TRANSIT ORIENTED DEVELOPMENT

FOR MEXICO CITY

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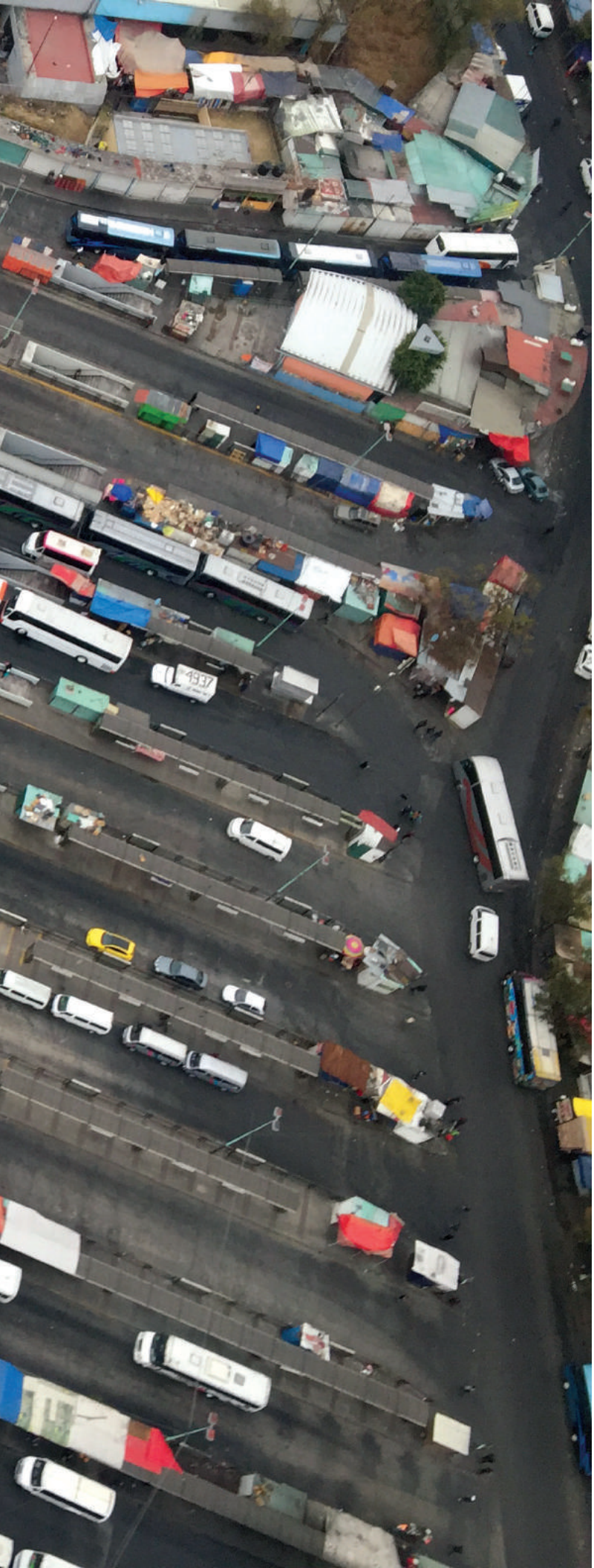

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About This Document

The writers of this document are 17 urban planning students at MIT who, with this document, seek to provide urban practitioners, private developers, and the public sector a means through which TOD can be considered a viable factor in improving the transportation, housing, and urban form issues confronting the modern Mexico City. Through the analysis of four metro stations, El Rosario, Cuatro Caminos, San Joaquin, and Tacubaya, as case studies, we developed a framework that addresses the major concerns and areas for potential improvement at each site. Through the use of extensive research, interviewing, and data analysis our research shows the potential for the implementation of successful plans and policies that will improve the vibrancy of street life above and below ground in Mexico City. We see great potential for successful urban growth and development in this city and we encourage you to engage critically with this document and the arguments posed.

This document is intended for use by urban practitioners, public policy makers, and private developers interested in developing TOD in Mexico City. The executive summary provided above details how, when, and why the project was carried out and by and for whom. The academic body of the document is then comprised of the following four sections:

- Chapter 2: Provides the country context, an overview of transit-oriented development (TOD), Mexico City, and the application of TOD principles to Mexico City
- Chapter 3: Contains our assessment of TOD, developed explicitly in a thematic framework that focuses on accessibility, affordability, design, and governance and implementation and from which comes a preliminary set of typologies for the metro stations.
- Chapter 4: Lists recommendations for implementing successful TOD, based on the analysis of four intensively studied stations – Cuatro Caminos, El Rosario, San Joaquín, and Tacubaya
- Chapter 5: Explains our integrated policy package for TOD

Following these sections, we provide a conclusion with our overall private and public sector recommendations, an appendix with further information, and a guide to the sources we consulted in organizing and executing this research. We hope this research provides a legible way to contribute to the development of equitable and accessible TOD across the Mexico City metropolitan region.

Acknowledgements

We are grateful to Group PRODI for choosing us to pursue this research project and for hosting us during our trips to Mexico City. We wish to thank in particular, José Miguel, Florencia Serranía, and Xavier Gómez Daza for their countless hours of support and guidance throughout the course of this project.

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Most importantly, we wish to thank the people of Mexico City, who inspired us to reimagine new possibilities for high quality, affordable, transit-oriented neighborhoods and the systems that integrate them.

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Why TOD is a Viable and Necessary Policy for Mexico City

WHAT IS TOD?

Transit-oriented development (TOD) is an urban development strategy that takes advantage of transit-served areas to support car-free travel, prioritize pedestrian and non-motorized mobility, and improve features of the neighborhood (EMBARQ, 2014). In particular, ideal TOD creates a multidimensional place, complete with "live, work, shop, and relax" options (Jacobson et al., 2008, p. 54).

Our ideal version of transit-oriented development (TOD) takes advantage of transit-served areas to support:

- Non-motorized travel and walkability
- Affordable neighborhood development
- Dense housing development close to transit stops
- Accessible public space
- A streetscape that promotes an active, diverse, and inclusive urban form

To tailor this definition to the Mexico City context, we developed our own framework for evaluating TOD and criteria for achieving "ideal" TOD. This framework, to be introduced in Section 3, relies heavily on existing TOD literature while also incorporating our knowledge of Mexico City-specific concerns.

WHY USE TOD?

There are numerous expected benefits of TOD. These benefits range from enhanced social capital, to overall healthier lifestyles for residents, to possible mode shifts, to greater property values, to environmental friendliness, to agglomeration economies, to lessened congestion, and also to cheaper commutes (Noland et al., 2014).

EXISTING EXAMPLES

Some global examples of successful TOD include:

- Copenhagen's "Finger Plan" – Uses rail lines to support radial development, extending outward from the city center (Suzuki et al., 2012, p. 4)
- Singapore's "Constellation Plan" – Creates a network of towns around the city center with "ring"-like connections (Suzuki et al., 2012, p. 5)
- Rosslyn, Virginia's Rosslyn Sector Plan – Revitalized the town of Rosslyn during the 1970s with incentive zoning (Jacobson et al., 2008 p. 62)
- Curitiba, Brazil BRT – Increased transit use and development potential by adding BRT (Rodriguez and Vergel, 2013)

Existing transit station and surrounding neighborhood conditions in Mexico City

WHY MEXICO CITY?

Urban Context + Development

Mexico City is a sprawling metropolis that spreads across two distinct yet interconnected federally recognized areas: the State of Mexico and the formerly named Federal District, which has recently been recognized as a federal state under the name Mexico City. The two geographically connected urbanized areas, commonly referred to together at the Zona Metropolitana del Valle de Mexico (ZMVM), the Valley of Mexico Metropolitan Area, combined contain a population of over 20 million people, many of whom travel by public transportation daily to reach jobs in the central economic districts of the city. The average daily commute time is about an hour and a half for residents. Low-density urban sprawl in the far suburbs has contributed to extensive car usage and growing traffic congestion has added to already high levels of pollution. Meanwhile, most subway lines are at or nearing capacity, increasing fears associated with ageing infrastructure and congested wagons. These factors highlight just a bit of the reasons for why Mexico City could benefit from extensive TOD that prioritizes non-motorized transit and affordable, dense housing development.

Existing Transportation Infrastructure

The metropolitan region is home to twelve subway lines (officially the Sistema de Transporte Colectivo (STC)), one light rail, one suburban rail, five BRT lines (MetroBus) within Mexico City and three BRT lines (MexiBus) in the State of Mexico, and hundreds of smaller microbus lines that traverse the city. Mexico City also has a large bike-sharing program (EcoBici) that is of yet just available in most of the central areas of the city. According to the STC, this year, January to March 2016, the STC has already seen 391 million rides, on track to reach over 1.5 billion by the end of the year. Of the 195 STC metro stations, 47 are considered Centros de Transferencia Modal (CETRAMs), or Intermodal Transfer Stations, of which 37 are terminal stations. As transfer hubs, these stations bustle with economic activity inside and outside of the station as pedestrians compete with car and freight traffic, street vendors, and microbuses for space.

Room for Improvement

While the transportation system is extensive, our research highlights the need for further development at transport sites to:

- Provide new and maintain existing affordable housing
- Encourage vibrant street life through better vendor design and attractive commercial space
- Construct consolidated bus stations, especially at the CETRAMs
- Redesign street and pedestrian networks to improve accessibility

APPLYING TOD PRINCIPLES TO MEXICO CITY

Although there are some successful examples of TOD in existence, there is certainly room to improve implementation. Mexico City, with its complex governance structure, large metropolitan area, and active informal sector, presents unique challenges to this model. A successful application of a TOD framework to Mexico City requires a greater focus on affordability and the informal sector than current literature provides.

Our proposed TOD framework builds out these aspects of successful implementation. In order to apply this framework to Mexico City cases, we parse rapid transit stations in the city into then typologies, detailed in Section 3. We have selected four metro stations in the Mexico City system to serve as case studies for these typologies, and apply the framework analysis to these locations.

Our selected stations, which will be discussed at length in Section 3, are El Rosario, San Joaquin, Tacubaya, and Cuatro Caminos. Each of these stations represents the complexity of TOD in Mexico City, including jurisdictional issues, public-private coordination, and a mix of different land uses around the sites. El Rosario is a CETRAM on the border with the State of Mexico, providing many transfers for commuters. San Joaquin is a neighborhood station in an area of the city currently experiencing a great deal of private investment and development. Tacubaya is a CETRAM and a neighborhood station in a dense well-connected area of the city. Cuatro Caminos is a CETRAM just over the border in the State of Mexico and heavily trafficked by commuters. Our framework, which expands on the affordability and informality aspects of existing literature, guides our analysis of these sites.

Layers of transportation infrastructure weave through the MXCD landscape

2 | WHY MEXICO CITY NEEDS A TOD POLICY

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Reversing Trends and Improving Quality of Life

DISORGANIZED GROWTH

Although growth rates have somewhat decreased recently, the population of ZMVM has grown exponentially in the last few decades. The population increase has been accompanied by an even faster territorial expansion. While the number of inhabitants in the municipalities that comprise ZMVM increased 1.6 times between 1980 and 2010, its area expanded 3.6 times in the same period of time (ONU-Habitat). This has not only reduced the mean density of the city, but has contributed to the aggravation of problems related to urban sprawl, such as bad air quality, increase of traffic, long commuting times, poor public transit options, social and economic spatial segregation, less housing options for the poorest populations, high public expenses to provide services, among others.

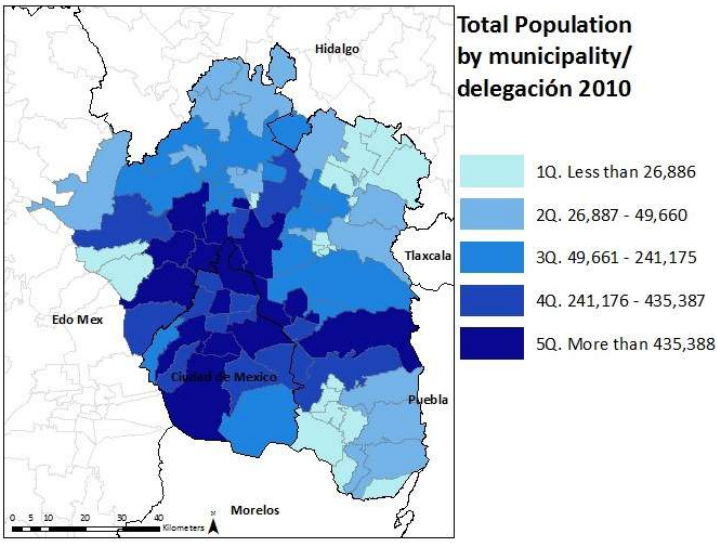
The image below shows the total population and population densities of municipalities and boroughs (delegaciones) of ZMVM. In terms of total population, the image shows that urban sprawl has made at least six municipalities in the State of Mexico part of the fifth quintile. In fact, three of the five most populated subdivisions of the ZMVM are in the State of Mexico, rather than in Mexico City itself. These are Ecatepec, Nezahualcóyotl and Naucalpan, where nearly four million people live within their borders. Additionally, although boroughs within Mexico City remain, on average, denser than municipalities of the State of Mexico and Hidalgo, many municipalities located as far as 50km away from the city center have densities larger than 1,000 people per square kilometer.

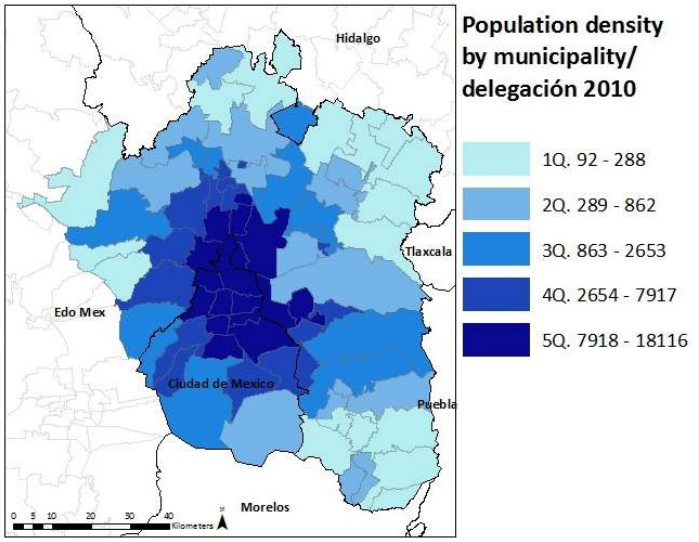
More concerning than the current population distribution are population growth indices. The map above displays annual population growth rates per municipality in the ZMVM. Whereas almost half of the boroughs of Mexico City are decreasing in terms of population, a belt of municipalities located about 40km away from downtown area have population growth rates above 2.5% per year. In 2010, the average population growth rate for Mexico City was -0.2% and that of the municipalities of the State of Mexico in the ZMVM was 1.8%.

If no measures are taken to prevent disorganized and unrestricted urban sprawl, the population share of the municipalities in the State of Mexico will increase from 56% to 63% of the inhabitants of ZMVM, whereas that of Mexico City

Mexico City's growth is largely unsupported by transit infrastructure

FIGURE 2-1 Total Populations and Population Densities for ZMVM Delegaciones





will decrease from 43.5% to 36%. This is a major challenge for the public sector, especially if we consider that the transit needs of these areas are mainly served by privately operated minibuses and vans, and by the fact that Mexico City has much higher tax revenue collection and production rates that make it more feasible to improve public services. The image could result surprising to anyone familiar with Mexico City, given the number of new developments and high-rise buildings in the city core area during the last years, yet this indicates that housing is becoming more expensive in Mexico City, and those who cannot afford it need to move to the suburbs. The section titled Affordability in this document will show how housing in Mexico City is unaffordable for a big portion of the population and our strategies for improvement.

In addition to housing affordability issues, a history of local and federal housing policies has produced incentives for developers to build large communities in the outskirts of the ZMVM. For instance, the mortgages offered by the federal institute for worker's housing, INFONAVIT, fall below a threshold of housing price in Mexico City, making it almost impossible for units in the jurisdiction to receive funds from this institution. On the other hand, lower land value in the suburban areas has allowed developers to build and sell units using incentives from INFONAVIT and the housing institute, INVI.

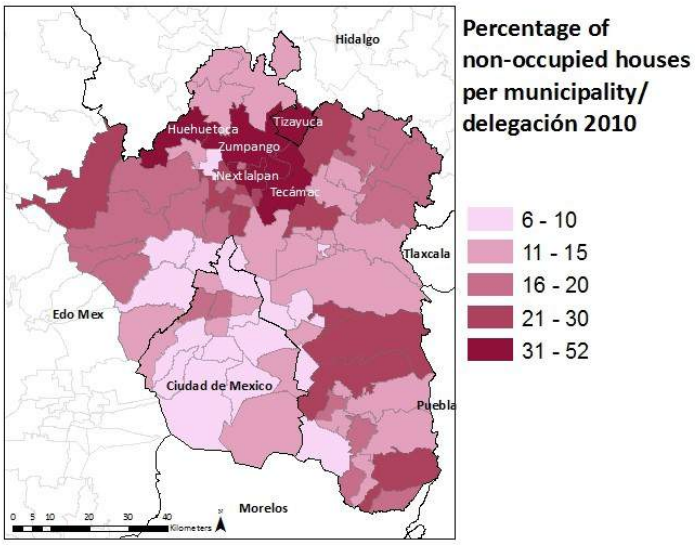
Although these policies have made it possible for lower income families to acquire a house, they have also exponentially increased the size of the metropolitan area, increasing the costs associated with urban sprawl, both for private individuals and the public sector. Car-ownership has increased rapidly and, by 2010, 43% of households in the ZMVM owned at least one motorized vehicle. The proportion of car-owning households is slightly higher in the municipalities of the State of Mexico and Hidalgo compared to the delegaciones of Mexico City, which is logic due to the lack of availability of formal transit options in areas that are mostly served by vans and minibuses. The large amount of cars in the ZMVM has increased traffic, commuting times, air pollution and an overall lower quality of life for its inhabitants, and makes it imperative to improve the supply and quality of transit options.

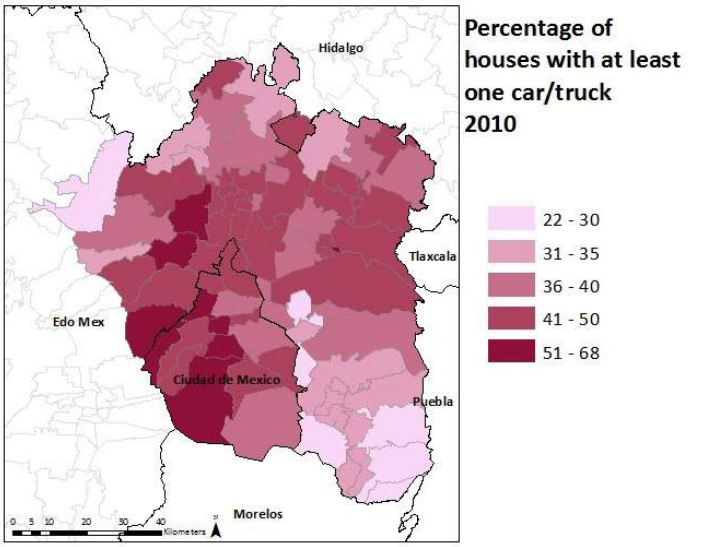
RELATED PROBLEMS

In addition to urban sprawl, the aforementioned policies have contributed to the rise of a problem of abandoned housing and its related consequences. The following maps show a belt of municipalities in the north of ZMVM where more than 30% of the housing stock is not occupied. While 11% of housing units are not inhabited in Mexico City, the proportion increases to 16% in the ZMVM municipalities in the State of Mexico and to 47% in Hidalgo, another neighboring state in the urbanized region. The most extreme cases are the municipalities of Huehuetoca and Zumpango in the State of Mexico, and Tizayuca in Hidalgo, where close to 50% of units are uninhabited. We can also notice that these municipalities usually coincide with areas that are experiencing very high population growth rates. While this correlation is clear, its causality could go both ways. Growth rates may be driving more developers in the area to capture the forecasted demand. However, it may also be the case that the costs associated with the distance of these developments from major work centers, urban amenities and service providers, as well as from efficient transit options deters families from moving into these new developments. Whichever the reason, the need for affordable, denser housing closer to the city center and/or the development of business districts closer to housing is necessary.

Newer development around metro stations lacks transit-oriented design and programming

FIGURE 2-2 Housing Occupation and Vehicle Ownership Rates for ZMVM Delegaciones





A TOD-BASED POLICY

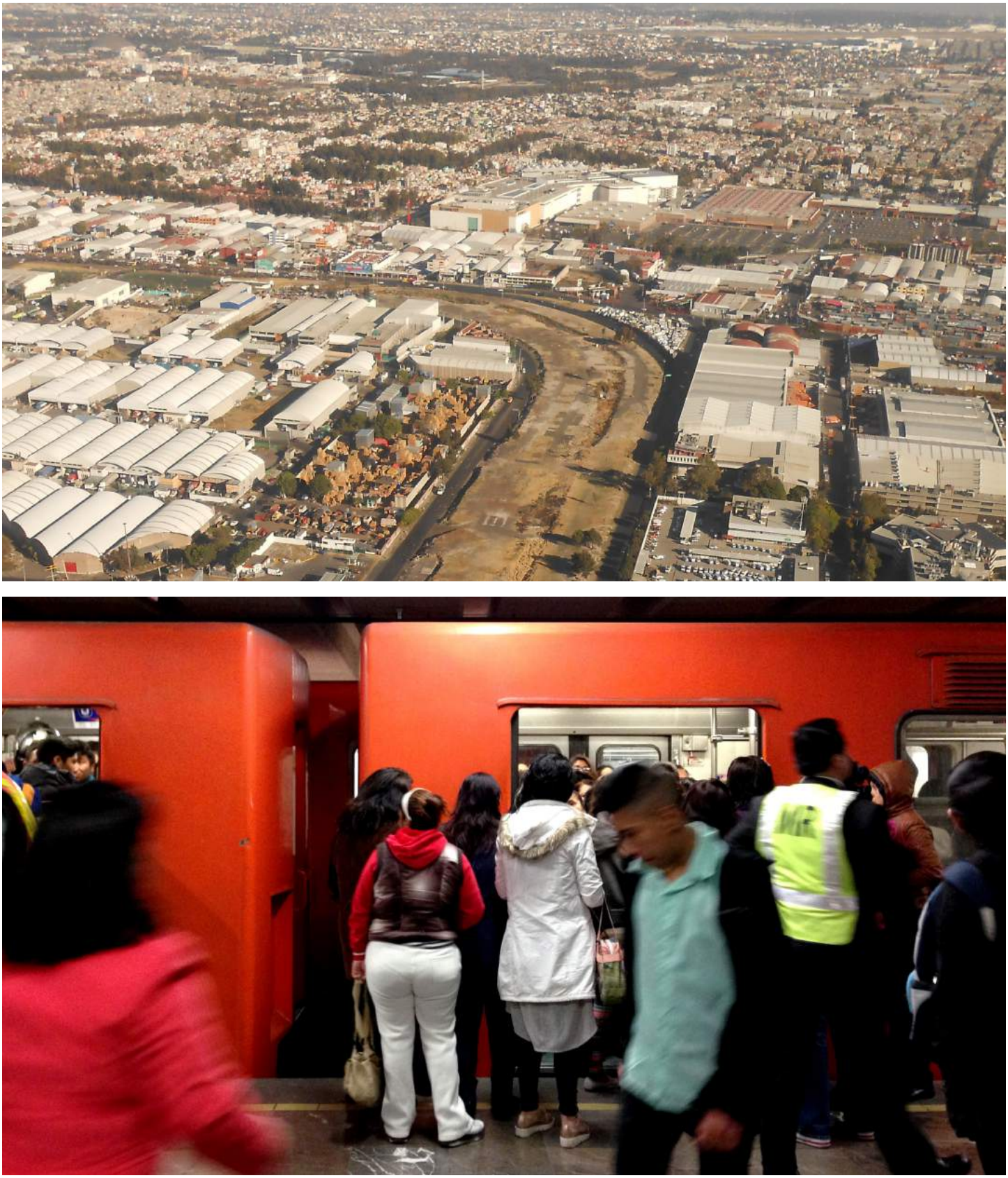
These facts demonstrate the need of a citywide policy that aims to prevent disorganized urban sprawl as a means to improve the quality of life of the residents and the economic competitiveness of ZMVM, as well as decreasing its ecological footprint. Our proposal is to create a mechanism that provides incentives for the private sector to develop market-value and affordable housing units around transit stations in ZMVM, taking into consideration the rights of current inhabitants and businesses, public sector capacity, transparency and accountability issues, implementation feasibility, and economic and demographic trends. Transit oriented development can contribute to the densification, diversification and economic improvement of zones that are well connected to other areas of the city.

This proposed policy aims to contribute reversing current expansive trends and the problems associated to them. The table below summarizes the last census and the projected 2030 populations for ZMVM as well as our projection of the population distribution for optimist and neutral scenarios. The metropolitan population is expected to grow at an average rate of 0.8% per year until 2030; the areas within Mexico City will decrease their population by 0.3% while municipalities in the State of Mexico will grow at a 1.4% rate. In the optimist scenario of creating 500 additional units per Metro station, 82,750 new units could be developed around transit. Assuming the population of the ZMVM as a whole increases at the same rate, this would result in an additional 282,575 people living in TOD polygons surrounding metro stations, instead of living in possibly unconnected areas. Of those, 93% would be living within the limits of Mexico City. In a pessimist scenario, with an average of 250 new housing units per station, TOD polygons would still attract 130,763 additional inhabitants to Mexico City. Although in the aggregate this accounts for less than 1% of the population of the ZMVM, this number could contribute to other policies and trends to stop urban sprawl.

The following sections describe our proposed policy in depth. In general, it recognizes that areas close to transit deserve a special treatment to attract developers and families. Special treatments have been implemented in Mexico City. Examples are relaxed zoning and land use regulations and fast track instruments. The policy is incremental and starts with a pilot managed by one borough, but is expected to evolve first into a Metro line-based area and later as a Metro network-based zone, managed by the Secretary of Urban and Housing Development, SEDUVI, and the borough.

TABLE 2-1 Projected Population Distributions Under Varying TOD Policy Conditions

	Last Census		No Policy		TOD Policy Scenario 1 (+500 units per station)		TOD Policy Scenario 2 (+250 units per station)	
	Pop. 2010	*%*	*Pop. 2030*	*%*	*Pop. 2030*	*%*	*Pop. 2030*	*%*
ZMVM	20,501,764	---	23,247,131	---	23,247,131	---	23,247,131	---
CDMX	8,944,599	43.6	8,439,786	36.3	8,678,150	37.3	8,558,968	36.8
HIDALGO	98,339	0.5	158,151	0.7	153,519	0.7	155,835	0.7
EDOMEX	11,458,826	55.9	14,649,194	63.0	14,415,463	62.0	14,532,328	62.5



A city-wide TOD policy would guide future development on sites around transit stations towards more affordable, accessible, and human-oriented outcomes

3 | ASSESSMENT OF TOD IN MEXICO CITY

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Themes and Typologies Developed for TOD Measurement

The following chapter details the thematic framework and methods through that we used to assess TOD in Mexico City. For the framework, we chose the four thematic areas of accessibility, design, affordability and informality, discussed below, to quantitatively and qualitatively evaluate the concerns at the selected sites of El Rosario, San Joaquin, Tacubaya, and Cuatro Caminos.

Within the thematic areas of the framework, we formulated a total of 44 elements that we deemed essential for good TOD as developed from our literature review and on-the-ground context evaluation. The framework is used to specifically assess the TOD potential around the four selected sites. An additional section contains our assessment of legal barriers to TOD in which we evaluate the components necessary for implementing successful citywide policies to drive TOD. Taken together, both the framework and barriers to TOD implementation are intended for further development of site-specific as well as citywide interventions.

It is important to emphasize that our assessment was executed for both the stations and their surrounding areas (a walkshed, or how far a person can actually walk given the constraints of the street network, of about 800 meters following the existing street network), as these represent the zones with the highest potential for TOD. The selection of the stations took into consideration their potential to represent different typologies of stations of the Mexico City metro system, their potential for TOD in the short, medium, and long terms, and their relatively similar region in the metro system.

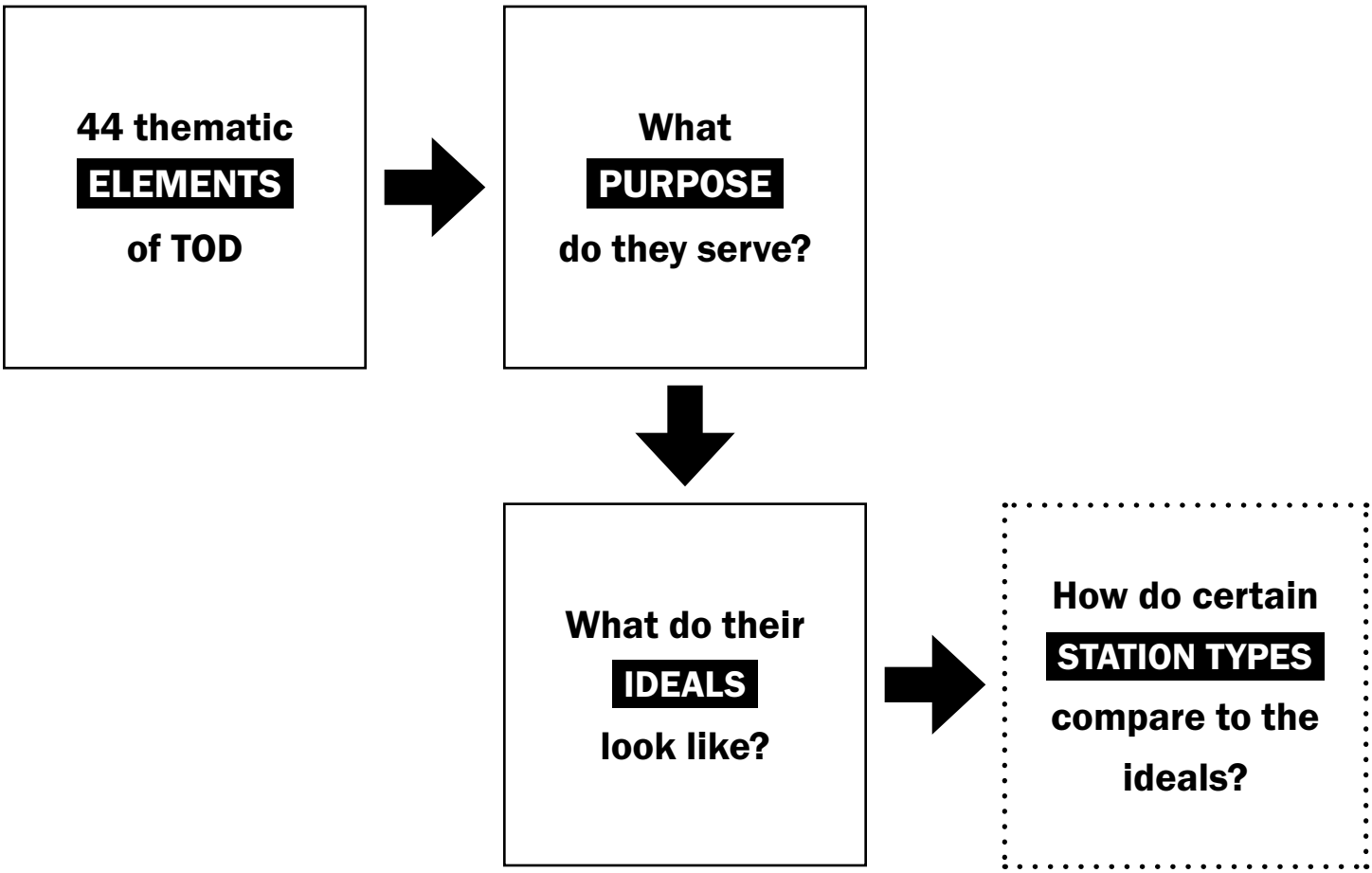
To generalize these assessments for Mexico City, we developed a set of typologies for the metro stations with a two-stage clustering process. This process allows us to group similar stations based on two sets of features. The first stage relies on a station's system characteristics (whether it is a CETRAM and/or terminus, and whether it has a depot) and the second stage relies on a station's socioeconomic characteristics (line ridership, walkshed ratio, and average sale price of nearby homes). We established ten typologies, and our four selected sites represent three different typologies.

Fencing and landscape barriers at the El Rosario CETRAM

FRAMEWORK

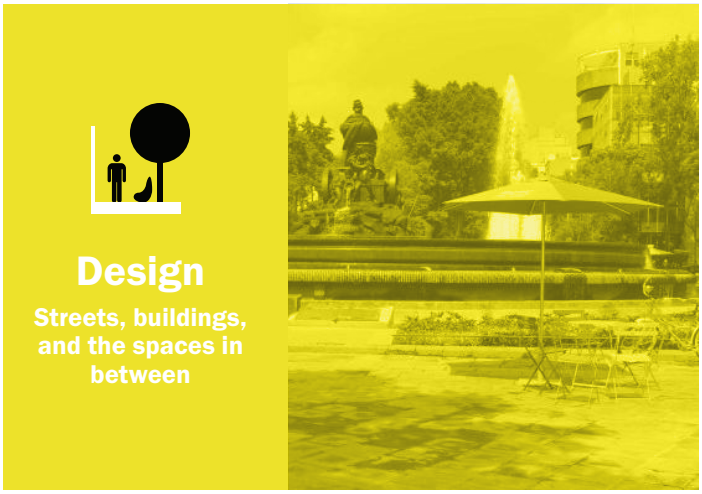
The current literature on TOD typically constructs a set of criteria to assess TOD quality. Many of these frameworks were sophisticated, but none fully addressed TOD as it applies to Mexico City, sufficiently addressed affordability, or incorporated the informal sector, specifically street vendors. We identified common themes in the existing literature and used the existing definitions of these TOD characteristics as the basis of our own definitions. These definitions create the structure of the framework. We then selected metrics—whether quantitative or qualitative—to measure the success of each characteristic for a TOD installation. Applying this framework to a site allows us to rate the success or potential for success at each station.

