

MEMORANDUM

TO: Green Line Extension Project Advisory Group **April 29, 2009**

FROM: Bruce Kaplan, Principal Transportation Planner
Scott Peterson, Manager of Transportation Systems Analysis

RE: Representation of Somerville Transit Mode Shares in the CTPS Model

At the November 12 meeting of the Green Line Extension Project Advisory Group, questions were raised as to whether CTPS's regional forecasting model was adequately capturing Somerville's current transit mode share. A member of the Project Advisory Group asserted that analyses performed for past projects had underestimated Somerville's potential for rapid transit ridership. He claimed that prior to the opening of the Davis Square MBTA station, transit ridership was only predicted at one-fourth of the level that actually occurred. He inquired as to what transit usage percentage was currently being used in the regional model. A representative of CTPS responded by stating that the average regional transit mode share in the model is 7% to 8%. The Advisory Group member retorted that according to U.S. Census data the transit share was between 40% and 60% in Davis Square and that CTPS and EOT were vastly underestimating that share.

There is actually no significant lack of accord between the census figures that were cited and the assumptions of the CTPS model or its estimates of transit share. A misunderstanding arose because although the model's *average* transit mode share for the entire *region* is 7% to 8%, the model uses - for each of 2,727 individual zones composing the region - a separately formulated set of mode shares, each of which applies only to trips with a certain combination of characteristics (including trip purpose, time of day, and relative cost and travel time of competing modes). This memorandum explains this further and also is intended to shed light on some other matters related to the misunderstanding that occurred at the meeting. It does not address the veracity of the Advisory Group member's claims regarding historical underprediction of ridership at the Davis Square station; that is beyond the scope of this memorandum. In addition, although the comparability of census figures on transit mode shares and the model's representation of them is inherently very limited, this memorandum does provide comparisons of them insofar as it is possible to do so. Finally, it presents preliminary future-year forecasts from CTPS's current modeling effort; they should allay concerns that the model does not adequately capture the impact of new transit service in Somerville.

ISSUES RAISED

The mode share figure cited by the Advisory Group member comes from a geographic display in the City of Somerville's *Five-Year Consolidated Plan: 2008–2013*. The data represented in this map was collected from the 2000 census long-form survey and is presented at the block group level of geography. This dataset is commonly known as "Journey to Work" (JTW) data. The map (reproduced in this memorandum as Exhibit 1) displays the percentage of people in each census block group area, aged 16 or older, who use public transportation for their commute trip. Indeed, very high transit mode shares (above 40%) are concentrated along the northern part of the Cambridge/Somerville border as well as near Somerville's border with Charlestown. The Somerville *Plan* attributes the high transit use to "a strong inter-modal network of subway trains and bus lines." The text echoes the Project Advisory Group member's claim that the Davis Square station ridership was underestimated prior to the station's opening; the report states that it was predicted at one-third of the level of the actual ridership. However, the presentation of the data is ambiguous, as it is not entirely clear whether the transit mode share percentages refer to the origin end of the trip, the destination end, or a combination of both. The text of the document does not clarify this.

CTPS RESPONSES

Methodology

Several things need to be addressed to answer the question of whether CTPS is adequately representing the cited JTW data in its regional travel demand model. Although the data cited by the Advisory Group member is relevant in a general way to the planning for the Green Line Extension by showcasing Somerville's high levels of transit use for commuter trips, its comparability to the assumptions or output of CTPS's multifaceted model, which is composed of many robust components, is quite limited. Census data is merely one of many empirical component sources upon which the model is built. Besides census information, the other collected items used for trip pattern calibration and validation include travel survey data, transit passenger survey data, external cordon survey data, transit ridership counts, and traffic volume counts. Furthermore, CTPS's travel forecasting model, as part of its capability of determining complex trip-making patterns, is segmented into many robust components, which, among others, include trip purpose, time of day, and geography. Some of the reasons why those three characteristics of the modeling method indicate that the JTW data are of limited significance will be presented below.

CTPS's regional travel model represents many different varieties of trips in terms of purpose. The model distinguishes between four major trip purposes: Home-Based Work (HBW), Home-Based Other (HBO), Home-Based School (HBSc), and Non-Home-Based (NHB). The census data cited by the Advisory Group member is valid only for HBW trips. It is not valid to use this data to calibrate the model's representation of trips with other purposes, which actually make up the bulk of the model's daily trips.

CTPS models trips in four distinct time periods (AM peak, midday, PM peak, and evening), each of which contains unique behavioral and system (transit and roadway) characteristics. The data cited by the Advisory Group member covers an entire day's worth of travel. Although ultimately a comparison of model results to the census data can be made by aggregating the model's trip information from the four separate time periods (such a comparison is made later in this memorandum), it must be understood that the census mode shares are not useful in terms of "universal application" across every time period due to the way that CTPS's regional model functions. No single transit mode share factor is ever universally applied in the model; mode shares are actually model outputs, not direct inputs.

Another issue is that the geographic level of analysis is slightly different between the census data and the CTPS model. CTPS uses a disaggregated geographic unit of analysis known as a transportation analysis zone (TAZ) in its model. The region is divided into TAZs based on demographic information and the patterns and volumes of trips being produced and attracted. JTW data uses a different geographic accounting system, based upon a geographic unit of analysis known as a census block group, which is chiefly determined by population data. The average TAZ has approximately 1,800 residents, whereas Boston-area census block groups, usually geographically smaller than TAZs, contain on average approximately 1,300 people. Thus, even given seemingly similar geography, individual units in either system have the potential of producing differing transit mode shares by virtue of containing discrete populations. Additionally, in the CTPS model, TAZs are frequently composed of several census block groups, each having distinct (and often differing) characteristics. Thus, sometimes a TAZ will have a slightly different mode share than its component parts. At the aggregate level, a smoothing effect may even occur in which extreme component parts are minimized. Hence, comparison between these two geographic units is imperfect at best.

