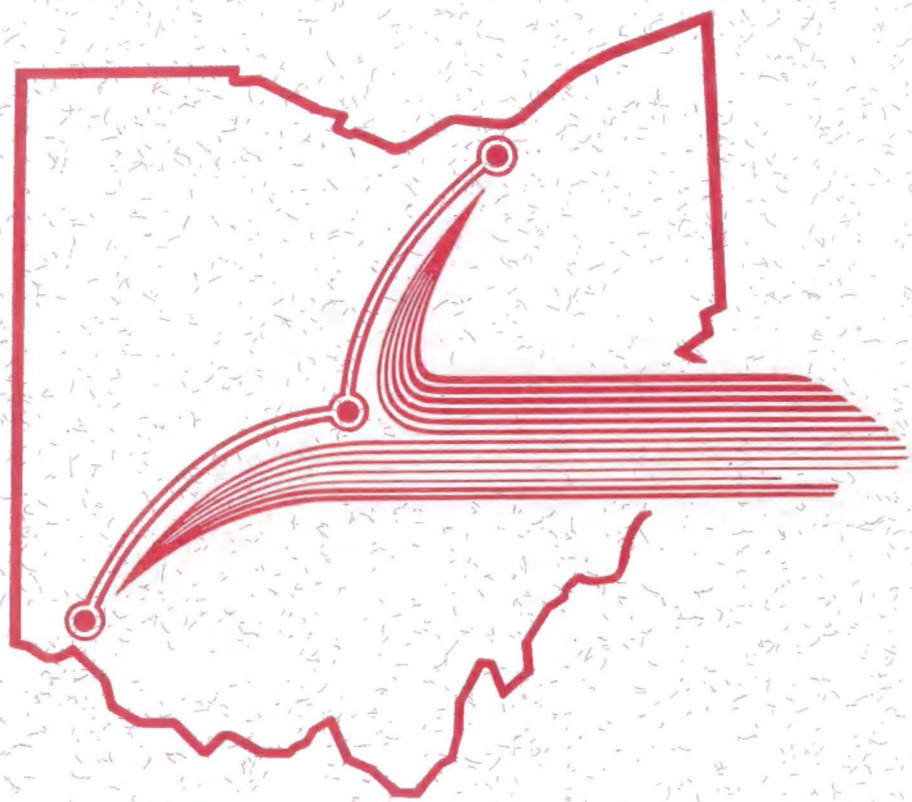
# Implementation Plan for High Speed Rail in Ohio

June 1992



prepared for

OHIO HIGH SPEED RAIL AUTHORITY

prepared by
**Ohio Railway Organization, Inc.**

24 - Industry Structure anc
Company Mgmt

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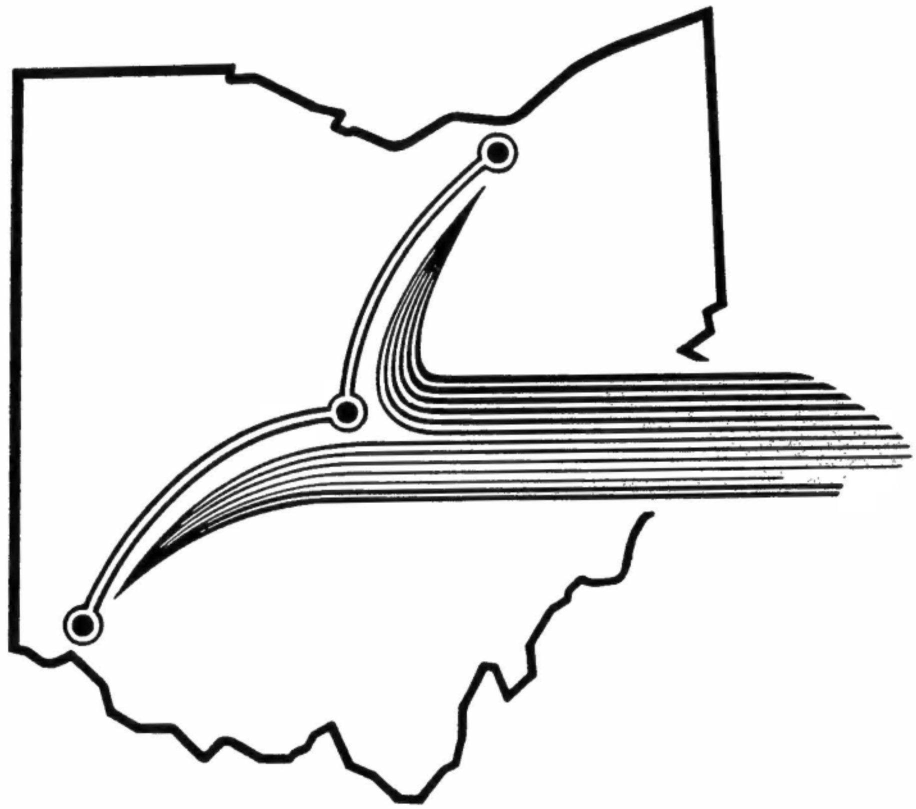

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# CHAPTER 1
# INTRODUCTION

## 1.1 GENERAL

The Ohio Railway Organization, Inc. (ORO) at its own expense prepared an action plan to implement a high speed rail passenger system linking Cleveland, Columbus and Cincinnati, Ohio. The action plan was initially published in October 1991 for review by the Ohio High Speed Rail Authority (OHSRA). This revised Implementation Plan for High Speed Rail in Ohio incorporates comments received from OHSRA and an independent evaluation team commissioned by OHSRA to review the action plan.

The Ohio Railway Organization, Inc. combines the technical, financial, and corporate resources of several of the world's most prestigious engineering, planning, and financial organizations. Individually, the ORO firms have built their reputations with a number of successful public and private sector transportation development ventures. The team is comprised of:

- Parsons Brinckerhoff, Inc.
- URS Consultants
- Wilbur Smith Associates, Inc.
- Public Financial Management, Inc.
- Credit Lyonnais
- Andrew J. Burin Associates
- Transportation Investments, Ltd.
- J.F. Pearce Associates

ORO has divided the Ohio High Speed Rail project into five phases which correlate to specific decision points in the planning and implementation process. This report concludes Phase One of the following Phases:

- Phase 1 - Implementation Plan
- Phase 2 - Pre-Construction
- Phase 3 - Construction
- Phase 4 - System Testing and Start-up
- Phase 5 - Revenue Service

The high speed rail system will link Cleveland, Columbus and Cincinnati following what is known as the 3-C Corridor. The major cities will have downtown stations and suburban stations. Intermediate stations will serve Mansfield, Springfield and Dayton.

Under current planning, the trains will be electrified and will incorporate the latest advances in high speed rail technology. The system will provide safe and comfortable travel at speeds up to 185 miles per hour. Travel between Columbus and Cleveland will take approximately 68 minutes. The trip time between Columbus and Cincinnati will be about 94 minutes.

Sixteen round trips daily are planned between Cleveland and Cincinnati with a departure approximately every hour from each station. The trains will operate from 6:00 am to about 1:30 am the following morning.

## 1.3 HIGH SPEED RAIL IMPLEMENTATION PLAN

On August 1, 1989, OHSRA issued a competitive Request for Proposals to the private sector to develop a planning process to finance, design, construct, and operate a high speed rail system in the 3-C Corridor.

The Ohio Railway Organization, Inc. was selected in February 1990 to perform these services at no cost to the State of Ohio. The agreement between OHSRA and ORO for planning a high speed rail system was finalized effective September 1, 1990.

During the contract period, ORO has provided quarterly progress reports to OHSRA. These status reports were supplemented by formal briefings of OHSRA and informal reports to members of the Authority. As previously noted, ORO prepared the Implementation Plan for High Speed Rail in Ohio in October 1991 for review by OHSRA.

## 1.4 KEY PLAN ELEMENTS

Key elements of the implementation plan, as documented in subsequent chapters of this report, are:

- a description of the alignment and station locations.
- infrastructure requirements.
- a discussion of high speed rail technologies, candidate high speed trains, and U.S. regulatory requirements.
- service concepts for the high speed rail system, and trip times.
- an environmental evaluation.
- estimates of the capital cost and operations and maintenance cost.
- travel demand and revenue estimates.
- an investment analysis.
- financing options.
- an economic analysis.
- institutional considerations.
- an implementation plan.
- an immediate action plan.

## 1.5 EVALUATION TEAM REPORT

OHSRA appointed an independent Evaluation Team to review the October 1991 Implementation Plan for High Speed Rail in Ohio prepared by ORO. The Evaluation Team members are experts in urban affairs, railroad engineering, environmental/land use aspects of transportation systems, railroad operations, financing and safety.

This revised report incorporates the comments and observations of the Evaluation Team. The detailed comments of the Evaluation Team and the corresponding ORO responses are published in a separate document.

# CHAPTER 2
# ROUTE LOCATION

## 2.1 INTRODUCTION

This chapter describes the proposed route location for the Ohio High Speed Rail Project. The route, as shown in Figure 2.1, is described in order from Cincinnati to Cleveland. Four alternative segments were considered along the route: two near Springfield (Springfield Bypass), one near Mansfield (Mansfield East) and one near Cleveland Hopkins International Airport. An access route to the Cincinnati CBD from the northern suburbs was also investigated and considered. The alternative segments and the Cincinnati access are described in this chapter and a list of proposed station locations is included.

## 2.2 CINCINNATI TO DAYTON

ORO would like the system's southern terminus in or near the Cincinnati CBD, however, it is difficult to reach the downtown area satisfactorily. The existing trackage extending north from downtown carries heavy freight traffic, and there are right-of-way limitations north to Winton Place. ORO will continue to address ways to serve the Cincinnati CBD, but it seems that initially the route will terminate at the Cincinnati North Station. This station location enjoys good acces via I-275 and I-75.

### 2.2.1 Cincinnati CBD To North Suburbs

The route investigated and considered for Cincinnati CBD access to the north suburbs starts at a new downtown Cincinnati station in the vicinity of Plum Street, just south of Third Street. This site is adjacent to the Central Business District northwest of Riverfront Stadium and requires further investigation and coordination with other development plans for the area.

This considered route leaves the new station on a new dedicated single track, heads west from the station through the northern portion of the produce terminal area and passes under the I-71/I-75 highway interchange. Here the track rises and becomes elevated as it parallels the existing CSX viaduct. A new structure will carry the track over Gest Street and Third Street. The new line joins existing CSX trackage several hundred feet west of Third Street (about 0.6 miles from Plum Street) at an existing railroad junction. This is accomplished by reconfiguring the existing stub-end side track and viaduct (which carries it over Gest Street) to meet the new elevated structure.

From this point the route utlizes existing CSX main trackage (Cincinnati Terminal Subdivision). This double track main line turns north to skirt the east side of the Queensgate railroad yard and passes behind Cincinnati Union Terminal. Joint-use trackage continues to Winton Place, about seven miles from Plum Street. No new grade-separated or at-grade crossings with other rail lines are required unless an additional section of dedicated trackage is desired south of Winton Place. Just north of its junction with the CSX main line to Dayton, the route becomes new dedicated trackage on the west side of the CSX main line to Ivorydale Junction where the Conrail Cincinnati-Columbus main line diverges on the north side of the CSX line.

The high speed line continues as dedicated trackage, now on the west side of the Conrail line main tracks, encounters its first highway grade crossing at Beech Street, in Ivorydale (eight miles from Plum Street) and continues on the west side of the Conrail main line to a point south of Sharonville. From this point at the southern end of the Sharonville Yard, the route uses trackage in the western section of the yard known as Gano Yard. Where the Gano Yard trackage rejoins the main tracks north of the main yard (near the Hamilton-Butler County line), the route runs on the west side of the Conrail line for about seven miles to a new north suburban Cincinnati station located near Kemper Road south of I-275 and east of I-75.

### 2.2.2 North Suburbs To Dayton

North of the suburban station the high speed line will be grade separated, but still on Conrail right-of-way with the exception of a half-mile-long curve realignment.

At the Maud Hughes Road overpass the high speed rail line will leave the Conrail right-of-way and run for about seven miles on new right-of-way. The route will head in a northerly direction following Gregory Creek and cross over SR-4 and the Great Miami River before joining the CSX (Toledo Subdivision) right-of-way about 1.5 miles north of Trenton.

For the next 24 miles, the high speed rail line will be dedicated trackage on existing CSX right-of-way, except for a half-mile-long curve realignment four miles north of Miamisburg. Grade crossings will be encountered. Most of the westerly track of this formerly double track CSX line has been removed. Since the high speed rail line will occupy the easterly portion of the right-of-way, some realignment of the existing CSX trackage will be necessary.

Northeast of Miami Junction, a new bridge over the Great Miami River will be constructed parallel to and north of the existing railroad bridge. This new bridge will carry CSX traffic to the Dayton station area. The high speed rail traffic will use the northwesterly track of the existing structure to reach the passenger station in Dayton. Station trackage will run between the two existing through-freight tracks.

## 2.3 DAYTON TO SOUTHWEST COLUMBUS

From the Dayton station the dedicated double track high speed line will occupy the northwesterly half of the existing Conrail right-of-way for about 13 miles. This wide right-of-way is comprised of the former double-track parallel lines of the Erie and New York Central railroads. Since the former Erie tracks have been removed in most locations, the available space may be usable for the double-tracks of the high speed rail line.

The line will occupy the space made available by the removal of the Erie double tracks until "Cold Springs Station" where it will continue along the existing active Conrail right-of-way which diverges from the former Erie route. A single dedicated track will run about 10.5 miles through Springfield to the I-70 overpass, about 4.5 miles east of the Springfield Station. The station will be located near Fountain and Limestone Streets in downtown Springfield. Near the station the high speed rail line will cross the existing Conrail track from the north to the south side. An alternative route near Springfield and an alternative route through Xenia are described in Section 2.7.

At the I-70 overpass, the high speed line will become double-track and parallel the existing Conrail line about 9.5 miles to a point about 4.8 miles west of London. It will then diverge to the southeast with a 4-mile-long reverse curve to a location near SR-38, about 1.5 miles south of London.

South of London, near the crossing of SR-38, the line will turn to the northeast and join the abandoned right-of-way of the London-Lilly Chapel Conrail line with a reverse curve about 3 miles east of London. About 1.8 miles west of Lilly Chapel, the high speed line will diverge to the northeast and with another reverse curve run parallel to the Conrail line about 0.75 mile to the north. About 0.5 mile east of the Big Darby Creek crossing the line will turn northeast again and bypass Galloway about 1,000 feet to the north.

## 2.6 SOUTHWEST CLEVELAND TO CLEVELAND

The dedicated high speed double-track line will join the existing Conrail Indianapolis main line right-of-way near Root Road, about 5 miles southwest of Berea. The first grade crossings since Columbus are encountered here. The dedicated high speed line will run on the south side of the Conrail line to Berea. Where the Conrail Short Line diverges from the main line, the high speed line will continue along the Conrail Cleveland Short Line right-of-way. A suburban Cleveland station will be located in the Holland Road/Snow Road vicinity. North of I-480 near West 130th Street, a grade separation will carry the high speed track under the east-west portion of the Short Line. This structure will also allow the high speed line to cross under the parallel track to the north of what is designated as the Conrail Flats Industrial Track.

The dedicated high speed line will use existing Conrail right-of-way for about 6 miles to Fulton Road. This grade separated right-of-way is generally about four track widths wide, but is currently occupied by one or two tracks. Near Fulton Road, the high speed line will utilize an abandoned right-of-way parallel to Greater Cleveland Regional Transit Authority (GCRTA) trackage which leads to the GCRTA's viaduct over the Cuyahoga Valley. The line will terminate at a downtown Cleveland station.

### 2.6.1 Cleveland Hopkins International Airport Alternative

A variation of this alignment, following the Conrail mainline and Rockport, was considered in order to serve Cleveland Hopkins International Airport more directly. This variation, however, was not recommended because of higher construction costs, freight rail congestion in the Rockport Yard and at the Ford Motor Company facility, and a relatively small ridership impact.

## 2.7 SPRINGFIELD BYPASS ALTERNATIVES

### 2.7.1 Downtown Springfield Bypass

An alternative alignment that bypasses downtown Springfield was examined for feasibility and capital cost. This alternative route near the city would run south of Springfield with a station located several miles south of the Central Business District. From a technical viewpoint the alignment is feasible and would save several minutes in travel time between Columbus and Cincinnati. This option has not been recommended because of the significantly higher capital cost compared to the benefits, as explained in Section 7.8.

Northeast of Dayton, about 1,000 feet northeast of the I-675 overpass, the high speed rail line would leave the Conrail right-of-way on a fly-over above the existing tracks. It would become grade separated, and head in an easterly direction for about 2.5 miles, bypassing the new housing developments south of Enon. Near the crossing of Mud Road, the proposed alignment would turn in a northeasterly direction for 5 miles before shifting to the east near the crossing of US-68. The Springfield Station for this alternative would be on the easterly side of this crossing, which is about 2 miles south of Interchange 52 of I-70.

From the proposed alternative Springfield Station, the alignment would follow an easterly direction for about four miles. Near the crossing of the north fork of the Little Miami River, the proposed line would shift to a northeasterly direction for another 4 miles to a grade-separated crossing with the Grand Trunk Western Railroad, near SR-41. From that point, the new high speed rail line would follow an easterly direction to a location south of London for about 13 miles, paralleling the existing Springfield-Columbus Conrail line about 1.35 miles to the south of London, where the alternative route would join the previously described line to Columbus.

## Table 2-1
## PROPOSED STATION LOCATIONS

| | |
|---|---|
| **Cincinnati** | Northwest of Riverfront Stadium, in the vicinity of Plum Street and Third Street, on the southwest side of the CBD. |
| **Cincinnati North** | Near I-275 east of I-75, possibly near Kemper Road. (May be southern terminus for initial system.) |
| **Dayton** | Near the Transportation Center at South Jefferson Street, on the southeasterly side of the CBD. |
| **Springfield** | Downtown Springfield, between Fountain Avenue and Spring Street. |
| **Columbus** | At or near the Ohio Center, North High Street, on the north side of the Columbus CBD. |
| **Columbus North** | Near I-270, east of US-23. |
| **Mansfield** | Near SR-309, approximately eight miles west of the center of Mansfield. |
| **Cleveland Southwest** | In the area of Cleveland Hopkins International Airport between Engle and Sheldon Roads, in the City of Brookpark. |
| **Cleveland** | Tower City, Public Square, west side of the Cleveland CBD. |

# CHAPTER 3
# INFRASTRUCTURE REQUIREMENTS

## 3.1 GENERAL

This Chapter describes requirements for components of the infrastructure for the Ohio High Speed Rail Project.

The design standards currently applied in the United States for railroad components (e.g., power distribution, track, signals, and structures) generally reflect the requirements of railroad freight operations. High speed rail passenger operations with higher speeds and lower axle loads have different design criteria than freight operations. Thus, the design requirements for high speed passenger operations in Ohio outlined here must be further examined. Appropriate modifications can be expected to insure the system is feasible, practical, and complies with FRA and other regulatory requirements. Infrastructure requirements are an integral part of train system design and both must be closely coordinated. The following description of the infrastructure requirements is preliminary and final infrastructure design will be fully integrated with the train system selected.

## 3.2 TRACK AND TRACKBED

The purpose of the track structure is to distribute the train load down through the rail, ties, ballast, and subballast to the subgrade. Since the magnitude of the force generated by a train increases significantly with increased velocity, track structure design for high speed rail requires heavy-duty construction that provides a resilient structure to absorb the increased forces without unacceptable stress or deflection.

At higher speeds design requirements become more stringent to maintain a smooth, stable track for the rail vehicle. The design of ballasted track has improved continually through the introduction of new materials and construction techniques. For example, reinforced concrete ties have been introduced. Spring clip systems to attach the rail to the ties have replaced the rail spike. The ballast sections are deeper and wider to absorb and distribute the load better. An alternative to using ties and ballast is a concrete slab with the rail directly attached to the slab. New turnouts have been developed that permit train operations at significantly higher speed than previously possible.

The following is a preliminary list of requirements for the Ohio system. The track system will comply with applicable American Railway Engineering Association (AREA) standards.

- Rail - 132 RE (132 pounds per yard) continuously welded rail
- Ties - Prestressed mono-bloc concrete tie, 8'6" long
- Fasteners - Resilient spring clip type with pads
- Ballast - Minimum depth of 12" under ties, 16" depth on structures. Ballast will be a hard, angular crushed stone

The preparation of the trackbed will require excavation, fill and embankments. At some locations, existing utilities may have to be relocated. Provisions for draining the track and maintaining existing drainage are critical design considerations. The restoration of affected areas to include seeding and planting of trees will be part of the overall construction plan.

## 3.4 ELECTRIFICATION

High speed rail systems currently operating at speeds above 125 miles per hour are electrically powered. The trains draw power through pantographs mounted on the power units from an overhead wire or catenary system. The catenary system obtains its power from substations spaced at regular intervals along the right-of-way. Commercial sources supply power to the substations where it is converted to the voltage and frequency required by the train's power units.

The substation equipment includes autotransformers, high voltage protection, transformers to step down the supply voltage to 25 kV and high speed circuit breaker protection. The commercial power supplied and the power delivered to the catenary will be metered at each substation. Close coordination will be required with the companies supplying power to the system.

The design of the catenary system must be tailored to the technology of the train system selected. It is essential that the train's pantograph maintains full contact with the catenary at all speeds and in all weather conditions.

High speed operations introduce dynamic forces in the catenary system. The catenary hangers and supports are subject to stress which results in wear and the need for periodic adjustment and repair. Forces at the contact point between the pantograph and overhead wire also result in wear and require periodic maintenance of both. The design of the catenary system will focus on measures to limit the dynamic forces and reduce the maintenance requirements.

The basic catenary requirements for a high speed system are uniformity of elasticity and high tension. Uniform vertical elasticity is essential to preclude any "hard" or "soft" spots that would affect the pantograph maintaining contact with the overhead wire. The system is kept under high tension to resist the impact of wind and minimize vibration induced by the passage of trains.

Basic design criteria for the catenary system are:

- Voltage: 25 kV, 60 Hz
- Type: Compound (tangent-chord, fixed termination, variable tension to avoid the need for ice melting apparatus)
- Contact Wire Height: 16 to 24 feet (depending on the train's pantograph design)
- Maximum Span: 160 to 180 feet between supports

The catenary design criteria will be subject to detailed engineering during the design stage. The design will insure that the usable portion of the train's pantograph collector head maintains contact on tangent and curved track considering wind velocity and vehicle dynamics.

