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HISTORIC CONTEXT FOR TRANSPORTATION NETWORKS IN PENNSYLVANIA

Introduction

To assist with establishing the significance of the historical background of bridge building in Pennsylvania, it is important to identify and understand the historic contexts associated with the resources. Bridges do not stand in isolation, historically or physically; they embody events and trends that need to be considered when evaluating their individual or collective historical significance. Historic contexts organize historic properties in terms of theme, place, and time, and only within a historic context can what is significant “be determined in relationship to the historic development from which it emerged and in relationship to a group of similar associated properties” (National Register Bulletin 16, 1986: 6-7).

In order to evaluate the National Register eligibility of the pre-1956 bridge population in Pennsylvania historic contexts have been researched and prepared twofold: one on the history of transportation networks in Pennsylvania, and the second on the application of bridge technology within the state. Both contexts address transportation issues from the earliest days of settlement to the 1950s, and both set the bridges within the national, state, and local contexts.

The historic contexts will provide a means of evaluating each bridge’s technological significance, and its relationship to Pennsylvania’s transportation systems. Based on the historic contexts and their application to National Register criteria, each bridge in the inventory will be evaluated on its own merits with the contexts identifying the crucial distinctions of significance to pools of similar resources.

1. Overview

Bridges are best understood as integral parts of transportation networks that carry people, vehicles, and materials over natural barriers such as rivers and streams, and over manmade barriers such as railroads, canals, and roads. They are utilitarian structures that function within larger transportation systems to support the social and economic life of the state. Consequently, Pennsylvania’s roadway system and bridges are the reflection of a variety of significant influences and technologies that have shaped the state’s cultural landscape and directly affected its development. From waterways and Native American trails that were well-traversed routes of communication prior to the arrival of the European colonists to the ascendancy of the motor vehicle following World War II, Pennsylvania’s transportation networks have played a dominant role in shaping the history of not only the state but the region and the nation as a whole. Often what occurred in Pennsylvania had ramifications, implications, and then application far beyond its borders.

Pennsylvania's transportation history from the 18th century to the present has been characterized by a series of technological changes aimed at increasing capacity, speed, directness, flexibility, and regularity of service. After the initial period of colonial settlement, the first great period of transportation growth occurred from about 1790 through the 1850s when turnpikes, canals, and railroads were introduced to advance the state's agricultural and industrial potential. Nationally, the period has been called the "transportation revolution" because of the impact these transportation technologies had on the transition from a colonial economy to a growing interconnected national economy that stretched from the east coast westward to the Mississippi River and beyond (Taylor 1951).

The second extraordinary period of growth occurred from about 1865 through the 1910s when railroads extended to every corner of the state and were eventually consolidated under the great rail systems such as the Pennsylvania Railroad, the B&O Railroad, the Reading, the P&LE RR, and the DL&W Railroad. The railroads and the access they provided to rich natural resources both within and outside the state were the catalysts behind Pennsylvania's industrial growth. Rail lines had a significant influence on transportation engineering and the cultural landscape. They were the most important innovators of metal truss bridge technology.

The third period of transportation growth occurred after 1918 when the emphasis shifted from railroads to the motor vehicle and the development of modern roadways. The majority of Pennsylvania's pre-1956 bridge population dates from after 1918 when the state's roadways were substantially modernized by stages to handle the increased volume and load requirements of truck and automobile traffic. The work was undertaken largely under the direction of the Pennsylvania State Highway Department, founded in 1903, in cooperation with county and municipal public works departments. Bruce Seely, a leading historian of America's highways, has called the period from the late 1910s to 1940 the "golden age" of highway construction. Record numbers of miles of highway and bridges were built throughout the nation under programs of federal and state aid. Even through the depths of the Great Depression in the 1930s, road and bridge building continued at record levels as highway projects were made part of New Deal work relief programs. After World War II, road and bridge programs focused on the upgrade of the original highway systems and the construction of urban expressways.

While Pennsylvania's transportation history may be broken down into three important periods of development, the overall picture is much more complex. New transportation systems did not immediately replace old ones but rather were integrated into existing networks. Thus, for many years, railroads transferred traffic to boats at navigable rivers and harbors. Likewise, competition between truck traffic and railroads was intense from the 1920s to the 1950s. Some railroads and navigable rivers still play important although limited and specialized roles in the state's economic life.

Finally, Pennsylvania bridges document the evolution of the institutional and financial arrangements through which highway bridges were built in the state. The responsibility for highway bridge building evolved from a local activity carried on by private individuals and elected local officials to a complex interaction between and among local, state, and federal officials and contractors. In the late-19th century, many Pennsylvania communities contracted with national metal truss bridge building companies, or still relied upon local craftsmen to build stone or timber bridges, or continued to call upon ferry operators to carry people and goods across the state's numerous rivers. By the early 1900s, the trend was increasingly toward trained bridge engineers in the employ of the state, county, and municipal governments. The engineers brought with them a scientific approach to bridge building that stressed theoretical and practical knowledge of structural behavior, strength of materials, and economy of design. They measured their progress by their ability to build bridges of greater strength, span, and durability to replace the functionally inadequate ferries and bridges of the earlier age. The many extant steel and reinforced-concrete highway bridges are part of their engineering legacy.

2. Pennsylvania's Transportation Network Prior to 1790

Although the majority of Pennsylvania's historic bridges date from the 20th century, the highways and byways on which they are located reflect patterns of transportation that have evolved from the colonial and early republic periods. The bridges on many local roads and state highways are often third, fourth, or even fifth generation structures at or near sites chosen and improved by Pennsylvania's first settlers and later inhabitants. In most cases, the bridge rights-of-way have been widened or realigned for modern vehicular traffic, but the purpose of conveying people and goods over natural and manmade barriers remains much the same.

Pennsylvania's geography has played a decisive role in the formation of transportation patterns. The earliest transportation routes, in place well before the arrival of European settlers, were the rivers and trails used by Native Americans. The rivers facilitated north-south travel by small craft, but Pennsylvania's topography of northeast-southwest running mountain ridges, ranging from 75- to 160-miles wide, are a major barrier to east-west travel and communication. Indian trails, such as the Frankstown Path (US 22) and Nemaquin's Trail (US 40)¹, traversed the mountains and were later improved by European settlers. Nonetheless, for most of the colonial period the trails over the mountains were little better than winding paths. More than 130 years passed from the 1620s and 1630s, when Swedes and Dutch first settled on the banks of the Delaware River, to the 1760s when pioneers crossed the Allegheny Mountains and established

¹The modern-day route equivalents are provided in parentheses with the historic route names as a guide to readers. In general, the modern highway routes do not exactly follow the historic trails and roads but have been regraded and straightened.

the first permanent towns in western Pennsylvania. The mountains have been a formidable barrier that each of Pennsylvania's successive transportation systems -- roads, canals, railroads, and modern highways -- has had to traverse, often with creative engineering solutions.

In the late 1600s and early 1700s, the center of the developing colonial transportation system was the city of Philadelphia, chosen in 1681 by William Penn as the site of the provincial capital. By the mid-1700s Philadelphia had grown to become America's leading commercial city, a transportation hub based on its thriving Delaware River port, serving as the transshipment point between the Atlantic trade and inland markets. Much of Philadelphia's prosperity was based on the trade of flour, grain, corn meal, beef, pork, and whiskey, produced in the southeastern Pennsylvania and New Jersey countryside and brought to Philadelphia by wagons on roads radiating outward from the city to market towns like Lancaster, Chester, Bristol, and Germantown.

Pennsylvania's colonial government early recognized two different general classes of roads: the first were those of significance to inter- and intra-regional travel, the major roads connecting the important market towns. These roads were sometimes designated king's highways and local inhabitants laid out and maintained the highways by order of the Governor or Provincial Council. The earliest king's highways reflected the dominant pattern of trade centered on Philadelphia. The first king's highway, laid out by order of Penn, was the Chester-Philadelphia-Bristol Road paralleling the Delaware River (US 13). The road eventually formed a link in the post road connecting Philadelphia with other major cities on the eastern seaboard such as New York and Baltimore. Another regionally important road was the Lancaster Road, heading west from Philadelphia through an area of fertile agriculture and connecting the city with western markets on the Susquehanna River and further west. Today, this corridor too continues to be an important corridor of travel and has been paralleled in turn by the Philadelphia and Lancaster Turnpike, the Pennsylvania Railroad's Main Line, and US 30.

In the early colonial period, the king's highways, by virtue of their importance and relatively heavy level of traffic, were those most likely to have bridges built replacing difficult and seasonally-passable fords. The nation's oldest known stone arch bridge, the Frankford Avenue Bridge over Pennypack Creek in Philadelphia, was built in 1697 on the King's Highway between Philadelphia and Bristol. Prior to the late 1700s, permanent stone arch bridges were not, however, the norm, probably because of the cost of hiring masons and quarrying stone; instead, most bridges were simple timber pile and beam structures, built using the region's ample supply of wood. Early examples of timber pile and beam bridges were built in the 1710s and 1720s on the road from Philadelphia to New Castle, Delaware, near present-day Chester, Delaware County. None of these early timber bridges are known to survive. Colonists did not have the technology to build long-span bridges, therefore rivers such as the Delaware, Schuylkill, and Susquehanna were serviced exclusively by ferries until the early 1800s when new long-span bridge technologies were developed.

In contrast to the king's highways, the second class of roads were those of local use, connecting individual farms and residences with nearby centers of community activity such as churches, mills, and crossroads villages. These roads often passed through private lands, and were only later turned into publicly maintained roads after the level of wagon, cart, horseback, and pedestrian traffic had reached a point to justify public maintenance. Southeastern Pennsylvania's rural settlement pattern of individual farmsteads separated from another by contiguous fields lent itself to the need for a large number of local roads, but roads that received a relatively low level of traffic because they served a small number of inhabitants. In the early 1700s, bridges were not a regular feature of local roads, which usually kept to high ground and avoided difficult stream crossings, however, by the mid-1700s population increases and expanded trade had reached a level to justify greater attention to local road and bridge improvements. The natural barriers of rivers and steep valleys that millers sought falling water for power frequently made mills difficult to reach. The location of many late 18th- and 19th-century bridge sites near old mills seats attests to the grist mill's role as a localized transportation hub in the rural economy.

The institutional process by which roads and bridges were built and maintained had its origins in traditions of English governance where local residents provided statutory labor, equipment and materials. The traditions of statutory road work were transferred to Pennsylvania by William Penn's government; as early as the 1680s, county courts of quarter sessions appointed road supervisors to call out local residents, usually in the early spring, to work on the roads. The process was formalized in the Act of 1700, which also provided a mechanism for citizens to petition the courts for road and bridge improvements and for the courts to appoint viewers to determine the necessity of the roads and bridges.

In response to the growing number of local roads and the need to finance their construction and maintenance, in 1762 the Pennsylvania General Assembly reformed the colony's road laws. The Road Law of 1762 was a milestone because it codified the locally based system of road administration that dominated (with minor modifications) until the early 1900s. The law firmly established the township as the principal unit for the finance and maintenance of roads. Township residences were provided with authority to elect their own road supervisors, who could levy a small road tax for the purpose of purchasing materials and hiring hands. Residents could either pay their tax in cash or "work off" the tax burden in the traditional manner of statutory labor. Road construction and maintenance was a labor intensive process using hand tools and draft animals to assist with clearing, grubbing, ditching, and grading road surfaces.

The Road Law of 1762 provided special procedures for bridges, recognizing that bridges usually required the purchase of substantial quantities of materials and at a minimum the skills of journeymen carpenters or masons. Because the lawmakers realized that larger bridges were often beyond the financial resources of townships, the law provided that townships could petition the county courts for relief when local residents believed that the cost of a bridge was too high for them to build. The original law required that court justices, upon the advice of the grand jury, appoint viewers

whose charge was to visit the bridge site and report back their opinion on the necessity, placement, and cost of the bridge. If favorably reported by the viewers, the justices then ordered the county commissioners to either take over the bridge from the township, or in the case where no bridge had existed before, pay for the construction of a new bridge. Over time, the county commissioners, by virtue of their tax-levying power and control of the county treasury, dominated the proceedings and had the ultimate say of whether a bridge would or would not become a county responsibility. Once taken over by the county, bridges were rarely ever turned back to the townships. Indeed, by the end of the 19th century, Pennsylvania counties had assumed responsibility for thousands of bridges, while most roadways and smaller bridges remained in the care of townships.

After 1750, much of Pennsylvania's transportation history has been dominated by the improvement of the overland linkages connecting the eastern side of the state with Pittsburgh, the gateway to the Midwest via the Ohio River. Road building over the Allegheny Mountains was initially driven by military concerns, transporting armies and supplies to the Ohio Valley to meet the threat of French claims to the region. In 1755-56 General Braddock forged the first of the important roads to Pittsburgh, striking out from the Potomac River at Cumberland, Maryland to the summit of Chestnut Ridge and then branching off toward Pittsburgh, following the approximate route of US 40 and SR 31. Following the defeat of Braddock, in 1759 General Forbes chose a different route over the mountains from the Susquehanna River by way of Raystown (Bedford) and Ligonier to the navigable Youghiogheny and Monongahela rivers and on to Pittsburgh, approximating US 30. In the 1760s, the Forbes Road, called more commonly the Pennsylvania Road, was extended and improved. Despite the difficulties of overland travel by military road, settlers streamed west, and once there built small roads connecting with the Pennsylvania Road, Braddock's Road, or preferably navigable water, beginning a road system in the western half of the state.

Following the American Revolution (1775-1781), Pennsylvania could put only limited funding into roadways, despite pressures from eastern merchants and western settlers to do so for the benefit of trade. Pennsylvania, with a road west to Pittsburgh at the head of the Ohio River, was the keystone to western transportation into Ohio and the Midwest, but the poor conditions of most roads, and the slowness and expense of shipping goods overland, limited trade. Rather than taking the overland route from Pittsburgh east over the mountains, bulky products like grains were floated down the Ohio and Mississippi rivers to the Spanish (later French) port of New Orleans, where they were transferred to ocean going vessels for shipment to the east coast and overseas. An alternative was to move goods via the Great Lakes to British Canada, or to convert grains to whiskey, which could be more conveniently transported overland by packhorse.

C. The Transportation Revolution, 1790-1860

The drive to make less costly and more efficient trade connections eventually placed Pennsylvania at the forefront of new transportation technologies. From 1790 to 1860, Pennsylvania was among the nation's leaders in the development of turnpikes, canals and railroads. These transportation systems, often first introduced in Pennsylvania for the improvement of the east-west trade, marked a transportation revolution that transformed the state's economy. By 1860, Pennsylvania was shifting from agriculture and merchant capitalism to an increasingly diverse economy where agriculture stood along side the massive extraction of natural resources such as timber, coal, iron ore, and oil, and the movement of those resources, mostly by canal and increasingly by rail, to growing urban centers for conversion to manufactured goods in steam-powered factories. The new transportation systems linked Pennsylvania with the nation, and they had a lasting impact on the state's transportation patterns and cultural landscape. As well, they spurred development of new bridge technologies.

Turnpikes and Toll Bridges, 1790s-1820s

Road building in Pennsylvania took a dramatic step forward in 1791 when leading merchants of Lancaster and Philadelphia proposed building an improved artificial road on a straight line between the two cities bypassing the old Lancaster Road. The Philadelphia and Lancaster Turnpike, constructed between 1792-1794, was the nation's first "Scientific Road," costing almost half a million dollars to build the 24'-wide macadam stone roadbed. The turnpike improved year-round transportation by preventing wagon wheels from cutting into the road, and was an instant success with teamsters and stage lines. The turnpike was paid for and operated by a state-chartered stock company. It set an important precedent for the future of transportation financing. The turnpike, situated as advantageously as it was on the heavily traveled route west from Philadelphia, soon turned a profit and was held up as an example of what a system of improved toll roads might achieve if extended to every corner of the state.

Inspired by the success of the Philadelphia and Lancaster Turnpike, the General Assembly granted charters to an increasing number of turnpike companies after 1800. By 1822, Pennsylvania led the country in turnpike mileage with over 102 turnpike companies in operation, with a combined total of 2,380 miles of improved road. Most turnpike companies took over already existing public highways, straightening alignments and surfacing with stone or clay. Typical of the turnpikes were the Lewistown and Huntington Turnpike, the Gettysburg and Petersburg Turnpike, and the Pittsburgh and Butler Turnpike, each connecting two regionally important but not far distant market towns. Turnpikes primarily served to gather and distribute goods for local and regional markets, and only in a few instances were the turnpikes part of integrated cross-state routes. The most significant of the trunk line turnpikes was the old Pennsylvania Road, improved and operated in segments by five separate turnpike companies beginning in the mid-1810s.

An exceptional long-distance improved road was the federally-built National Road, constructed between 1811 and 1818, connecting the headwaters of the Potomac River at Cumberland, Maryland with the Ohio River at Wheeling, Virginia (now West Virginia). Much of the road, in excess of 80 miles, passed through southwestern Pennsylvania and the towns of Brownsville, Uniontown, and Washington. The road, which was politically controversial in its time, threatened Philadelphia's western commerce by shifting trade away from Philadelphia, routing it to Washington, D.C. and Baltimore. The staggering cost of the road combined with the doubtful constitutionality of the federal government's involvement in internal improvements, caused President Andrew Jackson to order the road turned over to the states in the 1830s, after which time the Pennsylvania portion became a toll road. Among the improvements designed by the US Army Corps of Engineers for the National Road were some outstanding stone arch bridges, as well as America's first example of iron suspension bridges, the extant 1839 cast iron arch Dunlap's Creek Bridge in Brownsville, Fayette County.

Some turnpikes carried such volumes of traffic that ferry crossings became bottlenecks where teamsters and wagoners waited for ferry boats or were delayed by ice, flood, or drought. The problem was first experienced at the Schuylkill River ferry crossing in Philadelphia at the eastern terminus of the Philadelphia and Lancaster Turnpike near present-day Market Street. In 1798 the Schuylkill Permanent Bridge Co. was chartered for the purpose of spanning the river and replacing the ferry. The Permanent Bridge, completed in 1805 and erected by master New England bridge builder Timothy Palmer, stands out as a historic landmark in American bridge building; it was as one of the earliest examples of an arch truss bridge (i.e., a timber bridge composed of a timber truss superimposed with a timber arch), as well as the first recorded covered bridge in America.