FIGURE 3-1 Overview of Process Behind Framework



THEMES

The framework below is divided into the four high-level themes that are used throughout this document: Accessibility, Design/Urban Form, Affordability, and Informality. Each theme is broken down into its characteristic elements and we describe desirable condition for each element. In applying this framework to a location, each element should be considered with respect to the site. We used the following scale to apply this framework to sites: 3 = Very Good, 2 = Good, 1 = Poor, 0 = Very Poor. Although many of these elements are defined in quantitative terms, these are also ultimately ranked according to this qualitative measure. When applied, the profile of rankings for each theme area helps to define the success of TOD (or potential for TOD) at each site.



Accessibility

Accessibility is the ability to reach goods, services, friends, and places. It is fundamentally important to TOD. By coordinating transportation and land use to develop neighborhoods around transit stations, ideal TOD allows for the maximization of accessibility on alternative modes of transportation, such as public transportation, biking, or walking, so people can have a high quality of life without the need for an automobile. It is about neighborhood and metropolitan levels of connectivity.

At a neighborhood level, accessibility is not just the ability to get from point A to point B, but rather providing a range of jobs, housing, commerce, and services that may allow a resident to satisfy many of their needs close to home. Thus, ideal TOD needs to consider both the quality and availability of transit service, as well as the streetscape design and neighborhood fabric that enables all users to feel comfortable on streets, whether walking, biking or using transit. We analyzed this by looking at the walkshed, which is the area that we can cover within a ten-minute walk from the station. We calculated this for our four sites, and eventually for all the station in the system.

At a metropolitan level, TOD allows residents to reach economic, cultural, recreational center by public transportation. While Mexico City has a large and diverse transit ecosystem, land use planning in Mexico City has failed to capitalize on that infrastructure, leading to continued sprawl at the urban fringe and underutilized transit in some sectors of the city itself. Many neighborhoods that are well served by transit lack pedestrian connectivity, local jobs, and affordable housing. Consequently, many residents of ZMVM are transferring between multiple modes to reach their job or other daily needs during their long commutes (EOD, 2007).

As we look to evaluate the quality of TOD, we have to consider not only how a neighborhood is situated within and connected to the broader transit system, but also the quality of local connectivity within that neighborhood itself. In a similar procedure to the walkshed described above, we analyzed metropolitan-level accessibility by looking at the number of jobs and opportunities that could be reached on transit from each station within a given travel time. For this, we relied on openly available transit network data.

Design

An ideal TOD must consider the quality of the built environment as perceived by its users. Design goes beyond aesthetics and includes guidelines that ease walkability, define mobility hierarchy with the pedestrian on the top, and even determines how private interests must be aligned in order to create the desired diverse and comfortable environment. As such, design is not only concerned with the attractiveness of the streetscape, but also how the coordination between transportation and land uses creates a high performing and legible environment.

Design parameters in a TOD environment comprise three key areas:

- Public Realm: this includes neighborhood connectivity, streets location, block sizes and scale, streetscape, legibility, wayfinding and urban comfort. The design parameters aim for good quality, well-connected streets forming city blocks that, instead of being barriers, promote the walkable conditions. Pedestrian and biking infrastructure and freight access design all have to be designed to work together in order to shape a coherent public space.
- Private Realm: streets not only depend on the physical design and quality of their own realm, but also on the conditions set by the private properties along them. Design guidelines for private properties include active and engaging ground floors and a diversity of uses.
- Station Legibility: a TOD neighborhood with a specific focus on transit should signify a sense of arrival to a place based on the design elements of the station. Access points, especially transit stations, must have in some extent a landmark status along with public space surrounding it in order to create neighborhood identity.

Affordability

A complete plan for implementing TOD in Mexico City must consider the existing pattern of segregation and geographic disparities in the city and broader metropolitan area. The relatively stable population of the city proper, coupled with the continual expansion of the ZMVM, has resulted in a sprawling and fragmented region. As we've mentioned above, those unable to afford rising costs in the city, a large segment of the population, have been priced out to the neighboring State of Mexico, where developers—enabled in large part by INFONAVIT mortgage loans—have built massive housing subdivisions for low and moderate-income families employed in the formal sector. This concentration of affordable housing at the periphery has situated working families further from central sites of employment and services, thereby impacting their social mobility and economic opportunity, increasing pressures in transport, and promoting car ownership in a city already plagued with traffic congestion and chronic air pollution.

A TOD framework that values equity and incorporates affordable housing thus provides a critical opportunity to address a range of needs in Mexico City's segregated and fragmented urban structure. Dense, urban affordable housing development lessens the pressure on the continued sprawl by encouraging urban affordability options, including rental units, close to public transit and at higher densities. Furthermore, it offers working class families better access to the job market and critical services located in the city. In doing so, TOD with affordable housing also helps to reduce the existing income disparity between the city center and peripheral areas and creates viable mixed-income communities near transportation nodes. The diversity created in turn helps to sustain a variety of local businesses, employment, and services. In sum, affordable TOD presents an important tool to balance the city's equity goals and development needs with the return on investment for private investors.

Informality

When considering TOD in Mexico City, street vending is of unique importance given its presence as an economic activity closely tied to transit stations. Informal vendors rely on the significant amounts of foot traffic that pass through CETRAMs and metro stations to supply their business needs. As a result, informal markets emerge on the sidewalks, streets, waiting platforms, and other spaces around the transit stations. Vendors construct semi-permanent stalls made from sheet metal, tarps, or sometimes just a blanket laid out on the ground. While their stalls may appear makeshift and temporary, many of the vendors have been there for decades, some since the metro opened 40 years ago. However, because they are located in public space or on publicly owned land without a title, they don't have legal protection to occupy that space. Instead they rely on vending "associations" with politically connected leaders that provide protection for them. The result is a system with uneven protection for vendors, where they are at rWisk of being forcefully removed at the loss of their business and assets.

A complete TOD policy in Mexico City must include street vendors into its design and implementation. Street vendors need adequate services, such as improved stall design, access to gas and electricity, restrooms, and access to freight and storage. Furthermore, they need to be allocated space that allows for direct access to the pedestrian traffic that they rely on for business.

Thematic Breakdown of Framework

	TOD Element Name	TOD Element Purpose	Ideal Situation
Accessibility	**Neighborhood connectivity**	Local accessibility ensures a human-oriented design.	The "800 m buffer area" surrounding a station is accessible by foot in 15 minutes.
	Metropolitan connectivity	Metropolitan accessibility ensures that the site is well-connected to the rest of the city	Network distance and euclidean distance are approximately the same.
	Availability and ease of transfers	People are more likely to use public transit if transfers are reduced. Transfers should be easy to make and fare integrated in order to encourage transit use. Regional accessibility by transit ensures that people have the opportunity to fulfill all their needs and desires easily by transit.	There are transfer options for the same mode and to other modes -- all use an integrated fare system and are easy to decipher.
	Non-motorized environment	A TOD neighborhood puts pedestrians first and should ensure that it is easy for residents and users to safely access their activities.	At least 90% of the streets have sidewalks and bike lanes.
	Variety of transportation options	Allows for regional and local connections by individual preference.	At least two public transit options, in addition to biking and walking infrastructure, exist.
	Efficient movement of goods	Freight is important to allow businesses to thrive, but can also cause significant congestion and endanger non-motorized movement.	Freight movement is regulated in an efficient manner that supports local businesses, reduces environmental impact, and limits traffic interruptions.
	Diverse mix of activities	A diversity of jobs, housing, and third places types all within walking distance of one another increase convenience for daily life.	Land use mix is perfectly divided between residential, commercial, industrial, and commercial (and other) uses.
	Active ground floor	Creates a liveable neighborhood. Human scale design. Feeling of safety and eyes on the street. Contains a design attribute but requires an implementable component.	Main arteries provide ground-level retail and services that cater to the needs of the community.
	Job/housing balance	Balance of inflow/outflow in order to reduce peak unidirectional congestion in the transit system. Creates opportunities to work near home.	There are opportunities to live and work nearby.
	Temporal distribution of activities	Creates a neighborhood active during all times of day, often leading to the feeling of a safer environment. Encourages a wide variety of business types (i.e. informal).	There's a roughly consistent flux of people moving through the site during waking hours.
	Density	Density allows for a wider variety of activities within a smaller area.	Articulated densities are distributed in diverse and strategic areas around the transit stations. Density is not a flat number.
	Parking considerations	Parking spaces should be minimized because parking can encourage higher levels of car use, reduces amount of land available for other development, and increases the price of housing.	No minimum parking space requirements in developments around transit stations. Street parking is reduced.
	Variety of options for "basic needs" trips	To understand if people can live in the neighborhood without having to leave for day-to-day activities.	"Live, work, shop, and relax" options (Jacobson et al., 2008).

Design

TOD Element Name	TOD Element Purpose	Ideal Situation
Human-scale block dimensions	Shorter block lengths create a more interesting and comfortable pedestrian experience.	100% of blocks are less than 190 meters
Urban tissue connectivity	An interconnected street network improves walkability. New tissue should connect with existing streets.	Area around station exhibits a high level of street network connectivity. Streets connect several areas for a long distance.
Interaction between interior and exterior active spaces	Private spaces which are visible from the public realm to increase activity levels on the street throughout the day.	Significant presence of transparent or open ground floor uses that allow for interaction between building users and pedestrians within the station area.
Pedestrian-oriented and scaled streetscapes	Streetscapes which prioritize the pedestrian experience through human-scaled elements.	Sidewalk widths of 3 meters or wider, climate appropriate landscaping, inviting street furniture, transparent building facades.
Bicycle-oriented streetscapes	Streets with bicycle infrastructure allow cyclists with a variety of cycling experience to use the street safely and comfortably.	Station area includes an array of appropriate street-specific bicycle infrastructure which connects to surrounding bicycle networks. Bicycle share adjacent to station.
Legible street network	A legible street network includes identifiable patterns of block types and urban forms that help visitors intuit how to move through a place.	100% of blocks within the station area exhibit human scale dimensions, identifiable and repeated forms, and are easily navigated by a pedestrian via clear intersection crosswalks.
Density of intersections	Density of intersections contribute to a legible street network, which allows for ease of engagement with the urban environment.	High density ratio of intersections per street segment.
Proximity of open space	A network of inviting and accessible public open spaces within walking distance improve recreation, entertainment, and environmental opportunities.	High level of open space varieties within station area catering to range of users and program types.
Limited conflict points between drivers and pedestrians	Reducing the number of curb cutting driveways and loading areas that intersect the pedestrian realm.	Priority streets within the station area have no curb cuts or loading areas. Additional streets have less than 2 curb cuts per block.
Pleasant street level environment	Inviting and safe environments reduce exclusion of marginalized groups, encourages engagement with the environment, and increases street traffic.	The station area contains well-lit and shaded sidewalks, while its urban form reduces the likelihood of wind tunnels, amplified street sounds, and noxious smells.
Freight design considerations	Thoughtfully designed freight systems and infrastructure allow businesses to thrive while avoiding any potential threat to non-motorized travel modes.	Streets designated for freight possess clearly marked loading zones and exhibit the smallest-allowable turning radii and lane widths still capable of accommodating freight vehicles.
Variety of active ground floor uses	Active ground floor uses create a more lively and vibrant street level environment.	"50 to 75% of ground floor transparency per block segment along key station area streets. Presence of balconies along street-side facade. High mixture of active ground floor use types.
Flexible street parking considerations	Off-street parking requirements, or minimal parking space requirements increase the amount of land available for new development.	The station area restricts parking to no more than 0.5 spaces per unit and 1 space per 50 sq. m. of commercial space.
Preservation and enhancement of historic elements	Historic buildings maintain cultural value and identity in neighborhoods.	Historic buildings and urban forms are preserved and highlighted throughout the station area.
Proximity of travel modes to each other	Different non-motorized or public travel modes in proximity to one another (ex: bicycle and metro) incentivize travelers to avoid taking a vehicle for the last mile of their trip.	Presence of bicycle infrastructure (lanes, paths, bike share) directly adjacent to metro station, and bus pick-up/drop-off points.
Wayfinding elements	Wayfinding helps visitors navigate a site and can also serve as a form of branding for an area that illustrates its unique amenities and attractions.	The station area includes wayfinding devices which guide users through the area and indicate a sense of arrival to a unique place.

	TOD Element Name	TOD Element Purpose	Ideal Situation
Affordability	**Access to jobs**	Greater connectivity to employment opportunities via public transit indicates greater potential for socially equitable outcomes	Stations are scored based on their relative accessibility compared to the mean station area accessibility score in the Mexico City subway system (4.29).
	Household income	Ideally TOD areas should be affordable for a range of incomes, to enable access to good transit service, jobs, healthcare, and more for residents of all backgrounds.	There is no ideal for this metric, it is simply an indication of whether the station area is well below or well above the current mean for the city as a whole, and serves as an indicator for the affordability of the station area.
	Homeownership Affordability Measure	TOD areas should be affordable for a range of incomes; this measure indicates the % Area Median Income (citywide) that the average sale price would be affordable to.	Ideally, the average sale price should be affordable to 100% AMI.
	Rental Affordability Measure	TOD areas should be affordable for a range of incomes; this measure indicates the % Area Median Income (citywide) that the average rental price would be affordable to.	Ideally, the average rental price should be affordable to 100% AMI.
	Cost burden ratio	This measure indicates the percent income of the median household that would be required to afford the median rental property in the station area.	Ideally, people should be able to spend 30% or less of their income on housing.
	Housing market growth rates	While housing market growth is important for private developers and investors, prices that far outpace inflation and wage growth can undermine neighborhood stability and affordability.	Housing value increases that outpace the average annual housing value increase for Mexico City as a whole (which is already growing faster than the rest of the country) are cause for concern about affordability. Between 2010 and 2014, home values grew approximately 6.5% per year. (SHF)
	Vacancy rates	TOD areas should have enough vacancy to enable entry into the market, but not so much so that housing units, or potential housing units, are being underutilized.	While vacancy rates shouldn't be too low (lower than e.g. 5%) to enable entry into the market, high vacancy rates indicate underutilized or possibly abandoned housing stock. The average vacancy rate for all of Mexico City was 7.7% in 2010 (INEGI); vacant housing rates for each Metro station area were compared against this rate.
	Range of tenancy types	TOD areas should offer a range of housing options, including both homeownership and rental opportunities.	

Informality

TOD Element Name	TOD Element Purpose	Ideal Situation
Services and utilities	Vendors need services to operate their businesses. These services need to be convenient to prevent them from leaving their stalls too often.	Vendors have safe, reliable and convenient access to electricity, water, and bathrooms.
Waste removal	Waste removal is important to make sure the area is clean, safe, and free of obstructions.	There is daily waste removal for vendors that separates organics, recyclables and trash.
Refrigeration	Refridgeration can help vendors increase the shelf life of their goods and prevent them from taking frequent trips to wholesale markets.	Cold storage is available in-situ, or elsewhere on the site in a place that is easily accessed by ramp and/ or elevator for push carts.
Access to Storage	Access to convenient, secure, affordable storage reduces the stress and work associated with moving goods twice a day between their stalls and a distance storage location.	Storage is available in-situ, or elsewhere on the site in a place that is easily accessed by ramp and/or elevator for push carts.
Protection from inclement weather	Protection from inclement weather keeps vendors healthy and protects their goods from being damaged. It can also increase their sales by offering a place for clientele to get out of the elements.	Vendors have stalls and locations the protect them and their goods from rain, sun, and wind.
Access to foot traffic	Foot traffic provides the customer base for informal vendors and only through having direct access to it can the business be viable.	The vendors' locations gives them direct access to the areas of high foot traffic.
Avoids Congestion	Informal vendors often crowd areas of high foot traffic and increase congestion. Locating vendors in places so that allows for the flow of pedestrians is important to limit congestion.	Stalls are located where they do not interfere with the high amounts of pedestrian flow on the site.
Health Standards	Vendors are currently not subject to any health checks. Education and oversight could decrease the risk of negative health effects for those that eat in informal markets.	Training classes and oversight ensure that food vendors are meeting health standards.
Liveliness of the streetscape	Liveliness of the streetscape can make it a more enjoyable, attractive, and safer place.	Informal vendors add to the liveliness of the streetscape making for a more safe public space.
Protected vending locations	Having a protected space to sell their goods ensures that there is not the risk of getting kicked out and/or getting their goods confiscated.	Vendors hold a legally recognized contract with the government or landowner that gives them permissions to use their space.

STATION TYPOLOGIES

Overview

The Mexico City subway system has 163 stations in addition to a growing number of BRT stations. To this day, only a few have been analyzed for development potential, and fewer still have plans for improvement. This piecemeal approach limits the scalability of a citywide TOD policy, but it can be challenging to identify development opportunities and develop best-fit approaches to such a large number of unique cases. In order to facilitate the identification of TOD potential, we developed a typology of station areas. This process involved a classification or grouping of stations based on a set of common features. In order to do this, we first came up with a set of features that we identified as useful (based on the literature and the framework we had developed) to signify different types of development opportunities and interventions. After grouping by station type, we used a hierarchical clustering analysis, which is a mathematical tool that congregates stations based on their similarities and maximizes the dissimilarity between groups.

The following section describes the approach and criteria used to group station areas into typologies, as well as a general description of the characteristics of each station area typology.

Data Sources

In order to categorize the stations we drew data from a number of sources. After experimenting with several combinations, we came up with three key variables that help us differentiate the types of stations and could potentially inform the type of development that they could support.

- Ridership: the size of the pedestrian market to assess the demand and capacity of a station
- Average home sale price: the price of land and socioeconomic conditions of the station-area
- Walkshed ratio: the a priori walkability of the area

Process Overview

Because we were only able to conduct in-depth study of four station areas over the course of this project, we needed to rely on existing data sources to cluster all of the metro stations into typologies. A clustering algorithm is a method for quantitatively grouping observations based on the input criteria. The clustering algorithm aims to maximize the distance between clusters and minimize the distance within clusters. [1] “Distance” is analogous to “dissimilarity.” [2]

TABLE 3-1 Typology Variables and Data Sources

VARIABLE	DEFINITION	PURPOSE	SOURCE
Ridership	Ridership of the station	To understand line demand and capacity, and size of market	Sistema de Transporte Colectivo, 2015
Average Sale Price	Average sale price of homes within a 800 m buffer.	To understand the income level of the neighboring area and opportunities for development	Intelimetrica
Walkshed Ratio	Ratio of area to which you can walk in 800 m to an 800 m radius.	To understand the walkability of the neighboring area, and the walking market of a station	OpenStreetMaps

Method Overview: Two-Stage Hierarchical Agglomerative Clustering

In part to account for multiple data types (categorical and continuous), and in part to appropriately account for important station and system characteristics, we use two-stage hierarchical clustering. The first phase grouped stations according to physical station characteristics, while the second phase took into account socioeconomic and urban design characteristics of the surrounding station areas. Hierarchical clustering allowed us to decide on a final number of station area typologies after the clustering process rather than before.

Variable Selection

Developing the station area typologies was an iterative process, first running the clustering process with a wide range of variables corresponding to the criteria of the TOD framework described in the previous section. Variables were limited by the availability of data given the short duration of this project. Future work could elaborate on the typology methodology, particularly by including land use variables to characterize development potential in each station area.

Following the initial round of clustering with the maximum set of potential variables, consecutive runs of clustering process were conducted, using smaller and smaller sets of criteria for each iteration, in order to determine the best set of clustering variables. Clustering algorithms typically require that the same data type, either continuous or discrete, be used, and we arrived at this two-stage method in order to take into account discrete indicator variables in the first stage, and continuous explanatory variables in the second stage. The goal in determining a final set of clustering variables was to represent as many of the TOD Framework criteria as possible, to not allow individual variables to dominate the clustering, and to develop typologies that qualitatively makes sense to someone familiar with Mexico City. The Typologies Appendix describes the clustering steps, including all of the clustering variables initially considered, with the final variables highlighted.

Validation

In addition to the qualitative validation based on our general understanding of the metro system and its station area neighborhoods, we also conducted a quantitative validation process on the final station area typologies using an Analysis of Variance (ANOVA). For additional detail on validation, please consult the Typologies Technical Appendix.

FIGURE 3-2 Station Distance Schematic

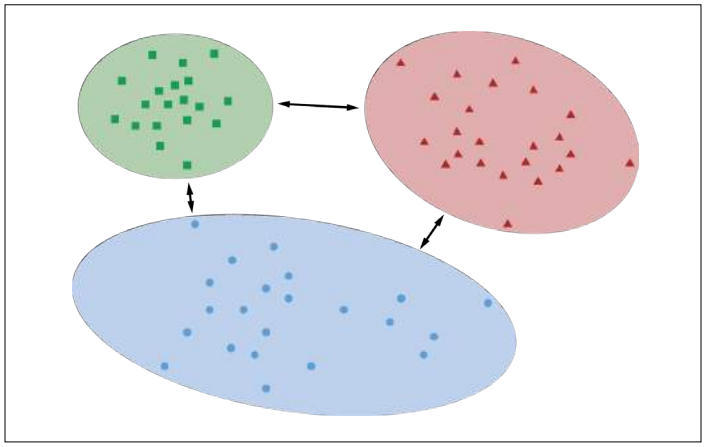
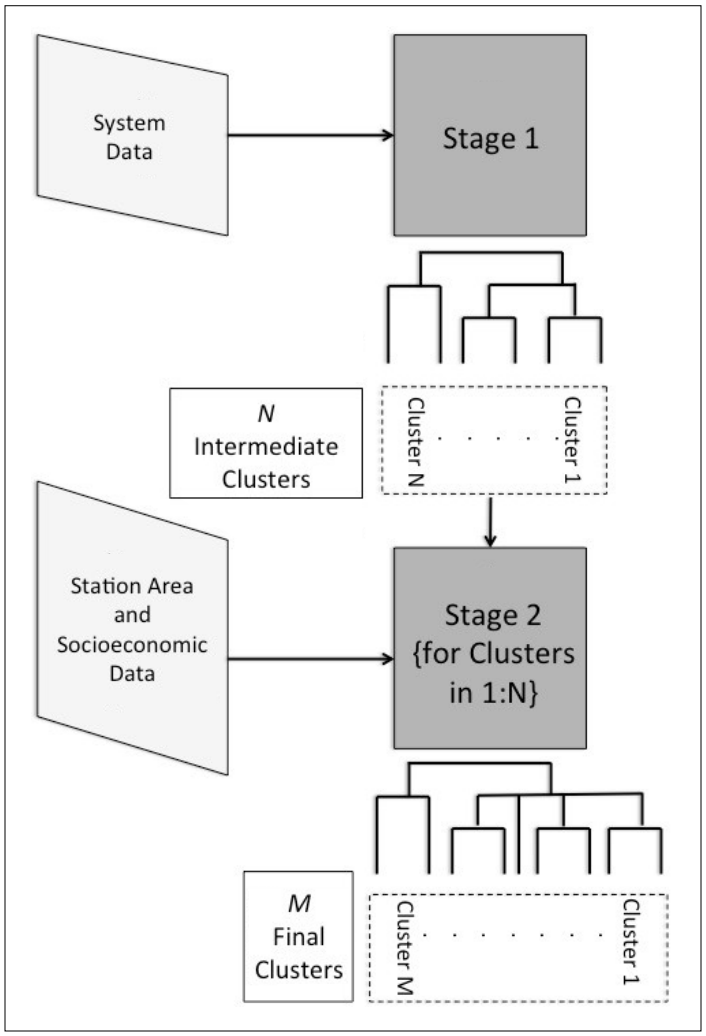


FIGURE 3-3 Station Distance Schematic



Typology Descriptions

The stations in Mexico City can be distinguished first by the characteristics of the station itself and its context within the transportation system, and then by other defining characteristics of its relative location and station-areas. We found nine station typologies for ZMVM that can help to inform how and where development can be carried out. Of the 163 stations we examined, 120 can be considered neighborhood stations, meaning that they are not a CETRAM, depot or terminal station. 43 are major stations, some combination of CETRAM, depot and/or terminal.

Firstly, the typologies are differentiated by the presence of a transfer station (CETRAM), terminal and/or depot. We then used clustering, discussed above, to differentiate based on characteristics of ridership, walkshed and local land value. In order to describe the clusters, we also looked at other characteristics of each cluster including the elevation of the subway station and the station area universal accessibility.

FIGURE 3-4 Station Typology Locations

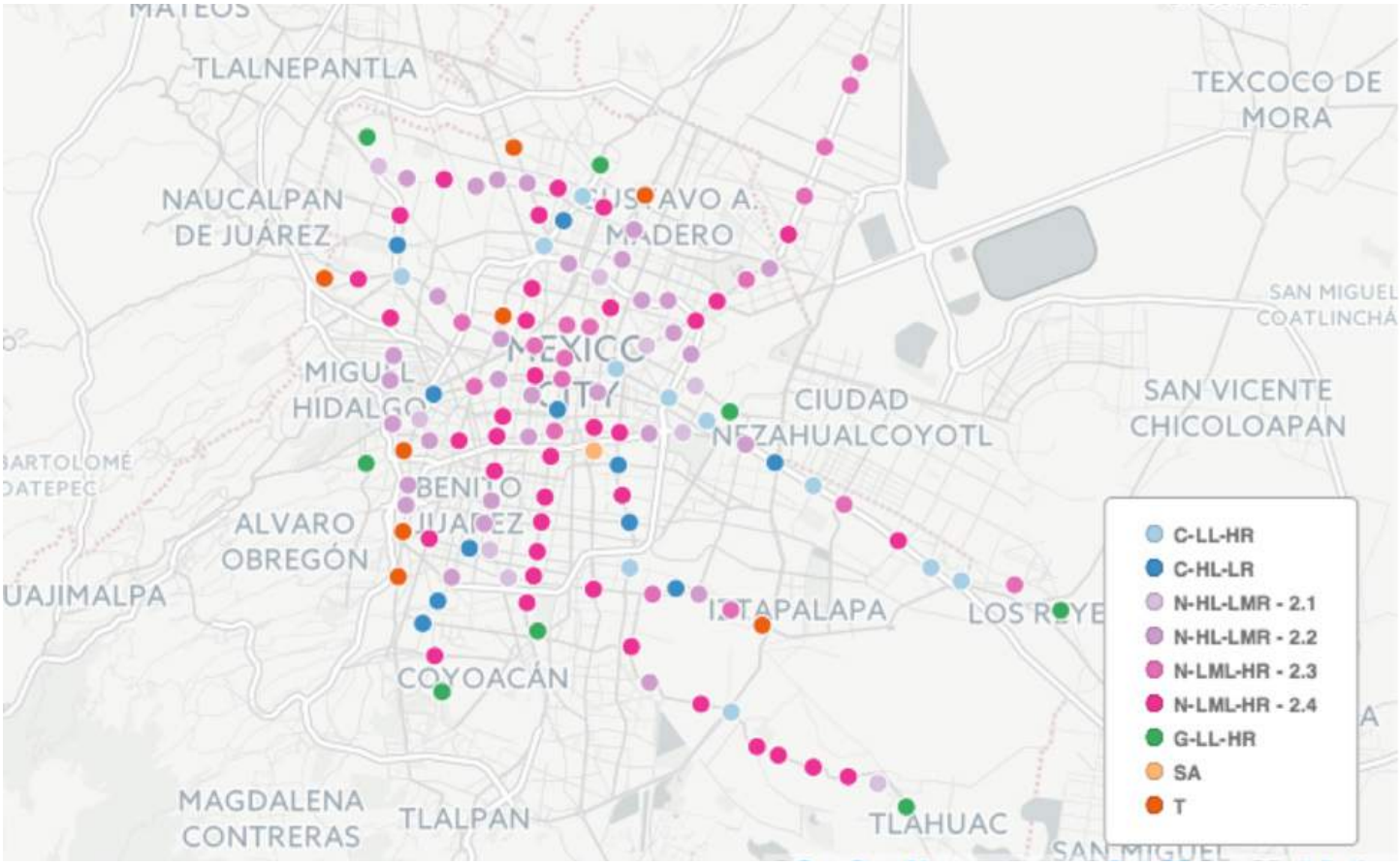
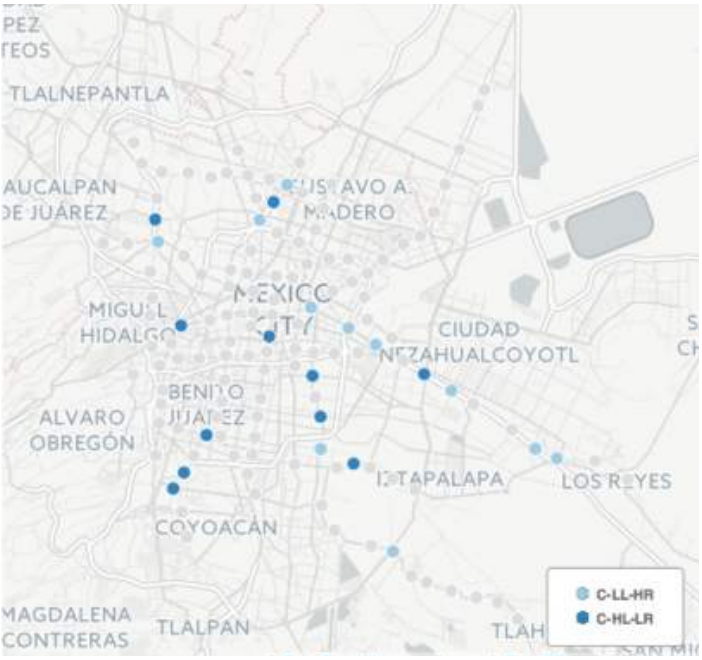
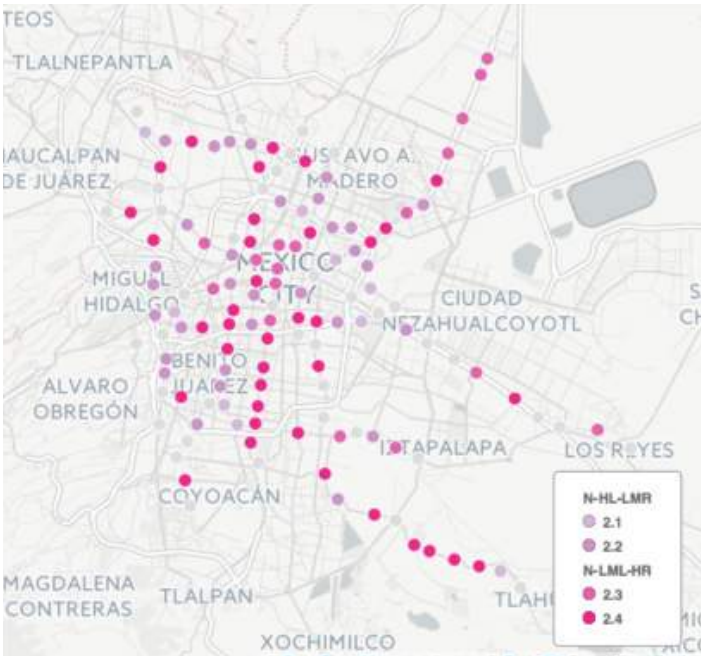


TABLE 3-2 Overview of Station Typologies

STATION TYPE	STATION TYPE GROUPS	MEANING	OTHER CHARACTERISTICS	TOTAL #	DEVELOPMENT POTENTIAL TYPE
C-LL-HR	CETRAM	Low Land Value High Ridership	Primarily elevated or at-grade tracks Small walkshed	12	Commercial
C-HL-LR		High Land Value Low Ridership	Primarily underground stations Bigger walkshed	12	Residential
N-HL-LMR 2.2	Neighborhood Station	High Land Value Low-Medium Ridership	Low intermodal connectivity	46	Dense Residential/ Office
N-HL-LMR 2.1					
N-LML-HR 2.4		Low-Medium Land Value High Ridership	Good intermodal connectivity	74	Commercial
N-LML-HR 2.3					
G-LL-HR	Gateway Yard	Low Land Value High Ridership	At-grade tracks Low walkability Primarily located at fringes of City	9	Commercial
SA	Terminal	Santa Anita Very Low Ridership	Intercity terminal Low network connectivity	1	Land Value Capture and Extension
T		High Ridership	Mid-range walkshed	9	Commercial/ Lower Income Residential





STATION TYPE 1 - CETRAMS

Type 1 stations are CETRAMs, but are not terminals. Stations of type 1.1 (C-LL-HR) have low land value and high ridership, and are primarily elevated or at grade stations. They have a small walkshed compared to C-HL-LR stations. Type 1.2 (C-HL-LR) are characterized by more underground subway stations, with higher sales prices, and levels of ridership closer to the average, but with bigger walksheds than C-LL-HR stations. All of type 1 stations have fewer jobs in the station area, compared to other station types.

C-LL-HR

Many elevated or at grade tracks

Smaller walksheds

Fewer jobs than other station types

Includes: Acatitla, Tacuba, Zaragoza

C-HL-LR

More underground subway

Bigger walkshed

Fewer jobs than other station types

Includes: Balbuena, Iztapalapa, Chapultepec

STATION TYPE 2 - NEIGHBORHOOD STATIONS

Typology types 2.x are considered to be “regular” neighborhood stations. They are not CETRAMs, depots nor terminals. Types 2.1 and 2.2 can be differentiated by 2.3 and 2.4 by the relative sale price of land surrounding the station. Types 2.1 and 2.2 are located in neighborhoods with higher land value and low to medium ridership. Types 2.3 and 2.4 have low to medium land value and high ridership.