## 3.5 TRAIN CONTROL AND COMMUNICATIONS

Emphasis will be placed on operational safety with a state-of-the-art train control and communications system. The system will be centrally operated by a Central Traffic Control (CTC) facility near Columbus.

An automatic train control (ATC) system will provide train protection, supervision, operation, and communication.

A train protection system monitors the track to determine the presence and location of trains. This ensures that trains on the same track are separated by a safe following distance to prevent collisions. The system provides route interlocking which prevents trains from making unsafe moves that would cause a

- Lighting including emergency lighting
- Site selection and proper location including access for public and private vehicles, long- and short-term parking and utilities

All structures will be designed in accord with the Ohio Basic Building Code and applicable local requirements. The buildings will be energy efficient and cost effective. Interior and exterior lighting will be attractive and provide security and safety. Lighting of maintenance areas will maximize the efficiency and safety of the work crews. The selection of building materials will consider attractiveness and the ease of cleaning and maintenance. The design of structures will consider aesthetics and consistency with the architecture of the surrounding area.

# CHAPTER 4
# ROLLING STOCK

## 4.1 GENERAL

The development of high speed rail power units and passenger cars over the last 150 years has been a gradual, evolutionary process. High speed rail is not new. For example, in 1893 a New York Central & Hudson River locomotive reached a speed of 115 miles per hour, and on June 12, 1905, a special Pennsylvania Railroad train achieved a speed of 132 miles per hour. Ohio holds the North American rail speed record of 183.85 mph established near the village of Melborn by a jet-powered New York Central rail car on July 23, 1966.

Over the past 30 years, there have been significant improvements in railroad vehicles and their performance characteristics. Advances in rail technologies provide the traveling public with a high speed alternative to highway and air transportation. The major advantages of high speed rail compared to other transport modes are that it is safe, comfortable, cost effective, energy efficient and environmentally acceptable.

High speed rail has been operating successfully in Japan for almost 30 years. France has operated its Train a Grande Vitesse (TGV) for nine years and has introduced a newer model, the TGV - Atlantique (TGV - A). Germany has developed the Intercity Express (ICE), which started regular service on new high speed rail lines in June, 1991. Japan, France and Germany all have long-range plans to continue the development and expansion of their high speed rail systems.

A high speed rail system has been approved by the Republic of China (Taiwan) and its implementation program is in the detailed planning phase. A system is also under development in South Korea.

In the United States, Amtrak is currently operating trains on the Northeast Corridor, Washington, D.C. to Boston, at speeds up to 125 miles per hour. High speed rail systems are under varying degrees of consideration in a number of locations in the United States. In addition to Ohio, high speed rail initiatives are underway in New York, Florida, Texas, Illinois, Minnesota, Wisconsin, Nevada and California. A high level of interest in high speed rail has been expressed in Pennsylvania, Missouri and Washington State.

## 4.2 HIGH SPEED RAIL VEHICLES

High speed rail vehicles are typically lightweight compared to freight vehicles, streamlined and electrically powered. The light weight of the trains reduces the power required to achieve high acceleration rates, reduces wheel wear and track maintenance requirements, and results in lower maintenance costs.

The electricity consumed to operate a train is a function of its weight, the route terrain, speed, distance between stops, and the energy conversion efficiency of the power units. Energy requirements are estimated at the point of delivery or at the pantograph for electrified high speed trains. This ignores the losses in the generation, substation and transmission lines for electric traction power systems. The power consumption is increased if there are numerous speed changes that require accelerations and decelerations. Speed changes are required approaching stations, at grade crossings, locations with civil speed restrictions, and where track curvature dictates slower speed. The power consumption of the generic train used in the study is estimated based on the experience of operating high speed rail systems. For this phase of the study, it is estimated that the trains will consume an average of 20 kwh per train mile for one power unit.

# 4.4 HIGH SPEED TRAIN SYSTEMS

## 4.4.1 Ohio High Speed Train

Based on the technology currently available, the Ohio high speed train will be electrified with a maximum sustained speed of 185 miles per hour. The Ohio train will incorporate the technology and passenger amenities of the world's most advanced systems. A brief summary of these systems is presented in the following sections.

## 4.4.2 Japanese Shinkansen

The Japan Railway's Shinkansen or "bullet train" started operations in 1964 and was the world's first high speed rail system. The Tokaido Shinkansen line opened on October 1, 1964 with service between Tokyo and Shin Osaka. The maximum speed on this line was 130 miles per hour.

In October 1985, a new trainset was introduced, the series 100 Shinkansen consisting of 16 permanently coupled units. The series 100 has 12 motor cars and four non-motorized coaches. Two of the non-motorized coaches are double deck cars. The top running speed of the series 100 Shinkansen is 162 miles per hour.

Japan Railway's long term goal is to achieve speeds of 186 miles per hour on the Sanyo, Tohoku and Joetsu lines. In 1986, design started on the next generation of the Shinkansen, the series 300, which is planned to be capable of a sustained speed of 186 miles per hour. The train will be constructed of lightweight aluminum, and preliminary estimates are that the axle load will be about 14 tons.

In its 28 years of operation the Shinkansen system has an unmatched safety record. Almost three billion passengers have been transported without a single passenger fatality.

## 4.4.3 French Train a Grande Vitesse (TGV)

The French National Railways (SCNF) designed, constructed and placed in operation the first high speed rail system in Europe. On September 30, 1981, revenue service started on the first section of a new rail line between Paris and Lyon using the Train a Grande Vitesse (TGV). Since September 1983, the TGV has been operating on the 260-mile Paris-Lyon route at a maximum speed of 168 miles per hour.

The second generation TGV is designated the TGV - Atlantique (TGV - A) and incorporates lessons learned from the operation of the first TGV trains. This train operates at speeds up to 186 miles per hour. In test runs, the TGV - A has reached speeds in excess of 300 miles per hour.

The TGV - A is a push-pull articulated train consisting of 12 vehicles (2 power units and 10 center coaches). The length of the train is 780 feet. Power bogies are mounted only under the power units and center coaches share a bogie at each end. Each trainset is "permanently" coupled. Two trainsets can be coupled to form one revenue service operating unit or for recovery of a disabled train.

On-board computers monitor and troubleshoot the train's systems. A data network provides a continuous flow of information to the operator, the conductor's station and the Central Traffic Control (CTC). Train operators and the CTC are also linked by radio.

The data system provides information for slip-slide control, condition of brakes, climate control, and automatic door control. The computer system automatically issues train preparation commands to check

Second-class cars have four compartments, and seating in rows in a 2 + 2 arrangement as well as face-to-face. In the second-class open plan area, seats are arranged to face the direction of travel. The second-class coaches have two toilets located at one end of the car.

All coaches are heated and air-conditioned. Noise is reduced by insulation, and the wheels are fitted with sound absorbers to reduce wheel/rail noise. The width of the aisles easily accommodates wheelchairs.

One car in the first- and second-class sections has video monitors built into the back rests of the seats. A selection of several video programs is provided. Train and plane reservations or hotel rooms can be booked using an onboard computer terminal. All cars have a loud speaker system for announcements.

The ICE has a system, similar to one proposed for the Ohio high speed rail system, called "Park & Rail" which provides passengers with reserved automobile parking space near the platform. A space can be reserved at the time of ticket purchase or by telephone. A "Rail & Road" system also reserves rental cars at the passengers' destinations.

ICE stations are spaced approximately every 60 miles. The network includes high speed rail and track sections where speeds of 125 miles per hour or less are dictated by traffic and track conditions. On some routes, the track is shared with conventional passenger and freight trains. With lower speeds dictated by the relatively short distance between stations and using track not dedicated to high speed rail, the power consumption of the ICE is less than the 186 mile per hour trains.

Driving and braking is controlled by micro-processors, and the operation can be fully automatic. Speed control automatically applies the brakes when authorized speed is exceeded. The automatic train control system provides the operator with information on track conditions six miles ahead of the train.

The ICE rail network is being expanded, and new lines will be opened as trainsets become available.

### 4.4.5 European Inter-railway Cooperation

The future of European high speed rail does not stop at the borders. The "Community of the European Railways" consists of the 12 railways of the European Economic Community member states and the Federal Railways of Austria and Switzerland. In January, 1989 a proposal was adopted for a cross-border high speed rail system. The first stage will link the high speed rail systems now in operation. When the system is complete, it will cover some 18,600 miles. High speed rail in Germany, France, Great Britain and Italy and fast train systems in Spain, Sweden, Switzerland and Austria will be linked in the final system.

The ultimate rail network will link Frankfurt and Cologne with Brussels, Amsterdam, London, and Paris. This system will serve the 325-million people in Europe and divert traffic from the currently congested highways and air routes.

## 4.5 MODIFICATION OF FOREIGN EQUIPMENT

Under the safety standards of the Federal Railroad Administration (FRA), foreign high speed rail equipment placed in service in the United States may require modification.

Power units are subject to the FRA's Locomotive Safety Standards. They must meet or exceed established standards for mechanical and structural components.

Standards are also established for wheels and axles in terms of stress, or fatigue cracking, and wear. They also address braking, suspension, coupling and electrical systems. A major factor is the crash

# CHAPTER 5
# HIGH SPEED RAIL SERVICE CONCEPTS

## 5.1 GENERAL

This Chapter describes the service concepts for the Ohio High Speed Rail system. The frequency of service, trip times, fleet size, supervision and operations and vehicle inspection and servicing are discussed. Services at the stations having concessions are addressed, and the marketing of rail services is outlined.

## 5.2 TRAIN SERVICE

In order to provide a high-quality service to the traveling public, high speed rail will operate 16 round trips per day on the 3-C Corridor. The service will start at 6:00 AM and end about 1:30 AM for nineteen-and-a-half hours of operations daily. Trains will depart each station at intervals of approximately one hour.

Market conditions as determined after the start of revenue service will dictate the frequency of service, hours of operation, station stop patterns, and the size of the train consists. For the morning, evening, weekend and special event peak travel times, the frequency of service may be increased based on demand. Express service between major stations may be offered during peak travel hours. Special trains will be scheduled for sports or other special events.

## 5.3 TRIP TIME ESTIMATES

### 5.3.1 Train Simulation Program

The travel time between stations in the 3-C Corridor was estimated using a train simulation program.

The simulation program was used to calculate the travel time impact of varying the train's maximum speed, acceleration, deceleration and the track superelevation. For each segment of track where there is a change in the curvature and/or grade, the program calculates the maximum achievable speed and the travel time over the segment in seconds. The total of the segment travel times provides the trip time between cities.

The program used does not decrease the acceleration rate of the train as the speed of the train increases. A high speed train, such as the TGV - A, has a maximum acceleration rate of 2.24 mph/second. For the travel time estimates, an acceleration rate of 1.1 mph/second (less than half the maximum rate of the TGV - A) was used to compensate for the program's lack of acceleration adjustment. This reduction in the acceleration rate penalizes the system trip times making the times shown below conservative.

A service braking or deceleration rate of 1.57 mph/second was used without adjustment.

To simulate actual conditions, a civil speed restriction of 30 mph was used for the track segments approaching stations with the trains slowed to reasonable speeds prior to reaching the 30-mph segments. Civil speed restrictions were used at all grade crossings and through towns where restrictions currently exist. An analysis was made to determine the reduction in travel time if the trains were permitted to travel at speeds up to 60 mph through grade crossings in urban areas and 90 to 110 mph through crossings

On the northern segment the trains achieve the maximum speed of 185 miles per hour for approximately 91 miles, or 68 percent of the total distance. The maximum speed is reached on the southern segment for 15 percent of the distance, or 19 miles.

The speed on the southern segment is restricted primarily by highway crossings, crossing other railroads, and civil speed restrictions through communities. For example, from Dayton to north of Springfield there are 40 road crossings and five railroad crossings where lower speeds are required. In some areas, topography and/or development result in the maximum speed being expensive to achieve and would require variances to local speed restrictions. The travel time from the Cincinnati North Station to Cincinnati, a distance of 16.65 miles, is the slowest in the 3-C Corridor. The low speed in this section is the result of the number of at-grade road crossings that require civil speed restrictions. Further analysis of costs, community and environmental impacts, travel times and ridership are required to achieve ORO's objective of service between Columbus and Cincinnati in approximately an hour.

The high average speed from the Cleveland Station to the Columbus Station is the result of several factors. The majority of the track in this segment will be new and dedicated to high speed rail traffic. On the new dedicated track, the trains can reach and maintain the maximum speed of 185 mph for considerable distances. The distances between stations are also the longest and have the least number of speed restrictions. The trains can make maximum use of their performance capabilities.

## 5.3.3 Alternative Trip Time Calculations

To explore the possible effects of selected changes in operating speed policies, the trip times were recalculated using a refinement to the program that provides the maximum achievable speed and is based on the following assumptions:

- The passenger trains will be permitted to operate at speeds up to 60 mph in urban areas including existing grade crossings.
- The passenger trains will be permitted to operate outside urban areas at speeds up to 110 mph including existing grade crossings and through communities that currently have speed restrictions.
- The passenger trains will be permitted to operate at slightly higher speeds on the limited track shared with freight traffic.
- The passenger trains will be permitted to operate at higher speeds than previously considered on track parallel to freight tracks.

The grade crossings along the entire right-of-way would be improved and provided with state-of-the-art full gates and warning devices that would alert the train operator of a stalled vehicle on the track. To the degree possible, grade crossings would be eliminated where traffic could be rerouted. Train speeds of 90 to 110 mph through grade crossings have been permitted in the United States for other passenger lines. Crossings with considerable vehicular traffic would be candidates for grade separation.

The passenger train speeds on track shared with freight traffic are only slightly higher than previously calculated and should present no operational problems. Higher speed passenger operations on track parallel to freight traffic may require the construction of crash barriers and sensors to warn the passenger and freight trains of any problem on the track.

## 5.4 FLEET SIZE

To provide service in the 3-C Corridor with train departures from each city approximately every hour, eight trains will be required. Six of the trains will operate daily to provide the 16 round trips or 32 train runs. One trainset will be on stand-by for replacement of any disabled operating train. A second trainset will be in the shops for routine inspections, maintenance, and cleaning.

The number of passenger cars per train will be based on the passenger demand. Based on current ridership projections, each train will consist of one power unit, one business class car, and two custom coaches. Each three-passenger-car train will seat 200 passengers. The number of passenger coaches per train will be increased as necessary to meet passenger demand.

The end custom coach on each train will be equipped with cab controls for reverse running, streamlined to reduce air resistance when reverse running and will be equipped with the required lights for safe operations.

### 5.4.1 Restaurant Car

An alternative to having the catering service in the first custom coach is to add a full restaurant car to each train. This would provide a major additional amenity to the service. The cost of each car is estimated as $2 million or an additional cost of $16 million for rolling stock.

## 5.5 TRAIN SUPERVISION AND OPERATIONS

Each train crew consists of an operator, a conductor, and a caterer for food and beverage service. Normally, each crew will work five eight-hour shifts per week. No train crew will work more than four ten-hour shifts per week.

Particular attention will be paid to safety in those locations where track is shared with freight traffic. The passenger train cab signaling system identifies occupied track ahead of the train and automatically orders an appropriate speed command. Where freight traffic crosses the passenger track, special operating procedures will insure there are no conflicting movements.

Where highways cross the track at-grade, crossing protection will include full gates, flashing lights, and audible warnings. The crossing protection will be designed to discourage highway traffic from attempting to defeat the system, and strict enforcement will be pursued.

Train supervision and operational systems will be state-of-the-art to provide safety for passengers, trains and the communities along the high speed rail line. Roadmasters will supervise all aspects of the operations to ensure all safety procedures are followed.

## 5.6 VEHICLE AND MAINTENANCE OF WAY INSPECTION AND SERVICING

### 5.6.1 Vehicle Cleaning

Car cleaners will be assigned on all three shifts for light cleaning of the coaches at the Cleveland and Cincinnati Stations. The car cleaners will have a minimum of 22 minutes to perform their duties when the trains turn back at the terminal stations. During turn-backs, the cleaning staff also will position the

## 5.6.4 Maintenance of Way

**Inspections**
Track and systems inspections are continually made by the maintenance crews during their daily work.

Scheduled inspections are:

- Each mile of track is visually inspected by trackwalkers a minimum of twice a week as required by the Federal Railroad Administration.
- An acceleration recording is made every week.
- A track geometry recording is made every month.
- Rail defect detection is performed annually.
- Detailed catenary inspections are made twice each year.

**Track Maintenance**
Track maintenance is performed as required. Scheduled maintenance activities are:

- Tamping and stabilization every two years.
- Rail grinding as required but as a minimum at least every eight years.

**Track Renewal**
Planned track renewal is based on the tonnage of traffic over the track.

General guidelines are:

- Ballast renewed as required but as a minimum at least after 250 to 300-million tons of traffic.
- Rail and fastenings renewed as required but as a minimum at least after 500 to 600-million tons of traffic.

## 5.6.5 Station Services

Station supervision is provided by station masters assigned on 10-hour shifts with two shifts daily at each station. The station masters are responsible for all aspects of station operations. This includes passenger assistance and supervision of assigned personnel. Station masters will insure that cleaning of the stations by contracted janitorial services is accomplished properly.

Ticket agents work the same shifts as station masters. They will sell tickets and assist passengers as required. A computerized system will be used for ticket sales, and, if possible, linked to the airlines' APOLLO and/or SABRE reservation systems. Ticket sales at the stations and by travel agents will be tied into the system. All seats will be sold on a reserved seat basis. Ticket vending machines will be installed in all stations.

Security guards at each station are assigned on a 24-hour three-shift basis. Their duties are to assist passengers, maintain order, and provide security to include security of out-of-service trains. There may be a requirement for closed-circuit television and other surveillance and alarm systems at the stations. Provisions will be made in the station design to add this equipment if required.

made by cash, check or credit card. The agent can determine if a cab or rental car is needed on arrival at Dayton, and if so, confirm arrangements.

The purpose of such trip planning is to provide the standard of travel service which contemporary technology allows and to make traveling by ORO's trains a safe, secure and pleasant experience.

# CHAPTER 6
# ENVIRONMENTAL EVALUATION

## 6.1 REGULATORY REQUIREMENTS

Although environmentally desirable, the high speed rail system described in the preceding chapters will be required to meet contemporary environmental regulations and standards. The Federal and State regulatory requirements listed in Appendix A reflect an overview of regulations that are known to address the high speed rail project. The list will be expanded as further refinement of the railway plans take place. In particular, within the broad policy acts at either the federal or state level, more specific subsections may be identified later that also pertain to the high speed rail system. Similarly, regulations are continually being revised and will be reassessed for appropriateness and/or additions prior to the initiation of a project.

## 6.2 ENVIRONMENTAL CONSIDERATIONS

### 6.2.1 Land Use

Virtually every land use type is likely to be encountered by the proposed high speed rail system. The corridor includes 15 counties, 7 urbanized areas and numerous additional small municipalities as well as expanses of rural land. The extensive rural property along the proposed corridor includes orchards, cropland, forested land, 10 named rivers (several of these are crossed more than once), over 200 streams, and at least 5 wetland areas (for listings of counties, rivers, and mileposts of wetlands see Tables 6-1 and 6-2). The Ohio Capability Analysis Program (OCAP) of the Ohio Department of Natural Resources has mapped land uses for the majority of property falling within the proposed corridor. These maps would be invaluable for a much closer approximation of actual land uses within the proposed corridor and would assist in identification of areas where additional studies may be appropriate for such things as: land-fill areas, cemeteries (regarding historical preservation issues), parks and recreation areas and wetlands. National Wetland Inventory maps will also be consulted to identify potential wetland areas as discussed further in Section 6.2.8. Natural areas and preserves are discussed in Section 6.2.9.

Rural parks and recreational areas have, for the most part, been avoided by the proposed corridor although the rail line would pass within two miles of Buck Creek State Park just east of Springfield, and within one-half mile of Mt. Gilead State Park near Mt. Gilead. Proximity to the Buck Creek State Park could be avoided if the Springfield bypass route is chosen over the downtown Springfield alternative. There are no federal or state forests along the proposed corridor.

For those portions of the proposed corridor passing through rural areas, prime and unique farmland must be identified. Soil Conservation Service offices responsible for properties along the proposed route must be consulted regarding the location of any prime and unique farmland.

Despite these concerns, it should be acknowledged that extensive use of existing rail rights-of-way by the high-speed system results in a minimal

## 6.2.2 Aesthetics

Much of the high speed rail route will follow existing railroad rights-of-way, and in some cases will use existing trackage, primarily in urbanized areas. For these portions of the corridor aesthetics should not be an important issue.

For the remaining portions where new alignment is to be utilized, the question of aesthetics could be more significant. Individual municipalities, counties and townships will require public meetings regarding various issues relating to the new rail line that will impact their communities. Aesthetics may be an issue for persons who will be able to see the tracks and train or hear train noise from their residences. Additionally, the visual impact of the high speed rail route on parks and historic sites may be of concern. As mentioned in the previous section, the route comes within two miles of two State parks, and will come within view of numerous small municipal, county and township parks as well. The proposed corridor falls within one and one-half miles of the birthplace of former President Harding at Blooming Grove near Mansfield, and could have a visual impact on this historic site. Impacts on historical sites are further discussed in Section 6.2.10.

## 6.2.3 Noise and Vibration

Noise and vibration impacts may result from construction of the proposed rail system as well as its long-term operation. In general, the potential adversity of impacts will depend on two considerations: 1) the degree to which project-derived noise and vibration levels exceed local noise ordinances or Federal Railroad Administration standards contained in 49 CFR Part 210, if applicable; and 2) the relative change in ambient noise and vibration levels between existing conditions and the expected post-construction situation. Thus, an impact may occur not only if any applicable standards are exceeded but also when a project causes a significant change from existing conditions, even though standards may not be exceeded. An important factor in determining level of impact will obviously involve evaluation of the existing noise and vibration environment along the rail route. The evaluation must take into consideration not only the measured ambient noise and vibration levels but also the character of the area in which the measurements are made, including the type of land use present, proximity of noise and/or vibration sensitive features, and future plans that may involve changes in land use or development patterns.

During project construction, potential noise and vibration impacts will depend on types of equipment in use, how the equipment is being used (usage factors) and the site sensitivity considerations discussed above. Some typical noise emission levels and usage factors for construction equipment are shown in Table 6-3. Certain types of equipment have the potential to generate severe noise impacts depending on how they are operated. However, low or intermittent usage factors ameliorate potential adverse impacts. In addition, the short-term nature of construction activities will minimize the severity of impacts. If construction is planned for areas with high sensitivity to noise and vibration, various mitigation measures may be required of the contractor, including:

- Limiting construction to normal daytime hours (7:00 a.m. to 6:00 p.m.)
- Ensuring that all diesel-powered equipment is properly muffled
- Erecting temporary noise or vibration barriers between sensitive receptors and construction operations
- Providing specific routes for truck movement to and from construction sites to avoid streets with sensitive receptors

Specific recommendations or requirements cannot be determined until site-specific project details become available.

