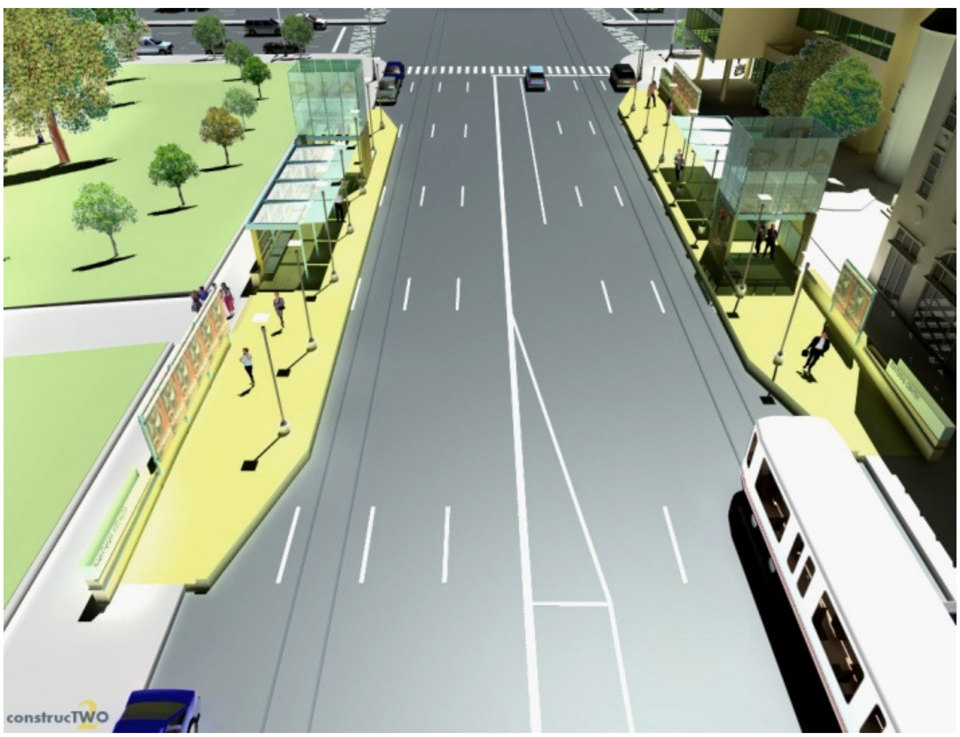
# The Woodward Transit Catalyst Project - System Plan

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# 1 The Case for the Woodward Transit Catalyst Project

## 1.1 The Catalyst for Effective Rapid Transit and Development in the Detroit Region

Seldom does a project present itself that has such potential for profound transformational impact on a region and its people as The Woodward Transit Catalyst Project. This project will, through the creation of a relatively small transit system, enable and activate the first critical stages of a region-wide rapid transit system . . . stimulating great economic development, easing highway congestion, reducing both energy consumption and air pollution, improving the quality of life and regenerating civic pride.

Many regions which (like Detroit) shut down light rail in the middle of the 20th century have reinstated systems since the 1980s. This resurgence of rail-based rapid transit has occurred for economic reasons. Research and experience have shown that real estate development occurs in light-rail corridors, and that this real estate development has a value many times of the cost of the transit system. Various studies and actual results have shown development investments between $6.50 to $11.00 can be expected for every dollar spent on the transit system. For example, the 3.6 miles of the Portland Streetcar System cost $88.7 million to build; during the first nine years after the original alignment was identified (and five years after operation began) $2.28 billion was invested within two blocks of the streetcar route providing a development investment over 25 times the cost of the system. When a regional system is implemented – and the Woodward Transit Catalyst Project is the first step – studies show net income in regions that have built rapid transit increases as well.

The real estate development is based on permanence of the route and stations. In the freeway era, many major commercial, residential and industrial developments have taken root near expressway on-ramps. Similarly, the regions that have built light-rail systems have seen enormous development near transit stations, which are the permanent access points to the rapid-transit network. Bus systems, including bus rapid transit, do not provide this permanence, and therefore, are not as effective in stimulating development. Further, in cities that have instituted both light rail and bus rapid transit, the light rail lines (in similar corridors) typically achieve double the ridership of the enhanced bus lines.

When linked to other transit elements in Southeastern Michigan, such as the planned enhanced intercity rail linkage between Ann Arbor and the Detroit New Center Area (using existing freight tracks), the Woodward Transit Catalyst Project and the resulting network will reduce highway congestion that is frequently caused by construction, accidents, weather and high traffic volumes in our region. The reduction of thousands of vehicles per day will improve the quality of life for both riders and drivers, reduce fuel consumption and improve air quality for our region.

Transit also allows for higher end use of land in the central business district (CBD). The demand for parking is reduced, thus freeing land for development. Downtown Detroit (as well as other regional downtowns) is now restrained from growing because on a typical day in the CBD most parking spots are taken and many lots are full or nearly full.

## 1.2 Woodward – A Route that Connects and Enables

This plan proposes a 3.4 mile light-rail line in the Woodward corridor from Hart Plaza to Grand Boulevard, a route selected for its destinations, its relative ease of construction and expansion, and its connectivity to other current and emerging transit systems

First, Woodward Avenue has many transit-supportive areas along its entire length from Pontiac to downtown Detroit. A transit-supportive area is one with enough residential, commercial, and/or industrial density to make transit useful to meaningful numbers of people. The Woodward corridor includes many important destinations such as the Detroit Cultural Center, New Center, Detroit Medical Center, Wayne State University, the State Fairgrounds, Detroit's sports stadiums, the riverfront and Campus Martius. It also connects an important set of Southeastern Michigan communities: Detroit, Highland Park, Ferndale, Royal Oak, Birmingham and Pontiac.

Woodward has another unique advantage: maximum connectivity to the existing bus transit systems. When this project is built, there are over 7,500 buses each week that will deliver riders to (or pick them up from) this light rail line (in just the 3.4 mile lower Woodward corridor). This project will connect to many D-DOT and SMART bus routes, the Transit Windsor Tunnel Bus, the Detroit PeopleMover, Amtrak intercity rail and Megabus intercity bus. No other corridor provides such extensive connectivity.

After this initial phase, the Woodward light rail line can be extended from downtown Detroit to any regional downtown or business areas including Royal Oak, Birmingham, Troy and others. This first phase from the riverfront to the New Center connects a large number of business, cultural and educational institutions with the downtown district. In addition, we are anticipating enhanced intercity rail service between Ann Arbor and Detroit in the near future, and as that service will (of necessity) terminate at the New Center. The Woodward Transit Catalyst Project provides a critical link from that point into downtown Detroit.

## 1.3 Light Rail – An Efficient and Cost Effective Transit System that Stimulates Investment

The Woodward Transit Catalyst Project will employ in-street semi-rapid light rail.

Recent systems across North America have proven light rail effective with regard to cost, popularity and stimulation of economic development. Urban areas around Portland, Denver, Dallas, St. Louis and many others have experienced the benefits of such systems.

There is significant evidence that urban redevelopment has occurred rapidly and substantially along these new light rail lines. This may be partly because of the perceived permanence of the rail system. For example, a Kenosha (Wisconsin) light-rail official said, "developers don't write checks for buses". A rail based system is critically important to attract investors to further accelerate the redevelopment of Detroit.

As Julian Wolinsky points out in Railway Age, "Transit is being woven into a partnership that includes municipalities and developers, all trying to rejuvenate old neighborhoods and create new ones with the added goals of a healthy environment, job growth, and business investment."

Minnesota transit advocates, evaluating the success of development around the Hiawatha light rail line, have found that form of development attracts many kinds of people including "young adults who prefer urban environments with convenient access to goods and services." (Transportation Choices 2020, Transit for Livable Communities, Minneapolis, 2005)

In Toronto, transit developers give a list of advantages to an enhanced light rail system: "Provision of the premium quality service – quiet, smooth, comfortable, fast, and reliable – which attracts people to ride transit; Highly energy-efficient technology – light rail vehicles produce 92 per cent less $CO_2$ than autos and 83 per cent less $CO_2$ than diesel buses, and produce zero local-area or 'tailpipe' emissions; Demonstration of long-term and substantial commitment to quality transportation, to instill the confidence which landowners and investors need to invest in development and city-building, and the confidence which residents need to choose a transit-oriented lifestyle; Creation of a strong and highly-recognizable presence which signifies the availability of high-quality transit"

In addition to attracting investment, light rail is cost effective with regard to both construction and operation. Alternatives such as elevated guideways or subways are far more expensive to build. Operationally, light rail vehicles last longer than buses, are simpler to maintain and less expensive (per rider) to operate.

Light rail, of one form or another, is by far the most popular choice for new implementations because its costs and characteristics are well understood. An enhanced in-street system, pre-board fare payment, and signal preemption (traffic lights turn green for the train as it approaches) provides a near-rapid-transit level of service for a comparatively low cost.