In Pennsylvania, the period from 1805 to 1820 was a period of great timber arch truss and truss bridges erected by chartered toll bridge companies. By the end of 1821, authority had been granted for the construction of 49 privately built toll bridges across the state, most across wide rivers such as the Delaware, Schuylkill, Susquehanna, Allegheny, and Monongahela. The opportunities and challenges of spanning Pennsylvania's widest rivers attracted the best of America's early bridge engineering talent, including the likes of Theodore Burr, Lewis Wernwag, and James Finley. These men developed the timber truss technology and pushed the limits of frame construction with such bridges as Theodore Burr's 360' long, single span bridge at McCall's Ferry over the Susquehanna River. The great timber bridges were copied by local millwrights and carpenters who continued constructing covered bridges over smaller tributaries for decades thereafter.²

²For a complete assessment of covered bridges, see Pennsylvania Department of Transportation, "Statewide Covered Bridge Assessment," 1991. Because of the previous assessment, covered bridges have not been included in the 1996-98 historic bridge inventory. This context, thus provides only an abbreviated recapitulation of their historical and

The era of the stone-surfaced turnpikes and the great timber toll bridges was for all of its achievement short lived. Even before the canals and railroads took over much of the turnpike business, turnpike companies found that income from tolls was simply not enough to recoup heavy capitalization and maintenance costs. By 1831, of the more than 270 turnpike and toll bridge companies chartered, slightly more than half had never raised enough capital to complete construction, and a majority of completed turnpikes were in receivership or simply not returning dividends to investors. As the value of turnpike stock plummeted, all but the most heavily traveled turnpikes abandoned their routes, and the roadways reverted to public ownership. Even though the turnpikes failed, they did have an impact strengthening the transportation ties between market towns and surrounding countrysides, stimulating intra-regional trade, as well as improving the state's east-west trunk line.

In 1911 the state government purchased and took over approximately 1,000 miles of 19th-century turnpikes, all that remained in the state. By that time, many of the turnpikes were operable toll roads in name only with the companies retaining charters but in reality doing little to maintain the routes. A few roads such as the Lancaster Turnpike and the Philadelphia Turnpike (Philadelphia-Chester) were still maintained and frequently traveled, although profits were marginal at best. The old turnpikes were incorporated with the state highway system of free public highways (Pa. Highway Legislation 1915: 597).

Pennsylvania's Canal Era, 1820s-1850s

In the 1820s, Pennsylvania began to turn both attention and financial investment toward the construction of a statewide canal system. The canal network, consisting of both privately- and state-owned canal lines, soon replaced turnpikes as the state's primary long-distance transportation system. The Schuylkill Navigation Canal, Lehigh Canal, and Delaware and Hudson Canal opened northeastern Pennsylvania coal fields, tapping the coal fields at points closest to urban markets in Philadelphia and New York City. Pennsylvania's rich coal fields had been mined as early as the 1760s for local use, but large scale exploitation of coal for home heating fuel was not accomplished until cheap transportation to urban markets existed via the canals. The potential profit to be made from coal encouraged investors and the state to pump huge sums of capital into the construction of the canal system. After 1830, anthracite coal became one of the backbones of Pennsylvania's industrial growth, stimulating the expansion of the iron and steel industry, and powering the steam engines in hundreds of different manufactories. Although designed for long-distance transportation, the canals also had a significant impact on the local distribution of goods to towns and rural areas along their routes. By 1857, Pennsylvania canal mileage peaked at over 1,290 miles operated by greater than

technological significance.

35 canal companies and state canal divisions. Thereafter canal abandonments occurred at a steady pace as their routes were taken over by the more progressive railroads, although a few canals continued operating into the 1920s.

Canals had been in use in Pennsylvania from as early as the 1790s, but few of the earliest ones were successful. Long-distance canals were not completed until the early 1820 with the most successful specializing in the movement of anthracite coal. The first of the important Pennsylvania coal canals, the Schuylkill Navigation Canal, was built from 1816-25, connecting Philadelphia with Pottsville in the southern anthracite coal field. The Delaware and Hudson Canal, built from 1826 to 1829, between Eddyville, NY and Honesdale, PA tapped the northern anthracite coal field, centered in Luzerne County. At Honesdale, a 15-mile long gravity railroad brought coal down the mountain to the canal from Carbondale. The Delaware and Hudson Canal served New York City and linked the far northeastern corner of Pennsylvania firmly with the metropolitan market. The Lehigh Canal, built from 1826 to 1829, followed the course of the Lehigh River from Easton to Mauch Chunk where it too was served by a railroad from Summit Hill. The Lehigh Canal was over the long run probably the most profitable canal ever built in Pennsylvania. It brought coal from the southern and central coal fields to Easton on the Delaware River where barges transferred downstream for Philadelphia. By the mid-1830s its connections to newly completed canals through New Jersey for Newark and Jersey City served the New York City market.

While the privately owned coal canals opened northeastern Pennsylvania coal fields to exploitation, the state-owned Main Line Canal was Pennsylvania's attempt to provide an improved east-west trunk line to compete with New York state's Erie Canal, completed in 1825. The cheap all-water route of the Erie Canal, connecting the Great Lakes with the Hudson River at Albany, tipped the balance of the competition for midwestern trade from Philadelphia to New York City. Responding to the threat caused by the shift of trade away from the Pennsylvania Road, in 1824 Pennsylvania's state government undertook an ambitious program to provide a water-based Philadelphia-to-Pittsburgh route along with feeder canals servicing neighboring communities and the branches of the Susquehanna River. Completed in 1834, the Main Line was actually a combination of railroad and canal, consisting of a rail line from Philadelphia to Columbia; canal from Columbia to Hollidaysburg; a unique portage railroad crossing the Allegheny Ridge to Johnstown; and canal continuing west to Pittsburgh. A triumph of engineering skill, especially given the unfriendliness of Pennsylvania's mountainous topography to canal builders, the Main Line greatly reduced travel time, but failed to live up to high expectations. Costs for the construction and maintenance greatly exceeded estimations, in part because of the huge number of locks needed to raise and lower boats across the mountains. Bottlenecks at the many locks slowed traffic, floods washed out canal sections, winter freezes shutdown the canal, and transfer of passengers and goods between canal boats and railroads was time consuming.

Another important influence of the canals was the opportunity they provided for training of an ambitious generation of civil engineers. While pioneering Pennsylvania's canal

system, young men learned how to survey routes, manage large construction projects, and design public works using scientific methods. Many engineers who cut their professional teeth on canal survey and inspection crews later would become important designers, builders, and managers of railroads, as well as innovators in the field of bridge technology. The canals themselves, although often not noted for their association with the development of new bridge technology, were associated with a few important innovative bridge builders. John A. Roebling, in 1844 built his first wire-rope suspension bridge to carry the Main Line Canal over the Allegheny River near Pittsburgh. From 1845 to 1850, Roebling was active with the Delaware and Hudson Canal, building four aqueducts, including the extant Delaware Aqueduct suspension bridge at Lackawaxen, Pike County, completed in 1848.

Railroad Growth and Development, 1830s to 1850s

Comparatively speaking, the railroad industry started late in Pennsylvania, in part due to the huge investment sunk by the Commonwealth and private investors into the turnpikes and then the Main Line Canal system. After the slow start of the 1830s, Pennsylvania became a national leader in railroad development in the 1840s and 1850s. By 1860 it had surpassed all states in total railroad mileage, a position it would hold into the 20th century.

Railroads initially developed as a means of more economically moving commodities such as minerals and farm goods to market. Yet they were also a function of, and a catalyst for, the state's industrial-based economy. The new dependable, all-weather transportation, in turn, spurred further industrial growth. Freed from dependence upon water-borne transportation, industries grew up in all corners of the state. With new industries, small towns with rail connections grew to urban centers, and other smaller rail towns were founded overnight wherever a railroad company decided to place a depot. Other towns such as Altoona grew specifically to service the railroads with car shops and maintenance yards. The most dramatic growth occurred in iron making and in coal extraction. Iron was spurred by the railroad's demand for metal rails and cars, and coal was the primary fuel for railroads, the metal industries, and home heating throughout the Northeast. In a symbiotic relationship, Pennsylvania railroads carried these products throughout the state and the nation.

In Pennsylvania, railroads made their first appearance as short gravity roads and horse-powered railroads designed primarily to connect mines and furnaces with docks and boat landings. In the 1830s, with the introduction of steam-powered locomotives, the railroads reached a level of technological maturity that enabled them to challenge and over the following decades even replace the canals in the anthracite region. In 1842, Philadelphia capitalists completed the first of the most important anthracite roads, the Philadelphia and Reading Railroad, between Philadelphia and Pottsville, paralleling the route of the Schuylkill Navigation Canal. Other rail companies followed into the coal fields. Among the most successful were the Lehigh Valley Railroad (LV RR) from

Easton to Mauch Chunk (Jim Thorpe), completed in 1852. The LV RR became a leading factor in the growth of Allentown and Bethlehem as iron and steel centers. Another important coal line, the Delaware, Lackawanna, and Western Railroad (DL&W), completed its route from Scranton to the Delaware River with connections to northern New Jersey and New York in 1851. The DL&W promoted the growth of Scranton as an important commercial and manufacturing center in the coal region.

As railroads revolutionized transportation in the anthracite fields, the need for improved cross-state transportation was again assumed importance. Philadelphia's status as a leading port city was challenged by improvements to its north and south. In 1828, Maryland pushed west with the Baltimore and Ohio Railroad. The B&O's charter called for the railroad to pass through Pittsburgh, thus diverting western trade from Philadelphia to Baltimore. Meanwhile to the north in New York, the Erie Canal remained a potent force, and plans were afoot to build a cross-state railroad connecting the mouth of the Hudson River with the Great Lakes. Beginning in 1835, the Erie Railroad was built in stages from the Hudson River, eventually reaching Binghamton, N.Y. in 1847. The Erie, although a New York railroad, ultimately became affiliated with numerous branch lines that dipped into Pennsylvania's northern tier of counties, and drew them into the New York orbit.

In response to the challenges from Baltimore and New York, in 1846 Philadelphia business interests chartered the Pennsylvania (Central) Railroad Company with the aim of constructing a direct route between Philadelphia and Pittsburgh. The Pennsylvania Railroad developed into the dominant transportation carrier in the state and one of the most important in the nation. The main line between Harrisburg and Pittsburgh, destined to become one of the busiest and most significant in the country, was constructed quickly under the able direction of company chief engineer J. Edgar Thompson. By 1852 the line cut the five-to-six day trip via the Main Line Canal to as little as 15 hours. Altoona, founded as the Pennsylvania Railroad's main shop complex, was located at the base of the Allegheny Mountains in Blair County, a convenient mid-point along the original route and a place to add helper locomotives for the push up the mountains. In 1857 the Pennsylvania Railroad purchased the state-owned Main Line Canal, putting it out of business.

The railroad industry influenced bridge technology and resulted in the development of new bridge types, new construction techniques, and the widespread use of structural iron. The railroads were a huge market for new bridges, and had special needs, including meeting the load requirements of heavy locomotives and cars. The leading practitioners of iron bridge construction were railroad civil engineers, who, beginning in the 1840s, experimented first with combination wood and iron bridges, such as the Howe truss, and increasingly, used all metal trusses, such as the Whipple truss or the Haupt truss, named after the Pennsylvania Railroad's chief engineer, Herman Haupt. Each railroad had its own preferred type of truss, and many railroad engineers patented the trusses they developed.

The growth of the railroads paced the emergence of an increasingly specialized and interdependent economic region in which Pennsylvania, by virtue of its "keystone" position in the Northeast, played a crucial part. Although much of the drive toward transportation improvements was motivated by the economic competition of merchants in northern cities to capture new resources and market areas, by the 1850s and 1860s the railroads had helped carve the state into distinct spheres with trunk lines flowing to and from the seaport cities. Philadelphia's rail connections first concentrated on coal, iron, and allied manufacturers at first east of the Susquehanna River, and then with the opening of the Pennsylvania Railroad further west. New York City methodically extended direct connections from the Erie Corridor southward into the coal regions of northern Pennsylvania, supplementing its dominance as the nation's new center of finance and foreign trade. Baltimore dominated Maryland and parts of southwestern Pennsylvania by virtue of the B&O Railroad. At the fulcrum of rail development was Pittsburgh, originally a transshipment point to eastern markets, but increasingly a manufacturing city in its own right serving the trans-Allegheny west. After the Civil War (1861-1865), rail entry to Pittsburgh would become hotly contested, and the city a maze of competing rail lines.

D. The Age of Railroad Dominance, 1860s-1910s

The leading story of Pennsylvania's transportation from the 1860s to the early 1910s was the dominance of railroads and the extension of rail lines into every corner of the state. The state's railroad industry grew from 2,600 miles of track in 1860 to more than 11,500 miles of track at its peak in 1920. The expansion of Pennsylvania's railroads was not unique but part of a nationwide trend that brought the railroads to the forefront of the American economy. Railroads evolved into the nation's first "big business," assuming control of vast holdings of capital, real estate, equipment, and employees. As they grew in size, the railroads moved to standardize operations, gradually eliminating the multiplicity of gauges that had plagued the industry during the Civil War. In favor of the standard gauge, the new standard gauge of four feet eight and one-half inches, helped the railroads to integrate the many lines into a vast network serving a national market. At the same time, the railroads upgraded their physical plant, replacing iron rails with heavier steel ones, wood and iron bridges with stronger steel and stone spans, wooden cars with steel, and early engines with larger, more powerful varieties.

The railroads had a profound impact on the state's economy and landscape, so much so that every major town or city was historically impacted in some way. American iron and steel manufacturers concentrated production at large, integrated plants in selected districts, most notably the Pittsburgh region, on its way to becoming "the steel city." After 1870, rail lines extended south and east from Pittsburgh to rich bituminous coal fields, such as the one centered around Connellsville, location of one of the nation's richest supplies of coking coal, an important fuel source for the iron and steel industry. Reflecting the railroad's role in the development of a national economy, Pittsburgh increasingly relied on iron ore shipped from the Marquette and Mesabi Iron ranges of

northern Michigan and Minnesota by Great Lake ore boats, and loaded onto rail cars for delivery from Erie, Cleveland and other ports.

As the rail lines opened national markets, thousands of Pennsylvania manufactories, great and small, benefitted from the new markets and availability of new resources. Northeast of Pittsburgh, rail lines extended into the oil fields around the towns of Oil City and Titusville, precipitating the boom in that industry. Logging railroads were a significant technological advance helping loggers reach vast stands of timber in the Allegheny Plateau of northern Pennsylvania. The state was soon known nationally not only for iron and steel, coal and coke, oil and lumber, but also textiles, machine tools, leather, railroad cars, ship building, glass, and printing.

Railroads were also a factor in the changing scale and scope of Pennsylvania agriculture. Farmers, unable to compete with cheap midwestern grains and meats, shifted to goods such as dairy products, eggs, tobacco, vegetables, and fruits that railroads quickly delivered before spoilage to growing urban populations. With increased specialization, farmers devised new ways to finance, market, and store their products with special railroad sidings, silos, and canning and packing operations.

By 1860, more than 140 railroad companies were operating in Pennsylvania. During the following decades, old lines were absorbed into larger rail systems and new lines constructed in a maze of corporate take overs, alliances, leases, and joint ownerships. While the tracing of the individual histories of each railroad is a herculean task, suffice it to say the majority of the state's railway mileage fell under the control of the Pennsylvania Railroad system. Numerous other systems served specific industries or regions or simply passed through small portions of the state on their way to other places. In addition to the Pennsylvania Railroad, major rail systems operating in Pennsylvania included the Reading Lines; the Lehigh Valley Railroad; the Delaware, Lackawanna and Western Railroad; the Erie Railroad; the New York Central (including the Pittsburgh & Lake Erie Railroad, 80 per cent owned by NYC); the New York, Chicago and St. Louis Railroad (Nickel Plate); Buffalo, Rochester, and Pittsburgh Railway (BR&P); the Western Maryland Railway; and the Baltimore and Ohio Railroad. Depending upon which lines passed through an individual community, specific ties to the various urban markets serviced by the regionally dominant carriers were created.

The Pennsylvania Railroad was the preeminent Pennsylvania rail carrier by sheer virtue of its size and economic power. By the early 1870s, its lines reached every part of the state, save for the far northeastern anthracite coal country. Much of the Pennsylvania Railroad's strength came not only from its control of in-state rail lines but its aggressive posture gaining connections to major urban areas east, west, and south. In 1869, a series of leases gave the Pennsylvania Railroad routes west to Chicago and St. Louis, and in 1871, the company acquired lines northeast from Philadelphia to Jersey City, NJ, the gateway to New York City. The Pennsylvania's New York-Chicago connections made it the nation's premiere mover of goods from the Midwest to the East Coast. In 1873, the Pennsylvania Railroad was also the nation's first rail company to offer through

service between New York City and Washington, DC, by way of Philadelphia. Over the years, the Pennsylvania Railroad's Northeast Corridor would gain fame as the nation's most profitable passenger service.

Competing with the Pennsylvania Railroad for the trade between the Midwestern cities and the East Coast were several rival lines originating in New York and crossing Pennsylvania's northwestern corner paralleling the shore of Lake Erie en route to Cleveland, Youngstown, and other Ohio and Midwestern cities. The railroad situation in the vicinity of Erie was complicated with the New York Central, Erie Railroad, and Nickel Plate, each possessing roughly parallel routes. The lines and their several branches into northern Pennsylvania towns like Williamsport, Bradford, and Meadville linked these small and previously isolated communities with New York cities such as Buffalo and Rochester.

Although frequently outmaneuvered by the Pennsylvania Railroad and the major New York lines, the eastern Pennsylvania coal roads that had their origins in the 1840s and 1850s expanded to serve specific regional markets after 1865. In 1882, the DL&W acquired trackage connecting New York Harbor and Buffalo, NY, by way of Scranton, and making the line an important carrier of passengers and general merchandise, as well as coal. Similarly, by 1892 the Lehigh Valley Railroad was operating on its own lines from Buffalo to New York Harbor by way of Wilkes-Barre. The Reading Railroad was far less successful at expansion, mainly concentrating on a system of branch lines to eastern Pennsylvania communities like Shippensburg, Allentown, and Williamsport. The Reading attempted acquiring tracks northeastward to New York City and New England, but eventually fell into receivership and came under control of the Central of New Jersey Railroad (CNJ) in the late 1880s, which itself was controlled by the B&O after 1901.