N-HL-LMR 2.1 + 2.2

Low intermodal connectivity

Opportunities for Residential

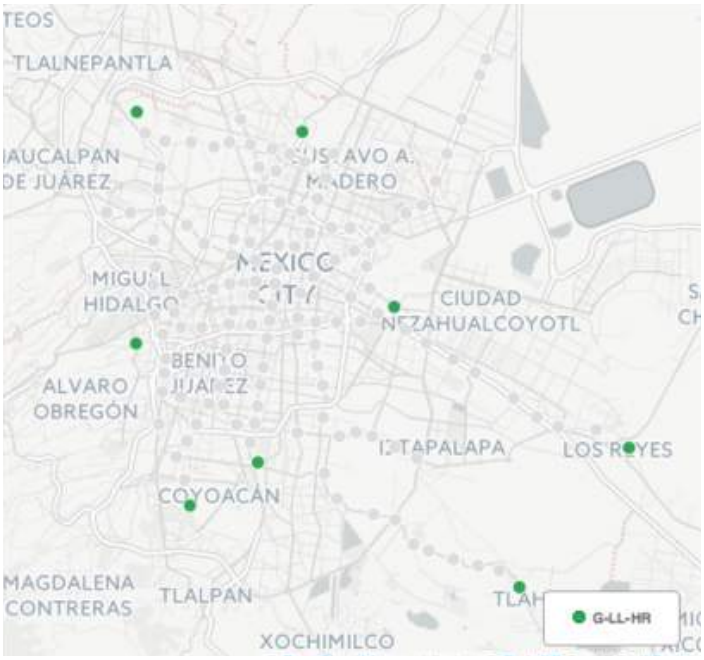
Includes: Auditorio, Constituyentes, Cuauhtémoc

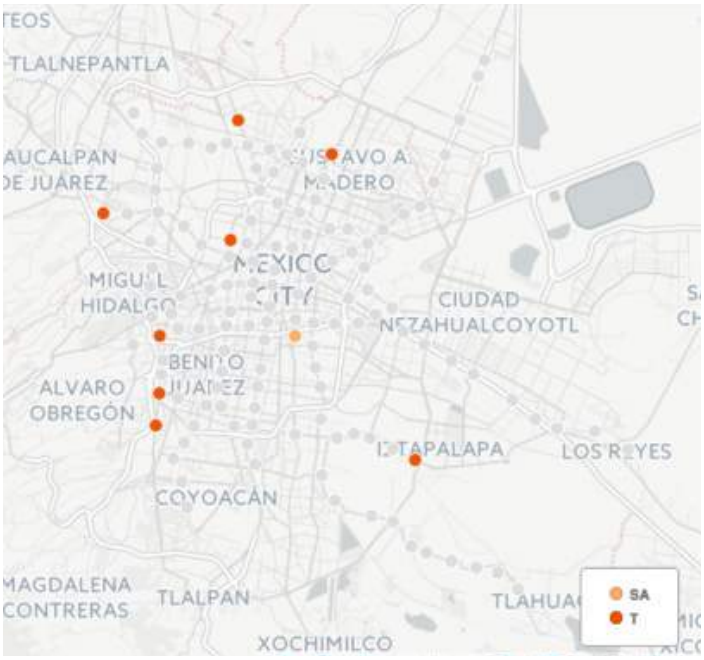
NL-LML-HR 2.3 + 2.4

Good intermodal connectivity

Opportunities for Commercial

Includes: Insurgentes, Ecatepec, **San Joaquín**





STATION TYPE 3 - CETRAM, DEPOT AND TERMINAL; GATEWAY YARD

Typologies 3.1 and 3.2 have been combined to describe stations that are gateways into Mexico City, and are found in the fringes of the City. These stations are CETRAMs, depots and terminals, and are characterized by very high ridership. Generally there are low levels of walkability in the surrounding areas, no underground subway and low universal accessibility. Opportunities for development in these stations are determined by the availability of government-owned land.

G-LL-HR

High ridership

Relatively low walkability and disconnected

Fewer jobs in station areas than other types

They are found in the fringes of Mexico City,

At-grade tracks

Feasibility of air rights development over rail yards

Clear opportunity for commercial

Includes: **El Rosario**, Ciudad Azteca, Observatorio, Pantitlán

STATION TYPE 4 - TERMINALS

Types 4.x are terminal stations, the majority of which are also CETRAMs. Type 4.1, Santa Anita, is an outlier station, a poorly connected terminal with very low ridership, despite being in the heart of the city. (As an aside, this outlier may present its own interesting opportunity for development.) Station types 4.2 have high ridership compared to the rest of the systems, with average sales prices and a mid-range walkshed.

SA

Outlier

Low ridership

Inner-city terminal with low connectivity

T

Medium-to-high Ridership

CETRAMs

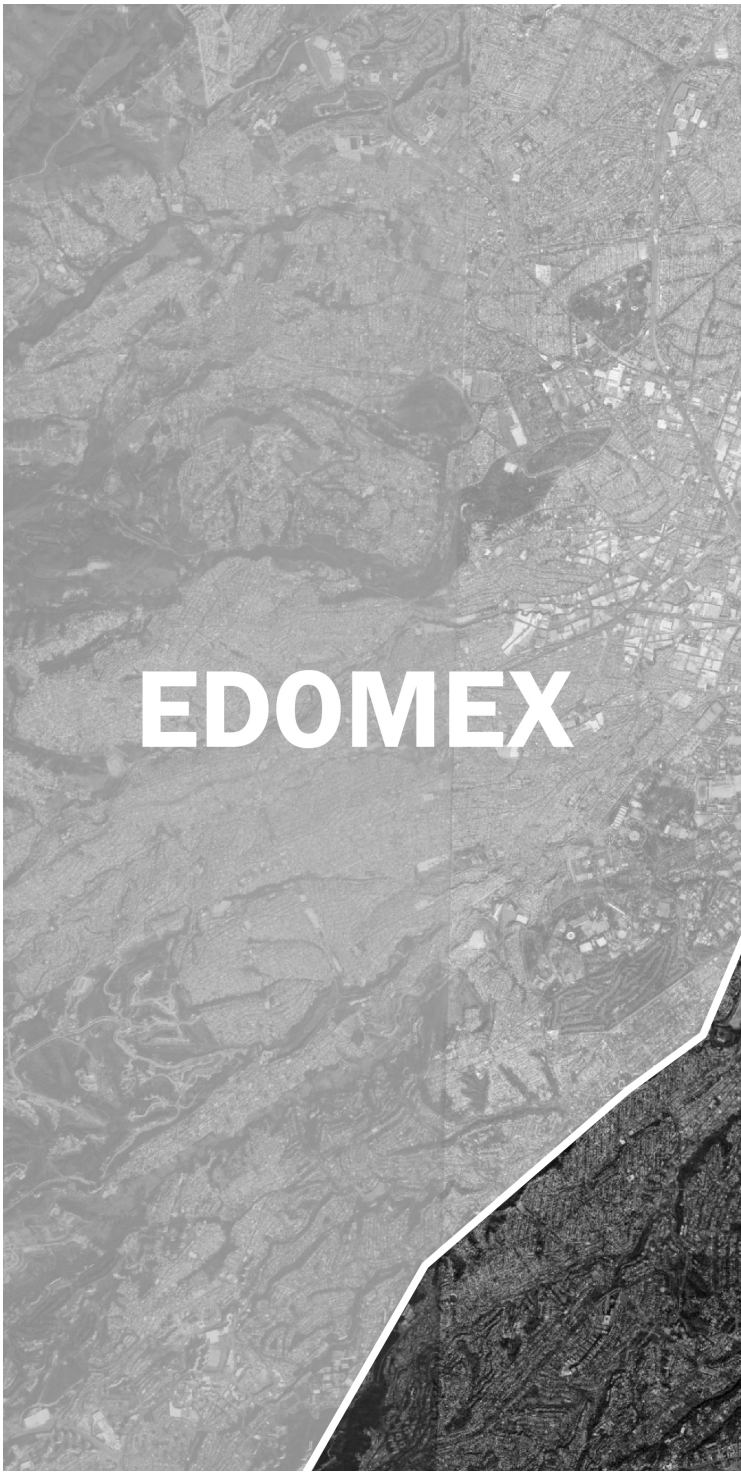
High ridership compared to rest of system stations except for 3

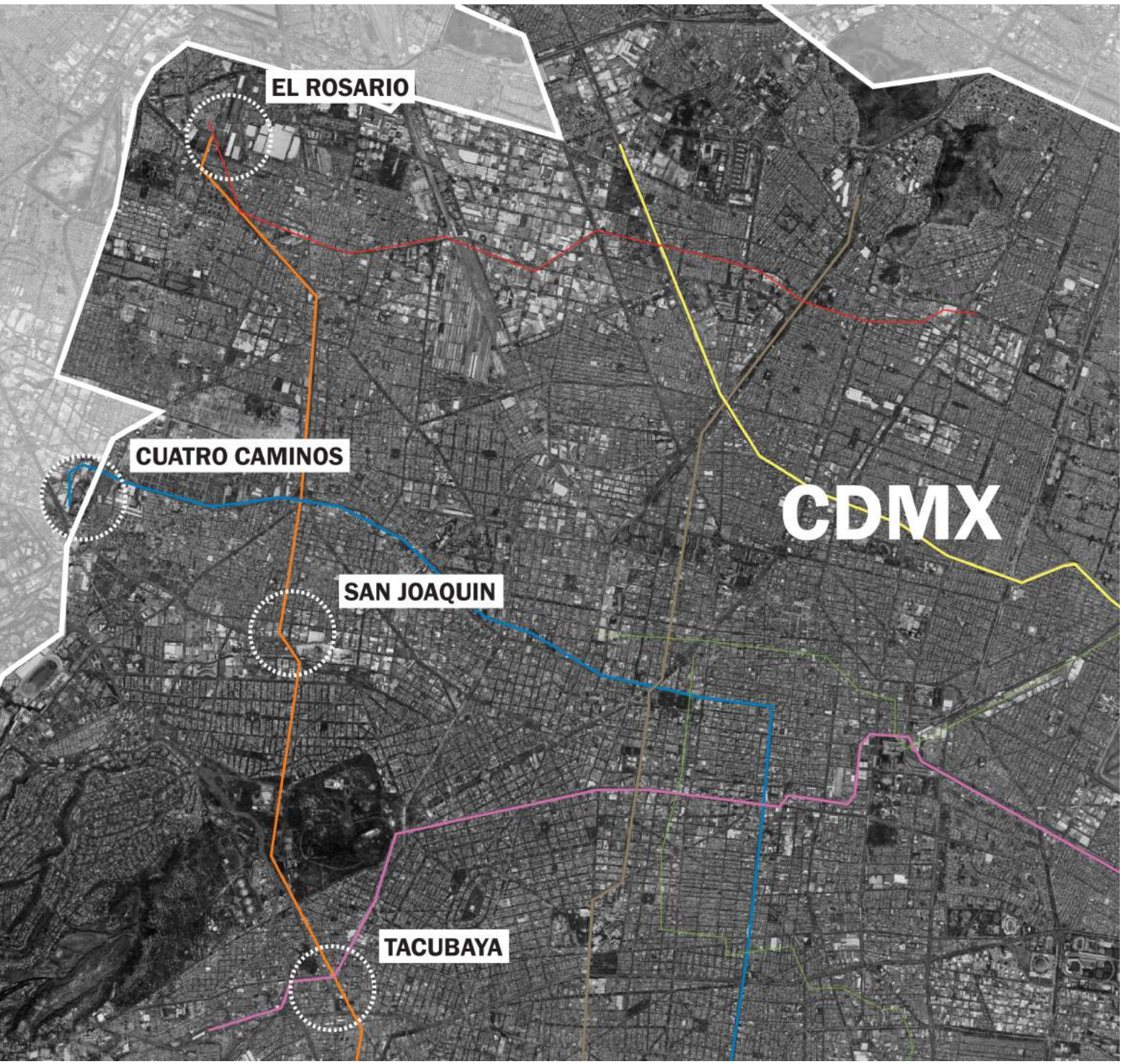
Medium sales price,

Mid-range walkshed

Includes: **Cuatro Caminos**, **Tacubaya**, Garibaldi

APPLYING THE FRAMEWORK




EL ROSARIO
CUATRO CAMINOS
CDMX
SAN JOAQUIN
TACUBAYA

San Joaquin

DESCRIPTION

Located in the Pensiles neighborhood on Metro Line 7, San Joaquin lies at the intersection of several emerging commercial and residential development centers, including Plaza Carso to the west, the Polanco Metro Station Area to the south, and Nuevo Polanco to the east. Additionally, there are several major employment centers within a 15-minute walk of the station, including the Hospital Español, and the Grupo Modelo factory and distribution plant. While not a traditional transfer station or CETRAM at the scale of others described later in this chapter, San Joaquin features a network of "last-mile" transfer types where many of the travelers moving through the station combine walking, biking, microbus, taxi, and colectivo (shared taxi) trips with a Metro ride as part of their daily commutes. Additionally, some companies located in Plaza Carso use private shuttles to transport employees the 1.5 kilometers between the Metro station and their offices. The recent emergence of these shuttles, as well as the station's proximity to a linear parkway with a multi-use path connecting Nuevo Polanco to Plaza Carso further illustrate the important role that San Joaquin's station plays in connecting people to these growing employment centers through a variety of travel modes. Further, the existing urban fabric of the station area with its short blocks, narrow streets, and consistently arranged street pattern is highly conducive to pedestrian trips. These underlying conditions work together to create a station area that has tremendous potential to serve as a new kind of CETRAM where pedestrian transfers to and from the station are prioritized and the entire neighborhood surrounding the station is envisioned as a cohesive and walkable mixed-use realm.

Despite San Joaquin's existing positive attributes that contribute to a walkable, human-scale urban environment, the area is facing an extreme affordability crisis unlike the other three stations examined in this document. Today the station area is notable for having both the highest average housing prices and the lowest median income of the four sites analyzed—a troubling scenario that threatens the future ability of this neighborhood to provide housing options for nearby workers of all income levels. One opportunity for combatting this unaffordability issue is to reimagine existing underutilized parcels as new opportunities for new, neighborhood-appropriate residential density. The station area contains numerous examples of blocks currently dedicated to surface area parking and one- to two-story warehouse structures. The size of these blocks and their proximity to transit and major employment centers suggest that many could support three to five additional stories of residential uses while also integrating new public open space and ground floor commercial uses that activate the public realm of the neighborhood and bring new vitality to the streets throughout the day.

BASIC FINDINGS

Affordability: The area has a significant affordable housing crisis with low household income averages and some of the highest housing costs compared to other station areas. Vacant land and publicly owned but underutilized parcels in the area could be used to build new residential development with significant on-site affordable units included.

Connectivity: The station area already features excellent neighborhood connectivity due to its small-scale human-sized blocks and consistent/legible street layout. However, regional connectivity is lacking with only one Metro line and a 32-minute travel time to the city center.

Legibility: Already featuring a highly legible street network, the station area however requires further on-street design elements that facilitate safe bicycle and pedestrian travel to the existing multi-use path that connects to nearby employment centers.

Transport: While the area already features a variety of transit types, their pick-up and drop-off points are relatively dispersed. A redesign of the station could transform it into a more integrated and efficient transfer hub for the various last-mile travel modes that service the station.

SURROUNDING COMMUNITY STATISTICS (2014)

43,468 Residents

15,372 Households
64% Lack Car Access

47% Employment

16 Schools

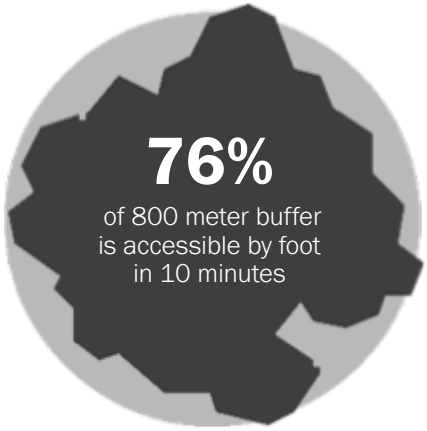


FIGURE 3-5 San Joaquin Station Area

SAN JOAQUIN SCORE

33/36 12/27 20/42 3/21

	TOD Element Name	Score	Reason
Accessibility	**Neighborhood connectivity**	●●●	Walkshed ratio is 76%.
	Metropolitan connectivity	●	32 minutes to city center; 6.5 km.
	Availability and ease of transfers	●●	San Joaquin is not a major transfer station, but many people transfer to the microbuses across the street, or to corporate buses right outside the station. At rush hour congestion traps public transport units, so long lines form along the sidewalks in surrounding blocks.
	Non-motorized environment	●●●	The neighborhoods around the station have a walkable environment. There is an underutilized cycle track.
	Variety of transportation options	●●●	Microbus and corporate buses are the preferred choice for last mile trips. There is bike infrastructure that is not utilized.
	Efficient movement of goods	●●●	There are warehouses near the station, but freight mainly caters to smaller local stores.
	Diverse mix of activities	●●●	The station is within a very well structured neighborhood, that has a diverse mix of local businesses and public markets (Land use mix is 0.02).
	Job/housing balance	●●●	The area adjacent to the station is predominantly residential, but new job centers are growing within a mile from it.
	Temporal distribution of activities	●●●	San Joaquin is in a lively neighborhood with activity throughout the day.
	Density	●●●	The neighborhoods around the station are quite dense.
	Parking considerations	●●●	Parking requirements have forced all new residential development to use the first floor of the building for car access, creating large portions of inactive blocks New office buildings in nearby developments are increasing the number of parking spaces in the area rapidly.
	Variety of options for "basic needs" trips	●●●	Several public markets and local businesses are found in the area
Informality	**Services and utilities**	●●	Public restroom provide water and bathrooms but there is no electricity provided
	Waste removal	N/A	
	Refrigeration		No cold storage exists.
	Access to Storage		Storage is only available in-situ for those with lockable stalls. Many need to carry their goods in.
	Protection from inclement weather		There is no additional protection beyond each vendor's stall.
	Access to foot traffic	●●	Vendors are located next to the subway entrances.
	Avoids Congestion	●●●	Vendors are sparse and located to allow plenty of space for walking on the sidewalk.
	Health Standards	●	The are no food standards enforced.
	Liveliness of the streetscape	●●	Vendors give color to what is an otherwise open concrete set of plazas.
	Protected vending locations	●●	Vendors have been in this location for many years and have had no threats to their occupation.

	TOD Element Name	Score	Reason
Design	**Human-scale block dimensions and a density of intersections**	●●○	Most blocks are less than 190 meters.
	Interaction between interior and exterior active spaces	●○○	There are some ground floor commercial units with transparent facades, however the majority of the ground floor units within the area are made up of blank facades, garage doors, and other auto-oriented elements.
	Pedestrian-oriented and scaled streetscapes	●○○	Sidewalks immediately surrounding the station are consistently greater than 3 meters and there are fairly consistent street trees throughout the station area, however there are no examples of street furniture and there are few instances of transparent facades.
	Bicycle-oriented streetscapes	●●○	The station area includes some bicycle infrastructure including bidirectional lanes along Lago Hielmar and a multi-use path running through the linear park along Ferrocarril de Cuernavaca.
	Legible street network	●●●	The repetitive formation of the street grid surrounding the station makes for easy navigating from the pedestrian's perspective.
	Density of intersections	●●●	The station area's tight compact grid formation results in a greater number of intersections that street segments.
	Proximity of open space	●●○	The station area exhibits three different types of public open spaces: two plazas which surround the station entrances, a linear park and multi-use path running along the southern half of the station area, and a 1.45-hectare park to the north of the station area.
	Limited conflict points between drivers and pedestrians	○○○	Driveway curb cuts are frequent along main streets and smaller residential streets alike within the station area.
	Pleasant street level environment	●●○	Many of the streets within the station area are tree lined, however there is limited street lighting.
	Freight design considerations	○○○	There are no examples of freight-designated streetscape elements within the station area.
	Variety of active ground floor uses	●○○	There are very few examples of balconies and ground floor active uses with the station area.
	Flexible street parking considerations	○○○	Existing zoning requires 1.7 parking spaces per residential unit.
	Preservation and enhancement of historic elements	**N/A**	No examples of historic or culturally significant architecture within the station area.
	Proximity of travel modes to each other	●●●	Bicycle lanes, bus access, and taxi pick-up points are all located within 100 feet of the station entrance.
	Wayfinding elements	○○○	No wayfinding elements exist.
Affordability	**Access to jobs**	●○○	Gravity score of 2.17, below the mean for the Mexico City subway system.
	Household income	○○○	San Joaquín's socioeconomic level is C, which translates to approximately $13,307 monthly median household income, and is substantially less than the monthly median income for the city as a whole (INEGI).
	Homeownership Affordability Measure	○○○	San Joaquin's average for sale housing unit would be affordable to households making 180% of the Area Median Income for all of Mexico City.
	Rental Affordability Measure	○○○	San Joaquín's average rental property would be affordable to 246% of the Area Median Income for all of Mexico City, making it the least affordable of all the areas studied.
	Cost burden ratio	○○○	To afford the median rent in San Joaquin, a household earning the current neighborhood household income would need spend 117% of their income on housing, far above the 30% affordability threshold.
	Housing market growth rates	●○○	Average home values in the zip codes surrounding San Joaquin increased on average 16% per year between 2010 and 2014, which is far above the average of 6.5% per year for Mexico City as a whole.
	Vacancy rates	●○○	INEGI data indicates that 17% of housing units are unoccupied in the Cuatro Caminos area.
	Range of tenancy types	**N/A**	

Cuatro Caminos

DESCRIPTION

Cuatro Caminos is the North terminus of Line 2 of the Mexico City Metro, the line with the highest number of riders. An average of 110,000 to 120,000 metro trips start in this station. Given its relatively centric location in the border between Mexico City and the State of Mexico within the ZMVM, a large number of buses, microbuses, vans and taxis arrive to the station to serve the millions of people who commute daily between the Mexico City central area and many municipalities in the State of Mexico. As a result, Cuatro Caminos is not only the third station of the whole metro system in terms of ridership, but also one of the largest local bus terminals in the continent. During rush time, an estimate of 1,900 street-level transit units arrive to the station each hour.

BASIC FINDINGS

- Informality: There are few protected vending locations, but very good access to foot traffic
- Legibility: The block dimensions are not human-scale, and the streetscape is not pedestrian-oriented. There is low intersection density and legibility
- Connectivity: Neighborhood connectivity is poor, and the non-motorized environment is very poor. However, there is good metropolitan connectivity because of the metro line and all the transfer points.

SURROUNDING COMMUNITY STATISTICS (2014)

14,126 Residents

5,805 Households
57% Lack Car Access

48% Employment

2 Schools

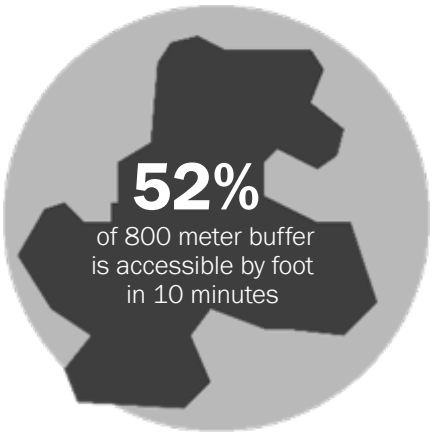


FIGURE 3-6 Cuatro Caminos Station Area

CUATRO CAMINOS SCORE

10/36 14/30 4/42 7/21

	TOD Element Name	Score	Reason
Accessibility	**Neighborhood connectivity**	●○○	Walkshed ratio is 52%.
	Metropolitan connectivity	●●○	34 minutes to city center; 9.15 km.
	Availability and ease of transfers	●○○	While there are many microbus options, the transfer process between modes is arduous. It isn't overwhelmingly time intensive (likely 6-10 minutes to the PRODI development and to the northern part of the site), but the "labyrinth" is intended to slow down foot traffic to the metro.
	Non-motorized environment	●○○	It's challenging to walk anywhere outside of Cuatro Caminos – traffic is usually bad, and a pedestrian bridge is required to cross the periphery.
	Variety of transportation options	●○○	There aren't a huge variety of modes (nor are there many NMT options), but there are many microbuses.
	Efficient movement of goods	●○○	Freight is mixed in with local traffic and not organized.
	Diverse mix of activities	○○○	Practically no land use diversity (score of 0 in land use mix).
	Job/housing balance	○○○	Traffic is probably one direction – inbound in the morning, outbound in the evening.
	Temporal distribution of activities	●○○	Temporal distribution in informal vendors within the station.
	Density	○○○	Not very dense around the station, but becoming more so with new construction.
	Parking considerations	●○○	Significant parking is common in new developments.
	Variety of options for "basic needs" trips	●○○	Local retail does not cater to basic needs for residents.
Informality	**Services and utilities**	●●○	The vendor association supplies services to most of the vendors.
	Waste removal	●●○	Separated waste collection is coordinated by the vendors.
	Refrigeration	○○○	No cold storage exists.
	Access to Storage	●●○	Most vendors can store their goods in their stall which has rolling metal doors that can lock.
	Protection from inclement weather	●●○	The association coordinated vendors to build a roof structure over much of the market which protects from the weather.
	Access to foot traffic	●●●	Vendors set up on the major routes of pedestrian flow traveling to and from the metro station.
	Avoids Congestion	○○○	Stalls often interfere with pedestrian flow or require you to walk on the street to get around them.
	Health Standards	●○○	The are no food standards enforced.
	Liveliness of the streetscape	●●○	The vendors activate what would otherwise be an empty bus station.
	Protected vending locations	○○○	A strong vending association protects the interests of the vendors. However, they are under threat due to construction and leaders that are not necessarily working in their interest.

	TOD Element Name	Score	Reason
Design	**Human-scale block dimensions and a density of intersections**	○○○	The site is surrounded by very large blocks (+500 m)
	Interaction between interior and exterior active spaces	○○○	Uses around the site are industrial or cemeteries. There are large walls and very few commercial uses.
	Pedestrian-oriented and scaled streetscapes	○○○	Narrow sidewalks with rough pavement. Lack of furniture, amenities and green areas.
	Bicycle-oriented streetscapes	○○○	Nonexistent bike infrastructure.
	Legible street network	○○○	No clear crosswalks and exits from the subway station. Impossible to read the street network. Very few streets connect with the rest of the urban fabric. The ones that do are high speed streets with many barriers.
	Density of intersections	○○○	Large Blocks, very few intersections.
	Proximity of open space	○○○	No open public spaces. There are several large cemeteries that could be consider public spaces, but they are walled and gated.
	Limited conflict points between drivers and pedestrians	●○○	Low intersection density may reduce conflict points, but poor crossing infrastructure for pedestrians increases jaywalking.
	Pleasant street level environment	○○○	Street level is chaotic and in terrible shape. Deficient lighting and presence of significant amount of trash.
	Freight design considerations	●○○	Important number of industries and warehouses in the area. The infrastructure is insufficient for freight control.
	Variety of active ground floor uses	●○○	Only few building surrounding the station has active ground floors. Most of the commercial activity comes from the informal vending in the area. Large walled or gated blocks around the area.
	Flexible street parking considerations	○○○	No parking control and organization.
	Preservation and enhancement of historic elements	**N/A**	
	Proximity of travel modes to each other	●○○	No bike infrastructure nor sharing system available. It is a very important transfer hub for buses or taxis but the transfer experience is chaotic
	Wayfinding elements	○○○	Wayfinding inside and outside station is barely present and difficult to interpret.
Affordability	**Access to jobs**	●○○	Gravity score of 1.89, below the mean for the Mexico City subway system.
	Household income	●●○	Cuatro Caminos' socioeconomic level is C+, which translates to approximately $21,647 monthly median household income, and is substantially less than the monthly median income for the city as a whole (INEGI).
	Homeownership Affordability Measure	●○○	Cuatro Caminos' average for sale housing unit would be affordable to households making 120% of the Area Median Income for all of Mexico City.
	Rental Affordability Measure	●○○	Cuatro Caminos' average rental property would be affordable to 146% of the Area Median Income for all of Mexico City.
	Cost burden ratio	●○○	To afford the median rent in Cuatro Caminos, a household earning the current neighborhood household income would need spend 42% of their income on housing, above the 30% affordability threshold.
	Housing market growth rates	●○○	Average home values in the zip codes surrounding Cuatro Caminos increased on average 17% per year between 2010 and 2014, which is far above the average of 6.5% per year for Mexico City as a whole.
	Vacancy rates	○○○	INEGI data indicates that 22% of housing units are unoccupied in the Cuatro Caminos area.
	Range of tenancy types	**N/A**	

Tacubaya

DESCRIPTION

Tacubaya, a Mexico city transfer hub, is located along a major transit route southwest of the city center in a neighborhood of the same name. The southwestern corner of the Tacubaya neighborhood is situated where the two-tiered Periférico highway forms a right angle with the major arterial road Viaducto. While the three subway lines, one BRT line, and dozens of bus lines that converge in the neighborhood contribute to a vibrant and bustling street life, the area is not easy to navigate. The multiple pedestrian bridges and underpasses, traffic, street networks, street vending, and lack of a centralized bus station complicate the accessibility of the neighborhood for commuters and locals alike. The neighborhood's historical charm, beauty, and prime location, however, make this area ideal for short and long term development.

BASIC FINDINGS

- Affordability: Tacubaya has good affordability but poor socioeconomic status.
- Accessibility: The site suffers from poor non-motorized local accessibility. There is good metropolitan accessibility but poor intermodal transfers.
- Informality: The site suffers from poor provision of services for vendors.
- Design: The precinct has good human scale streetscape but poor pedestrian infrastructure.