In summary, it appears that the Advisory Group member was under the impression that the model assumes and applies a single, universally applied transit mode share factor, whereas in fact each geographic unit (TAZ) has different mode shares for each time period and each trip purpose that are based on competing modal travel times and costs to get from an origin TAZ to a destination TAZ. The 7%-8% regional transit mode share cited by CTPS was an average aggregated for the entire geographic region for all purposes for an entire day. By no means is this figure actually applied in any specific forecasting.

Comparison of Model Data (Base Year) and Journey to Work Data

The HBW trip purpose is the closest analogue in CTPS's model to the JTW data. Upon comparison of the JTW data (Exhibit 1) with the 2006 base-year HBW model data for trips to all destinations (Exhibit 2), although, in the latter, Somerville TAZs do have high modeled transit HBW mode shares, they are not as high as the JTW shares. This may stem from aforementioned factors such as the difference in geographies. Additionally, the HBW purpose is not completely identical to the JTW data. Fundamentally, the JTW data and modeled HBW trip purpose measure different things

even when adjusted for geographic region. The JTW represents a *usual* day (respondents were asked about their usual behavior) while the modeled HBW purpose represents an *average* day. Several methodological concerns have historically dogged the JTW data – such as not accurately capturing all trips (only the primary mode of mixed-mode trips is reported; only the primary work trip is reported, not secondary jobs/moonlighting efforts, nor even the return trip from work to home), poor question asking (resulting in the JTW data's capturing intermediate trips between home and work), and poor response rate. Ultimately, as good a source as it is, and although CTPS considers it useful for calibration and validation, it is not a perfect source. Hence it is not surprising that the HBW transit mode shares of Somerville TAZs do not perfectly match the JTW transit mode shares.

Notwithstanding the above, CTPS has deemed it appropriate to take further analytical measures to reassure the public that its model accurately represents the current high work trip transit shares in Somerville. The results of these analyses are as follows.

When focus is placed on the area's major HBW markets, the model not only matches, but sometimes exceeds, the high transit mode shares found in the JTW data. Presumably, the high level of transit mode shares located primarily in West Somerville is due to the presence of two Red Line rapid transit stations (Davis and Porter). Thus it would be a safe assumption that the other end of a HBW trip from a West Somerville origin would lie somewhere along the Red Line alignment or a single transfer away from the Red Line. Conveniently, the major employment centers of the Boston metropolitan area are located in Boston and Cambridge, which are both served by the Red Line. In addition, the claims of the Advisory Group member and the City of Somerville about historical forecasting inaccuracy appear to be predicated on the Red Line. For both of these reasons, it makes sense to isolate and focus on the HBW markets served by the Red Line to see if CTPS's regional model is adequately representing the transit mode share.

When the model looks at HBW trips that have the residence (origin) end in West Somerville and the workplace (destination) end in either Boston or Cambridge, the transit mode shares of the JTW data (58% or higher) are either matched by or are only slightly higher than the transit mode shares (41%-71%) resulting from the model (Exhibits 3 and 4). If Boston alone is assumed as the other end of trips originating from West Somerville, the JTW transit mode shares are matched (Exhibits 5 and 6).

Addressing Concerns about Future-Year Forecasts

The Advisory Group member raised the concern that past modeling efforts had not adequately forecast the impact of new rapid transit service in Somerville. CTPS takes such concerns about modeling accuracy very seriously and wishes to address the issue by looking at preliminary results from its current modeling efforts. Using again the HBW major-rapid-transit-markets rubric (residence trip end being in a specific Somerville TAZ near the proposed extension and the other in either of the major activity centers, Boston or Cambridge), the introduction of Green Line service to Union Square and College Avenue along existing MBTA commuter rail corridors causes substantial

spikes in daily transit mode shares (Exhibits 7 [2030 No-build] and 8 [2030 Alternative 1]). If Boston alone is assumed as the other end of HBW trips originating in the Green Line Extension study area, transit mode shares rise even more significantly in some TAZs, as shown in Exhibits 9 (2030 No-build) and 10 (2030 Alternative 1). In fact, in both of these cases, the transit mode shares for TAZs in the Green Line Extension study area are predicted to be roughly at the same high levels as the transit mode shares for Somerville TAZs near the Davis and Porter Red Line stations.

Conclusion

The transit mode shares produced by the CTPS forecasting model are not inconsistent with those reported in the U.S. Census JTW data. Furthermore, CTPS forecasts of likely transit ridership levels on the Green Line Extension indicate mode shares approaching those currently observed near Somerville Red Line stations.