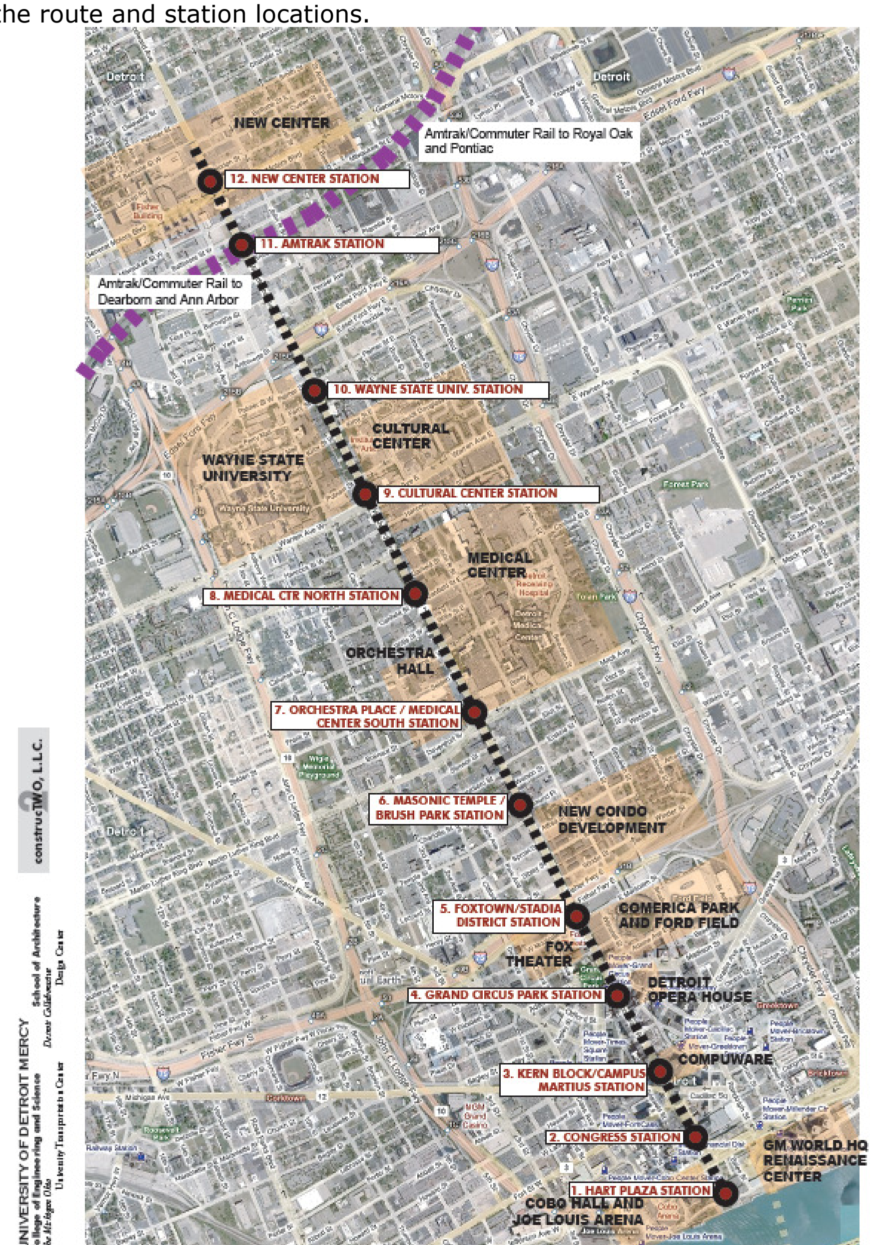
The Woodward Transit Catalyst Project is quite simply right for southeast Michigan. It employs a design that has proven to be popular and effective in attracting ridership and development in cites across the nation. It is an enabling "linchpin" for a regional transit system. Its construction and operation are affordable and can be accomplished in a relatively short time. In short, it will be a first key step to securing federal funds and a catalyst for not only regional transit development, but indeed for regional economic and community development

# 2 System Description

The proposed transit system will provide service that is convenient, economical, safe and efficient to riders. The following sections describe the design and operation that assure such service.

## 2.1 Route and Station Location

The Woodward Transit Catalyst Project will travel a 3.4 mile route on Woodward from just north of Grand Boulevard to just south of Jefferson with twelve stops along that route. The map below depicts the route and station locations.




POSSIBLE STATION LOCATIONS FOR WOODWARD LIGHT RAIL TRANSIT

Each station location is described (including aerial photos) in Appendix A

## 2.2 Service Provided

The Woodward Transit system will provide convenience and efficiency for riders through frequent train arrivals. The "headway" (time between trains in one direction) will range from four to ten minutes, depending on the time of day which the system is in operation.

During peak times (6:00 am to 9:00 am weekday mornings and 3:30 pm to 6:30 pm weekday evenings) the light rail vehicles will arrive at stations every 4 minutes in each direction. During off-peak times the vehicles will arrive at stations every 10 minutes in each direction. In the middle of the night the system will not operate and the DDOT Woodward buses will provide service in the corridor.

When the trains are running on a 4-minute schedule, the average wait time will be 2 minutes with a maximum wait time of 4 minutes. During off-peak hours, the average wait time will be 5 minutes with a maximum wait time of 10 minutes.

All trains will stop at the southernmost and northernmost station on the line each trip. Other than that, the trains will "flag stop"; that is, they will stop if anyone is waiting on the platform to board the train, or if any passenger on the train has signaled for a stop by pressing the stop-request strip. This saves travel time since most trains will not have to stop at all stations


*Portland Transit System Stop at Portland State University (Photo courtesy of Portland Streetcar, INC)*

The travel time for the entire length of the system (one way) will be ten minutes. This is based on an estimated average speed of 20 mph, including dwell time at stations, acceleration, braking and speed limits. Travel time will be improved by providing traffic signal preemption by the trains thereby eliminating delays due to stoplights.

Trip Details (minutes: seconds)

NORTHBOUND

| Arrive | Station | Depart |
|---|---|---|
| | Hart Plaza | 0:00 |
| 0:30 | Congress | 0:42 |
| 1:12 | Campus Martius | 1:18 |
| 1:48 | Grand Circus Park | 1:54 |
| 2:36 | Foxtown | 2:54 |
| 3:48 | Brush Park | 3:54 |
| 4:36 | Orchestra Place | 4:42 |
| 5:36 | Medical Center | 5:54 |
| 6:36 | Cultural Center | 6:42 |
| 7:36 | Wayne State U. | 7:42 |
| 8:54 | Amtrak | 9:00 |
| 9:30 | New Center | 10:00 |

SOUTHBOUND

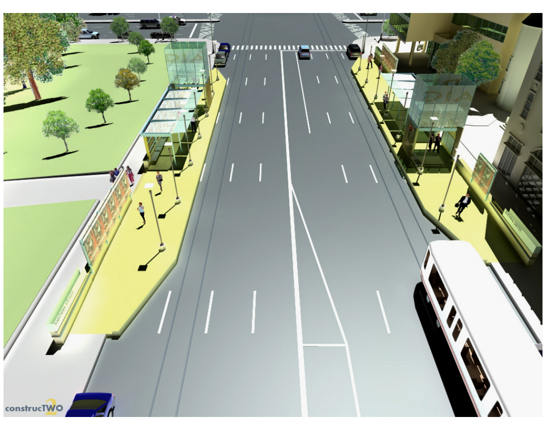
| Arrive | Station | Depart |
|---|---|---|
| | New Center | 0:00 |
| 0:30 | Amtrak | 0:36 |
| 1:42 | Wayne State U. | 1:54 |
| 2:48 | Cultural Center | 2:54 |
| 3:36 | Medical Center | 3:54 |
| 4:48 | Orchestra Place | 4:54 |
| 5:36 | Brush Park | 5:42 |
| 6:36 | Foxtown | 6:54 |
| 7:36 | Grand Circus Park | 7:42 |
| 8:12 | Campus Martius | 8:18 |
| 8:48 | Congress | 9:00 |
| 9:30 | Hart Plaza | 10:00 |


*Metro Transit Hiawatha Line – Minnesota*
*(Photo courtesy of Metro Transit, Minneapolis/St. Paul, www.metrotransit.com)*

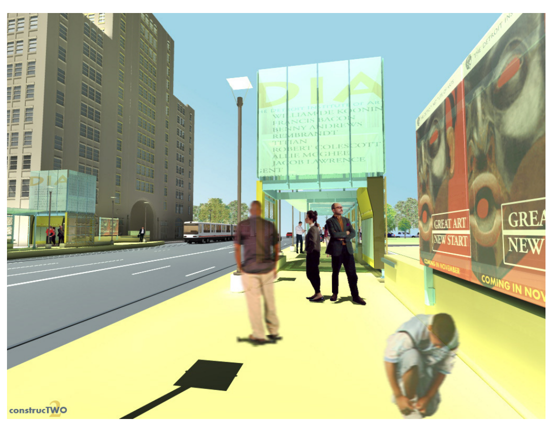
Since vehicles arrive frequently, there is no great value or need to publish schedules. Rather, a visual and/or audible annunciator will be installed in each station providing an estimated time until the next train's arrival.

## 2.3 Station Design

The idea of defining a series of vertical landmarks along Woodward Avenue motivates the design of the stations. As one moves through the city, the consistent architectural language of the station offers a common visual measure of the global system. Each of the parts (the stations) contributes equally to the whole (the system).



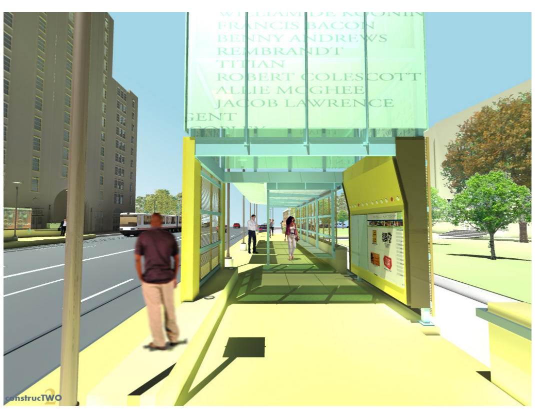
*View of "DIA" branded Cultural Center Station looking South*



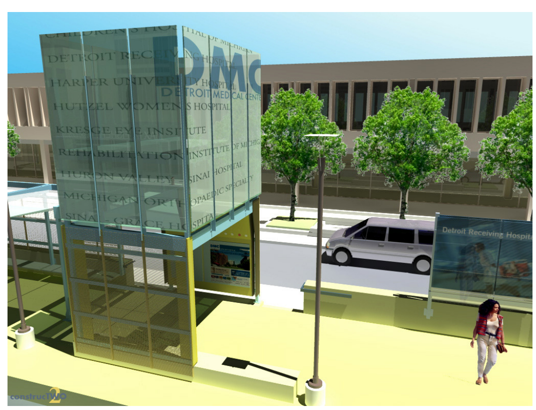

*View of Approach to "DIA" branded Cultural Center Station*

*View of "DMC" branded Orchestra Hall/Medical Center South Station looking North (Medical Ctr. North Station visible in distance)*

The incorporation of a taller structure, an "information cube," defines the datum along the route. A series of vertical translucent glass panel skins, emphasizing the spirit of lightness embodied by the station designs, defines the tectonic of the information cube. LED lighting systems are integrated with the panels, offering the ability for themed lighting for seasons, holidays, or special events. For example, in celebration of a Detroit Red Wings championship season, all of the stations could glow with a red light, or for Thanksgiving, they would all be orange. For the DIA branded stations, this proposal suggests exhibited artists' names be etched into the glass panels. Likewise for the DMC branded station, affiliated health care institutions' names are embedded in the panels.