Along parts of Pennsylvania's southern border and into areas of southwestern Pennsylvania, the most important of the rail systems was the B&O. The B&O, which began in the 1820s as a route from Baltimore west along the Potomac River, expanded in the 1870s to connect east with Philadelphia by way of Wilmington, DE, and west with Pittsburgh. Its main-line routes was further extended west to Chicago, Cincinnati, and St. Louis. The B&O competed with the Pennsylvania Railroad and the New York Central on the New York-Chicago and New York-St. Louis runs. In southwestern Pennsylvania, the B&O was an important mover of coal to Pittsburgh. The Western Maryland Railway provided an alternative route to the B&O from Baltimore to Cumberland. By virtue of several branch lines, the Western Maryland connected the southern Pennsylvania towns of Connellsville, Shippensburg, Gettysburg and York with Baltimore.

From the 1870s to the 1890s, the business climate of the railroad industry was characterized by intense rivalries with different railroad companies, virtually duplicating routes and services to key industrial points throughout the state. The overbuilding led to rate-cuts and rebates, and companies, especially weaker ones, struggled for business.

By the early 1900s, ended, the hectic pace of expansion and the era of cutthroat competition. The stabilization of the larger rail systems. Focus turned from building new lines to improving the existing infrastructure. Work included straightening alignments; constructing low-grade lines for freight; double or quadruple-tracking rights of way; rebuilding bridges to carry faster, heavier traffic; and adding automatic block systems to improve safety.

The most significant of the technological improvements, and perhaps the most significant railroad achievement in the northeast in the 20th century, was the Pennsylvania Railroad's electrification of service between Washington and New York and Philadelphia west to the Enola Yards outside Harrisburg. The project, which took over 25 years to complete, began in 1910 when the Pennsylvania Railroad initiated electric service in its tunnel under the Hudson and East rivers in order to eliminate the choking smoke caused by steam locomotives. In a bold move, the Pennsylvania Railroad determined to extend the electric service south from New York. Between 1915 and 1930, the Pennsylvania Railroad electrified five branch lines out of Philadelphia, including its 20-mile Paoli to Philadelphia commuter line, the company's first experience in regular service with overhead trolleys. From 1926 to 1930, the Pennsylvania section of the Northeast Corridor main line between Trenton, NJ and Wilmington, DE. was electrified. Between 1936 and 1938, the Pennsylvania Railroad electrified the 45-mile long Trenton Cut-off, the main line west between Paoli and Harrisburg, and the low grade freight line between Perryville, MD, and Enola Yards.

Although railroad bridges are not the focus of the historic bridge survey, since the survey includes only of those railway bridges that intersect highways, the bridge engineering accomplishments of Pennsylvania railroads from 1865 to 1920 are worth noting briefly. Each of the major Pennsylvania railroad companies employed engineering staff responsible for bridge design and construction. Although each rail system had its own bridge standards and bridge type preferences, after 1890, the trend was away from pin-connected trusses and toward riveted-connected trusses and expanded use of larger and heavier riveted plate girders. Some exceptions to this rule were the Pennsylvania Railroad's decision to build massive stone arches to replace bridges in the early 1900s, and the DL&W's innovative use of reinforced concrete at the Clark's Summit-Hallstead Cut-off north of Scranton. In general, the railroads were the most advanced bridge builders of their day, often applying new bridge technologies and design standards such as Cooper's loadings years before such techniques and standards appeared in use for the ordinary highway bridges constructed by Pennsylvania's counties and municipalities.

In the late 19th century, railroad-company-built highway bridges were generally few in number and usually found in situations often required by law, where railway cuts and fills passed below or above previously existing streets and farm lanes. While many of these older crossings still exist, most are second or third generation bridges that have been replaced and raised for the greater vertical clearances required by present-day freight cars.

As both locomotives and automobiles increased in size and speed, after 1900, the problem of providing safe and efficient crossings of railroads and roads became widespread. Safer grade crossings received national publicity from the 1900s to the 1930s. In 1919 alone, nearly 14,000 persons all across the nation died from being struck by trains. Railroads and local, state, and federal governments struggled to find ways to meet the safety needs of the traveling public. The railroads erected signals and signs, and sponsored public education campaigns to "Stop, Look, and Listen." The separation of tracks and roads was another answer to the problem, but grade crossing eliminations involved costly changes in elevation of either track or roadway, the railroads rarely were willing to bear alone. Railroad officials usually preferred less substantial means of providing for safer crossings, but they were sometimes had no option but to build viaducts and bridges. This was especially true in densely populated urban areas where at-grade crossings also caused significant delays to the railroad's own traffic. Concerted grade crossing elimination campaigns outside of metropolitan areas did not occur until the 1930s with the help of massive federal and state funded programs. (Stilgoe 1983: 167-188).

Railroads In the Highway Era, 1920s-1990s

Despite their great success as a transportation system, railroads were always a business of comparatively modest profits. The industry was heavily capitalized, with high fixed costs tied up in essential holdings like rights-of-way, track, bridges, locomotives and cars, stations, warehouses, and other fixed structures. Large land holdings, in turn, subjected the railroads to an equally great property tax load, often this burden increased beyond what could be justified by traffic. Competing lines, which were legion in Pennsylvania, assured that most bulk commodities shipping rates remained comparatively low. Moreover, arcane freight pricing structures did not establish rates strictly based on competition, commodity, and distance but instead used various factors to establish maximum and minimum rate levels. So long as other costs and competition from outside forms of transportation remained static the railroad industry remained profitable. Its position was, however, precarious (Douglas, 379-395; Harwood interview).

Competition increased from other forms of transportation, particularly private automobiles, trucks, barges, and pipelines. During World War I, more and more shippers, exasperated with railroad car shortages and freight bottlenecks, turned to the nascent trucking industry. After World War I, massive infusions of federal aid helped Pennsylvania and other states build and improve integrated state highway systems. State highways paralleled the routes served by the rail lines and trucking offered shippers the advantage of door-to-door service, eliminating the long delays associated with shifting railroad cars in freight yards and cargo between cars and destination. For the railroads, the Depression only worsened the situation; freight and passenger traffic slipped to all time lows. During World War II, the railroads shouldered most of the nation's transportation duties moving troop trains and increased freight loads, but

physically, the railroad industry was in near-shambles by war's end. After 1945, outside competition continued to erode the railroads' business, as new, government-subsidized highways and, later, interstates gave the trucking industry a major boost. Trucking companies, which offered greater flexibility and a much lower incidence of damaging goods in shipment, took the high volume products the railroad industry counted on to subsidize higher weight, but less profitable goods like coal. The improved road system also spurred the growth of automobile suburbs, shifting passengers and businesses away from railroad corridors. The dramatic growth of the airline industry decimated long-distance railroad passenger traffic and made slow but steady inroads into the freight business.

Years of overbuilding, high-fixed costs, heavy debt loads, and declining business were catching up with the industry. With railroad traffic and profits declining precipitously following World War II, there was no money to spare, and further debt was something few railroads could afford. Pennsylvania's anthracite railroads were among the hardest hit, victims of outside competition, mine depletion, a switch from hard coal to oil as the primary choice in home heating, and the completion of the St. Lawrence Seaway, which siphoned off Great Lakes traffic. The decline of manufacturing and mining in Pennsylvania and the northeast, the lifeblood of the Commonwealth's railroads, sapped the carriers. The railroad companies, led by the Pennsylvania Railroad, reorganized ruthlessly, consolidating shop operations, reducing employment, and abandoning unprofitable branch lines.

Despite the gloom, the railroad industry introduced a number of innovations that won back some traffic. Diesel and electric locomotives increased efficiency, allowing an engine to operate 28-30 days per month, rather than 15-18, the limit of a steam locomotive. Equally important, joint ventures with the trucking industry revolutionized the industry. The introduction of piggyback trains (truck trailers on flat cars), containers on flat cars, and unit trains (trains shipped and routed as a unit, eliminating switching) regained some of the medium distance and long haul freight business. Ironically, the introduction of the tri-level car carriers secured for the railroads the movement of automobiles from manufacturing plant and import point to their final destination (Douglas, 382-395).

But the inroads could not halt the painful restructuring. Declining freight revenues and massive debt forced the B&O into a merger in the early 1960s with the Chesapeake and Ohio Railway, a union that eventually became known as the Chessie System. In 1968 the rival New York Central and Pennsylvania Railroads, the pride of northeast railroading concluded lengthy negotiations by announcing a merger of operations. It was destined to be short lived. Within two years the unwieldy Penn-Central had collapsed in on itself. A number of other notable carriers, such as the Erie, DL&W, Lehigh Valley, and Central of New Jersey, followed them into bankruptcy.

The Penn-Central bankruptcy and the ailing condition of the railroad industry in general convinced many in Congress that a legislative solution was needed. In 1970 Congress

created the National Railroad Passenger Corporation (Amtrak) to run the nation's passenger service, including the northeast corridor through Philadelphia and southeastern Pennsylvania and the main route between New York and Chicago. The Penn-Central's freight business was reorganized and, with remnants of other northeastern railroads, formed the basis for a quasi-public company, the Consolidated Rail Corporation, better known as Conrail.

The formation of Conrail and Chessie System closed a number of railroad yards and produced a spate of abandonments of feeder lines throughout Pennsylvania, but railroading survives in Pennsylvania. Partial deregulation in 1980 with the passage of the Staggers Act finally gave the railroad industry the ability to set rates competitively and to own other forms of transportation, like barge and truck lines. This has led to a boom in the intermodal business, particularly on routes greater than 400 miles. It has also led to an improved climate for the railroad business (Martin, 390; USRA, 49-59).

The railroad industry thrives in Pennsylvania in a form much different from as recently as 50 years ago. The Pennsylvania's major east-west freight and passenger lines still handle traffic as Conrail and Amtrak. Both Conrail and CSX Corporation, the successor to B&O/Chessie, carry freight along their historic routes, although the lines have been regraded and tracked for modern equipment. Smaller carriers, like the Monongahela Railroad and the Pittsburgh and Lake Erie, continue to serve coal mines and industrial customers, but in volumes well below historic levels. Other railroads live on as highway routes, their abandoned rights of way appropriated for multi-laned roadways carrying vehicular traffic.

E. Modern Roadways, 1880-1956

Overview

The history of the motor vehicle and the development of modern roadways is a dynamic story of a transportation technology that has come to dominate the very fabric of the American culture and society. For average Americans, the automobile became the preferred mode of travel between home, work, school, and shopping during the first half of the 20th century. The landscape is divided and shaped by highways and bridges, and marked with parking lots, drive-ins, motels, diners, gas stations, convenience stores, shopping centers, and garages, each purposely designed to accommodate the automobile. The close connection between the motor vehicle and the American lifestyle was established in the first half of this century. From 1905 to 1945 the number of registered cars and trucks in the United States grew from about 9,400 to over 30.8 million (Jackson 1985: 162). The automobile, which started life in the 1880s as an impractical curiosity, the horseless carriage, had by the 1950s become a powerful, fast, mass-produced vehicle that was an essential component of everyday life. It captured

the minds, hearts, and pocketbooks of Americans of all classes and became the very symbol of an age (Flink 1988).

From the late-19th century through the mid-20th century, America's system of modern roadways evolved from the dirt roads of the age of the horse and buggy to an impressive system of interconnected interstate, primary, and secondary highways capable of supporting long-distance automobile and truck travel. The highway improvement campaigns were undertaken largely under the direction and influence of federal and state highway policy makers. A key ingredient to the campaigns was the establishment of professionally staffed state highway departments to oversee and direct the work of improving roads and bridges. Throughout the United States, federal and state government involvement with improved roads and bridges began with the Good Roads Movement of the 1880s and 1890s, but did not gain significant momentum until the advent of the automobile in the first decade of the 20th century (Seely 1987: 11-23).

Pennsylvania was a leader of the Good Roads Movement. In 1903 the Pennsylvania legislature created the Pennsylvania Department of Highways, and in 1911 designated a system of over 8,500 miles of highway to be taken over, maintained, and improved by the department as a system of primary routes connecting county seats and forming cross-state trunk lines. The state highway department's staff worked to establish policies that centralized highway funding and unburdened municipal and county governments from responsibility for roads and bridges on the state highway system.

The Good Roads Movement had a broad historic context related to changes in Pennsylvania's demography and rural economy in the late-19th and early 20th centuries. From 1870 to 1930, Pennsylvania's population increased three-fold from 3.5 million people to 10.5 million people. Over the same period, the percentage of urban and rural population shifted from 70 percent rural in 1870 to 35 percent rural in 1930. As urban markets expanded, Pennsylvania's traditional agricultural economic base changed from grains and self-sufficient farming to dairy farming, poultry husbandry, livestock raising, truck gardening and fruit growing. After 1880, the amount of land under cultivation in Pennsylvania began declining, but productivity increased, in part by mechanization and improved scientific farming methods.

As the Good Roads Movement gained momentum, better roads helped end rural isolation and strengthen the agricultural economy. Good roads made it possible for rural families to participate in Rural Free Delivery (RFD) and to frequent meetings of farm associations such as the Grange, and dairymen's, fruit growers, and women's volunteer associations. Better schools were also fueled by better roads; in 1895 the state legislature mandated that all children from the age of 8 to 13 attend school, and in 1897 local school districts were authorized to begin providing means of transporting children to school. Better roads made possible a host of other rural social and educational activities that were impractical when poor transportation had limited those events to a small neighborhood. By 1919, most farmers were strong supporters of good

roads. During and after World War I (1914-1919), tractors and trucks replaced the horse as the most common farm motive power. The Grange and other farm interests advocated new state and federal legislation that funded an interconnected system of improved rural highways (Stevens 1956: 482-484; Klein and Hoogenboom, 1980: 338-341).

After 1919 the Pennsylvania Department of Highways expanded, influenced by increased funding from the federal government, state bond issues, and the gasoline tax and motor vehicle registration fees. By 1939, the state highway system had increased from the original 8,500 miles of roadway to over 33,500 miles of roadway owned and maintained by the state highway department. Although municipal governments remained responsible for over 65,000 miles of local roads and streets, much of this mileage was also subject to design standards established by the department through programs of state aid and technical assistance. After 1945 the department again expanded the scope of its programs with the emphasis on urban expressways such as Pittsburgh's Penn-Lincoln Parkway and Philadelphia's Schuylkill Expressway (Stevens 1956: 441-445, 679-680).

A key ingredient to the growth of the Pennsylvania Department of Highways was its cooperative relationship with the federal highway administration. After World War I, much road and bridge construction on state highways was funded with the financial assistance of the Bureau of Public Roads (BPR)³, the agency responsible for managing national highway policy. Beginning in the 1910s, the BPR worked with the American Association of State Highway Officials (AASHO) and the American Society for Testing and Materials (AST&M) to establish national standards for highway design and construction. Most states, including Pennsylvania, sent their highway officials to national conferences where committees prepared and reviewed minimum standards for all roadways and bridges. Although federal aid usually amounted to less than one-fifth of the department's annual budget, it had a proportionately greater impact because any project using the federal funds matched by state funds had to meet AASHO and ASTM guidelines, as well as approval of BPR engineers.

Under the growing influence of the federal aid system and ever growing federal appropriations, the nation's and Pennsylvania's road and bridges reached an unprecedented level of standardization. In the 1920s, federal funding formulas required state highway departments to expend a large portion of the aid on new construction of US highways. In the 1930s, the federal and state governments turned road construction into the largest New Deal public works program. Pennsylvania's government used work relief programs and funding to widen existing state and local roads, and to build hundreds of bridges. The Pennsylvania Turnpike, constructed from 1938 to 1941 with financial assistance from the Works Progress Administration (WPA), was a path-breaking achievement, the first long-distance, median-divided, limited-access toll highway in the nation.

³The BPR was renamed the Federal Highway Administration (FHWA) in 1967.

After World War II, federal and state aid for highways continued to increase as Pennsylvanians took to their automobiles in record numbers. Highway engineers sought to improve the capacity, driveability, and safety of the state's highways by widening, paving, and regrading the existing system. Even as road and bridge construction reached all-time levels, federal and state legislators and highways officials debated whether to create a new system of toll highways in the model of the Pennsylvania Turnpike or to create a toll-free system of interstate highways. A system of limited-access highways was seen as the key to improving long-distance automobile and truck travel alleviating crowded city traffic conditions. During the early 1950s, the turnpike model was favored in Pennsylvania and plans were prepared by the turnpike authority to extend the turnpike to all of the state's major cities. Events at the federal level, however, eventually overtook the turnpike authority's plans when in 1956 Congress passed and President Eisenhower signed the Federal-Aid Highway Act creating an integrated system of free limited-access interstate highways. The act marked a major redirection of federal, and by extension state, highway policy, providing 90 percent federal funding for interstate highways. The Interstate Highway System marked a new era of highway construction, including new post-1956 developments in the field of bridge technology. Because of the historically significant impact of the interstate highway system, the year 1956 was chosen as the cut-off date for the historic bridge survey.

The vast majority of Pennsylvania's pre-1957 bridge population dates from the post-1918 period of federal- and state-sponsored or influenced highway improvements. The modern approach to highway and bridge construction contrasted markedly with the traditional local approach to road and bridge construction that had dominated earlier periods. In 1910 most all of Pennsylvania's highway bridges were either owned or maintained by county or municipal governments or private corporations such as toll bridge companies and railroads.⁴ By 1956, the highway bridge situation had changed

⁴No exact breakdown of bridge ownership is available for the years 1910 to 1956. Reporting of bridges owned or maintained by local governments was not systemized until the 1980s. State highway department estimates from 1910 to 1950 are in the neighborhood of 24,000 bridges statewide with the total number of bridges increasingly only slightly over the period. The number of state-owned highway bridges increased from an insignificant number in 1910, prior to the creation of the state highway system, to approximately 18,000 bridges in 1950. There was a corresponding decrease in the number of municipally owned bridges as they were taken over by the state highway department. The current historic bridge inventory of 11,855 pre-1957 bridges breakdown as follows: 7,455 (62.9%) PADOT-owned bridges; 2,043 (17.2%) township, borough or city-owned bridges; 1,624 (13.6%) county-owned bridges; 248 (2.1%) bridges owned by other state agencies such as DCNR; 242 (2.0%) railroad-owned bridges; 39 (0.3%) privately owned bridges; 17 (0.1%) bridges owned by federal agencies such as the National Park Service; 14 (0.1%) bridges owned by toll authorities; and, 173 (1.5%) bridges with unreported or unknown ownership.

dramatically; standard state- and county-designed bridges, such as reinforced concrete T beam bridges or steel stringer bridges, had replaced most of the local craftsmen-built wood or masonry bridges and patented metal truss bridges of the pre-automobile era. The Pennsylvania Department of Highways had built or taken over nearly 18,000 bridges of an approximate total of 23,000 highway bridges statewide (Pa. Dept. of Hwys. Biennial Report 1955-56). The policies and practices of the engineering profession in the first half of the 20th century dominate the context for evaluating the state's bridges.