BK/SP/bk

Exhibit 1

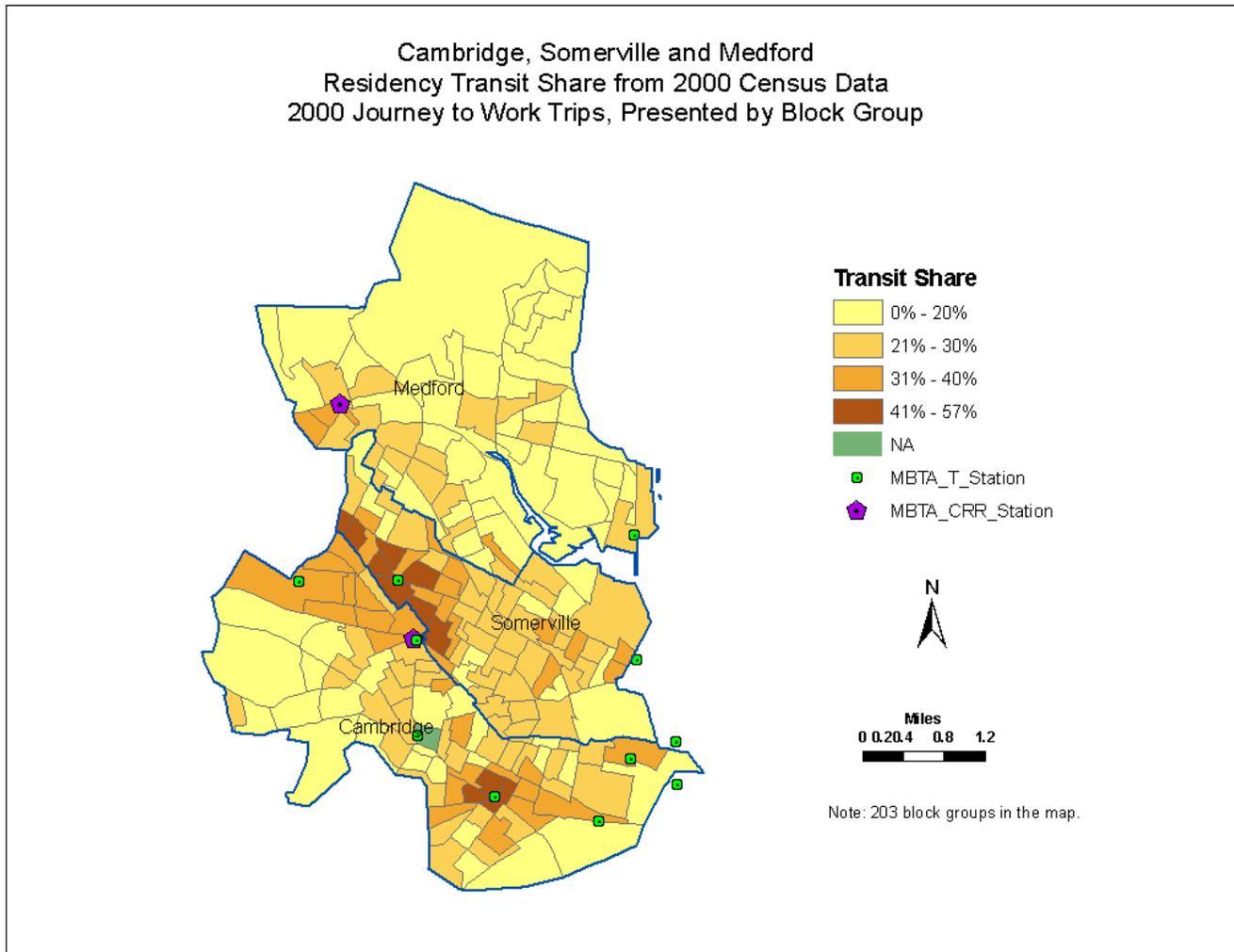


Exhibit 2