SURROUNDING COMMUNITY STATISTICS (2014)

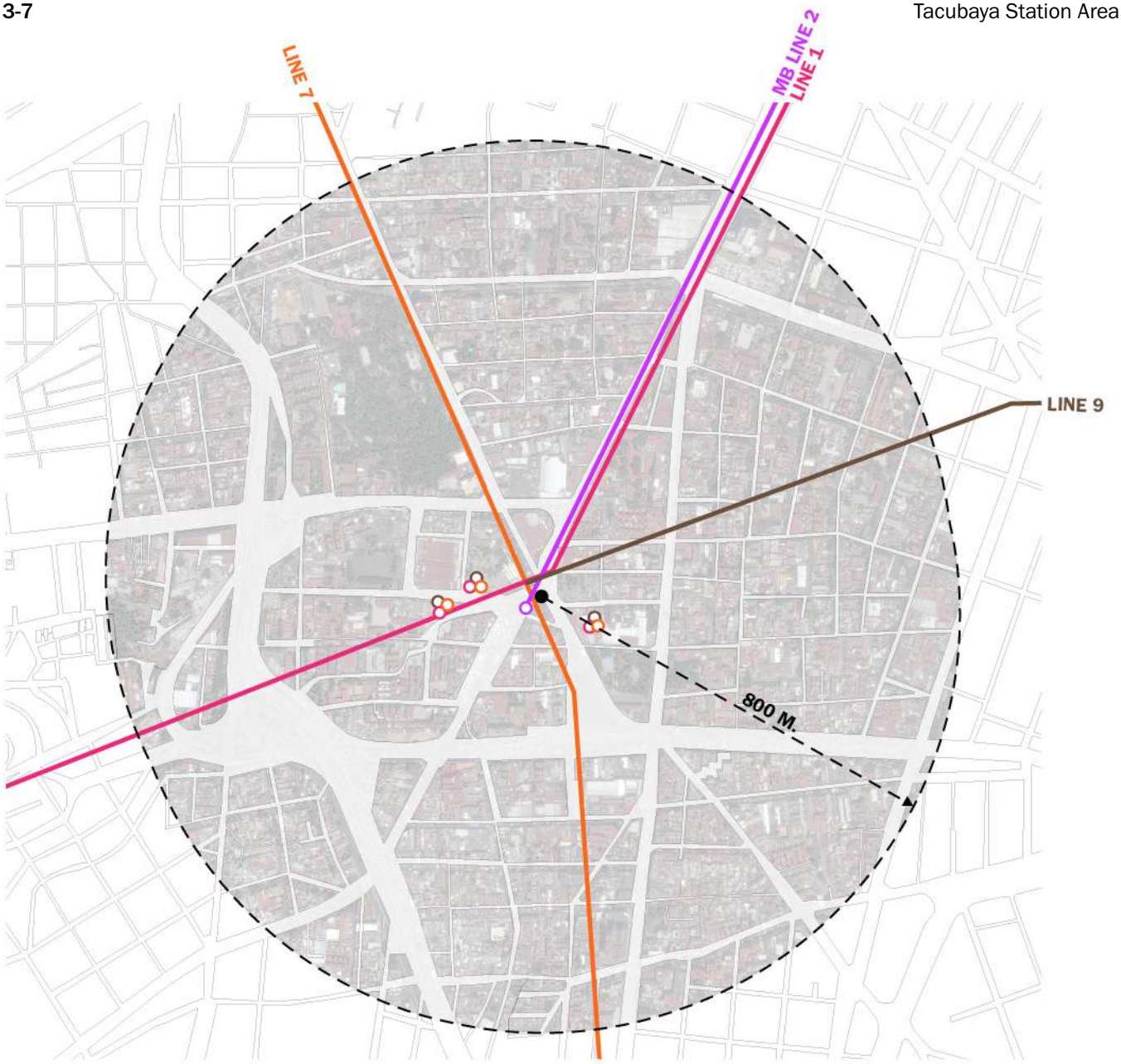
31,048 Residents

11,757 Households
59% Lack Car Access

51% Employment

22 Schools

FIGURE 3-7 Tacubaya Station Area



TACUBAYA SCORE

21/33 14/30 15/45 8/21

	TOD Element Name	Score	Reason
Accessibility	**Neighborhood connectivity**	●●●	Walkshed ratio is 86%
	Metropolitan connectivity	●●○	31 minutes to city center; 6.7 km
	Availability and ease of transfers	●●○	Connections between subway lines, microbuses and BRT are plentiful but chaotic. It is necessary to know where your bus is before you arrive because there is very little wayfinding. Transfers are also complicated by traffic and congestion and difficulty in accessibility.
	Non-motorized environment	●○○	It is very difficult to walk around Tacubaya because of congestion. There are primarily overpasses and underpasses that make pedestrians second class citizens.
	Variety of transportation options	●●●	All the modes are available except for bike share.
	Efficient movement of goods	●○○	Freight vehicles are forced to go through the heart of Tacubaya in order to reach other points in the city. It is located near the highway, but the congestion is neither beneficial for passengers, pedestrians or for freight movement.
	Diverse mix of activities	●○○	The land use mix is 0.18.
	Job/housing balance	●●○	The existing jobs/housing balance is 0.7. There are a number of jobs in Tacubaya, but they are not necessarily of a diverse set of industries or skill levels.
	Temporal distribution of activities	●●○	The neighborhood maintains an active street life during the day and afternoon, especially during rush hours, but slows down after around 6 pm. There are a variety of business types including informal, permanent market, clothes, chains, restaurants, etc. However, the commuting and transferring element can lead to a transient feeling of the neighborhood.
	Density	●●○	The area around the station of Tacubaya has significant underutilized land but Tacubaya is generally an active place.
	Parking considerations	**N/A**	Parking guidelines are unknown, but there is significant informal bus parking.
	Variety of options for "basic needs" trips	●●○	There are a number of markets in Tacubaya but a lack of medical services or entertainment.
Informality	**Services and utilities**	●●○	Only some vendors have electricity.
	Waste removal	●●○	Association organizes trash removal.
	Refrigeration	○○○	No cold storage exists.
	Access to Storage	●○○	Some stalls have on site storage within permanent stall structures, but most must carry their goods in daily.
	Protection from inclement weather	●○○	Some vendors have space in permanent stalls with roof structure, but most are in semi-fixed structures or sell their goods under an umbrella or on a blanket.
	Access to foot traffic	●●○	Vendors are able to set up in subway tunnels, on pedestrian bridges and around subway entrances. The vendors that are not in favor with the leaders get locations further away from foot traffic.
	Avoids Congestion	●●○	Stalls are often located on tight sidewalks and the loading platforms for buses making it difficult to walk in places.
	Health Standards	●●○	The are no food standards enforced.
	Liveliness of the streetscape	●○○	Vendors activate what would otherwise be empty tunnels and alleys.
	Protected vending locations	●○○	A strong vending association protects the interests of the vendors

	TOD Element Name	Score	Reason
Design	**Human-scale block dimensions and a density of intersections**	●●○	Most of the blocks fulfil the required dimensions but an important presence of physical barriers divide the connectivity of the area
	Interaction between interior and exterior active spaces	●○○	Some ground floor uses allow interaction. However most of the buildings facades are in bad shape and are not transparent enough.
	Pedestrian-oriented and scaled streetscapes	○○○	Very poor conditions for pedestrians. The open spaces are taken by vendors, large barriers do not allow easy crossing. Sidewalks are narrow and there is no furniture and amenities for pedestrians.
	Bicycle-oriented streetscapes	●●○	There is one bike lane in the area but it is around 3 blocks away from the station.
	Legible street network	●○○	Although the street network seems to be connected to the surrounding neighborhoods, large elevated street sections require pedestrians to use over and underpasses. The area has potential is those barriers disappear.
	Density of intersections	●●○	High number of intersections in the area except for the barriers form by the Periferio and Revolucion avenue.
	Proximity of open space	●●○	There are several squares and parks in the area, including a large park in the north but they are not easily accessible from all the Tacubaya area.
	Limited conflict points between drivers and pedestrians	●○○	Low intersection density may reduce conflict points, but poor crossing infrastructure for pedestrians increases jaywalking.
	Pleasant street level environment	●○○	Street level is in bad shape and the excess of buses in the streets generate a lot of noise and pollution. Narrow sidewalks, a lot of trash from the street vending.
	Freight design considerations	○○○	No freight design.
	Variety of active ground floor uses	●○○	Inside the residential areas is deficient and in the commercial streets is not transparent enough. Only few buildings have active transparent ground floors.
	Flexible street parking considerations	○○○	All the buses park in the street. Most of the public space is used as bus parking
	Preservation and enhancement of historic elements	●○○	Some historic or relevant artistic buildings. They are poorly consider or not consider at all in the urban design.
	Proximity of travel modes to each other	●○○	It is a large transfer area with buses but the pick-up/drop-off points are not clearly defined. There is no bike-sharing in the area.
	Wayfinding elements	○○○	No wayfinding elements in the area.
Affordability	**Access to jobs**	●●●	Gravity score of 7.48, highest of the 4 stations studied.
	Household income	●○○	Tacubaya's socioeconomic level is C+, which translates to approximately $20,744 monthly median household income, and is slightly less than the monthly median income for the city as a whole (INEGI).
	Homeownership Affordability Measure	○○○	Tacubaya's average for sale housing unit would be affordable to households making 185% of the Area Median Income for all of Mexico City.
	Rental Affordability Measure	●○○	Tacubaya's average rental property would be affordable to 158% of the Area Median Income for all of Mexico City.
	Cost burden ratio	●○○	To afford the median rent in Tacubaya, a household earning the current neighborhood household income would need spend 48% of their income on housing, above the 30% affordability threshold.
	Housing market growth rates	●○○	Average home values in the zip codes surrounding Tacubaya increased on average 12% per year between 2010 and 2014, far above the average of 6.5% per year for Mexico City as a whole.
	Vacancy rates	●○○	INEGI data indicates that 16% of housing units are unoccupied in the Cuatro Caminos area.
	Range of tenancy types	**N/A**	

El Rosario

DESCRIPTION

El Rosario is the northwestern terminal station of the six and seven subway lines. The station lies at the border of Mexico City and the State of Mexico, on the Mexico City side. Most passengers traveling through the station arrive by minibus from the outer suburbs of the city, although immediate surroundings of the station include schools and universities, a mall, a large logistics hub, and fairly dense neighborhoods. The logistics hub and a large rail yard on the eastern side of the station significantly reduce the walkshed in the area, limiting access to the station from the surrounding neighborhood. There are several walled off or closed parks and vacant parcels in the area, and informal vendors cater to commuters along the sidewalks near the station. The station was recently reconstructed by PRODI to include a shopping center, and in January 2016, a BRT station opened just north of the station perimeter, part of the Metrobús Line 6.

BASIC FINDINGS

- Affordability: Vacant land in the area could be used to build out TOD, particularly affordable housing and healthcare facilities.
- Connectivity: Expanding site access by removing barriers to entry around public land.
- Legibility: Improve access by introducing wayfinding, both in the station complex and in the surrounding area.
- Safety: Improve perceptions of safety by removing barriers.
- Transport: Use simple technology improvements to decrease transfer time and complexity.

CETRAM STATISTICS (AS OF 2012)

- Modes public transportation: 5
- Daily transit users: 187,000, of which 108,000 use the subway and 79,000 use buses

SURROUNDING COMMUNITY STATISTICS (2014)

43,468 Residents

6,239 Households
56% Lack Car Access

41% Employment

10 Schools

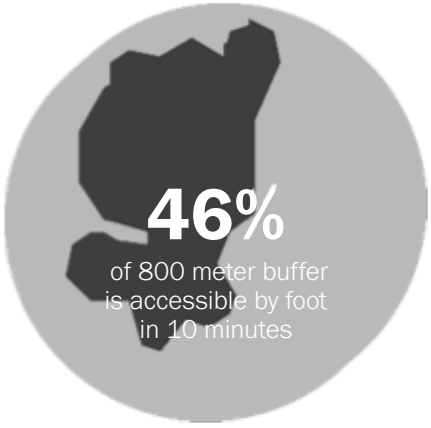


FIGURE 3-8 El Rosario Station Area

EL ROSARIO SCORE

19/33 6/27 11/42 12/24

	TOD Element Name	Score	Reason
Accessibility	**Neighborhood connectivity**	●○○	Walkshed ratio is 46%
	Metropolitan connectivity	●○○	45 minutes to city center; 10.6 km
	Availability and ease of transfers	●○○	Transfers are possible between two subway lines, one Metrobus line and many microbuses within relatively close proximity. However, any transfer between the metro and other modes require multiple flights of stairs and navigation of the mall above the CETRAM. In addition, the Metrobus station is physically separated from the rest of the CETRAM by a 500 m divider with perceived safety issues.
	Non-motorized environment	●●○	Within the residential neighborhood, there are many pedestrian-only streets, but the area closest to the station is dominated by high-traffic streets, without safe access for pedestrians or bicyclists.
	Variety of transportation options	●●○	Metrobus, subway, minibus lines, cabs, and local scooter services.
	Efficient movement of goods	●●○	Large freight hub in the area.
	Diverse mix of activities	●●○	Land use mix is 0.57.
	Job/housing balance	●●○	Area has many colleges, a large logistics hub, and residential neighborhoods.
	Temporal distribution of activities	●○○	As a commuter hub, crowding is much higher during rush hours than non- peak hours and weekends.
	Density	●○○	Relatively high density residential neighborhoods, but otherwise large parcels of vacant land.
	Parking considerations	●○○	Unknown zoning for parking, but underused parking available at CETRAM site.
	Variety of options for "basic needs" trips	●●●	Within the two local malls, there are supermarkets, shops, and movie theaters. Also in the area are schools and residences.
Informality	**Services and utilities**	●○○	Electricity connections available.
	Waste removal	N/A	
	Refrigeration	○○○	No cold storage exists.
	Access to Storage	●○○	Storage may be available in closed stalls.
	Protection from inclement weather	○○○	Vendors only have the protection that their stalls provide.
	Access to foot traffic	●○○	Vendors are on the street opposite the station and along the pass through the park to the adjacent neighborhood after being removed from the bus platforms themselves.
	Avoids Congestion	●●○	There are few vendors to create congestion because they are restricted access to the transit station.
	Health Standards	●○○	The are no food standards enforced.
	Liveliness of the streetscape	○○○	Few vendors exist.
	Protected vending locations	○○○	Vendors were removed from their locations on the platforms.

	TOD Element Name	Score	Reason
Design	**Human-scale block dimensions and a density of intersections**	●○○	Adjacent neighborhood has fine grained, pedestrian street network. Outside of residential neighborhood, area is dominated by very large blocks.
	Interaction between interior and exterior active spaces	○○○	Little or no ground-floor transparency, high walls.
	Pedestrian-oriented and scaled streetscapes	●○○	Very good within the residential neighborhood and very poor in the surrounding area, most of station perimeter.
	Bicycle-oriented streetscapes	○○○	No bike infrastructure in streetscape.
	Legible street network	●○○	Very good within adjacent neighborhood, but large blocks, large buildings, and walls hinder legibility of the area.
	Density of intersections	○○○	Large blocks, low intersection density.
	Proximity of open space	●○○	Open space exists, but is largely inaccessible.
	Limited conflict points between drivers and pedestrians	●○○	Low intersection density may reduce conflict points, but poor crossing infrastructure for pedestrians increases jaywalking.
	Pleasant street level environment	●○○	Narrow sidewalks, wide, busy streets, high walls, and lack of shade makes the pedestrian environment inhospitable.
	Freight design considerations	●○○	Large freight hub located nearby, but little separation for large trucks.
	Variety of active ground floor uses	●○○	Very good within the residential neighborhood and very poor in the surrounding area, most of station perimeter.
	Flexible street parking considerations	●●○	Well used bike parking, underused car parking. Potential to remove car parking in Phase II.
	Preservation and enhancement of historic elements	**N/A**	
	Proximity of travel modes to each other	●○○	Well-used bike racks, but no on-street bike infrastructure, high speed roads in area limit bike accessibility.
	Wayfinding elements	○○○	Wayfinding inside and outside station is barely present and difficult to interpret.
Affordability	**Access to jobs**	●○○	Gravity score of 2.65, below the mean for the Mexico City subway system.
	Household income	○○○	El Rosario's socioeconomic level is C, which translates to approximately $14,419 monthly median household income, and is substantially less than the monthly median income for the city as a whole (INEGI).
	Homeownership Affordability Measure	●●○	El Rosario's average for sale housing unit would be affordable to households making 95% of the Area Median Income for all of Mexico City.
	Rental Affordability Measure	●●○	El Rosario's average rental property would be affordable to 87% of the Area Median Income for all of Mexico City, making it the most affordable station area we studied.
	Cost burden ratio	●●○	To afford the median rent in El Rosario, a household earning the current neighborhood household income would need spend 38% of their income on housing, which is only slightly above the 30% affordability threshold.
	Housing market growth rates	●●○	Average home values in the zip codes surrounding El Rosario increased on average 8% per year between 2010 and 2014, which is above the average of 6.5% per year for Mexico City as a whole.
	Vacancy rates	●○○	INEGI data indicates that 11% of housing units are unoccupied in the El Rosario area.
	Range of tenancy types	●●○	Includes single family homes, apartments, and housing complex for union members.

4 | LEVERAGING SITES FOR TOD

4 | LEVERAGING SITES FOR TOD

Site-Specific Critiques and Recommendations for TOD Growth

SAN JOAQUIN

Affordable Housing Requirements

Development Incentives

Preserving Affordability for Long-Time Residents

Public Land Disposition Plan, Standards, and Incentives

Public Land Acquisition Plan

Building Form Standards

Public Space Standards

Pedestrian and Bicycle Network Improvements

Travel Mode Integration Design for Station

CUATRO CAMINOS

Accessibility and Design Standards

Inclusion of Informal Vendors

Freight Coordination

TACUBAYA

Bus Station and Traffic Flow Reorganization

Traffic Pattern Adjustments

Quick Win Projects

Affordable Housing Incentives

EL ROSARIO

Community Land Trust

Microbus Technology

Wayfinding

SAN JOAQUÍN STATION AREA RECOMMENDATIONS

Designing for Affordability at the Neighborhood Scale

Site Introduction

As noted in the TOD Framework, the San Joaquín site area simultaneously has the highest average housing prices and the lowest median income of the four sites analyzed. Prices are likely rising fast in response to the significant growth taking place in nearby Polanco, Granadas, and other employment areas. In order to allow long time lower income residents to stay in place, and for new residents of a range of incomes to be able to afford to live in San Joaquín, multiple strategies will be necessary to create and preserve affordable housing.

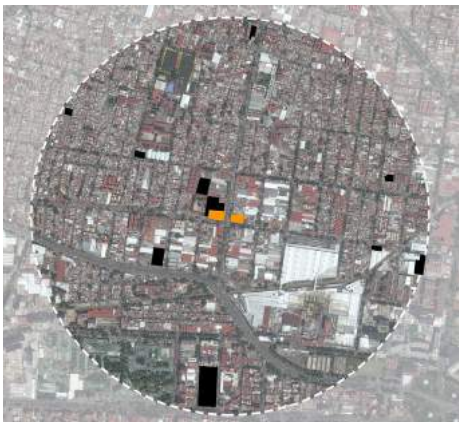
In order to create new affordable housing, applying certain incentives and regulations to the station area through a TOD zone instrument (discussed further in Chapter 5) could set a favorable and predictable environment for private developers to build affordable housing without the requirement of public subsidy. Essentially, allowing for increased density and less parking requirements can enable private developers to build more housing at lower cost and still earn a profit, depending on the market conditions and levels of requirement.

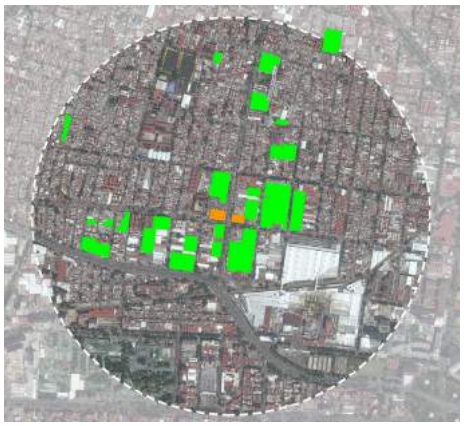
From a physical urban design standpoint, the San Joaquín Metro Station Area currently features several of the physical attributes of quality transit-oriented neighborhood, namely a street network characterized by human-scaled block lengths highly conducive to pedestrian trips. The consistent repetition of this block pattern throughout the station area creates an identifiable formal character for the neighborhood, and also serves as a clear physical framework in which future development can locate while still maintaining the highly pedestrian-oriented condition of the neighborhood.

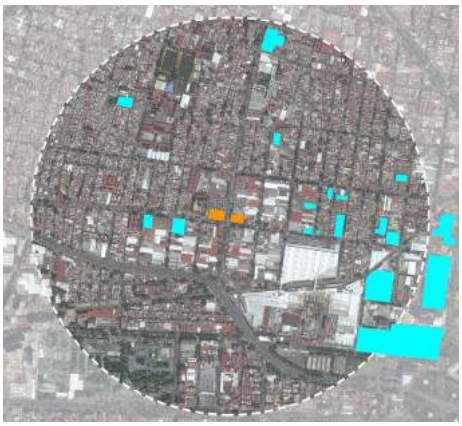
Despite a robust network of walkable streets, there is a disparity of development densities between the blocks in the station area that creates an unpredictable development context, both in terms of urban form and street-level activity. Throughout the station area there are low-rise warehouses with two-story freight entrances abutting one- and two-story residential buildings, and there are parking lots abutting 6-story multi-family buildings. Lago Hielmar, despite its integral role as a key connector to the San Joaquín Metro station from surrounding commercial districts like Granada and Polanco, contains numerous warehouses and auto-oriented development types along its frontage. These underutilized development conditions prevalent in the Station Area offer an opportunity to thoughtfully and contextually introduce new affordable housing units, public open space, and transit and mobility circulation through infill development.

The following sections describes our affordable development modeling approaches, aimed at understanding both the financial and physical feasibilities of introducing denser infill development, public open space, and circulation improvements at both the district-wide and Metro station scales.

San Joaquin Station Area







Left to right: Land dedicated to surface parking, Low-rise warehouses and other underutilized parcels, new multi-family and office development

District-Wide Strategy Recommendations

While some infill development is beginning to occur in the San Joaquín station area, substantial portions of the area remain underutilized, including surface parking, automotive uses (e.g. car sales lots), and one-story warehouses (Figure 1). While the zoning of these areas allow for mixed use and residential development, redevelopment appears to be taking place slowly, and much of the area is still zoned for 3-story development only. For our analysis, we examined potential incentives, regulations, and guidelines to support incremental infill development that meets the goals of preserving affordability, improving public space and circulation, and increasing density.

AFFORDABILITY

In order to create new affordable housing in San Joaquín, leveraging the strong real estate market combined with a package of inclusionary zoning requirements and development incentives could yield a continuous stream of new affordable units. Throughout our recommendations, we use area median income (AMI) to define income brackets.

- Affordable housing requirements: We recommend requiring a certain percent of affordable housing for residential developments that receive development incentives. Our pro forma analysis indicates that with moderate levels of development incentives, requiring 20% of units affordable to 80% AMI could be feasible. With additional development incentives, higher numbers of affordable units at deeper levels of affordability (30-50% AMI) could be feasible, though more analysis is needed to ensure accuracy.
- Development incentives: We recommend offering reductions in required parking and density bonuses in order to incentivize the production of affordable housing while simultaneously supporting other TOD goals of reduced driving and higher densities. Specifically, we examined density bonuses of 1.5x the base FAR and 2x the base FAR, the second of which is what Monterrey has introduced in its TOD areas. For parking reductions, we examined reducing the requirements by 50% and 100%. By increasing the number of units developers could build, and reducing the costs of parking, the city government or local governance could require a certain percentage of construction of affordable units while still enabling the developer to earn a return. Additionally, other development incentives could be considered, such as reduced permitting time and costs.
- Preserving affordability for long time residents: In addition to new housing stock, preserving affordability for long time residents of San Joaquín is essential to guard against neighborhood instability. Preserving affordability in rapidly changing real estate markets is challenging and will require separate and complementary policies and efforts to the package of requirements and incentives described above. Specifically, we recommend further analysis of the following initiatives aimed at preserving affordable housing for long time residents of San Joaquín:

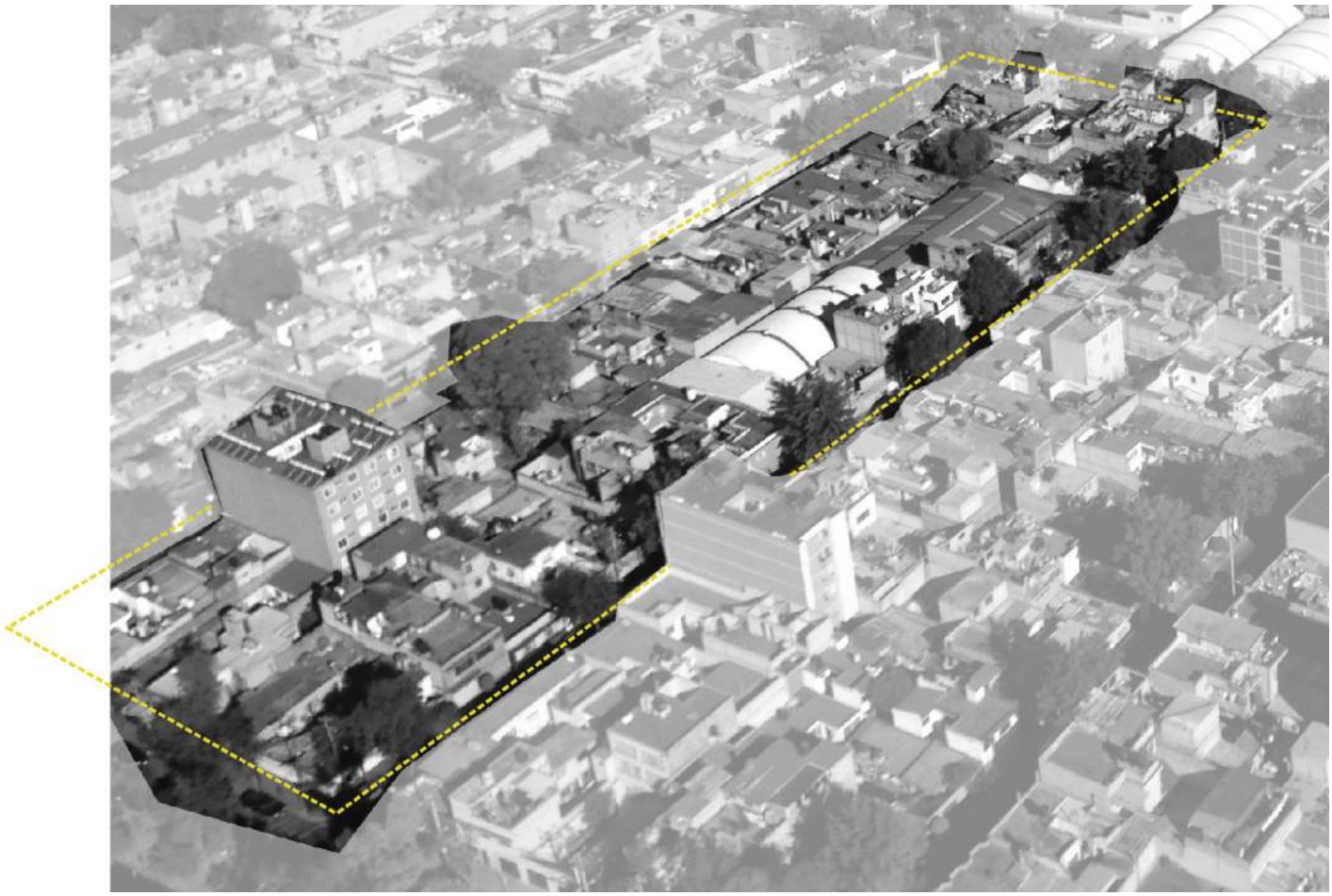
  → *Community research: First, we recommend undertaking a community engagement and research effort to understand the housing needs of existing San Joaquín residents. Anecdotally, many locals have been residents for multiple decades, incrementally improving their homes over time. The degree to which current residents are cost burdened by property taxes, maintenance, or other costs, is unknown, along with any specialized needs they may have, such as senior housing.*

  → *Property tax relief: For those suffering from rapidly rising property tax costs, create program whereby they can defer tax payment until sale.*

  → *Maintenance support: Connect low income homeowners to maintenance grants, either through a city funded program or Infonavit and other federal homeowner renovation programs.*

  → *Stabilization vouchers: If the city were to pursue a rental voucher program, discussed further in Chapter 5, priority could be given to long time residents of a neighborhood in order to encourage neighborhood stability.*

Left: Low-rise warehouses make up the dominant building typology in the San Joaquin station area
Right: 5-story multi-family buildings are scattered throughout the station area



A typical station area block measuring 110 by 200 meters

DESIGN

One of the more common block types found throughout the Station Area is one shown in Figure 2, a mixture of low-rise warehouse structures and 5- to 6-story multi-family residential buildings on a block roughly 110 by 200 meters. In this district-wide development scenario, numerous parcels could either be consolidated for purchase by a single owner and then redeveloped to infuse both residential density and new open spaces into the existing block, or development could take place incrementally with small patches of parcel redevelopment within a block. These development recommendations illustrate the flexibility that the San Joaquín station area represents, with options for a range of scales and timelines.

Building Form

- Buildings abutting a street should have an active facade on the ground floor with commercial uses, and should clearly define the street space. Facades located along block border should also be at 50% active with commercial land use.
- In terms of building types there should be variation in terms of number of floors, typology and styles. Roughly 20% of the building footprint should correspond to units with a private garden (which does not prevent having additional units on top floors). For each scenario, roughly 20% of buildings should be low rise, 60% mid-rise, and 20% high-rise, where these definitions vary depending on the scenario.
- Existing residential buildings should be preserved and building layouts should promote their integration within new development.
- New development could be incrementally introduced to the neighborhood at a variety of scales–either with entire blocks being redeveloped all together, or in a more patchwork fashion with only a few parcels within a larger block redeveloping at once.

Public Space

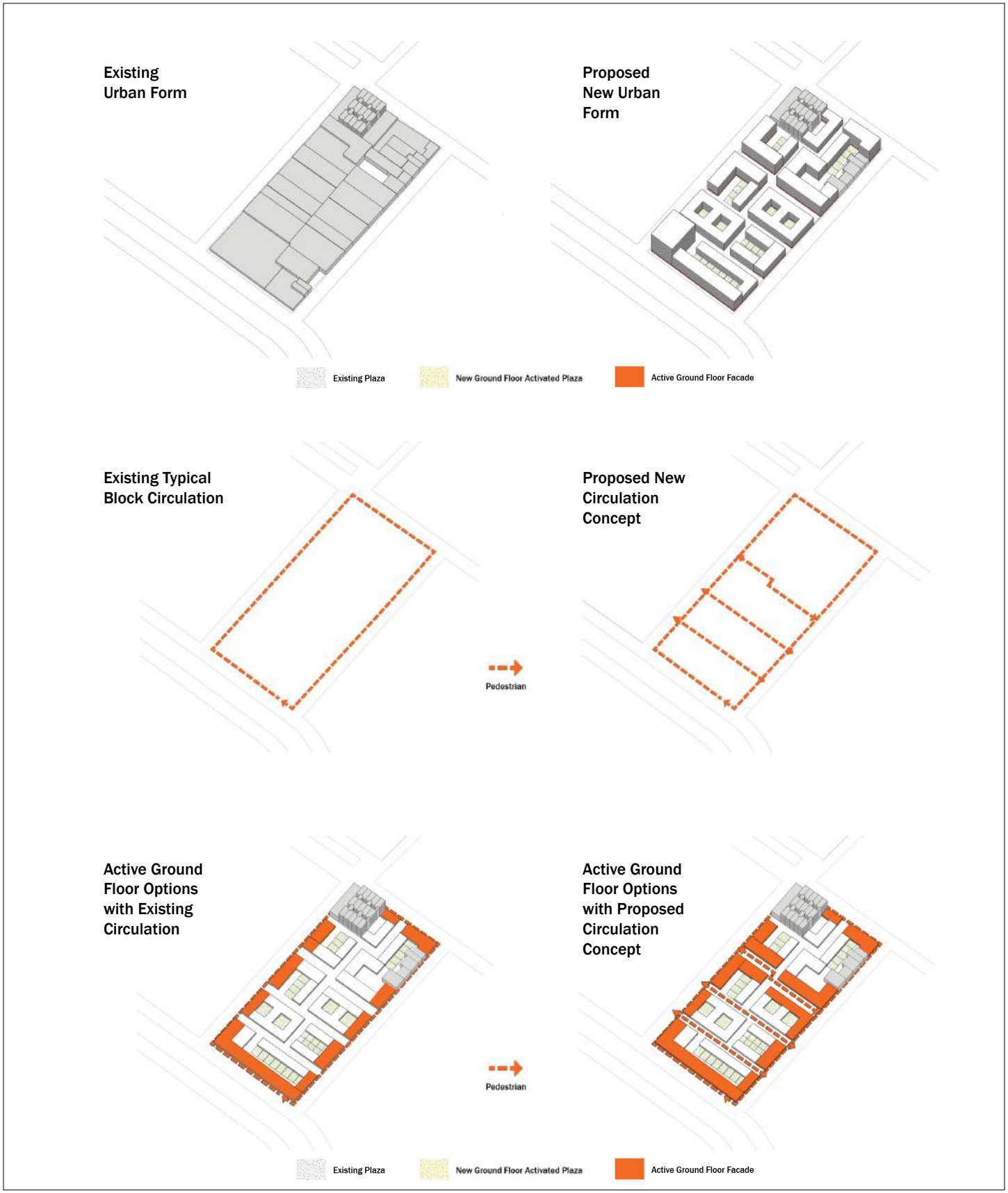
- We recommend that redevelopment create at least one new public non-vehicular street cutting through a block. San Joaquín's rectangular blocks have one side that is longer than 190 m (the maximum block length according to ITDP's standards). Having redeveloped blocks with new crosscutting streets will reduce block length by up to 50% and increase walkability and active ground floor façade totals throughout the area. Guidelines for new public non-vehicular streets include the following: a width between 9 and 12 meters, to allow for access for vehicles in service or emergency situations.
- New streets should cut blocks roughly at mid points, so that a sequence is created once all redevelopments have occurred.
- Additional streets, whether public or private, cannot be narrower than 9 meters.

ACCESSIBILITY

Our district-wide accessibility-enhancing measures are intertwined with the design recommendations outlined above. Broadly, they rest on enhancing the pedestrian connectivity of the area and creating an urban environment that is pleasant and safe for those on foot and bicycles.

We propose the installation of new infrastructure to connect the San Joaquín Metro station to surrounding employment centers, as well as the enhancement of existing pedestrian and bicycle connections. San Joaquín has a unique asset in the multi-modal path that runs along a reused train track. It connects the station to Plaza Carso and other business centers in Nuevo Polanco. Targeted improvements that improve the conditions of the multi-modal trail and district-wide connections to it could incentivize commuters to choose active forms of travel for the first of last section of their trip, relieving congestion, and preserving the livability of the neighborhoods.

FIGURE 4-1 Typical Block Development Scenarios



District-Wide Justification

For our analysis, we examined the potential redevelopment of a relatively common building typology in the San Joaquín area: low rise warehouses. While the San Joaquín station area is primarily residential, the area also contains substantial numbers of blocks dominated by large one story warehouses, surface parking lots, and other auto-oriented uses such as car dealerships. Given the area's excellent transit connections and access to employment centers, incentivizing the redevelopment of these relatively underutilized parcels could provide more housing, affordable to a range of incomes, in a prime location.

PRO FORMA ANALYSIS

To understand thee potential for equitable development surrounding San Joaquín station on underutilized parcels, we conducted a basic pro forma analysis to test different levels of development incentives and affordability requirements, and understand the relative financial impacts to a developer. For this analysis, we looked at an illustrative set of adjacent low-rise industrial warehouse properties to get a potential approximate site size for redevelopment. The site we examined would cover more than half of a city block (currently warehouses), or approximately 18,543 m2. Assuming 30% open space (generally required by current zoning) that could be dedicated to public spaces, new alleyways, and other uses, the buildable area would be 12,980m2. We also assumed that part of the ground floor area of the development would be devoted to retail uses in order to activate the streetscape, or 5,085 m2. Ultimately, smaller individual low rise parcels could also be redeveloped, but for this analysis we wanted to understand the potential design impacts for the redevelopment of a larger site. For all assumptions of the pro forma analysis, please see the Pro Forma Appendix.

Utilizing these inputs, we then tested three different scenarios of developing the site for rental units. To simplify the analysis and results reporting, we did not run the analysis for a potential for-sale development, though the relative returns between different levels of incentives and affordability requirements would likely be similar.

- Scenario 1: Business as usual: This scenario assumes the current zoning for the area, which generally allows for up to 4 floors in height, and building 100% market rate rental housing.
- Scenario 2: Moderate affordability and development incentives: This scenario is a moderate approach to allowing higher density and less parking requirements in exchange for a moderate level of affordability requirements (20% units affordable to 80% of the Area Median Income).
- Scenario 3: Higher affordability and development incentives: This scenario is a more ambitious approach that would enable higher density and zero parking requirements in exchange for a much higher level of affordability requirements (40% affordable units to a mix of AMI levels).

While the pro forma analysis should be interpreted as illustrative only, the results suggest that by providing increasing levels of incentives in combination with increasing affordability requirements, developers could build affordable housing and still receive similar or even increasing returns. These incentives would also support TOD in general by providing more housing units overall (affordable and market-rate) near transit than current zoning allows, with less parking, which will likely result in less traffic and higher transit ridership. These scenarios represent the tradeoffs policymakers and communities must make between allowing greater density and less parking (and the perceived impacts of these measures), and creating affordable housing (for which there is an obvious and substantial need).