1. The Good Roads Movement, 1880-1917

Origins and Influence of the Good Roads Movement

During the 1880s, interest in improved roads and bridges revived in Pennsylvania and the United States for the first time since the turnpike boom of the early 19th century. The Good Roads Movement, which predated the widespread use of the automobile, was promoted by a variety of groups, including bicycle enthusiasts, proponents of rural mail delivery, and the railroads, who saw improved vehicular roads as a means of bringing more business to their terminals. The Good Roads Movement was national in scope, but intensity varied from region to region, with the greatest efforts in and around urban areas of the Northeast and Midwest, where there were greater financial resources and a politically influential upper-middle class.

The movement for good roads originated with a craze for the bicycle. In 1887 the safety bicycle, a chain-driven bicycle with two wheels of equal size, was introduced in the United States from England. It was an overnight success, especially among affluent city dwellers who by the mid-1890s were buying over one million per year. The cyclists formed groups to organize cross-country rallies, road races, and weekend excursions. Through these activities they gained first-hand knowledge of the poor condition of rural roads and the need to improve them for both bicycles and farm wagons.

The leading cyclists' organization was the League of American Wheelmen (LAW), founded in 1880. The LAW became an outspoken proponent and powerful political lobby in the cause of good roads. Seeking social and economic justification for good roads, as well as the support of farm interests, who initially viewed the Good Roads Movement as a hobby of the rich city dweller, the LAW claimed that good highways would raise land values, open new markets, provide access to manufactured goods, end rural poverty, increase political participation by farmers, and improve education. By the early 1890s the LAW was increasingly drawing the backing of state granges and farmers' cooperatives.

The LAW promoted state aid for local roads throughout the Northeast, successfully guiding model legislation through various state houses. In 1892, New Jersey became the first state to pass a state-aid road bill, and in 1893 Massachusetts created the nation's first state highway department. In 1895, on the federal level, the LAW persuaded Congress to form the Office of Road Inquiry (ORI) within the Department of

Agriculture. The ORI began as a small bureau with the task of gathering information on the nation's roads. ORI developed a strong reputation for highway engineering expertise, promotion of the gospel of good roads, and cooperation with state officials on matters related to state road laws and supplies of road materials. In 1899 renamed the Office of Public Road (OPR), began an expanded program of technical bulletins and circulars on new road and bridge building techniques and later joined with other groups such as the Automobile Club of America (later the American Automobile Association [AAA]) and the National Good Roads Association to advocate good roads legislation (USDOT 1976: 36-53; Seely 1987: 11-23).

During the late 1880s and 1890s, good roads reformers lobbied Pennsylvania law makers for model roads legislation but initially failed to build on the successes they had in other states and at the federal level. In Pennsylvania the main political stumbling block was establishing a method for funding a state road program. In successive sessions of the legislature from 1891 to 1901, bills that would have created a state aid program were held up by farmers objections to possible tax increases. By 1901 state law makers had little doubt that a state road program was necessary, the only question was how to pay for good roads and bridges (ORI 1894: 94-95; ORI 1895: 23-24; Hamilton 1901; Plummer 1925).

In 1903 Pennsylvania joined the growing list of states adopting the model good roads legislation promoted by the LAW, the federal OPR, and other reform groups. The Pennsylvania road bill that finally passed was aimed at improving roadways by providing state funding to municipal governments in rural areas. The success of Rural Free Delivery (RFD), the federal program delivered mail directly to rural dwellers. Approved by Congress in 1896, RFD began as a small experimental program. The first experimental RFD routes were located in Pennsylvania's Lancaster and Westmoreland counties due to the influence of Postmaster-General John Wanamaker of Philadelphia. By 1903 the program had expanded to more than 8,600 mail carriers traveling 200,000 miles per day and reaching almost five million people nationwide. The post office department ruled that RFD routes would be established only where roads and bridges were reasonably well maintained and fit for travel. These requirements marshaled support in many rural Pennsylvania communities for road improvements so that mail delivery would not pass them by. Postal department records confirm that mailmen and postal inspectors frequently wrote letters to local and state officials urging them to repair or improve specific RFD routes. With the introduction of automobiles for mail service in the 1910s, mail carriers could carry larger parcels and cover more miles on their routes. By 1924, Pennsylvania alone had 2,036 RFD routes totalling 53,385 miles of mail service daily (Fletcher 1955: 522-523; USDOT 1976: 80-81).

Pennsylvania's 1903 Road Law provided three-quarters of the cost of road reconstruction to rural second-class townships⁵ for RFD routes selected by petition to

⁵In 1899, the state legislature defined first-class townships as those with population densities of greater than 300 persons per square mile, and second-class townships as those with

the State Highway Commissioner. The law created the Pennsylvania Department of Highways to administer the state aid, approve all state-aid work, hire engineers to provide technical expertise to township supervisors, and oversee maintenance of the roads after improvement. From this small beginning as an agency to distribute funds to township road supervisors, the Department of Highways grew within 20 years to become the leading builder of roads and bridges in the state.

The Local Context of County and Municipal Road and Bridge Building

With the exception of several hundred remaining miles of turnpike and a number of private toll bridges, prior to the creation of the state-aid program in 1903, all roads and bridges in Pennsylvania were built and maintained by the county and municipal governments. By-and-large, Pennsylvania's more than 2,600 local governmental divisions operated under laws and local ordinances that provided counties, cities, boroughs, first-class, and second-class townships a varying degree of authority to levy road taxes and oversee the construction and maintenance of roads and bridges. Cities, such as Philadelphia and Pittsburgh, had by the late-19th century established public works departments, hired engineers, and undertaken extensive programs to pave streets and build bridges. In contrast, most rural areas still used local labor and materials to provide minimal upkeep to the highways.

Bridge Building in the Cities.

In the second half of the 19th century, immigration, industrialization and technological innovation brought startling growth and change to Pennsylvania's cities. As cities grew, so did the responsibilities of urban governments for water, sewers, education, public health, and highways. As a result of the pressing need to design and manage large public works, cities hired full-time professional civil engineers. For instance in 1863, Philadelphia created the Department of the Chief Engineer and Surveyor to approve all plans for streets, bridges, sewers, and other public works such as eliminating or improving railroad grade crossings. In 1887 Philadelphia's city government combined the street, sewer, and water departments into a single department of public works headed by the city's chief engineer. By 1895 Pittsburgh, Reading, Scranton, and Allentown had also created public works departments headed by engineers. The city engineers emphasized planning, economy, and business-like management of public works. City bridge engineers usually worked with the street departments and designed

less than 300 persons per square mile. First-class township governments had powers similar to those of boroughs. In first-class townships, commissioners had the power to pass ordinances, lay fines, and care for public safety and health, whereas in second-class townships, supervisors did not have those powers, and were primarily concerned with maintaining roads and bridges. Most first-class townships were located in suburban areas where citizens demanded the services of borough governments, but were not thickly settled enough for borough status. First-class townships were relatively few in number (Scott 1917: 186).

their bridges in conjunction with projects to pave and widen city streets. By the late 1890s, the city engineers increasingly were influenced also by the City Beautiful Movement. This progressive urban reform movement merged engineering, architecture, and landscape architecture to improve city life with parks and parkways, as well as devising master plans for all sewers, water systems, public transit and other public improvements (Daly 1970: 219; Chudacoff 1981: 186-190).

As a result of the City Beautiful Movement and the professionalization of public works departments, cities like Pittsburgh, Harrisburg, and Philadelphia moved to the forefront of American highway bridge building practice, both in terms of the application of new materials, especially concrete and reinforced concrete, and emphasis on bridges aesthetics. Many cities developed master plans in with projected improvements that often included architectonic bridges associated with parkways, boulevards, and water control projects. Bridges, such as Harrisburg's Mulberry Street bridge (1907-09), designed by James H. Fuertes, reflected the neoclassical architectural tastes of the progressive urban reformers (Wilson 1989: 132-146).

Philadelphia's, Chief Engineer George S. Webster from 1894 to 1909 and Bridge Engineer H. H. Quimby oversaw the design of a number of important city bridges beginning with the Falls Bridge over the Schuylkill River (1894-95), an extant pin-connected K-truss bridge, originally intended to carry a second deck as part of a trolley line through Fairmount Park. By the mid-1900s, Webster had introduced concrete and reinforced-concrete arch bridges, reporting that they were particularly well-suited to the new suburbs where the ornamental balustrades, textured spandrel walls, and scored abutments and piers produced "an attractive outline in harmony with the surroundings." An early example of a reinforced concrete arch bridge is the 1904 Frankford Avenue Bridge over Poquessing Creek. In 1908 Webster capped his career with the city public works department with the construction of the Walnut Lane Bridge over Wissahickon Creek in Fairmount Park. The open-spandrel arch bridge is noteworthy as a large and early example of the type and design; its 233'-long main span is even more remarkable considering it is composed of unreinforced (massed) concrete (Webster and Quimby 1909; Engineering News 1909: 300-301).

Bridge building in Pittsburgh was even more dynamic than in Philadelphia, because of the rugged topography of hills, valleys, and rivers. In 1908 Pittsburgh's Bureau of Construction, headed by engineer N. S. Sprague, had charge of 78 bridges including several long-span bridges over the Allegheny and Monongahela rivers. From 1908 to 1915, Pittsburgh undertook a bridge-building program that, like Philadelphia, made extensive use of reinforced concrete. According to City Engineer Sprague, the Bureau of Construction adopted a policy of building concrete bridges after extensive study of the problem of maintenance of steel bridges proved that painting the steel was "expensive and unsatisfactory" in Pittsburgh's smoky, soot-filled air. Concrete bridges were economical, utilitarian, and resistant to the corrosive effects of smoke. Concrete arches, in particular, were "monumental and artistic looking structures" that beautified the city. After some experiments with encasing existing steel girder bridges in concrete,

Sprague moved full swing into the new bridge program designing more than two dozen open spandrel arch, closed spandrel arch, and thru girder bridges. The city engineers were proud of their accomplishments and frequently published articles in engineering journals; they dubbed Pittsburgh “the city of bridges” (Sprague 1912: 214-215; Municipal Engineering 1913: 167-174).

Urban progressive reform and the City Beautiful Movement waned after World War I, but they left behind a legacy of urban planning headed by professional engineers, landscape architects, and planners who continued through the 1920s to further shape the growth and development of Pennsylvania’s cities. In Harrisburg, for example, the Market Street Bridge (1928) and Soldier and Sailors Bridge (1930) tied into earlier City Beautiful improvements and plans for the state capitol complex. These monumental and architectonic bridges, however, were an exception to the growing influence of what some planners called the “city practical,” which stressed functionality and economy over beauty and neoclassical taste. Ornamental balustrades, fancy luminaries, and other elaborate architectural treatments increasingly were seen by urban bridge engineers as unnecessary costs and maintenance problems that were best avoided or at least tempered in favor of simpler treatments, such as stone veneers applied to fascia beams and parapets, concrete parapets horizontally scored in the Moderne style, and standard overhead highway lighting (Wilson 1989: 291-305).

Bridge Building in Rural Areas

In contrast to cities where civil-servant engineers designed and approved bridges, in rural Pennsylvania the selection and approval of bridge designs was a process carried out largely by laymen serving as township supervisors or county commissioners. Prior to the 1910s, county engineers were not employed except in a few counties such as Delaware, and Montgomery, which by virtue of their larger populations and wealth, could afford higher property tax rates and more extensive road and bridge construction programs.

During the late-19th century, building a bridge in rural Pennsylvania was a political process wrapped in the traditions and routines of local governance. In general, county commissioners were responsible for building and maintaining larger highway bridges and township supervisors responsible for roads including most smaller bridges and culverts.⁶ As late as 1910, the division of responsibility between counties and municipal

⁶The only county government that maintained a large highway system was Allegheny County. In 1895 Allegheny County State Senator William Flinn secured the passage of a law permitting the county to take over main township roads and to levy a special county road tax. In 1897 Allegheny County created a road department and took over 400 miles of main roads leading from Pittsburgh to the outer borders of the county, connecting up with roads to Butler, New Castle, Washington, and Freeport. By 1911, the department had hard-surfaced the roads and built concrete and metal truss bridges. Allegheny County had an exceptionally active bridge

governments was based on an amended version of the 1762 Road Law. It provided that county commissioners take over bridges from municipalities only after local residents had petitioned the county court and secured the concurrence of the grand jury and a court-appointed panel of bridge viewers. But this division of responsibility had many exceptions; first-class townships, boroughs and smaller cities in rural areas often owned and maintained their own large bridges. A special state law, passed in 1836 but often ignored, stated that counties were responsible for all bridges within one-fourth of a mile of the county line. Under a special provision of the state's road laws passed in 1879, county commissioners could opt to furnish money to the townships to build bridges but then hold no future liability for the maintenance, repair, or rebuilding of the bridges. Further confusion over responsibility for bridges was caused when county commissioners built bridges without bothering with the process of petitioning the courts. The court records of the late-19th century are filled with disputes between townships and counties over bridge ownership and responsibility (Trickett 1905: 231-241).

From the late 18th century to 1910, rural township supervisors tended to rely on local laborers and locally available materials such as stone and timber for most of their smaller bridge building needs. Typically, supervisors "sold" sections of road to nearby local landholders who agreed to maintain the road and bridges in exchange for the value of their labor being written off against their road taxes. Landholders who did not "buy" a section of road paid a small cash tax that was then used by the supervisor to purchase wood planks, spikes, and nails for the maintenance of the smaller bridges and culverts. Rarely did rural township supervisors maintain enough cash in the road fund to afford the services of a bridge-building company or engineer (Plummer 1925; East Caln Township, 1823-1902).

The responsibility of maintaining bridges over larger streams and rivers was a major preoccupation of county commissioners. In most counties hardly a meeting of the commissioners passed without some reference to the repair or construction of bridges. By the late-19th century, as new methods of construction such as iron truss and girder bridges became common, county commissioners solicited bids for alternative plans based on both the new bridge types and more traditional bridge such as timber trusses and stone arches. Commission meetings were spirited affairs, often with builders and bridge-company sales agents gathering on the banks of the stream to make presentations, display models, and, if charges are to be believed, sometimes offer kickbacks and gifts to the commissioners.

Regional and local variations in late-19th and early-20th century bridge types and designs reflect a variety of factors that influenced the choices of local officials. In particular regions of Pennsylvania, such as the more isolated northern tier counties,

building program, which by the late 1920s had grown to include more than 300 bridges including 28 larger river bridges, aggregating over seven miles in length (Gillespie 1913; Helick 1928: 616).

smaller truss bridge companies, such as the Groton Bridge Company of New York, either because of proximity or good salesmanship, built large numbers of pin-connected trusses from the 1890s to the 1910s. In the early 1890s Clearfield County favored pin-connected Pratt truss bridges fabricated by one of the nation's largest bridge builders, the King Iron Bridge Company of Cleveland, Ohio. In Lancaster County, local craftsmen skilled in timber framing continued to build Burr truss covered bridges, long after neighboring counties had adopted metal truss bridges.

There is little doubt that after the mid-1880s the Good Roads Movement quickened the pace of county and municipal bridge building, especially in counties nearest to urban areas. Growing populations in Delaware, Montgomery, Bucks, Berks, and Allegheny counties supported local road improvements. Groups such as the Allegheny County Good Roads and Tree Planting Association, and the Wheelman's Road Association of Bristol, Bucks County were able to influence local officials to grade and hard-surface roads and replace bridges so that residents could take rides into the surrounding countryside. By the early 1890s, the good roads reformers increasingly were supported by farmers who used the roads to transport perishable goods, such as vegetables, fruits, and dairy products, to nearby railroad depots for transshipment to urban markets. Farmers' organizations, such as granges and cooperatives, also worked with reformers for better roads legislation, not only lobbying federal and state officials for aid to local governments, but publishing pamphlets and magazine articles touting the potential benefits of good roads to their rural members. Especially after the introduction of RFD in the late 1890s, rural residents viewed improved roads and bridges as a means of ending rural isolation (Fletcher 1955: 321-327; Rhawn 1894: 39; Creasy 1901: 48).

Impact and Influence of the Prefabricated Metal Truss Bridge Building Companies

Although most rural counties and municipalities had limited funds for bridges, the late-19th-century interest in good roads was a boon to prefabricated metal truss bridge building companies. Beginning in the 1880s, builders increased their efforts to market prefabricated metal truss bridges to local governments, with many companies gaining dominance in local areas or regions of Pennsylvania. Bridge fabricators published catalogues, pamphlets and recruited sales agents who canvassed the county seats. The advertisements explained the ease of erection, low cost, durability, and strength of the patented designs (Darnell 1989: 42-46).

The history of the Phoenix Bridge Company of Phoenixville illustrates how bridge builders broke into the highway bridge market in the 1880s, marketing truss bridge types that had been developed in earlier decades for the railroads. Prior to the 1880s, the company had sold its bridges exclusively to the railroads, but finding the market for highway bridges expanding and the market for railroad bridges increasingly competitive, the Phoenix Bridge Company signed a deal with engineers Casper Dean and John Westbrook of New York City to serve as the exclusive salesmen and general contractors of Phoenix Bridge Company highway bridges. Dean and Westbrook

traveled the east coast promoting bridges with the patented Phoenix columns and connecting pieces, and seeking out large and small highway bridge contracts from towns and counties. From 1885 to 1895 Dean and Westbrook constructed more than 280 highway bridges, the majority in Pennsylvania, New York, and New Jersey. One of the finest surviving Phoenix bridges anywhere is Harrisburg's Walnut Street Bridge, fabricated at the Phoenix Bridge Company shops and erected by Dean and Westbrook in 1890. (Phoenix Bridge Company Order Books, 1885-1895).