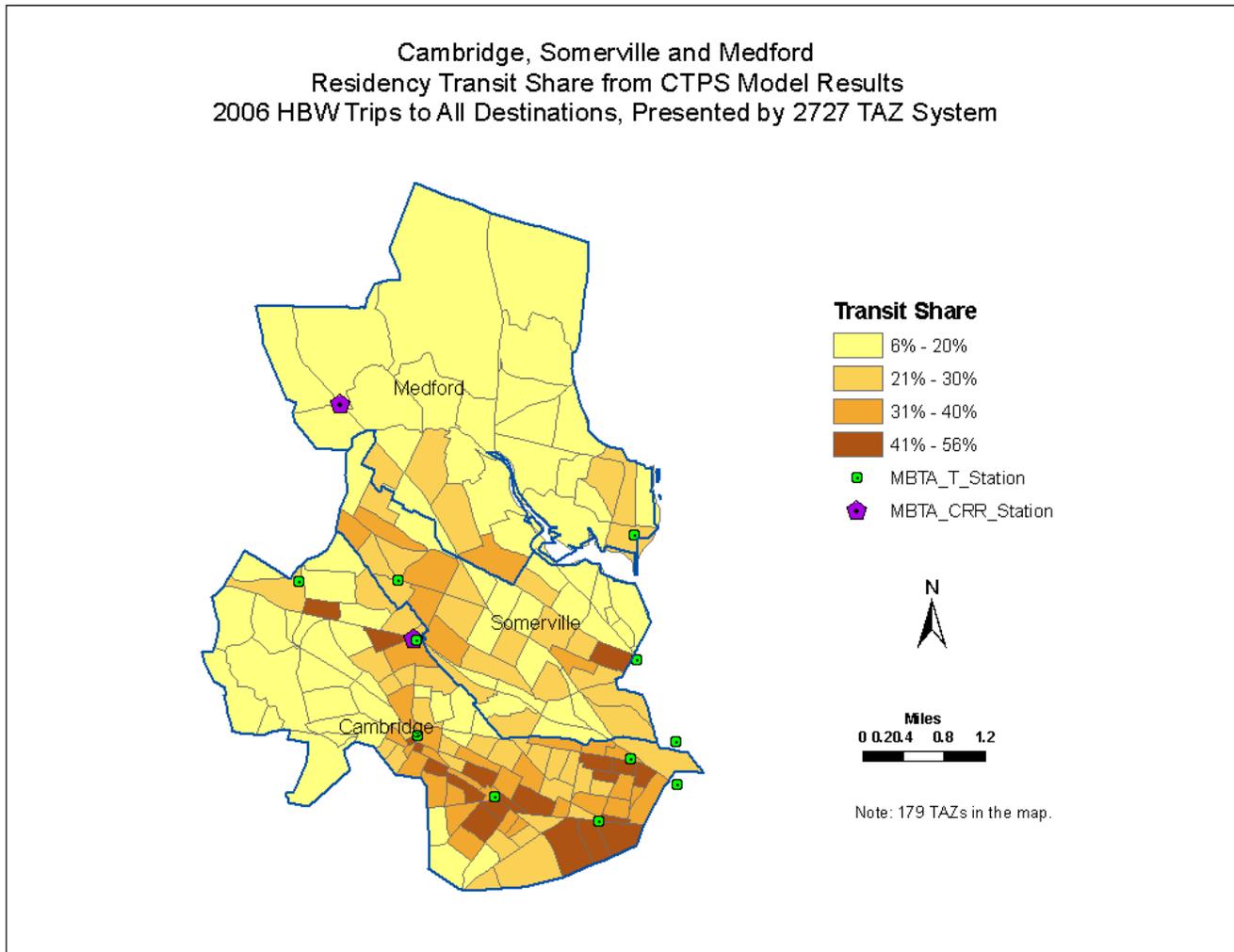


Exhibit 3

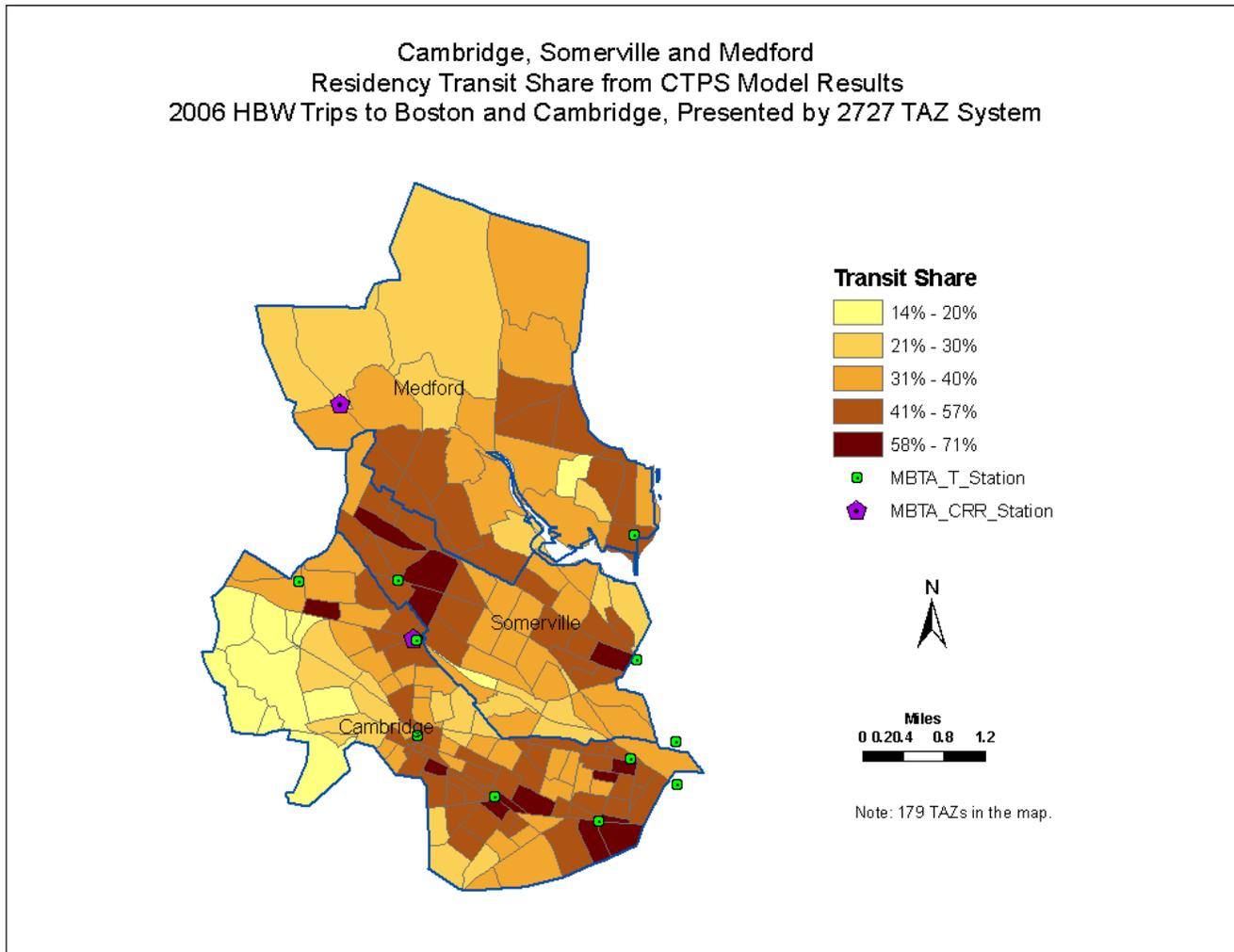