District-Wide Implementation

These district-wide improvements could be made through the TOD Zone instrument, described in greater detail in Chapter 5, through which development incentives, affordability requirements, and financing mechanisms could be specified and managed. The TOD Zone would be planned, developed, and implemented through SEDUVI and the Delegación, in collaboration with neighborhood stakeholders.

TABLE 4-1 District-Wide Development Scenarios Pro Forma




	Scenario 1 *100% market rate* *1.0 FAR* *No parking reduction*	Scenario 2 *20% Affordable* *1.2 FAR* *50% parking reqt. reduction*	Scenario 3 *40% Affordable* *1.5 FAR* *100% parking reqt. reduction*
DEVELOPMENT PROGRAM			
Total units	605	742	947
Parking ratio	1.3	0.7	0
Parking spaces	790	485	0
Total FAR	2.8	3.36	4.2
Floors	4	5	6
% Affordable - 100% AMI			
% Affordable - 80% AMI		20%	20%
% Affordable - 50% AMI			10%
% Affordable 30% AMI			10%
COST BREAKDOWN			
Construction costs - % of total	39.5%	45.9%	55.1%
Parking costs - % of total	16.3%	9.6%	0.0%
Land costs - % of total	35.9%	34.8%	33.4%
Development/ impact fees - %	2.4%	2.8%	3.3%
REVENUES			
Annual NOI	$96,221,902.32	$100,786,977	$102,905,709
Project value (Year 1)	$1,603,698,372.00	$1,679,782,943	$1,715,095,142
PROJECT FEASIBILITY			
Profit (Project value - total project cost)	$758,371,434.73	$806,741,223	$804,953,791
% Profit (profit/total cost)	89.7%	92.4%	88.4%
Unleveraged IRR	17.6%	18.1%	18.1%
Leveraged IRR	32.8%	33.8%	33.7%

Site-Specific Recommendations: Leveraging Public Land for Public Good

Like many Metro station areas, the San Joaquín Station Area encompasses multiple publicly owned parcels that could be leveraged for different goals, including affordable housing or producing revenue for the Mexico City Metro. Specifically, we recommend considering redevelopment of the Metro station entrance parcels, the adjacent auto impound lot, and possibly in the future the nearby public market, and parts of the community center parcel. For this analysis, we looked at the Metro station area, where two station entrances which straddle Lago Hielmar and sit at the center of parcels roughly 8 times the size of their respective footprints. A City-owned vehicle impound lot borders the western station entrance parcel, offering an additional swath of underutilized land at a highly transit-proximate location.

AFFORDABILITY

We recommend careful consideration of how to best leverage publicly owned land in areas of the city with high land value, including to meet goals that support TOD such as affordable housing or transit revenue.

- Public land disposition plan, standards, and incentives: We recommend creating a plan and minimum standards for the use of public land for different purposes, such as a minimum percentage of affordable housing for land disposed of for residential development. This would create a predictable and transparent environment for development, that could also be leveraged for higher levels of affordability with higher levels of development incentives. While we examine leveraging public land for affordable housing primarily in this section, given the intense need in the San Joaquín Station Area, the revenue could also be split or set aside for revenue for the subway system.
- Public land acquisition plan: Given the high levels of vacancy and unoccupied units in San Joaquín and throughout Mexico City, we recommend the exploration of a combined set of tools aimed at transforming unoccupied, vacant, or underutilized land into new residential capacity. Specifically, we recommend considering the use of the city's current "preference right" (right of first refusal) policy in conjunction with a new TOD acquisition fund to acquire new land in TOD areas that could be leveraged for centrally located affordable housing, as discussed further in the Affordability section.

DESIGN

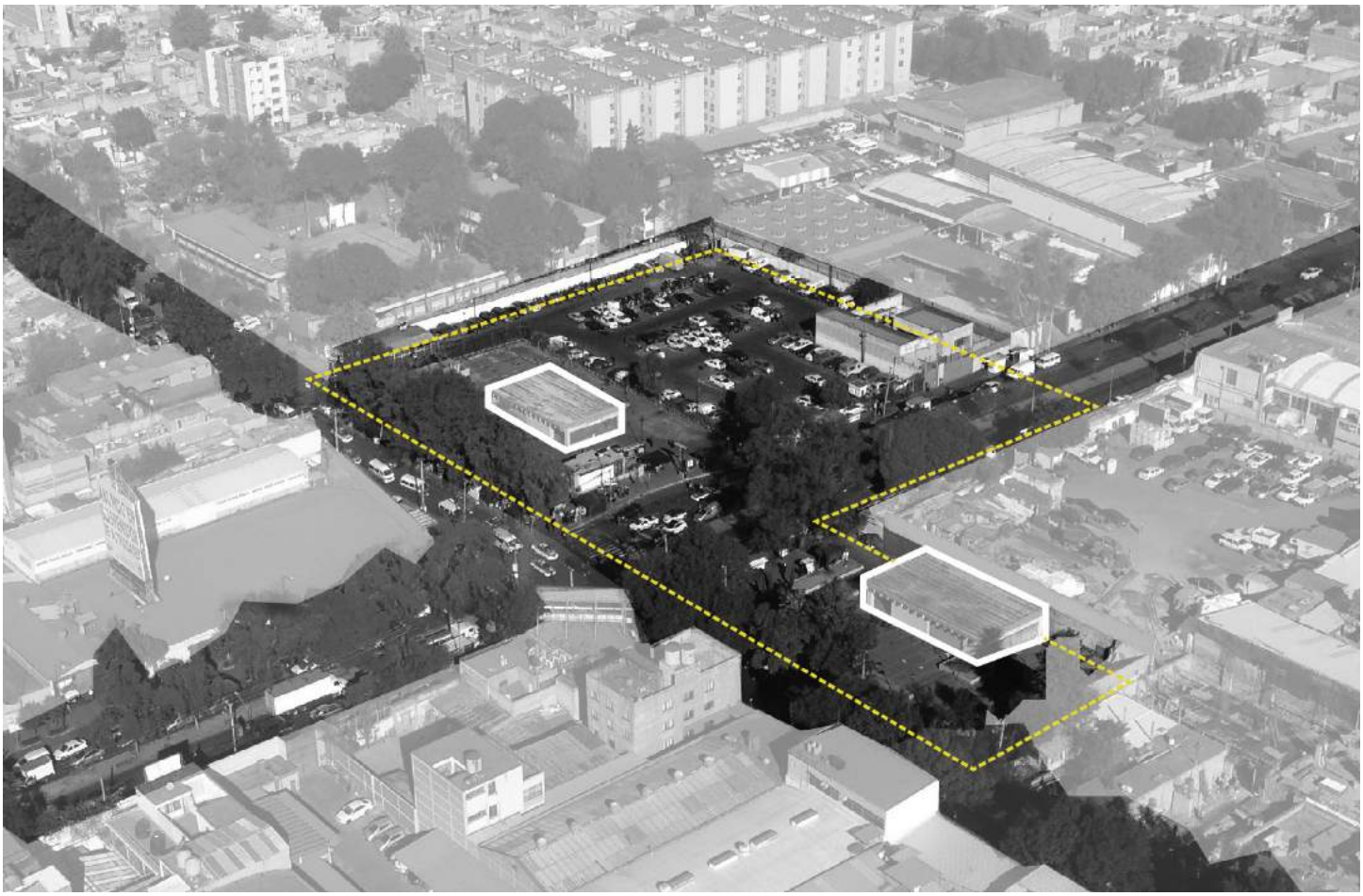
A lack of both street presence and floor area utilization of these large parcels–coupled with the fact that these are publicly owned properties–provide significant opportunity for a new and denser form of development that could serve as a gateway element to the neighborhood. Specific recommendations for redevelopment of the Metro Station site include guidelines for new building typologies, open spaces, and onsite transit circulation improvements.

Building Form

The station today lacks a formal design that both signifies its role as the gateway to the San Joaquín district and provides for a diverse range of district residents' daily needs. Its location at the intersection of Lago Hielmar and Laguna de Términos is an ideal location for targeted and thoughtful pockets of density that accentuate the role of the station area as a vibrant and bustling heart of the larger neighborhood and provide new residential and commercial uses that cater to both existing residents and commuters traveling through the area.

- New development on and around the existing station entrances should integrate commercial uses with residential above while respecting existing lower-density and sensitive uses that surrounding the station with lower heights, setbacks, and stepbacks.
- Building heights should be greatest along the public streets and immediately around the station entrances to highlight the sense of arrival to the station and the greater San Joaquín district.
- By introducing density along the public streets, new development will bring visual interest and character to the surrounding public streetscapes already heavily utilized by pedestrians moving to and from the Station. Buildings abutting existing public streets as well as new pedestrian connections should have an active facade on the ground floor with commercial uses that cater to daily needs of residents as well as the needs of nearby office workers (markets, banks, pharmacies, local restaurants and shops).
- Buildings should exhibit a range of heights and floor plate sizes to prevent monolithic forms and scales incongruent with a pedestrian-oriented environment.
- For each development scenario, roughly 75% of new buildings should be a mid-rise building type, while the remaining 25% should be high-rise to ensure maximum potential for affordable units and public open space.
- The layout of new buildings should promote a permeable and accessible onsite environment for the pedestrian with building footprints that carve out generous pedestrian walkways (6 meters in width or greater) and patches of open spaces.

Left: Each of the station entrances are surrounded by a large plaza that diminshes its street presence
Right: Minibus passengers board in the middle of a street with oncoming traffic



San Joaquin Station site

Public Space

The following open space guidelines will help create a cohesive and dynamic public space system around the Metro Station.

- Accessible surface level open space that encourages fluid movement from street to site and connects with surrounding patches of open space should be a central theme of a new station site development.
- New open spaces, roughly 230 square meters in size, should be integrated into the site to ensure high visibility from the surrounding public realm. The design and proportions of these spaces should be flexible enough to provide for a variety of different uses, from gathering and relaxing spaces, to dining or seating areas, to recreation and play spaces. As public spaces with private ownership, these spaces could be actively programmed by surrounding ground floor commercial uses or could take on a more passive form with local residents activating the spaces on a temporary basis through markets, concerts, and other civic events.
- Each station entrance should include a plaza or open space which serves as a hub of neighborhood travel. These spaces should include a variety of pedestrian, bicycle and transit amenities, such as seating, bicycle storage, illumination, and shelters for bus and taxi passengers.

ACCESSIBILITY

As public land owned by the Mexico City Metro and other public agencies this station site presents important opportunities for transit-oriented development that integrates travel modes onsite and off the street. By developing the existing station into a “mini-CETRAM”, transferring between mass-transit and “last-mile” options would be more efficient, and new commercial development types could be used to target both travelers and residents. Given high land values in the area, city officials should carefully consider the best way to leverage the value of the land they own for city goals, including providing affordable housing or transit financing.

Currently, in addition to a Route 7 Metro stop, the station-area features two mini bus transfer points and protected bicycle lanes along Lago Hielmar, which connect the station to a linear multi-use path less than 400 meters to the south. Minibuses, colectivo taxis, and corporate shuttles, mostly take riders to nearby employment centers in Nuevo Polanco and Granada, on short trips or less than a mile in length, and that could be easily done on non motorized modes of travel.

The boarding of these modes happens within the public right-of-ways of cars, pedestrians, and bicycles, causing conflicts and increasing congestion. Pedestrian flow is dispersed and disorganized, as is the informal commerce that follows it, and the cycle-track is blocked frequently by people waiting to transfer. This affects the urban environment in the neighborhood, making it an unpleasant and unsafe environment that remains largely empty during off-peak hours.

A small-scale integrated neighborhood transfer hub would direct micro buses, vans, corporate shuttles and taxis to an interior driveway that loops around the existing station, facilitating the fluid movement between the Metro and other “last mile” travel choices, and freeing up space for recreation and other uses. An ordered streetscape that is inviting to pedestrians and recreation. This approach can be implemented on several subway stations in the city, where disorganized transfers, although not as intensively as in large-scale CETRAMS, contribute to a poor urban environment and an unsafe travel experience.

FIGURE 4-2 Station Site Development Scenarios

Site-Specific Justification

PRO FORMA ANALYSIS

In the San Joaquín station area, we focused on the two parcels owned by the Mexico City Metro (currently open space), as well as an adjacent auto impound lot. In the future, a large public market a few blocks away represents another potential for public land redevelopment. Together, the Metro station parcels and auto impound lot represent 8400 m2. Again assuming 30% open space, the total buildable area would be 5880 m2. Assuming 20% of this buildable space is dedicated to common areas such as hallways and stairways, we estimated available ground floor space would be approximately 4074 m2. Given the important location, we envisioned using half of this available space for ground floor retail to activate the streetscape, and half for a possible "mobility hub" to facilitate last mile connections (discussed later in this chapter).

With these inputs, we then tested four different scenarios of developing the site for rental units with different mixes of development incentives, land subsidy, and affordability requirements:

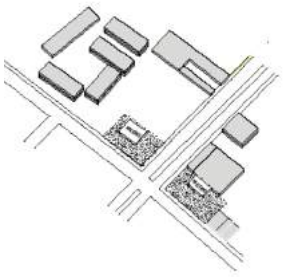
- Scenario 1: Business as usual: This scenario assumes the current zoning for the area, which generally allows for up to 4 floors in height, and building 100% market rate rental housing. This scenario represents the potential value to the city, and return to a developer if the land were simply sold or bid out for a long term lease for development.
- Scenario 2: Moderate affordability, development incentives, and land subsidy: This scenario is a moderate approach to allowing higher density, less parking requirements, and land subsidy in exchange for a relatively high level of affordability requirements. In testing different levels of affordability, we determined that 50% of units affordable to a range of income levels could be provided while maintaining similar levels of return and profit for the developer as Scenario 1. Given that the land is only partially subsidized in this case, some of the value of the land could still presumably be captured by the subway company, the owner of the land.
- Scenario 3: Higher affordability, development incentives, and complete land subsidy: This scenario is a more ambitious approach that would enable higher density, zero parking requirements, and complete land subsidy in exchange for a much higher level of affordability requirements. Through testing different levels of affordability, it was determined that up to 90% affordable units could be provided while still generating a similar return to the developer as Scenario 1.
- Scenario 4: High development incentives, high revenue for other uses: This scenario represents the potential revenue if the subway company and city government were to maximize the value of the land for other priorities, such as financing the transit system. This scenario would involve 100% market rate housing with 50% less parking, with a density bonus.

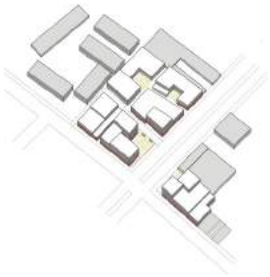
While the results are illustrative only and not indicative for a particular development proposal, the results do suggest the significant potential to leverage public land in a very strong real estate market like the San Joaquín area for the creation of affordable housing or other revenue purposes. By providing different levels of land subsidy and development incentives, developers could provide up to 90% affordable units (to a mix of incomes) while still earning a return. Moving forward, determining a policy that requires certain levels of affordability in the disposition of public land for residential development would be an important step for ensuring greater accountability, predictability, and transparency in the use of public land for public goods.

Site-Specific Implementation

As discussed further in the Affordability section, leveraging public land for affordable housing should be planned for and managed by a particular agency or set of agencies – including potentially SEDUVI, INVI, and the subway company as the owner of the land in this case - in order to identify parcels owned by different agencies, negotiate affordability requirements and incentives, and ensure compliance. Ultimately, it may be best to create a new sub-department of one of the agencies mentioned who could be tasked with public land acquisition and redevelopment aimed to meet city goals for affordable housing and more.

TABLE 4-2 Site-Specific Station Development Scenarios Pro Forma





	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	100% market rate *1.0 FAR* *No parking reduction*	*20% Affordable* *1.5 FAR* *50% parking reqt. reduction* *50% Land subsidy*	*90% Affordable* *2.0 FAR* *100% parking reqt. reduction* *100% Land subsidy*	*100% Market Rate* *2.0 FAR* *50% parking reqt. reduction* *100% Land subsidy*
DEVELOPMENT PROGRAM				
Total units	273	428	583	583
Parking ratio	1.3	0.7	0	0.7
Parking spaces	357	280	0	381
Total FAR	2.8	4.2	5.6	5.6
Floors	4	6	8	8
% Affordable - 100% AMI			30%	
% Affordable - 80% AMI		20%	25%	
% Affordable - 50% AMI		20%	25%	
% Affordable 30% AMI		10%	10%	
COST BREAKDOWN				
Construction costs - % of total	39.6%	57.9%	82.6%	70.0%
Parking costs - % of total	16.2%	12.4%	0.0%	15.3%
Land costs - % of total	35.9%	17.5%	0.0%	0.0%
Development/ impact fees - %	2.4%	3.5%	5.0%	4.2%
REVENUES				
Annual NOI	$43,665,350	$41,903,549	$35,294,795	$83,609,366.40
Project value (Year 1)	$727,755,840	$698,392,486	$588,246,578	$1,393,489,440
PROJECT FEASIBILITY				
Profit (Project value - total project cost)	$344,992,376	$306,240,486	$221,874,221	$960,918,160.11
% Profit (profit/total cost)	90.1%	78.1%	60.6%	222.1%
Unleveraged IRR	17.6%	17.6%	18.0%	26.9%
Leveraged IRR	32.9%	32.3%	32.7%	52.5%

CUATRO CAMINOS STATION AREA RECOMMENDATIONS

Design and Urban Form for Improved Walkability and Street Vending

Site Introduction

The CETRAM Cuatro Caminos contains the Metro station and two paraderos (bus terminals). A commercial and office building is under construction in the southern paradero and a provisional area has been set by the developers for the time being. A private company is in charge of the operation of the South paradero and hundreds of vans, taxis and buses from different companies enter the station paying a small fee. The platforms have been organized to group vehicles with similar route schedules. The northern station operates in a similar fashion, but the private sector has not yet intervened the area and is less organized. Additionally, more than 700 informal vendors, many of them members of three organizations, have fixed and semi-fixed stalls both in the South and North sides of the CETRAM, as well as on the sidewalks surrounding it.

The location of Cuatro Caminos gives it special challenges and opportunities for TOD. Contrary to most other stations in the system, Cuatro Caminos is located in the State of Mexico, and as a result metropolitan coordination is essential for successful TOD, since municipal/delegational and partial plans, zoning and land use regulations are set by different jurisdictions. Its proximity to Periférico and Río San Joaquín, two main highways that connect the city center to upper-middle class suburban neighborhoods connect the area to the rest of the city, but are main barriers for pedestrians and local traffic. Land value in the area has sharply increased in the last years due to the construction of office complexes and luxury shopping malls, such as the Toreo Mall, located only three blocks away from the station. The presence of large military facilities and cemeteries represents another barrier for pedestrians and new developments, but the industrial parks in Naucalpan have the potential to host new and affordable housing.

Cuatro Caminos Station Area

Accessibility and Design Recommendation

Cuatro Caminos is surrounded by huge blocks and other seemingly impenetrable barriers, like the Periférico, several cemeteries, and Escuela Militar de Transmisiones. The last three barriers are not changeable, realistically -- the street network, though still a challenge to change, offers a small ounce of potential. The street network and resulting block sizes are remnants of an industrial age, and they reflect the neighborhood's remaining industry. However, with policy efforts made jointly with community efforts and potential developers, the street network could be greatly improved. It's clear that these blocks are a barrier to pedestrianization, and even more, they are a barrier to having a successful, vibrant neighborhood for TOD.

We recommend a design solution that will divide large blocks. As an extension to the metric described in the Framework, we recommend reducing all block perimeters such that they are ideally 600 m and at most 750 m, total. Furthermore, we recommend making public right of ways through the nearby cemeteries and aim for a pedestrian connection through the military facility. These connectivity improvements also pave the way for a commercial corridor between Cuatro Caminos and Toreo Parque Central.

Accessibility and Design Justification

Currently the walkable conditions only cover the potential area from the 800m buffer from the subway station. This happens because the station is located in a large block which is additionally surrounded by two blocks with a similar length. Future development should not occupy the totality of the parcels without creating the proposed new connections. By requiring new streets that divide the large blocks and connect with the existing street network there is an important improvement in the walkability and overall connectivity of the area.

The eastern block is occupied by a large housing complex and several large parcels, by creating new streets, it is possible to see in Figure 4-2 that the residential neighborhood in the east is now accessible from the station. On the west the military facility presents a more challenging situation. Ideally just by creating a pedestrian connection (that would consider all the security requirements by the SEDENA) could allow access to an important industrial area on the other side, attractive for further development.

Furthermore, beyond the 800m buffer, the industrial area is a great opportunity for new development but it will be crucial to avoid large projects to occupy all the parcel. Breaking down the superblocks in order to fulfill the suggested metric will encourage the creation of a TOD neighborhood.

Accessibility and Design Implementation

There are layers of stakeholders involved in modifying the street network, which means that a process-oriented implementation strategy is critical. The steps shown in Table 4-3 reflect a potential sequence of actions. This is based in part on a project evaluation framework, as proposed by Jenkins and Harberger (2000).

This process will involve a concerted joint effort between public and private sector bodies and will involve both the Mexico City government (Miguel Hidalgo Delegation) and the Municipal government of Naucalpan.

TABLE 4-3 Sequence for Modifying Street Network

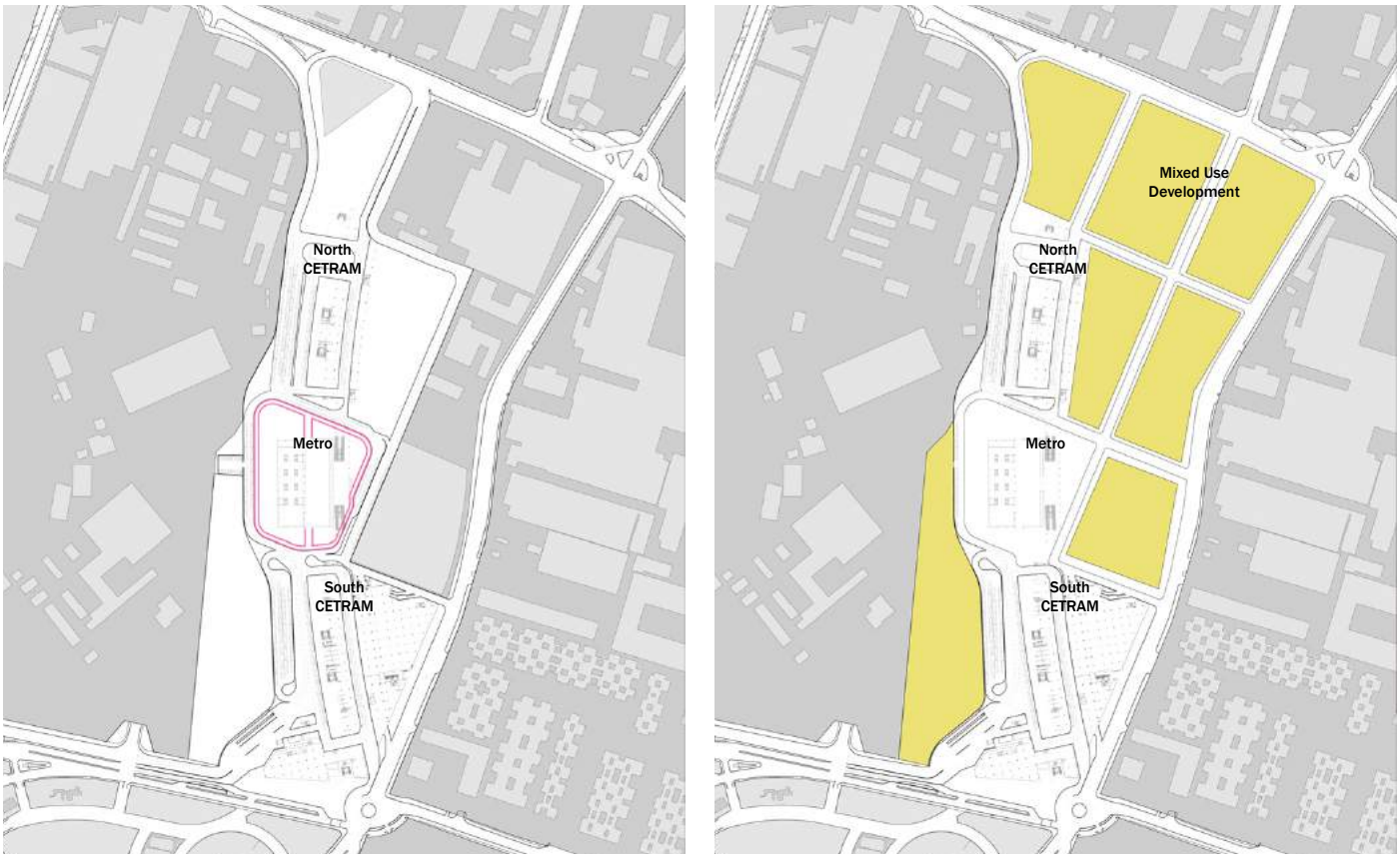
STEP	ACTION REQUIRED	DATA REQUIRED
1	Create a street network first-draft based on visual inspection in the immediate area from the subway station and CETRAM, aiming for all new streets to follow and connect with surrounding existing ones and following the block perimeter metric	On-the-ground observation Aerial map inspection
2	Examine the existing land use and parcel ownership as part of a viability study and initiate community outreach	Land-use map; parcel map; land ownership
3	Revise the proposed street network	
4	Develop a set of stakeholders based on the the viability study and revised proposal	Land ownership
5	"Open" gated streets in the surrounding neighborhood.	Open/closed street status

FIGURE 4-3 Walkshed Comparison between Existing and Proposed Grids

Current walkshed

Walkshed with the proposed street grid

FIGURE 4-4 Existing Block Structure and Proposed New Street Grid



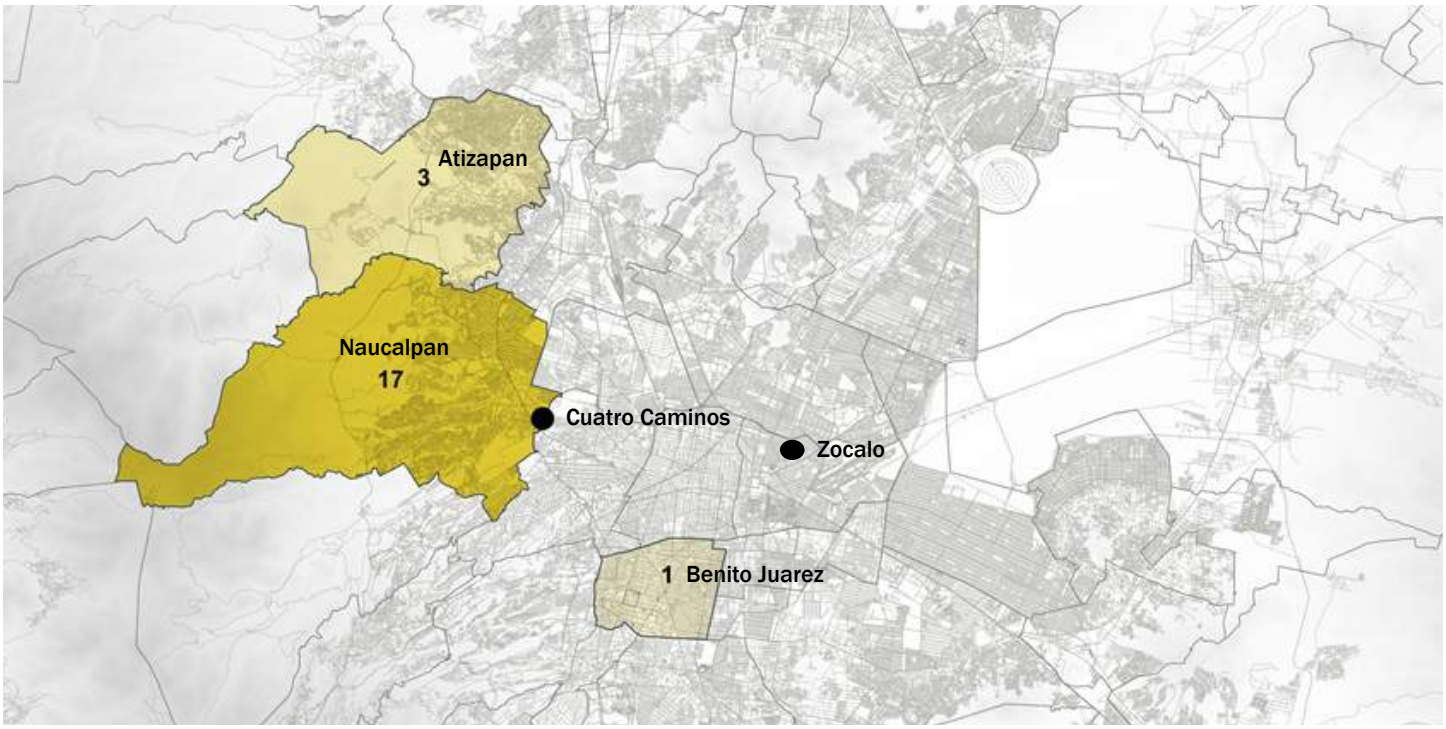
Recommendation for Inclusion of Informal Vendors

Since Cuatro Caminos is home to approximately 700 vendors, the new development on the site will have to consider how to include them in the future of the site. Despite their ad hoc appearance, vendors have often been in their locations for many years (see Figure 4-3) and live in close to their work (see Figure 4-4). If they are not included, many of them will be displaced and likely suffer financial loss. There is also the likelihood that many of them will attempt to stake out new territory on the public space around the new development that could cause congestion and detract from the viability of the retail center. We argue that if the vendors are included in the development, they can maintain their livelihood while also contributing to the attraction of the retail center.

OBJECTIVES

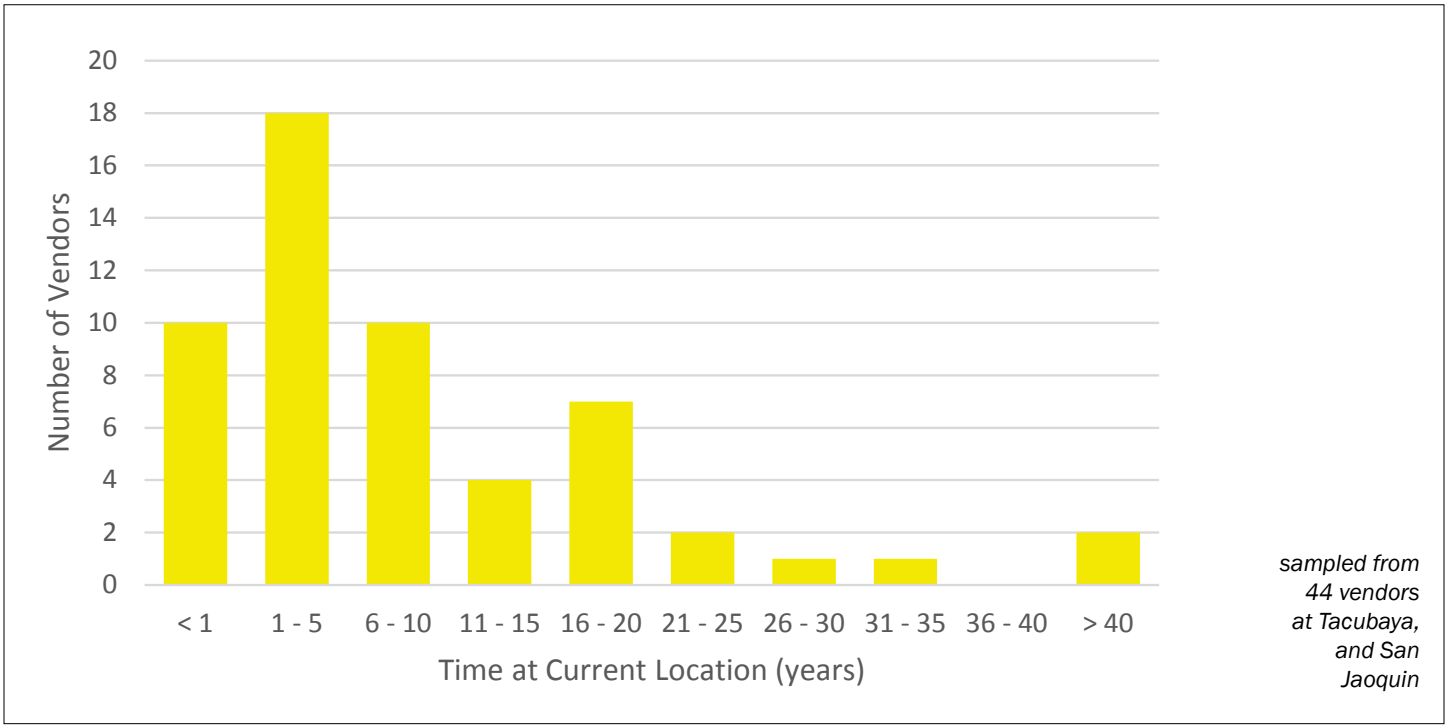
- Improve the quality of life, security, and income mobility of street vendors.
- Increase the vibrancy, efficiency, and safety of Mexico City's public spaces.
- Create an environment that attracts shoppers to the retail center.

FIGURE 4-5 Where Vendors from Cuatro Caminos Live



Portraits of vendors at Cuatro Caminos

FIGURE 4-6 Years Spent Working at Current Location



sampled from 44 vendors at Tacubaya, and San Jaoquin

Justification for Inclusion of Informal Vendors

VENDOR ASSOCIATION

Just like other CETRAMS, the Cuatro Caminos vendors are part of a vendor's association. The association negotiates with the local government to secure the use of space in the CETRAM. This arrangement does not provide legal protection to the vendors, putting them at risk of abuse and displacement. The current construction, for instance, has resulted in the displacement of the vendors from the south bus terminal. While they've been able to relocate to other locations on the site, once phase two is underway, the vendors will not have any place left to go. The association often exploits the precarious position of the vendors by keeping them in the dark about issues related to construction before displacing them at the last minute.

