AREAS OF PRACTICE
Transportation and Infrastructure
## Planning for Transportation

### Significant Federal Actions and Programs

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1956</td>
<td>National Interstate and Defense Highways Act – enacted under President Dwight Eisenhower and established uniform design standards for federal highways. Provided significant amounts of funding for highways through the creation of the Highway Trust Fund, which accumulates funds from excise taxes on new vehicles and taxes per gallon on gasoline. Affected land use patterns and city design in many locations and promoted the shift toward auto-oriented, less dense, dispersed land use patterns.</td>
</tr>
<tr>
<td>1964</td>
<td>Urban Mass Transportation Act – provided federal funding to local governments and transit operators for the capital and operating cost of transit services. Since the 1980s, the federal government has curtailed funding for transit operating costs in large urbanized areas. The law provided for the federal government to pay up to 80% of capital costs and up to 50% of operating costs for eligible transit systems. Due to the high demand for transit funding in recent years, successful grantees often have to “overmatch” their grants and provide a greater percentage of local funding in order to secure federal funds.</td>
</tr>
<tr>
<td>1975</td>
<td>Energy Policy Conservation Act – established the Corporate Average Fuel Economy (CAFÉ) standards that set the average miles per gallon requirements for cars. Standard for cars was 27.5 miles per gallon and the standard for light trucks was 20.7 miles per gallon. The improvement in technology over the years relative to CAFÉ standards has resulted in a decline of federal gas tax revenues available for distribution to states, regions, and local governments for highway and transit projects.</td>
</tr>
<tr>
<td>1990</td>
<td>Americans with Disabilities Act (ADA) – required that public transit systems be accessible to those with physical disabilities. Required paratransit services to be provided (within certain limitations) to those who cannot drive themselves or use conventional public transit.</td>
</tr>
<tr>
<td>1991</td>
<td>Intermodal Surface Transportation Efficiency Act (ISTEA) – call for greater coordination of transportation and land use planning; required the participation of stakeholders, such as public transit providers, who had not been traditionally involved in the regional transportation planning process. Called for state Departments of Transportation (DOTs) to share responsibility for transportation funding decisions with metropolitan planning organizations (MPOs) in order to address investments in public transit, and bicycle and pedestrian systems as well as on highways. Required coordination between states and metropolitan areas for plans that meet air quality standards set by the US Environmental Protection Agency (EPA). Created the Transportation Enhancements (TE) Program to fund projects related to scenic byways, certain historic preservation activities, bike and walking paths, and other enhancements related to transportation.</td>
</tr>
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</table>
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<table>
<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>1998</td>
<td><em>Transportation Equity Act for the 21st Century (TEA-21)</em> – successor to ISTEA as the reauthorization of the federal transportation program; continued and renewed ISTEA efforts along with a greater focus on highway safety, protecting the natural environment, advancing national economic competitiveness, and allowing for more flexible funding strategies. Emphasized transit system development as an alternative to highway construction and expansion. Continued Transportation Enhancements Program.</td>
</tr>
<tr>
<td>2005</td>
<td><em>Safe, Accountable, Flexible, Effective Transportation Efficiency Act: A Legacy for Users (SAFETEA-LU)</em> – reauthorization of the federal transportation program with a greater focus on the movement of freight along with passenger transportation in order to increase US economic competitiveness.</td>
</tr>
<tr>
<td>2012</td>
<td><em>Moving Ahead for Prosperity in the 21st Century (MAP-21)</em> – realigned and consolidated federal transportation programs. Strong focus on performance measurement in transportation decision making and required the setting of performance targets in key program areas by state DOTs and MPOs. Two-year funding authorization for highways and transit—about $105 billion authorized. National performance goals relate to safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environment and sustainability, and reduced project delivery delays.</td>
</tr>
</tbody>
</table>