Exhibit 4

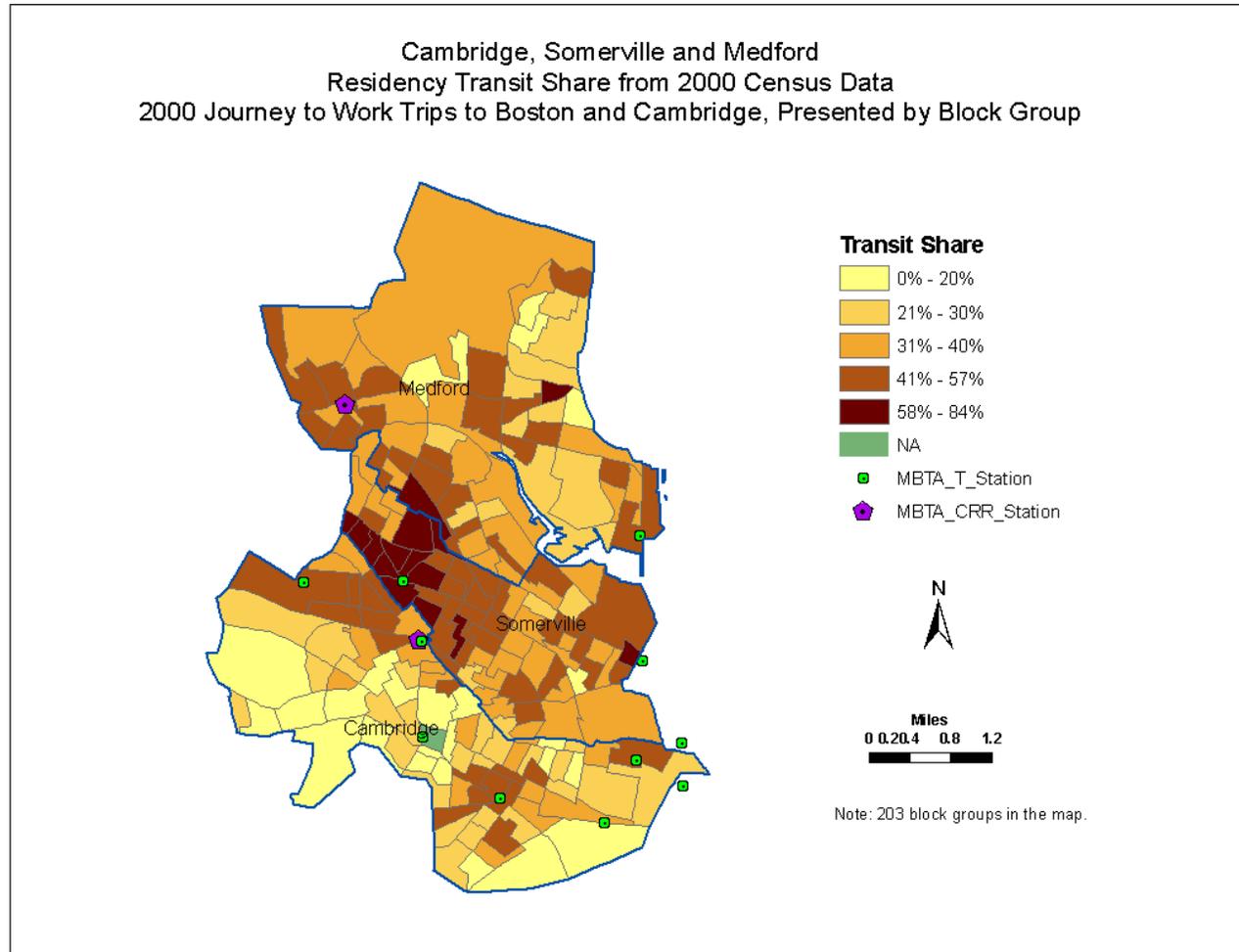


Exhibit 5