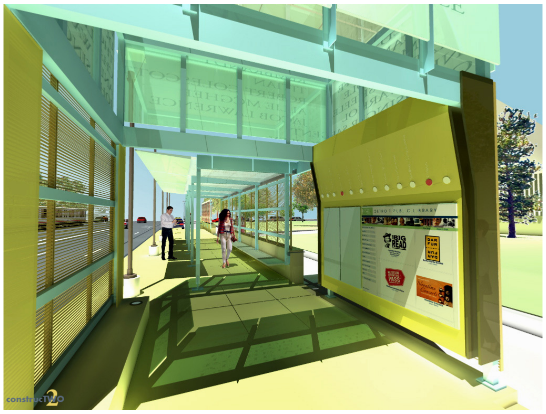


*View of branded Cultural Center Station Information Cube*



*View of branded Information Cube at Medical Center South*

The stations all share a universal structural logic of steel framing with a cladding system of metal and translucent glass panels. The proposed stations are open structures; therefore, they offer transparency and porosity between the sidewalk and the street, enabling pedestrians to move easily between the city and the transit system. Permeable metal mesh panels line the sidewalk side of the sheltered waiting platform, allowing views from sidewalk to street. The information cube not only offers a common architectural response but also responds to the pragmatic programmatic requirements by housing self-service ticketing machines, an electronic route locator, an electronic flat screen display for advertising, and other pieces of information related to each specific stop, such as local entertainment and retail venues.


*View of branded Cultural Center Station Information Cube*


*View of "DIA" branded Cultural Arts Center Station*

In addition to the information cube, each of the stations offers a sheltered waiting area for passengers with specialty indirect light fixtures to illuminate the platform. Visibly mounted cameras offer 24-hour surveillance of the stations to ensure safety of the passengers as well as to deter potential vandalism. Additionally, the use of durable materials will accommodate the daily wear and tear associated with environmental and social conditions. The stations at each of the particular sites responds to the potential of vehicular mishap via strategic location of a concrete "seating" wall as well as the actual siting of the station itself.


*View of Base Medical Center South Station*

All of the stations, base and branded, include the information cube with sheltered waiting platform. The upgraded "branded" stations will offer additional mechanisms for advertising and graphic displays with the addition of changeable display panels along the sidewalk edge of the stations. For example, at the DIA branded station, the additional display panels could exhibit graphics related to the "Great Art/New Start" opening of the museum. At the DMC branded station, the additional display panels could feature specific hospitals. Within the information cube, the difference between the base and branded stations is seen in the electronic flat screen display unit. For the base station, the display might be a simple changeable display that welcomes passengers to the station. For the branded station, interactive logos on a touch screen display could link passengers to local institutions' web sites, local restaurants, or entertainment venues.


*View of Branded Medical Center South Station*


*View of "DMC" branded Orchestra Hall/Medical Center South Station looking North (Medical Ctr. North Station visible in distance)*

This proposal envisions a series of light rail stations operating as landmarks along Woodward Avenue. The stations not only offer consistency to the architectural language of the light rail transit system but also have the opportunity to establish Detroit as a leader in the integration of technology, transportation, and sustainability.

## 2.4 Vehicles

The vehicles employed in this system will be of the "low weight variety," such as the Skoda-Inekon Astra which are used in Portland and Tacoma for their in-street systems. A fully loaded vehicle does not exceed Michigan's maximum allowable weight for a truck or bus on the street. Their low weight enables them to be placed in streets with relatively minor modification to the street. Only a "shallow trench" is necessary compared to a "deep trench" for other vehicles, significantly reducing construction costs. Further, it is anticipated that no additional support structures will be needed where Woodward passes over the I-75 and I-94 expressways.

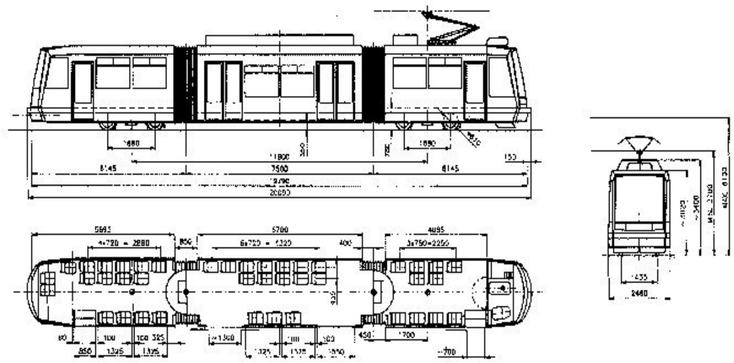
*Skoda-Inekon Astra Transit Vehicle in Portland (Courtesy Portland Streetcar, INC)*

These vehicles are 66' long and 8' wide and employ a standard US rail gauge. The vehicles fit into a normal width lane of a road. They hold 41 seated passengers and up to 113 standing passengers under normal loading. Two vehicles may be coupled together to create a double length train. The proposed system will operate two-car trains, such that each train has a capacity of 82 seated passengers, plus 226 standees, for a total normal capacity of 308 passengers.

The "crush load" (absolute maximum) is 221 passengers. Thus during special events when many people are trying to enter or leave the corridor at once, each train could carry up to 442 passengers.

These vehicles are "low floor" meaning that their passenger floors are only one step above the pavement. The stations will be designed so the floor of the station is the same height as the vehicle floor, allowing people to walk on or off the trains without stepping up or down, and wheelchair users can simply roll onto and off the trains.

The vehicles are designed to reach speeds of 47 mph, but are intended for operation at 31 mph. When operating in-street, the system follows posted speed limits. The vehicles are powered by overhead electrical wires.



*Drawing Courtesy of Portland Streetcar, INC.*

Electrical power is very quiet, and an efficient use of energy resources. Electric vehicles also have the advantage that they do not produce pollution at the vehicle's location. Electricity also powers the heating and air conditioning units

<u>Number of vehicles required</u>:

With a 20 minute round trip time and a four-minute headway during peak hours, five trains of two vehicles need to be in operation. It is customary to have two extra units in reserve for maintenance, so the total number of vehicles required is twelve. In this way, the system can run at full capacity even if 16% of the fleet is out of service for repairs.

In times of extreme demand, it is possible some passengers will not be able to board the first train that comes by but will have to wait for the next train. Under those circumstances, wait times can double. If that becomes a persistent problem, additional vehicles can be added to increase system capacity. The lack of a ridership history precludes justification of such additional investment for the initial system.

## 2.5 Ticketing System


To make the light rail service more efficient, passengers will pay for their fare before boarding the vehicles. Tickets and passes will be dispensed by ticket machines at every station, such as the system shown on the left. Tickets and passes will also be available in advance. Similarly, there are many ways for a DDOT or SMART bus passenger to buy tickets or passes before boarding a bus, including on-line sales and sales through local merchants. Passengers in the loading area of the stations and on vehicles will be required to have a valid pass or ticket, and this will be done on the honor system with spot enforcement.

In other transit systems that are underground or elevated, such as the Chicago system, it is possible to enforce fare collection with a system of gates and turnstiles.

*Light Rail Ticket Vending Machine*
*(With permission from www.RTD-Denver.com)*

Using barriers such as that shown on the right ensures that virtually every passenger has a ticket. However, installing gates and barriers is far more expensive than random enforcement because of the additional equipment. Also, gates and barriers cause a dramatic change in the public perception of the transit system by making the system appear to be an unwelcoming fortress. Having gates also slows the loading of the transit vehicle. If passengers are "queued up" at the gate at the last minute operators must either wait for such passengers or leave them behind . . . neither of which improves system performance or passenger satisfaction.

Turnstile System
*(C Photographer: Stanislav Perov | Agency: Dreamstime.com)*

Further, in a street-level system such as is being proposed, it is nearly impossible to use gates and turnstiles for enforcement because a determined fare-jumper can simply enter a station from the track side.

A "trust but verify" alternative, such as the one St. Louis uses, will be employed by the Woodward Transit system. Guards or officers who ride on the system have an additional responsibility of randomly checking tickets. On average they check one third of the tickets per trip. Neither the driver nor anybody else tries to verify that each and every rider has paid. However, anyone persistently riding without a ticket is eventually caught and fined. To make this system work the fine for riding without a ticket will be many times the fare amount.

By employing this ticketing system, boarding can be very fast and efficient and the stations can be designed with a very welcoming, open style without barriers that are constraining and intimidating.