Planning Tools, Techniques, and Standards

The following concepts, terms, tools, techniques, and standards are used by planners engaged in planning for transportation.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicle Miles of Travel (VMT)</td>
<td>Aggregate measure of travel demand for an area that indicates the amount of transportation activity by mode. In the 1990s, VMT, especially in major US cities, was increasing more rapidly than population growth. However, with the Great Recession, since 2008, VMT has been falling due to underemployment and other demographic factors.</td>
</tr>
<tr>
<td>Adequate Public Facilities Ordinance</td>
<td>Concept used by some states and communities that requires the planning and investments for transportation and other infrastructure to be linked with the planning and construction of developments (also known as “concurrency”).</td>
</tr>
<tr>
<td>Financially Constrained Plan</td>
<td>Refers to the federal requirement by the USDOT that statewide and regional/MPO long-range transportation plans must be developed within the bounds of reasonably available funds.</td>
</tr>
<tr>
<td>Air Quality Conformity</td>
<td>Requirement related to the Clean Air Act, as amended, that requires MPO plans conform (or meet) federal air quality standards.</td>
</tr>
<tr>
<td>Traffic Calming</td>
<td>A set of strategies used to lower vehicular speeds to provide safer and more conducive environments for walking and biking. These strategies relate to the design of streets, including using raised intersections, speed bumps, chicanes, traffic circles, roadway curves, and narrow lanes to slow auto and truck traffic.</td>
</tr>
</tbody>
</table>
Planning for Transportation