The key to the prefabricated bridge builders' success was the establishment of foundries and shops for forming, drilling, assembling and riveting bridge materials before shipment to the bridge site to be quickly erected. Metal truss bridge builders required a cheap supply of structural iron and steel from rolling mills. The many iron and steel mills and access to major rail lines for shipment made Pennsylvania an ideal location for bridge builders. Between 1870 and 1900 over 100 bridge-building companies operated in the state. The number of prefabricated metal truss bridges erected on Pennsylvania roads numbered in the thousands⁷ (Darnell 1984: 58-70).

By the late-1890s, the prefabricated metal truss bridge industry began a restructuring. Competition among the smaller manufacturers led to price cutting, which in turn had led to falling profits and numerous bankruptcies. In order to maintain prices, the larger and dominant companies had resorted to price fixing, pooling, and dividing markets, that brought charges of corruption and illegal dealings from local officials. In 1900, after more than a year of rumors, the American Bridge Company formed merging 24 companies, or roughly fifty percent of the nation's bridge fabricating capacity in one company. Pennsylvania-based bridge builders included in the merger were the Pencoyd Iron Works of Philadelphia, the Shultz Iron Bridge Company of McKees Rocks, and the Keystone Bridge Works, Pittsburgh Bridge Company, and Shiffler Bridge Company of Pittsburgh. In 1901 American Bridge Company itself became a subsidiary of the U. S. Steel Corporation, thus revealing that the Carnegie interests had been

⁷Victor Darnell's Directory of American Bridge-Building Companies in America, 1840-1900 (Washington, DC: 1984) is the most comprehensive list of metal truss bridge fabricators. It is, however, by no means exhaustive, since many builders erected only a small number of bridges, and those bridges have long ago been lost. The reader is referred to the bridge survey forms for more information on specific builders. Among the builders referenced on survey forms for extant bridges are Canton Bridge Co. (Canton, OH); Dennithorne & Son (Phoenixville, PA); Erie Bridge Co. (Cleveland, OH); Fort Pitt Bridge Works (Pittsburgh, PA); Groton Bridge Co. (Groton, NY); Horseheads Bridge Co. (Horseheads, NY); King Bridge Co. (Cleveland, OH); Morse Bridge Co. (Youngstown, OH); Massillon Bridge Co. (Massillon, OH); Murray, Dougal & Co., (Milton, PA); Nelson & Buchanan (Chambersburg, PA); Penn Bridge Co. (Beaver Falls, PA); Pittsburgh Bridge Co. (Pittsburgh, PA); Schuylkill Bridge Co. (Pottstown, PA); Smith Bridge Co. (Toledo, OH); West Penn Bridge Co. (New Brighton, PA); Wrought Iron Bridge Co. (Canton, OH); York Bridge Co. (York, PA); Youngstown Bridge Co. (Youngstown, OH).

behind the merger movement from the outset. The American Bridge Company closed the smaller plants and consolidated its operations at its new facilities in the company town of Ambridge outside of Pittsburgh. The American Bridge Company, along with several other smaller independent steel manufacturers, such as the Phoenix Bridge Company of Phoenixville and the Pennsylvania Steel Company of Steelton, dominated the steel bridge business through the middle of the 20th century (Darnell 1984: 85-86; Engineering Record 1903).

Establishing the Pennsylvania State Highway System, 1903-1917

In the years from 1903 to America's entry into World War I in 1917, the Pennsylvania Department of Highways grew from a small agency created to administer state aid restricted to second-class townships into a large, professionally staffed department maintaining over 10,000 miles of state highway. During the department's formative years, the first Highway Commissioner Joseph Hunter and Chief Engineer W. R. D. Hall hired personnel, established working relationships with municipal and county officials, and developed the institutional framework to manage a statewide system of roadways. The period from 1903 to 1917 was marked by experimentation with new roadway technologies; state highway engineers tested new types of concrete and bituminous pavements, adopted motorized roadway-making equipment, took traffic surveys to determine traffic volumes and roadway capacities, and created standard plans for highway bridges using low-cost reinforced concrete and rolled steel beam materials.

The mandate of the department was improving rural roads in keeping with the spirit of the progressive Good Roads Movement. Under the 1903 Road Law, also known as the Sproul-Roberts Act, the department provided state aid only to the approximately 1,400 rural second-class townships in the state. No state aid was provided directly to counties, cities, boroughs, or first-class townships. The state aid program was voluntary, but Pennsylvania's second-class townships were quick to take advantage of the funding; between 1904 and 1908, townships in all but one of Pennsylvania's 67 counties applied for state aid.⁸ The program was so popular that the department turned down many requests for assistance. Roads selected to be built with state aid were no less than 16' wide, and were dirt and oil/tar or macadamized construction.

⁸Philadelphia, considered both a county and a first-class city, had no second-class townships and therefore was not eligible for state aid.

In addition to providing state aid to townships, the department also undertook “object lesson road” building in conjunction with federal OPR engineers. Object lesson roads were demonstration projects to show municipal officials how good roads could be built using modern roadway equipment and materials, usually donated by the manufacturers. Object lesson roads were graded, wide, and hard- or semi-hard surfaced, usually with gravel, stone, or concrete. Most object lesson roads were short projects, a mile or two in length on existing right-of-way, but beginning in 1905, the most ambitious demonstration project involved the reconstruction and widening of the approximately 82-mile long National Road and its bridges in Somerset, Fayette, and Washington counties (Pa. Dept. of Hwys. Biennial Report 1905-06; PH&MC 1995).⁹

In 1908 the department established the state’s first standard bridge designs. Prepared by the state’s first bridge engineer, Willis Whited, a former Pittsburgh assistant city engineer, the specifications were for the smaller culvert and drainage structures from 4’ to 20’ long, typical of township roads that were improved with state aid. While the recommended culvert types for smaller spans were vitrified clay pipes or reinforced-concrete slabs, the longer 20’-long bridges were encased steel stringer bridges with the deck slab poured to the bottom of the beam flanges.

Beginning in the early 1910s, townships were urged to contact the department for special assistance with longer bridges (greater than 20’) including encased steel stringer, thru girder, and truss bridges, and reinforced concrete arch, slab and T beam bridges. State engineers prepared the first standard designs for all of these bridge types prior to World War I. Bridge engineer Whited advocated that all bridge construction be supervised by an engineer or experienced foreman because the selection of bridge type and design was necessarily dependent on local conditions including area of waterway, foundation conditions, the type and weight of traffic, and knowledge of the cost of materials and labor. Arch bridges were recommended, for instance, only in locations with a good rock or gravel foundation. Reinforced concrete slab bridges were economical up to about 20’ span, and T beam bridges recommended for spans from 20’ to 30’. Steel stringer bridges, with rolled I-beams and concrete decks formed with corrugated metal tube liners (called jack arch decks), could be built economically for spans ranging from 15’ to 40’. Thru girder bridges were excellent for spans from 60’ to 80’ long but had the disadvantage of requiring special equipment for transporting and lifting the girders into place. Warren or Pratt trusses were recommended for bridges ranging anywhere from 70’ to 200’ span.

While economy was the main criteria for the bridge types and designs advocated by the state’s bridge engineer, aesthetics was also given consideration. The Pennsylvania

⁹PH&MC has prepared a National Register Multiple Property Nomination, "Historic Resources of the National Road in Pennsylvania, 1811-1945." The nomination recognized the significance of resources on the National Road, including those that date from the automobile era.

Department of Highways followed the federal Office of Public Road's advice that "a design may be in excellent taste and yet be almost totally devoid of ornamentation. A few simple panels and copings are usually sufficient to lend an attractive appearance provided the planes of the wingwalls, parapets, etc. are in proper relation to each other and the roadway." Accordingly, the department added few ornamental features to the bridges it recommended to township and county officials (Pa. Dept. Of Hwys, Biennial Report 1907-08; Burr and Hoyt 1912; Municipal Journal 1913; Moorehead 1913: 39).

By 1910 the state aid program as established in 1903 had produced over 740 miles of roads and bridges and was considered by most Pennsylvania law makers as moderately successful. The department's engineers and good roads advocates, however, felt otherwise. The state aid program lacked coordination of planning effort between the various townships. Neighboring townships often chose not to improve the same roadways, resulting in sections of improved highway ending at rutted ditches at township lines. Furthermore, the department had no control over which second-class townships chose to avail themselves of state aid; in the thinly populated mountainous sections of the state, many townships could not raise even the 25 percent funding needed to match state aid allotments. The uneven geographic distribution of improved rural roads was highlighted in a 1909 survey taken by the OPR; only the counties of Berks, Blair, Montgomery, Allegheny, Delaware, and Lebanon reported more than 10 percent of road mileage improved. An improved road was defined as any road that at a minimum had been graded and covered with a semi-permanent (earth or gravel) surface. Only slightly less than 2,000 miles of roads of a total of over 99,000 miles of roads in the state had been improved with and without state aid, and in some counties such as Fulton and Indiana, no roads had been improved at all (Hunter 1908; OPR 1911: 100-101; Uhler 1916).

State highway department engineers, good roads reformers, and automobile industry interests pressed forward a plan for an integrated system of state highways connecting county seats and major towns. Roads designated as part of the state highway system would be taken over by the department and improved and maintained by its own personnel. In this manner, the department would have greater control over where and how state funds were spent. The department found a powerful ally in State Senator William C. Sproul (1870-1928) of Chester, Delaware County, who sponsored a bill calling for the establishment of the proposed state highway system. Sproul, a newspaperman and manufacturer, was a political reformer and strong advocate of good roads, who also knew how to work within the state's powerful Republican Party machine. He served as Delaware County's state senator from 1896 to 1916, and was governor from 1919 to 1923. His political career was closely linked to the growth and development of the Pennsylvania Department of Highways. Sproul was a sponsor or co-sponsor of most all of Pennsylvania's important roads legislation from the 1896 to 1923, including the Sproul Act of 1911 that gave the department authority over 296 state routes and created a state highway system measuring approximately 8,500 miles,

80 percent of which were unimproved dirt roads (Dictionary of American Biography 1935: 484-485).

The Sproul Act of 1911 was landmark roads legislation that anticipated by ten years the federal act that required states to establish state highway systems in order to qualify for federal aid. The Sproul Act placed Pennsylvania at the forefront of the nation's highway developments, and made Pennsylvania's State Highway Department and State Highway System models for other states to study and copy. The Sproul Act brought sweeping change to roadway administration, beginning a process that diminished local road control in favor of departmental centralized control. Like most good roads legislation, the Sproul Act was designed primarily to benefit rural residents by providing access to cities and markets and free rural mail delivery. The roads also naturally benefitted the residents of principal cities, towns, and county seats, even though state-aid funding was not permitted for use on roads within the boundaries of the state's approximately 700 cities, boroughs, and first-class townships. Thus, state highway department activity was concentrated on the longer stretches of country road and not on the shorter sections of the routes passing through more densely developed areas (Pa. Dept. Of Hwys. Biennial Report 1911-12; Foote 1913: 361-362).

To function more efficiently under the increased responsibilities of the Sproul Act, the department reorganized and expanded. The department established 15 districts, each headed by a district engineer, who was in charge of all new construction, including bridges, and maintenance in a several county area. The central office in Harrisburg was organized as a "management division" to establish department policy, set engineering standards, and provide operational support to the districts. The district engineering offices were given a degree of latitude to determine construction priorities, and the organization of district engineering offices has continued to the present day. The current number of 11 districts was established in 1938 as part of the New Deal-era restructuring of the department (Municipal Journal 1913: 755; Biles 1920: 31-33).

The Sproul Act required the department to take over certain township roads but did not require that the state take over county-owned bridges on those same routes. Because the counties owned most of the longer bridges in the more populous sections of the state, the department did not for some years take direct responsibility for a large number of long-span bridges. Instead, the department played an advisory role and offered state aid to the counties that owned and maintained the bridges on the state routes. The department's bridge unit focused its efforts on replacing short span bridges and culverts that had been the responsibility of townships, and designing bridges for locations such as fords, ferries, at-grade railroad crossings, and highways on new alignments where no bridges had existed before. Not until 1929 did the legislature pass a law authorizing the department to take over the county-owned bridges on state highways (Uhler 1916: 801).

Willis Whited, the department's bridge engineer, issued instructions and standard plans to the district engineers for the construction of bridges on the state routes. These instructions were intended as guidelines and district engineers and their assistants were

encouraged to use the standard plans whenever practicable, but also told that “experience is a much better guide than any standard formula.” The final choice of bridge type and design was left to the district engineer, who presumably knew about local conditions, including the cost and availability of materials and labor.

Pre-1919 specifications for bridges on Pennsylvania state highway routes were for short-span structures, most measuring under 30'-long. For bridges in the 20'-to-30' range the two preferred bridge types were encased steel stringers and reinforced-concrete T beams, with concrete arches also an option if sufficient vertical clearance was available. The bridge specifications provided simple, unadorned economical designs with usually either solid concrete parapets or pipe railings. District engineers were encouraged to reuse old stone abutments if “of good square stone, well laid,” otherwise abutments and piers were to be rebuilt with concrete. When longer bridges were required than provided for by standard specifications, district engineers were to submit the plans to the state bridge engineer for approval but were encouraged to consider such standard types as riveted Warren pony trusses or plate girders (PA Dept. Of Highways, Bridge Plans, #S-1 to S-300, Engineering and Contracting 1915: 32).

The task of improving the state highway system, which was increased by 1,200 miles to a total of 9,700 miles of roadway in 1913, was an expensive undertaking. Even with increased revenues from motor vehicle license fees and large annual appropriations from the state budget, department administrators regularly noted that they lacked the necessary capital to improve all of the designated state highway routes. In 1916 Department Chief Engineer William D. Uhler (1915-1922) reported that the greatest problem facing the department was that too many miles of unimproved highways had been forced on the department without adequate funding. All of the department’s money was being used up on maintenance of earth- and stone-surfaced roads with little left over to upgrade the routes to the “permanent” bituminous- or concrete-surfaced highways and concrete or steel bridges that the department’s engineers desired. Furthermore, the legislature had “unloaded” on the department many miles of township road that had been neglected, or even abandoned, for years. To put these roads back in service required huge sums of money that the department simply did not have if it was also to maintain the nation’s largest state highway system (Uhler 1916: 797-799).

In 1913 the department was dealt a major financial blow when voters narrowly failed to pass a \$50 million bond issued that was earmarked for new road and bridge construction. The bond issue was opposed by the Republican party machine in Philadelphia primarily on the grounds that the rural highway program did not benefit urban areas and that the department was being used as a source of patronage for political rivals. Following the failure of the bond issue, the department undertook most new state highway construction cooperatively with counties such as Chester and Delaware that were willing to help pay for the highway improvements. The department also concentrated its efforts on particularly bad sections of important cross-state highways, such as the treacherous section of road running along the banks of the

Juniata River from Mifflintown to Lewistown (US 22), known as the Lewistown Narrows. The department's financial problems remained unresolved until after 1916, when events at the federal level prompted the state legislature and the voters to expand state highway funding (Municipal Journal 1913: 756-57).

Automobile Tourism and Trail Associations

The Sproul Act was not aimed at improving roads exclusively for automobiles, but for all travelers, including wagons and farm equipment. In 1911 the special road needs generated by automobiles were not yet apparent to highway engineers or road users. Nevertheless, prior to World War I, the automobile did contribute to the Good Roads Movement by sparking an interest in long-distance automobile travel. In the 1910s, small but ever increasing numbers of Pennsylvanians were taking to their automobiles to experience the "freedom" of the road. Despite difficulties with bad roads, early automobilists saw their cars as a means for a new type of personalized vacation. They did not have to rely on train and boat schedules, all they needed were good directions and knowledge of road conditions. There were, however, surprisingly few accurate road maps, and most people did not know the roads except within several miles of their own homes. The need for directions and marked routes was met by trail associations.

Trail associations promoted travel on specified routes or "trails" that generally ended at urban areas, such as Philadelphia and Pittsburgh. Included along the way were desirable tourist destinations such as the battlefield at Gettysburg or resorts in the Poconos. The tourist trails were not new but existing roads marked and described for the convenience of automobile travelers. In Pennsylvania the tourist trails were frequently marked by banded poles, such as the red, white and blue poles used on the Lincoln Highway. In most instances, the associations chose their routes over improved roads and bridges, but often they had no choice but to pass over country roads and across unimproved river fords. The designation of an unimproved road as part of a trail sometimes aroused local or state officials to improve roads or bridges along the route. Most tourist trails crossed several states.

The most famous of the trail associations was the Lincoln Highway Association, founded in 1913 to promote a paved coast-to-coast route from New York to San Francisco, including a stretch in Pennsylvania that followed portions of the old Pennsylvania Road (US 30). The Lincoln Highway was backed by wealthy automobile and parts manufacturers Carl Fisher (Prest-O-Lite Company, automobile headlights) and Henry Joy (Packard automobiles), who saw the coast-to-coast highway as personal dreams, as well as a convenient way to promote automobile sales and improved roads.

Although Fisher and Joy began with the intention of paving the entire route, the astronomical cost of the venture soon led them to pave only a few short demonstration sections and to plow their funds into promotion and recruiting local "consuls" (businessmen, lawyers, editors) to represent the association along the highway. The Lincoln Highway Association promoted the Pennsylvania section of its route as one of

the best maintained cross-state highways in the nation. In 1911, the route had already been marked as State Route 1 by the Pennsylvania Department of Highways. In 1915 travelers reported that the Pennsylvania state highway crews were out repairing and paving the road, except for some parts that had yet to be purchased from moribund turnpike companies. The greatest difficulty for Pennsylvania's cross-country motorists was climbing the steep Allegheny ridges where cars frequently overheated and broke down (Hokanson 1988:44-46).