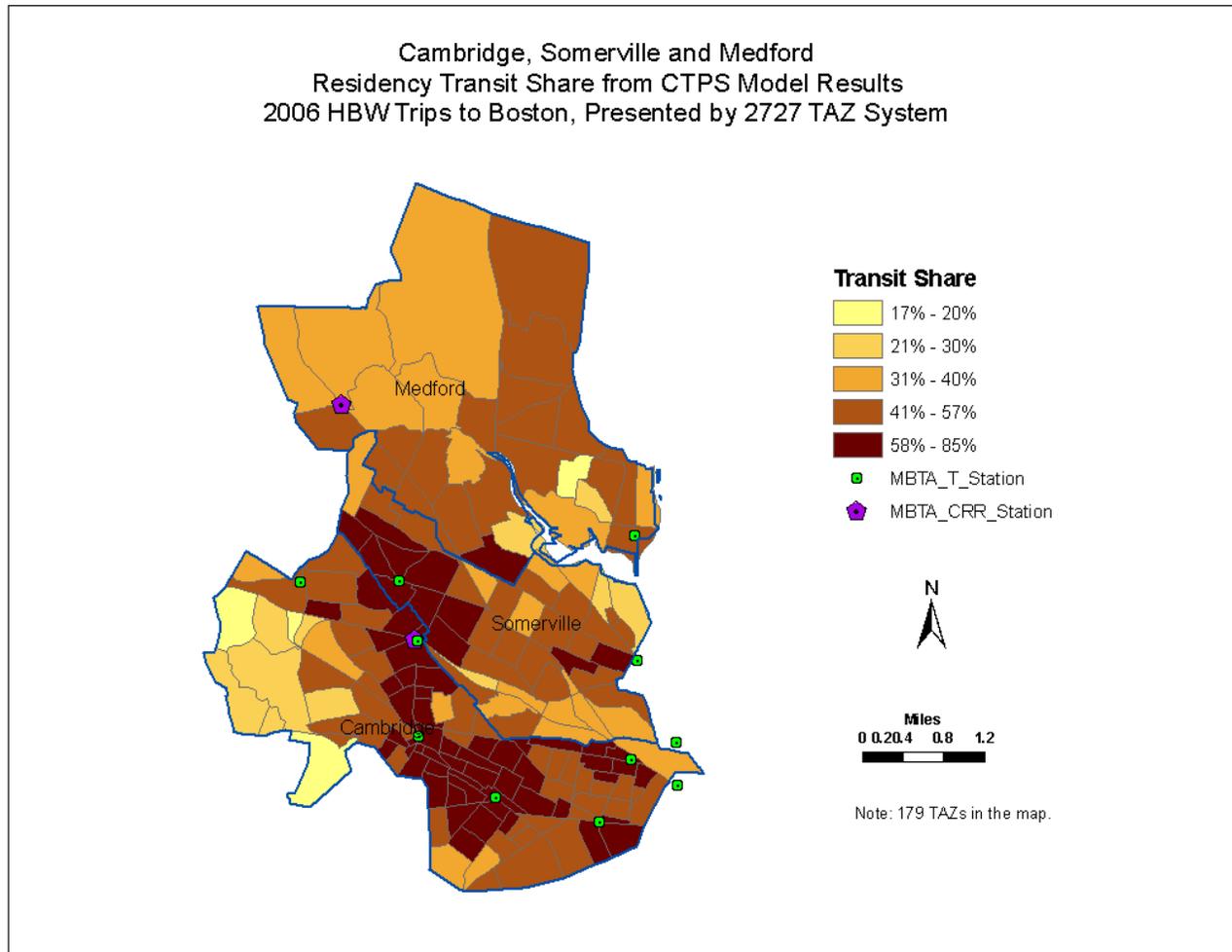


Exhibit 6

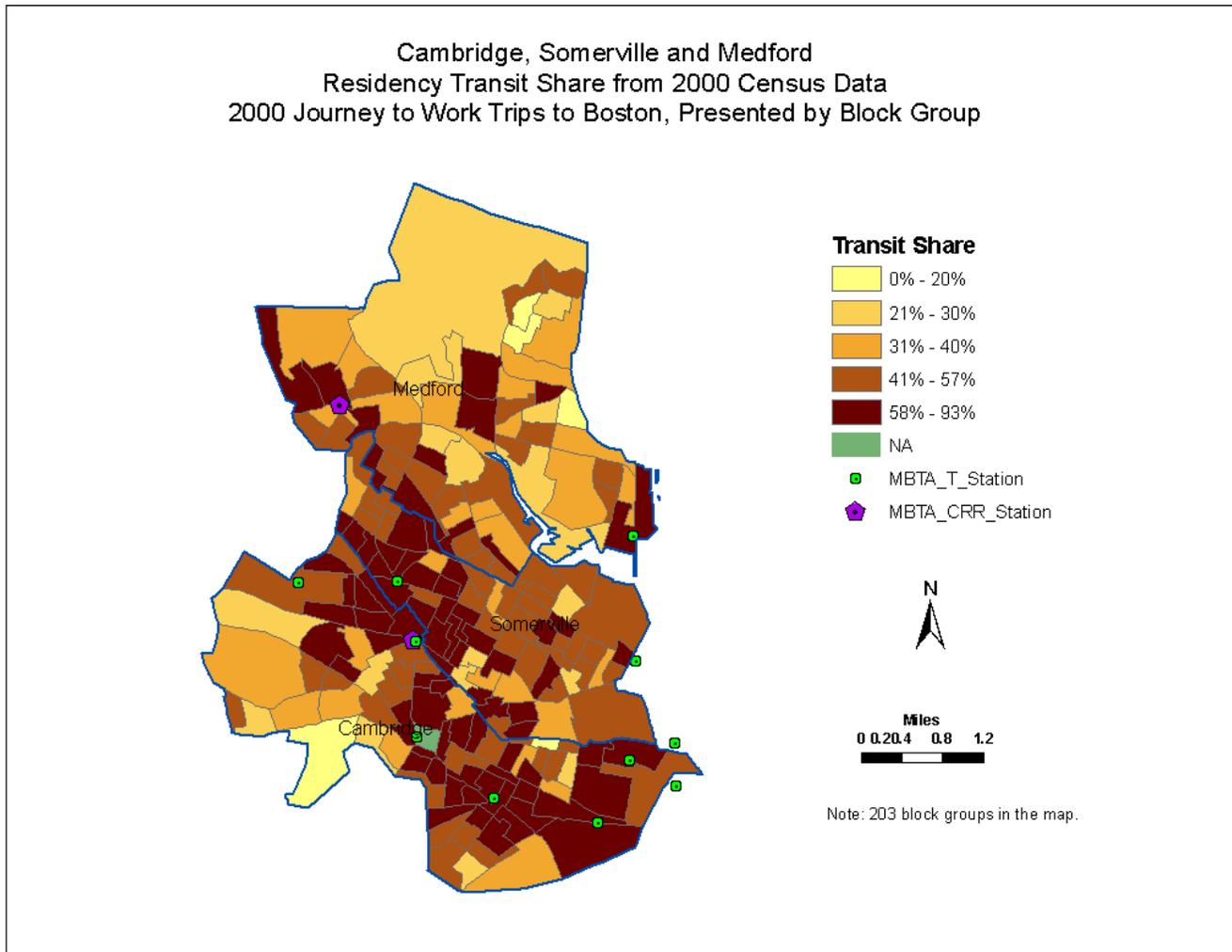