In terms of long-term project operations, potential noise impacts will depend on train-derived noise levels (locomotive and cars) and the nature of the surrounding land uses. Measurements of noise emissions from TGV trains in France amount of environmental disruption indicate that, at a distance of 82 feet from the track, a train passing at 170 miles per hour will generate a noise level of 100 dB(A) from the locomotive and 98 dB(A) from the trailing cars. At 1000 feet, the maximum noise level was estimated to be 78 dB(A). While these are significant levels of noise emission, it is unlikely that the trains will be passing through the most noise-sensitive types of land uses at this operating speed. In developed urban areas the proposed project will generally operate at lower speeds which should reduce noise emissions from the measured results mentioned above. In specific cases noise barriers can be effective in reducing noise impacts.

At speeds below approximately 50 miles per hour, an electrified train operates with noise emissions comparable to that of a typical urban bus. In comparison, turbine-powered trains emit higher levels of noise.

Other sources of noise and vibration associated with this project will have to be evaluated on a site-by-site basis. These sources will include electrical substations, train maintenance or layover facilities and stations. Noise from automobile traffic attracted by any of these facilities could be a significant consideration in project planning, once again depending on site location.

## 6.2.4 Electromagnetic Interference

Electromagnetic interference (EMI) is an important environmental issue both from a scientific and a public perception standpoint. EMI issues have recently received increasing public attention with the current focus on electric utilities. Electric railways and other generators of electromagnetic fields will be included in continuing research and investigations of EMI issues. EMI is not regulated at this time at either the federal or state level; however, the federal Departments of Energy and Transportation currently are conducting research involving measurements of electromagnetic fields and investigations of the possible effects of EMI on the biological (including human) community. The results of this research may lead to future legislation. At present, projects such as the high speed rail system that may be funded in part by the federal government are required to demonstrate that the managers and planners of the project are sensitive to the issues related to EMI as reflected in any environmental impact statement prepared for the project. There are no requirements at the Ohio state level to evaluate EMI impacts however, eight states do currently require some level of analysis of EMI impacts, and more states are likely to follow suit as EMI gains further publicity.

## 6.2.5 Air Quality

Short term air quality impacts may occur during the construction phase of the project during which time construction vehicle fumes and construction dust would be generated. More importantly, the proposed high speed rail system is planned to be electrically powered. Currently, there are no air quality regulations at the state or federal level that regulate the railway industry. If electricity is used as the only energy source, long term air quality impacts of the rail system would derive from the emissions of the stationary electricity generators providing the electricity for the rail system. However, evidence accumulated in studies for high speed systems in other states establishes that reduced emissions result in any shift away from petroleum-burning motor vehicle and aircraft usage.

## 6.2.6 Energy Consumption

As indicated above, it is currently envisioned that the high speed rail system will use electricity as its primary energy source. Tradeoffs in energy consumption between petroleum fuels used by vehicles making the same trip and the coal and oil used in generating the electricity to power the train would depend on current and projected traffic between the principal cities along the rail corridor and the projection would depend on patronage of the train system by those currently using their personal vehicles.

State of Ohio using LANDSAT photography. The project is in its early stages and mapping is being started at the Lake Erie counties and working southward.

**Groundwater**
The ODNR has completely mapped groundwater resources within the State on a county-by-county basis highlighting two different categories: pollution potential/susceptibility and water resources/yield. The pollution potential maps have been completed for only six of the fifteen counties within the study area, with three additional counties scheduled for completion in 1991. Water resource maps are currently available for all but two counties in the study area. These maps will be important in areas where new tracks are to be constructed.

**Floodplains**
Sections of the proposed high speed rail system using existing trackage or existing rail rights-of-way for new trackage are not alignments expected to have any additional major impact on floodplains. However, for routes on new alignments, the federal flood insurance program rules require that no embankment built to support the railway impede natural waterways in such a way as to cause a rise in floodwaters greater than one foot above the natural 100-year flood level. Floodmapping of the entire corridor should be consulted to address this issue.

## 6.2.9 Fish and Wildlife

Fish and wildlife resources of the state are protected primarily through the ODNR, Division of Natural Areas and Preserves. Preliminary mapping received from this office indicates that as many as ten State Nature Preserves (Table 6-4) may be directly or indirectly affected by the proposed system. A specific map of the rail line would have to be presented to the Division of Natural Areas and Preserves to verify whether the railroad would pass through or nearby these preserves; only a rough map of preserve locations is available. Preserves are areas for which there has already been detailed review to claim preservation as a best use. Once land is dedicated as a preserve, it cannot be changed unless an "imperative and unavoidable" argument can be proven.

There are other locations outside of designated preserves that could also necessitate a close examination regarding exact location of tracks. High quality plant communities, rare plants and animals and/or important geologic features need to be considered along the rail corridor. Identification of these rare or significant natural features can be provided through a search done by the Natural Heritage Program of the ODNR Division of Natural Areas and Preserves. On-site surveys for identified sensitive areas would be necessary for a full environmental assessment.

Additionally, three rivers that will be crossed by the proposed high speed rail system are designated as scenic rivers by the State of Ohio: the north fork of the Little Miami River, Little Darby Creek and Big Darby Creek. Any crossings of scenic rivers must be reviewed and approved by the Director of the Ohio Department of Natural Resources (through the Division of Natural Areas and Preserves). It should be noted also that in addition to state designation as a scenic river, Little Darby Creek has also been nominated for national recognition as a scenic river. Should the national registry be granted, additional review and approval for crossing the river would be required from the National Park Service.

### 6.2.11 Solid and Hazardous Wastes

The high speed rail system will require a considerable amount of new property for its trackage, as well as using existing right-of-way and trackage (mostly in urbanized areas). For those properties to be acquired, a thorough investigation would be prudent to determine whether any hazardous materials may be present on the sites. The following guidelines outline items included in a Phase I environmental site assessment (from the Ohio Department of Transportation, 1989):

- Title search - to determine past property owners and possible past land uses
- Building permits - local government agencies should have records for development and/or demolition on the property.
- Zoning - determine if land is or ever was zoned for industrial or commercial uses as these uses would most likely have led to possible site contamination.
- Spills - local fire departments or emergency management agencies should have records covering information on spills or hazardous materials within their jurisdiction.
- Underground storage tanks - information on active tanks and some past closures of tanks can be obtained from the State Fire Marshall.
- Sanborn Maps - these maps help identify specific activities (industrial or other) that took place on specific properties, or generally, the activities within a close radius to a proposed project.
- RCRA and CERCLA lists from the Ohio Environmental Protection Agency and the U.S. Environmental Protection Agency record known hazardous waste sites and hazardous waste generators in the vicinity of the corridor.
- Aerial photographs may further clarify or identify potential areas of contamination.
- Interview current and past land owners.
- Site visit for evidence of surface contamination, buried tanks, drums, or other evidence of on-site waste storage or treatment.

Additionally, abandoned sanitary landfills could present problems with having firm ground on which to set new trackage. Old landfills can be identified by state or local health department records, deeds of property, and soils maps. For any landfills falling directly within the path of the rail system "authorization to dig" must be obtained from the Director of the OEPA prior to laying any track.

Solid wastes generated by the high speed rail project will be disposed of properly as required by applicable State and Federal Regulations.

## 6.3 SUMMARY

A broad overview of environmental regulations and environmental concerns that will affect the proposed high speed rail project has been presented above. Beyond this overview considerable effort remains to define the environmental community and address the corresponding issues before the final design engineering can fully proceed. Particularly, those environmental concerns (and associated regulations) that will directly impact the final routing of the rail, or require special engineering of the train itself (for noise and vibration impacts, for example), should be addressed as soon as further refinements of the route location begin. Environmental categories most likely to immediately concern the design engineering of the project include historical and archaeological impacts, wetland area impacts, and other ecologically sensitive area impacts. The Cincinnati-Columbus portion of the corridor, for example, is rich in each of these categories. Most of the nature preserves are in this portion of the state; the three scenic rivers

# CHAPTER 7
# COST ESTIMATES

## 7.1 GENERAL

The capital and operations and maintenance cost estimates are presented in this Chapter. A detailed capital cost estimate was prepared (400 pages) using criteria based on the requirements of the high speed rail technology. The operations and maintenance costs are based on policies and procedures of an operating high speed rail system.

## 7.2 CAPITAL COST ESTIMATES

The capital cost was developed using cost criteria for construction in the United States for a high speed rail system, the plan and profile data for the 3-C Corridor route were developed from 1:25,000 scale maps, and preliminary design criteria were specified for stations, structures and ancillary facilities.

## 7.3 CAPITAL COST DEVELOPMENT

The capital cost estimate for the preferred route is based on prices as of mid-1991. Unit costs are from recent engineering studies and actual bid experience for various types of railroad, bridge and building construction. Detailed knowledge of the railroad construction industry pricing policies and regional variations in construction costs were used in developing the estimate.

Costs were developed by pricing the components of individual work items. The component prices were combined to develop unit costs for the construction elements. The unit costs were applied to the construction requirements to develop a total system cost.

Major system cost items are:

- Right-of-way
- Sitework
- Track structure
- Structures
- Road and rail crossings
- Stations
- Yard and shops
- Maintenance-of-way facilities
- Administration building
- Track maintenance road
- Traction power
- Signals and train control
- Communications

These cost items are defined in the following section.

All stations have parking for rental cars. Short-term parking for private vehicles is provided at the Cleveland, Columbus, Dayton, Springfield and Cincinnati Stations. Long-term parking lots for private vehicles will be provided at the Cincinnati North, Columbus North, Mansfield, and Cleveland Southwest Stations.

The maintenance facilities capital costs are for the main yard and shops and eight maintenance-of-way bases. The cost includes the structures, yard track, electrification and tools and equipment for vehicle and right-of-way maintenance.

The main yard and shops, located north of Columbus, will perform scheduled maintenance, major and minor repair, and train cleaning. The shops have service facilities for vehicle inspection, preventive maintenance and running repair. Space is provided for storage of track materials, repair parts, maintenance vehicles and employee parking. Yard tracks store trains not in revenue service.

Eight maintenance-of-way bases are equally spaced along the right-of-way. The maintenance crews and track inspectors operate out of these facilities. Secure space is provided for the storage of repair parts, maintenance vehicles and employee parking.

The administration building is collocated with the main yard and shops. Central Traffic Control (CTC) is in the administration building which provides a central location for administration and operations.

### 7.4.6 Maintenance Road

A gravel road is parallel to the track inside the security fencing. This road provides access to the track for maintenance crews.

### 7.4.7 Electrification

Electrification costs include the catenary poles, overhead wire system, substations, feeder lines, switchgear and power transmission lines. Costs have not been estimated for the extension of local power company distribution systems. Since existing power transmission lines are close to the route along the entire right-of-way, this cost is projected to be relatively small.

Catenary poles are located on the outside of each track. This permits maintenance on one track without interfering with operations on the second track. The catenary system includes cantilevers, steady arms, insulators, messenger and contact wires, hangers, overhead and feeder wires, tensioning equipment, cables for grounding and connections to substations.

Traction power substations are located approximately every 15 miles along the right-of-way. Spacing of these unmanned substations may vary based on the requirements of the vehicle selected. Power will be supplied by local utility companies. Substation costs include the structures and installed equipment. The equipment includes a high-voltage bus bar, main isolating breaker, transformer, auxiliary transformer, bus tie breaker, feeder breaker and relay, and supervisory control systems. Each substation has a security fence or wall around it. Intrusion alarm systems will be installed.

### 7.4.8 Signals

The state-of-the-art signal and train control systems provide automatic train protection and track circuits for cab signals and train speed monitoring. The system has continuous wayside-to-train data transmission. The CTC system controls and monitors train operations, the status of traction power equipment and system data at the stations and substations. The passenger trains will be equipped with

## 7.8 CAPITAL COST - PREFERRED ROUTE

The total capital cost of the preferred route is shown in Table 7-1.

For the route from Cleveland to Columbus, the alignment west of Mansfield has a capital cost that is approximately $58,000,000 less than an alignment east of the city. The cost differential is due to the more difficult terrain east of Mansfield.

For the route from Columbus to Cincinnati, the alignment through downtown Springfield is about $298,000,000 less than a by-pass route south of the city. The downtown alignment uses existing right-of-way that avoids the cost of a new dedicated right-of-way south of Springfield. The estimated cost savings for right-of-way using the downtown alignment is $115,602,000. The balance of the savings using the downtown route is construction cost avoidance. The by-pass route requires construction of 50 minor structures compared to 31 using the downtown alignment. The downtown route also requires 33 fewer medium structures and six fewer major structures. Additionally there are five less major railroad structures on the alignment through downtown Springfield compared to the bypass route.

An option for the Columbus to Cincinnati segment is to locate the southern terminus of the route at the Cincinnati North Station. This would avoid operations shared with the considerable freight traffic (seven miles of shared track) between the Cincinnati North Station and the downtown Cincinnati Station. The elimination of service to downtown Cincinnati would enhance operational safety, improve the reliability of on-time service and reduce the capital cost of the high speed rail system by an estimated $112,000,000. Public transportation would provide service for train passengers from the Cincinnati North Station to the Central Business District.

The preferred 3-C Corridor route west of Mansfield and through downtown Springfield is $356,000,000 less expensive than the alignment east of Mansfield and south of Springfield.

## 7.9 OPERATIONS AND MAINTENANCE COSTS

The operations and maintenance practices are based on comparable experience for European high speed rail systems. Labor costs are based on the experience of passenger rail facilities in the United States.

## 7.10 OPERATIONS AND MAINTENANCE ASSUMPTIONS

Operations and maintenance costs are based on the following assumptions:

- Trains make 16 round trips daily.
- All trains stop at all stations.
- The trains are electrified and capable of operating at a sustained speed of 185 mph.
- Each train has one business class coach and two custom coaches. There are 48 seats in the business class cars and 76 seats in each custom coach. The seating capacity per train is 200 passengers. The potential of adding a restaurant car to each train was discussed earlier.
- The costs are in mid-1991 dollars and projected for a mature system that has been operating for ten years. The operations and maintenance costs in the initial years of operation are projected to be lower.

## 7.11 SYSTEM OPERATIONS

- Equipment

| | |
|---|---|
| Number of train-sets | 8 |
| Power units per train | 1 |
| Passenger cars per train | 3 |
| Type of power | Electrified |
| Top commercial speed | 185 mph |
| Power consumption - kWh/train mile | 20 |

- Infrastructure

| | |
|---|---|
| Length of right-of-way | 260 miles |
| Percentage of double-track | 99 percent |
| Track-miles (ROW + 4 for yard) | 520 miles |
| Number of stations | 9 |
| Track shared with freight operations | 10 miles |

- Operations

| | |
|---|---|
| Train-set miles per year | 3,036,800 |
| Trains per day - both directions | 32 |
| Running time - end-to-end | 166 minutes |
| Light cleaning at turn backs | 22 minutes (minimum) |

## 7.12 LABOR AND WAGE CALCULATIONS

Labor and wages are based on the following assumptions:

- Work days per employee per year - 230 days with an allowance of 30 days for vacation, holidays, training and sick leave.
- Employees work a forty-hour week.
- Station employees work a ten-hour day, four-day week.
- Fringe benefits are 40 percent of base salary.

## 7.13 STAFF REQUIREMENTS AND COSTS

An Operations and Maintenance organization chart is presented in Figure 7.1. The organization has a total of 710 personnel. Administration including the President's office has 189 personnel assigned with 24 personnel performing administrative duties (7 senior managers, 10 professionals, and 7 secretaries). The balance of the personnel under administration operate in the field and are revenue collectors (8), perform catering services (34), and work as station masters (36), ticket agents (36) and guards (51).

There are 521 personnel under the Vice President for Operations. The Assistant Vice President for Transportation has 111 personnel, and there are 410 personnel under the Assistant Vice President for Engineering and Maintenance.

The personnel costs for Administration, including the President's office, are $7,499,800 annually. The estimated annual cost for Vice President for Operations and the personnel under the Assistant Vice President for Transportation is $7,889,000 and the cost for the Engineering and Maintenance staff is $21,862,400. The total annual personnel cost including fringe benefits is $37,251,200.

The track and systems maintenance force during the initial years of operation may be reduced and the work performed by contractors. This possibility depends on the availability of skilled contract labor in a timely manner. The personnel costs in the initial years would be reduced but, to a degree, offset by increased contracting expenditures. When the system is mature (10 years of revenue service), an analysis will be made as to the economy and responsiveness of using contractors for track and systems maintenance as opposed to a fully staffed in-house maintenance organization.

A description of the responsibilities for each element of the organization is in Appendix B.

## 7.14 MATERIAL AND OTHER COSTS

The annual material costs for maintenance of the rolling stock, structures, track, systems, stations/buildings and the right-of-way drainage, roads and fences are calculated as a percentage of the initial capital cost.

Other costs include contract services, energy costs, commissions to travel agents, advertising, insurance and consumable supplies. These costs are projected based on the experience of rail organizations and estimates of requirements for the Ohio system.

The maintenance material and other costs are summarized in Table 7-2. The development of the maintenance material and other costs is detailed in Appendix C.

## 7.15 SUMMARY

The annual personnel costs are $37,251,200. The maintenance material and other costs total $24,768,000 annually. The total annual operations and maintenance cost is $62,019,200. The costs are summarized in Table 7-3.

## Table 7-3
## SUMMARY OF OPERATIONS AND MAINTENANCE COSTS

| Item | Annual Cost (in Millions of 1991 $) |
|---|---|
| **PERSONNEL COSTS** | |
| Administration | $ 7.5 |
| Transportation | 7.9 |
| Engineering and Maintenance | 21.9 |
| Total Personnel Costs | $ 37.3 |
| **MATERIAL COSTS** | |
| Equipment Maintenance | $ 5.6 |
| Maintenance-of-Way | 8.5 |
| Electric Power | 4.1 |
| Other Costs | 6.5 |
| Total Material Costs | $ 24.8 |
| **TOTAL O&M COSTS** | $ 62.1 |

# CHAPTER 8
# RIDERSHIP AND REVENUES ESTIMATES

## 8.1 GENERAL

In order to prepare ridership estimates for a high speed rail line in Ohio, the models developed by Peat Marwick in association with Frank Koppelman for the Ohio High Speed Rail Authority (OHSRA models) in 1988 were reviewed and revised. These models are documented in the 1989 "High Speed Rail Ridership Study" report. Only modifications made as part of this project and some of the major assumptions are described in this chapter.

The OHSRA models are capable of estimating both the total amount of future travel in the 3-C Corridor and the modal shares of that travel. These models were developed based on data describing travelers and behavioral characteristics in the 3-C Corridor and the U.S. in general. The ridership models and results are not based on rail ridership on existing high speed rail systems in other countries.

## 8.2 TOTAL TRAVEL MODEL

The total travel model used for the Ohio 3-C Corridor is a model developed by Frank Koppelman using 1977 National Passenger Transportation Survey (NPTS) data. This model relates the change in travel between a future year and a base year to the corresponding changes in population, per capita income, and transportation service.

The numerical relationships between these variables were estimated separately for business and non-business travel based on studies conducted in areas other than Ohio in the 70's.

The original model predicted an average annual growth rate of 0.9 percent for business travel and 0.6 percent for non-business travel between 1988 and 2010. Such an average annual growth seems low even considering that the population is estimated to decrease very slightly (0.05 percent annually). During the same period, per capita income is assumed to increase by 2.01 percent annually (see Table 8-1).

There has been a general trend in the United States of increased vehicle miles of travel (VMT) on rural highways (intercity travel) even with no population growth. This trend was even more noticeable during the 1980's which also saw the deregulation of the airline industry and increased air travel.

While a continuous growth in travel cannot be sustained indefinitely without socioeconomic changes, the growth in travel estimated by the OHSRA model might underestimate potential travel in the 3-C Corridor.

The validity of the total travel model for Ohio was checked for reasonableness by comparing the growth in travel the model estimated between 1980 and 1988 with the growth in rural vehicle miles of travel (VMT) reported by the Federal Highway Administration during the same period. Table 8-2 shows the growth in vehicle miles of travel. Non-local rural VMT, which can be considered as the best indicator of intercity travel grew 15.4 percent in Ohio between 1980 and 1988. Applying the OHSRA total demand model between city pairs in Ohio would show only a 2.5 percent growth in travel between 1980 and 1988 (see Table 8-3).

The discrepancy is due to the fact that the model as presently structured, cannot represent the increased rate of trip making observed in national VMT statistics. While the underlying reasons for increased per capita rates of travel are complex, one of the factors is a trend toward smaller family sizes (more households for the same population). By simply changing the "growth in population" in the OHSRA model

## Table 8-2
## ANNUAL VEHICLE MILES OF TRAVEL IN OHIO
## (Millions)

| | 1980 | 1988 | Total Growth 1980 - 1988 (Percent) | Average Annual Growth (Percent) |
|---|---|---|---|---|
| All Roads | 72,000 | 81,990 | 13.9 | 1.64 |
| Rural Roads | 30,636 | 35,023 | 14.3 | 1.69 |
| Non-Local Rural Roads | 24,305 | 28,036 | 15.4 | 1.80 |

**SOURCE:** "Highway Statistics", Federal Highway Administration.

## Table 8-3
## ANNUAL TRIPS IN 3-C CORRIDOR
## (Thousands)

| | 1980 (1) | 1988 (1) | Total Growth 1980 - 1988 (Percent) | Average Annual Growth (Percent) |
|---|---|---|---|---|
| OSHRA Model (using Population) | 37,696 (3) | 38,644 (2) | 2.5 | 0.31 |
| Alternative Model (using No. of Household) | 34,754 (4) | 38,644 (2) | 11.2 | 1.34 |

**NOTES:**

(1) Trips between major city pairs only.
(2) From OHSRA study 1988 Trip Table (based on survey data).
(3) Calculated by applying original OHSRA Total Demand Model which uses population as one of the variables.
(4) Calculated by applying revised OHSRA Total Demand Model replacing the population variable by number of households.

## 8.3.1 Selection of Stations and Airports

Resource Systems Group suggested that rail boarding and alighting stations be selected based on closeness (time) to the trip origin and destination but did not change the selection of airports. The argument for not changing the airport selection method was that, unlike rail, "air service is highly variable across the airports and it is likely that travelers will incur higher access costs in order to reach an airport with better service."