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<thead>
<tr>
<th>Topic</th>
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</thead>
<tbody>
<tr>
<td>Environmental Justice</td>
<td>Principle rooted in US civil rights law that requires the need for transportation alternatives and recommendations to consider the impacts of actions on all societal groups and assure that no one group is unduly impacted in a negative way. Seeks to balance the “benefits” from an action with its “burdens.” This principal was articulated in Executive Order 12989 signed by President Clinton.</td>
</tr>
<tr>
<td>Spatial Jobs/Housing Mismatch</td>
<td>Refers to misalignment of residential location choices to location of jobs. Often, it is seen where residents of a central city have obstacles to traveling to jobs in the suburbs (i.e., lack of public transportation, etc.).</td>
</tr>
<tr>
<td>Modal Split</td>
<td>The proportion of total trips in an area using each of the different modes of travel (car, walk, bike, transit, etc.).</td>
</tr>
<tr>
<td>Active Transportation</td>
<td>Range of travel options that encourage physical activity, including walking, biking, etc.</td>
</tr>
<tr>
<td>Paratransit</td>
<td>A form of transportation that blends some characteristics of public transit with those of private transportation. Includes specialized services for seniors, disabled, and low-income individuals; circulator services for airline travelers; circulator services in major activity centers, such as theme parks, etc.</td>
</tr>
<tr>
<td>Transit-Oriented Development (TOD)</td>
<td>Type of mixed-use development located near a transit station or center that is typically higher in density than the areas surrounding it. TOD is meant to enable a larger number of people to access the transit service, either by walking or biking to it.</td>
</tr>
<tr>
<td>Metropolitan Planning Organization (MPO) Area</td>
<td>A geographic area proposed by the US Census Bureau and designated by the governor of each state to an area greater than 50,000. Governed by a policy board of designated elected and appointed officials. Has the responsibility of preparing a 20-year long-range transportation plan and Transportation Improvement Program (TIP) identifying all federal and state transportation expenditures for projects over a four-year period. The MPO is not a unit of general government and does not have the authority to regulate land use.</td>
</tr>
<tr>
<td>Transportation Improvement Program (TIP)</td>
<td>A listing of transportation projects for highway, transit, bicycle, pedestrian, and freight system improvements to be undertaken in four years consistent with the MPO area’s long-range transportation plan.</td>
</tr>
<tr>
<td>Traffic Analysis Zone (TAZ)</td>
<td>Geographic unit created by dividing a planning area into smaller areas of similar land use. Often the size of a census tract, although they may be smaller. Used as a unit of analysis in the traditional travel demand modeling activity by state DOTs and MPOs.</td>
</tr>
<tr>
<td>Travel Demand Model</td>
<td>Important tool used by transportation planners to forecast the need for transportation facilities (highways and transit service) in the future. Typical structure is the four-step model comprised of (1) trip generation (estimating the number of trip origins and trip destinations in a given area); (2) trip distribution (relates to distributing the trips along destinations to and from traffic analysis zones); (3) modal split (determine the division of trips by mode [i.e., highway, bus transit, rail transit, etc.]); and (4) trip assignment (designating the path of the trips along the street and transit networks by segment).</td>
</tr>
<tr>
<td>Transportation Funding</td>
<td>Traditional sources of funding include federal grants (federal apportionments from the Highway Trust Fund); state-level revenues from the general fund, state motor fuel taxes, and bonds; and local sales taxes and general funds.</td>
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<tr>
<td><strong>Transportation Alternatives</strong></td>
<td>Term used in the planning process to connote a set of potential actions that can be taken to “improve” the transportation system; alternatives are analyzed using various tools, such as a regional travel demand model, and evaluated and compared to other options, and a determination is made on the “best-performing” alternative. The “best” alternative is typically the foundation for the transportation plan.</td>
</tr>
<tr>
<td><strong>Roadway Functional Classification</strong></td>
<td>Principle that establishes a set of roadway types based on their role in the transportation system and characteristics of their design and use. System reflects how roads address two primary dimensions: mobility (ease of movement) and accessibility (to land parcels and activities). The major functional classes include (1) interstate highways and expressways; (2) arterial roads; (3) collector streets; and (4) local roads.</td>
</tr>
<tr>
<td><strong>Conflict Point</strong></td>
<td>Term refers to the opportunity for a crash to occur. For example, either by two vehicles or a vehicle and pedestrian at an intersection.</td>
</tr>
<tr>
<td><strong>Intelligent Transportation Systems (ITS)</strong></td>
<td>A system that uses computer-based information and sensing technologies to improve traffic flow, coordination, and system capacity as well as safety and efficiency. ITS strategies include overhead changeable freeway message signs, passenger information systems at transit stations, coordinated signal systems, and automated toll collection systems.</td>
</tr>
<tr>
<td><strong>Transportation Level of Service</strong></td>
<td>A qualitative measure from “A” (best) to “F” (worst) describing the operational characteristics in a traffic stream.</td>
</tr>
<tr>
<td><strong>Volume-to-Capacity Ratio (V/C Ratio)</strong></td>
<td>Measure of the number of vehicles passing through a point divided by the number of vehicles the point (in a street or intersection) that it was designed to carry. Also known as the ratio of demand flow rate to capacity for a given traffic facility. Also used to prioritize transportation projects based on the premise that the “worst” performing locations in the transportation system should be fixed “first.”</td>
</tr>
<tr>
<td><strong>Performance-Based Transportation Planning</strong></td>
<td>New requirement by MAP-21 (2012) that requires state DOTs and MPOs to collect, analyze, and make investment decisions based on analysis of quantitative and qualitative data.</td>
</tr>
<tr>
<td><strong>Visualization</strong></td>
<td>Set of tools and methods to convey complex technical information on transportation and potential future projects using graphic and computer techniques. Required by the US DOT in regional transportation planning.</td>
</tr>
<tr>
<td><strong>Public and Stakeholder Outreach</strong></td>
<td>Essential part of statewide, regional, and local transportation planning to engage those interested in and affected by potential transportation actions (projects and policies) to help influence and shape them before decisions are made by policy boards and government officials.</td>
</tr>
<tr>
<td><strong>Project Development</strong></td>
<td>Typically refers to the engineering and environmental analysis tasks associated with a particular transportation project that follows after the planning phase. Steps taken after planning include environmental analysis, design, right-of-way acquisition (if needed), permitting, construction, and operations and management (after open to users).</td>
</tr>
<tr>
<td><strong>NEPA Process</strong></td>
<td>Part of the project development process that refers to the analysis and actions needed for a federally-funded project or a project requiring a federal permit to undergo. Federal agencies require compliance with more than 40 laws related to safety and the environment that directly impact the design, operations, and management of the transportation system.</td>
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</tbody>
</table>
Planning for Transportation