The Lincoln Highway promoters successfully introduced the nation to the idea of long-distance interstate roads. They also spawned numerous imitators. By 1924, at least 250 marked trails crossed the United States. Most trail associations produced maps and magazines that reassured automobile tourists that the roads were passable, had adequate services, and led to desirable tourist destinations. In addition to the Lincoln Highway, tourist trails in Pennsylvania included the National Old Trails Road (State Route 11, redesignated US 40 in 1926), established in 1912 by the National Old Trails Road Association and following the old National Road across the state's southwest corner; the William Penn Highway, designated circa 1916 (State Route 3, redesignated US 22 in 1926) from Easton to Pittsburgh with a branch from Reading to Philadelphia (route of present day US 422); the Susquehanna Trail, designated ca. 1916-17, following the Susquehanna River from the Maryland border north to the New York border at Lawrenceville (present day US 15 north of Harrisburg, I-83 south of Harrisburg); and the Roosevelt Highway, designated circa 1919 (State Route 7, redesignated US 6 in 1926) across the northern top of the state (For a more complete list of Pennsylvania tourist trails and their histories, see Appendix I).

An unusual tourist trail was the Lackawanna Highway (US 11) from Scranton to Binghamton, New York. The Department of Highways built the road on the old right-of-way of the Delaware, Lackawanna, and Western Railroad (DL&W), which had abandoned the route in 1915 when it completed the Clark Summit-Halstead Cut-off. With the urging of automobile associations and local businessmen, the DL&W donated the right-of-way to the State of Pennsylvania. In 1917 the Department of Highways paved the route and built bridges, touting the road as one of the "most beautiful and safest" on earth because of the long tangents, easy curvatures, and low grades provided by the railroad right-of-way. The Lackawanna Highway was also one of the first routes in Pennsylvania to benefit from federal funding under the Federal Aid Act of 1916 (Rapelje 1919).

In Pennsylvania, the tourist trail associations' historic significance was primarily one of promoting automobile tourism through printed materials such as maps and magazines, and recruiting businessmen to advertise roadside fuel, food, lodging, and automobile repair shops. By the time the Lincoln Highway Association was established in 1913, the job of initially identifying and mapping Pennsylvania automobile routes had already been undertaken by the state highway department as part of the establishment of a state highway system in 1911; the trail associations merely adopted the numerically designated state highway routes (e.g. State Routes 1, 3, 7 etc.), promoting them with

new names, such as the Lincoln, William Penn, and Roosevelt highways. In some states other than Pennsylvania and similar northeastern states early infected with the Good Roads Movement, the trail associations played a much more active role identifying routes and were often the very first organizations to designate cross-state automobile roads that would later become state highway routes. This was especially true in the Midwest and South where many states did not establish highway departments and highway systems until the end of World War I.

The Pennsylvania Department of Highways historically approached the need for long distance automobile travel from a different perspective than the trail associations. Engineers did not wish to promote tourist destinations or scenic routes per se. In general, they wanted cross-state routes to follow the most direct path possible, to connect major centers of population, and to serve existing patterns of travel, only secondarily serving specific tourist sites or roadside businesses. State highway departments were in the job of building state highway systems, not just improving certain routes. State highway departments had an ambivalent relationship with the trail associations; the associations were important political backers of highway improvements but they also sometimes used their political influence to back improvements that engineers did not feel were justified by traffic volumes, existing traffic patterns of local importance, or the most efficient use of state highway funds. For instance, the Pittsburgh to Buffalo Highway Association was established in the mid-1920s to justify expensive improvements for specific roads in the vicinity of Indiana, PA, on one of several routes between Pittsburgh and Buffalo.

In the 1920s state highway officials began to complain that the tourist trail associations too often promoted branch and overlapping routes and did not maintain signage, failing to repaint stripes and replace markers as they were worn or lost. Automobile travelers reported confusion at intersections where telephone poles had multiple markings, striped like candy canes, indicating several different overlapping or branch trails; where old markers had not been removed for trails that had been relocated to better roads or disbanded; or where local businessmen placed unauthorized signs indicating lengthy and out-of-the-way alternative routes in order to lure travelers past their places of business.

In 1926, the American Association of State Highway Officials (AASHO), in direct response to the problems created by more than 250 named tourist trails in the United States, adopted a uniform system of US numbered highways to discourage the trail associations from placing their own highway markers in competition with state-designated routes (USDOT 1976: 109-110). The tourist trail markers were replaced by the now familiar shield-shaped signs bearing the US route number. By the late 1920s, most of the trail associations no longer served an important purpose and disbanded. Nonetheless, the names of the more popular tourist trails, such as the Lincoln Highway (US 30) and National Road (US 40), continued to be widely used, especially for bypassed sections of the old trails, and lived on in the names of gas stations, motels, restaurants, camp grounds, and attractions that had sprung up along the original routes.

2. The Golden Age of Pennsylvania Highways, 1917-1940

The Federal Aid System and Its Impact on Pennsylvania Highways, 1917-1929.

Pennsylvania's highway program prior to 1916 had been the largest in the nation in terms of total mileage incorporated into a state highway system (9,700 miles) as well as one of the most successful in terms of the total mileage of improved state highway (1,050 miles hard or semi-hard surfaced). Nevertheless, Pennsylvania's leading highway advocates and automobile enthusiasts realized that securing stable funding was the key to future improvements. The landmark 1916 Federal-Aid Road Act directly involved the national government in highway building and established a national funding formula. It provided \$75 million in federal money to be matched dollar for dollar by the states. Funds were available for the grading and surfacing of rural post roads, as well as for the construction of bridges and were apportioned among the states on the basis of population and total mileage of postal department certified roads. Federal aid road and bridge projects had to be initiated and supervised by state highway department officials, a system already in place in Pennsylvania, but lacking in many southern and western states. Funds were available for construction only, not to pay for highway department staff or administrative costs.

As part of the federal aid program, the Bureau of Public Roads (BPR) was charged with developing technical standards in cooperation with state highway departments, as well as with approving all project plans and specifications. The federal agency sponsored a convention out of which was formed the American Association of State Highway Officials (AASHO). AASHO became the primary forum for the discussion and formulation of technical standards for the nation's roads and bridges. By involving state officials in the standardization process, the BPR ensured that minimum standards would be cooperatively applied throughout the nation including Pennsylvania (Seely 1987: 46-65; USDOT 1976: 84-88).

The 1916 Federal Aid Road Act spurred the Pennsylvania State Highway Department to a new level of activity. The state legislature appropriated an unprecedented \$25 million dollars for the department, more than enough to match the available federal aid for new construction. Another \$20 million, from the Motor Licensing Fund, was earmarked for maintenance. Additionally, in 1918 the voting public overwhelmingly approved a 30-year, \$50 million state bond issue for road improvements. In 1921 the department received another financial boost when the state legislature enacted a state fuel tax. The one-cent-per-gallon tax was raised to three cents by the end of the decade with one-half cent of the tax returned directly to the county in which it was collected, where it could be used only for roads and bridges (Sproul 1919: 26; Public Roads 1919: 70-72; PA Dept. Of Hwys Biennial Reports 1919-1923).

Between 1917 and 1920, World War I restrictions on materials and labor temporarily interrupted almost all highway construction projects. The war did, however, highlight the need for good roads. During the war, freight car shortages and rail shipping bottlenecks led industries and manufacturers to ship freight by motor trucks. Two of Pennsylvania's highways of interstate character, the National Road and the Lincoln Highway, were declared war emergency routes by the federal government, and were ordered to be kept open. This was accomplished by the Department through a heroic effort during the severe winter of 1917-1918. Although small by today's truck standards, the 12- and 15-ton trucks used by the army and express companies tore apart Pennsylvania's gravel or thin bituminous roadways. The wartime lesson was not lost on either Pennsylvania voters or the Department; bond issue funding was earmarked only for properly drained, heavily-built roadways and bridges .

With wartime shortages at an end, road and bridge building activities resumed in earnest in 1920. The emphasis for the Pennsylvania Department of Highways was improving the system of more than 10,000 miles of state highway. Several standard grades of new highway construction were established based on traffic counts and the level of truck traffic using state routes. In 1923-24 the state conducted one of the nation's first comprehensive statewide traffic surveys gathering traffic counts from over 300 survey stations. The survey identified those state routes that were most heavily traveled, especially those serving a large number of trucks. These routes included the major cross state US-designated highways and the state routes radiating from urban centers such as Philadelphia, Pittsburgh, Erie, Reading, Allentown, and Scranton. The routes with the greatest level of truck traffic were targeted for heavily built concrete roadways while hard-surfacing with bituminous macadam was used on the more lightly traveled rural state highways. Standard minimum road width increased on the state highway system from 16' to 20', while major cross state routes such as US 1, US 22, and US 30 could be as wide as 40'. Routes were realigned eliminating steep grades and curves. By the late 1920s all but the most remote portions of the state highway system had been hard surfaced while the remaining routes had been graded and drained (Engineering News-Record 1931: 1028-29).

Activities and Influence of the Bridge Unit, 1920-1929

With the end of World War I, the Department of Highways geared up for the large job of expanding both its central office and district engineering staffs. To manage the cost, design, construction, and inspection of bridges, the Bridge Unit was reorganized with bridge engineers assigned to each district. During the 1920s, the bridge unit designed more than 1,400 new bridges and oversaw the maintenance of hundreds of other bridges included on the state highway system. The unit undertook the first detailed inspection of all bridges on the state highway system, and in addition reviewed and approved plans for all bridges built by second-class townships (BPR and PA Dept. of Hwys. 1928: 38).

Chief Engineer of Bridges was E. E. Brandow. Like most engineers, then and now, he stressed economy in the design of Pennsylvania's highway bridges. The design philosophy emphasized bridge utility and capacity, with aesthetics a secondary concern if it did not greatly increase the cost of the bridge. Bridge types and designs were driven by the cost and availability of materials and labor. After 1920 steel stringer and T-beam bridges were built more heavily in anticipation of heavier traffic and loads. Common to steel stringer, T beam and reinforced concrete arch bridges were well-proportioned concrete balustrades. The construction of greater numbers of steel stringer bridges in the 30'-to-60' range was made possible by Pennsylvania's steel industry. By the 1920s they had solved the problems of producing inexpensive rolled I-shaped beam sections ranging up to 36"-deep. The bridge unit developed longer-span bridge designs, preferring in most instances to use large riveted thru girder bridges, or in some cases rivet-connected Warren and Parker trusses. Open spandrel, reinforced concrete arch bridges were normally reserved for large river crossings, or cities and park settings where the aesthetically pleasing open spandrel design with architectural detailing was desired.

The emphasis on heavier construction was driven by careful analysis of the state's traffic conditions. Goods trucking was expanding rapidly, and the bridge unit adapted its designs to heavier 15-and 20-ton loadings. But, despite the bridge unit's forward thinking approach to bridge design, the engineers, like those throughout the United States, often found themselves struggling to catch up with the demands of the motoring public. In 1922, bridge engineer Brandow wrote that Pennsylvania built "all new bridges with a width of at least 24'." This at a time when bridge widths of 18' or 20' were still common place in less heavily trafficked states like Georgia and Nebraska (Municipal and County Engineering 1922: 197).

In 1923 the Department of Highways took a comprehensive survey of at-grade railroad crossings on the state highway system. The survey identified more than 1,200 crossings that were labeled as "exceptionally dangerous" because of the speed of trains, number of tracks, alignment of the roadway, and poor sight distances. Between 1923 and 1926 the department eliminated 251 grade crossings. Some eliminations were achieved by simply relocating the road, but 74 were eliminated by the construction of an overpass or underpass. The bridge unit designed most of these bridges using standard bridge types such as thru girder, T beam, and steel stringer bridges (BPR and PA Dept. Of Hwys. 1928: 29).

A special problem facing the bridge unit in the 1920s was working with counties to maintain county-owned bridges on state highway routes. The original 1911 state law had excluded county-owned bridges on state highways from state ownership. By the mid-1920s, however, the bridge unit reported that the state was maintaining or paying for the replacement of most of the county-owned bridges. Many of the county bridges were wood truss (covered) bridges, metal truss bridges, stone arch bridges, and wood stringer bridges, which dated to the pre-automobile era. In order to clarify the bridge

ownership question and to make it easier for the department to bring county-owned bridges on state highway routes up to standards, in 1929 the legislature passed a law authorizing the department to take over all county and township bridges on state highway routes. The law transferred more than 2,000 bridges to state ownership (PA Dept. of Hwys., Biennial Reports, 1929-30; Public Law 1054, No. 408, 1929).

Pennsylvania Road and Bridge Building During the Great Depression, 1929-1940

In October, 1929, the stock market crashed and the Great Depression hit the nation. While the nation's economy languished and unemployment soared, funding for road administration was little affected by the country's economic downturn. On the federal level, the Hoover administration and the BPR strove to maintain the basic, efficient intergovernmental relationships that had been put in place by the Federal-Aid Road Acts. One of the few existing programs in place for distributing federal funds on the state and local levels when the Depression hit, the federal-aid apportionments continued to flow to the states. State-generated road-user revenues such as motor vehicle registration fees and gasoline taxes remained surprisingly stable (USDOT 1976: 123-124).

In Pennsylvania the economic crisis reached critical proportions with more than 900,000 workers out of jobs in 1931. Governor Gifford Pinchot (1931-1935), pledged state government programs to the relief effort. As part of a campaign promise "to get farmers out of the mud" and create thousands of jobs, Pinchot secured legislation adding more than 20,000 miles of township roads to the state highway system. The Department of Highways mobilized, hiring contractors to pave roads and build bridges. In many instances, contractors were required to hire laborers from unemployment pools. The department also directly hired tens of thousands of unemployed workers for its own maintenance and construction forces. Under the program, as many as 250,000 workers were employed from 1931 to 1933. The lightly built 16'-wide roads covered with stone, slag or gravel, although not up to the highest road building standards of the day, were called "Pinchot Roads" by grateful residents (Stevens 1956: 627-28; Lewis 1933: 309).

The typical Pinchot Road bridge was a standard low-cost steel stringer bridge composed of I-beams with welded angle crossbracing between the beams. The bridge had a timber laminated deck and welded steel railings composed of angles and channels. The preferred substructure was to reuse old stone abutments and piers with the addition of new concrete caps when possible. When a new substructure was required additional abutments or piers were built with stone, if locally available, or otherwise concrete. The bridge unit prepared standard plans with material complete tables for every span length up to 76'. The depth of I beams could be from 6" to 36" depending on the length of the span and the loading. About the only erecting

equipment required were portable welding outfits. The beams were usually rolled into place, although A-frame derricks were available. The bridge program was tied to work relief programs; out-of-work stone masons, painters, and welders were given preference for bridge work. By mid-1933, more than 460 low-cost steel stringer bridges had been built. The standard steel stringer design proved so successful that it continued to be built in great numbers through the mid-1950s. Over 850 pre-1957 examples of the low-cost steel stringer bridge have been identified by the survey, with more than 40 dating to before 1935. (Engineering News-Record 1933: 709-710).

The success of state relief projects such as Pennsylvania's Pinchot Roads inspired the Roosevelt administration to sponsor similar projects throughout the nation as part of the New Deal begun in early 1933. Large federal highway appropriations in 1933, 1934, and 1935 were made available through the regular federal aid system and also through the National Industrial Recovery Act (NIRA) of 1933, the Hayden-Cartwright Act of 1934, and the Emergency Relief-Appropriation Act of 1935. These acts channeled money to the federal-aid system of highways, and, for the first time, to urban roads and secondary farm-to-market roads not on the federal-aid system.

Additional federal funds were made available in 1935 through the Public Works Administration (PWA) and Works Progress Administration (WPA) for hiring thousands of workers to build roads and bridges for state, county, and municipal highway projects. The Pennsylvania Department of Highways employed 143,000 WPA workers at the peak of the program in 1936-37. The department's WPA workers assisted with paving, widened existing roads, built up shoulders, improved drainage, built bridges and planted flowers and trees as part of roadside beautification. Bridges built with WPA assistance did not differ from other standard-design bridges of the period, and the department's bridge plans and records do not differentiate WPA-built bridges from those built using other funding and employment sources. There is no available record of how many bridges were built by WPA workers, but the number was considerable. The survey has identified over 1,250 surviving state-owned bridges built from 1936 to 1940, more than for any other five year period from 1911 to 1955. (PA Dept. of Hwys., Biennial Reports, 1935-39; USDOT 1976: 125-126).

The Civilian Conservation Corps (CCC), one of Roosevelt's pet projects, provided temporary jobs for young men building recreation and conservation projects, mostly in national and state forests and parks. National forest bridges were usually built to plans prepared by the federal Bureau of Public Roads (BPR). In Pennsylvania the CCC developed fourteen of the eighteen state parks opened between 1931 and 1940. The work performed by the CCC crews included clearing of campsites, construction of roads, trails, bridges, and water and sewerage systems, and the building of a variety of service, administrative, and recreational buildings and facilities.¹⁰

¹⁰CCC-built resources have been considered for the National Register as part of the "Emergency Conservation Work (ECW) Architecture in Pennsylvania State Parks: 1933-1942,

Pennsylvania's state government embraced the New Deal policies and expanded upon them with its own highway programs to bale out financially strapped townships and municipalities. Even before the Depression, the Pennsylvania Department of Highways had advocated expanding the state aid program to include the “urban” first-class townships, boroughs, and cities that had been excluded from the original funding formulas. In many cases, these municipalities lacked the tax base for undertaking large-scale road and bridge improvements or for maintaining the routes to the same standards as the department. Thus, newly paved state highways frequently turned into unimproved roads, especially at the boundaries of smaller cities, boroughs and first-class townships. With the onset of the Depression, municipalities were in an even less advantageous financial position; if the municipal roads were to be brought up to standards, the department's policy makers concluded that local governments needed to be relieved of tax burden and an even greater portion of the state's roads and bridges brought under the direct care of the department. In 1931 the legislature passed a law authorizing the department to provide special funding to municipalities and counties to improve sections of state highway that passed through boroughs and cities. Finally, in 1936 the Department of Highways took over the connecting sections of state highway in first-class townships, boroughs, and cities, and extended its obligations to maintaining urban bridges. By the same law, the department was authorized to acquire the state’s remaining private toll bridges.