This argument may be true for air trips in a corridor where one of the airports is a dominant hub but not in the 3-C Corridor. The major city pairs with existing air service in the corridor all have between 9 and 13 flights daily during the week. While air fares vary between city pairs, they are high (indicating a high value of time) and vary only slightly between airports. This suggests that it is unlikely that air travelers would want to incur higher access or egress time to obtain fare benefits. Therefore, the selection of airports and stations was modified as follows:

> Select the station or airport pairs which result in the lowest total trip time where access and egress times are penalized by a factor of 1.25.

For air, this methodology is equivalent to choosing the closest airports since all flying times in the corridor are very close (in the 45 minutes to 1 hour range). For rail, this methodology is also equivalent to choosing the closest station in most cases. However, for trips whose true origin or destination is between two stations, it discourages choosing a station further away from the final destination (adding linehaul time).

## 8.3.2 Selection of Candiate Trips for Rail and Air Services

As suggested by Resource Systems Group, any potential rail trip for which the sum of access and egress time is higher than the auto-only trip time was eliminated. This criterion was extended to air trips too.

In addition, rail or air trips for which total travel time is higher than the auto only trip time and for which the in-vehicle time (rail or air) represents only a small portion of the total travel time were also eliminated. The intent was to eliminate as potential trips for rail those rail trips which would consist of a long access and egress time and a short in-vehicle time when the total auto-only travel time is shorter than the overall rail travel time. Following several logic tests, the following methodology was retained:

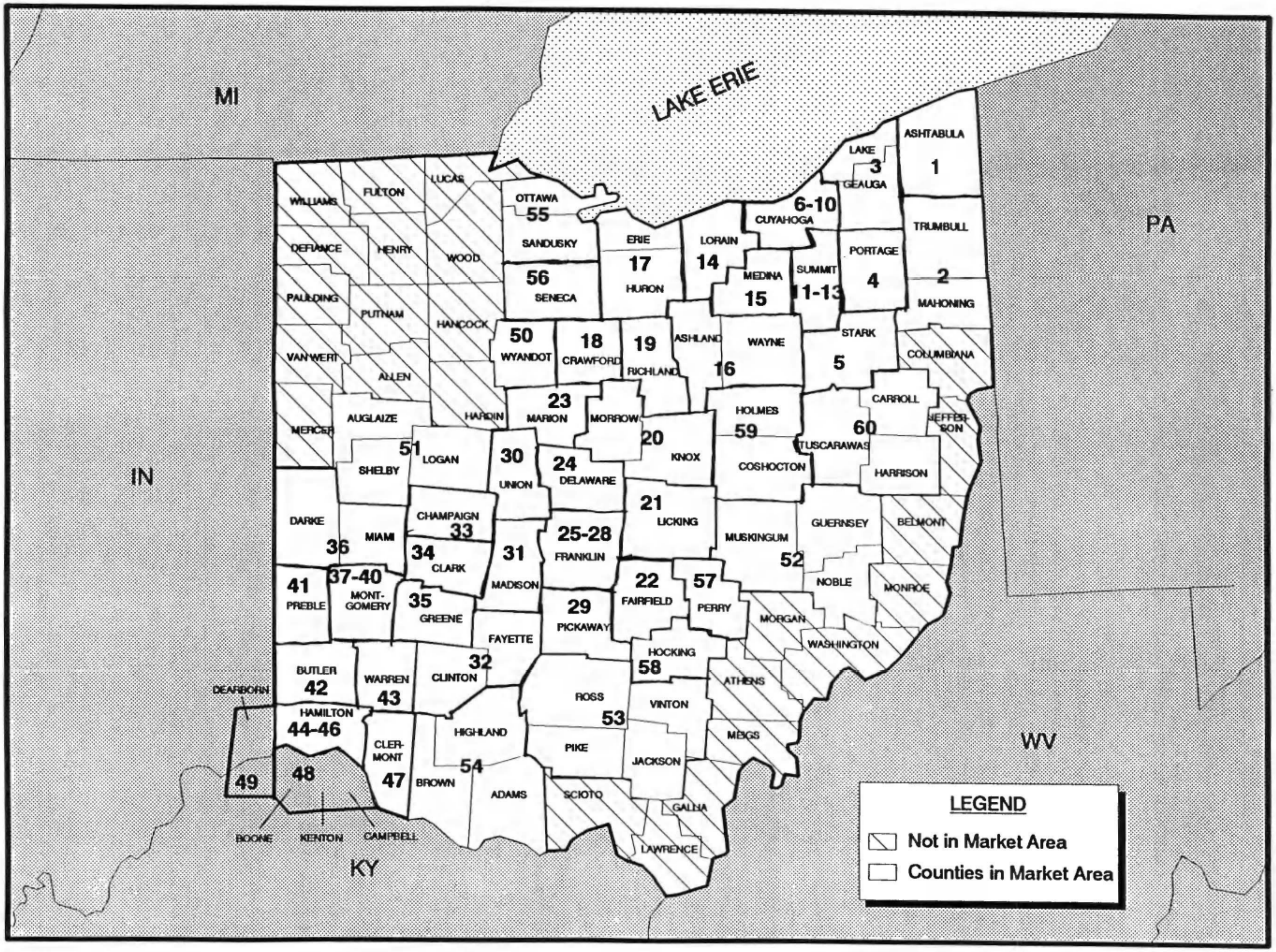
1. Eliminate as potential rail or air trip any trip for which:

   Access plus Egress Time (including terminal time) > Total Driving Time

2. Eliminate as potential rail or air trip any remaining trip for which:

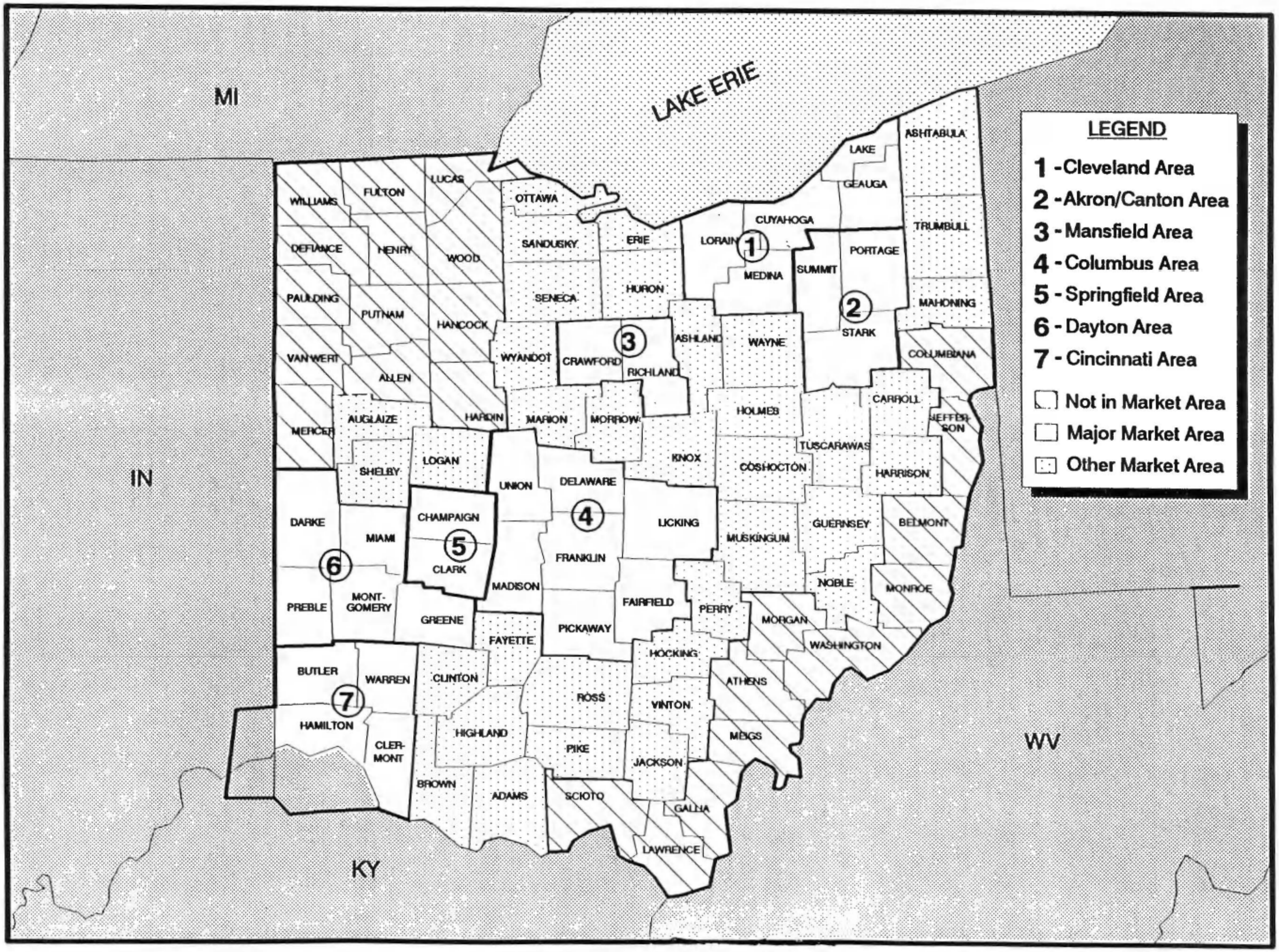
   Total Traveling Time (by air or rail) > Total Driving Time
   and
   (Access Time + Egress Time + 1/3 (Terminal Time)) > (Total Driving Time/2)

The second test is to eliminate as potential common carrier trips, those trips which would result in longer travel time than the total highway time and for which the total access and egress time (not including terminal time) was higher than the in-vehicle time. However, if applied like this, the test would have had the illogical results of increasing potential ridership as the rail time increases (for some zone pairs the access plus egress time could become lower than the in-vehicle time as the rail time increases). The second test as described above leads to similar results without this inconsistency.




**OHIO NEW ZONE SYSTEM**

**Figure 8.1**




**OHIO GEOGRAPHICAL AREA DEFINITION** **Figure 8.2**

## Table 8-4
## SELECTED HIGHWAY SERVICE CHARACTERISTICS

| From (Zone) | To (Zone) | Highway Distance (Miles) | Highway Time (Minutes) |
|---|---|---|---|
| Downtown Cleveland (7) | Downtown Columbus (26) | 144 | 172 |
| Downtown Cleveland (7) | Mansfield (19) | 83 | 108 |
| Downtown Cleveland (7) | Downtown Cincinnati (45) | 248 | 284 |
| Mansfield (19) | Downtown Columbus (26) | 78 | 99 |
| Downtown Columbus (26) | Springfield (34) | 57 | 76 |
| Downtown Columbus (26) | Downtown Dayton (38) | 71 | 92 |
| Downtown Columbus (26) | Downtown Cincinnati (45) | 112 | 133 |
| Springfield (34) | Downtown Cincinnati (45) | 85 | 111 |
| Downtown Dayton (38) | Downtown Cincinnati (45) | 53 | 65 |

**NOTE:** Highway trip time includes time reflecting stops and other travel delays at a rate of six minutes per hour of trip time (or ten percent).

## Table 8-6
## OHIO HIGH SPEED RAIL OPERATING TIME ASSUMPTIONS

| Station | Time Between Stations (Minutes) |
|---|---|
| Cleveland Downtown | |
| | 9 |
| Cleveland Southwest | |
| | 26 |
| Mansfield | |
| | 19 |
| Columbus North | |
| | 8 |
| Columbus Downtown | |
| | 27 |
| Springfield | |
| | 20 |
| Dayton | |
| | 22 |
| Cincinnati North | |
| | 19 |
| Cincinnati Downtown | |

**NOTE:** All times exclude dwell time. The following dwell times were added:

- 4 minutes Columbus Downtown
- 2 minutes all other intermediate stations

Rail Fare - Two types of fare, business class and coach class were assumed to be available. The business class fare schedule was developed on a per-mile basis as follows:

Business Class Fare = $10 + $0.40/Mile

This roughly corresponds to 60 percent of the air fare for the longer distance trips. The following exceptions applied:

- The same fare was used for downtown and suburban stations (for example the same fare applies to a trip between Mansfield and Cincinnati North and Mansfield and downtown Cincinnati).
- Suburban to Downtown fares for the major cities were set to $5.

Coach Class fares were set to 60 percent of business class fare with the same exceptions mentioned above. The resulting fare schedule is presented in Table 8-7.

Finally, a rail service frequency of 16 round trip trains per day was assumed in the forecast.

## 8.5 RIDERSHIP FORECAST RESULTS

Using the revised OHSRA model and the various assumptions described in the previous section, ridership forecasts were prepared for 1991 and 2010.

Table 8-8 presents the estimates of rail ridership for business, non-business and total markets, respectively, for the years 1991 and 2010. Total rail ridership estimates grow from 1.778 million trips in 1991 to 2.174 million trips in 2010, a 22.2 percent total increase or a 1.1 percent annual increase. These ridership estimates are presented in more detail in Appendix E.

Rail market shares vary between the business market and the nonbusiness market from 8 percent to 3 percent. This difference is due in part to the fairly high fare assumptions. Business travelers with higher values of time are more willing to pay these fares. Another reason is that non-business travelers are typically less willing to travel without their car.

Rail market shares also vary by district pairs. For example, 18 percent of the business market between Cleveland and Columbus would be captured by the high speed rail system but only 15 percent of the business market between Columbus and Cincinnati.

These variations are due to various factors. First, the average operating speed of the rail system varies along the 3-C Corridor (lower between Columbus and Cincinnati than between Cleveland and Columbus, for example). Second, there is no real air mode alternative between some district pairs (the rail system only competes with the highway alternative). Third, the longer the rail trip, the more time advantage the rail mode can accumulate (if competitive) vis-a-vis the highway mode. Other factors such as access/egress time or overall cost of the various modes available also contribute to this variation in market share.

At 5 percent, the total market share for rail may appear low. However, one must remember that the total market for this study has been defined broadly. As shown in Figure 8.2, many of the counties included in the potential market are relatively far from the proposed rail line. Because of their large access or egress time they contribute only marginally to the rail ridership but are included in the total market. Also, one of the largest markets, Dayton to Cincinnati, is estimated to contribute only one percent of its total market to the rail mode because there is neither time advantage nor cost advantage in using the proposed rail mode between Dayton and Cincinnati.

The estimate for average rail trip length is 93 miles in 1991 and in 2010. This is nearly twice the OHSRA study estimate and more in line with the trip length to be expected for a high speed rail from Cleveland to Cincinnati.

Table 8-9 presents the estimated rail trips by source. In 1991, 82 percent of the rail trips for business are diverted from auto while two percent come from the air market. This low proportion of rail trips from the air market (even more noticeable for nonbusiness) is due to the fact that the air market is fairly small in the 3-C Corridor compared to other parts of the country. Also, the proposed rail time of 2 hours and 40 minutes between Cleveland and Cincinnati, where the most significant air market exists, is only marginally competitive with the air travel time.

Induced traffic represents more than thirteen percent of the business rail trips and four percent of the nonbusiness rail trips. The lower percentage of induced traffic for the nonbusiness market is due to the fact that the relatively high fares assumed for the rail system do not induce many additional trips for the cost conscious non-business market.

## Table 8-9
## ESTIMATED RAIL TRIPS BY SOURCE

### YEAR 1991

| | BUSINESS | | NONBUSINESS | | TOTAL | |
|---|---|---|---|---|---|---|
| | Trips | Percent | Trips | Percent | Trips | Percent |
| From Auto | 1,049,833 | 82.1 | 461,632 | 92.3 | 1,511,465 | 85.0 |
| From Air | 22,888 | 1.8 | 2,616 | 0.5 | 25,504 | 1.4 |
| From Growth | 33,338 | 2.6 | 15,754 | 3.2 | 49,092 | 2.8 |
| Induced | 172,363 | 13.5 | 20,070 | 4.0 | 192,433 | 10.8 |
| Total | 1,278,422 | 100.0 | 500,072 | 100.0 | 1,778,494 | 100.0 |

### YEAR 2010

| | BUSINESS | | NONBUSINESS | | TOTAL | |
|---|---|---|---|---|---|---|
| | Trips | Percent | Trips | Percent | Trips | Percent |
| From Auto | 1,049,832 | 67.6 | 461,585 | 74.5 | 1,511,417 | 69.5 |
| From Air | 22,885 | 1.5 | 2,614 | 0.4 | 25,499 | 1.2 |
| From Growth | 271,656 | 17.5 | 130,668 | 21.1 | 402,324 | 18.5 |
| Induced | 209,418 | 13.5 | 25,002 | 4.0 | 234,420 | 10.8 |
| Total | 1,553,791 | 100.0 | 619,869 | 100.0 | 2,173,660 | 100.0 |

3-C corridor are projected to average 118 mph between Cleveland and Columbus and 80 mph between Columbus and Cincinnati. With these speeds, the market shares of 11, 10 and 9 percent projected for Cleveland-Columbus, Cleveland-Cincinnati, and Columbus-Cincinnati, respectively, appear reasonable even considering the travel environment in the Northeast Corridor is different from Ohio.

Market share forecasts for other high speed rail studies are shown in Table 8-11. Again, the market shares projected for the 3-C Corridor are reasonable, especially considering the average speed of the systems. For example, the Detroit-Chicago rail share is predicted to be more than 15 percent with an average speed of 80 mph - equivalent to the slowest segments of the 3-C Corridor.

**Table 8-11**

**MARKET SHARE COMPARISON - PROPOSED SYSTEMS**

| | Minneapolis/St. Paul - Chicago | | | Detroit - Chicago | |
|---|---|---|---|---|---|
| Corridor Length | 433 mi | 433 mi | 433 mi | 287 mi | 287 mi |
| Maximum Speed | 125 mph | 185 mph | 300 mph | 110 mph | 125 mph |
| Average Speed | 100 mph | 133 mph | 192 mph | 70 mph | 80 mph |
| Train Frequency | 12/day | 18/day | 24/day | 6/day | 10/day |
| Market Share | 10.3% | 12.9% | 14.5% | 9.6% | 15.2% |

Overall, comparing operating railroads and forecasts from other high speed rail studies confirm that the ORO market share estimates are reasonable.

## 8.8 RAIL RIDERSHIP REVENUES

The revenues to be derived from ridership were obtained by multiplying the forecasted number of train riders for each origin-destination station pair by the applicable rail fares and summing the calculated revenues. In this calculation, the percentage of riders paying business class fare versus coach class fare, as computed by the rail class choice model, was applied.

Table 8-12 summarizes the estimated fare box revenue for 1991 and 2010. In 1991 constant dollars, the revenue from ridership will grow from $88 million in 1991 to $107 million in 2010. Nearly 24 percent of total passengers are projected to take advantage of coach class fares which contribute less than 17 percent of the revenues.

A detailed revenue estimate by station pairs is presented in Appendix E.

# CHAPTER 9
# INVESTMENT ANALYSIS

## 9.1 INTRODUCTION

This chapter describes the financial model used to predict the results of developing and operating the high speed rail system using the financial plan, system cost, revenues and operating expenses.

## 9.2 METHODOLOGY

### 9.2.1 Cash Flow Projections

The initial efforts to assess the quality and likelihood of investment in the rail system center on the development of a financial model to assess the operating results of the system and, from these net operating results, the availability of funds sufficient to finance the development costs of the system itself. The model is formulated to allow for sensitivity in the input parameters to test the differing degrees of revenues and expense and the impact each had on the financial net results. Annual projections of cash flows in the model forecast the future based on present assumptions of future events.

The following are the criteria used to develop a financial model for the Ohio High Speed Rail System. This financial model encompasses not only the operational criteria for the system but also the development criteria or, more precisely, the means, timing and resources required to bring the system and its components through development to a state of operational readiness.

## 9.3 DEVELOPMENTAL CRITERIA

During the development of the rail system, there are two major categories of costs/revenues needed in the cash flow projections for the model. These are the development costs themselves and the sources of funding for the development.

### 9.3.1 Development Costs

- Preliminary Engineering
- Economic Studies
- Detailed Design
- Right-of-way Acquisition
- Construction and Procurement
- Rolling Stock, Traction Power and Equipment
- Construction Management
- Insurance
- Capitalized Interest
- Contingency

In 1991 dollars, the present estimate of the development costs for the system is $3.1 billion. The schedule for this development effort is shown in Chapter 13.

**Non-Operating Revenues**
The following are presently identified as the sources of non-operating revenues of the system:

- Financing Proceeds
- Investment Income
- Governmental Sourced Revenues
  - Dedicated
  - Periodic
- Lease Income
  - Air Rights
  - Communications
  - Other
- Grant Receipts
  - Federal
  - State
  - Other

### 9.4.2 Operating Costs

The following operating cost elements were incorporated into the cash flow analyses to round out the modeling effort for the cash flow projections.

- Labor
- Benefits
- Repairs and Maintenance
- Power
- Other Fuel Charges
- Insurance
- Provisions for Injuries and Damages
- Other

### 9.4.3 Non-Operating Costs

In addition to the operating costs, certain non-operating costs of the system were identified for incorporation in the model. The predominant cost here was debt service while other identified costs included franchise fees and royalties. There is also the potential for taxes becoming an additional non-operating cost to the extent that there is private ownership of all or a portion of the system.

## 9.5 INVESTMENT ANALYSIS

For a predominately private sector development and funding effort, the private sector participants would need to be shown a return of their contributed capital that would equate to other investment returns available in the marketplace. In addition to the overall return on investment, the risk of achieving this return would also be subject to quantification. On an overall basis, net operating revenues of the system are desired to cover operating expenses, provide for debt service and generate a return to the investors willing to shoulder the major cost risks of the development of the system while a lower return would be applicable to later investors coming in when the construction risk (and completion risk) is materially lower.