Current Issues and Trends

The following topics represent some key issues and concerns of local communities and planners engaged in planning for transportation systems in the US.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Complete Streets</td>
<td>Principle that refers to the allocation of space and design of a street in consideration of the needs of the full range of users—motorists, transit riders, pedestrians, bicyclists, truck drivers, and emergency responders. Features addressing complete streets typically include sidewalks, bike lanes, wide roadway shoulders for bicyclists, crosswalks, medians (pedestrian refuges), bus pullouts or bus lanes, raised crosswalks, audible pedestrian signals, street trees, and street furniture.</td>
</tr>
<tr>
<td>Sustainable Transportation</td>
<td>Concept related to the planning and development of a multimodal transportation system created with travel modes that have a low impact on natural resources, such as walking, biking, bus and rail transit, etc., as well as the use of renewable energy.</td>
</tr>
<tr>
<td>Transportation and Public Health</td>
<td>Recognizes the linkage between better health outcomes from increased physical activity from walking, biking, etc.</td>
</tr>
<tr>
<td>Climate Change and Transportation</td>
<td>Recognizes the relationship between outcomes from climate change, such as sea-level rises, etc., and their impact on transportation infrastructure, including roads and bridges. Transportation planners and other practitioners are analyzing the potential impact and ability of state DOTs and metropolitan regions to develop “resilient” transportation systems can rebound quickly after major weather events and other disasters.</td>
</tr>
<tr>
<td>Public/Private Partnership or “P3”</td>
<td>Method of creating financial support for major transportation infrastructure investments; blends contributions from government agencies with those of the private sector to enable infrastructure projects to be delivered to the public more quickly than if built by conventional means; typically involves transportation tolls and operation and management of the system by private entities.</td>
</tr>
<tr>
<td>Managed Lanes</td>
<td>Concept that involves using transportation pricing, design strategies, and vehicle occupancy requirements to “manage” the availability roadway capacity of a particular corridor or network of corridors. Typical managed lane configurations include “free” general use lanes and “high-occupancy toll” (HOT) lanes, where willing motorists pay a premium to travel in uncongested lanes. Pricing of HOT lanes typically is linked to the level of traffic congestion so that during the most congested periods, the tolls are highest.</td>
</tr>
<tr>
<td>Mobility and Accessibility</td>
<td>Two dimensions addressed by transportation systems, with mobility referring to the ease with which people and goods can move and accessibility is related to the extent of choice a traveler has to reach his/her destination by mode and time of day.</td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT) Tax</td>
<td>New strategy for funding transportation infrastructure; rather than having motorists pay a set tax per gallon of fuel (federal and/or state), motorists would pay a rate per vehicle mile travelled. This approach mitigates the problem of reduced transportation revenue occurring due to higher fuel efficiency standards for cars and trucks being enacted. The states of Oregon and California area leaders in the use of this technique.</td>
</tr>
</tbody>
</table>
Planning for Transportation

Supplementary Materials

The following supplementary information can assist in understanding the nature of planning for transportation:

- APA Website
- “Handbook for Transportation Planning”
- Association of Metropolitan Planning Organization (AMPO) website
- American Association of State Highway and Transportation Officials (AAHTO) website
- US Department of Transportation website
- Introductory sections of the APA Policy Guides on Surface Transportation
- Transportation-Land Use Connection (2007)
- Practice of Local Government Planning (2002)
Complete Streets

In the last decade transportation planners and urban designers have made a significant shift in their approach to the design and intended function of streets. Conventional transportation planning was concerned primarily with the safe and efficient movement of cars. Today many transportation planners are working with land-use experts and urban designers to create what have been termed “complete streets.”