Exhibit 7

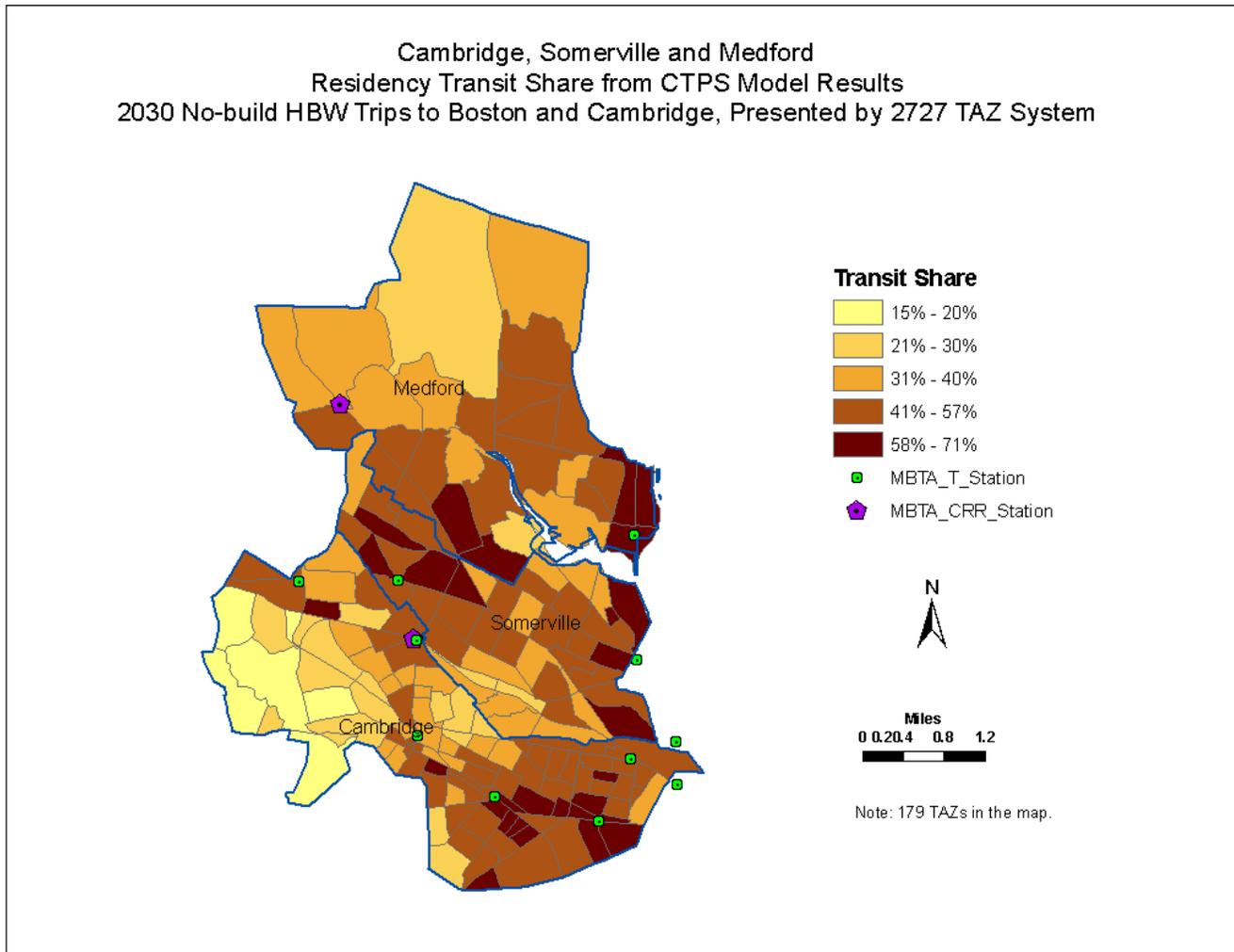


Exhibit 8

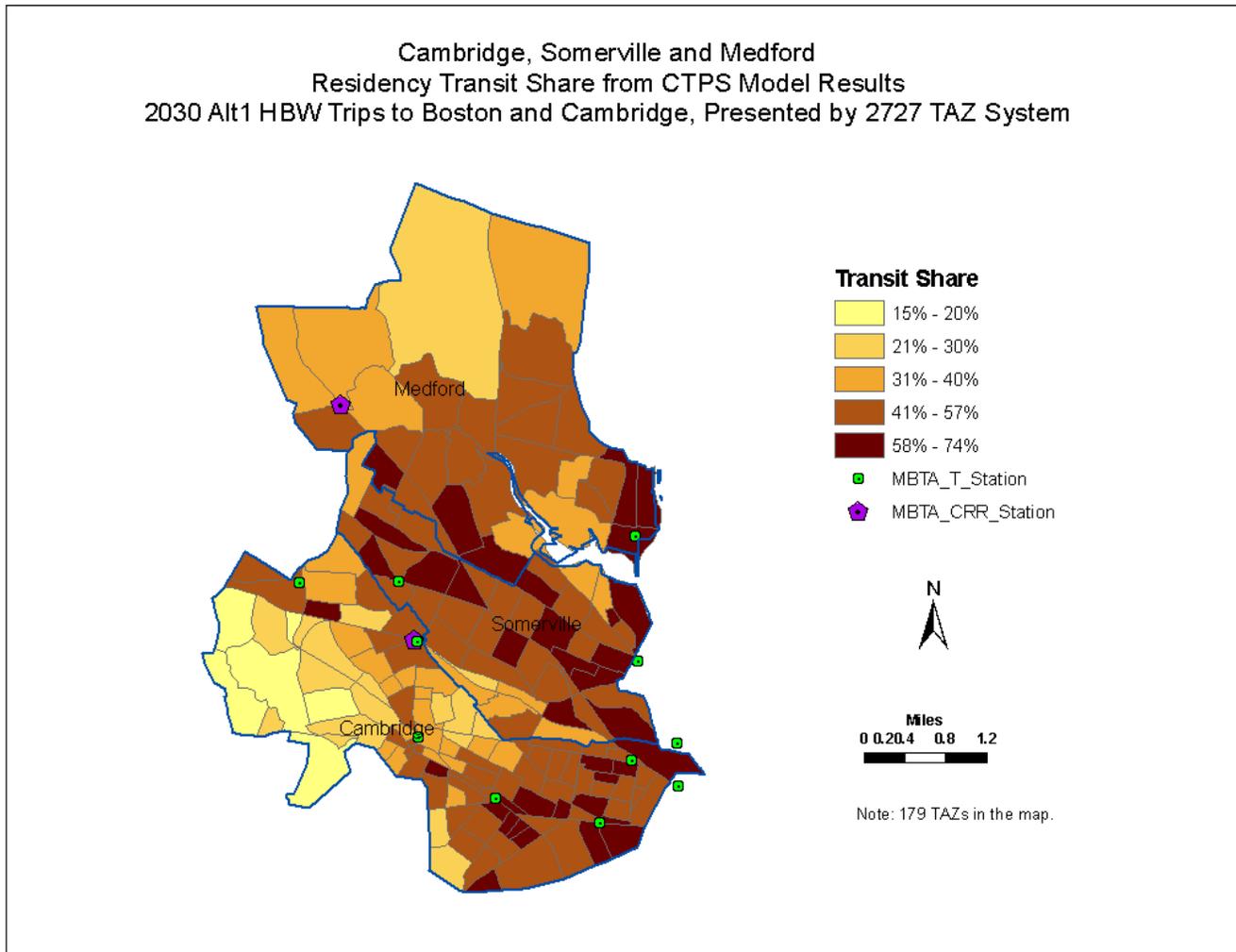