An additional component of the New Deal highway program was the elimination of hazardous railroad grade crossings by separating vehicular and train traffic. With both locomotives and automobiles increasing in size and power, the problem of providing for safe and efficient crossings was becoming more widespread. From 1932 to 1941, the federal government made available several hundred million dollars to the states to build more than 2,100 grade-crossing elimination bridges and to install thousands of automated train-activated protective signaling devices. The Pennsylvania Department of Highways used the funding to supplement its existing grade crossing elimination program, eliminating 507 dangerous intersections.

The most spectacular New Deal project did not involve the Department of Highways, but the independent Pennsylvania Turnpike Commission. In May 1937 the Commission was formed with the objective of building the nation's first modern, limited-access, four-lane highway. When its bonds found few purchasers on the open market, the federal Reconstruction Finance Corporation and the Public Works Administration stepped in, funding what they saw as a massive unemployment relief program. Using the graded right-of-way and abandoned tunnels of the old South Penn Railroad, the turnpike across the Allegheny Mountains ushered in the era of high-speed automobile travel and marked the development of new highway design standards. The original turnpike was a 160-mile-long limited access highway that was built from Irwin to Carlisle and opened to traffic on October 1, 1940. An immediate success, the turnpike averaged 26,000 vehicles per day, easily enough to pay off the bond issues. More important, the turnpike demonstrated the value of limited-access highways and ushered in a new era of highway construction that would begin in earnest after World War II.¹¹

In summary, the impact of the New Deal was to expand the state government's responsibility for roads and bridges. The New Deal marked a significant shift in state highway policy to include urban highways in addition to the traditional farm-to-market roads and township roads. From 1931 to 1940 the state highway system expanded from over 10,000 miles of roadway to over 40,000 miles of roadway. As a result, the department's bridge responsibilities grew nearly fourfold: in 1930 the department maintained 4,300 bridges; by 1940, the department was responsible for building and maintaining over 18,000 bridges, more than 75 percent of all the state's highway bridges (PA Dept. Of Hwys. Biennial Report, 1939-1940).

3. World War II and the Postwar Highway System, 1941-1956

Planning the Postwar Highway System, 1941-1945

The great national highway boom that began in the early 1920s and continued through the Great Depression came to an end when the nation mobilized for World War II. The federal Office of Defense Mobilization restricted road-building supplies such as steel and asphalt in June 1941, and gas rationing sharply curtailed tax revenues for highway construction and maintenance beginning in April 1942. State highway departments worked with reduced staffs after employees left for the armed services. Nationally, federal aid highway projects fell from an all time high of 12,936 miles in 1941 to only 3,035 miles in 1945 (Seely 1987: 177).

Pennsylvania's Department of Highways had entered the 1940s optimistically, ready to launch a new, more scientific design program of seven highway classes whose different characteristics depended on traffic load. But America's entry into the war

¹¹ The bridges owned by the Pennsylvania Turnpike were not evaluated as part of the PADOT Historic Bridge Inventory.

changed everything. Federal funding concentrated on National Defense Highway Projects, designed to improve access to military installations. Road building activities in Pennsylvania centered around Fort Indiantown Gap, the New Cumberland Army Depot, and army and navy industrial plants throughout the state. One of the largest wartime projects was the relocation of US 22 for 13 miles east of Harrisburg on the route to the Indiantown Gap Military Reservation. Begun in 1944, the three million dollar project paid for the construction of a four-lane median divided highway on a straightened alignment with low grades. Another wartime project of note was the Industrial Highway (Essington Avenue) from Chester to Philadelphia. Constructed beginning in 1943, the Industrial Highway consisted of a 36'-wide divided roadway with raised medians and several large continuous steel stringer bridges. The highway served the factories and shipyards along the Delaware River near the present location of the Philadelphia Airport (Roads and Streets 1944).

Shortages in key materials required the bridge unit to redesign bridges using unreinforced concrete, rubble stone abutments, and wood plank decks. District bridge engineers made use of salvaged materials and abandoned railroad steel girder bridges. Wartime traffic punished Pennsylvania roads and bridges. Heavy truck loads destroyed many miles of lightly built roads and bridges, especially in industrial and coal mining areas. The department estimated in 1943 that \$500 million would be necessary following the war simply to rehabilitate roadways (PA Dept. Of Hwys. Biennial Report 1942-43).

Although most of the wartime effort focused on temporary repairs and deferred maintenance, department policy makers looked beyond repair work, planning for the postwar period and the construction boom that was seen as a necessary component of postwar economic recovery. The initiative came from Washington, where the BPR used the postwar planning process to build support for urban expressways and a system of free interstate superhighways. In 1939 the BPR had sponsored the publication of *Toll Roads and Free Roads*, a master plan advocating a system of limited-access, express highways linking urban centers. The expressways were seen as a remedy to urban traffic congestion and a realignment of federal highway policy from its traditional rural roads emphasis to a more comprehensive approach to urban and rural highways.

Toll Roads and Free Roads came out squarely against toll road arrangements like the Pennsylvania Turnpike, constructed from 1937 to 1940. Despite the enormous success and popularity of that roadway, BPR Chief Thomas MacDonald feared that self-liquidating toll roads undermined the federal-aid funding formula and its dedicated fuel tax upon which the BPR and state highway departments had built their financial stability. The Federal Aid Highway Act of 1944 granted the BPR's wish, providing \$125 million for the planning, acquisition of right-of-way, and construction of expressways in urban areas and large funds for the upgrade of U.S. highways. The 1944 Act signaled a fundamental shift in federal highway policy away from rural road systems. Pennsylvania lawmakers, however, opposed the BPR's free road policy, preferring to fund, long-distance, limited access highways with revenue from tolls. The Pennsylvania Turnpike

Commission undertook a massive program to extend the turnpike from state line to state line. As a result, the Department of Highways was largely left out of the planning for the new cross-state trunk lines built by the turnpike.

Following the BPR's lead, the Pennsylvania Department of Highways proposed an ambitious postwar program of highway construction. The department called for four-lane, limited-access highways and bypasses to relieve traffic congestion around urban areas like Philadelphia, Pittsburgh, Harrisburg, and Allentown. In 1945 the legislature passed a law providing the department with the authority to deny adjacent property owners access to routes the department designated limited-access highways. Intersections at grade could be eliminated by constructing grade separations, relocating intersecting highways, or closing the intersecting highways (Van Riper 1955: 107).

From 1944 to 1945 with the help of consulting engineers (to compensate for wartime manpower shortages) the department laid out Philadelphia's Schuylkill Expressway, Pittsburgh's Penn-Lincoln Parkway, the Lehigh Valley's US 22 realignment, and the Harrisburg-York expressway (I-83). Special attention was also given to upgrading US highways between major urban centers. Plans were made for widening the highways to three or four traffic lanes, some with median dividers. To supplement the urban expressway program and appease the department's traditional rural backers, the department also proposed a large scale paving program for secondary highways in rural areas (PA Dept of Hwys. Biennial Report 1945-46).

The Postwar Highway Program in Pennsylvania, 1946-1956

The department began working on its postwar program immediately in 1945 but quickly ran into complications. Wartime traffic had taken an even heavier toll on Pennsylvania's roadways than had been anticipated, driving up rehabilitation costs, as did postwar inflation, which made goods and labor much more expensive. Almost at once, the Department revised its \$500 million rehabilitation estimate to \$825 million, and slowed the pace of construction contracts awards waiting for inflation to come under control (Engineering News-Record 1947:137-38).

Countering these cost increases was a record level of federal aid, now set at \$24 million dollars for Pennsylvania, and, beginning in 1945, a one-cent increase in the state's liquid fuels tax. The state's total revenue from highway users was now the second highest in the nation. In 1950 the legislature further increased funds available to the department by the creation of a State Highway and Bridge Authority to issue bonds for \$40 million earmarked for urban expressway projects. The department used the funding to launch the nation's largest postwar highway and bridge building program. As a by-product, it assumed even greater control over road administration. For the first time, the Department began making direct grants to all of Pennsylvania cities and

boroughs for the purpose of improving local streets and building express highways in and around urban areas. Appropriations also increased for the maintenance and improvement of local rural roads in second class townships..

But the funding increases still could not keep pace with the explosion in vehicular traffic and the associated maintenance costs for roads and bridges. Americans released their pent up consumerism and went on a car buying frenzy. Between 1948 and 1950 more than 45 million vehicles used Pennsylvania's roadways, a significant portion of them trucks carrying increasingly heavy loads to and from Pennsylvania's industries. The growing number of cars and trucks created congestion, especially in urban areas, such as US 30 through York, Lancaster and Philadelphia, US 1 in Philadelphia, and US 22 through Allentown, Harrisburg, and Pittsburgh. The postwar boom also revived the state's tourist industry, which had languished during the Great Depression and World War II. The increasing number of vehicles influenced the roadside landscape and resulted in the rapid development of commercial strips and accelerated rates of suburbanization (Van Riper 1954: 107).

By the end of 1954 the department had more than 100 miles of access-controlled highway, most of it short stretches of urban expressways and bypasses. The department's largest postwar expressway project and crowning achievement was the Penn-Lincoln Parkway in Pittsburgh. The 9.5-mile-long parkway from downtown to the intersection of US 22 east of Forest Hills was constructed from 1947 to 1953. The four- and six-lane divided, limited-access highway was designed to bring traffic from three major highways (US 22, US 30, and the Pennsylvania Turnpike) into downtown Pittsburgh. As an engineering project, the Penn-Lincoln Parkway was at its time considered "the most complex" parkway project ever attempted in the United States because of Pittsburgh's rugged and hilly terrain. In order to maintain grade, shallow curves, and limited access, the parkway included viaducts, railroad underpasses and overpasses, a tunnel, difficult drainage, and complicated interchanges through a heavily built-up area. The parkway featured 34 bridges of a variety of types and designs including open spandrel steel arch, rigid frame, continuous deck truss, and plate girder bridges (Roads and Streets 1944: 62-66; Schmidt 1947: 74-75).

The Department's bridge unit was incredibly active in the immediate postwar period, preparing designs for over 1,000 bridges. Steel I beam and reinforced concrete structures still dominated, but the department continued experiments begun during the war with rigid frame designs and precast, prestressed designs. In 1950, the three-span Walnut Lane Memorial Bridge, the first important prestressed concrete beam bridge designed and built in the United States was completed by the City of Philadelphia. That same year, the state highway department bought eight small, prestressed bridges from the Concrete Products Company of Pottstown. By 1953, the state had purchased at least 47 precast prestressed bridges, including a five-span, 250'-long prestressed box girder bridge at Gleniron. The Department's bridge unit worked in cooperation with

Concrete Products making Pennsylvania a leader in the development of the new prestressed concrete bridge material (Engineering News-Record 1953: 35-38).

From 1946 to 1956, Pennsylvania's highways saw significant physical improvements. From a highway public policy standpoint, however, the period was one of tentative steps toward the conclusion that what the state, and indeed the nation, wanted was an integrated system of limited-access interstate highways. While most observers concluded that limited-access interstate highways were desirable from a convenience of travel standpoint, just what government agency should be responsible for the roads, and whether to fund these highways by tolls or taxes continued to be major points of political disagreement. In Pennsylvania, the toll versus free road debate was dominated by the Pennsylvania Turnpike Commission, which used its financial success and political strength to promote itself as the logical choice to build the new system of limited-access highways. The commission saw the Pennsylvania Turnpike, which had been extended from Carlisle to north of Philadelphia and from Irwin to the Ohio state line from 1948 to 1951, as the trunk interstate highway from which all other interstate highways would extend. In a 1954 brochure, the commission unveiled a proposal that would have led to the construction of hundreds of miles of new turnpike of an interstate character. The proposal included a continuation of the Northeast Extension (then under construction from north of Philadelphia to Scranton) to the New York State line; a connection from the State of Delaware near Chester, PA, to the main turnpike north of Philadelphia; an extension from Harrisburg to Gettysburg and the Maryland state line; a connection from Pittsburgh to Erie, and another running south to the West Virginia state line; and an east-west highway across the state's northern tier. The turnpike's proposal essentially laid out what today we know as I-476, I-95, I-80, I-81, and I-79.

In the end, however, events at the federal level overtook the turnpike commission's proposal, shifting the burden of funding from tolls to a federal fuel tax. By 1954, despite the popularity of toll roads in Pennsylvania, national support for toll roads had begun to ebb. In 1956 President Eisenhower signed the Interstate Highway Act, providing \$25 billion over a three year period for interstate highways. In Pennsylvania, the 90 percent federal funding formula shifted the responsibility for interstate highways from the turnpike commission to the state highway department. In 1956, the Department of Highways adopted the turnpike commission's 1954 blueprint and in coordination with neighboring states began to layout the right-of-ways for the new interstate highway system. The department quickly geared up for the new construction, which began in federal fiscal year 1957-58 (Seely 1987: 204-223; Cupper: 30-32).

By 1956, when Congress passed the act creating the Interstate Highway System and launched a new era in American highway history, the administration of Pennsylvania's roads and bridges had reached maturity. In place was a system of intergovernmental cooperation involving federal, state, and municipal officials, but with the largest burden placed on the state highway department. In under 75 years, bridge design and construction had gone from the age of the horse and buggy to the age of the automobile. Bridge materials of the earlier age -- native timber, stone, and cast and

wrought iron -- had given way to the materials of the late-20th century -- high alloy steel, reinforced concrete, and prestressed concrete.

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APPENDIX 1

Early State Highway Routes and Tourist Trails

In 1911 the Sproul Road Act was passed, designating approximately 8,500 miles of existing Pennsylvania roadways as the state highway system. The guiding principal was to link the state's county seats and major population centers and to serve the rural areas through which the state highways passed. The state highway department boasted that Pennsylvania "was one of the first states to give trans-state thoroughfares a single numerical designation." The numbered state highways followed cross-state travel routes previously established by the early byways and turnpikes.

Three principal east-west routes were recognized as state highway routes beginning in 1911. The most southerly, from Philadelphia to Pittsburgh, was designated Route 1; it approximated the Pennsylvania Road and would become part of the Lincoln Highway in 1913. Across the middle part of the state, from Easton to Pittsburgh, was a system designated as Route 3; it would become known as the William Penn Highway in about 1916. Route 7, the northernmost system, began at Port Jervis and ended at Erie; it would become known as the Roosevelt Highway in 1919. These routes in combination with dozens of other state routes would form the nucleus of the state's highway system serving cross-state, regional, and local traffic.

These and other cross-state routes were promoted by automobile tourist associations, such as the Lincoln Highway Association, William Penn Highway Association, and the American Automobile Association. The associations promoted travel on specified routes, or "trails" that generally included desirable tourist destinations. Most trail associations were loosely organized by groups of businessmen along their routes, who through magazines, maps, and brochures reassured automobile tourists that the roads were passable and had adequate services. They also lobbied local and state governments for road improvements. By the mid 1920s, 15 tourist trails were recognized by the State Highway Department in its publication, *Pennsylvania Highways: Facts Motorists Should Know* (1926), but this was by no means a full accounting of the tourist trail associations. By one estimate, at least 50 tourist trail associations were active in Pennsylvania in the 1910s to the 1920s.

The Pennsylvania Department of Highways approached the need for long distance highway travel from a different perspective than the trail associations, and its annual reports made very few mentions of tourist trails. Department engineers, while recognizing the need for cross-state trunk routes, felt that the trail associations too often promoted branch and overlapping routes. In 1926, the American Association of State Highway Officials (AASHO) adopted a uniform system of US numbered highways to discourage the trail associations from placing their own highway markers in competition with state-designated routes (USDOT 1976: 109-110). In general, state highway engineers wanted state highways to follow the most direct path possible, to connect

major centers of population, and to serve existing patterns of travel, while only secondarily promoting automobile tourist destinations. The department undertook staged improvements designed to improve the most heavily trafficked sections of highway, often those serving regional or local populations. For example, in 1920 State Route 7 (Roosevelt Highway) was a hard-surfaced, improved highway in the vicinity of Scranton, but 50 miles west of Scranton was still a seasonally impassable dirt road.

Throughout the 1920s and early 1930s, the Pennsylvania Department of Highways undertook a series of staged improvements that significantly changed the physical character of the tourist trails and early state highway routes. Roads were graded and surfaced with bituminous macadam or concrete, and widened to three or four lanes to provide passing lanes for trucks and slower traffic. State highway improvements included the construction of hundreds of bridges and culverts. More often than not, the bridges were standard T-beam and steel stringer designs with only a few concessions given to aesthetic details such as balustrades and paneled parapets. Before 1930, major river crossings were sometimes bridged with attractive open spandrel arch bridges.

After World War II, Pennsylvania's highway department undertook another series of major improvements to the US numbered highways to upgrade them for safe and efficient travel by modern automobiles and trucks. On heavily traveled sections of road, the highways were dualized. Design standards for gradients and curves often necessitated the realignment of the routes, and in many cases required the acquisition of entirely new rights-of-way. Portions of the old routes were abandoned or retained as local roads. Numerous bridges were rebuilt or replaced to meet modern highway requirements for wider roadways and heavier loads. Because the post-1945 improvements were based on national standards established by AASHO, the new highways were similar to those in other states. Today, only short bypassed sections of the original tourist trails and early state highways remain without significant alterations.

Pennsylvania's Principal State Routes and Tourist Trails, ca. 1925.

<u>Route and Name</u>	<u>From/To & Federal/State Route Numbers (Approx.)</u>
Route 1 - Lincoln Highway Philadelphia to Pittsburgh on US 1 and US 30 Binghamton, NY, to Philadelphia (US 11 from Binghamton to Scranton, and SR 611 from Scranton to Philadelphia) Pittsburgh to Easton on US 22, with a branch from Reading to Philadelphia on US 422	Route 2 - Lackawanna Trail Route 3 - William Penn Highway Route 4 - Susquehanna Trail

Lawrenceville to New Freedom (Lawrenceville to Harrisburg on US 15, local roads parallel to I-83 from Harrisburg to New Freedom)
 Erie to Philadelphia (Erie to Port Matilda on US 322; local roads from Port Matilda to Water Street; from Water Street to Harrisburg on US 22; old SR 41 from Harrisburg to Lancaster; Lancaster to Philadelphia on US 30)
 Dubois to MD state line south of Meyersdale on US 219
 Erie to Port Jervis, NY, on US 6
 Erie to Waynesburg (SR 8 from Erie to Pittsburgh, US 19 from Pittsburgh to Waynesburg)
 Conneaut, OH, to Northeast, PA, on US 20
 Pittsburgh to Bradford (Pittsburgh to Black Lick on US 22; Black Lick to Dubois on US 119; Dubois to Bradford on US 219)
 New Alexander to Addison on US 40
 Baltimore, MD to Philadelphia on US 1
 Route 17 - Ben Franklin Highway New Castle to Philadelphia on US 422
 Route 20 - Buchanan Trail

Route 5 - Lakes to the Sea Highway
 Route 6 - Old Monument Trail
 Route 7 - Roosevelt Highway
 Route 8 - William Flinn Highway
 Route 9 - Yellowstone Trail
 Route 10 - Buffalo to Pittsburgh Hwy.
 Route 11 - National Road
 Route 12 - Baltimore Pike
 Emmitsburg, MD to Mt. Union on SR 16, US 30, and US 522

In order to assist with the evaluation of historical significance of bridges located on old state routes and tourist trails, historical sketches of several of the trails have been developed.