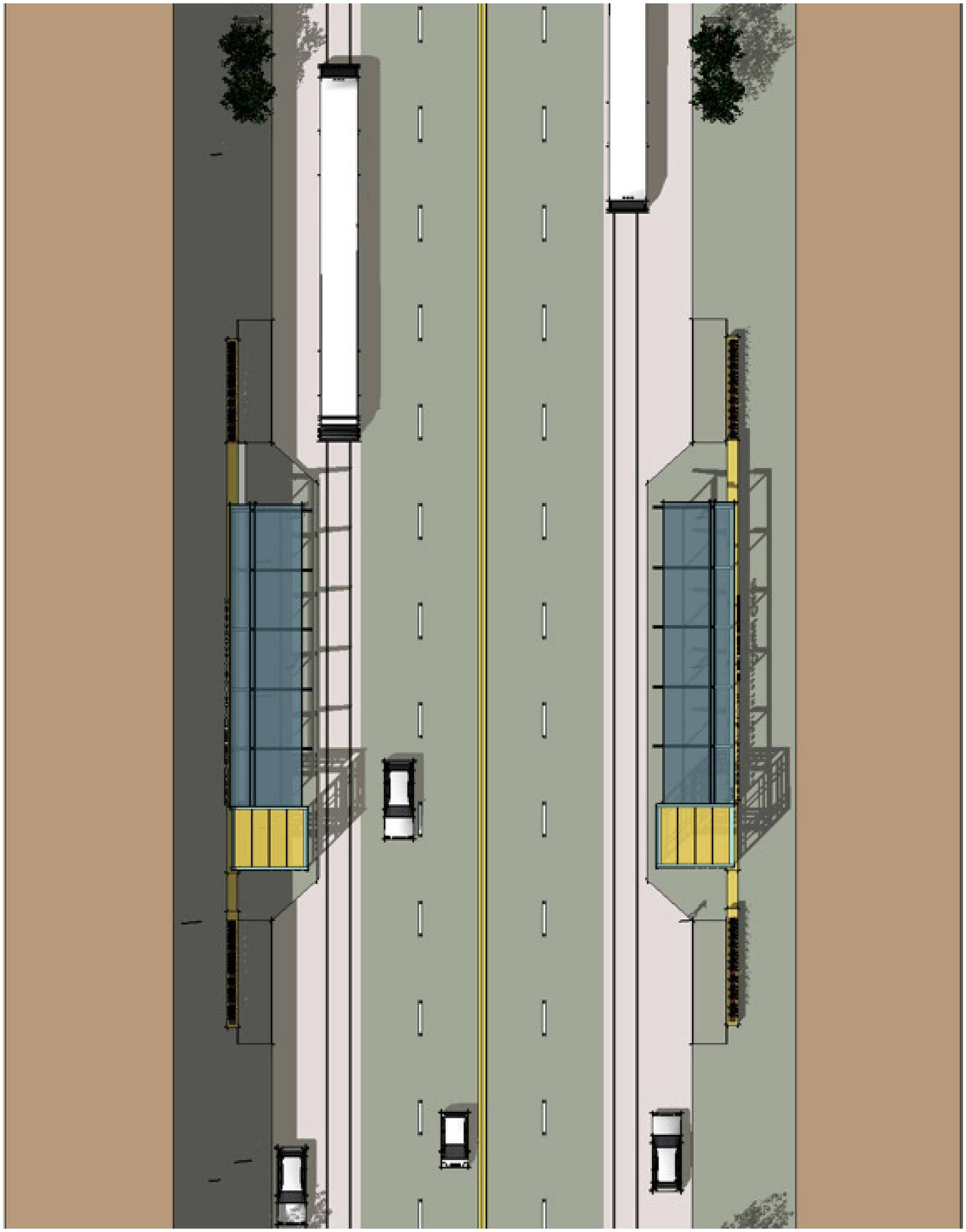
*Open Transit Station Design in New Jersey Transit System*
*(photo courtesy NJ Transit ©2007NJ Transit*
*Michael Rosenthal – Photographer)*

## 2.6 Infrastructure

### 2.6.1 Track Location

Final track locations will be determined by engineering analysis. This plan is based on discussions with MDOT and current knowledge of conditions in the project corridor.

The planned track location is the second lane from the curb for the entire route except between Campus Martius and Jefferson. Near Jefferson, the center portion of Woodward will be used because of a change in the layout and width of the street.



Track location in the second lane allows the outer lane (curbside) to be used for parking. It also dramatically reduces the cost of utility relocation. The second lane and center median are the usual choices for in-street rail transit. The second lane is used by the Portland Streetcar which shares many characteristics with the proposed system for Detroit.


*Rail Placement in Second Lane in Portland, Oregon Transit System*
*(Photo courtesy of John Smatlak, Railway Preservation Resources, from www.railwaypreservation.com)*

For rail placement in the second lane, the stations are placed in the first (parking) lanes.  On-street parking is allowed except at the stations where the sidewalk extends into the parking lane (as shown in the photo above).

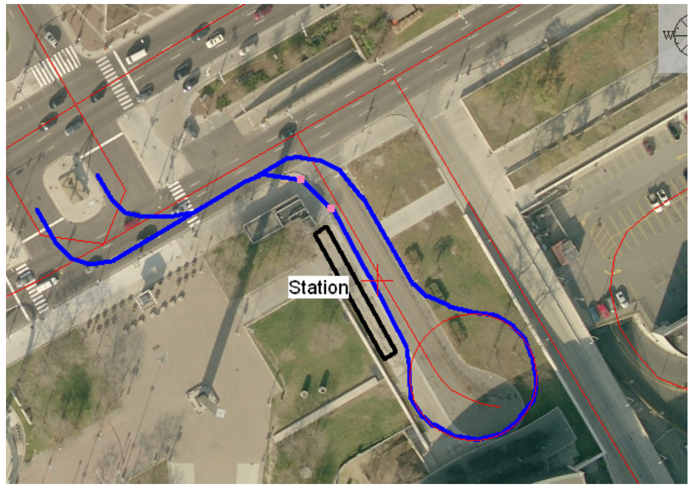
### 2.6.2 Control and Communication

The trains will be tracked by GPS (such as is already done today by DDOT for their buses).  Since trains only go in one direction on a given track, the motorman can see any train ahead of him, so there is no need to centrally control the trains in any way.  As with bus transit and other light rail systems, it is the motorman's responsibility to try to keep to his schedule.  With GPS, operations and maintenance staff will be able to see the position of each train at all times.

The GPS will also allow the system to provide passengers at stations with the estimated arrival time of the next train on electronic display boards. The same display boards can give passengers estimated arrival time for DDOT buses crossing the line.  In addition, these boards can also display the scheduled departure times of Amtrak trains and SMART buses (based on the schedule as there is no real-time information available).

The motorman will have a two-way radio for communication with maintenance and operations personnel.  Since cell phones are now ubiquitous, there is no need to provide emergency phones at stations.

### 2.6.3 Turnarounds

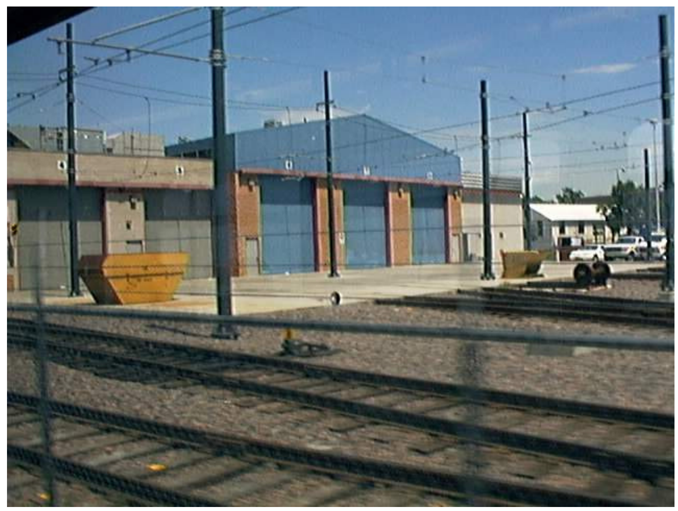



At the south end of the line, trains will reverse direction on a spur that also serves as the station at Hart Plaza. One option for the location of that station and track for the turnaround in front of the Ford Auditorium is depicted at the right. This station location will conveniently serve Hart Plaza without interfering with events.

At the north end of the line, trains will turn around across Woodward at a new traffic signal. There will also be a track extension going a short distance further north so when the line is extended in the future it can be done without disrupting the existing service.

### 2.6.4 Maintenance

A car barn and maintenance shop will be constructed in a new yard a block or two east or west of Woodward Avenue, probably near the north end of the line. The car barn will be large enough to store all twelve vehicles, and the maintenance shop will be sized to accommodate two vehicles at any one time. Trains will enter and exit the yard via a wye turnout (a short Y-shaped section of track) from Woodward, and a turntable or wye turnout will be provided within the yard in order to turn around the trains since the vehicles are not double-ended.



*Mariposa Maintenance Facility in Denver*
*(from [www.rtd-denver.com](www.rtd-denver.com))*

There will always be two vehicles idle even during peak operating hours, and most vehicles are idle the rest of the time, so there is ample opportunity to provide routine maintenance without disrupting service. The two reserve vehicles also provide the opportunity for the shop to do only maintenance and minor repairs, since a vehicle could be sent elsewhere if major repairs or overhauls are required. When the system grows to where there are many more vehicles, it would then be advantageous to take all maintenance in house, but with a system initially consisting of one short line and twelve vehicles, provision in house for all maintenance is unnecessarily expensive.

## 2.7 Interaction with Street Traffic

Vehicles will operate in the second lane from the curb, as depicted in the schematic in section 2.6 above.

