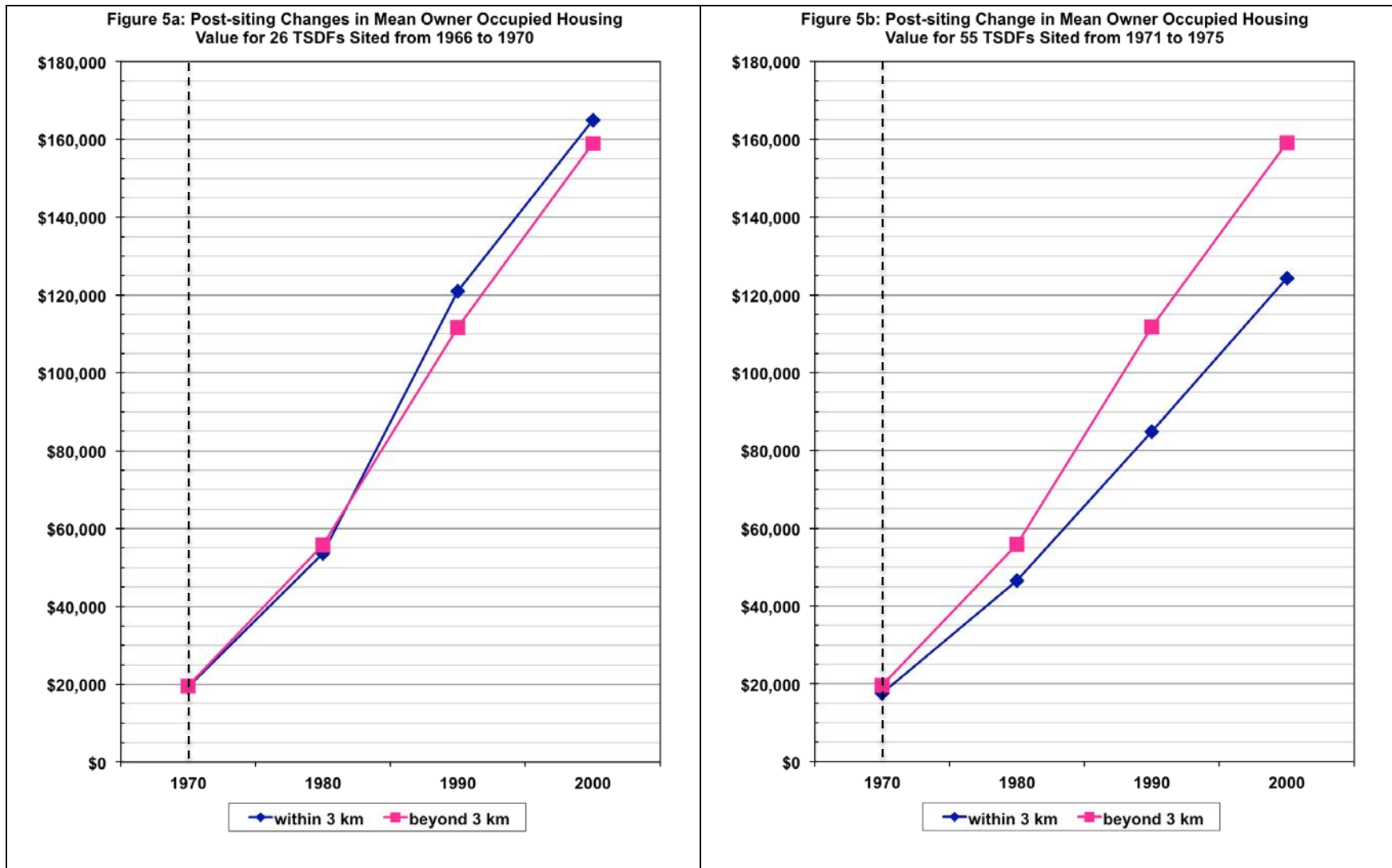
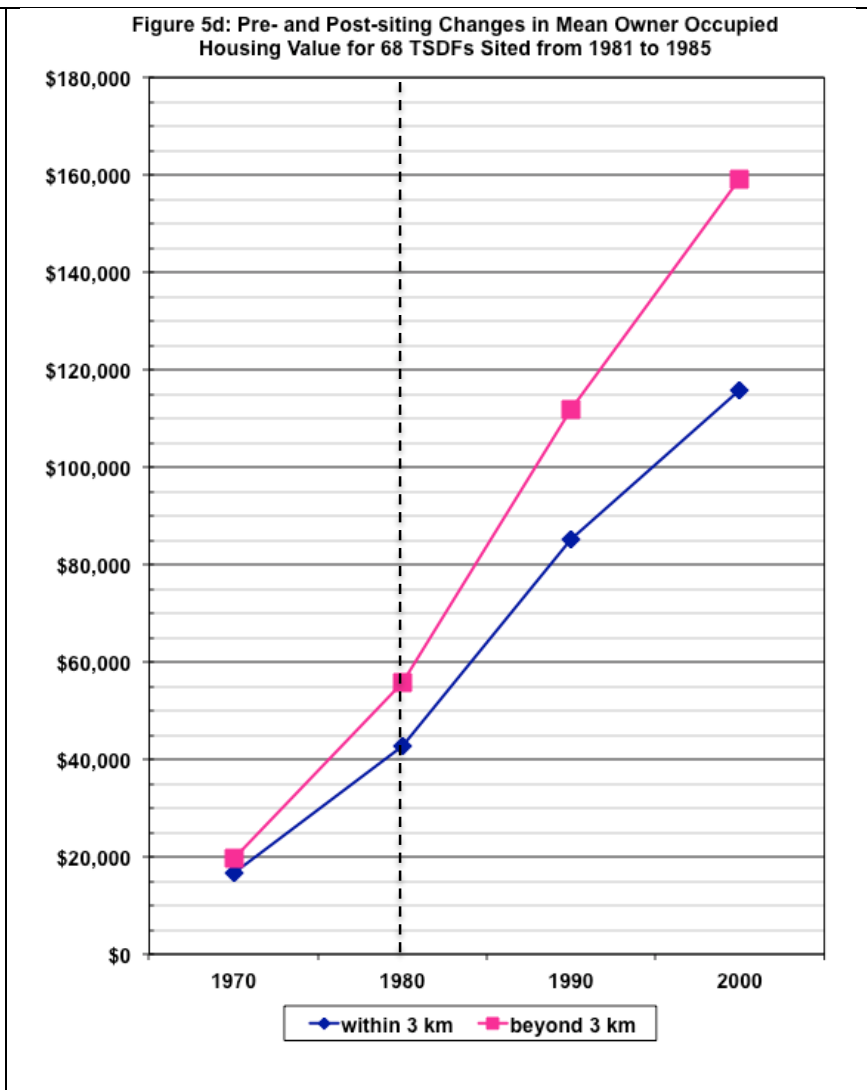
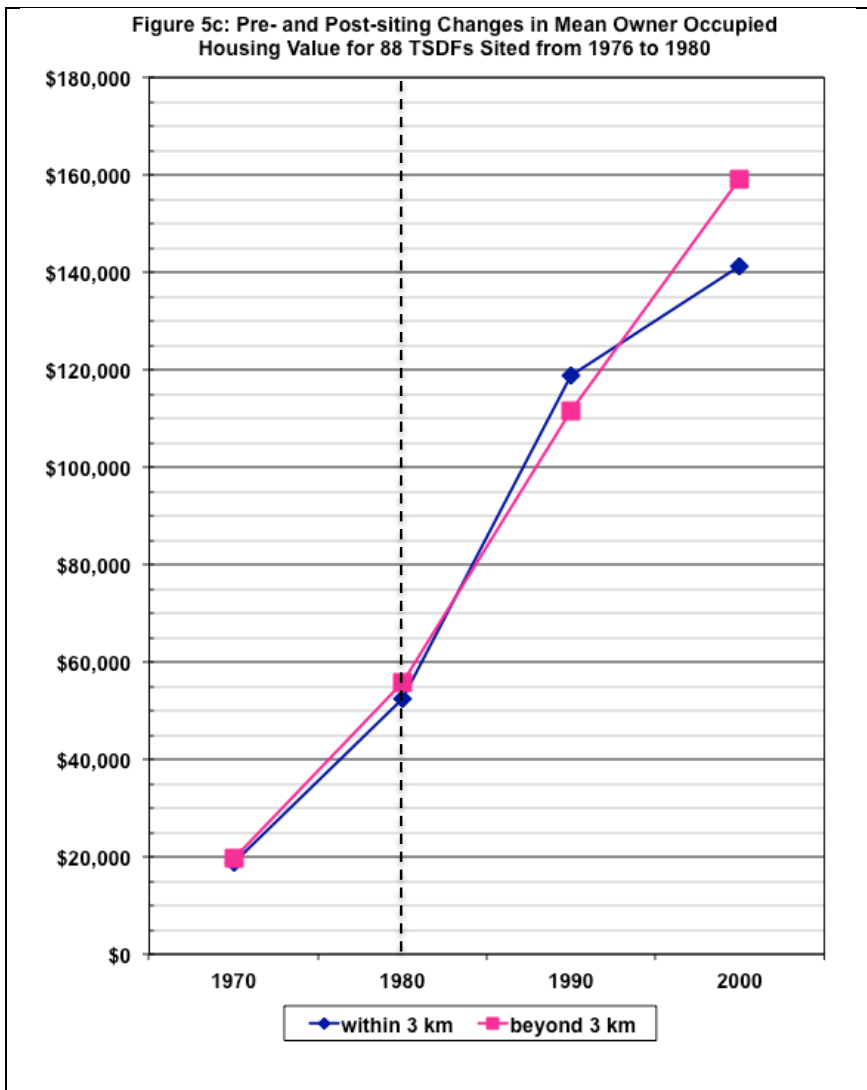