**WHAT ARE COMPLETE STREETS?**

A complete street is a safe, accessible, and convenient street for all users regardless of transportation mode, age, or physical ability. Complete streets adequately provide for bicyclists, pedestrians, transit riders, and motorists. Complete streets promote healthy communities and reductions in traffic congestion by offering viable alternatives to driving.

**Democratizing the Streets.** Because streets and roads are the largest component of public space in every city, they should benefit the entire community. Improved design, a redefinition of function, and physical reorganization are the ways to achieve these benefits. Jurisdictions that adopt complete streets policies aim to create a comprehensive and integrated local and regional transportation network for all travel modes—driving, walking, and cycling.

**Policy Considerations.** Creating complete streets may mean changing the policies and practices of transportation agencies. Advocates argue that it will take new training, new procedures, and design manual changes to accommodate bicycling, walking, and transit to an equal degree with motor vehicles.

**Different Approaches.** The principle behind complete streets policy is that multimodal corridors should become the default design mode for streets—and a formal exception process must be followed when they are not. Many existing policies are based on the U.S. Department of Transportation’s design guidance for Accommodating Bicycle and Pedestrian Travel: A Recommended Approach, which names only three exceptions where roads can lack facilities for all users: (1) excessive cost, (2) absence of need, and (3) roads where bicyclists and pedestrians are prohibited. More comprehensive policies include accommodation for people with disabilities and for transit vehicles and users.

**COMPLETE STREETS DESIGN CONSIDERATIONS**

**Skinny Streets.** Skinny, or narrow, streets complement complete streets policies. Narrower traffic lanes result in slower travel speeds that translate into safer, more accessible, and more pleasant thoroughfares for all users. A physical narrowing of the actual street may be unnecessary because on-street parking can also visually narrow the thoroughfare for drivers.

**Street Connectivity.** Street connectivity—meaning the directness and length of the street blocks and the density of connections within a street system— influences the accessibility of destinations in a community and holds important implications for modal choice. Complete streets in areas with higher levels of street connectivity will produce greater overall accessibility for all travelers, regardless of the mode they choose.

**Context-Sensitive Streets.** All streets are not alike. Streets in industrial areas have a much different character than streets in residential, commercial, and mixed use districts. Traffic engineers and urban designers are beginning to combine the functional classification of streets with their adjacent land uses to yield a more comprehensive array of street types. This approach takes into account land uses adjacent to the street and recommends five basic classes of street design: commercial streets,

**PAS QuickNotes**

**PAS QuickNotes No. 5**

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(Continued on back.)
mixed use streets, main streets, residential streets, and industrial streets. Streets in each class can be designed as complete streets.

**Complete Streetscape Design Elements.** Undertaking major construction projects to achieve complete streets is not always necessary. In fact, small projects can have a large impact. Examples include raised medians, pedestrian refuge islands within medians, bicycle lanes, bus pullouts, transit shelters, and street furniture.

**COMPLETE STREETS ARE FOR EVERYONE**

**Pedestrian Safety.** Communities with complete streets policies protect travelers from cars. Walkways should provide secure footing, pedestrian pathways should be clearly indicated, and signaling must consider the rights of all users of the road. Designing the street with pedestrians in mind—sidewalks, raised medians, better bus stop placement, traffic-calming measures—all improve pedestrian safety. One study found that designing for pedestrian travel by installing raised medians and redesigning intersections and sidewalks reduced pedestrian risk by 28 percent.

**Public Health.** Public health officials are calling for Americans to increase their physical activity. Officials argue that increased walking and bicycling will help to combat the current obesity epidemic. A 2002 report issued by the National Conference of State Legislators noted that the most effective policy for encouraging bicycling and walking is complete streets.