Exhibit 9

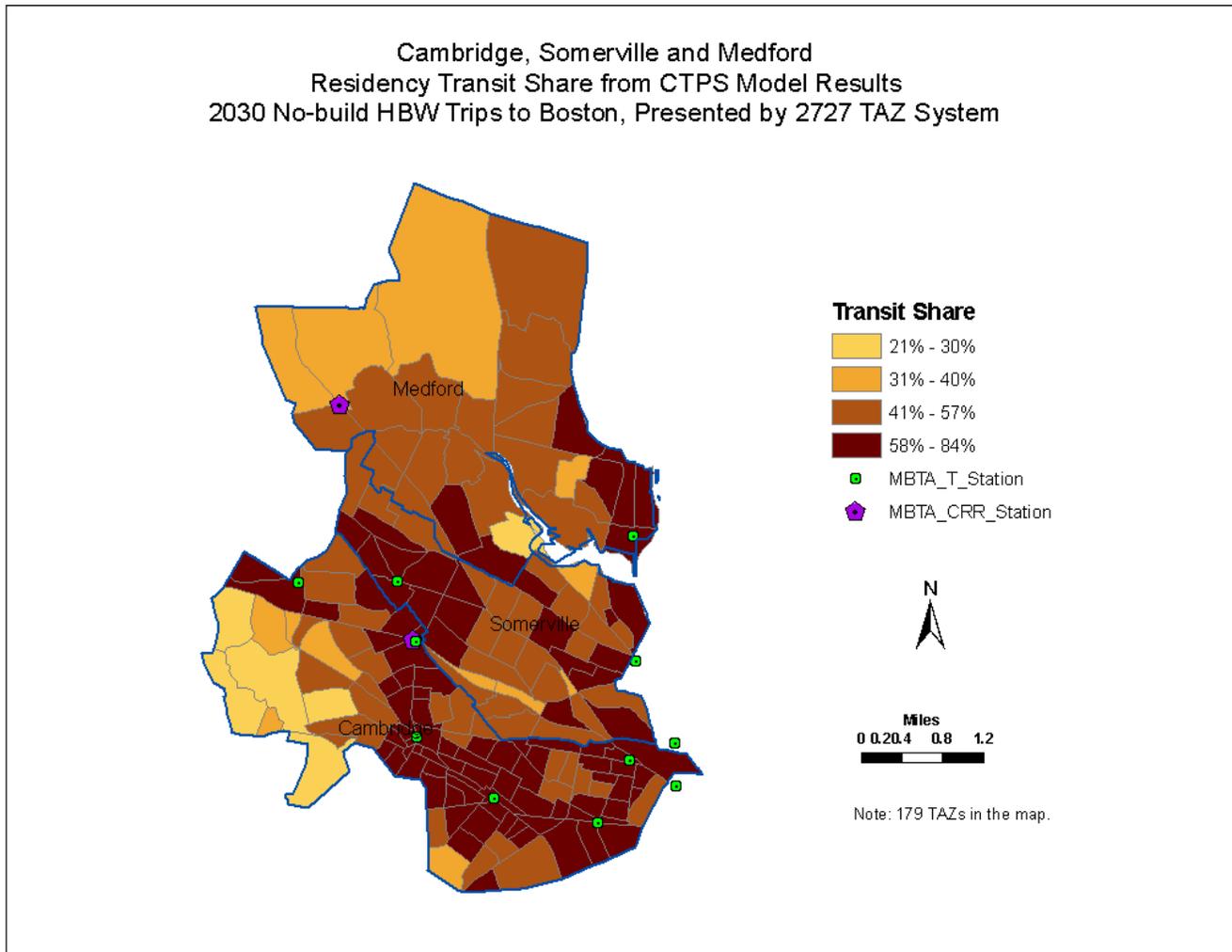


Exhibit 10