State Route 1 (Lincoln Highway)

Of all Pennsylvania's early tourist trails, the Lincoln Highway (est. 1913) possesses the greatest historical significance. It was the first automobile road to cross the United States. The Lincoln Highway Association was the first automobile tourist association aggressively to promote a tourist trail, and the model association on which most later associations were based. Most of all, the Lincoln Highway, more than any other early highway, captured the spirit of progress that stimulated automobile and highway improvements in all parts of the country.

The Lincoln Highway follows the present-day route of US 1 from Trenton, NJ, to Philadelphia, and US 30 from Philadelphia to Pittsburgh, but it has many bypassed loops including one very long stretch on SR 462 from Lancaster to York. Most recently, the several routes of the Lincoln Highway in Pennsylvania have been carefully

researched in Brian Butko's Pennsylvania Traveler's Guide to the Lincoln Highway (1996).

Carl Fisher, founder of the Prest-O-Lite Company, maker of automobile headlights, was the leader and founder of the Lincoln Highway Association. In 1913 with the backing of the automobile industry, he mapped a trans-continental highway, without tolls, in memory of Abraham Lincoln. The association linked existing roads into a 3,389-mile highway across the country, and simply hoped that local and state governments would improve their own sections. The association's timing was ideal, catching the wave of state sponsored highway improvements sweeping the nation. Aided by federal funds appropriated by the Federal Aid Act of 1916, the route had become a practical trans-continental highway by the early 1920s.

In 1911, the Pennsylvania Department of Highways took over the old Lancaster Pike and Pennsylvania Road from Philadelphia to Pittsburgh, numbering the highway State Route 1, in recognition of its importance as the state's leading thoroughfare. As owner and caretaker of the highway, the department has been the primary developer of the highway and its bridges since the Lincoln Highway's inception.

The state highway department's construction policies did not distinguish the Lincoln Highway from other state routes and US highways. For this reason, the Lincoln Highway's bridges and roadway differ little from standard state highway department designs. In general, the Lincoln Highway was among the first state highways to be improved with concrete pavements, wider traffic lanes and shoulders, turning and passing lanes, bypasses, and roadside beautification, but the improvements were applied selectively and at the discretion of the state highway department's district offices. Thus, improvement of the route proceeded unevenly. For example, the section east of Lancaster concrete paved and three lanes wide by the early 1930s. But the section east of Bedford was still a two lane, bituminous pavement from the 1920s to the 1950s, when truck passing lanes were added. While some sections of the Lincoln Highway maintain the character of the 1930s to 1950s highway, perhaps only a few small bypassed sections retain their 1910s and 1920s character.

A similar characterization can be applied to the Lincoln Highway's numerous roadside attractions and services: the diners, motels, campgrounds, gas stations, souvenir stands, and historic sites. Most of the highway's extant roadside attractions and service buildings date from the 1940s and 1950s. The commercial roadside of the 1910s to the 1930s was much more modest, and dominated by campgrounds, small complexes of cabins, tiny gas stations without service bays, and tearooms and boarding houses, often located in private residences and older taverns.

A five-county section of the Lincoln Highway from Caledonia State Park to Irwin (Franklin County to Westmoreland County) has been identified by PHMC in a draft National Register Multiple Property Nomination, Historic Resource of the Lincoln

Highway (1997) and a context prepared. The roadway has been given a period of significance from 1750 to 1947, recognizing the route's historic importance from the French and Indian War (1756-1763) to the boom in automobile tourism following World War II. The bridges along the route have not been specifically addressed as a historic property type.

A goal of the Historic Bridge Inventory will be to develop and assess the historical significance of approximately 60 bridges dating from the late-19th century to the 1950s on the Lincoln Highway and its bypassed sections. A full assessment of these bridges is pending field investigations and further research.

State Route 2 (Lackawanna Trail)

The Lackawanna Trail, traversing the eastern border of the state and following modern-day SR 611 and US 11 from Philadelphia to Binghamton, NY, was established as a tourist trail about 1917. The route appears to have derived its name from the Delaware, Lackawanna & Western Railroad, which in 1915 abandoned part of its line between Scranton and Binghamton. The railroad right-of-way was given to the State of Pennsylvania in 1917, and the highway department constructed a new highway on top of the old railroad grade. The section of the Lackawanna Trail (US 11) north of Clark Summit was one of the first federal-aid projects in Pennsylvania. No bridges associated with the early development of the Lackawanna Trail appear to have survived.

The southern section of the Lackawanna Trail (SR 611) was noted primarily as a route used by automobile tourists traveling to the Poconos summer resorts. By the mid-1920s, the area boasted more than 2,000 hotels, camps, and summer retreats.

State Route 3 (William Penn Highway)

The William Penn Highway follows the present-day route of US 22 east from Pittsburgh, touching on Blairsville, Hollidaysburg, Lewiston, Harrisburg, Lebanon, Reading, Allentown, Bethlehem, and Easton. The trail also had a branch from Reading to Philadelphia (US 422). In 1911 the entire route from Easton to Pittsburgh was designated State Route 3 by the state highway department.

The William Penn Highway has little in its history to distinguish it from other tourist trails and US highways. The route was promoted primarily by local businessmen along the road, who advertised automobile supplies and repairs, lodging, food, and roadside attractions. The earliest mention of the William Penn Highway occurred in 1916. The route was first promoted by civic leaders in the Easton-Bethlehem area. In 1916 the local portland cement industry helped pay for the construction of an 8-mile long, concrete-paved object lesson road on the right-of-way of an old turnpike connecting Easton and Bethlehem. The new road was renamed the William Penn Highway. In 1917 the concrete highway was extended to Allentown. Apparently, the Easton-Bethlehem-Allentown group promoted all of State Route 3 as the William Penn

Highway, at the same time recruiting businessmen from other towns and cities along the route. The William Penn Highway was included as part of a transcontinental tourist trail called the Pikes Peak Ocean to Ocean Highway, also established in 1916. This highway featured as its destination the Pikes Peak, CO, attraction, a privately built 20-mile-long highway to the summit of Pikes Peak, considered the highest road in the world at more than 14,000 ft. elevation. The William Penn Highway, however, terminated in Pittsburgh.

Like other trails, the William Penn Highway followed preexisting roads. As early as 1825, most of the route was operated by a series of turnpike companies, and the section from Harrisburg to Pittsburgh, was sometimes referred to as “the northern turnpike,” as opposed to the “Pennsylvania Road,” the more southerly and more popular road from Lancaster to Pittsburgh (modern-day US 30). In 1911, the remaining turnpikes were taken over by the state highway department. Sections of the route was resurfaced beginning in the mid-1910s. By 1922 it was considered “improved” for most of its route, except for some rugged central mountain sections near Port Royal, Mt. Union, and Millersville.

The William Penn Highway held one advantage over the Lincoln Highway; by sticking closely to the Juniata River it avoided some of the steep grades over the mountain ridges. For this reason, much the same general route west of Harrisburg had been used by the Pennsylvania Railroad. The William Penn Highway was, however, a less direct route than the Lincoln Highway, covering approximately 70 more miles from the eastern side of the state to Pittsburgh. In the 1920s, the primacy of the Lincoln Highway as the state’s major cross-state route was shown during the winter months when the state highway department published maps of routes kept open by snow plows; all of the Lincoln Highway was plowed but only the eastern section of the William Penn Highway from Harrisburg to Easton open. In 1924-25, the state highway department undertook its first comprehensive cross-state traffic survey, and found that the two most heavily traveled cross-state routes were first and foremost the Lincoln Highway, and a surprising but distant second the Roosevelt Highway (US 6).

The William Penn Highway’s significance as a cross-state route was negligible. It appears nonetheless, that the eastern portion from Easton to Harrisburg, played an important role as a feeder of traffic from New York, northern New Jersey, and east-central Pennsylvania to connections with the Lincoln Highway at Chambersburg, and after 1940 with the Pennsylvania Turnpike at Carlisle. The section of US 22, east of Pittsburgh, no doubt played a regionally important role for travelers from towns in central Pennsylvania wishing to reach Pittsburgh, but this fact does little to distinguish the route from numerous other state highways. Well-preserved by-passed loops dating from ca. 1916 to 1925 may have technological significance as examples of state roads and bridges from the first generation of state highway improvements. Any associated ca. 1916-17 bridges in the Easton-Bethlehem area may have local historic significance (Automobile Blue Book, 1914-1923; Bethlehem, Pennsylvania: The Golden Years,

1841-1920, pp. 241-242; Connell 1925, pp. 195-202; “The World’s Highest Road,” 1916).

State Route 4 (Susquehanna Trail)

The Susquehanna Trail was a route promoted by the Susquehanna Trail Association, established ca. 1916-17. The trail followed the route of US 15, north-south from near the New York border at Lawrenceville to Harrisburg, and then local roads parallel to I-83 from Harrisburg through York to New Freedom. By the mid-1920s, the state highway department had paved in concrete the entire route.

The Susquehanna Trail Association advertised the route’s scenic beauty, claiming that it rivaled the Lincoln Highway and National Roads. The association marked the route with black-and-white Indian heads painted on poles, trees, and other markers. The trail, which was a weak imitation of other national trails, was designed to serve as a route for travelers from Buffalo, Rochester, and Toronto to Baltimore. In the mid-1920s, the association extended the route further south from Baltimore to Washington, DC, and then to Miami, FL, using other marked routes such as the Capitol Trail and Coastal Highway.

State Route 5 (Lakes to Sea Highway)

The connection of Erie and Philadelphia, the Lakes to Sea Highway appears to have epitomized everything state and federal highway officials found objectionable about trail associations. For well over one-half the route, from Philadelphia to Water Street, the Lakes to Sea Highway overlapped other tourist trails including the Lincoln Highway, William Penn Highway, and Susquehanna Trail. As a separately named road, the Lakes to Sea Highway existed only between Water Street and Erie (US 322 from Port Matilda to Erie). Furthermore, the trail followed a windy section of narrow road in Clearfield County, which the highway department warned was exceptionally dangerous and frequently traveled by pedestrians moving between small mining communities.

State Route 6 (Old Monument Trail)

Following the present-day route of US 219, south-north from Salisbury, MD, to the New York State line near Bradford, PA, there is little to distinguish this obscure tourist trail from others in the state. The 1926 edition of *Facts Motorists Should Know* identified State Route 6 as the Old Monument Trail, but by 1927 the same publication had ceased to list the trail, probably indicating that the trail association had disbanded and the markers, if any, were unmaintained. The "old monument" was apparently the monument at Cherry Tree, PA, where under the terms of a 1768 treaty, the Indians granted land east of the Susquehanna River to colonists.

State Route 7 (Roosevelt Highway)

The Roosevelt Highway (US 6) from Matamoras on the Delaware River to Erie on Lake Erie was named in memory of President Theodore Roosevelt (d. 1919) by the State of Pennsylvania. While considered a direct route to the Midwest from New York and New England, it passed through the most rugged and isolated section of Pennsylvania. Until the late 1920s, it was an unpaved earth road for most of its length, making it an undesirable cross-state route for heavy trucks, and any travelers in poor weather. State highway department engineers considered the route of secondary importance to the region's north-south arteries such as Routes 2, 4, and 8.

In the early 1930s, a campaign was begun by the Sons of the Union Veterans of the Civil War (SUVCW) to pay tribute to their fathers by naming US 6 the Grand Army of the Republic (GAR) Highway. The GAR was an organization of veterans who had fought for the North during the Civil War, and the SUVCW was a companion organization consisting of descendants of the veterans. In the early 20th century, the SUVCW was active placing Civil War monuments and organizing encampments. US 6 was chosen by the SUVCW for designation as a memorial highway because it passes through more northern states (MA, RI, CT, NY, PA, OH, IN, IL, IA, NB, CO, UT, NV, and CA) than any other US-numbered highway. From 1937 to 1954, a committee of the SUVCW lobbied each of the 14 state governors to issue proclamations designating US 6 the GAR Highway. In 1948, Governor James Duff of Pennsylvania named the Pennsylvania segment. The SUVCW campaigned for memorial designation, but did not actively promote the physical development of the route.

Today, US 6 is a very scenic highway, maintaining the feel of a 1950s and 1960s US highway, along large sections of the route. In 1994, the highway was designated a National Scenic Trail by the National Park Service. Established by the National Trails Act of 1968, scenic trails provide a variety of outdoor recreation uses and are reasonably accessible to urban areas. Significant natural and cultural features in surrounding areas are also considered as part of the designation, but the historic significance of the route itself is not a major factor in designation. For a brief period in the early to mid-1990s, a Grand Army of the Republic Highway Association, made up of local Pennsylvania chamber of commerces, economic development councils, government officials and businessmen, attempted to promote the route for recreation and tourism. According to local residents, the association no longer exists (Potter County Historical Society).

State Route 8 (William Flinn Highway)

Named after a prominent Pittsburgh politician, the William Flinn Highway traversed the west side of the state from Erie to Waynesburg, passing through Pittsburgh, on the routes of present day SR 8 and US 19. By 1927, the Pennsylvania Department of Highways had ceased listing the William Flinn Highway, indicating its trail association likely had disbanded. The obscure tourist trail does not have historic significance.

State Route 9 (Yellowstone Trail)

The Yellowstone Trail was one of several trans-continental tourist trails that followed in the footsteps of the Lincoln Highway. The Yellowstone Trail was on the present-day route of US 20, west from New England to Yellowstone National Park, and on to Portland, OR. In Pennsylvania, the route clipped the state's northwest corner, passing through Erie en route between Buffalo, NY, and Conneaut, OH. Next to the Lincoln Highway, the Yellowstone Trail was probably the busiest artery of east-west automobile traffic in the state, albeit a short connecting section between New York and Ohio.

State Route 10 (Buffalo to Pittsburgh Highway)

The Buffalo to Pittsburgh Highway follows the present-day course of US 22 (William Penn Highway) from Pittsburgh to Black Lick, US 119 from Black Lick to DuBois, and US 219 from DuBois to Bradford near the New York State line. The route was promoted by the Buffalo-to-Pittsburgh Highway Association, as one of several alternative trails forming north-south connections across the state. Of very minor importance, the trail association was not noted in state highway department records until 1927, when John S. Fisher of Indiana, PA, a vice president of the trail association, was elected governor of the state. His administration used the trail association as one means of justifying increased funding for roads in the region.

State Route 11 (National Road)

The National Road (a.k.a. National Pike, National Highway, National Old Trails Road) while dating back to the mid-18th century as Braddock's Road, and perhaps most famous in its 1820s and 1830s incarnation, was revived in the early-20th century as an important overland automobile tourist trail. The National Road was one of the first routes to be promoted for automobile tourism, predating the Lincoln Highway Association's efforts by several years. In 1905, the road was chosen by the Pennsylvania Department of Highways and the federal Office of Public Roads as one of the nation's first stretches of highway improved for long-distance automobile travel. State and federal engineers widened and macadamized the 82-mile-long highway, signaling the revival of the National Road after decades of decline.

In 1912, the National Highway Association marked the National Old Trail Road, a tourist trail that began in St. Louis and passed through Indianapolis, Columbus, Wheeling, and southwestern Pennsylvania before terminating in Washington, DC. The association, like the Lincoln Highway Association, was one of the first associations to promote a long-distance automobile tourism. It also recruited businessmen as "local consuls" to advertise and offer services to early automobilists. The association built on the road's patriotic themes, encouraging tourists to follow a route traveled by General Braddock and George Washington. The association worked with groups such as the Daughters of the American Revolution to place historic markers and monuments.

Like other US highways, the National Road was from the 1920s to the 1950s widened, repaved, and improved piecemeal as part of standard Pennsylvania Department of Highways projects.

A National Register Multiple Property Nomination was prepared for the National Road in 1995 by PHMC. The nomination traces the history of this historically significant route with discussions of the development of the road as a tourist trail in the early 20th century. The period of significance is 1811 to 1945. The Historic Bridge Inventory will build on the nomination to determine the historic significance of the bridges on the National Road (US 40) and its bypassed sections.

State Route 12 (Baltimore Pike)

The Baltimore Pike (US 1) from Philadelphia to Baltimore by way of Media, Kenneth Square, and Oxford in the southeast corner of the state, was a tourist trail following the old Baltimore Pike, an early-19th-century turnpike that served as one of several overland routes from Philadelphia to Baltimore. The highway has been repeatedly improved from the 1910s through the 1960s, and is characterized by heavy commercial strip development, although sections through the towns of Media, and west of Kenneth Square have been bypassed by a limited access highway.

State Route 17 (Ben Franklin Highway)

Another trans-continental highway, patterned after the Lincoln Highway, the Ben Franklin Highway entered the state near New Castle and traveled over portions of US 22 and US 422 to Philadelphia. A relative late comer, the Ben Franklin Highway Association settled for one of the least desirable east-west through routes across Pennsylvania, avoiding the large centers of population, and traveling on roads that had already been claimed by other trail associations

State Route 20 (Buchanan Trail)

The Buchanan Trail paid honor to the only Pennsylvanian to be elected president, James Buchanan, and passed through this birth place near Cove Gap. The route offered a scenic alternative to travelers between Pittsburgh and Baltimore. Waynesboro was the largest town on the trail, which meandered over Tuscarora Mountain and Sideling Hill before connecting with the Lincoln Highway at McConnellsburg. It was one of many tourist trails to follow a previously established state route that had itself been built on top of an old turnpike.