**Vulnerable Populations.** Truly complete streets go beyond accommodating bicycling and walking to consider children, the elderly, and people with a disability. More often than not, the elderly and people with disabilities rely on the pedestrian and transit infrastructure for access and mobility. Complete streets policies make it possible for vulnerable populations to better use transportation systems by equipping streets with the necessary infrastructure, including curb ramps, textured and varied pavement, audible crossing signals, countdown signals, and high-visibility crosswalks.

**DEVELOPING WITH COMPLETE STREETS**

**Economic Development.** Streets create marketable value for abutting private property by providing access. Complete streets can increase the economic viability of a city district by improving access for more people, thus increasing the potential number of customers to businesses.

**Transit-Oriented Development.** Complete streets policies go hand in hand with transit-oriented development (TOD). Traffic-calming measures, streetscape improvements, and transit have successfully been combined to revitalize entire commercial districts. Both residential and commercial projects near transit typically appreciate in value more rapidly than other projects. In a TOD land uses and infrastructure are arranged to encourage and to facilitate the use of transit while accommodating a range of travel modes and purposes. Transition points where travelers transfer easily from one mode of transportation to another are key features of both complete streets and TODs.

**Challenges.** One challenge to complete streets implementation is a lack of right-of-way in cramped thoroughfares. Another is the misconception that complete streets cost more to build than “normal” streets when, in fact, complete streets most often cost no more and many times can cost less. Current methodologies for studying traffic pose another problem. Many contemporary traffic studies fail to consider how the presence of transit and decreases in automobile use associated with mixed use neighborhoods may lower trip generation rates. Communities should reevaluate traffic studies based on antiquated trip generation models. **Patrick C. Smith**
WHAT ARE COMPLETE STREETS?

1. Published by American Planning Association


2. Other Resources


McCann, Barbara. 2006. Email interview with author, June 15.


COMPLETE STREETS DESIGN CONSIDERATIONS

1. Published by American Planning Association


2. Other Resources


COMPLETE STREETS ARE FOR EVERYONE

1. Published by American Planning Association


2. Other Resources


DEVELOPING WITH COMPLETE STREETS

1. Published by American Planning Association


2. Other Resources


Concurrency Planning Process

1. Identify Existing Service Levels
2. Adopt Preferred LOS Standards
3. Identify Capacity Needs
   - Identify Existing Deficiencies
     - Identify funding sources for deficiencies
   - Identify Facilities needed to accommodate new development
     - Identify funding sources from new development
4. Prepare CIP
5. Identify and allocate available capacity for development
6. Monitor

The process is cyclical, with the final step leading back to identifying existing service levels.
Planning for Infrastructure Systems

Significant Federal Actions and Programs

- Certain types of infrastructure are influenced by federal laws and policies, such as highway, transit, airport systems and facilities for handling hazardous materials; while other infrastructure systems are guided primarily by states and local jurisdictions, such as water system management, waste management, and so on.
- States and local governments may adopt more stringent regulations for handling hazardous substances than required by federal legislation. States may establish trust funds to enable owners of tanks containing hazardous materials to clean up releases.
- The following federal laws relate to the planning and development of infrastructure systems in the US.

<table>
<thead>
<tr>
<th>Year</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>Resource Conservation and Recovery Act (RCRA) – requires EPA to develop a comprehensive regulatory program for storage of hazardous substances. Requires owners of tanks to prevent, detect, and clean up any releases.</td>
</tr>
<tr>
<td>1996</td>
<td>Telecommunications Act – first major overhaul of telecommunications law in over 60 years; intended to increase competition in the communications businesses; meant to streamline the installation of cell phone towers by giving telecommunications companies preemption powers over local regulations as well as eminent domain powers over private property.</td>
</tr>
<tr>
<td>2009</td>
<td>American Recovery and Reinvestment Act – passed by the US Congress and signed by President Obama to create jobs, provide temporary relief to those affected by the Great Recession, and invest in infrastructure systems, education, health, and renewable energy.</td>
</tr>
</tbody>
</table>

Infrastructure Types

The following primary types of infrastructure systems serve communities. This section provides definitions for key terms, typical methods for paying for various types of infrastructure, and other key characteristics of the various infrastructure types.