## Table 9-1
## REVENUE REQUIREMENTS TO COVER $62.1 MILLION OF O & M COSTS PLUS DEBT SERVICE (CAPITAL COSTS - $3.1 BILLION)

**INTEREST RATE - 8%**

**COVERAGE REQUIREMENTS**
**($ in $1,000)**

| Amortization (Yrs) | 1.00 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.30 |
|---|---|---|---|---|---|---|---|
| 20 | 377,842 | 393,629 | 409,416 | 425,203 | 440,990 | 456,777 | 472,564 |
| 25 | 352,504 | 367,024 | 381,645 | 396,065 | 410,585 | 425,105 | 439,625 |
| 30 | 337,465 | 351,233 | 365,002 | 378,770 | 392,538 | 406,306 | 420,075 |
| 35 | 328,090 | 341,390 | 354,689 | 367,989 | 381,288 | 394,588 | 407,887 |
| 40 | 322,067 | 335,065 | 348,063 | 361,061 | 374,060 | 387,058 | 400,058 |

## Table 9-2
## REVENUE REQUIREMENTS TO COVER $62.1 MILLION OF O & M COSTS PLUS DEBT SERVICE (CAPITAL COSTS - $1.0 BILLION)

**INTEREST RATE - 8%**

**COVERAGE REQUIREMENTS**
**($ in $1,000s)**

| Amortization (Yrs) | 1.00 | 1.05 | 1.10 | 1.15 | 1.20 | 1.25 | 1.30 |
|---|---|---|---|---|---|---|---|
| 20 | 163,952 | 169,045 | 174,137 | 179,230 | 184,323 | 189,415 | 194,508 |
| 25 | 165,779 | 160,463 | 165,147 | 169,831 | 174,515 | 179,198 | 183,882 |
| 30 | 150,927 | 155,369 | 159,810 | 164,252 | 168,693 | 173,134 | 177,676 |
| 35 | 147,903 | 152,193 | 156,484 | 160,774 | 165,064 | 169,354 | 173,644 |
| 40 | 145,960 | 150,153 | 154,346 | 158,539 | 162,732 | 66,925 | 171,118 |

# CHAPTER 10
# FINANCE

## 10.1 INTRODUCTION

Like highways, airports and other transportation facilities, high speed rail provides a vital public service which is the proper concern of state and local government and a proper object of governmental financial assistance. High speed rail is also a candidate for a financing structure which relies substantially on private user charges--in this case, passenger fares. For the 3-C Corridor project to be financeable, it will be necessary to fuse public and private finance concepts; as our study reveals, fares and other operating revenues, standing alone, will not be sufficient to support the full development and construction costs of the system, the acquisition cost for rolling stock and the necessary competitive return on equity. It will not be possible to look solely to the private sector for the necessary development and construction funds. Indeed, substantial public subsidies will be required if the public purposes served by the 3-C rail corridor are to be met.

Rather than implementing a pure privatization model, the goals of a financing plan for the 3-C Corridor system are to ensure that adequate funds are available for planning, development, construction and operation on a basis which minimizes overall construction cost and financing cost, and thereby limits the level of public support required from the State of Ohio. These goals can be accomplished by maximizing:

- The use of federal financial assistance programs
- The use of tax-exempt financing
- The role of private debt and equity capital

In evaluating possible sources of financing, it became clear that a distinction can usefully be drawn between phases of the project, because the potential sources of funds will vary depending upon the stage of development. We have grouped the necessary activities into (i) a planning, design and demonstration phase during the pre-construction activities and (ii) a construction phase. During the pre-construction phase the feasibility work already completed will be upgraded to a level where construction can commence, and a portion of the system may be constructed. Construction funding will be finalized after this work is completed and in conjunction with a plan for permanent project financing.

## 10.2 FUNDING SOURCES DURING THE PLANNING, DESIGN AND DEMONSTRATION PHASE

As described in more detail in Chapter 14, the next steps toward the realization of a high speed rail system for Ohio will entail detailed feasibility studies, environmental analysis and permitting, planning, route selection, preliminary design and possibly an initial demonstration project.

### 10.2.1 Federal Assistance

At this point in the project development, the successful completion of planning, design and demonstration activities must depend heavily on governmental investment. Several potential sources of federal assistance are incorporated in the Intermodal Surface Transportation Efficiency Act of 1991 ("ISTEA"). While the Administration has not to date requested funding for these programs, it may be possible to obtain funding in the future. Potentially helpful federal programs include the following:

development period, rights with respect to the ownership and management of the facilities developed and the basic terms of an ultimate franchise award.

## 10.3 FINANCING SOURCES FOR THE CONSTRUCTION PHASE

### 10.3.1 Ownership Structure

The financing arrangements made for the construction and operation of the 3-C Corridor will be linked to the ownership structure of the completed facility. The Ohio High Speed Rail Authority Act in its current form clearly permits the final system to be owned by a public agency and financed by issuances of tax-exempt debt. Whether, at the opposite end of the spectrum, a franchise could be awarded by the State of Ohio for private development and ownership of the high speed rail system is not clear under the current form of the Act. Significant legislative changes would, in any event, be necessary to remove uncertainties in the law relating to matters other than ownership structure and to permit the financing of a privately owned project. Such private development and operation would be consistent with the emerging federal policy, as restated in the recent Executive Order of the President, of encouraging maximum private participation in the development of the nation's infrastructure with financing supported by user charges.

As indicated earlier, projections indicate that the system revenues will not be sufficient to support the costs of private financing, including the reasonable return on equity investment necessary to attract private capital to a wholly privatized project. However, there will be significant opportunities for private capital to participate in the construction, ownership and operation of various components of the high speed rail system. Ohio should encourage a hybrid form of development which utilizes the resources of both the public and the private sectors.

### 10.3.2 Federal Sources of Funds for the Construction Phase

At the present time, federal programs specifically aimed at fostering high speed rail are primarily concentrated in the areas of research, development, and demonstration. However, ISTEA did initiate one change in the federal law which, if fully implemented, ultimately could have important ramifications for the construction of high speed rail systems. ISTEA amended the loan guarantee program under the Railroad Revitalization and Regulatory Reform Act of 1976 to authorize federal guarantees specifically for the financing of high speed rail facilities. The law now permits the Secretary of Transportation to guarantee obligations of a public or private railroad, including (as a result of ISTEA) obligations incurred to establish high speed rail facilities and equipment. High speed rail is defined as rail transportation "reasonably expected" to reach speeds of 125 mph. Not more than one billion dollars of guaranteed debt can be outstanding at any one time. Any high speed rail facilities and equipment financed with a federally guaranteed loan must be at least 85 percent produced or manufactured in the United States, unless the Secretary finds that such a requirement would be inconsistent with the public interest, that items of satisfactory quality could not be produced in the U.S. in sufficient quantities, that the requirement would increase the cost of the facilities by more than 25%, or that the requirement would result in a violation of the obligations of the U.S. under an international trade agreement. While the federal guarantee is outstanding, dividends payable by a privately owned railroad are limited. Notwithstanding the enactment of ISTEA, the Federal Railway Administration has not been given budget authority at the present time to enter into any loan guarantee agreements. Correction of this situation should be high on the legislative agenda of advocates of high speed rail.

Other provisions of federal law which may be helpful in defraying the cost of a high speed rail system deal with sharing of right-of-way and elimination of grade crossing hazards.

a congressional intent that conventional rail facilities be considered in their entirety for application of STP funds. The report of the Conference Committee on ISTEA notes that:

> "In certain instances, passenger rail operations provide significant mass transit services. The conferees do not intend to preclude consideration of passenger rail capital costs where those operations provide significant commuter service on a regular basis."

Clearly, a favorable resolution of the availability of STP funds would facilitate high speed rail construction finance, by providing a layer of federal "equity" to supplement debt financing.

ISTEA provides for further flexibility in the use of federal assistance by permitting a state to transfer 50 percent of its funds apportioned for the National Highway System (NHS) to the Surface Transportation Program. Up to 100 percent of the NHS apportionment may be transferred to the STP if the Secretary of Transportation approves the state's transfer request as being in the public interest after notice and opportunity for public comment. Under certain limited circumstances ISTEA even permits funds apportioned to a state for the NHS to be obligated for construction of a "transit project" eligible for assistance under the Federal Transit Act. To qualify for this reallocation, the transit project must be in the same corridor as, and in proximity to an access controlled highway which is part of the National Highway System. The transit project must improve the level of service on the access-controlled NHS highway and must be more cost-effective than a comparable improvement to the access-controlled NHS highway. This is a strong argument in support of NHS funding for the 3-C Corridor because it parallels segments of I-70, I-71 and I-75.

It is evident from the foregoing that a successful strategy for capturing federal monies not specifically earmarked for high speed rail will require two types of state support: (i) seeking expansive Department of Transportation interpretations of its statutory mandate; (ii) state designation of high speed rail as a primary recipient of available federal assistance, in preference to other rail and non-rail projects which also are eligible for such assistance.

## 10.3.4 State and Local Government Sources

### Financing Options

Given the probable limitations on both federal and private sources of funding, it is clear that the State of Ohio will have an integral role in funding the construction of the Ohio high speed rail facility. The funding can be provided through a combination of debt financing, contribution of assets, and/or pledge of a specified revenue stream or an excise or sales tax as credit support for the financing. Assets which may be contributed toward the development of the Project are discussed in Section 10.3.5.

The amount of the State's contribution during the pre-construction phase will be determined as the project is further developed. Because the 3-C project will produce no revenues during the pre-construction phase, any debt financing issued by the State to support this phase of the project's development would have to be secured by the pledge of excise or sales tax receipts or other specific revenue source.

Although it may be possible to finance all or part of the project on a current basis it is anticipated that the State of Ohio, or an agency of the State, will issue debt financing for a major portion of the cost of the project's development during the construction phase.

### Tax-Exempt Finance

Depending on the terms of the financing, the debt issued by the State may be tax-exempt or taxable; that is, the interest received by bond holders may or may not be subject to federal and state income tax. Tax-exempt financing is preferable because the interest rate on the financing is lower than the interest rate on there is no obligation to pay the principal and interest due on the financing. A lease purchase agreement is essentially an installment purchase agreement.

**Credit Support**
Regardless of the form of the debt, revenues realized from the operation of the high speed rail facility will be pledged to the payment of debt service. Debt can be structured so that it provides funds to pay construction cost but no repayment on the debt will be scheduled until operating revenues are realized. To the extent that rail system operating revenues do not provide sufficient coverage for the debt, one or more identified revenue sources, such as an excise or sales tax, may be pledged to secure the financing.

In light of the projected revenue scenarios discussed above, it would be desirable for the Ohio legislature to initiate consideration at the earliest possible time of supplemental revenue sources which could be pledged in support of debt issued to finance the 3-C project.

The State of Ohio currently imposes a 5 percent sales tax, with counties having the option to impose additional taxes on their own. Table 10-1 shows the optional sales rate tax (apart from the state tax and transit related taxes) currently applied in each county in Ohio and the collections received for 1990. Because counties imposed varying levels of supplemental tax (from 0.50 percent to 1.50 percent), the theoretical collections per 1.00 percent of tax were computed. This computation revealed that the annual statewide collections for an additional 1.00 percent sales tax would be approximately $629.5 million. Assuming an interest rate of 7.5 percent, 30 year amortization, and debt service coverage at 125 percent, it would require $328.1 million of revenue annually to service all $3.1 billion of system cost. Revenue in this amount could be produced by statewide imposition of an additional 0.5 percent sales tax. Further assuming availability of federal financial assistance to reduce requirements for borrowed funds, and/or operating income sufficient to support a portion of debt service, the incremental sales tax required for credit support could be less than 0.5 percent. Moreover, on a pay-as-you-go basis, sales tax revenue for five to ten years at 1 percent would cover the entire project cost and avoid substantial interest payments and the restrictions of tax exempt debt.

Tax-exempt financing will restrict the alternatives available for developing the project. This choice of financing will affect the permitted sources and applications of revenue and the terms of operating contracts. Because of the savings realized by the use of tax-exempt financing, it may be necessary to accept these restrictions in order to enhance the financeability of the 3-C project.

### 10.3.5 Contribution of Existing Assets Owned by State and Local Government

Since construction and operation of a high speed rail system will be beneficial to the economies of the State of Ohio and of individual localities, state or local governmental units may choose to reduce the total land acquisition cost of the 3-C Corridor system by donating necessary parcels. Planning of the system should include a review of publicly owned parcels which are currently unused, or are used for purposes which could easily be moved elsewhere, freeing up suitably located acreage for stations, service yards, and ancillary parking. In some cases it may also be possible for governmental units to make track right-of-way available on the shoulders or median strips of existing highways and roads, or to divert automobile traffic from a particular lightly travelled route in order to free the roadbed for rail use. Any such contribution must be carried out in compliance with applicable statutes. The legal availability of such contributions might be affected by whether the project was publicly or privately owned.

## 10.3.6 Revolving Fund Loans

ISTEA authorizes each state to lend federal assistance funds to public or private developers of specified tolled transportation facilities (bridges, tunnels, highways and approaches) and to deposit loan repayments in a revolving fund, which may then be reloaned for other eligible transportation projects (including mass transportation, which, as we have seen, arguably includes high speed rail). Many states are exploring the extent to which they can achieve a rapid first revolution of such funds so that federally-imposed restrictions on subsequent fund use will be reduced. They are also exploring methods for the expansion of such funds through leveraging techniques. Assuming that a portion of the proposed Ohio high speed rail facility qualifies for transit funding under federal law, amounts contained in any transportation revolving fund established by Ohio pursuant to ISTEA could be made available for financing of the 3-C Corridor. This could prove to be a powerful financing tool.

## 10.3.7 Private Sector Contributions

**Private Ownership of Assets**
In order to reduce the need for public financial support, some of the components of the high speed rail system might be developed and owned by the private sector. In some cases these components could be operated as well as owned by the private sector; in other cases the assets might be leased to a public rail operator while the owner retains the tax benefits. A third scenario would involve private ownership of assets and lease of these assets to a private operator. (Choice among these options must take into account the operating contract rules discussed above in subsection 10.3.4 "State and Local Government Sources.")

Rail cars are well suited to private ownership, since they are not eligible for financing with tax-exempt private activity bonds. Privately owned and financed rail cars can be leased by the private owner to the facility operator.

**Vendor Participation**
Valuable financial concessions may be made available by equipment vendors interested in participating in expansion of the U.S. high speed rail movement. While vendor participation may not be a major financing source for the development of the system, it can reduce overall system cost.

Vendor participation can occur in several ways. First, a vendor could reduce the cost of its product in return for having it specified in the design criteria for the system or specified for components that could otherwise be procured only on a piecemeal basis. By arranging for a longer production run, or a less competitive procurement, a vendor may be able to reduce the per-unit cost of the components being supplied. The benefits of such savings should be reflected in total system cost.

Second, for some system components acquired from a non-U.S. supplier, the price may be reduced to reflect credits received from the supplier's export credit finance agency. While the owner of the system must be careful in conforming the acquisition of foreign materials to "Buy America" and "Buy Ohio" provisions accompanying many public acquisition programs, the owner can benefit from the fact that foreign governments regularly issue credits for their own manufacturers or provide financing that is below market. Pass-through of savings from these mechanisms can result in a reduction of system development costs.

Finally, in exchange for the right to be named as part of the development group, suppliers may be willing to either subordinate their profit or defer it until the system is partially or completely in service. Such subordination or deferral reduces the burden on the system of having to finance supplies (and the profit earned on them) up-front or during the construction period. It also lessens the burden that finance charges would otherwise have on the system's overall cash flow. Suppliers may also be willing to accept taxes, rentals or sales of air rights may not be sufficiently certain to represent a primary repayment source for construction debt, such revenues can provide additional security for debt service or a basis for early retirement of debt.

## 10.4 IMPLICATIONS FOR PROJECT IMPLEMENTATION

Review of the financial alternatives available for system development points to several key project implementation conclusions:

- The 3-C Corridor analysis is not yet sufficiently advanced to justify immediate overall financing for the program. For this reason, a two phase development approach should be utilized. Upon the completion of the planning, design and demonstration phase, there will be sufficient project definition, technically and in terms of projected cash flows, to initiate full scale project development. Demonstration of the merits of the project through construction of an initial segment would significantly enhance project credibility in the financial markets.
- If the two phase approach is utilized, federal research, development and demonstration programs, coupled with available investment from potential vendors, may be sufficient to bring the project to a point where it is ready for construction financing and can attract long term private equity and public and private debt commitments. As previously noted project revenues alone will not be sufficient to support the necessary financing or to permit a purely private project. While promising federal programs are on the books, they are either not currently funded, or are funded at a level insufficient to need. It is important to pursue vigorously federal administrative interpretation of STP funds availability, agency direction of available funds to the project, congressional action to reprogram funds from maglev to high speed rail and congressional action to assure adequate funding of financial assistance programs.
- There can be no assurance that federal support will be sufficient to provide necessary public financing. Consequently, state action to assess or dedicate sales or excise tax revenues to support 3-C Corridor bonds appears to be essential to meet the balance of project costs. The leverage on state funds may be enhanced through inauguration of a state revolving fund under ISTEA and through reprogramming of eligible STP funds.

An adequate financing package will thus reflect a long-term targeted effort to maximize private and public, state and federal involvement.

# CHAPTER 11
# ECONOMIC BENEFITS

## 11.1 INTRODUCTION

Although the costs of developing and operating the high speed rail system are substantial, the system will generate significant operational benefits for the passenger as well as societal, environmental and economic benefits for the Ohio region. Since the funds to construct and operate the system will be spent about the time the economy is recovering from recession, the high speed rail system will generate enough development to improve Ohio's economy faster than its neighbor's, attracting the infusion of additional capital resources from outside the state.

### 11.1.1 Key Conclusions

- Constructing the high speed rail system will result in over $5.5 billion in direct economic output for the state, increasing household earnings by over $1.7 billion and creating 71,000 person-years of employment
- Ongoing operations activities will result in over $3.2 billion in economic output for the state over a 25-year period following construction of the system, increasing household earnings in Ohio by over $1.2 billion and creating 79,000 person-years of employment
- Users of the high speed rail system will save the equivalent of $400 million through reduced travel times by not using their automobiles for journeys along this corridor
- As travellers divert to high speed rail, fewer automobile accidents, injuries and fatalities will result in a total savings to society of $200 million
- Diverting to high speed rail will save the Ohio environment over 57 million kilograms of hydrocarbons, carbon monoxide and nitrogen oxides
- Using high speed rail for trips will save over 220 million gallons of fuel that otherwise would have been consumed by private automobiles
- The total economic benefits of developing and operating the Ohio high speed rail system will amount to $11.1 billion in 1991 dollars

## 11.2 ECONOMIC BENEFITS TO THE STATE OF OHIO

The first economic benefits for the state of Ohio will come from constructing the system and the multiplier effects of spending these construction dollars on business and employment activities within the state. Continuing economic benefits will accrue from operating and maintaining the system and the economic spin-offs of the expenditures on operating costs, the multiplier effects of these expenditures, and the business and jobs created as a result of the ongoing operations and maintenance of the system.

The initial economic benefits from constructing the high speed rail system will require substantial infusions of capital resources. The current estimate for developing the system between Cleveland and Cincinnati is approximately $3.1 billion (1991 dollars), including contingencies. This includes the trackwork, structures, electrification, signalization, right-of-way, rolling stock and fencing. The direct benefits will be the creation of jobs for the construction of the system and the business expansion needed to provide materials and equipment.

## Table 11-1
## TOTAL IMPACTS ON OHIO OUTPUT, HOUSEHOLD INCOME AND EMPLOYMENT FROM CONSTRUCTING THE OHIO HIGH SPEED RAIL SYSTEM

| Cost Element | Construction Cost (1991 Dollars) | Cost w/ 20% Cont (1991 Dollars) | % of Exp. in Ohio | Ohio Cost (1991 Dollars) | Total Output for Ohio Economy (1991 Dollars) | Household Income (1991 Dollars) | Employment (person years) |
|---|---|---|---|---|---|---|---|
| Track work | 781,874,186 | 938,249,024 | 68% | 638,009,336 | 1,582,901,163 | 496,179,861 | 20,672 |
| Roadway Preparation | 71,608,730 | 85,930,476 | 95% | 81,633,953 | 202,533,837 | 63,486,725 | 2,645 |
| Structures | 304,676,712 | 365,612,054 | 97% | 354,643,693 | 879,871,002 | 275,806,400 | 11,490 |
| Fencing | 52,202,570 | 62,643,084 | 100% | 62,643,084 | 155,417,493 | 48,717,527 | 2,030 |
| Crossing Protection | 36,095,458 | 43,314,549 | 0% | 0 | 0 | 0 | 0 |
| Yards | 44,440,106 | 53,328,128 | 68% | 36,263,127 | 89,968,818 | 28,201,834 | 1,175 |
| Stations | 43,469,798 | 52,163,758 | 90% | 46,947,382 | 116,476,455 | 36,510,979 | 1,521 |
| Electrification | 444,983,249 | 533,979,899 | 50% | 266,989,949 | 662,402,064 | 207,638,084 | 8,650 |
| Signalization | 161,265,190 | 193,518,228 | 30% | 58,055,468 | 144,035,617 | 45,149,738 | 1,881 |
| Rolling Stock | 74,741,000 | 89,689,200 | 16% | 14,350,272 | 35,603,025 | 11,160,207 | 465 |
| RoW | 242,481,000 | 290,977,200 | 100% | 290,977,200 | 721,914,433 | 226,292,968 | 9,428 |
| Engineering/Management | | 406,410,840 | 85% | 345,449,214 | 857,059,500 | 268,655,854 | 11,193 |
| **TOTALS** | **$2,257,838,000** | **$3,115,816,440** | | **$2,195,962,679** | **$5,448,183,406** | **$1,707,800,175** | **71,149** |

Our projections show that business and non-business travellers alike will save over half a million hours per year by using the high speed rail system in Ohio as opposed to using their automobiles during the first year of operations. These time savings are projected to grow to almost 650,000 hours per year by 2014. These substantial time savings are valued by users, and economic benefits can thus be attributed to the value of the time savings themselves. Using a value of $50 an hour for business travel in Ohio, and $30 an hour for non-business travel, the time savings for the first year of operations will be worth over $24 million. This grows to almost $30 million annually by 2014. On a present value basis, the accumulated time savings for the period between 1996 and 2014 amount to almost $400 million.

By using the high speed rail system, business and non-business travellers will benefit from not having to operate their automobiles. The operating costs of a private automobile include vehicle fuel costs, maintenance, repair, depreciation, insurance, tolls and other operating costs such as vehicle registration fees. We have projected that by the first year of operations, high speed rail users would be saving over $87 million annually by not using their automobiles. These savings grow to over $165 million annually by 2014. On a present value basis, the accumulated savings for the period between 1996 and 2014 are projected to amount to over $1.6 billion for business and non-business users.

## 11.4 SOCIETAL AND ENVIRONMENTAL BENEFITS

Highway traffic, like air traffic, is vulnerable to adverse weather conditions, reduced visibility and congestion. High speed rail service does not typically suffer under these conditions. Trains are rarely delayed and continue to operate under fog, rain, snow, windy conditions and traffic congestion.