Though this vehicle is on steel rails, it can stop in fairly short distances, and so it is reasonable to treat it like any vehicle in the street. In order to make each trip more rapid and predictable, the trains will use signal preemption, a system whereby traffic signals (lights) give priority to the light rail vehicles over autos and trucks. Cars crossing Woodward will be stopped by a normal red light when a train approaches, and simply proceed on a green light as they do today. For cars and trucks on Woodward itself, electronically controlled "No Right Turn" signs will notify motorists that a train is coming up on the right. Since autos will park between the tracks and the curb, motorists will be reminded by signs to "watch for trains when parking."

The light rail vehicles will be operated by a motorman who can apply the brakes if an unsafe situation presents itself. The motorman may also sound the horn. The vehicle has a stopping distance similar to a bus or truck.

Light rail is a very safe means of transportation for the passengers. It is safer than travel by car or bus. The fatality rate for light rail passengers (per million miles traveled) is less than 1/10 the rate for bus passengers and less than 1/100 the rate for automobile riders. [FTA National Transit Statistics and Trends; Bureau of Transportation Statistics] Pedestrians are in danger only if they cross the path of the vehicle at the last moment.

Safety at the station will be ensured by making the stations resistant to traffic accidents through footprint design and the use of energy absorbing devices. Safety of passengers boarding the light rail vehicle is ensured by the motorman who observes the passengers. Since the passengers board and alight from the stations directly onto and off of the train, and are never in the street, there is no danger to them from street traffic during the boarding.

## 2.8 Capacity and Ridership

As described above in the Vehicle section (2.4) above, each of vehicles in this system will have a normal capacity of 308 passengers. During peak hours, there are fifteen trains per hour going past a given point in each direction, providing a total one-direction capacity of 4,620 passengers per hour. In a three-hour peak period the system can transport 13,860 passengers.

During off-peak hours, there are six trains per hour, so the total per-hour capacity is 1,848 passengers.

If the trains run at peak capacity six hours each weekday (three in the morning and three in the afternoon), and run at base (off-peak) capacity an additional twelve hours each weekday the total weekday capacity of the system will be 49,896 passengers per day. With trains running at base capacity sixteen hours on Saturday and twelve hours on Sunday, the total capacity is just over 300,000 passengers per week, totaling an annual capacity of 15,600,000 passengers.

Ridership is conservatively estimated at 3,000,000 passengers per year.

By comparison, the People Mover, which was not designed for good connectivity to the bus systems and which does not serve as many cultural, business, health or educational destinations as this system, frequently achieves ridership of 2,400,000 per year. Ridership 25% greater than the People Mover should be achievable by the Woodward Transit System. Currently over 6,000,000 passengers per year ride DDOT and SMART buses in the Woodward corridor over its entire length. Further, since trains typically attract many passengers who choose not to ride buses, many individuals who do not use transit today will be riders on this proposed system tomorrow.

# 3 Cost – Income Estimates

This section of the plan provides cost and income estimate that are based on reported experiences of similar light rail systems that were completed in US cities in recent years. As such, they provide a good planning estimate, but are not at the level of precision of estimates to be created following preliminary engineering of the Woodward Transit Catalyst Project.

## 3.1 Capital Cost

The overall capital budget is projected to be slightly over $100 million. The details below are derived from actual project costs of similar projects in Portland, Denver and St. Louis since 2000 and studies done in the past five years for other planned systems. (These calculations are presented in the Appendix.) These were inflation adjusted to January 2009, a date assumed as a midpoint of the construction phase of the project. Significant contingency and management reserves are included to cover unforeseen expenses. The projections given here are upper end, based on the experience of most recent, similar projects.

The following assumptions were employed in calculating these estimates:

1. The midpoint of the construction phase of the project is January 2009. Capital costs are inflated to that date.

2. Michigan Department of Transportation will take on itself the road bed reconstruction after the track is laid, and that this project will not be responsible for that cost. If the onset of the project is delayed, or if completion is pushed back by changes, that increases the risk that this assumption will not be achievable.

3. The system length for this project will remain 3.4 miles.

The budget categories are based on those used by transit systems in the United States to report to the Federal Transit Administration.

| Category | Elements | Cost Estimate (millions) | Subtotals by Category (millions) |
|---|---|---|---|
| **Category 1** | **Track, Roadway & Utilities** | | **$29.8** |
| | Track (including overhead electrical wiring) | $21.2 | |
| | Roadway (traffic- controls) | $3.9 | |
| | Utilities (relocation and station connections) | $4.7 | |
| **Category 2** | **Stations** | | **$7.4** |
| | Station Design | $0.2 | |
| | Station Construction | $7.2 | |
| **Category 3** | **Maintenance** | | **$13.4** |
| | Property purchase | $1.8 | |
| | Maintenance facility | $5.9 | |
| | Track and traction | $5.7 | |
| **Category 4** | **Contingency (30%)** | | **$14.1** |
| **Category 5** | **Vehicles (12)** | | **$27.7** |
| **Category 6** | **Engineering and Procurement** | | **$5.4** |
| | Preliminary- Engineering | $1.7 | |
| | Final Design | $3.5 | |
| | Vehicle Procurement | $0.2 | |
| **Category 7** | **Management** | | **$3.5** |
| | Construction- Management | $1.8 | |
| | Organization/Project- Mgmt. | $1.7 | |
| **Category 9** | **Management Reserve** | | **$1.6** |
| | **Total Project Cost** | | **$102.9** |

Notes:

<u>Category 1: Track, Roadway and Utilities.</u>

The projected cost is $3.9 million for traffic control systems, $4.7 million for utility work (relocation of underground utilities and connection of utilities to stations), and $21.2 million for track and all components of the overhead electric wire used to power the vehicles, for a total of $29.8 million.

Category 2: Stations.

The assumption here is that all stations will be "basic" and that the additional cost of any branded and "enhanced" stations will be borne by the branding organization. Any decision to brand a station, and details of all enhancements, must be complete very early in the project in order to avoid delaying the overall schedule. The estimate for the total construction cost for each of the base stations is $316,500, and the cost of the branded station is $438,000 each. Since the "branding cost is borne by the branding organization the base cost is employed in the overall system cost calculation. (Note: See the appendix for the cost estimate worksheet for both the basic and branded stations.)

The projected station cost is $0.2 million for the design of the basic station and $7.2 million to construct 23 basic stations (two each at 11 locations and one at Hart Plaza) for a total of $7.4 million.

Category 3: Maintenance Facility.

It is planned to purchase land near the north end of the project and a block or two from Woodward Avenue. The basis for this is that land prices are less expensive near the north end of the project than in the downtown district at the south end, and that by keeping the maintenance facility near the transit line, the cost of extra track and traction power to run trains to and from the facility can be limited. The land for the maintenance facility will include a space to park the vehicles when they are not in operation; this does not have to be indoor space but must be fenced and protected. The projected cost is $1.8 million for the property, $5.9 million for design and construction of the facility and $5.7 million for the track and traction power within the facility and to connect it to the transit line, for a total of $13.4 million.

Category 4: Contingency.

Because there are significant cost risks in all the above item, a fairly large figure of 30% is used for contingency; here, this is 30% of the sum of the above three subtotals. The contingency is $14.1 million.

Category 5: Vehicles.

Twelve identical vehicles will be purchased. Significant cost savings in such a small purchase can be realized if the organization makes its purchase at the same time another light-rail system is purchasing vehicles, and purchases a substantially similar vehicle. If the organization must make the purchase completely on its own, and chooses a stock-model vehicle with minimal customization, the projected cost is $2.31 million each, for a total of $27.7 million. One risk in this figure is that since at this time all such vehicles are manufactured outside the United States, currency fluctuations could have a significant influence on the actual price.

Category 6: Engineering and Procurement.

Costs in these categories are estimated as a fixed percentage of the relevant subtotal; $1.7 million for preliminary engineering, $3.5 million for final design and $0.2 million for vehicle procurement, for a total of $5.4 million.

Category 7: Management.

This is divided into construction management, which will be undertaken by the lead construction contractor, and organization/project management, which will be within the scope of the light rail system organization itself. As with engineering and procurement, these are projected as a percentage of the relevant hard-cost subtotals, giving an estimate of $1.8 million for construction management and $1.7 million for organization/project management for a total of $3.5 million.

Category 8: Management Reserve.

This category covers unforeseen expenses related to the management of the project, and explicitly does not include increases in construction expenses; those are covered by the contingency amount above. The proposed management reserve budget of $1.6 million.

Total Cost of the Project

The projected total cost for the three-year project to design and construct/purchase the entire Woodward Transit Catalyst Project is $102.9 million.

## 3.2 Cost of Operation

It is common, in transit operations, to report costs per vehicle revenue hour (VRH). This is the cost of operating a single vehicle for a single hour. The Woodward Transit Catalyst System will operate 652 vehicle revenue hours per week, or approximately 34,000 vehicle revenue hours per year.

Light rail systems of this type all report costs between $110 and $145 per VRH. The Portland Streetcar, which is used as a model for many of the characteristics of the system proposed here, projects a $125 per VRH cost for the year 2009. The operating philosophy of that system is similar to what is contained in this proposal: an in-street system with lightweight vehicles and a high degree of operator responsibility (that is, the trains are not so much controlled centrally as they are controlled by the individual motorman). Therefore it provides a sound basis for a comparison.

This operating cost projection gives two sets of numbers: "Average Cost" represents the cost if this system achieves unit-cost figures similar to Portland. "High Cost" represents the cost if everything in this system costs 30% more than it costs in Portland providing a conservative high estimate.

The categories are described first, followed by a chart which gives the average and high projected costs by category.

- Labor: This represents over two-thirds of the costs of nearly all transit systems. This includes wage and benefit costs of motormen, maintenance personnel, janitorial staff and field supervisory personnel.

- Management: This includes the cost of the system general manager, assistant and accounting personnel.

- Utilities: Includes the cost of the electric power for the trains, and lighting, heat and water at the car barn and maintenance facility, plus lighting at stations.