<table>
<thead>
<tr>
<th>Infrastructure System</th>
<th>Key Terms and Concepts</th>
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</thead>
<tbody>
<tr>
<td>Wastewater Collection and Treatment</td>
<td>Relates to the facilities and activities associated with collecting, transporting, treatment, and disposing of domestic (household) and nonresidential waste; includes septic systems and sewer systems.</td>
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### Planning for Infrastructure Systems

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<tr>
<td><strong>Wastewater Supply and Distribution</strong></td>
<td>Communities generally use “gravity feed systems” for supplying water to homes and businesses by using the force of gravity to move water. In such a system, water storage tanks should be located at least 70 feet above the distribution area. When planning for water infrastructure demand, some considerations including current and future supplies of water, the capacity of treatment plants, water pressure and velocity in the water system, the potential demand for water to fight fires, locations and capacity of pumping stations to move wastewater, and the depth and velocity of flow in sewer mains. When new development is proposed, planners estimate its impact on the ability of the community to meet the demand for water and sewer services; the planners estimate the municipal costs and anticipated revenue associated with the new development. Since a wellhead is a source of current and future drinking water, it must be protected from pollution. When the water supply is drawn primarily from groundwater, the distance from potential sources of pollution is the simplest form of protection.</td>
</tr>
<tr>
<td><strong>Stormwater Management</strong></td>
<td>Relates to the collection and management of water that is associated with weather events and the movement of water to streams or storm sewers.</td>
</tr>
<tr>
<td><strong>Telecommunications Infrastructure</strong></td>
<td>Demand for wireless telecommunications infrastructure is steadily increasing. There are federal, state, and local regulations concerning the placement of wireless communication towers. Regulations address tower height, lighting, power levels, signage, fencing, and landscaping. State and local jurisdictions cannot discriminate among wireless service providers or prohibit wireless service. Wireless facilities can be colocated on water towers, silos, smokestacks, or church steeples.</td>
</tr>
<tr>
<td><strong>Pipelines</strong></td>
<td>Typically relates to the planning, development, and construction of pipelines and pipeline systems related to gas and oil. Typical planning issues are associated with safety (in terms of a potential hazardous material spill), conflicts with adjacent land uses (especially residential areas); and economic development considerations (for job creation in communities). End-of-the-line transfer facilities are usually addressed as part of the transportation system (i.e., intermodal facilities, such as ports, etc.)</td>
</tr>
<tr>
<td><strong>Solid Waste Management including Recycling</strong></td>
<td>Relates to a community’s capabilities to collect and manage trash and other waste generated by residential and nonresidential uses. Major issues include landfill capacities to serve growing populations. Some communities are using resource recovery methods at landfills to collect landfill methane gas to generate it for other uses.</td>
</tr>
<tr>
<td><strong>Hazardous Materials Management</strong></td>
<td>Related to the handling and management of oil; fuel; solvents; wastewater treatment sludge; pesticides; toxic materials, such as lead-based paint; and flammable or unstable materials. Hazardous materials threaten water supplies in various ways, including leaks from underground storage tanks.</td>
</tr>
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<td>Solid Waste Management</td>
<td>About 40% of the solid waste stream of the US is paper; 18% is yard trimmings; 7% is food scraps; 8% is plastics; and 27% is metal, rubber, leather, textiles, wood, glass, and other materials. The amount of solid waste generated per person in the US increased by over 40% between 1960 and 2001. Planners may be involved in finding new sites for solid waste disposal or landfills that meet geological specifications for sustainable, safe, and long-term storage; locations that will not harm other services; sites with adequate capacity to meet the needs of a growing population; and do not place an undue burden on one sector of the population.</td>
</tr>
</tbody>
</table>

### Planning Tools, Techniques, and Standards

The following tools, techniques, and standard are used by planners engaged in planning for infrastructure systems. The following terms apply to certain aspects of infrastructure planning.