VENDORS' LOW RENT IS NOT PROFITABLE FOR DEVELOPERS

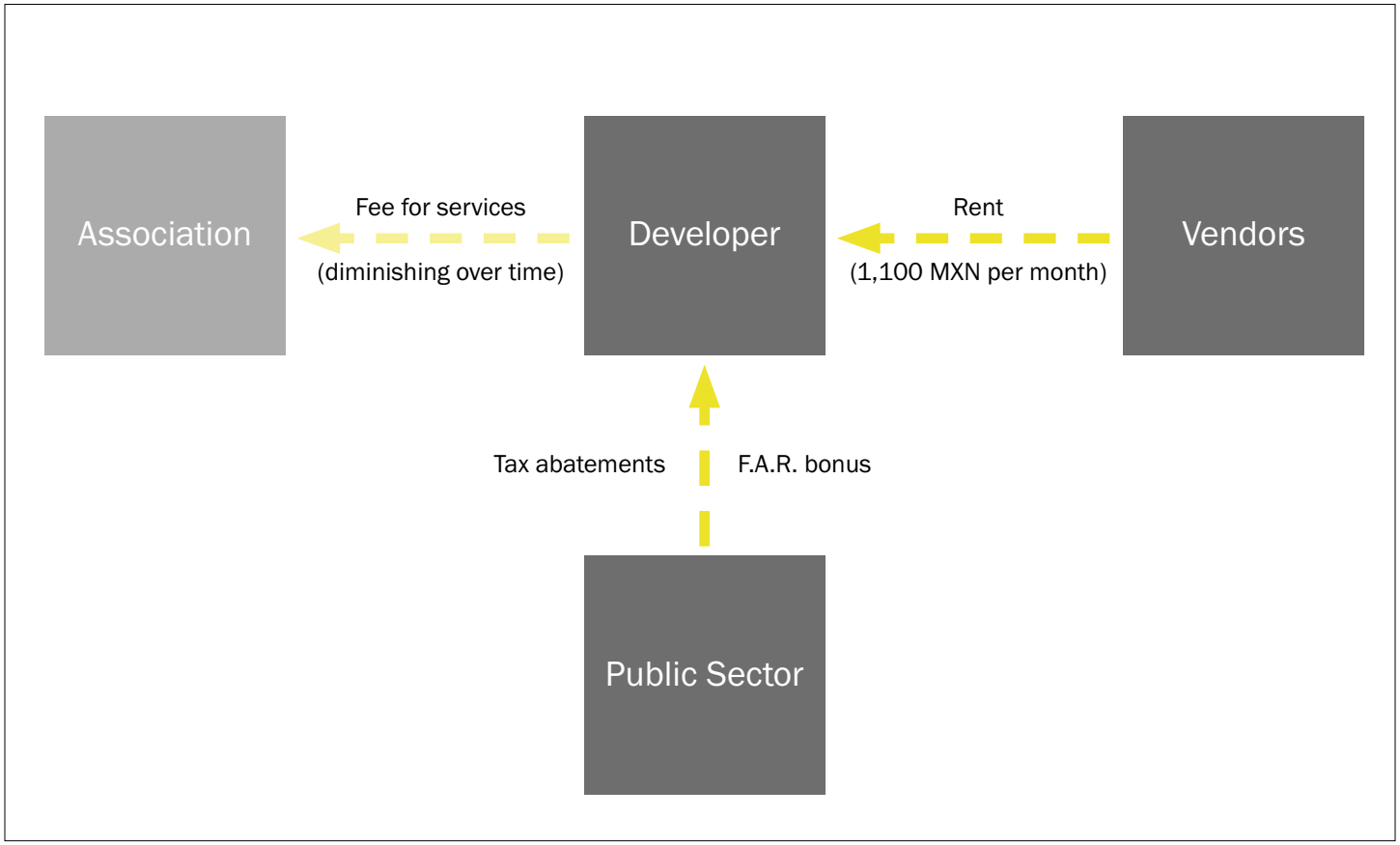
Currently, the vendors pay rent to the vendor association (see Figure 4-5). The association negotiates the rent on a vendor by vendor basis. Some pay as little at $400 pesos a month while others pay $2400. From our surveys (reference here) we've estimated the average rent per month is $1100. The low rent along with the inability for vendors to sign long term leases make them unattractive to try to integrate into the shopping center.

PUBLIC INCENTIVES TO ENCOURAGE VENDOR INCLUSION

With such low rent, how then can we incentivize developers to include informal vendors? We suggest a coordinated public-private effort that provides incentives and support to developers of CETRAMS to create opportunities for existing street vendors. These incentives would come from the public sector in the form of tax abatements and F.A.R. bonuses.

FIGURE 4-7 Current Arrangement between Vendors and Vendor Association

FIGURE 4-8 Proposed Arrangement with Developer and Public Sector Incentives



Implementation of Inclusionary Informal Vendor Process

THE VENDOR INCLUSION PROCESS

The first step is for the developer to hire a consultant which will provide much of the expertise and legwork for working with the vendors. The consultant will provide services in each step of the process to ensure that the vendors' interests are being recognized.

VENDOR IMPACT ASSESSMENT (EVALUACIÓN DEL IMPACTO DE LOS VENDEDORES, EIV)

The EIV is one of the most important steps in the vendor inclusion process. The EIV will be a comprehensive assessment of the vendors and their business. Working with vendors on an individual basis is crucial because vendors are diverse in their financial situation, business operations, and personal needs. Through the assessment, the team will be able to identify how to best accommodate the needs of the vendors. The likely outcome will not be a one size fits all, but rather a series of tailored paths which the vendors can choose to follow. Some vendors will have the option of getting a job at the new retail center or transportation center. Others' businesses will may want to take the step to formalization and rent space within the retail center. Still other may benefit best from their informal job and will seek ways to keep their current business on site. Each of this range of options must be considered in the resulting strategy.

LEVERAGING THE VENDOR ASSOCIATION

Because of the vendor association's political connections, it would be impossible to execute a successful plan without them on board. Rather than viewing the vendor association as an obstacle in the process, it's important that they are utilized it as an important partner. The association has the ability to organize the vendors and enlist their cooperation in the short term. In the longer term, they are able to enforce the plan and ensure that new vendors do not come and try to vend in places where they do not have permission. It is important, however, that the vendor association gets phased out in the long run.

FOUR POTENTIAL STRATEGIES FOR A CUATRO CAMINOS VENDOR INCLUSION PLAN

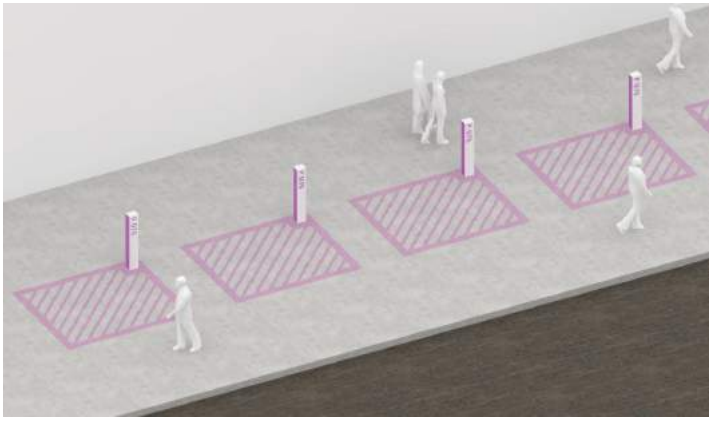
We drafted four potential strategies a developer could implement in a site-specific Vendor Inclusion Plan. We demonstrate the application of the four strategies on the Cuatro Caminos site, including design recommendations, conservative calculations of the number of incorporated vendor stalls and basic financial considerations.

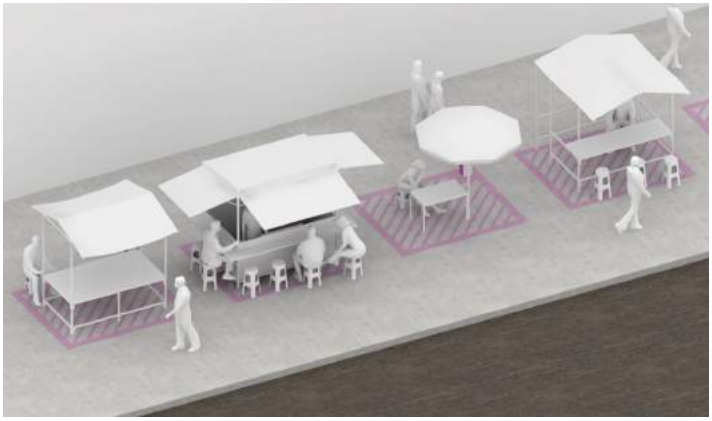
1. **Allocate underutilized sidewalk space to vendors and provide access to key services in exchange for monthly fees.** The developer would demarcate available sidewalk space on and around the site (see Figure 4-7). The spaces would be well-spaced, connected to basic services, and located in a fashion that does not obstruct traffic. The vendors would have access to such basic services as bathrooms, water, storage space and electricity. By building affordable stall spaces, the developer can allow for the expansion and contraction of the number of vendors as the needs of the site shifts over time.

2. **Build and maintain an open air food market, activating the street, and creating a food-centered cultural destination for commuters and the surrounding neighborhood.** The developer can designate space on the site or work with the public sector to provide space adjacent to the site to house an open air food market. Since Cuatro Caminos vendors currently operate hundreds of viable food stalls, the market could accommodate a large number of existing vending businesses, whose services already have a proven demand and loyal cliental base. The food market could be either be built and managed by the developer or leased to private operators. Taiwanese Night Markets, seen below, provide a good example of how food markets organize informal vendors.

3. **Supply indoor retail spaces for more established vendors at a subsidized rate to encourage vendor business formalization.** Providing indoor retail space would help already strong informal businesses move to the next level and potentially take advantage of the recent federal programs incentivizing formalization. Two such programs include the "Program for the Formalization of Employment" (PFE) and "Let's Grow Together Strategy" (Crezcamos Juntos). Rents would likely need to be subsided by the developer, or leases modified to adapt to smaller, more flexible business models compared to traditional retail.

4. **Place qualified and interested vendors into jobs within the new site facilities.** The developer could partner with local workforce development or community organizations to place interested vendors into alternative jobs on the site. Since we found that most vendors live within close proximity of Cuatro Caminos this approach would help maintain a local workforce around the TOD site.





Top: Painted stall for vendors; Left: Stalls positioned to prevent congestion; Right: Stalls allow for different types of vendors

Example of the Taiwanese Night Market

Recommendations for Future Work

FREIGHT COORDINATION

Cuatro Caminos is located on challenging -- but critical -- real estate. Situated on the border between Mexico City and the state of Mexico, Cuatro Caminos serves as a gateway between the city and the suburbs, and this fact is intensified by its proximity to the Periférico. The ongoing Phase I (retail-intensive) development lies at a critical traffic juncture that is overwhelmingly congested, and a proper freight management plan is needed to ensure that goods are moved efficiently, and so as to not obstruct the microbuses serving the station. Furthermore, the presence of informal vendors means that dispersed individual good movements should be accounted for.

A freight circulation plan could be developed, as part of a joint effort between the state of Mexico, Mexico City, and Grupo Prodi. This plan could: (1) restrict freight vehicle travel during peak travel times (7-9 am, and 4-7 pm); (2) offer storage units for the goods of informal vendors as a means of cutting down the travel time of the goods; (3) raise the possibility, on the Prodi side, of installing (and earning rent from) a separately-located urban consolidation center. Furthermore, this plan could be expanded to include a parcel delivery service within the Phase I development to localize package delivery and pick up and reduce citywide congestion.

Only the portion of Mexico city that lies within Perimeter A is subject to freight restrictions -- and even these are limited, at best. The current restrictions dictate that freight vehicles -- those longer than 7.5 meters and exceeding 3.5 tons -- can't deliver between 7 and 9 am. Often, it's better, from the perspective of a company receiving or delivering goods, to be fined and "pay" to travel during these hours.

Given the numerous stakeholders that would be involved in this process, an inclusionary process is critical. We suggest that all current informal vendors be involved in the transition process to more formalized semi-fixed stalls, which should be incorporated into upcoming stages of development. Furthermore, the retailers entering the Phase I development site should be rewarded (somehow) for consolidating goods movements with other retailers in the site or nearby.

Without any formal freight loading areas onsite, travel lanes at Cuatro Caminos become loading zones and sources of congestion

TACUBAYA STATION AREA RECOMMENDATIONS

Land Value Capture Strategies in a Chaotic Streetscape

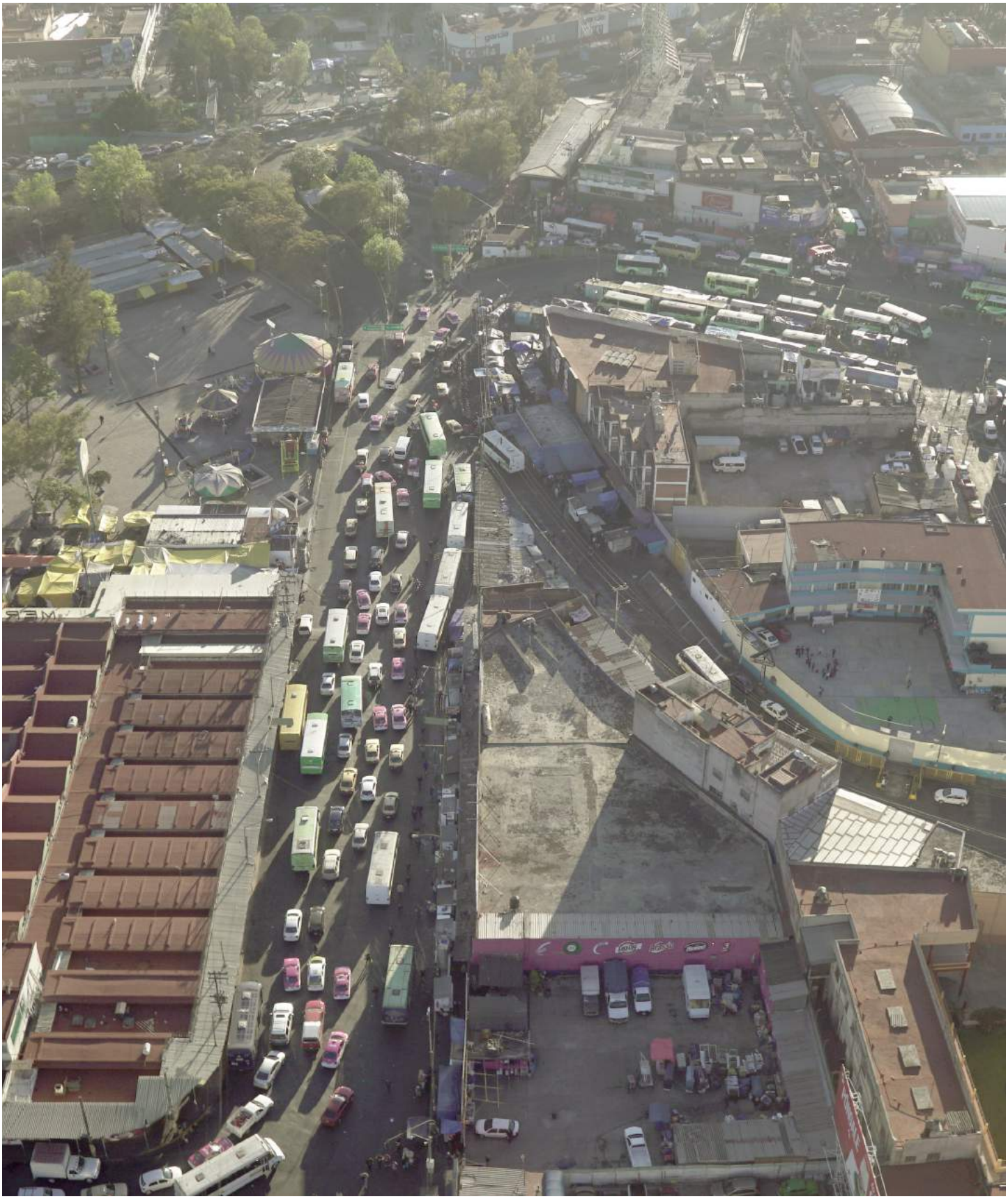
Site Introduction

Tacubaya, a Mexico city transfer hub, is located along a major transit route southwest of the city center in a neighborhood of the same name. The southwestern corner of the Tacubaya neighborhood is situated where the two-tiered Periférico highway forms a right angle with the major arterial road Viaducto. While the three subway lines, one BRT line, and dozens of bus lines that converge in the neighborhood contribute to a vibrant and bustling street life, the area is not easy to navigate. The multiple pedestrian bridges and underpasses, traffic, street networks, street vending, and lack of a centralized bus station complicate the accessibility of the neighborhood for commuters and locals alike. The neighborhood's historical charm, beauty, and prime location, however, make this area ideal for short and long term development.

Here, we propose three recommendations for the successful development of the neighborhood through tackling the issues at large and small scales. We recognize that while rush hour in Tacubaya has the feeling of a chaotic transfer hub, the neighborhood is residential and any proposed development needs to include residents as key stakeholders. Furthermore, to ensure that the neighborhood continues to be affordable for the current residents, the implementation of the following recommendations needs to acknowledge these local needs.

Site level interventions have been proposed in Tacubaya to, among other things, improve the pedestrian and road networks and build a bus station to consolidate the transport modes. While the plans have proposed physical solutions to many of the issues experienced at the site, little meaningful change has been implemented. In our approach, we provide three recommendations to break down the big barriers and problems at this site into their component parts in such a way as to transform the implementation process into one that holistically, yet incrementally, affects change at the site.

Long-term change relies on bringing organization to the chaotic street life of Tacubaya and finding a home for the buses that currently clog the streets. Then, it will be possible to bring density and changes in land use. However, finding street space is not a quick fix and in the meantime there are other smaller interventions that can be completed to improve the experience for commuters and locals alike.



Tacubaya Station Area

Bus Station and Traffic Flow Recommendation

We strongly recommend that traffic be reorganized in Tacubaya and a centralized CETRAM building be built in order to return the street to pedestrians, make it easier to navigate the vast transportation options in the area, and prepare Tacubaya for further affordable development that capitalizes on its location near the heart of Mexico City. This plan should: 1) build a bus station, potentially on the current site of Mercado Tacubaya, 2) incorporate informal vendors into the design of the CETRAM to continue to serve passengers and maintain economic viability of their businesses and 3) reorganize traffic on Av. Observatorio to bypass the heart of Tacubaya, allowing for future pedestrianization projects.

DEVELOPMENT INCENTIVES AND OPERATIONALIZING THE TOD POLICY

Private investment can play an important role in unlocking the potential of Tacubaya and can also help reduce the fiscal burden on the municipality. But attracting private investment can be a challenge. With this in mind, we designed a TOD policy which was discussed earlier in the report. We take the site of Tacubaya to show a stylized case of operationalizing the TOD policy. The diagram below shows the five steps of implementing TOD policy in Tacubaya.

DELINEATING THE TOD ZONE

In the case of Tacubaya, a SAC was recently proposed and a partial plan already exists. To implement our TOD Zone, we will use the boundary delineated by the partial plan as in Figure 4-9.

ASSESSING THE PRIORITIES

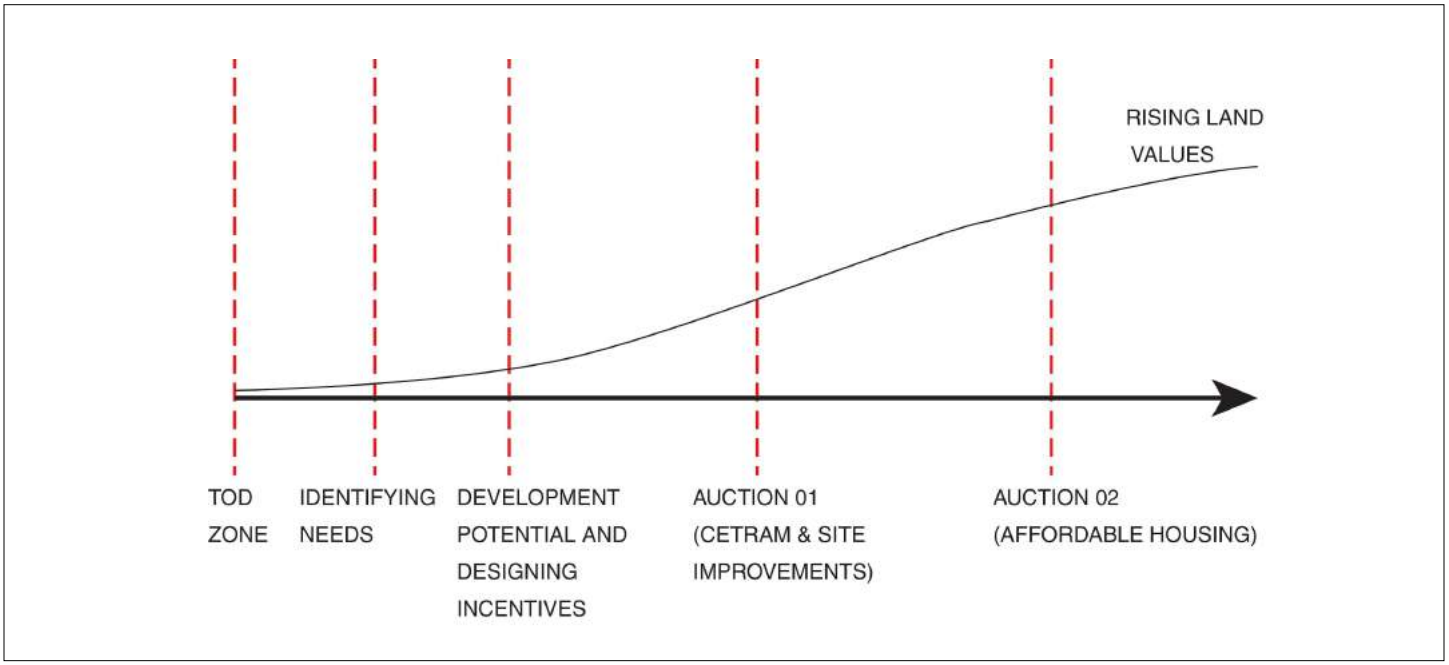
Based on the typology of the stations under which Tacubaya falls and our site analysis, the three priorities and recommendations for Tacubaya are: 1) Centralize Buses and Reduce Congestion. 2) Implement Short term and quick win projects. 3) Land value capture and Inclusionary Zoning.

DEVELOPMENT POTENTIAL AND INCENTIVIZING PRIVATE INVESTMENT

Once the priorities and recommendations have been decided for a site, the next step for the TOD policy should be to assess the development potential of the site. This assessment should be based on the future improvements on the site and not just the current condition. This is an important step in implementing a successful TOD policy and should be assessed by a team of experts. Once the potential of the site has been gauged, ways to leverage and monetize the excess development potential needs to be worked out. In Figure 4-10 you can see a stylized case showing this step for Tacubaya.

FIGURE 4-9 Proposed SAC for Tacubaya

FIGURE 4-10 Project Sequence with Land Value Increase



Auctioning the development rights, either through a private auction with qualified list of bidders or a public auction would be an effective way to monetize the development rights. As the diagram shows, the government officials involved need not monetize all the development rights at once, but can spread the process over time. In Figure 4-10, we have assumed that the development rights are monetized in two separate auctions.

AUCTION 01

The first bundle of development rights can be auctioned to generate revenues for the Bus station, reducing congestion and other quick win projects. Phasing the development rights allows later auctioning of development rights to capture the benefits accrued due to improvement projects from earlier development rights. Figure 4-11 is a representation of this step for the case of Tacubaya. The development rights highlighted in yellow represent the bundle which, in the case of Tacubaya, will be auctioned first.

REORGANIZATION OF TRANSPORTATION

Tacubaya is located at a crossroads in the heart of the city. It is an entry way into the city, as well as providing a transfer point for workers going out to the suburbs, primarily Santa Fe in the southwest. There have been previous plans to develop Tacubaya, but all have failed. The streets are congested with buses, both those loading passengers and those idling until their next service. Traffic from the Periférico is sent through the center of Tacubaya, making it difficult to cross the streets.

Constructing a Bus Station Justification

Tacubaya is already classified as a CETRAM, but the transportation business has eclipsed the ability of other businesses to survive in the heart of Tacubaya. By organizing the buses and changing traffic patterns, the heart of Tacubaya will be opened up and returned to people, allowing for future residential and commercial development. Tacubaya is facing development pressures from San Miguel Chapultepec, the Escandón and Condesa, but prices are currently depressed in Tacubaya due to congestion. The other three neighborhoods are primarily residential so Tacubaya represents an opportunity for mixed use development and a focus on maintaining affordability.

BUILDING A BUS STATION

Building a bus station is key for opening up the streets and removing idling buses from the heart of Tacubaya. A bus station can provide good and clear connections to the Metro

FIGURE 4-11 System for Auctioning Development Rights

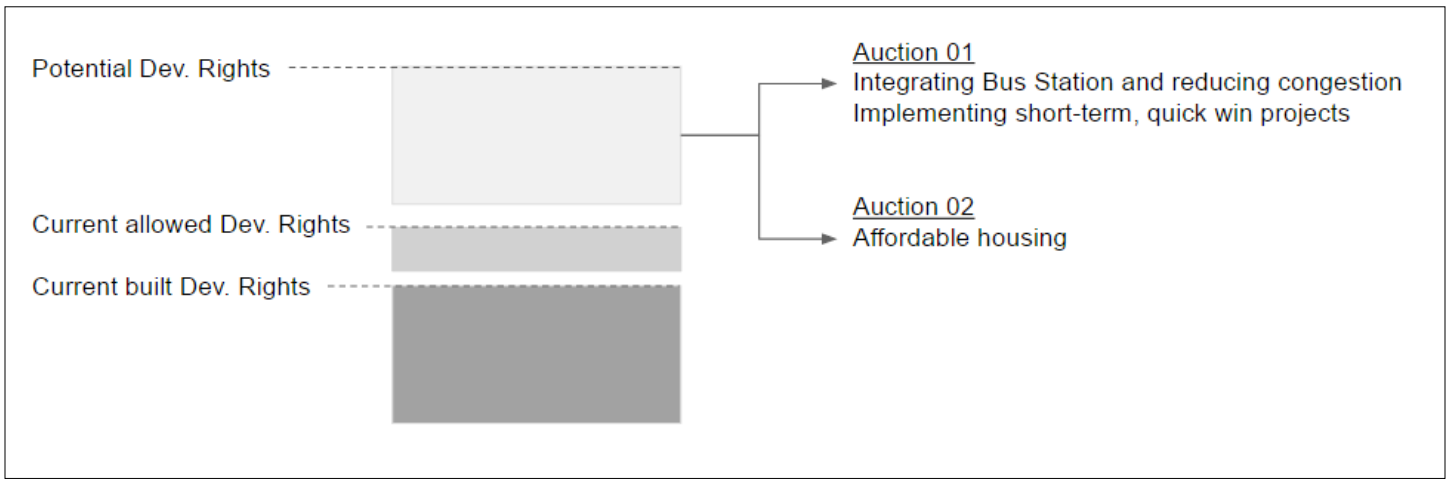
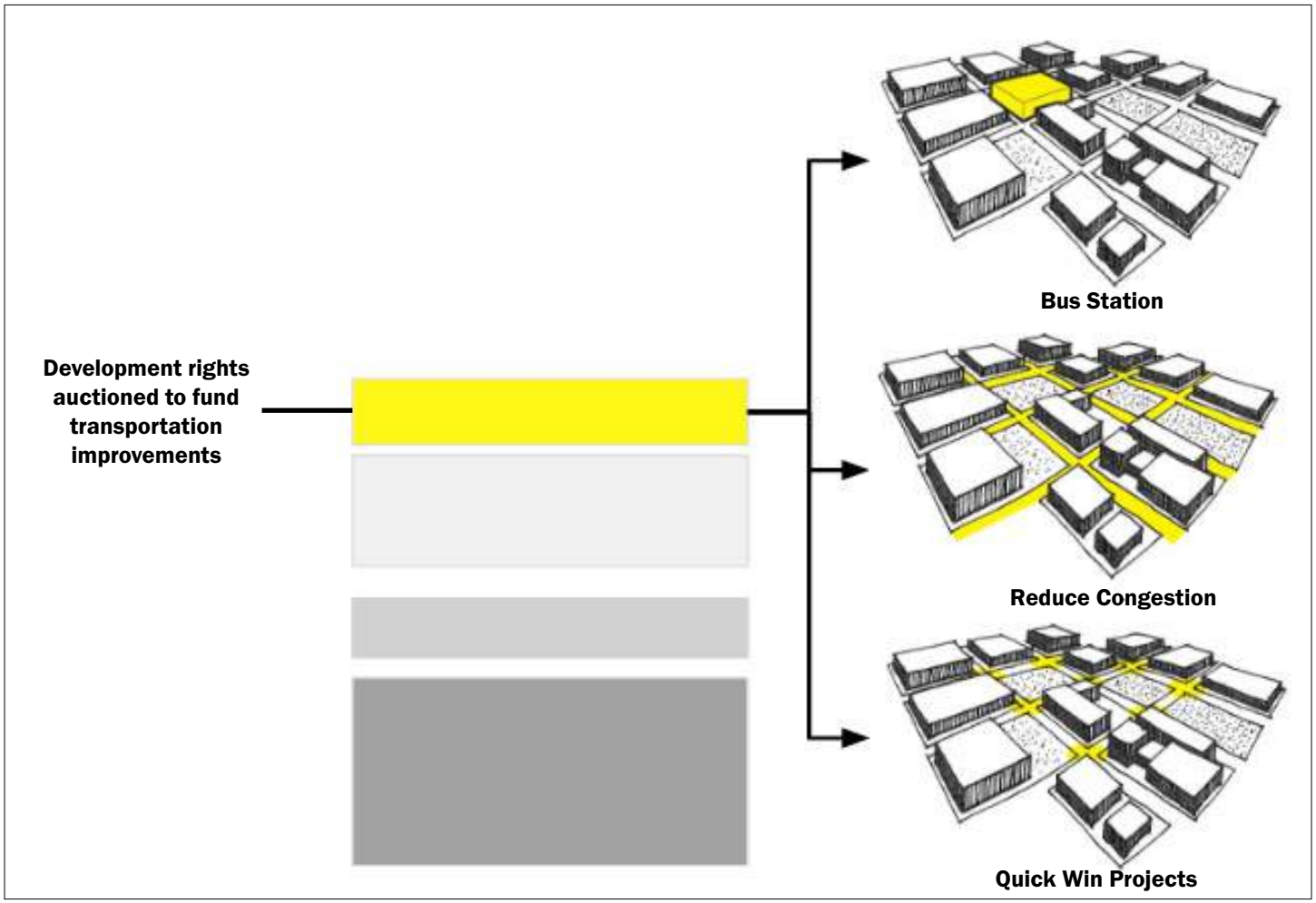


FIGURE 4-12 Improvements Funded by Auction 1



and Metrobus through wayfinding, and contain active and waiting buses. The bus station must be open to the street and the neighborhood however; a closed development that does not integrate with the neighborhood will not help to make Tacubaya a livable place. Currently the buses in Tacubaya are organized by ruta, but organizing by geographic destination can help make the station easier to use for passengers and prevent conflicts among entering and exiting buses. There is a desperate need for parking for waiting buses, and a need to reorganize access to major roads to avoid creating congestion again on the streets. It will be necessary to understand the existing routing of buses, as well as potential future routes that they can take with the reorganization. By reorganizing how traffic enters the bus station, conflicts among buses and pedestrians can be reduced, and service can be more efficiently organized.

INCORPORATING VENDORS INTO THE BUS STATION

This is part of reorganizing the streets and opening up space for rethinking their use. There are many stakeholders involved in informal vending in Tacubaya: the existing vendors and associations, the market vendors, the customers, the government and private businesses in the area. In order to successfully build a market into the bus station, it is necessary to consider the needs of all of the stakeholders. Vendors and private businesses want to be profitable, associations want power, the government wants organization. However, in order to best approach this, it is going to be necessary to ensure that moving into a bus station is not going to impede pedestrian access to their businesses.

Challenges include the fact that there may not be space for thousands of vendors within the station, and that the needs or desires of the stakeholders may be in conflict.

In order to implement this, it is necessary to do outreach and better understand the landscape, as well as explore potential models for vending in a bus station. One model is that of Singapore, in which the government organized informal street vendors into hawker markets that provide service and infrastructure, and a scaled pricing structure that grandfathered in informal vendors. They are subject to health codes and regulation.

FIGURE 4-13 Potential Future CETRAM Location

transit station market in Singapore

Recommendations for Changing Traffic Patterns

The government needs to be involved in changing traffic flow. Currently traffic, automobile, bus and freight, is forced through the heart of Tacubaya. Av. Observatorio is one way at the north-side of Tacubaya, sending buses, freight and private vehicles through a heavily trafficked pedestrian intersection. Pedestrians are sent on overpasses and underpasses. Changing the traffic patterns for necessary traffic and limiting non-local traffic through the heart of the neighborhood will open up space for pedestrians and return the streets to the people. Buses need to be taken off the street. The potential location of the bus station can send buses more directly to the Periferico and other primary roads, taking them off of local roads.

PEDESTRIANIZATION

Once the streets are opened up, we have to rethink how they are used. Pedestrians are not prioritized currently in Tacubaya. Pedestrian streets improvements such as wider sidewalks, priority at intersections, at-grade crossings and improved ground floor environments can help make these changes.

A major challenge is how to de-elevate as many pedestrian overpasses as possible and unearth the underpasses. Traffic also needs to be slowed through traffic-calming and intersections should be prioritized for pedestrians.