- Repair/Maintenance: Includes the cost to operate the maintenance facility itself, net of utilities and labor, plus parts and supplies to repair and maintain the vehicles and buildings.

- Printing/Distribution: Cost of fare media and consumer-distributed items such as take-away maps and fare/schedule information and informational posters at stations, plus ordinary office printing such as letterhead and business cards, etc., and the cost of distributing such material.

- Communication: Includes telephone and internet connectivity at the system office and cost of communication between the office, maintenance facility and vehicles.

- Facilities: This is the cost to lease or sublease space for the system office if for some reason it cannot be co-located with the maintenance facility.

- External Services: Cost of contracted services such as audit and legal personnel.

- Miscellaneous: Captures any costs not included in any other category.

- Insurance: Cost of liability insurance and other necessary insurance for the system.

The cost per VRH is projected at $125 using average cost figures or $165 using high cost figures. As an annualized number, this comes to $4.2 million or $5.6 million. Broken out by the above categories, this is the projected annual operating budget:

| | Average Cost | High Cost |
|---|---|---|
| Labor | $ 2,885,000 | $ 3,808,000 |
| Management | $ 424,000 | $ 560,000 |
| Utilities | $ 148,000 | $ 196,000 |
| Repair/Maintenance | $ 170,000 | $ 224,000 |
| Printing/Distribution | $ 21,000 | $ 28,000 |
| Communications | $ 21,000 | $ 28,000 |
| Facilities | $ 106,000 | $ 140,000 |
| External Services | $ 148,000 | $ 196,000 |
| Miscellaneous | $ 148,000 | $ 196,000 |
| Insurance | $ 170,000 | $ 224,000 |
| **Total** | **$ 4,242,000** | **$ 5,600,000** |

## 3.3 Revenue Estimates

Most transit system revenue comes from three sources: fare payment and the sale of advertising, which are estimated below, and subsidies, which are discussed in section 3.3.3.

### 3.3.1 Revenue from Fare

Fare Structure and Analysis

The proposed base system fare is $0.75; several special fares are also considered and accounted for. The $0.75 is appropriate for the length of the system and type of service to be provided. The following are used in the fare-box revenue projection.

1. If a passenger boards the light rail and wishes to transfer to the bus systems (DDOT, SMART or Transit Windsor), the light rail system will charge $1.50 and issue a transfer. The light rail system will keep the $1.50.
2. If a passenger boards the light rail system holding a valid transfer from the bus systems, the light rail system will validate his transfer and not charge him anything; the bus system will keep whatever fare was collected from that passenger.
3. The system will market and sell passes. The system will charge $2.00 for an all-day pass, $4.00 for a weekend pass (valid from Friday through Sunday), $8.00 for a week-long pass (any seven consecutive days) and $20 for a monthly pass (calendar month). Other event-specific or destination-specific passes may also be considered, but these will suffice for this projection. In each case, the pass holder is likely to board more times than he would if he did not have the pass. In the case of the monthly pass, $20 is the equivalent of 27 single fare payments, so if the rider uses the system 27 times or more, he/she is getting a bargain; however, he/she might not have used the system so many times if he/she did not have the pass. For the purposes of these projections, it is assumed the rider boards 20% more often than what was "paid for" in terms of single-fare payments. So if someone pays $8.00 for a week long pass it is assumed that he/she uses that to replace approximately $9.60 (20% over $8.00) worth of single-fare payments.
4. The model used is that 60% of riders are transfer passengers, who pay an average of $0.75 per boarding, 20% are cash-fare passengers, who pay $0.75 each time they board, and 20% are pass holders, who (based on the above analysis) have paid $0.625 for each time they board on average.

Revenue from fare collection

Based on the above analysis, the average fare collected per boarding is $0.725. From the projected annual ridership of 3,000,000 boardings per year, this gives annual fare-box revenue of $2,175,000.

The first year ridership is estimated at 1.8 million boardings. Annual ridership is projected to grow linearly by 300,000 riders per year for the next four years as follows:

Year 2: 2.1 million
Year 3: 2.4 million
Year 4: 2.7 million
Year 5 and onward: 3.0 million

Since the 3,000,000 boardings per year is a prediction, it is helpful to consider the risk that actual ridership will vary from that prediction. The chart below gives variations of plus or minus 10%, 20% and 50% from the base ridership projection.

| | Boardings per Year | Projected annual fare-box revenue |
|---|---|---|
| -50% | 1,500,000 | $1,088,000 |
| -20% | 2,400,000 | $1,740,000 |
| -10% | 2,700,000 | $1,958,000 |
| **Base** | **3,000,000** | **$2,175,000** |
| +10% | 3,300,000 | $2,393,000 |
| +20% | 3,600,000 | $2,610,000 |
| +50% | 4,500,000 | $3,263,000 |

This shows quite a wide variance, as fare revenue of course completely depends on ridership. As the cost of transporting one additional rider is very nearly zero, the system can cover much more of its operating costs through a combination of quality service and marketing to attract more riders

### 3.3.2 Revenue from Advertising

The Woodward Transit Catalyst System will have stations and vehicles, and large numbers of people will occupy those stations and vehicles throughout the day. Therefore this system will be able to sell advertising to gain incremental revenue, as nearly all transit systems do.

On the vehicles, the system will market two forms of advertising. First, horizontally-oriented poster advertisements can be sold, which occupy space above the seats on each side of the vehicles. These poster advertisements are standardized as to size, and are identical to those seen on the DDOT and SMART bus systems today. Second, since each vehicle will have an electronic display giving next-station information, that display can be used for advertising when no other message is presented.

(Note: In order to keep a high level of public perception, it is important to control what types of advertisers are allowed to use these spaces, even if that means forgoing some incremental revenue. For instance, it might be desirable to restrict the electronic display advertising on board to only promote events in the corridor.)

Some bus systems, including SMART and DDOT, also sell "wrapper" advertising, where an advertiser can display a message on nearly the entire vehicle exterior. To keep public perception of this system at the proper level, the exterior of the light rail vehicles should be free of advertising.

Within the stations, the same two advertising methods are available: poster advertisements, which will be restricted to one area of the station, and display advertising on an electronic display in the station. Additionally, it is likely that some stations will be enhanced and "branded".

Transit systems are typically able to gain, from the sale of advertising, approximately 5% of their fare-box collections. The correlation is logical: as a transit system attracts more riders, thereby gaining additional revenue at the fare box, advertisers are willing to pay more to reach the larger audience.  Expanding the above chart, advertising revenue is projected using the 5% figure, and the total direct revenue is given.  From the base projection of 3,000,000 riders, the projected advertising revenue is 5% of $2.175 million, or $109,000, giving a projected total direct revenue (net of subsidy) of $2.284 million.

| | Boardings per Year | Projected annual fare-box revenue | Projected annual advertising revenue | Projected Total Direct Revenue |
|---|---|---|---|---|
| -50% | 1500000 | $1,088,000 | $54,000 | $1,142,000 |
| -20% | 2400000 | $1,740,000 | $87,000 | $1,827,000 |
| -10% | 2700000 | $1,958,000 | $98,000 | $2,056,000 |
| **Base** | **3000000** | **$2,175,000** | **$109,000** | **$2,284,000** |
| 10% | 3300000 | $2,393,000 | $120,000 | $2,513,000 |
| 20% | 3600000 | $2,610,000 | $131,000 | $2,741,000 |
| 50% | 4500000 | $3,263,000 | $163,000 | $3,426,000 |

### 3.3.3 Indirect Income/Subsidies

It is not within the scope of this plan to foresee the long-term governance and operation of this system, as the system proposed here is intended to be the first phase of a much larger and longer-term project.  However, it is useful to understand how other communities have provided for long-term funding of operations of their transit systems, since the operational shortfall will need to be eventually resolved in the Detroit region.

No public transportation system in North America pays for its own operations through farebox and incremental revenue (such as the sale of advertising and the subleasing of space in stations to retailers).  Every public transportation system is subsidized in some way by money collected in one form or another by a governmental entity.  The following are some of the most common methods of providing such support:

1. General fund budget: The City of Detroit subsidizes DDOT operations out of general fund money.  This is very common in other communities as well.  This is most common for a system contained within one community.

2. Dedicated tax-based funding: The SMART bus system operates with such an income stream providing much of its revenue.  All communities in Macomb County, and most communities in Wayne and Oakland Counties, assess a property tax levy of $5.00 per $1000.00 valuation to pay for SMART service.  The Michigan Constitution does not allow for local sales-tax levies for this or any other purpose, though other states have used that funding vehicle.

3. Incremental taxation on increased property value: This is called Tax-Increment Financing (TIF).  In Michigan communities can set up one or more TIF authorities to capture property-tax levies on only the increase in property values (from a base property value, which is the snapshot assessed value as of some particular date).  The TIF authorities can use these funds for any purpose which they believe will improve conditions within the TIF district.

4. Surcharges: Many communities impose a surcharge on particular activities or services and use this revenue to help pay transit operating costs.  For instance, in Portland, Oregon, a parking surcharge is applied to all paid parking within the City, and this revenue supports transit operations.  There are many particular types of businesses to which such a surcharge might be applied.

# Appendix A – Possible Station Locations for Woodward LRT

General Notes:

a. Stops are generally 1/4 mile apart, although there are a couple of places where they are closer due to the adjacent development OR where they are more separated due to the lack of development.

b. Locations of utilities will need to be more fully considered.

c. Red circles identify the general areas for station locations and are not to scale.

d. To identify possible station locations, the following criteria were considered: adjacent development, potential for future development (in some cases), and the distance between the stops.