As business and non-business travellers divert to high speed rail service away from highway travel, the rail system is expected to save numerous lives along the corridor. The state of Ohio has an average accident rate of 2.1 fatalities per hundred million vehicle miles travelled on interstate highways. If the high speed rail system can divert, as we have predicted, over 198 million vehicle miles away from Ohio's highways, there would be between 4.4 and 5.2 lives saved annually between 1996 and 2014 respectively, close to 50 lives in total. Highway accidents causing property damage occur at a rate of approximately one per 100,000 miles driven. One in ten results in personal injury. Thus, high speed train ridership could also result in an expected reduction of 1,980 accidents and close to 200 injuries annually for the first year of operations and more than 40,950 accidents and 4,095 injuries over the period between 1996 and 2014.

Using the NHTSA's societal cost of motor vehicle fatal accidents (these include medical and legal costs, court awards and property losses), each fatality costs $654,311 in 1991 dollars; each injury $20,000 and each accident involving property damage $2,000. The total costs of fatal accidents averted amount to over $33 million; of injuries, $81.9 million; of accidents, $81.9 million. These savings total $196.8 million in 1991 dollars for the period between 1996 and 2014.

Finally, high speed rail results in substantial environmental savings as an energy efficient mode of surface transportation over certain distances. The state of Ohio can achieve substantial pollution reduction by developing a reliable, high speed rail service. Since most of the rail passengers, business and non-business alike, diverted from highway travel, substantial reductions in vehicular emissions will result. Using the figures estimated by the American Public Transit Association for typical commuting trips in the U.S., and using the national average vehicle occupancy rate, the pollution emitted by rail (measured at the power plants) was compared to the passenger automobile with the following results. Ohio high speed rail users will spare the environment over 6.3 billion grams of hydrocarbons, 45.5 billion grams of carbon monoxide and 4.8 billion grams of nitrogen oxides for the period between 1996 and 2014 by diverting from their automobiles.

We projected the savings in operating costs for users of high speed rail to include the savings of not having to pay for the fuel costs of driving passenger vehicles. From society's standpoint the lower fossil fuel consumption provides tangible environmental resources savings. For business and non-business

# Figure 11.1
# SUMMARY OF ECONOMIC BENEFITS
# OF
# OHIO HIGH SPEED RAIL

## A. CONSTRUCTION PERIOD

CONSTRUCTION SPENDING

$ 3.1 BILLION
($ 519 MILLION/YEAR)

↓

DIRECT SPENDING ON LABOR, MATERIALS AND EQUIPMENT IN OHIO

$ 2.2 BILLION
($ 370 BILLION/YEAR)

↓

DIRECT, INDIRECT AND INDUCED ECONOMIC OUTPUT FOR OHIO ECONOMY

$ 5.4 BILLION
($ 908 MILLION/YEAR)

↓

71,150 JOBS

$ 1.7 BILLION IN HOUSEHOLD EARNINGS

## B. ONGOING OPERATIONS

DIRECT OPERATIONS AND MAINTENANCE SPENDING

$ 1.46 BILLION

↓

DIRECT, INDIRECT AND INDUCED ECONOMIC OUTPUT FOR OHIO ECONOMY

$ 3.2 BILLION

↓

79,000 JOBS

$ 1.2 BILLION IN INCREASED HOUSEHOLD EARNINGS

## C. TIME TRAVEL SAVINGS

TRAVEL TIME SAVINGS

8.7 BILLION HOURS TOTAL
WORTH: $ 390 MILLION

## D. ACCIDENT COST SAVINGS

50 FATALITIES AVERTED
1,980 ACCIDENTS AVERTED
200 INJURIES AVERTED

$ 197 MILLION IN SOCIETAL COSTS SAVED

## E. SAVINGS IN VEHICLE OPERATING COSTS

SAVINGS FROM NOT HAVING TO OPERATE AUTOMOBILES

$ 1.6 BILLION

## F. FOSSIL FUEL SAVINGS

220 MILLION GALLONS OF FUEL SAVED

$ 268 MILLION SAVED

## SUMMARY TOTALS

| | 1991 $'S |
|---|---|
| A. CONSTRUCTION PERIOD | $ 5.4 BILLION |
| B. ONGOING OPERATIONS | $ 3.1 BILLION |
| C. TIME TRAVEL SAVINGS | $ 0.4 BILLION |
| D. ACCIDENT COST SAVINGS | $ 0.2 BILLION |
| E. SAVINGS IN VEHICLE OPERATING COSTS | $ 1.6 BILLION |
| F. FOSSIL FUEL SAVINGS | $ 0.3 BILLION |
| **TOTAL BENEFITS OF OHIO HIGH SPEED RAIL** | **$ 11.1 BILLION** |

# CHAPTER 12
# INSTITUTIONAL CONSIDERATIONS

## 12.1 INTRODUCTION

High-speed train technologies are proven and an intercity travel market exists for the trains in selected corridors in the United States, such as the 3-C Corridor. In this country the impediments to high-speed trains are institutional. An effort must be undertaken to modify policies and practices at various levels of government.

The 1991 Intermodal Surface Transportation Efficiency Act passed by Congress provides a significant increase in federal support for high speed rail projects. The act will permit the use of highway right-of-way for high speed rail at less than the fair market value of the land. Grants and contracts can be provided, at the discretion of the Secretary of Transportation, for demonstration of any advance in high speed rail technology to be incorporated in a revenue service system under construction. The bill also authorizes loan guarantees for high speed rail projects. Federal highway funds, at the discretion of the states, may be used where the high speed rail line impacts highways, such as grade-separation of the systems. The Act demonstrates the increased interest of the federal government and the Federal Railroad Administration in high speed rail. This interest and support is expected to grow in future years.

Implementation of Ohio's high speed rail will require creation of new organizations or major changes to existing ones. These changes will, in time, affect the project's relationships with other institutions. This chapter explores some of the changes which might occur, first in terms of how ownership and management might be structured, then in terms of relationships to various governmental and private institutions.

## 12.2 OWNERSHIP

The predominance of public funding required for this project suggests that ownership should be vested primarily in a public entity, and the intra-state focus of the project suggests an agency of the State of Ohio. Although a new agency could be created by the legislature, it would appear that the Ohio High Speed Rail Authority may be the most appropriate existing public body. Significant expansion of the Authority's staff would be required but, in general, appropriate powers are already available to the Authority to implement high speed passenger rail service. Another alternative may be the Ohio Department of Transportation, but a dedicated Rail Authority appears more likely to focus on the project's advancement.

The preliminary estimates in this report suggest that some elements of the project might be financed privately from project revenues. The most likely candidate for this is the rolling stock, although other major elements such as the traction power system, signals and communication systems, stations, and maintenance facility could be privately owned. In considering such options, care must be taken to protect the tax exempt status of as much of the project as possible. Tax exemption and other ownership issues for the rolling stock merit particular attention.

## 12.3 MANAGEMENT

Related to, but quite distinct from ownership, are the issues of management. For a project which involves a construction cost of three to four billion dollars (1991 dollars) over a period of ten years, a dedicated, experienced, skillful management team for project design and construction is essential. The projected construction cost does not include debt service on funds to finance the construction or the cost escalation

The Ohio Department of Development has expressed strong support for high speed rail in view of its clear advantages to the state's economic development. Funding for certain facilities, training and other programs may be available from the Department of Development.

The Ohio Department of Natural Resources, Ohio EPA and the State Historic Preservation Office all have regulatory functions as set forth in Chapter 6.

The State Treasurer may have a significant role in the management of funds for the project.

The Public Utility Commission of Ohio may have a regulatory role in the project as well as some jurisdiction over arrangements for delivery of electric power.

As with the federal government, the support of the legislature as well as departments in the Executive Branch of state government will be essential. It will be important to keep key members of the General Assembly and the Senate well informed about the project.

## 12.6 LOCAL GOVERNMENT AGENCIES

At the local level it is quite clear that all counties, cities and municipalities traversed or served by the project will have important inputs into its planning, design, construction and operation. Some of these inputs relate to mitigation of community impacts, others to such items as coordination of emergency services and maintenance of traffic. ORO has met with representatives of Cincinnati, Dayton, Springfield, Columbus, Mansfield, Brookpark and Cleveland and responded to numerous requests for information. Extensive additional contact with local governments is envisioned.

## 12.7 ORGANIZED LABOR

Organized labor during construction and operation will be another key element in the project. During construction, operating engineers and many of the construction trades will be called upon for project roles. During preparation of this plan ORO met with representatives of the Brotherhood of Locomotive Engineers, the United Transportation Union and the Brotherhood of Maintenance of Way Employees to explore collaboration for cost-effective operations and maintenance.

Preliminary discussions with organized labor indicate that they are strongly supportive of ORO and will assist, as possible, to make high speed rail in Ohio a reality.

## 12.8 PRIVATE INSTITUTIONS

Agencies of major private bodies related to the project will be Amtrak and the three private freight railroads impacted by Ohio's high speed rail system -- Conrail, CSX and Norfolk Southern. ORO has met with senior executives of all but Norfolk Southern and verified their interest in, and support for the project. One key interface will be acquisition of right-of-way and/or operating rights from each of the three freight railroads. These railroads and Amtrak also have, or are developing, track, rolling stock, signal, communication and other technology that may be of use to the project. Continuing relationships at management and technical levels will be vital to the project's success. Amtrak has also expressed a strong desire to be considered a candidate organization for operating the service.

In Ohio there are numerous industry and trade associations, Chambers of Commerce, and service organizations that will have roles and interests in the project. Each of these will need attention during all phases of project development and operation if the full resources of Ohio are to contribute to the project's success.

# CHAPTER 13
# IMPLEMENTATION PLAN

## 13.1 GENERAL

This chapter outlines major elements of the plan for project implementation in terms of the organizational structure required and in terms of four principal activities:

- Design
- Finance
- Construction
- Commissioning

A preliminary construction schedule is shown in Figure 13.1. The construction phase will follow the estimated three years or pre-construction activities discussed in Chapter 14. The phasing of major activities and estimated durations are shown. Annual expenditures expressed as a percentage of the total capital cost are shown on the schedule.

## 13.2 ORGANIZATION

### 13.2.1 Project Development

When ORO's implementation plan is accepted by the Ohio High Speed Rail Authority further project development will be initiated. This development will focus primarily on design, environmental, financial, legislative and right-of-way issues to be resolved before construction, always keeping in mind the ultimate goal of providing a quality rail transportation service for the 3-C Corridor. Thus even during project development the seeds of organizations for construction, commissioning and operations will be nurtured.

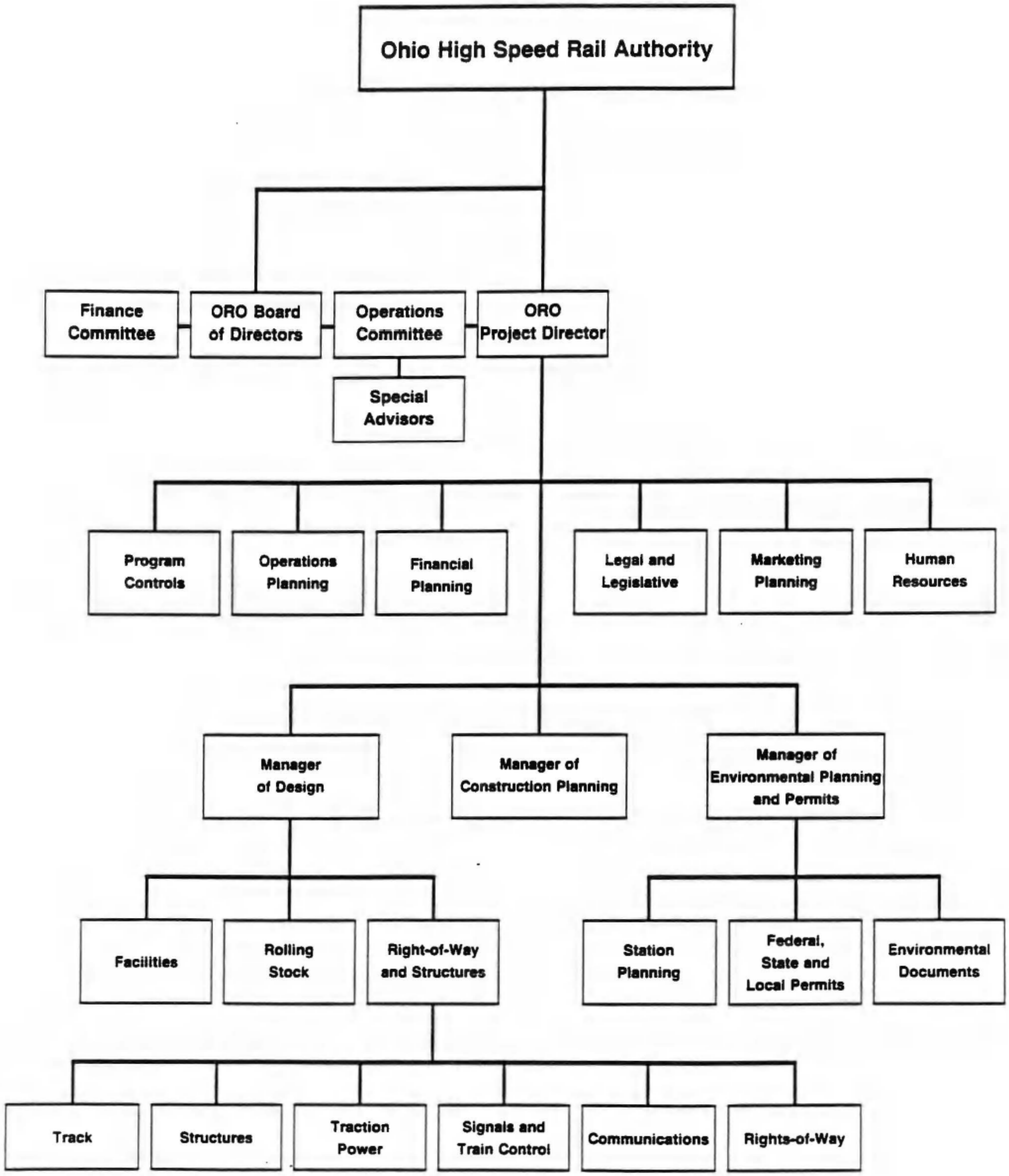
ORO has a key role to play in the development of a public/private project. Because ORO has been instrumental in the project's definition and evolution for several years, has key members ready to advance the project further, and can draw upon its shareholders for rapid deployment of needed resources, it can serve well as the vehicle for both publicly and privately funded project elements.

For publicly funded parts of the project, ORO can serve OHSRA as general program manager in charge of all activities necessary for development of the project. For the privately financed part of the project, ORO can establish the operating entity which must then arrange acquisition of rolling stock and other key operating sub-systems. The essential consideration is that the entire project advance as an integrated enterprise so that the service objectives are achieved in a timely way, within budget, at the levels of quality sought for the traveling public.

During design, finance, construction and commissioning the organization will focus primarily on project management. Figures 13.2 and 13.3 illustrate organizational structures that can manage the design and construction of a $3 billion project effectively and utilize both public and private resources. Essential ingredients include:

- Configuration management
- Project control -- scope, schedule, budgets
- Quality assurance

## Figure 13.2
## DESIGN ORGANIZATION



From the point of view of the overall project these are the key functions. Design, finance, construction and commissioning would be defined and controlled by the project management.

Key advisors during this stage of the project include representatives of riders, operators, maintainers of vehicles and track, marketers of the service and owners. The interests of these future "stakeholders" will be represented by various advisory panels and/or individuals to ensure that the project serves the needs of those who will use it for decades rather than the desires of the designers and builders.

During the project's operational life a different organization will be used as represented by Figure 7.1 in Chapter 7. ORO has defined this organization not only to form a basis of the O&M estimates, but also to indicate the type and range of skills which will be needed. Many of these skills will need to be developed during the design and construction phase in order to be in place when operations commence.

ORO's organization will be flexible and continually evolve during the project to meet changing needs. The evolution will be orderly and planned to minimize cost and disruption.

## 13.3 DESIGN

### 13.3.1 Mapping

The basis for any further planning, environmental and design development of Ohio's high speed rail system must be up-to-date mapping. Work to date has been based on United States Geological Survey (USGS) maps at a scale of 1:25,000 or about one inch = 2,000 feet. Although adequate for preliminary planning, these maps are not appropriate for future activities which may require scales of one inch = ten feet or 1:120 although 1:480 may suffice generally. A computer-based geographic information system (GIS) should be developed for the project's alignment as a basis for a series of overlays to represent such things as topography, geology, soils, surface hydrology, development, archeology and historic sites, property boundaries and various utilities.

These inventories can then be used in various combinations for planning, environmental and design activities.

### 13.3.2 Design Development

Based on an up-to-date GIS, design can advance for the track and structures as well as power, signals and communication. Criteria for each of these need to be defined further and then the design and specification advanced. Concurrently, the rolling stock must be specified, and industry comment sought on the practicability of alternative methods of procurement. In general, the rolling stock and other designs must advance at the same time with rigorous control of configuration, scope, schedule, budget and quality to ensure an integrated result. It should be remembered, however, that virtually all of the project's elements have already been designed and built somewhere so that the major challenges become communications within the team and between the team and the community. Design would typically be advanced to the 25 percent to 35 percent stage to provide the documentation necessary for evaluation of environmental impacts.

### 13.3.3 Environmental Documents

All federal, state and local environmental regulations will be observed by the project. The environmental documentation will be accomplished during the Phase 2 pre-construction activities. This will include

# 13.5 CONSTRUCTION

## 13.5.1 Construction Management

Construction management will include the management of specific procurement and construction packages from the time of award to successful completion of the work. This will include the activities of resident engineers, inspectors and associated staff.

To build up a construction management team, its formation will begin early in the design phase of the project to assist in constructability reviews and realistic scheduling for construction.

Matters of configuration management, project control and quality assurance will remain with the program management team.

It is anticipated that the long distance over which construction will occur will require six area managers working within roughly a 25-mile radius from an office as well as specialist managers for procurements such as power, signals, and communications. Rolling stock procurement will also require a specialized organization.

## 13.5.2 Structures

Structures will include approximately 149 grade separations from roads, 63 cut and cover boxes under roads, 124 medium to major bridges over streams and rivers, 1.1 miles of elevated wetland crossing, 17 railroad grade-separated crossings, 72 culverts at minor streams and other minor structures. The total cost of these structures is approximately $300 million.

Some minor at-grade crossings of roads will be eliminated by the construction of frontage roads for access to an overpass or underpass. However, there are eight road and two railroad at-grade crossings at the north end of the Columbus-to-Cleveland segment. In the Columbus-to-Cincinnati segment, there are 95 road and 14 railroad crossings at-grade. ORO will negotiate with the appropriate authorities to determine whether some of the road crossings, particularly those close together, can be closed. The use of federal highway funds to grade-separate the remaining crossings will be fully explored. The long-range goal of ORO is to grade-separate the entire high speed rail right-of-way.

Because these are discrete project elements, they lend themselves to rapid design by a number of design firms working simultaneously. Structures are expected to be designed and built as soon as right-of-way can be made available so that continuous access along the railroad can be provided. This should minimize disruption to adjacent communities during the remainder of construction and establish early and forcefully Ohio's commitment to high speed rail.

## 13.5.3 Earthwork

The project's major earthworks will be related to some structures, and its completion will be coordinated with the completion of the structures. ORO's objective is to design the earthwork to be unobtrusive and to arrange for the movement of borrow and fill along the property rather than adjacent public roads and highways. Some 59,000,000 cubic yards of earth and rock are expected to be moved at a cost of roughly $270 million.

FRA regulations as well as AAR, AREA and other North American standards. The initial specifications will be made available to interested vendors for comment.

After consideration of all comments and appropriate amendment, the specification will be incorporated in bid documents and offered for bids in two steps. First, interested suppliers would submit technical qualifications/proposals. Those firms whose proposals can be brought into compliance with the specifications will then be invited to bid. Negotiations would then commence with the lowest bidder to arrive at a contract. If these negotiations fail, the second lowest bidder would be invited to negotiate.

ORO anticipates that federal funding may be involved in the project and therefore "Buy America" provisions may apply. In addition, preference may be granted for Ohio content in the rolling stock. Arrangement of financing for the rolling stock by the vendor is also a consideration.

In addition to the lengthy procurement process for rolling stock, the rolling stock specification is essential to define a number of track, power, station and signal issues early in the design phase and reduce uncertainty in these interfaces.

Full accessibility to the coaches and appropriate seating arrangements under the Americans with Disabilities Act (ADA) will be required.

## 13.6 COMMISSIONING

### 13.6.1 Train Operations and Maintenance

About two years before revenue operations begin, ORO plans to establish the operations and maintenance organization described earlier. This will allow for a careful selection, training and build-up of key operating personnel. Training will include participation in acceptance testing for various project elements. Also required of these key personnel will be final development of operating and maintenance plans and procedures. A series of operations drills, peer reviews, safety reviews and other exercises will also be conducted. These may include brief assignments for ORO employees to Amtrak, TGV, ICE or other high speed rail operators to observe and participate in routine and emergency operations.

### 13.6.2 Pre-Revenue Testing

The final six months of the construction phase are reserved for pre-revenue testing of each element of the project and for integrated testing of the entire operation. This will include certifications for safety and operations as well as a few days of "open house" to exercise customer relations skills and familiarize the public with the stations, trains and service. Testing and certification will be in accordance with written, carefully designed procedures and will use appropriate industry standards.

Should all go well with the testing phase, revenue service could commence ahead of schedule. However, ORO is committed to having all reasonable assurances of a safe and reliable system before revenue service begins.

### 13.6.3 Revenue Service

The final step of commissioning will be commencement of revenue service. At this stage, the program management functions of ORO and the organizations for design and construction become essentially part

# CHAPTER 14
# IMMEDIATE ACTION PLAN

## 14.1 INTRODUCTION

This chapter discusses the next steps required for further development of Ohio's high speed rail project. These immediate actions fall into two groups. First, there are governmental actions to be taken at the state and federal levels. Second, there are technical and private development actions that can be advanced by ORO.

## 14.2 GOVERNMENTAL ACTIONS

Continued development of high speed rail in Ohio will require fullfillment of the State's commitment since 1975 to implementation of this quality transportation service. Although it may be premature to commit to the project's construction, the time has come for Ohio to agree in principle to go forward with high speed rail subject to further advancement of the design. Such agreement must include willingness to invest substantial public funds in the activities necessary for project development up to the point of a decision whether to proceed with construction. ORO estimates that three years and forty to sixty million dollars may be needed to complete the design, environmental, financial and other investigations which must necessarily precede construction. Not all of the cost must necessarily be borne by the state, but a substantial share can be expected to be derived from public sources as discussed in Section 10.2.