FIGURE 4-14 Existing Traffic Circulation and Traffic Reconfiguration to Bypass Tacubaya

Existing Traffic

Through-traffic is reorganized to bypass Tacubaya

Recommendation for Quick Win Projects

While many of our proposed strategies in Tacubaya will take time, there are small, low cost interventions that can be implemented quickly to improve the daily lived experience in the neighborhood. The utilization of wayfinding, utilization of vacant station space for services, public space improvements, and storage for vendors are four ways in which the neighborhood can be improved in a low cost, quick manner to improve the connectivity and accessibility of the area.

We recommend that wayfinding inside and outside of the station, service provision for residents, commuters, and vendors, pedestrian environment improvements, and improved park access and beautification be implemented in low cost ways to improve the overall experience of the area.

Justification for Quick Win Projects

Tacubaya is in a prime location for pedestrian commuters, locals, and vendors to conveniently access services, comfortably navigate the streets, and relax in a historic location. Within the metro station, a heavily used health care provider located at the juncture of two stairwells has lead to long lines impeding the movement of passengers. Within the station and outside, there are few if any maps guiding pedestrians to their appropriate bus routes, the parks, or other locations in the neighborhood. Outside of the station, the many street vendors have little or no storage for the products they sell, making their set-up and take-down processes difficult and time consuming. The historical charm of the Alameda of Tacubaya and Parque Lira are damaged by their inaccessibility and poor services.

Implementation of Quick Win Projects

The stakeholders involved within these recommendations are: STC, local government officials, residents and commuters, and vendors. The STC ... The Alameda needs better lighting at night, a clean up

Similarly to other stations across the city, including El Rosario, Tacubaya can benefit from improved wayfinding, both in the station and outside of the station. There are many different transportation services currently unlabeled and spread apart; signage can help to simplify the transfer process. Additionally, contextualizing Tacubaya within the rest of Mexico City can highlight its location and connections to other vibrant neighborhoods.

SERVICE PROVISION FOR RESIDENTS, COMMUTERS AND VENDORS

The area around the station is relatively devoid of vital services. There is an opportunity to serve both local residents using the station to commute, as well as commuters and vendors by making use of the underutilized and vacant commercial space within the station. There is already a thriving medical service, and an opportunity to introduce other municipal services, such as tax payment, or other services that meet basic needs.

There is precedent for this in Curitiba where terminal stations often include a range of municipal services (such as offices for the payment of utility bills), sports facilities, and retail and commercial development (funded by the private sector).

PEDESTRIAN ENVIRONMENT IMPROVEMENTS

The area in the heart of Tacubaya is difficult and dangerous for pedestrians. While attempts have been made to improve pedestrian flow by utilizing crossing guards during peak hours and other small interventions, people are sent on over and underpasses, and dashing across traffic in order to reach their destinations.

Projects including the addition of street lights, curb bump out using paint and small improvements in underpasses can help to improve the existing pedestrian environment in anticipation of future change. This work can be incorporated with work already being done at the City-level through Vision Zero (Vision Cero) in Mexico City.

Example of wayfinding in Singapore, A and B match with same labels on a map of the station that indicates which exit to use.

Recommendation for Affordable Housing: Incentivizing Development to Maintain and Grow Affordability

AUCTION 02

The development rights should be auctioned taking into account factors like cyclical real estate markets and thriving financial markets to maximize the returns from monetizing the development rights. Figure 4-12 highlights this fact.

The development rights are auctioned as bonds and each bond should have the following information: 1) Which TOD Zone it corresponds to, 2) Which parcel in the respective TOD Zone can it be exercised, 3) What building type can be constructed using this bond (like residential or commercial or mixed use), 4) How much area can be constructed through each bond.

To show a stylized version of auctioning of the bonds for the case of Tacubaya, we will assume that all the development rights will be used for residential construction only. The TOD Zone in Tacubaya can be divided into two parcels, based on the urban fabric, land use, and proximity to the metro station. Parcel Type A will tend to have higher property value as it is closer to metro than Parcel Type B. Thus two separate types of bonds need to be designed for auctions.

For this stylized example, we can refer to the bond for parcel type A as Bond A and for parcel type B as Bond B. Both the bonds will have the same face value but different information associated with it. As Bond A corresponds to the parcel having higher property values, it will have lesser allowable construction area associated with it. Figure 4-13 shows an example of how the two bonds might be. Please note that the values mentioned in the bond information in the figure is hypothetical, they should studied in comparison to the other bond, to understand how designing of the bond works.

INTEGRATING INCLUSIONARY ZONING IN THE BONDS

As private investments are made in Tacubaya and improvement projects are undertaken, the precinct will experience an increase in property values. This may result in gentrification and low income families being priced out of the market. To increase the supply of affordable housing in Tacubaya, we suggest that the residential bonds being sold should have an additional requirement of affordable housing in it. An example of such a bond with inclusionary development for affordable housing is shown in Figure 4-14.

The information highlighted in RED is the affordable housing component attached to each bond. Let's assume that the developer buys 1000 of Bond Type A mentioned above. This will enable him to develop 10 x 1000 square meters of residential development in the TOD Zone. As there is an affordable housing component associated with each bond, when the developer decides to exercise the bond, he will have to develop 25% of the 10,000 square meters as affordable housing. This example is shown in Table 4-5.

FIGURE 4-15 Project Sequence with Land Value Increase

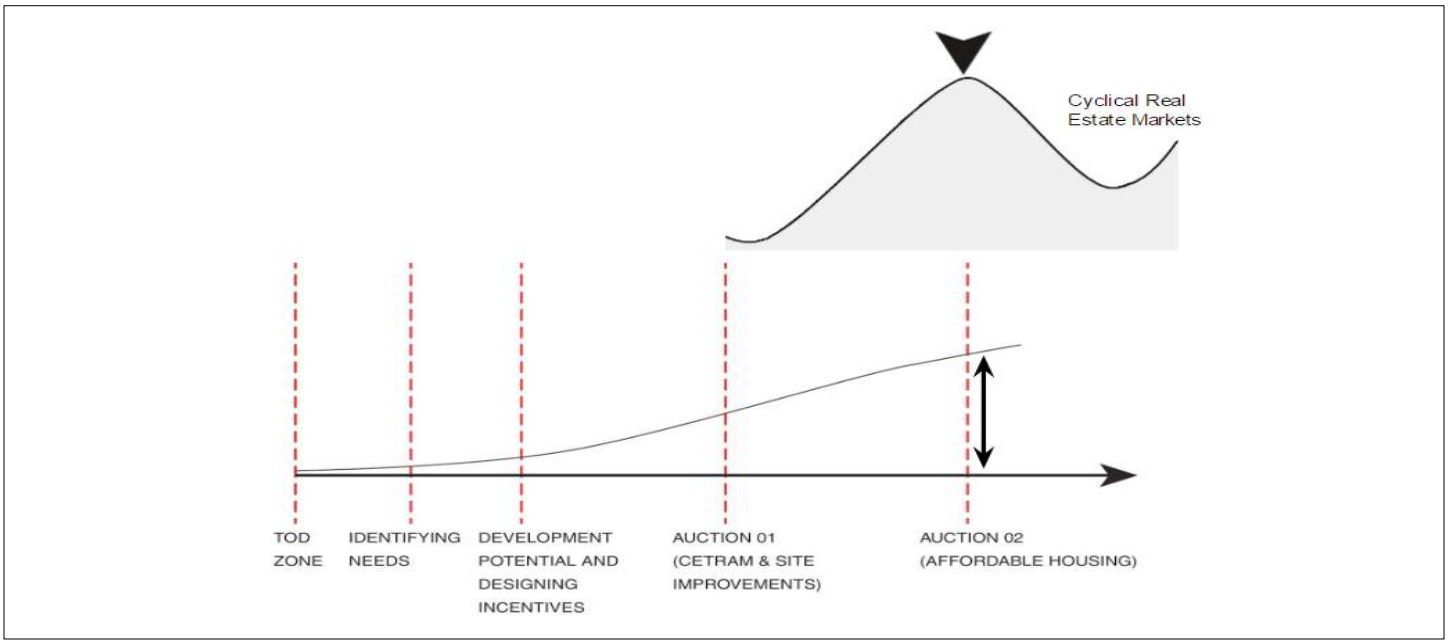
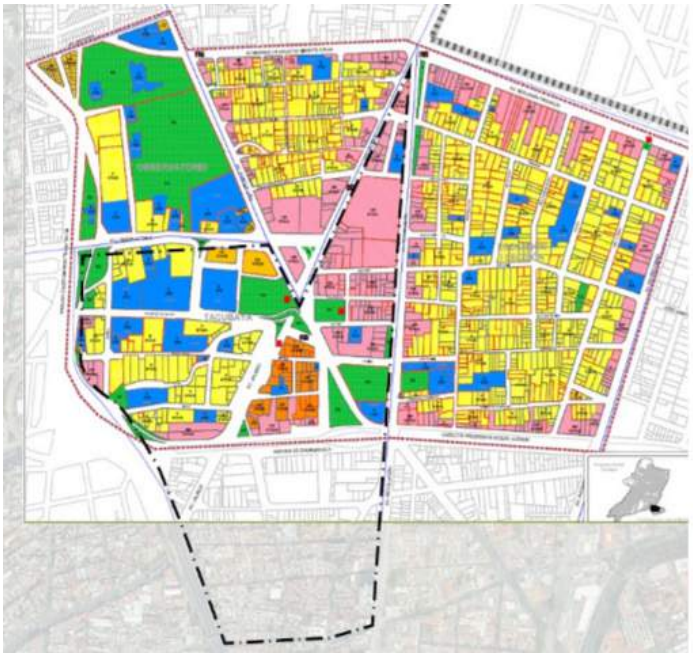
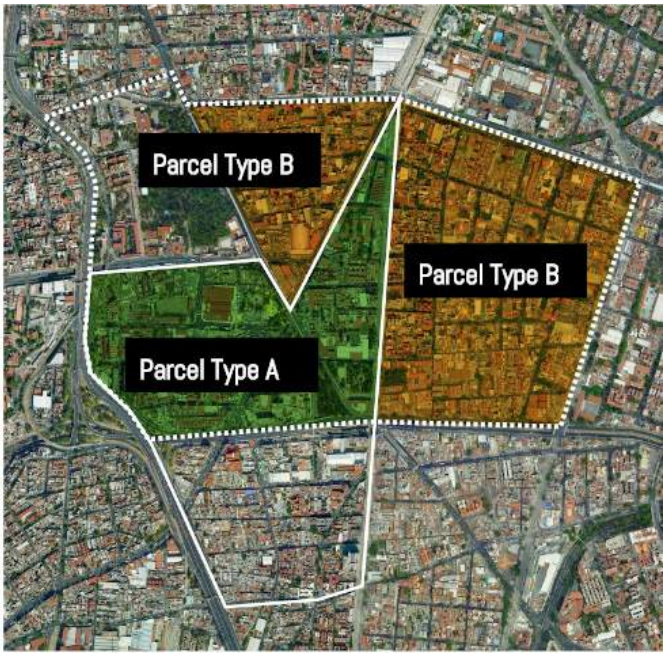


FIGURE 4-16 Tacubaya Zoning Regulation Figures



Tacubaya land use map



Parcel types for development bonds

TABLE 4-4 Example of Affordable Housing Potential

AREA ASSOCIATED WITH EACH BOND TYPE A	10 SQ. M
TOTAL NUMBER OF BONDS	1000
TOTAL CONSTRUCTION AREA	10,000 SQ.M
TOTAL AFFORDABLE HOUSING	2,500 SQ.M

TABLE 4-5 Project Sequence with Land Value Increase and Affordable Housing

DEVELOPMENT RIGHT BONDS TYPE	ZONE	PARCEL	AREA
Type A	Tacubaya TOD Zone	Parcel A	10 SQ. M.
Type B	Tacubaya TOD Zone	Parcel B	25 SQ. M.
Type A (w/ Affordable Housing)	TOD Zone	Parcel w/in TOD Zone where it can be used	10 SQ. M. 25% of the area to be used for affordable housing

EL ROSARIO STATION AREA RECOMMENDATIONS

Affordable Housing and Urban Form for Improved Walkability

Site Introduction

With an average of 187,000 daily transit users, El Rosario is in a prime high traffic area for a TOD. Despite this, the surrounding area is currently low density. Large blocks occupied by logistics facilities, metro infrastructure, and department stores make it difficult and lengthy to travel by foot to the schools, universities, mall and surrounding neighborhoods. In order to implement a TOD strategy, El Rosario will need increased connections and legibility. This would serve to both create easier access for existing neighborhoods, as well as future developments.

In order to maximize the location on an important transit hub, the density around El Rosario should be increased. Because of the relatively weak housing market in the area, it's a particularly good place in promote affordable housing that would be feasible where there is a stronger real estate market.

El Rosario Station Area

Recommendation for Community Land Trust

To enable housing affordability in El Rosario, we first recommend leveraging the area's weaker-than-average real estate market by supporting inclusionary zoning requirements and development incentives that can catalyze the production of housing options for lower income families. El Rosario has the weakest rental and for-sale housing market among the four sites being assessed, and thus also has a smaller affordability gap to close. This setting presents an opportunity to explore affordability models that may be less feasible in transit-rich locations with stronger real estate markets and higher land values.

One such instrument is the residential community land trust (CLT), which reduces the cost of homeownership by separating the title to a property from the title to the land underneath it. In this dual tenure structure, the nonprofit land trust retains ownership of the land, while the homebuyer owns the housing unit and leases the land from the trust. This legal separation of land and property enables homeownership among low- and moderate-income families, who can obtain a smaller mortgage to purchase just the home rather than a house-plus-land in the conventional market (Thaden, 2012).

The relationship between the CLT and lessee-homeowner is defined by a ground lease (or deed covenant in some instances) that establishes rights and responsibilities of each party, monthly lease payments to the CLT, and resale and value appreciation formulas should the homeowner decide to sell their unit back to the land trust. Resale terms are designed to offer the homeowner opportunities for modest equity building through value appreciation and home improvements, while limiting the resale price of units so that they can remain affordable for future homebuyers (Girga et al, 2002).

Justification for Community Land Trust

While the CLT model has not been implemented in Mexico City, it has been in existence in the United States and other nations since at least the 1960s. There are currently over 250 community land trusts in the U.S., including 18 in Massachusetts and 21 in New York. An average of twenty CLTs are started annually, either as new nonprofits or as programs or subsidiaries of existing organizations (David and Jacobus, 2008).

Over the past decade, the upsurge of CLTs has been notably led by growing local government investment and involvement in promoting affordable housing. More cities and counties have opted to support existing land trusts as well as establish new ones to guide their development and sponsor their affordable housing initiatives. American cities like Denver, Atlanta and Minneapolis have looked to the land trust model as a tool to stimulate affordability in the face of limited developable land, increasing property values and rents, and strong real estate markets. Seeking to address their own mix of housing policies and market conditions, municipalities are exploring alternate variations of the tradition CLT model. In particular, many cities have engaged CLTs to manage the stewardship and land ownership functions of affordable housing units, drawing on the capacity of existing developers through partnerships.

Key among the benefits of the CLT model to municipalities is the retention of public investment in affordable housing. When scarce funds are used to subsidize the initial affordability of residential units, the mission of the CLT is to lock those subsidies in place and recycle the units in perpetuity. This is different than policies and programs where subsidies are either claimed by the property owner at resale or reclaimed by the public agency that invested them.

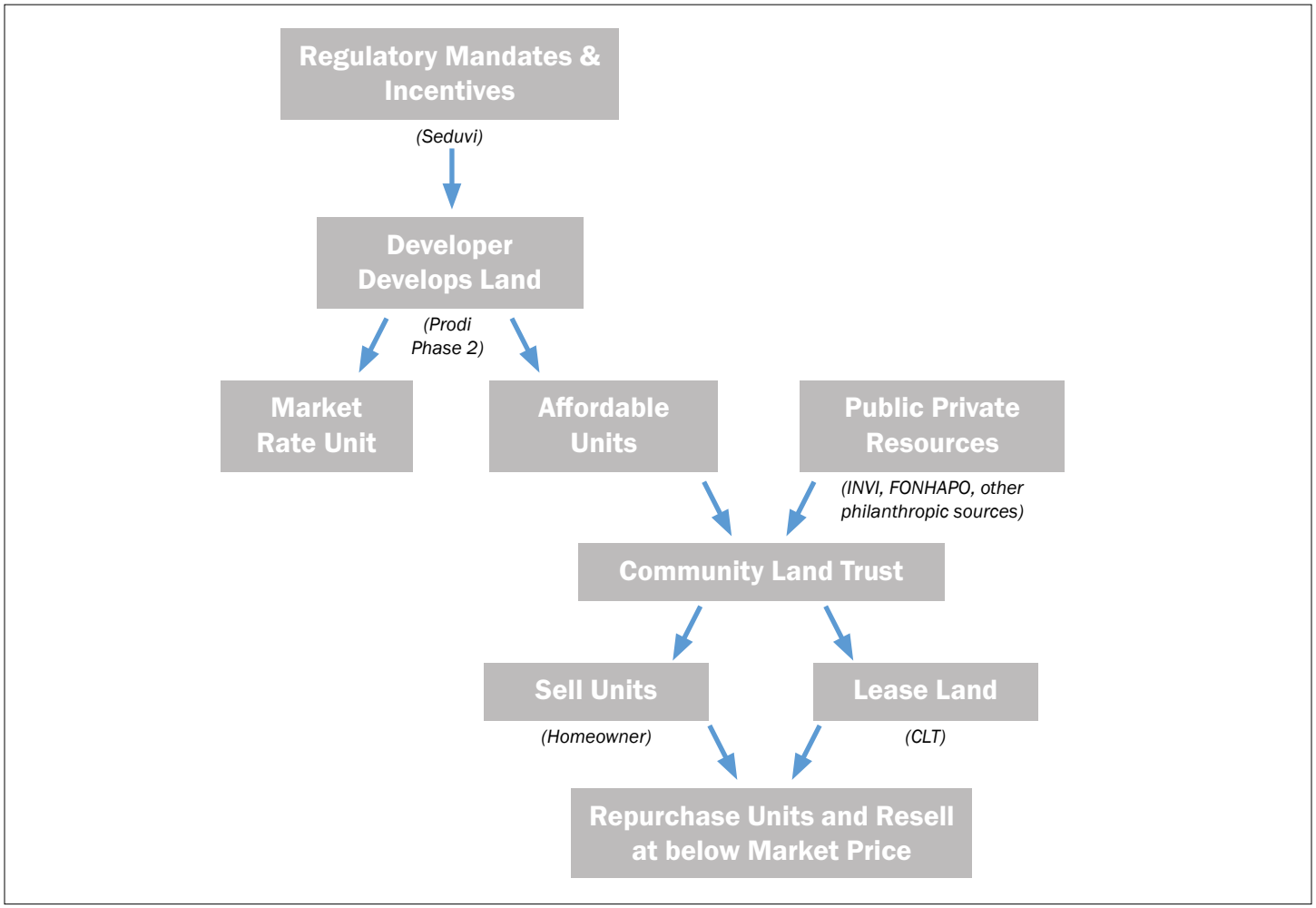
In addition, CLTs are a useful mechanism for assembling land—through purchase, donation, or bargain sale—and making it available to developers for various types and methods of development. The model has the flexibility to combine uses of land, levels of income, types of housing, and tenures of housing within the same or different projects. These projects may be developed on adjoining land parcels or be scattered throughout an entire city or region (Davis 2006).

With this in mind, we examined the potential to apply the CLT model in the redevelopment of the area adjacent to the new CETRAM station at El Rosario. The site is half of a large parcel of land owned by the city, which was granted to PRODI through a concession for thirty years. The first phase of development saw the completion of the new El Rosario CETRAM complex in 2013. The pending phase two will develop the remaining area, totaling over ten thousand square meters of land for a range of housing, office and commercial development.

While the thirty year concession raises questions about possible limitations of long-term homeownership opportunities, the availability of developable land and the area's modest housing market presents a unique opportunity at El Rosario. The site provides a platform to assess the outcomes of appointing a residential community land trust as the steward of affordable housing built with public subsidies and development regulations and incentives. The flexibility of the CLT model enables it to accommodate the likely restraints of the public-private concession, and may therefore be feasibly implemented at El Rosario.

Locations of Phase 1 and Phase 2

FIGURE 4-17 Potential Plan to Develop and Steward Affordable Housing at El Rosario



Implementation of Community Land Trust

As the cost of living in Mexico City continues to rise due to increasing land and construction values, the community land trust model presents an alternative conduit to motivate collaboration among policymakers, homebuilders, homebuyers and housing advocates in the building and preservation of affordable housing.

During the second phase of development at El Rosario, a CLT can serve as the entity responsible for stewarding units of permanently affordable, owner-occupied housing created with municipal assistance during new construction. This model therefore relies upon and reinforces the TOD Zone instrument detailed in Chapter 5, though which development incentives, affordability mandates, and financing mechanisms are defined and administered for new construction projects. As previously described, the TOD Zone would be planned, developed, and implemented through SEDUVI and the delegation, in partnership with neighborhood stakeholders.

Once the TOD Zone is in place, the local government can create, or support neighborhood-led efforts to create, a new community land trust. Municipal assistance for a startup CLT is especially critical in the year before incorporating as a nonprofit corporation, and the first two years of operation. During these three years, INVI (Instituto de Vivienda del Distrito Federal) can help the CLT create a plan for bringing its portfolio to scale, including a staffing plan, operating budget, policies and procedures, and housing development goals. As the local housing institute of Mexico City, INVI works to promote affordable social housing, and ensures that its construction obeys land use planning laws and contributes to jobs and economic development.

At El Rosario, the community land trust can draw on the capacity of INVI on such tasks as designing the ground lease and resale formula for homebuyers, creating an outreach plan to build CLT membership, developing and implementing homebuyer selection and orientation programs, establishing relationships with private financial institutions to embrace mortgaging of CLT housing, completing a staff hiring process, and identifying the first board of directors. The board of directors of a typical CLT balances three land-based interests: homeowners leasing the CLT land, residents of the surrounding service area who do not lease CLT land, and individuals representing the public interest, including municipal officials, local funders, and social service providers.

Cities like Chicago and Portland have taken the extra step of paying consultants to offer the CLT advice ground lease issues, project feasibility, and other planning items. Some local governments, including Burlington (Vermont) and Minneapolis, have provided startup grants to fund the research, launch and incorporation of the CLT (David and Jacobus, 2008).

To complement this range of support services, the community land trust and INVI may seek additional aid from the national housing trust fund, FONHAPO (Fondo Nacional de Habitaciones Populares). FONHAPO is tasked with administering subsidy and funding programs to assist low-income families in acquiring, building, expanding, or improving their homes. Notably, the fund's Supportive Housing Program (Programa de Apoyo a la Vivienda) has national coverage and operates in all federal entities, including in Mexico City. Through this program, FONHAPO collaborates with state housing agencies, municipal governments as well as foundations and nonprofit organizations in reducing the housing shortage for low-income families.

Once the CLT is in place, the units of affordable housing created through inclusionary development mandates and incentives can be transferred to the land trust for long-term stewardship. This transferal alleviates the developer of the process of securing homebuyers that qualify for the lower-priced affordable units, as well as other education and support to help lower-income families attain and retain homeownership. Among the stewardship activities that CLTs assume are educating buyers pre- and post-purchase, supervising loan acquisition for purchase and refinancing, supporting regular maintenance and repairs, aiding homeowners at risk of default or foreclosure, and communicating with first mortgage lenders.

To understand the potential for affordable units to be built on the phase two site at El Rosario, we conducted a basic pro forma analysis assessing the levels of development incentives and affordability requirements necessary, as well as the relative impacts to the developer. For this analysis, we first looked at a previous mixed-use development plan proposed for the site, which included over 400 units of housing despite the modest housing market in the area. The phase two site covers approximately 10,263 m2, of which 7,184 m2 would be buildable area when accounting for the 30% open space zoning requirement. Given the previous development proposal, we tested two different scenarios of developing the site for housing units. The first option shows "business as usual," assuming the current zoning for the area, with no required affordable units, an floor-area ratio of 1, and no reduction of parking provisions or development fees. Scenario two depicts an approach that incorporates the community land trust, and which would enable greater affordability options in exchange for higher density and other development incentives.

TABLE 4-6 El Rosario Station Development Scenarios Pro Forma

	Business As Usual	CLT Development
AFFORDABILITY	100% Market Rate	50% Donated to CLT under Inclusionary Zoning
DENSITY BONUS	1.0 FAR	2.0 FAR
PARKING REDUCTION		50%
DEVELOPMENT FEE REDUCTION		50%
LAND SUBSIDY	100% Land Subsidy	100% Land Subsidy
Total Units	379	757
Parking Ratio (spaces)	1.3 (494)	0.7 (494.5)
Total FAR (floors)	2.8 (4)	5.6 (8)
Total Sales Revenue	$347,343,750	$601,945,677
Total Development Cost	$312,207,414	$526,903,069
Profit	$35,136,336	$75,042,608
% Profit (profit/ total cost)	11.3%	14.2%

While the pro forma analysis should be interpreted as illustrative only, the results suggest that by providing increasing levels of incentives in combination with increasing affordability requirements, developers could build affordable housing and still receive similar or even increasing returns. In fact, given the modest housing market at El Rosario, the development's total sales revenue and overall profit would be relatively conservative in "business as usual" scenario. The analysis indicates that by making half of the units affordable in the development project (through inclusionary incentives and requirements), the overall profit for developers may actually increase by a few percentage points.

Additionally, developers may benefit from the proven performance record of CLTs in securing and retaining tenants. In the U.S., homeowners that purchase their units through a land trust are on average ten times less likely to experience foreclosure than households that purchased market-rate homes. In addition, CLT housing units are often the first to be pre-sold in a new development, given the land trust's continued efforts to identify eligible buyers and support them the homeownership process. As a co-owner, the CLT also has an invested stake in making sure that these units remain occupied. The CLT also offers assurance to housing developers that seek to ensure full occupancy of their new development (Thaden and Rosenberg, 2010)

Finally, the inclusionary zoning requirements, development incentives, and CLT model would also support equitable transit oriented development in El Rosario. The approach would augment the creation of affordable and market-rate housing options near transit than is presently permitted, with reduced parking and greater density. And most notably, it represents an opportunity to balance the varying interests of policymakers, developers, homebuyers, and housing advocates in creating affordable housing and a more equitable Mexico City.

Parking lot adjacent to El Rosarioa a potential site for housing

Recommendation for Microbus Technology

As the terminus for two metro lines and one Metrobús BRT line, as well a terminal for over 20,000 microbuses every day, El Rosario is a key link between the city's northwest suburbs and rest of the metro area, as well as one of the busiest transfer stations in Mexico City. A successful TOD strategy for El Rosario must incorporate its critical role as a transfer point, and work to improve operations and the user experience of the many microbuses that serve the station. To this end, we propose developing the CETRAM of El Rosario as Microbus Technology hub to pilot test operations and user-experience focused technology improvements for microbuses. This hub would focus on implementing two strands of technology improvements across the microbuses serving the El Rosario CETRAM—automated vehicle location (AVL) devices and mobile fare payment platforms.

Developing an AVL program for microbuses will require a technology provider/manager to partner with microbus operators to install the GPS-based devices in their fleet's vehicles. While AVL hardware had previously been prohibitively expensive and thus restricted to use by major public transport operators, low-cost AVL solutions have emerged in the past few years, making their implementation potentially viable for microbus operators. In addition to providing hardware, the technology provider, ideally also the CETRAM manager, would manage the data streams produced by the AVL devices and process the data into outputs useful to the microbus operators as well as for CETRAM operations and user-oriented information.

The processed AVL data could be structured into performance reports for microbus operators, allowing them to track the driving behavior of their drivers, as well as generally improve their operational efficiency by improving scheduling and vehicle allocation. Once a critical mass of participating microbus operators install AVL hardware on their vehicles, AVL data could facilitate real-time allocation of platform space within the CETRAM, increasing efficiency and reducing vehicle idling in and around the station. The adoption of AVL could be incentivized by giving platform priority to vehicles participating in the AVL program, reducing dwell time in the station for operators. Arrival time estimates based on the AVL system could be incorporated into the wayfinding program within the CETRAM. Dynamic vehicle arrival screens may replace the existing static lists of routes. This would be critical to the success of dynamically assigned platform space.

A mobile fare payment program would require the development of a mobile phone application, which would then be accepted by participating microbus operators as a valid (but not the only) means of fare payment. If integrated with an application for tracking cash fare payment, fare payment data could be incorporated into the performance reports for microbus operators, allowing them better understand passenger travel demand on their routes. In addition, a mobile fare application would provide a platform for CETRAM managers to develop market power to negotiate with microbus operators on behalf of riders by purchasing fares in bulk for distribution via the mobile application. Through these negotiations, CETRAM managers could potentially exact commitments by microbus operators for vehicle safety and driver behavior, where attempts have previously failed. A

FIGURE 4-18 Examples of Mobile Technology for Microbuses

mobile fare payment app could also serve as a platform for "enhanced" microbus service, in which operators would charge a higher fare in return for amenities addressing some of riders' complaints about current microbus service. Pre-assigned seats through the mobile app could address rider concern about adequate space in microbuses during peak commuting times.

Justification for Microbus Technology

At present, many of the problems with microbus service at El Rosario and other CETRAMs around greater Mexico City stem from a lack of coordination among microbus operators. This lack of coordination leads to inefficient use of platform space, and unnecessary idling by waiting microbuses in and around the CETRAM. This causes unnecessary delays and uncertainty about microbus arrival times for riders. While aggressive and unsafe driving is a frequent complaint of microbus passengers, enforcement of safe driving standards and route adherence is currently difficult for microbus operators. An initial pilot implementation of RFID technology (more limited than full AVL) on microbuses serving the Zumpango suburban rail stop has shown that microbus operators are willing to invest in technology if they believe it will benefit their operations.

In addition to the convenience and operations efficiency benefits of a mobile ticketing system, the need for negotiating market power for microbus riders is a critical justification for a mobile ticketing platform. Currently, microbus riders are largely dissatisfied by many aspects of microbus service, ranging from unsafe, poorly maintained vehicles to unsafe driving and rude driver behavior. With few alternatives and an artificially low fare, however, riders are held captive in this market. At five pesos per trip, microbus fare is lower than in many other Mexican Cities. With the daily "micro-negotiations" of fare purchase as the riders' only opportunity to engage with microbus operators, they lack negotiating power around these service concerns. The bulk ticketing program described above, enabled by a mobile ticketing app, would allow CETRAM operators to negotiate on behalf of riders.

Implementation for Microbus Technology

Previous attempts at improving microbus operations through top-down regulation have largely failed, with over 94% of microbuses currently operating in a legal gray area as city officials have been allowed the ten-year operating licenses for microbuses to expire as they come up for renewal. There is thus the potential opportunity to explore market based incentives to improve microbus operations. The technology package proposed above seeks to use technology improvements benefiting both microbus operators, riders, and CETRAM managers as a lever to encourage cooperation between these stakeholders. Table 4-7 describes the rationale for participation and the required actions for each stakeholder that would need to participate to successfully implement a microbus technology program.

TABLE 4-7 Microbus Technology Implemenation Action List

	Rationale for Participation	Required Actions
CDMX GOVERNMENT	Reduces idling times and local air pollution at stations	Craft policy to allow CETRAM manager and microbus operators to implement tech. programs
MICROBUS OPERATORS	Allows for route operations performance metrics; Provides mechanism for driver accountability/tracking	Install GPS/vehicle rotation hardware; Accept mobile app fare payment; Ensure driver participation in vehicle location/mobile fare payment programs
CETRAM DEVELOPER / MANAGER	Improves efficiency of microbus platforms; Improves rider experience on CETRAM	Provide coordination/oversight for development of vehicle location/mobile fare programs; Negotiate for bulk purchase of fare
TRANSPORT TECH PROVIDERS	Introduces a new market with potential for growth/expansion	Develop vehicle location data/analysis platform and hardware; Develop/adapt mobile fare application

Recommendation for Wayfinding

We propose a wayfinding system to be implemented both inside the station and in the surrounding neighborhood to both improve the station's connection to the surrounding area and to improve circulation within the station building. Wayfinding elements outside of the station should include a "heads-up" map (which is oriented to the direction a viewer is facing) and walking times to local landmarks, including the station building. The highest-quality implementation would include real time arrival information for subways, Metrobús, and even microbus routes. Incorporating real time arrival information would require a larger technology coordination effort, which we detail in our third recommendation for El Rosario. We propose clear demarcation of the entrances to the station building, which would help to draw people inside, and wayfinding elements inside the station to demarcate a clear route between subways and buses, improving circulation in the station and lowering the perceived costs of a transfer at El Rosario.

Two good wayfinding references are New York City's wayfinding program, called WalkNYC, and Legible London, created by Transport for London. WalkNYC and the London system look very similar, and both cities developed a family of signs for different situations: narrow, tall signs for sidewalk installations, wider neighborhood signs for plaza areas, and signpost-style signs with directional flags.

WalkNYC also successfully incorporated their signage -- both content and visual language -- into other modal infrastructure and street furniture. The city worked with the bike share program to include maps on bike kiosks, and partnered with the city's bus rapid transit program to include real-time arrival information at some bus stops.

Justification for Wayfinding

Aside from a small, pedestrianized residential neighborhood to the northwest of the station, the street network in the Rosario area is composed of large blocks, surrounded by high walls and busy streets. There is no access to the station from the eastern side of the site, and large buildings dominate the area. This illegible street network prevents easy access to the station site and may impose barriers to entry. The entrances to the station are not immediately obvious, nor is the station's function. Once inside the station building, the path to intermodal transfer is not clearly delineated, disadvantaging people who are not already familiar with the station layout.

Implementation of Wayfinding

Mexico City's subway system already has a strong visual identity that is internationally known. A developer, working with the public agency responsible for open space, could develop a successful wayfinding system around this visual language. Funding for a wayfinding pilot could be generated directly through advertising revenue on the signs, or indirectly by increasing foot traffic into the station building and better connecting the station to the neighborhood.