**12. NEW CENTER STATION**

- located just north of Grand Boulevard, south of Horton
- Grand Blvd, historic 3-mile ring road, is identified with a potential flagship/branded station (New Center Council could potentially fund)
- proximity to the Fisher Building
- could assist in encouraging future development


**11. AMTRAK STATION**

- located south of Baltimore
- adjacency to the Amtrak station makes this an ideal location for a stop
- could help promote development north of station to strengthen the urban fabric
- potential for re-design of Amtrak station
- should offer walk-over connection between E-W side of Woodward to facilitate ease of transfer
- connection to Techtown


**10. WAYNE STATE UNIVERSITY STATION**

- located south of East Palmer
- anchors the north edge of WSU campus

## 9. CULTURAL CENTER STATION

• located just north of Warren
• adjacency to the Detroit Institute of Arts, Detroit Public Library, Detroit Historical Museum, et al.
•anchors the south edge of WSU campus
• connection to DDOT cross-town bus

## 8. MEDICAL CENTER NORTH STATION

• located just north of Canfield
• serves the Medical Center (DMC/VA) community
• Whitney located in the immediate area
• close proximity to proposed Arts District (Detroit Artists' Market, et al.)
• shuttle bus service should be included as part of station to provide transportation to and from the Medical Center

## 7. ORCHESTRA HALL/MEDICAL CENTER SOUTH STATION

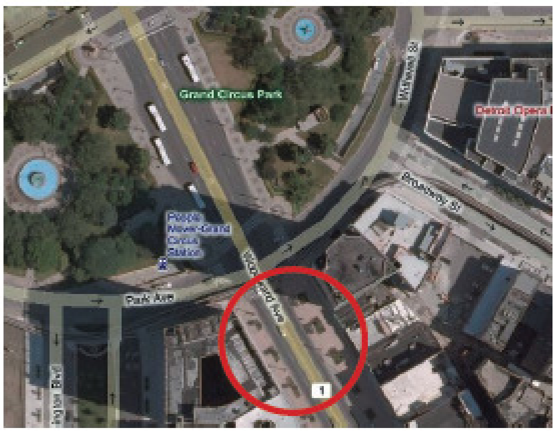
• located one block north of MLK/Mack
• close proximity to the Max Fisher Music Hall
• anchors southern edge of Medical Center
• not too far from Majestic, Union Street, and cPOP gallery (within walking distance)
• connection to DDOT Mack Avenue bus

### 6. MASONIC TEMPLE /BRUSH PARK STATION

- Northbound located north of Edmund Place and Southbound located south of Charlotte
- while there is not a great deal of positive development here, there is the Atlas Bistro (at the corner of Charlotte) and a new stop here could encourage more spin-off development to strengthen the area
- Masonic Temple is within walking distance
- anchors edge of Brush Park Neighborhood District

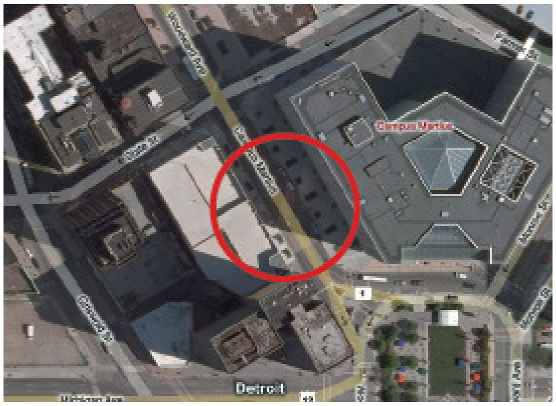

### 5. FOXTOWN/STADIA DISTRICT STATION

- located between I-75 and Montcalm
- close adjacency to the Fox Theater, State Theater, Comerica Park, Ford Field, various other restaurants
- anchors the northern edge of the Theater District
- although this station is close in distance to the Grand Circus Park Station, this area warrants two stops to accommodate potentially larger crowds on special events days/game days




### 4. GRAND CIRCUS PARK STATION

- located at south of Park/Witherell
- close proximity to the Detroit Opera House, Harmonie Park, Comerica Park, Ford Field, Gem Theater, Music Hall, Detroit Athletic Club, and Century Club.
- anchors the southern edge of the Entertainment District
- connection to People Mover stop




### 3. KERN BLOCK/CAMPUS MARTIUS STATION

• located at just north of Campus Martius/ south of Gratiot
• anchors the north edge of Campus Martius
• Compuware headquarters
• close proximity to downtown business development


### 2. CONGRESS STATION

• located south of Congress
• anchors the south edge of Campus Martius
• serves the Central Business/Financial District
• close proximity to City/County Building
• all SMART and DDOT crosstown bus connections
• Windsor Tunnel Bus


### 1. HART PLAZA STATION

• located in Hart Plaza, south of Jefferson
• use switchback, double switchback, or loop to turn around
• close proximity to the GM HQ/Ren Cen, Cobo Hall and Joe Louis Arena
• connection to international border and riverwalk development
• adjacent to the proposed and existing riverfront development

# Appendix B - Connectivity to Other Transit Syetems

**DDOT** **SMART** **OTHER**

| Station | Connections |
|---|---|
| **1 Hart Plaza** | DDOT: **25** |
| **2 Congress** | DDOT: **7 10 34 40 48 49 70 72 76**; OTHER: **Tunnel Bus**; SMART: **125 135 150 200 305 510 515 530 560 580 610 615 620 635** |
| **3 Kern Block** Walk 1 block west to Capitol Park Transit Center | DDOT: **19 21 27 29 37 38** |
| **4 Grand Circus Park** | OTHER: **PeopleMover – Megabus** |
| **5 Foxtown** | DDOT: **16 18 23 36 78** |
| **7 Orchestra Place** Medical Center South | DDOT: **31 47** |
| **9 Cultural Center** | DDOT: **14** |
| **11 Amtrak** | OTHER: **Amtrak** |
| **12 New Center** | DDOT: **20**; SMART: **415 420 445 450 460 465 475 495** |

Transit Crossings per week in the Lower Woodward Corridor

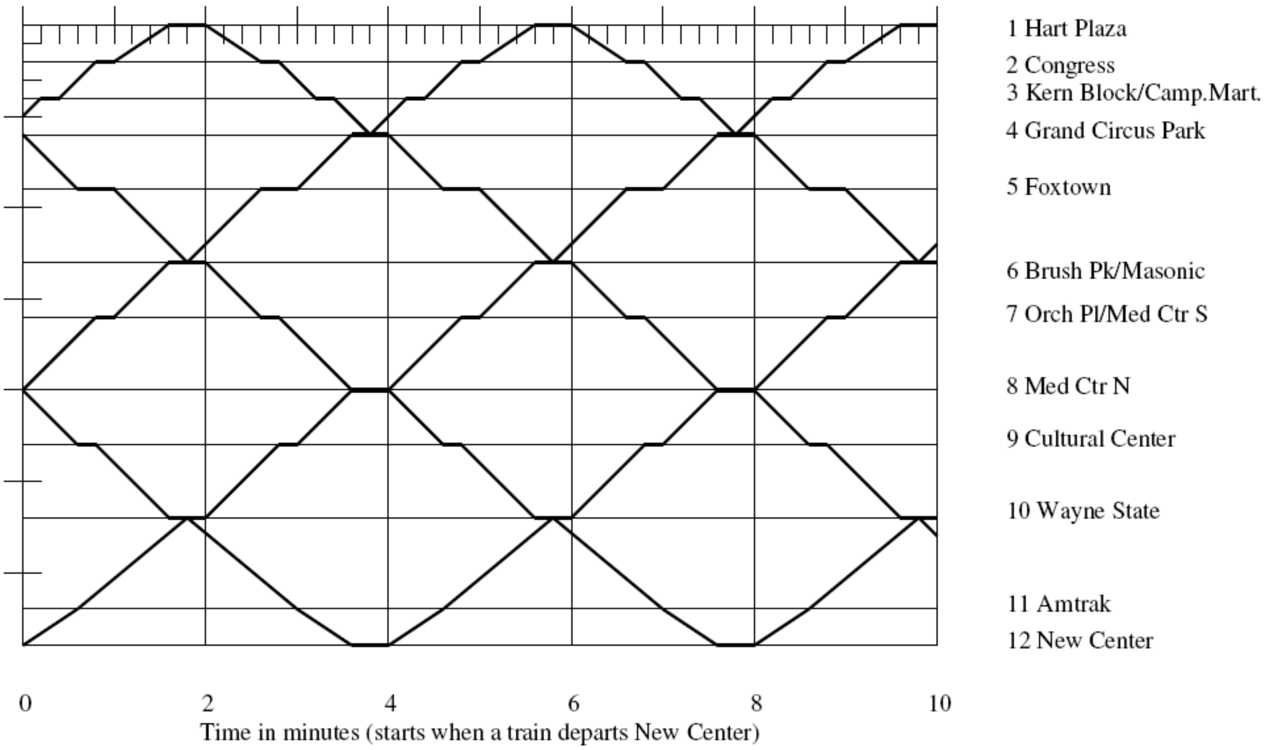
| | Larned/ Jefferson | Larned/ Congress | Park | Warren | Fisher Svc Dr | Grand Blvd | Mack | TOTAL |
|---|---|---|---|---|---|---|---|---|
| DDOT | 808 | 1793 | | 352 | 991 | 883 | 468 | 4795 |
| Smart | | 1679 | | | | 781 | | 2460 |
| Transit Windsor | | 279 | | | | | | 279 |
| DPM | | | 1776 | | | | | 1776 |
| TOTAL | 808 | 3751 | 1776 | 352 | 991 | 1564 | 468 | 9810 |

Sources: DDOT and SMART published per-route schedules; DPM website, Transit Windsor Tunnel Bus published schedule.