The other key governmental participant in realization of high speed rail in Ohio is the federal government. In 1990 and 1991 the U.S. Congress in both houses has indicated strong support for establishment of high speed rail in the United States This support has, in turn, provided to the Federal Railroad Administration funds and encouragement that were not in evidence during Ohio's earlier efforts to implement high speed rail service. The current highly supportive thrust of federal participation in high speed rail offers Ohio a great opportunity to seek and define federal partnership for the development and perhaps for the construction of the project. ORO has suggested federal participation in the form of grants, loans, loan guarantees and tax exemptions as options for consideration.

In essence, the majority of the resources for high speed rail in Ohio must come from the state and federal governments. Only with their commitment can the project be implemented and high speed rail become a vital part of Ohio's 21st century transportation system.

## 14.3 TECHNICAL AND PRIVATE SECTOR ACTIONS

### 14.3.1 General Approach

In ORO's approach to the major project activities of design, construction, operations, marketing, management and financing, all must occur simultaneously. For example, at the commencement of design, advice from seasoned specialists in operations and marketing is required to be sure that appropriate designs are prepared. Although the level of activity will vary in each major element over the life of the project, the integration of all of them is essential to the high speed rail system's success.

- Outline specifications of all system elements, civil engineering requirements, structures, and rights-of-way will be prepared.

- Construction schedules for all aspects of the work will be prepared.

**Preliminary Design - System Components, Support Facilities and Stations**
Concurrent with the finalization of the alignment and design of the track, design must proceed on a number of other system components and support facilities. The design effort for all systems and facilities must interface closely with the alignment and be coordinated with the train vehicle system. These system components and support facilities which are an integral part of the design include:

- Train control
- Electrification
- Communications
- Maintenance and repair facilities
- Storage yards
- Maintenance of way facilities

For stations, coordination is needed with the communities served, and should include community leaders, public interest groups, transit agencies, developers, and utilities. Preliminary designs of the stations will be prepared and coordinated with all interested parties.

The scale, layout, size and style of the stations will be determined. In addition to the functional layout and architectural treatment, preliminary designs will include the structural, mechanical and electrical requirements of the stations. Parking, access roadways and utilities will also be considered.

When preliminary station sites have been identified, all station locations need to be reviewed. In general, the suburban station sites have more flexibility regarding location. The potential for long-term development in the vicinity of the stations will be identified.

**Environmental Documents**
Environmental report documents to meet federal and state requirements already identified will be prepared. These reports will include a data base that will characterize those components of the natural environment likely to be impacted by the construction and operation of the high speed passenger rail system. Impact areas include those in the immediate vicinity of the rights-of-way and station areas as well as those affected by secondary developmental activities, i.e., new development induced by the system. The assessment will also identify and evaluate areas of particular sensitivity. Component areas will include:

- Ecological resources
- Cultural resources
- Groundwater resources
- Hazardous wastes
- Disposal sites
- Noise-sensitive areas
- Air quality resource inventory

The economic impact of a program of this magnitude will be significant -- affecting virtually all Ohioans. Accordingly, it will be essential to conduct further, more detailed analysis of the economic costs and benefits of the high speed rail system. The economic evaluation will address the following areas:

- Project life-cycle costs
- User costs
- Direct benefits to industry

much as possible. For each package, in addition to its scope, a budget and schedule will be prepared. These scopes, budgets, and schedules will then be incorporated into the project's Financial Plan.

Throughout Phase 2 of the project the work will be reviewed to ensure its constructibility and quality. ORO plans to convene review panels of three to five specialists for in-depth reviews of each preliminary design package. Specialists will be drawn from operating high speed rail organizations, other railroads, consultants, government agencies, and universities. These review sessions will be open to OHSRA members and staff.

### 14.3.7 Financing

Further development of financing plans will be accomplished concurrently with design, environmental and marketing work. This will require close coordination with state and federal entities to refine the mix of public and private resources to be applied to the project. The scheduling of work will also allow more refined estimates of cash flows and judgements about the needs for new revenue sources.

## 14.4 PRELIMINARY DESIGN SCHEDULE

Two to three years will be required for preliminary design and environmental permit activities. Figure 14.1 illustrates the duration and interrelationship of major elements of the work. The critical path is expected to be mapping, design, right-of-way definition, environmental impact statements, and granting of permits. The alternative critical path may be specification, development and testing of the vehicles.

## 14.5 STAFFING

For the preliminary design, ORO will establish a project office in Columbus. An average staff size of about 100 people will be required for the work. Consultants will be engaged throughout Ohio to assist with the work and its timely completion.

# APPENDIX A

# ENVIRONMENTAL REGULATORY REQUIREMENTS

# APPENDIX A
# ENVIRONMENTAL REGULATORY REQUIREMENTS

The federal and State of Ohio regulatory requirements that will apply to the high speed rail project are discussed in this section. The listed environmental requirements will be reviewed and any new requirements considered for appropriateness at the time of project initiation.

## A.1 FEDERAL REQUIREMENTS

### A.1.1 National Environmental Policy Act (NEPA)

Under NEPA (42 U.S.C. Section 4332) environmental review is triggered when any "major federal action" will significantly affect the human environment. A "major federal action" includes procedures that require federal permitting, for example: crossing of navigable waters, highway crossings, wetland disruption or when any federal funding is involved in a program or project. NEPA requires that an environmental impact statement (EIS) be prepared and reviewed. Environmental impacts cover a broad range of topics including, historical, cultural, economic, social and ecological review. The proposed railway's application for federal funding would trigger the need for environmental review of the study corridor under this act. Following are several acts which cover NEPA-related concerns.

**National Historic Preservation Act of 1966**
The National Historic Preservation Act of 1966 (16 U.S.C. Section 470) calls upon the Advisory Council on Historic Preservation to advise the President and Congress on matters involving historic preservation. The Council reviews and comments upon activities licensed by the federal government that will have an effect upon properties listed in the National Register of Historic Places, or eligible for such listing. The Archaeological and Historical Preservation Act of 1974 (16 U.S.C. Section 469 et seq.), further defines action to be taken by granting power to the Secretary of the Interior to recover and preserve significant historical or archaeological data threatened by a federal construction project or federally licensed project, activity, or program prior to the commencement of the project.

**The Endangered Species Act**
The Endangered Species Act (16 U.S.C. Section 1531 et seq.) defines the intention of the Congress to conserve threatened and endangered species and the ecosystems on which those species depend. It requires that federal agencies, in conjunction with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, carry out programs for the conservation of endangered or threatened species. Federal agencies must take all actions necessary to insure that projects that are authorized, funded, or carried out by a federal agency are not likely to jeopardize the continued existence of threatened or endangered species, or result in the destruction or adverse modification of critical habitat of such species (50 CFR Parts 17 and 402.)

**The Wild and Scenic Rivers Act**
The Wild and Scenic Rivers Act (16 U.S.C. Section 1271 et seq.) designates certain rivers for preservation. The Act provides that no federal department or agency shall assist by loan, grant, license, or otherwise in the construction of any water resources project that would have a direct adverse effect on the values for which such a river was designated, 16 U.S.C. Section 1278.

3) A discharge that does not exceed ten cubic yards of fill into waters other than wetlands (Section 330(a)(18))

4) A discharge of concrete in tightly formed structural members (Section 330.5(a)(25))

5) A discharge into isolated waters where less than one acre is affected (where one to ten acres are affected, notification is required, and the Corps has discretion whether to require an individual permit) (Section 330.5(a)(26), 330.7).

Any activities undertaken during railway construction which fall into these categories are permitted generally under Section 404. Any other construction, grading or filling in, or around, wetlands, rivers and other water bodies may require an individual Section 404 permit from the Corps of Engineers.

## A.1.3 Rivers & Harbors Act of 1899, Section 1D

The U.S. Army Corps of Engineers also regulates structures or work in, or affecting, navigable waters, 33 U.S.C. Section 403; 33 C.F.R. Part 322. The term "navigable waters" is limited to coastal waters and waters used, susceptible to use, or used in the past to transport interstate or foreign commerce, 33 C.F.R. Section 322.2(a). The high speed rail crosses three navigable rivers: the Cuyahoga, the Scioto, and the Great Miami. Construction of a new bridge over a navigable waterway requires a Section 10 permit. Section 10 general permits are similar to Section 404 general permits except that number (4) above, covering structural concrete forms, is not applicable under Section 10, 33 C.F.R. Section 330.5(a)(3), (14), (18), (25) & (26).

The Rivers and Harbors Act of 1899 also delegates authority to the U.S. Coast Guard to regulate construction of bridges over navigable waters under Section 9 of the Act. The Coast Guard exercises its jurisdiction through a permit system. The definition of navigable waterway under Section 9 is generally interpreted much more narrowly by the Coast Guard than by the Corps of Engineers' definition under Section 20. Based on actual use for commercial navigation purposes, the Coast Guard may waive its jurisdiction under Section 9 over all or part of a navigable waterway.

Consequently, because the high speed rail alignment requires bridging over one or more waterways, the project will be coordinated with the appropriate district office of the Coast Guard to determine if jurisdiction has been waived over each affected waterway. If Section 9 is determined to be applicable, the permit application will have to be accompanied by an environmental evaluation discussing alternatives to the proposed project as well as project effects on potential Section 4(f) sites, wetlands, floodplains, threatened or endangered species, wild/scenic/recreational rivers, prime and unique farmland soils, air quality, ambient noise levels, and displacements of residences or businesses. There will also be a need for a water quality (Section 401) certification from the Ohio EPA.

## A.1.4 Noise Control Act of 1972

Section 17(a) of the Noise Control Act of 1972 (42 U.S.C. Section 4916(a)), establishes decibel- specific noise standards for locomotives and rail cars operated by "carriers." "Carrier" is defined as follows: A common carrier by railroad, or partly by railroad and partly by water, within the continental United States, subject to the Interstate Commerce Act, as amended, excluding street, suburban, and inter-urban electric railways unless operated as a part of a general railroad system of transportation. 40 C.F.R. Section 201.1(c), 49 C.F.R. Section 210.3(b)(2). Depending on the technical system chosen, an argument for exclusion from these noise standards might exist under the above definition.

Should the standards apply, they will require specific maximum noise levels for locomotive operations, rail car operations, car coupling operations, and load cell test stands. These maxima are summarized in table any pollutant into waters of the state without a National Pollutant Discharge Elimination System (NPDES) permit, 33 U.S.C. Section 1342; O.A.C. Section 3745- 33-02. An NPDES permit issued by Ohio EPA requires, generally, the installation and operation of treatment works, monitoring and testing to ensure compliance with authorized discharge levels, and submission of regular reports to Ohio EPA. O.A.C. Section 3745-33-03 to -05.

NPDES permit regulations cover only discharges from "point sources" which are defined as "any discernible, confined and discrete conveyances," and include "any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, rolling stock...." O.A.C. Section 3745-33-01(O). Regulated pollutants include those from sewage, industrial waste, and "other waste." O.A.C. Section 3745-33-01(T). NPDES permits would probably pertain to the proposed high speed rail system in terms of discharges of sewage waste from train station terminals or coaches, or liquid wastes generated in cleaning and maintenance of trains if they are discharged directly to state waters.

Should waste disposal be discharged to a existing Publicly Owned Treatment Works (POTW) then OEPA regulations would require an indirect discharger permit instead of the NPDES permit, O.A.C. Section 3745-36-03. POTW's having approved pretreatment programs will issue their own indirect discharger permit instead of the OEPA, O.A.C. 3745-3.

Additionally, O.A.C. Section 3745-31-02(A) requires a permit to install a new disposal system whether the discharge will be directly to state waters or through a POTW. The applicant must install best available technology (BAT) and meet other criteria of O.A.C. Section 3745-31-05 to be issued the permit to install.

## A.2.3 Hazardous Waste Generator Requirements

Section 3010 of the Resource Conservation and Recovery Act (RCRA) requires generators of hazardous waste to notify U.S. EPA of such activity and to obtain an identification number. 42 U.S.C. Section 6930, 40 C.F.R. Section 262.12. Ohio EPA has been delegated authority to implement the federal RCRA Program in Ohio, O.A.C. Chapter 3745-52.

Waste is considered hazardous if it meets any of the following criteria:

a. if the material exhibits any characteristics of hazardous waste such as ignitability, corrosivity, reactivity or EP toxicity, (soon to be replaced by TCLP analytical method for detection of metals, organics and pesticides) O.A.C. Section 3745-51- 21 thru 24;

b. if the material is listed in 40 C.F.R. Section 261.31-33 as hazardous;

c. if the material is listed in the Ohio Administrative Code as hazardous;

d. if the material is a mixture of waste and hazardous waste listed in (b) and (c) unless the resultant mixture no longer exhibits hazardous waste characteristics or is subject to regulation under Section 402 or Section 307(b) of the Clean Water Act.

It is important to note that O.A.C. Section 3745-51-03(E) places the burden of proving that the waste is not hazardous on the organization or person making the claim.

If any waste resulting from the operation of the proposed rail system is determined to be hazardous, the railroad must comply with O.A.C. Section 3745-52-12. If the railroad generates less than 1000 kg. of a hazardous waste not listed as "acutely hazardous" in a month, the railroad is a "small quantity generator" of that waste for that month. O.A.C. Section 3745-51- 05. As such, the railroad is exempt from the generator rules so long as it observes the conditions of the exemption contained in O.A.C. Section 37435-51-05(a).

## A.2.7 Natural Areas and Preserves

Chapter 1517.05-07 of the Ohio Revised Code describes three basic components governing the protection of natural areas and preserves in Ohio:

1) a description of a nature preserve and its purpose
2) the requirement for notification of land for preservation
3) the requirement for public hearings for challenges to preservation as a best use of property already designated as such.

Under these requirements only "imperative and unavoidable" circumstances will allow a designated nature preserve to be given an alternate use. State nature preserves potentially affected by the Ohio Speed Rail are shown in Chapter 6, Table 6.4.

## A.2.8 Soil and Water Conservation

Any projects requiring new or relocated structures that will disturb or change the surface or subsurface of the land must submit a plan to the ODNR Division of Real Estate and Management, and the Soil & Water Conservation Division for review. O.R.C. Section 1511.02. This review will include analysis of project impacts on erosion and drainage.

## A.2.9 Historic Preservation

The State of Ohio addresses the National Historic Preservation Act of 1966 by conducting a thorough review of potential impacts on historical and archaeological sites for a planned project under 36 CFR Part 800 (Section 106 Review). All projects potentially impacting historical or archaeological sites, such as the proposed High Speed Rail, must coordinate the project with the State Historic Preservation Office (in Ohio, this is the Ohio Historical Society).

# APPENDIX B
# OPERATIONS AND MAINTENANCE STAFF REQUIREMENTS AND RESPONSIBILITIES

# APPENDIX B
# OPERATIONS AND MAINTENANCE STAFF REQUIREMENTS AND RESPONSIBILITIES

The operations and maintenance staff positions and the responsibilities are discussed in this appendix. The operations and maintenance organization chart is in Chapter 7, Figure 7.1.

## B.1 PRESIDENT

The President directs all aspects of system operations and administration. One secretary is assigned to the President's office. Legal support, as required, will be provided under contract services. If supported by requirements, a legal staff will be added to the Office of the President.

## B.2 VICE PRESIDENT FOR ADMINISTRATION

The Vice President for Administration supervises personnel operations, procurement, finance, sales and marketing, and station operations. One secretary is assigned to this office.

Administration including the President's office has 189 personnel assigned. Twenty-four of these personnel perform administrative duties, and the balance works in the field as revenue collectors, station masters, ticket agents, guards and caterers.

### B.2.1 Director for Personnel

The Director for Personnel is responsible for supervising benefits and staff hiring. He is assisted by two personnel analysts and a secretary.

### B.2.2 Director for Procurement

The Director for Procurement is responsible for contracting services such as elevator and escalator maintenance, specialized personnel training, safety training and inspections; he also manages contracts for station cleaning services, automotive vehicle maintenance, the purchase of consumables, and material for the operations and maintenance organizations. The director has a staff of four procurement specialists and one secretary.

### B.2.3 Director for Finance

The Director for Finance is responsible for the payroll and for revenue collection; he disburses funds for contract services and material purchases and audits financial operations. His staff consists of three financial specialists, eight revenue collectors and a secretary.

## B.4.1 Director for Road Crews

The Director for Road Crews assigns and supervises the operators and conductors on revenue service trains, the switch engineers and yardmen. One secretary is assigned to the director.

- One operator is assigned to each train with a 0.72 driving/duty ratio (5.73 hours driving per 8-hour shift). Each operator makes two train runs per day. Train runs start and end at the operators' home stations, which eliminates providing overnight accommodations and premium pay. Six trainsets will operate from 0600 hours to 0130 hours. Twenty-five operators are required for 365-day operations.
- One conductor is assigned to each train. They work the same runs as the operators. Twenty-five conductors are required for 365-day operations.
- Two switch engineers are assigned at the yard on the first and second shifts. One switch engineer is on the third shift. Eight switch engineers are required for 365-day operations.
- Two yardmen are assigned on the first and second shifts. One yardman is on the third shift. Eight yardmen are required for 365-day operations.

## B.4.2 Director for Central Traffic Control

The Director for Central Traffic Control (CTC) supervises the CTC managers, traffic dispatchers, power supply managers, and their assistants. He is assigned one secretary.

- One CTC manager, traffic dispatcher, and power supply manager is assigned on each eight hour shift (three shifts) with the CTC operational 24 hours a day. Five personnel are required for each position for 365 day operations.
- One assistant works with the traffic dispatcher and one with the power supply manager on the first two shifts (primary periods of revenue service). One assistant is assigned to support both positions on the third shift. Eight assistants are required for 365 day operations.

## B.4.3 Director for Labor Relations

The Director for Labor Relations works with all elements of the organization; he is assisted by a labor relations specialist and a secretary.

## B.4.4 Director for Training and Safety

The Director for Training and Safety directs the development and conduct of safety training and inspections. The staff consists of four training/safety specialists, five roadmasters and a secretary.

The roadmasters supervise field operations to ensure safe that practices are followed by the operators, conductors, maintenance personnel and the station staffs.

# APPENDIX C
# MAINTENANCE MATERIAL
# AND OTHER COSTS COMPUTATIONS

# APPENDIX C
# MAINTENANCE MATERIAL AND OTHER COSTS COMPUTATIONS

This appendix presents the computations for maintenance material and other costs associated the operations and maintenance of a high speed railroad.

The annual material costs for rolling stock are based on the train miles operated for depot maintenance and the capital cost of the rolling stock for the repair shop. Coach rebuilding is calculated as a percentage of the initial capital cost of the rolling stock. The structures and systems maintenance costs are calculated as a percentage of their initial capital cost. The maintenance costs are based on a program developed by TGV for operation of a high speed rail system in the United States (Operating and Maintenance Costs of the TGV High-Speed Rail System, Journal of Transportation Engineering, Volume 115, No. 1, January 1989).

Other costs are based on the experience of operating passenger railroads with the costs adjusted for a high speed rail system in Ohio.

## C.1 MAINTENANCE OF EQUIPMENT (M.O.E.)

### C.1.1 Depot Maintenance

Material costs are based on a factor of 0.0069% of the capital cost of the rolling stock per each 1,000 miles of train operations plus 6% of the total for warehouse and supply charges. The annual cost is ([0.000069 x $74,741,400] x [3,036,800/1000] / 8) x 1.06 = $2,075,116 or $2,075,000 annually.

### C.1.2 Repair Shop

Annual material costs are based on 1% of capital cost of the rolling stock including maintenance-of-way equipment. The cost is (0.01 x $74,741,400) = $747,414 or $747,000 annually

### C.1.3 Coach Rebuilding/Refurbishing

The coaches will be rebuilt/refurbished every three years at a cost estimated at 25% of the original cost. The funds set aside annually to rebuild the 24 coaches are ([$1,400,000 x .25} x 24 / 3 ) = $2,800,000. Maintenance of the power units is performed as required and incorporated in the depot and repair shop funding.

## C.2 MAINTENANCE-OF-WAY (M.O.W)

The cost to maintain the system is based on the initial capital cost, projected service life, and the percentage of each system component to be renewed during its service life. An overhead rate is applied to the annual maintenance cost for each component of the infrastructure.

## C.2.7 Drainage/Roads/Fences

The material cost for drainage, roads and fences renewed during their projected service life of 30 years $106,000,000 x .15 x 1.20 = $19,080,000. The average annual material cost for drainage/roads/fences and miscellaneous items is $19,080,000 / 30 years = $636,000.

# C.3 OTHER COSTS

## C.3.1 Contract Services

Services will be contracted for the maintenance of elevators, escalators, and automobiles. Other services such as legal representation and track geometry inspections which do not justify the hiring of permanent staff will also be contracted. An allowance of $2,000,000 is provided for these contracts.

## C.3.2 Energy

The energy cost calculation assumes the use of 20 kWh trainset miles at an average cost of $0.06 per kWh. An additional 1.5% is added for shunting of train-sets during non-revenue service hours. An annual allowance of $400,000 for house power for the stations and yard and shops is provided. The estimated annual energy cost is (3,036,800 x 20 x 0.06) x 1.015 + 400,000 = $4,098,822 or $4,100,000.

## C.3.3 Station Cleaning

Station cleaning will be performed under contract with janitorial service companies. The estimated cost for this service is $50,000 per year for each of the large stations (Cleveland, Columbus and Cincinnati). An annual cost of $35,000 is estimated for each of the other six stations. The total annual cost for janitorial service is $360,000.

The cost of operating, cleaning and maintaining parking lots at the stations is assumed to be offset by revenue from the lots.

## C.3.4 Station Consumables

An annual allowance of $250,000 is estimated for consumable supplies at the stations.