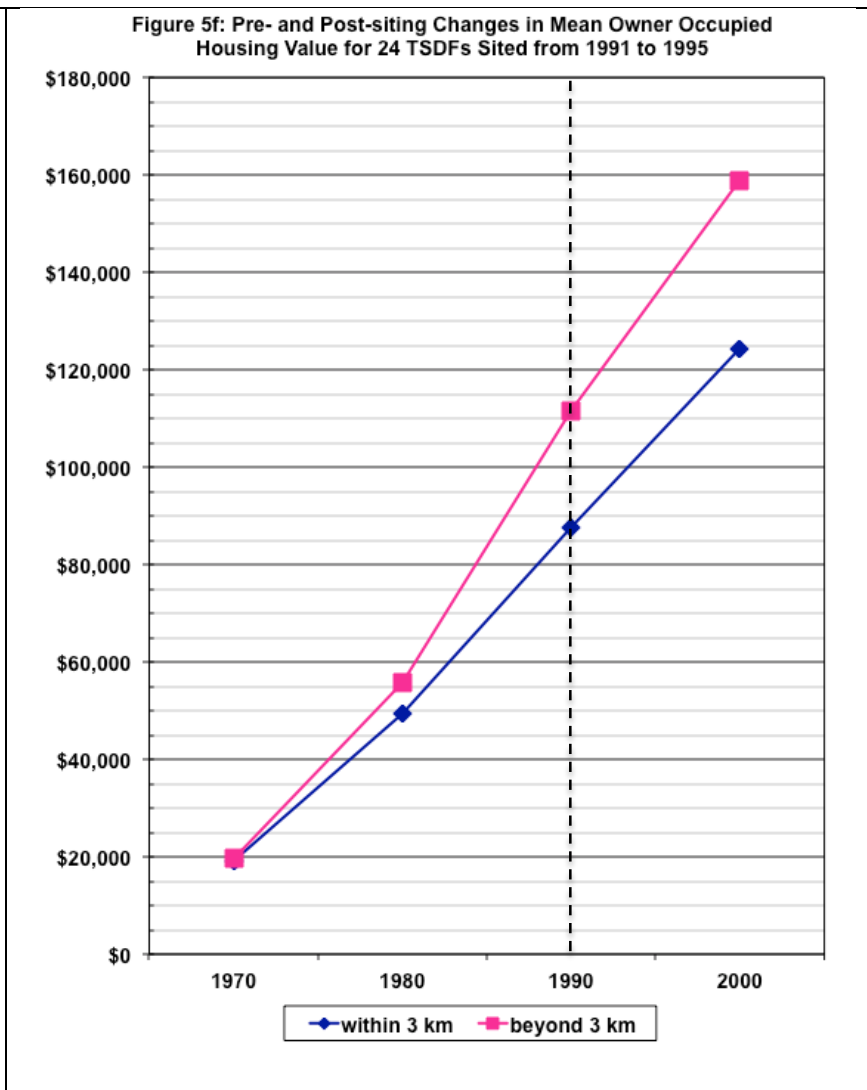


Figure 5: Mean Property Values before, during and after TSDF Siting in 3 Km. Host Neighborhoods and Non-host Areas







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