Note: “Larned/Jefferson” means eastbound buses cross Woodward on Larned and westbound buses cross Woodward on Jefferson; “Larned/Congress” means eastbound buses cross Woodward on Larned and westbound buses cross Woodward on Congress.  In all other cases, eastbound and westbound buses go across Woodward on the named cross street.  The DPM station closest to Woodward is the Grand Circus Park station at Woodward and Park, so we use that for the DPM connection.  DDOT and SMART buses that run on Woodward are considered to intersect with the LRT when they leave the Woodward alignment or, if they go beyond Grand Blvd, are considered to intersect with the LRT at Grand Blvd since that is the logical transfer point.

# Appendix C – Peak Period Stringline

(For simultaneous tracking of all train locations over a ten minute cycle)



# Appendix D - Capital Cost Calculations

| City | Original Extension. | Miles | Year.Fraction (Proxy) | Total Cost (Millions) | Cost Per Mile (Millions) | Contract Price Lock-in 1/1/2009 | |
|---|---|---|---|---|---|---|---|
| | | | | | | Inflation Factor | Inflation Adjusted Cost Per Mile |
| Portland Streetcar | Original | 2.4 | 7/1/2000 | $56.9 | $23.7 | 1.40 | $33.1 |
| Portland Streetcar | Extension | 0.6 | 3/1/2005 | $16.0 | $26.7 | 1.16 | $31.0 |
| Portland Streetcar | Extension | 0.6 | 9/1/2006 | $15.8 | $26.3 | 1.10 | $28.9 |
| Denver | Extension | 8.7 | 5/1/2000 | $187.0 | $21.5 | 1.41 | $30.2 |
| Denver | Extension | 1.8 | 4/1/2002 | $43.0 | $23.9 | 1.30 | $31.1 |
| Portland Max | Original | 5.5 | 8/1/2001 | $125.0 | $22.7 | 1.34 | $30.4 |
| St. Louis | Extension | 17.4 | 4/1/2001 | $348.0 | $20.0 | 1.36 | $27.1 |
| Average (Millions) | | | | | $23.5 | | $30.3 |
| Detroit LRT Total (Millions) | | 3.4 | | | $80.1 | | $102.9 |

| | |
|---|---|
| Average inflation (CPI) 1982-2006 | 4% |

# Appendix E - Operating Cost Calculations

| Portland Costs | Seg 1 | Seg 2 | Seg 3 | Seg 4 | Seg 5 | Total | Pct |
|---|---|---|---|---|---|---|---|
| Labor | 3600000 | 2630000 | 3533000 | 4103000 | 4801000 | 18667000 | 73.6% |
| Agency | 404000 | 298000 | 404000 | 457000 | 532000 | 2095000 | 8.3% |
| Other | 170000 | 125000 | 170000 | 192000 | 224000 | 881000 | 3.5% |
| Utilities | 150000 | 111000 | 150000 | 170000 | 197000 | 778000 | 3.1% |
| Repair/Maint | 175000 | 129000 | 175000 | 198000 | 230000 | 907000 | 3.6% |
| Ext Svc | 15000 | 11000 | 15000 | 17000 | 20000 | 78000 | 0.3% |
| Ext Rent | 72000 | 72000 | 72000 | 72000 | 72000 | 360000 | 1.4% |
| Misc | 156000 | 115000 | 156000 | 176000 | 205000 | 808000 | 3.2% |
| Fleet Svcs | 30000 | 30000 | 30000 | 30000 | 30000 | 150000 | 0.6% |
| Printing/Dist | 12000 | 9000 | 12000 | 14000 | 16000 | 63000 | 0.2% |
| Facilities | 0 | 0 | 0 | 0 | 0 | 0 | 0.0% |
| Comm | 23000 | 17000 | 23000 | 26000 | 30000 | 119000 | 0.5% |
| PDOT Svc | 85000 | 63000 | 85000 | 96000 | 112000 | 441000 | 1.7% |
| Total | 4892000 | 3610000 | 4825000 | 5551000 | 6469000 | 25347000 | 100.0% |

| Detroit Projection | | high cost (with 30% contingency) | high cost per vehicle revenue hour | avg. cost per vehicle revenue hr |
|---|---|---|---|---|
| Labor | 68% | $3,808,000 | $112.00 | $85.00 |
| Management | 10% | $560,000 | $17.00 | $13.00 |
| Utilities | 3.50% | $196,000 | $6.00 | $4.00 |
| Repair/Maintenance | 4% | $224,000 | $7.00 | $5.00 |
| Printing/Distribution | 0.50% | $28,000 | $1.00 | $1.00 |
| Communications | 0.50% | $28,000 | $1.00 | $1.00 |
| Facilities | 3% | $140,000 | $4.00 | $3.00 |
| External Services | 3.50% | $196,000 | $6.00 | $4.00 |
| Miscellaneous | 4% | $196,000 | $6.00 | $4.00 |
| Insurance | 4% | $224,000 | $7.00 | $5.00 |
| Total | 100.0% | $5,600,000 | $165.00 | $125.00 |

| | **Average Cost** | **High Cost** |
|---|---|---|
| Labor | $ 2,885,000 | $ 3,808,000 |
| Management | $ 424,000 | $ 560,000 |
| Utilities | $ 148,000 | $ 196,000 |
| Repair/Maintenance | $ 170,000 | $ 224,000 |
| Printing/Distribution | $ 21,000 | $ 28,000 |
| Communications | $ 21,000 | $ 28,000 |
| Facilities | $ 106,000 | $ 140,000 |
| External Services | $ 148,000 | $ 196,000 |
| Miscellaneous | $ 148,000 | $ 196,000 |
| Insurance | $ 170,000 | $ 224,000 |
| **Total** | **$ 4,242,000** | **$ 5,600,000** |

# Appendix F - Station Cost Calculations

| Station Initial 'Hard' Cost Description | | | | |
|---|---|---|---|---|
| | | | | |
| 11.02.07 | | | | |
| **Station Draft Estimate** | | Station Base | Branded Adds | Rail Infrastruct |
| | | | | |
| **DIVISION 1 - GENERAL REQ.** | | | | **$1,500.00** |
| Dumpster 4 fills | | | | $1,500.00 |
| **DIVISION 2 - SITEWORK / DEMOLITION** | | | | **$31,500.00** |
| Site Demolition & Removal | | | | $5,000.00 |
| Earthwork/Sitework prep. | | | | $5,000.00 |
| Asphalt & Concrete Cut/Repair | | | | $6,500.00 |
| Landscape Improvements | $7,000.00 | **$7,000.00** | | |
| Utility Connections & Rework | | | | $15,000.00 |
| **DIVISION3 - CONCRETE** | | **$32,000.00** | | **$14,000.00** |
| Foundations - Structure, Lights, Edge Walls | $16,000.00 | | | |
| Reworked Curb & Gutter Street Edge | | | | $14,000.00 |
| Flatwork - Station Slabs, Ramps, Stairs | $16,000.00 | | | |
| **DIVISION 4 - MASONRY** | | **$12,000.00** | **$6,000.00** | |
| Station Edge Wall | $12,000.00 | | | |
| *Branded Paving Insets* | | | $6,000.00 | |
| **DIVISION 5 - METALS** | | **$64,000.00** | **$10,000.00** | |
| Station Steel Structure [hot dipped galvanized] | $40,000.00 | | | |
| *Branded Signage S.S. Support Steel* | | | $10,000.00 | |
| S.S. Wire Façade Screens | $18,000.00 | | | |
| S.S. Ramp&Stair handrails | $6,000.00 | | | |
| DIVISION 6 - WOOD & PLASTICS | | | | |
| **DIVISION 7 - THERMAL & MOISTURE PROTECTION** | | **$17,000.00** | | |
| Flashing, Gutters & Downspouts | $5,000.00 | | | |
| Kalwall/Translucent Roof Systems | $12,000.00 | | | |
| DIVISION 8 - DOORS & WINDOWS | | | | |
| DIVISION 9 - FINISHES | | | | |
| **DIVISION 10 - SPECIALTIES** | | **$43,000.00** | **$37,000.00** | |
| Lam. Glass Vertical Cube Façade Panels & Connections | $28,000.00 | | | |
| *Branded Lam. Glass Vertical Signage Panels & Connections* | | | $12,000.00 | |
| Station Base Signage | $15,000.00 | | | |
| *Branded Signage Additions* | | | $25,000.00 | |
| **DIVISION 11 - EQUIPMENT** | | **$34,000.00** | **$30,000.00** | |
| Base Station Information/Ticket Wall | $22,000.00 | | | |
| Security and Surveillance System | $12,000.00 | | | |
| *Branded Base Station Information/Ticket Wall - addition* | | | $30,000.00 | |
| **DIVISION 12 - FURNISHINGS** | | **$8,000.00** | | |
| Seating Benches | $8,000.00 | | | |
| DIVISION 13 - SPECIAL CONSTRUCTION | | | | |
| DIVISION 14 - CONVEYING SYSTEMS | | | | |
| **DIVISION 15 - MECHANICAL** | | | | **$8,000.00** |
| Drainage Hook Ups | $8,000.00 | | | |
| **DIVISION 16 - ELECTRICAL** | | **$85,000.00** | **$25,000.00** | **$12,000.00** |
| Station Service Connection/Transformer | | | | $12,000.00 |
| Distribution & Panel | $10,000.00 | | | |
| Base Station Lighting | $50,000.00 | | | |
| Specialty LED Theme Lighting | $20,000.00 | | | |
| *Radiant Heating System Station Slabs* | | | $15,000.00 | |
| *Radiant Heating System Overhead* | | | $10,000.00 | |
| Technology & Communications System | $5,000.00 | | | |
| | | | | |
| | | | | |
| SUB-TOTALS | | **$302,000.00** | **$116,000.00** | **$67,000.00** |
| | | | | |
| Inflated to Jan. 2009 Dollars | | **$316,496.00** | **$121,568.00** | **$70,216.00** |

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