## C.3.5 Commissions to Travel Agents

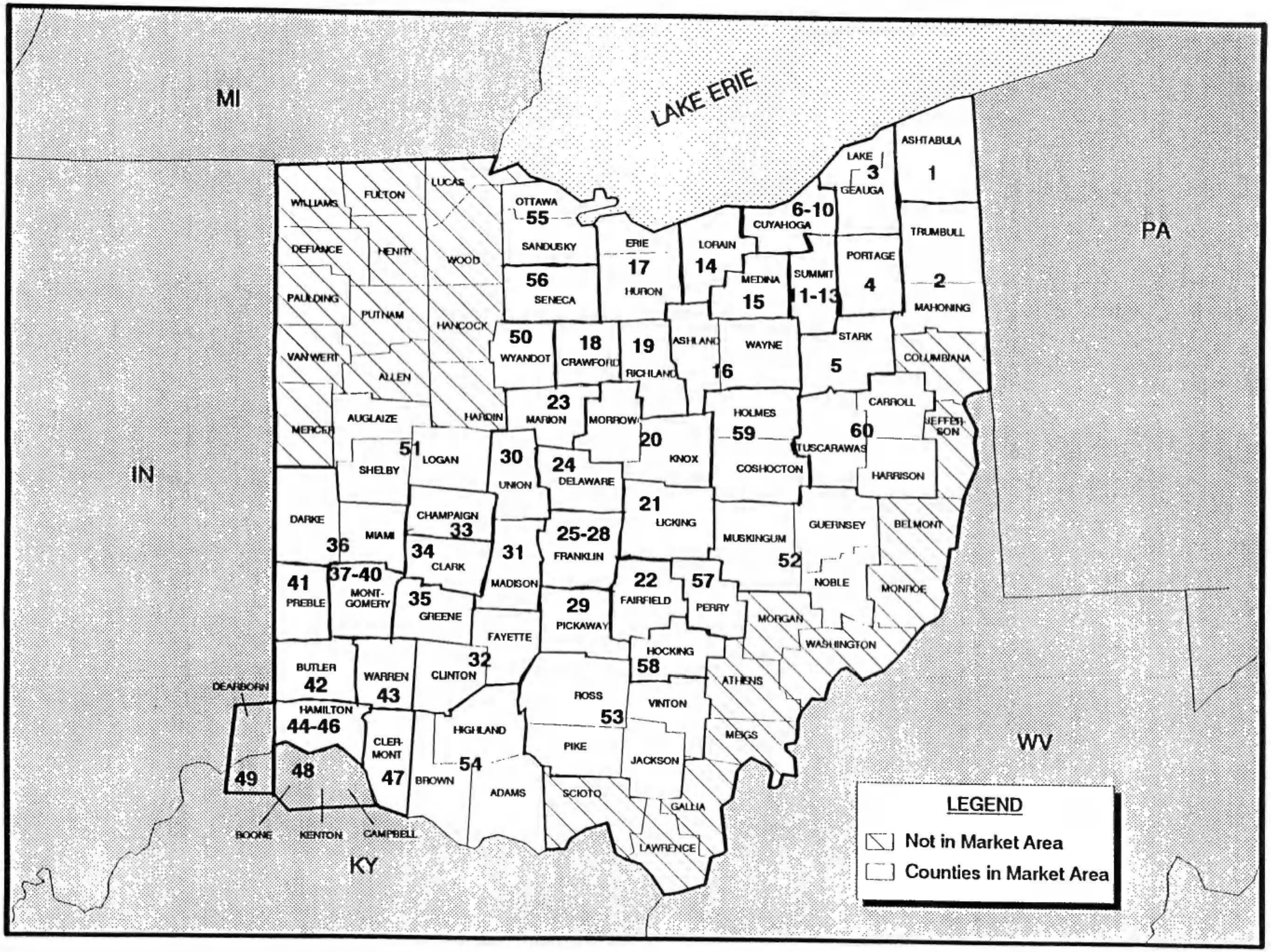
Travel agents will receive a 10% commission on the cost of tickets sold. The annual commissions paid travel agents are estimated as $2,000,000.

## C.3.6 Train Cleaning Supplies

Consumable cleaning supplies are estimated to cost $100,000 per year.

# APPENDIX D
# OHIO SOCIO-ECONOMIC DATA

**Sources:** **(1)** **Ohio Data User's Center, Department of Development**
**(2)** **1990 Edition of "Key Indicators of County Growth 1970-2010" from NPA Data Services, Inc.**




**OHIO NEW ZONE SYSTEM**

**Figure D.1**

# OHIO SOCIO-ECONOMIC DATA 1988 to 2010

| ZONE | 1988 HH | 1988PCI | 2010 HH | 2010PCI |
|---|---|---|---|---|
| 1 | 36315 | 10315 | 37770 | 17580 |
| 2 | 187050 | 11615 | 190754 | 18118 |
| 3 | 105938 | 14267 | 135022 | 24181 |
| 4 | 48998 | 11670 | 59395 | 20397 |
| 5 | 140026 | 12074 | 165994 | 19575 |
| 6 | 302459 | 14883 | 296906 | 21376 |
| 7 | 3032 | 14883 | 2977 | 21376 |
| 8 | 76322 | 14883 | 74920 | 21376 |
| 9 | 19119 | 14883 | 18768 | 21376 |
| 10 | 162437 | 14883 | 159455 | 21376 |
| 11 | 118779 | 13393 | 120582 | 20521 |
| 12 | 7558 | 13393 | 7673 | 20521 |
| 13 | 71855 | 13393 | 72946 | 20521 |
| 14 | 96551 | 11638 | 109301 | 18655 |
| 15 | 40812 | 13556 | 56102 | 24520 |
| 16 | 52719 | 11699 | 59741 | 20332 |
| 17 | 49798 | 12246 | 56865 | 20482 |
| 18 | 18729 | 10484 | 20276 | 18364 |
| 19 | 47419 | 12048 | 45969 | 19704 |
| 20 | 26689 | 10505 | 32389 | 19177 |
| 21 | 46836 | 12031 | 56750 | 19688 |
| 22 | 35698 | 12182 | 44614 | 21310 |
| 23 | 24045 | 10203 | 25041 | 16809 |
| 24 | 22079 | 13554 | 33418 | 23749 |
| 25 | 143941 | 13766 | 180875 | 21431 |
| 26 | 9012 | 13766 | 11324 | 21431 |
| 27 | 71088 | 13766 | 89328 | 21431 |
| 28 | 144832 | 13766 | 181994 | 21431 |
| 29 | 15254 | 10440 | 18034 | 17736 |
| 30 | 11472 | 12125 | 16459 | 19553 |
| 31 | 12632 | 10802 | 16021 | 19626 |
| 32 | 23550 | 10987 | 28258 | 19687 |
| 33 | 12836 | 10714 | 14978 | 19460 |
| 34 | 55831 | 11940 | 59901 | 18997 |
| 35 | 46816 | 12826 | 52429 | 20085 |
| 36 | 54419 | 12242 | 61915 | 21530 |
| 37 | 33241 | 13400 | 36424 | 20145 |
| 38 | 529 | 13400 | 579 | 20145 |
| 39 | 101427 | 13400 | 111141 | 20145 |
| 40 | 86996 | 13400 | 95327 | 20145 |
| 41 | 14263 | 11254 | 17907 | 21939 |
| 42 | 100661 | 12683 | 118934 | 20131 |
| 43 | 36970 | 12150 | 46426 | 22477 |
| 44 | 108045 | 14452 | 116799 | 20913 |
| 45 | 2181 | 14452 | 2358 | 20913 |
| 46 | 228431 | 14452 | 246939 | 20913 |
| 47 | 50467 | 11721 | 76278 | 20680 |
| 48 | 101024 | 11845 | 134762 | 20572 |
| 49 | 14046 | 11575 | 21220 | 19308 |
| 50 | 8167 | 11992 | 9237 | 22004 |
| 51 | 47148 | 11499 | 59652 | 20098 |
| 52 | 50102 | 10338 | 55812 | 17917 |
| 53 | 48396 | 9381 | 59314 | 15831 |
| 54 | 34593 | 9097 | 45832 | 18219 |
| 55 | 37708 | 13176 | 42354 | 22363 |
| 56 | 21444 | 10843 | 21522 | 17968 |
| 57 | 11455 | 8893 | 15391 | 16541 |
| 58 | 9679 | 9382 | 12318 | 17070 |
| 59 | 23529 | 9330 | 29922 | 17449 |
| 60 | 47709 | 10499 | 54538 | 18598 |

HH = Households
PCI = Per Capita Income

# APPENDIX E
# STATION TO STATION ANNUAL RIDERSHIP AND REVENUE

**Notes for Tables E-1 Through E-6:**

- Districts include more than the cities they are named for. The definition of each district is shown on Figure 8.2, page 8-9. For example, the Cleveland district includes the counties of Lorain, Medina, Cuyahoga, Geauga and Lake.
- Tables E-1 through E-6 show the "true" origin district and destination district of the travelers. This origin or destination may be different from the rail station actually used. For example, a traveler departing from Madison county and going to Hamilton county would be shown in the Columbus-Cincinnati district pair but would probably use Springfield station and Cincinnati downtown station.

**Note for Tables E-7 and E-8:**

- These two tables show the actual rail station pairs used by travelers as opposed to their "true" origin and destination.

# Table E-1
# OHIO HIGH SPEED RAIL
# SUMMARY TRIP TABLE
# ANNUAL BUSINESS TRIPS - YEAR 1991

| DISTRICT PAIR | | AUTO TRIPS | AUTO SHARE | AIR TRIPS | AIR SHARE | RAIL TRIPS | RAIL SHARE | TOTAL TRIPS |
|---|---|---|---|---|---|---|---|---|
| Cleveland | -Mansfield | 351442 | .89 | 0 | .00 | 44629 | .11 | 396071 |
| Cleveland | -Columbus | 816387 | .80 | 21925 | .02 | 188077 | .18 | 126389 |
| Cleveland | -Springfield | 103825 | .69 | 13700 | .09 | 32538 | .22 | 150063 |
| Cleveland | -Dayton | 13669 | .77 | 956 | .05 | 3234 | .18 | 17859 |
| Cleveland | -Cincinnati | 169344 | .59 | 75094 | .26 | 43075 | .15 | 287513 |
| Cleveland | -Other Ohio | 586857 | .94 | 2454 | .00 | 36275 | .06 | 625586 |
| Akron/Canton | -Columbus | 505256 | .91 | 5598 | .01 | 42875 | .08 | 553729 |
| Akron/Canton | -Springfield | 1321 | .85 | 129 | .08 | 109 | .07 | 1559 |
| Akron/Canton | -Dayton | 35226 | .70 | 6548 | .13 | 8363 | .17 | 50137 |
| Akron/Canton | -Cincinnati | 68412 | .66 | 18691 | .18 | 16417 | .16 | 103520 |
| Akron/Canton | -Other Ohio | 48525 | .96 | 991 | .02 | 825 | .02 | 50341 |
| Mansfield | -Columbus | 555035 | .83 | 0 | .00 | 111728 | .17 | 666763 |
| Mansfield | -Springfield | 6233 | .82 | 0 | .00 | 1396 | .18 | 7629 |
| Mansfield | -Dayton | 8061 | .82 | 0 | .00 | 1787 | .18 | 9848 |
| Mansfield | -Cincinnati | 24180 | .77 | 142 | .00 | 7285 | .23 | 31607 |
| Mansfield | -Other Ohio | 35727 | .96 | 6 | .00 | 1296 | .03 | 37029 |
| Columbus | -Springfield | 901048 | .90 | 0 | .00 | 100252 | .10 | 1001300 |
| Columbus | -Dayton | 1889297 | .92 | 184 | .00 | 160720 | .08 | 2050201 |
| Columbus | -Cincinnati | 1423811 | .85 | 7082 | .00 | 245040 | .15 | 1675933 |
| Columbus | -Other Ohio | 17986467 | .96 | 8255 | .00 | 67621 | .04 | 1872343 |
| Springfield | -Cincinnati | 304768 | .85 | 0 | .00 | 53377 | .15 | 358145 |
| Springfield | -Other Ohio | 33903 | .76 | 487 | .01 | 10225 | .23 | 44615 |
| Dayton | -Cincinnati | 4069058 | .98 | 0 | .00 | 62933 | .02 | 4131991 |
| Dayton | -Other Ohio | 88823 | .80 | 6454 | .06 | 16381 | .15 | 111658 |
| Cincinnati | -Other Ohio | 227627 | .86 | 14713 | .06 | 21313 | .08 | 263653 |
| Other Ohio | -Other Ohio | 13031 | .94 | 229 | .02 | 651 | .05 | 13911 |
| **TOTAL** | | **14077333** | **.91** | **183638** | **.01** | **1278422** | **.08** | **15539393** |

# Table E-3
# OHIO HIGH SPEED RAIL
# SUMMARY TRIP TABLE
# TOTAL TRIPS - YEAR 1991

| DISTRICT PAIR | | AUTO TRIPS | AUTO SHARE | AIR TRIPS | AIR SHARE | RAIL TRIPS | RAIL SHARE | TOTAL TRIPS |
|---|---|---|---|---|---|---|---|---|
| Cleveland | -Mansfield | 1177952 | .93 | 0 | .00 | 85298 | .07 | 1263250 |
| Cleveland | -Columbus | 2064391 | .88 | 23528 | .01 | 253885 | .11 | 2341804 |
| Cleveland | -Springfield | 42332 | .87 | 1076 | .02 | 5116 | .11 | 48524 |
| Cleveland | -Dayton | 360444 | .85 | 15523 | .04 | 45894 | .11 | 421861 |
| Cleveland | -Cincinnati | 441822 | .75 | 87169 | .15 | 58669 | .10 | 587660 |
| Cleveland | -Other Ohio | 1893152 | .97 | 3694 | .00 | 64508 | .03 | 1961354 |
| Akron/Canton | -Columbus | 1238141 | .95 | 5925 | .00 | 59799 | .05 | 1303865 |
| Akron/Canton | -Springfield | 17168 | .92 | 231 | .01 | 1163 | .06 | 18562 |
| Akron/Canton | -Dayton | 174703 | .88 | 7732 | .04 | 15355 | .08 | 197790 |
| Akron/Canton | -Cincinnati | 212789 | .82 | 21460 | .08 | 24279 | .09 | 258528 |
| Akron/Canton | -Other Ohio | 336673 | .99 | 1076 | .00 | 1526 | .00 | 339275 |
| Mansfield | -Columbus | 1433087 | .90 | 0 | .00 | 160830 | .10 | 1593917 |
| Mansfield | -Springfield | 11834 | .88 | 0 | .00 | 1689 | .12 | 13523 |
| Mansfield | -Dayton | 62254 | .93 | 0 | .00 | 4814 | .07 | 67068 |
| Mansfield | -Cincinnati | 92190 | .89 | 184 | .00 | 10951 | .11 | 103325 |
| Mansfield | -Other Ohio | 126675 | .98 | 8 | .00 | 2404 | .02 | 129087 |
| Columbus | -Springfield | 1983249 | .93 | 0 | .00 | 143900 | .07 | 2127149 |
| Columbus | -Dayton | 4026396 | .95 | 193 | .00 | 215333 | .05 | 4241922 |
| Columbus | -Cincinnati | 3301299 | .91 | 7538 | .00 | 325492 | .09 | 3634329 |
| Columbus | -Other Ohio | 4116954 | .98 | 10109 | .00 | 86460 | .02 | 4213523 |
| Springfield | -Cincinnati | 304768 | .85 | 0 | .00 | 53377 | .15 | 358145 |
| Springfield | -Other Ohio | 118320 | .90 | 966 | .01 | 12906 | .10 | 132192 |
| Dayton | -Cincinnati | 8436804 | .99 | 0 | .00 | 86187 | .01 | 8522991 |
| Dayton | -Other Ohio | 353504 | .91 | 8178 | .02 | 24793 | .06 | 386475 |
| Cincinnati | -Other Ohio | 722167 | .93 | 20321 | .03 | 31655 | .04 | 774143 |
| Other Ohio | -Other Ohio | 106991 | .97 | 668 | .01 | 2211 | .02 | 109870 |
| **TOTAL** | | **33156059** | **.94** | **215579** | **.01** | **1778494** | **.05** | **35150132** |

# Table E-5
# OHIO HIGH SPEED RAIL
# SUMMARY TRIP TABLE
# ANNUAL NON-BUSINESS TRIPS - YEAR 2010

| DISTRICT PAIR | | AUTO TRIPS | AUTO SHARE | AIR TRIPS | AIR SHARE | RAIL TRIPS | RAIL SHARE | TOTAL TRIPS |
|---|---|---|---|---|---|---|---|---|
| Cleveland | -Mansfield | 830625 | .95 | 0 | .00 | 40719 | .05 | 871344 |
| Cleveland | -Columbus | 1642285 | .95 | 2015 | .00 | 83245 | .05 | 1727545 |
| Cleveland | -Springfield | 33077 | .94 | 134 | .00 | 2144 | .06 | 35355 |
| Cleveland | -Dayton | 286828 | .94 | 1965 | .01 | 14749 | .05 | 303542 |
| Cleveland | -Cincinnati | 310786 | .91 | 13660 | .04 | 17673 | .05 | 342119 |
| Cleveland | -Other Ohio | 1469030 | .98 | 1612 | .00 | 33617 | .02 | 1504259 |
| Akron/Canton | -Columbus | 973438 | .98 | 445 | .00 | 21886 | .02 | 995769 |
| Akron/Canton | -Springfield | 18279 | .93 | 119 | .01 | 1221 | .06 | 19619 |
| Akron/Canton | -Dayton | 164004 | .94 | 1379 | .01 | 8193 | .05 | 173576 |
| Akron/Canton | -Cincinnati | 175448 | .93 | 3298 | .02 | 9464 | .05 | 188210 |
| Akron/Canton | -Other Ohio | 350443 | 1.00 | 121 | .00 | 991 | .00 | 351555 |
| Mansfield | -Columbus | 1044312 | .95 | 0 | .00 | 58372 | .05 | 1102684 |
| Mansfield | -Springfield | 5797 | .95 | 0 | .00 | 303 | .05 | 6100 |
| Mansfield | -Dayton | 57186 | .95 | 0 | .00 | 3209 | .05 | 60395 |
| Mansfield | -Cincinnati | 74823 | .95 | 52 | .00 | 4033 | .05 | 78908 |
| Mansfield | -Other Ohio | 98236 | .99 | 2 | .00 | 1309 | .01 | 99547 |
| Columbus | -Springfield | 1404558 | .96 | 0 | .00 | 56196 | .04 | 1460754 |
| Columbus | -Dayton | 2838094 | .98 | 11 | .00 | 71167 | .02 | 2909272 |
| Columbus | -Cincinnati | 2571421 | .96 | 597 | .00 | 109480 | .04 | 2681498 |
| Columbus | -Other Ohio | 3238365 | .99 | 2321 | .00 | 23953 | .01 | 3264639 |
| Springfield | -Other Ohio | 103973 | .96 | 573 | .01 | 3278 | .03 | 107824 |
| Dayton | -Cincinnati | 5185675 | .99 | 0 | .00 | 29122 | .01 | 5214797 |
| Dayton | -Other Ohio | 330387 | .96 | 1993 | .01 | 10431 | .03 | 342811 |
| Cincinnati | -Other Ohio | 637577 | .97 | 6689 | .01 | 13033 | .02 | 657299 |
| Other Ohio | -Other Ohio | 124987 | .98 | 554 | .00 | 2081 | .02 | 127622 |
| **TOTAL** | | **23969634** | **97** | **37540** | **.00** | **619869** | **.03** | **24627043** |

# Table E-7
# YEAR 1991
# RAIL STATION-TO-STATION TRIPS AND REVENUE: TOTAL

| STATION PAIRS | | AVERAGE PASSENGER MILES | PASSENGERS | PAS-MILES | REVENUE | REVENUE/ PASSENGER |
|---|---|---|---|---|---|---|
| 1 | 2 | 10 | 34122 | 341220 | 170610 | 5.00 |
| 1 | 4 | 72 | 42487 | 3059064 | 1516856 | 35.70 |
| 1 | 5 | 123 | 25645 | 3154335 | 1514990 | 59.08 |
| 1 | 6 | 134 | 24288 | 3254592 | 1438948 | 59.25 |
| 1 | 7 | 180 | 9343 | 1681740 | 700394 | 74.96 |
| 1 | 8 | 204 | 1715 | 349860 | 142324 | 82.99 |
| 1 | 9 | 244 | 8360 | 2039840 | 801787 | 95.91 |
| 1 | 10 | 261 | 3583 | 935163 | 348092 | 97.15 |
| 2 | 4 | 63 | 65608 | 4133304 | 2368384 | 36.10 |
| 2 | 5 | 113 | 128527 | 14523551 | 7628240 | 59.35 |
| 2 | 6 | 124 | 170127 | 21095748 | 10146886 | 59.64 |
| 2 | 7 | 170 | 16284 | 2768280 | 1190730 | 73.12 |
| 2 | 8 | 195 | 38255 | 7459725 | 3185076 | 83.26 |
| 2 | 9 | 234 | 47774 | 11179116 | 4572126 | 95.70 |
| 2 | 10 | 251 | 14837 | 3724087 | 1431213 | 96.46 |
| 4 | 5 | 51 | 86568 | 4414968 | 2894211 | 33.43 |
| 4 | 6 | 61 | 76758 | 4682238 | 2577741 | 33.58 |
| 4 | 7 | 107 | 18285 | 1956495 | 886388 | 48.48 |
| 4 | 8 | 132 | 14850 | 1960200 | 866060 | 58.32 |
| 4 | 9 | 171 | 23055 | 3942405 | 1634064 | 70.88 |
| 4 | 10 | 188 | 3767 | 708196 | 267344 | 70.97 |
| 5 | 6 | 11 | 60627 | 666897 | 303135 | 5.00 |
| 5 | 8 | 81 | 502 | 40662 | 16781 | 33.43 |
| 5 | 9 | 121 | 7533 | 911493 | 359076 | 47.67 |
| 5 | 10 | 137 | 2526 | 346062 | 120879 | 47.85 |
| 6 | 7 | 46 | 150509 | 6923414 | 3847853 | 25.57 |
| 6 | 8 | 71 | 208638 | 14813298 | 7220589 | 34.61 |
| 6 | 9 | 110 | 282877 | 31116470 | 13590227 | 48.04 |
| 6 | 10 | 127 | 35372 | 4492244 | 1709782 | 48.34 |
| 7 | 8 | 25 | 18579 | 464475 | 357479 | 19.24 |
| 7 | 9 | 64 | 51283 | 3282112 | 2039538 | 39.77 |
| 7 | 10 | 81 | 2094 | 169614 | 83293 | 39.78 |
| 8 | 10 | 56 | 86187 | 4826472 | 2513974 | 29.17 |
| 9 | 10 | 17 | 17529 | 297993 | 87645 | 5.00 |
| TOTAL | | 93.18 | 1778494 | 165715333 | 78532715 | 44.16 |

STATIONS:

1. Cleveland--Downtown
2. Cleveland-SouthWest
4. Mansfield
5. Columbus-North
6. Columbus-Downtown
7. Springfield
8. Dayton
9. Cincinnati-North
10. Cincinnati-Downtown