Creating a unified visual identity that would both improve access to El Rosario and improve circulation within the station would require close coordination between private developers and the government of Mexico City. Especially in the Rosario area, this has been difficult, especially intra-governmental coordination, which is physically instantiated as the gap between the Metrobús station and the subway and microbus transfer building. Because of the opportunity to test and improve challenging intra-governmental coordination, the Rosario site may be a good pilot location for a Mexico City-specific wayfinding system, expanding on the existing visual language

Entrance to El Rosario

5 | IMPLEMENTATION AND CITY-WIDE POLICY PACKAGE

5 IMPLEMENTATION AND CITY-WIDE POLICY PACKAGE

IMPLEMENTATION INTRODUCTION

As has been said in earlier chapters of this report, Mexico City, as many other Mexican metropolitan areas, faces some of the most pressing challenges for housing and urban development such as rapid urban expansion, a depopulating city center, and a lack of centrally located affordable housing (OECD 2015). TOD renders itself as a new urban development model that may contribute to revert the patterns of horizontal expansion by integrating mobility and spatial planning with adequate instruments and an institutional architecture that facilitates redevelopment in proximity to transit. While urban regeneration and TOD have increasingly gained attention in the public agenda, little has been said on how to accomplish it. For example, although the Programa Integral de Movilidad 2013-2014 of the Federal District identifies TOD as a key strategy to address the existing planning and mobility challenges in the city, there is no clarity on the means and actors who could move TOD forward.

A number of economic, normative and planning instruments to promote urban regeneration already exist in Mexico City (see ITDP 2015); however, many of these do not have clear and harmonized TOD criteria and are implemented on a piecemeal basis rather than as part of an integrated, holistic urban regeneration strategy. The complexity of the institutional environment in Mexico City makes the implementation of TOD challenging. Implementing TOD will require, as has been said in other reports (ITDP 2015; CTS-EMBARQ 2015; OECD 2015), overcoming regulatory, financial and political barriers, as well as adjusting and creating new instruments to foster development in transit-oriented areas in partnership with private developers.

We believe that TOD areas must be treated differently from those not covered by the transit network. Regulatory and financial frameworks with a TOD focus should be created specifically to facilitate development in sites like Cuatro Caminos, San Joaquín, El Rosario and Tacubaya. These policies should be given priority in the political agenda in order to promptly address the housing and urban development challenges the city is currently facing. The following section briefly describes some of the existing challenges for the implementation of TOD in Mexico City. Subsequently we describe a number of existing urban development instruments that may inform a city-wide TOD policy. Lastly, we use two recent city-wide TOD policies currently implemented in the cities of Chicago and Monterrey to exemplify how transit-oriented areas could be given a different treatment than those without access to transit.

In Muévete en Bici, a weekly open streets event, roughly 40 km. of Paseo de Reforma is closed to vehicle traffic so that people can enjoy the street as a form of open space.

CHALLENGES FOR IMPLEMENTATION

One of the most pressing challenges for the implementation of TOD in Mexico City is the high cost of development in central areas, which in turn significantly increases the price of housing. Between 2005 and 2011 housing prices in Mexico City increased approximately 1.75 the national average (OECD 2015). This is, in part, due to a shortage of developable land in Mexico City, as about 59 percent of the land in Mexico City is zoned as "suelo de conservación" and thus can not be used for urban development (Ibid). Accordingly, Mexico City could better deal with the shortage of land by leveraging public land –as is later shown in chapter # (San Joaquín)- or by using land more intensively. In other words, the city could overcome the constraint on land supply by increasing the heights and densities of development in central areas (Bertaud 2004), and most importantly, in areas with access to transit. There is, however, an absence of a TOD vision in Mexico City's land use regulations, which put exceptionally severe restrictions on the FAR that can be built in viable sites for TOD like Cuatro Caminos, San Joaquín, El Rosario and Tacubaya.

For example, while most parcels in transit-oriented areas like el Rosario and San Joaquín have a maximum as-of-right floor-area ratio (FAR) of 2.1, which may not be adequate to promote TOD, neighborhoods not covered by the transit network and located in the urban peripheries of the ZMVM, such as Quetzalcoatl, Hank González, and Reforma Política in Ixtapaluca, and Héroes de Chalco in Chalco, have maximum as-of-right densities of a 3.2 FAR. This reveals that the current state of land use planning and regulation in Mexico City and the ZMVM lack a TOD vision to facilitate and incentivize urban development and regeneration in central areas covered by the transit network. In other words, as these example may show, the incentives for urban development run opposite to a TOD strategy, as it may be more attractive for private developers to promote development in the outskirts of Mexico City.

Similarly, current parking regulations require that all new developments are equipped with parking at very high ratios, which increases the costs of development and further limits the possibility to promote development in central areas. Parking requirements become especially important for the implementation of TOD if we assume, as ITDP (2014) suggests, that parking can represent up to 21 percent of the total price of an affordable housing unit. While transit-oriented areas like Cuatro Caminos, San Joaquín, El Rosario and Tacubaya are required to provide one parking stall for every housing unit of up to 65m2., neighborhoods in Ixtapaluca and Chalco, in the peripheries of the city, are required to provide one stall for every housing unit of up to 120m2. Likewise, neighborhoods like Tejedores and Alfareros in Chimalhuacán, with no access to the transit network, are required to provide 0.5 parking stalls for a housing unit of up to 72m2, which is half the requirement for the TOD areas studied in this report. Moreover, parking incentives in Mexico City's planning instrument seem to be running opposite to the principles of TOD. Rather than designing incentives to cut parking requirements in areas with access to transit to help drive down the costs of development, the Programas Delegacionales de Desarrollo Urbano in delegaciones like Miguel Hidalgo, in fact include special norms to incentivize parking as can be read in the Norma para Incentivar los Estacionamientos Públicos y/o Privados (Mexico City Government 2008). Similarly, Planes Parciales like the one for the historical zone of Tacubaya consider increasing the supply for parking stalls as a "high and immediate priority" (Mexico City Government 2012)

Land regulations in Mexico City thus make the implementation of a comprehensive TOD strategy financially infeasible. This is especially true in the case of affordable housing, a key element of TOD. The provision of affordable housing is one of the most pressing issues in Mexico City and will become a greater challenge as the population and housing demand continue to grow. According to the OECD (2015), the lowest viable price of a housing unit, given the current land values in Mexico City, is MXN 800,000, which is still unaffordable for low-income households. Moreover, most of the housing built in Mexico City is above the threshold that could be eligible for federal subsidies. This may be, in part, why in 2015 only 5 percent of the housing financed through INFONAVIT, FOVISSTE, banks and other financial entities, was issued in Mexico City, despite being home to 18 percent of the country's population and housing stock (Ibid).

The Mexico City government could thus create special regulatory and financial frameworks with TOD criteria to promote development in areas with access to the transit network. Certainly, there have been efforts to design and implement planning strategies to promote urban regeneration in specific areas of Mexico City. For example, the Mexico City government has introduced Transfer of Development Rights to enable higher intensity of development in rapidly growing Delegaciones such as Miguel Hidalgo, Benito Juárez, Cuauhtémoc and Venustiano Carranza and remove development pressure from historic and environmental preservation areas. However, the use of this and similar instruments has been piecemeal and has not been linked to any city-wide TOD strategy.

Moving TOD forward in Mexico City would therefore require a city-wide TOD policy that could bring the wide array of instruments into an overarching framework with a clear TOD vision. We believe three elements would be key in a new policy approach. First, special land regulations could be created for TOD areas, including land uses, heights, densities and parking requirements. Second, a TOD policy could be implemented at specific sites with well-defined boundaries. Third, special financing mechanisms and incentives could be created to mobilize private investment in TOD areas. A number of planning instruments existing in Mexico City that

FIGURE 5-1 Existing Zoning Regulations within Transit Station Neighborhoods

Neighborhoods in	Max. FAR	Min. Parking / DU
Rosario	2.1	1 / 65m²
San Joaquín	2.1 (few 3.5)	
Tacubaya	1.4, 4.2	
4 Caminos	4.2	
Tlalpan (1)	2.1	1 / 65m²
Chimalhuacán (2)	2.25	0.5 / 72m²
Iztapalapa (3)	1.8	1 / 65m²
Tláhuac (4)	1.8	1 / 65m²
Ixtapaluca (5)	3.2	1 / 120m²
Chalco (6)	3.2	

1) Pedregal San Nicolas, Héroes de Padierna; Talabarteros; 2) Tejedores, Alfareros; 3) Quetzalcóatl, Hank Glez., Reforma Política; 4) Ampliación Selene; 5) Santa Cruz Tlapacoya; 6) Héroes de Chalco

incorporate some of these elements were studied for this report. Three instruments, namely the Programa Parcial de Desarrollo Urbano, Área de Gestión Estratégica, and Sistema de Actuación por Cooperación illustrate that in order to boost development in a specific site and for a particular goal, specific sites should be subject to different legal, regulatory and financial frameworks. These instruments are briefly described below.

Partial Urban Development Programs (PUDP)

The Partial Urban Development Programs are designed to improve urban areas with pressing needs; ensure a proper use of natural resources; preserve heritage buildings and sites; and improve the basic infrastructure, equipment and urban image of a specific site. The PUDPs establish special legal and financial frameworks as well as land use regulations for specific sites. These are created and modified by each Delegación in coordination with SEDUVI and are subject to the general dispositions established in the LDUDF and the Programa General de Desarrollo Urbano of the Federal District. In cases of trans-jurisdictional sites, the Delegaciones in Mexico City and municipalities in the states of Mexico and Hidalgo can convene to elaborate and manage the PUDPs (Ley de Desarrollo Urbano del Distrito Federal 2010).

The PUDP is perhaps the best suited planning instrument to implement TOD in the ZMVM. Not only it allows defining special rules and regulations for urban development according to the particularities of a site, but also does not require the approval from the Asamblea Legislativa, which might help overcome political barriers to urban development. Moreover, PUDPs can be implemented in sites that fall in more than one Delegación, municipality or state, such as Cuatro Caminos, as local authorities can jointly design and manage the PUDP. Currently, there are 45 PUDPs in Mexico City, although none was identified to have been designed specifically to promote TOD. PUDPs reflect that a different treatment should be given to areas with special urban characteristics to advance urban development goals, and is thus a powerful instrument that can facilitate the implementation of TOD. We will further elaborate in following sections on how PUDPs can be leveraged to advance the implementation of TOD in Mexico City.

Área de Gestión Estratégica (AGE)

The AGE, managed by SEDUVI, was created in 2010 as a planning and urban development instrument to facilitate urban regeneration and revitalization of distressed cultural, environmental, and urban areas in Mexico City. Its main and most powerful feature is that once it is instituted in a strategic area, the AGE allows changes in the existing land use regulations without the need to modify planning instruments that may be in place in the area such as a Plan Parcial and a Plan Delegacional (Ley de Desarrollo Urbano del Distrito Federal 2010). While this planning instrument could certainly be used to promote TOD around transit stations and along corridors by eliminating some of the regulatory barriers earlier mentioned, it requires the approval from the Asamblea Legislativa, running the risk of becoming politicized and creating uncertainty for implementation.

Sistema de Actuación por Cooperación (SAC)

The SAC is a financial instrument established by the LDUDF to facilitate the improvements a specific urban area may need. SEDUVI can establish a SAC, at the request of landowners, to enable urban development projects that will generate direct benefits to the area. By charging landowners, a "compulsory charge to defray, in whole or in part, the cost of a specific improvement or services that is presumed to be of general benefit to the public and of special benefit to the owners of such properties" (OECD 2015), the SAC seeks to distribute the costs and benefits of urban development more equitably, and efficiently manage the provision of infrastructure, equipment, urban services and public spaces the city needs (Ley de Desarrollo Urbano del Distrito Federal 2010). The government levies the charge prior to the start of construction undertaken by private developers. In turn, SEDUVI guarantees a fast-track permitting process for projects within a SAC, which not only creates legal certainty for private developers but also reduces the costs of construction and financing.

The SAC presents several advantages that may inform the design of citywide TOD policy. First, this kind of financial tools are essential to mobilize public resources that can be used for urban regeneration. Second, it can effectively create an attractive legal and institutional environment by expediting permits to ensure greater involvement from private developers in the process of urban regeneration. Third, it creates a different legal and financial framework for a specific site to facilitate new development. And fourth, SEDUVI has the authority to establish a new SAC without approval from the Asamblea Legislativa.

Despite many of the advantages of a SAC it also presents several limitations and challenges for TOD. First, as the SAC is primarily a financial instrument, it does not allow changing the existing urban regulations and requirements existing in a site. In other words, any project built within a SAC has to comply with what is already established by the Programa Delegacional de Desarrollo Urbano or a Plan Parcial. This means that any change in heights, densities, and parking requirements, for example, would have to be negotiated on a project-by-project basis that may delay the implementation of TOD. Moreover, although a committee, integrated by government officials, landowners and private developers, is created to operate and manage a SAC, there are no clear rules on how the allocation of resources is decided. This creates the possibility not only for a discretionary and opaque use of resources but also to ignore the needs and priorities of a community living within a SAC. Many of the essential elements of the SAC, nonetheless, can be utilized for the implementation of TOD.

Multi-use paths and linear parks are examples of public benefits a SAC could help to leverage from developers

CITY-WIDE TOD POLICY PROPOSAL

Identify and create a TOD Zone

TOD Zones could be overlaid around transit stations to encourage a mix of commercial, residential employment-generating activities (Suzuki et al. 2015). Although, delimiting the exact boundaries of a TOD Zone may vary according to the typology of station, some criteria should be kept in mind. For example, the boundaries could initially be drawn using the walkshed methodology as described in chapter # to capture the influence zone of the transit stations by walking or cycling. Accordingly, if a SAC is already in place around a station with TOD potential, the same boundary could potentially be used for a TOD Zone. Socio-demographic criteria such as income could also be taken into account to define the exact boundaries. SEDUVI in coordination with the boroughs could take the lead in identifying the TOD Zones.

Assess the needs and priorities and development potential of the TOD Zone

Once a TOD Zone is identified and delimited, SEDUVI and the boroughs could assess the specific needs and priorities within its boundaries. This is particularly important to better understand what should or could happen around a station, which, again, may vary depending on the typology of station. According to the themes identified in this report, key needs and priorities may be related to accessibility (e.g. connectivity, non-motorized environment, mix of activities), urban design (e.g. streetscape and street grid, ground floor uses, public spaces), affordability (e.g. homeownership and rental affordability, vacancy rates) and informality (e.g. waste removal, access to foot traffic, congestion, health standards). The methodology to assess the particular needs and priorities for each site as the one presented in chapter # (Scorecards) could certainly be used to inform this process.

Assessing the development potential of a TOD Zone is especially important to know the extent to which a site could handle greater densities assuming higher infrastructure capacity is in place. As the capacity of each site may vary, SEDUVI along with the boroughs could first assess the existing gap between the built development rights and the as-of-right development rights in a TOD Zone, to then assess the amount of additional development rights that could be promoted in a zone.

Creating a Partial Plan at the TOD Zone to incentivize private investment

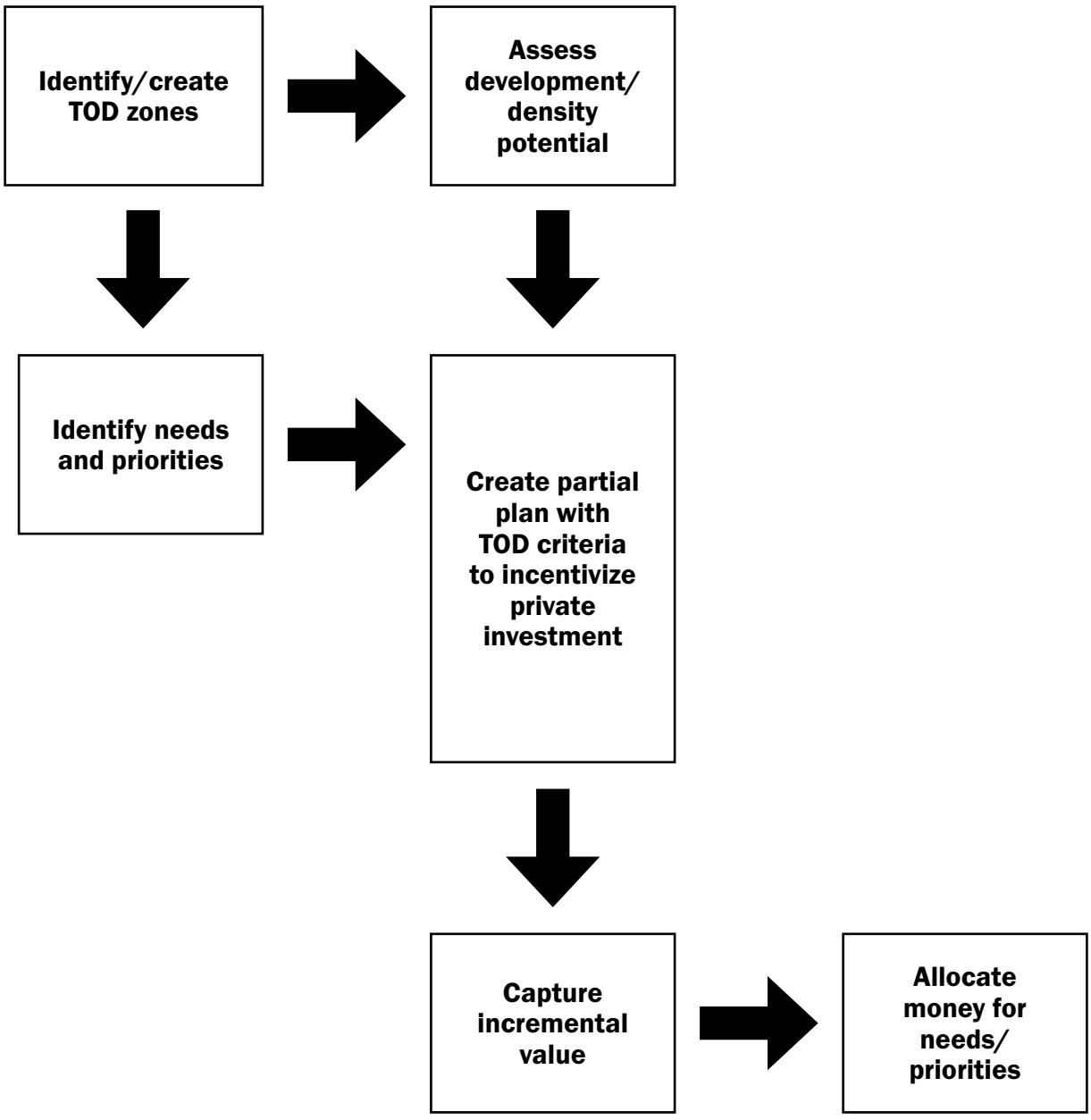
A partial plan could be created specifically to introduce a clear vision of what could be achieved in the TOD Zone. Moreover, according to the needs and priorities and development potential previously identified, a partial plan should introduce new land regulations to incentivize private investment in the area. The partial plan should be intended to make development practices in the zone more flexible, subject to development parameters and land use criteria (Ibid.). TOD Zones may require an increase in FAR and heights and lowering parking requirements to make development financially feasible. For example, a partial plan in areas like El Rosario and San Joaquín could greatly raise the current maximum FAR of 2.1 to make development viable. Similarly, land use changes may be needed to ensure that the envisioned activities can be promoted within the zone.

Additionally, administrative incentives like fast track permitting should be provided within a TOD Zone to further incentivize private investment. Time is money when it comes to real estate development; local authorities can thus help reduce the cost of development in TOD Zones by expediting development permits for projects within the zone. Doing so would help reduce the costs of construction and lower the costs of financing for private developers (MITOD 2016). SEDUVI and the boroughs would have to ensure that development permits will in fact be expedited; they could do so by assigning a project expediter within the agency for each TOD project (Ibid). SEDUVI could also create publicly available guiding documents to help developers understand the role of the different agencies involved in the implementation of TOD and the type of assessment they would need to turn in to invest in a TOD site. These incentives should be clearly stated in a Partial Plan.

Capture incremental value generated in the TOD Zone and allocate resources

The new development potential, such as for different types of uses and additional development rights, created by rezoning, in the TOD Zone should not necessarily be available for free (Smolka 2013). Rather, the Mexico City government and the boroughs could capture some of the value generated in the TOD Zone to deliver public amenities, affordable housing or infrastructure improvements. Several mechanisms to capture part of the incremental value have been widely used in countries in Latin America (see Smolka 2013). We have identified two mechanisms that could be employed to capture some of the value. The first mechanism is imposing a charge for the additional development rights established by the partial plan of the TOD Zone. A charge could also apply

FIGURE 5-2 Process for Developing a City-Wide TOD Policy



to changes in land use or additional reductions in parking requirements. Charging private developers for additional development rights or changes in land uses could allow pooling resources to deliver the infrastructure and services necessary to handle greater densities in the zone. The charge on private developers, however, would have to be set at a level that allows private developers to design commercially viable projects. The value of the additional development rights could be negotiated on a project-by-project basis and decided by SEDUVI and the boroughs, who would have to evaluate a project proposal to estimate the value increment and decide, along with the private developer, how the value would be shared. This mechanism, however, might lead to a discretionary use of land permitting powers, an inaccurate valuation of land, and opaque management of resources.

A second mechanism to capture the incremental value generated in a TOD Zone could be through the auctioning of additional development rights under competitive market conditions, which could not only help address the difficulties of valuing a change in development rights but also to ensure a more transparent and efficient process (Ibid). Through this mechanism, SEDUVI and the boroughs could auction the total additional square meters of development for a TOD Zone - according to what the Partial Plan for the zone would have established. Packets of additional development rights would not necessarily have to be auctioned at once, but could be released during different phases to ensure that SEDUVI and the boroughs capture additional land value increments.

These mechanisms have been extensively used in Latin American cities, especially in Brazilian cities like Sao Paulo, where private developers have understood the benefit of investing in additional development rights and having all revenues reinvested in the same area (Ibid). The resources captured through either of the two mechanisms above described could then be utilized to address some of the needs and priorities of a TOD Zone. In this manner, the cost of delivering additional infrastructure, services or amenities would be partly borne by those benefiting directly from special treatment and regulations (Bertaud 2004).

Either of the mechanisms would require having a Partial Plan and zoning prescriptions in a TOD zone. Similarly, it is necessary to define a detailed formula of how the building rights are to be assessed, forms of payment, definition of rules to apply the resources -which is usually done by the establishment of a special fund- and a council to oversee the resources (Smolka 2013). The Mexico City government could further explore these mechanisms to assess their viability in this particular context. The operationalization of these mechanisms is further explained in chapter # (Tacubaya).

POLICIES AND PROGRAMS FOR TRANSIT-ORIENTED AFFORDABLE HOUSING

Over the last two decades, Mexico has made significant progress in addressing critical challenges to provide decent and affordable housing for millions of working families. A substantial increase in financing available for social housing, led primarily by housing agencies Infonavit and FOVISSSTE, has expanded the access to formal housing on a grand scale through subsidized mortgage loans and other housing solutions. In particular, the expansion and reforms of Infonavit throughout the 1990s enabled the development of the national housing production system and supported the growth of several commercial home-building firms. Presently, it is by far the largest provider of mortgage loans in Mexico, as well as in all of Latin America, managing more than five million individual accounts (Infonavit, 2016).

However, making affordable housing available for millions of formal sector households has also contributed to accelerated sprawl in Mexico. To avert issues of land availability and development costs, commercial housing developers often opt to build large subdivisions far from urban centers, on tracts of land that are less expensive and complicated to acquire. Meanwhile, the sprawl has also been accelerated by informal housing, as families without access to formal sector housing options have been pushed to informal settlements in urban peripheries and beyond. In fact, the 2010 census indicated that over sixty percent of the housing stock was produced outside of the formal sector (BBVA Research, 2012).

These sprawling development patterns have resulted in significant consequences, including an increase in land values and development costs at the urban core and fringe. For example, as Mexico City has experienced rapid metropolitan expansion over the last few decades, the city has been failed to adequately address the growing needs for urban housing and public space. The following graph indicates the rapidly rising and increasingly unaffordable housing prices in Mexico City.

Example of publicly financed INVI housing located in the San Joaquin station area

EXAMPLES OF CITY-WIDE TOD POLICIES

Chicago

The City of Chicago established in 2015 a city-wide TOD ordinance to increase incentives for development near transit stations and to increase transit ridership in the region (Figure #). The TOD ordinance applies to all arterial streets up to a quarter mile from transit and rail stations, and up to a half-mile from a station in streets with pedestrian designation. A series of development incentives are provided by the TOD ordinance. For example, it allows a decrease of 100 percent in the minimum parking requirement for non-residential projects and a decrease of up to 50 percent in the minimum parking requirement for residential buildings. Similarly, as a way of incentivizing the provision of affordable housing, the TOD ordinance allows an increase of 17 to 33 percent in FAR for projects that provide from 25 to 100 percent of the required affordable housing units on site.

Moreover, if a residential project within a TOD area provides no more than 1 parking space per housing unit, the minimum lot area per unit can be reduced from 400 to 300 square feet on parcels with a minimum area of 6,000 square feet, which allows developers to increase the number of units in a project. Lastly, the ordinance also gives incentives in terms of maximum building heights as a function of the amount of commercial space provided on the ground-floor.

Monterrey

TOD is already part of the regulatory framework of other Mexican cities. For example, article 73 of the Zoning and Land Use Code for the Municipality of Monterrey establishes special regulations to create incentives to densify and diversify new developments around transit stations and along transit corridors. These special regulations apply to all plots larger than 2,000m2 within a “TOD-Zone” which is defined as the area within an 800 meter Euclidean buffer from subway and BRT stations or 500 meters from a subway or BRT corridor. Plots within these zones are allowed to increase the height and density of a development by 100 percent and to cut the amount of parking by 50 percent; mixed-use developments are given even more incentives. Parcels smaller than 2,000m2 are not entitled to receive the benefits from the TOD ordinance; however, the Code permits the fusion of parcels as a way of incentivizing landowners to assemble their parcels to promote new development.

FIGURE 5-3 Potential Chicago Sites for TOD and Corresponding Development Incentives

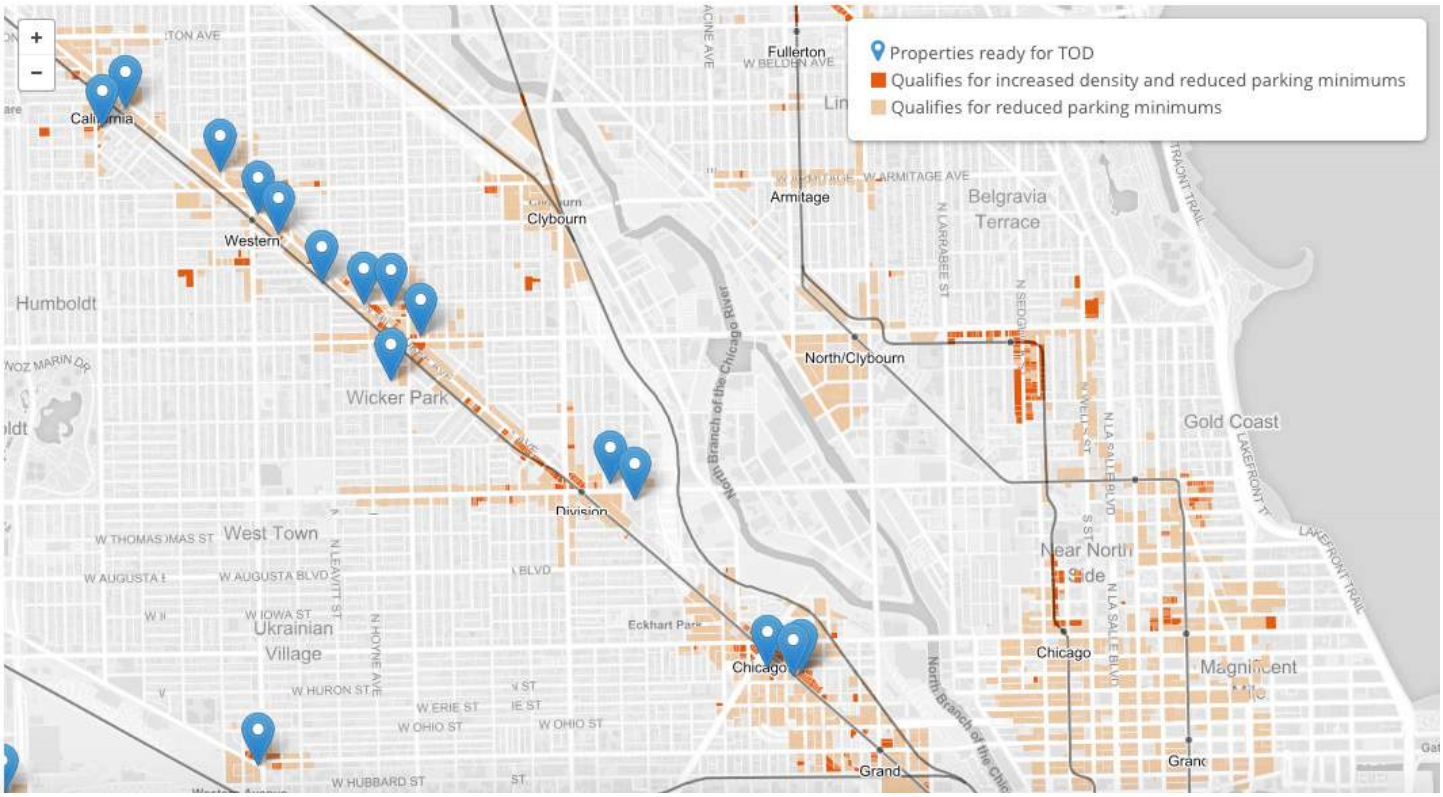


FIGURE 5-4 Monterrey's 2014 TOD Ordinance Boundaries

6 | CONCLUSION: MOVING TOWARDS A TOD FUTURE

6 CONCLUSION: MOVING TOWARDS A TOD FUTURE

As described in previous chapters, the complexity of Mexico City's economic and infrastructural conditions will present a challenging uphill battle for the implementation of any meaningful TOD policies. Decades of population and urban area growth have yielded a sprawling urban landscape of unsustainable development patterns and infrastructure, and the City's complex governance structure and active informal sector only deepen the complexity. Yet despite these present difficulties, the successful implementation of TOD policies in Mexico City holds tremendous potential for social, economic, and environmental gains for the entire region. Our class was tasked with developing a set of policy recommendations that could jumpstart TOD discussions, both in the private and public sector, in a way that has not yet taken place in Mexico City. In order to create recommendations that were highly tailored to the city's unique conditions, we first built a framework for evaluating transit oriented development as it exists today in Mexico City. This framework was a crucial first step in developing our final recommendations in that it allowed us to thoroughly explore the baseline conditions of transit neighborhoods in Mexico City and prioritize only the most relevant topic areas.

Our framework for evaluation was broken down into four themes: accessibility, urban design, affordability, and informality. These themes, although distinct, are highly integrated with one another and create an ecosystem of different infrastructure, uses, people, and spaces—all of which are connected to transit. To test this framework and root it in a place-based context, we chose four Metro stations as our test sites. Using our own custom typology methodology, we chose four highly different station types to apply the framework to: San Joaquin, Cuatro Caminos, Tacubaya, and El Rosario.

For San Joaquin, a neighborhood scale station at the intersection of several emerging commercial and residential development centers, affordability is of critical concern. Low household income levels coupled with some of the highest housing costs (in comparison to other station areas) makes for a mismatched housing market where long-time residents with ties to the area are no longer able to afford housing, despite the recent emergence of new employment centers that could conceivably employ local residents at a range of income levels. San Joaquin's abundance of both vacant and underutilized public land also presents a unique opportunity for denser mixed-use residential development with higher rates of subsidized affordable units included on site.

New development around transit stations cannot afford to not consider transit in its design and programming

Cuatro Caminos, a terminal station on line 2 at the border of Mexico City and the State of Mexico, serves as the gateway to the most highly traveled line in the Metro system. It also sees an estimated 1,900 street-level buses arriving to the station each hour during peak rush hours. The scale of this station is massive in every way. In addition to its significant ridership numbers, the physical layout of the station area is dominated by large superblocks with few pedestrian facilities. Connectivity issues, both within this massive and complex site as well as to surrounding neighborhoods, are significant, however the station offers good metropolitan connectivity due to the reach and number of transfer points that Line 2 offers.

Tacubaya, a southwest city transfer hub, is situated within a complex network of Metro lines, BRT, arterial roads, pedestrian bridges and dozens of bus lines. The result is a bustling and chaotic area with difficult navigability for pedestrians and transit users alike, and poor on-site provisions for the street vendors surrounding the station. Despite its transportation issues, the surrounding neighborhood features more affordable housing options (as compared to the other three stations), and some historical development that create a unique charm and beauty for the area. Recommendations for Tacubaya

El Rosario, another terminal station at the border of Mexico City and the Station of Mexico, serves as the gateway to the city for passengers mostly arriving by minibus from the outer suburbs. Despite featuring a mixture of neighborhood land uses around the station, the area immediately surrounding the station is dominated by a large rail yard, a Metro logistics hub, and several walled off vacant parcels. Recommendations for this station include a community land trust for spurring the creation of more affordable housing in proximity of the station, and new microbus and wayfinding technology for improving the transit user's experience at this terminal station.

Together, these diverse recommendations are intended to demonstrate the tremendous array of possibilities that existing transit stations in Mexico City pose for transit-oriented development. We hope that the ideas presented spark new conversations between other urban practitioners, public policy makers, and private developers interested in improving the transportation, housing, and urban form issues confronting Mexico City.

MIT Students and Faculty, January, 2016

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