- **Projected Demand for Service**: The appropriate capacity for infrastructure facilities, such as water treatment plants, sewage treatment plants, size of the fire department, and so on, depends on the current and project population of the community and the projected per capita demand for service.
- **Capital Improvement Program (CIP)**: Improvements in infrastructure systems are capital improvements and are identified in the community’s Capital Improvement Program.

<table>
<thead>
<tr>
<th>Infrastructure Type</th>
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</thead>
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<tr>
<td><strong>Water</strong></td>
<td>Nitrogen Loading Analysis</td>
<td>The key variable that influences the amount of nitrogen found in water supplies is land use. Nitrogen loading analysis looks at how land use development decisions impact water quality and affect the rate of nitrate-nitrogen levels in the water supply.</td>
</tr>
<tr>
<td></td>
<td>Darcy’s Law</td>
<td>Velocity of water is proportional to slope or the hydraulic gradient of porous media like sand or gravel.</td>
</tr>
<tr>
<td></td>
<td>Hydraulic Gradient</td>
<td>Direction of groundwater flow due to changes in depth of the water table.</td>
</tr>
<tr>
<td></td>
<td>Drainage of Surface Water</td>
<td>Depends on the type of soil, topography, and types of vegetation that are present.</td>
</tr>
<tr>
<td></td>
<td>Zone of Influence</td>
<td>Portion of the watershed most likely to contribute sediment to a stream.</td>
</tr>
<tr>
<td></td>
<td>Wellhead</td>
<td>Source of current and future drinking water.</td>
</tr>
<tr>
<td><strong>Wastewater Management</strong></td>
<td>Generation Rate</td>
<td>Residents of an urbanized area typically create about 150 gallons of waste water per capita per day for a public sewer system to handle.</td>
</tr>
<tr>
<td></td>
<td>Secondary Treatment</td>
<td>Second major step in the wastewater treatment process where bacteria consume the organic parts of the waste.</td>
</tr>
<tr>
<td></td>
<td>Septic System</td>
<td>On-site system designed to treat and dispose of domestic (household) waste.</td>
</tr>
<tr>
<td></td>
<td>Absorptive Capacity</td>
<td>In order to determine if soil at a site is appropriate for a septic system, a percolation or “perc” test is conducted.</td>
</tr>
</tbody>
</table>
# Planning for Infrastructure

<table>
<thead>
<tr>
<th>Infrastructure Type</th>
<th>Topic</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wastewater Management</strong></td>
<td>Septic System Upgrades</td>
<td>Typically required when property is transferred to maintain conformity with existing land use regulations and protect ground and surface water by repairing or replacing old or malfunctioning septic systems.</td>
</tr>
<tr>
<td></td>
<td>Private Sewage Treatment Facility (PSTF)</td>
<td>Usually permitted and constructed only if no public treatment facilities are available; must be consistent with municipal capital facilities plans and local zoning ordinances.</td>
</tr>
<tr>
<td></td>
<td>Sand Filter System</td>
<td>Type of wastewater treatment system that pretreats septic tank effluent by filtering it through sand before sending it on to a treatment system.</td>
</tr>
<tr>
<td></td>
<td>Grey Water</td>
<td>Domestic (household) wastewater that does not contain human excrement; includes sink drainage, washing machine discharge, and bath water.</td>
</tr>
<tr>
<td><strong>Hazardous Materials Management</strong></td>
<td>Secondary Containment</td>
<td>Used for storage of waste oils and other such potentially harmful liquids to provide additional storage capacity for any materials that may leak due to the failure, overfilling, or improper draining of the primary storage container.</td>
</tr>
<tr>
<td></td>
<td>Leak Detection</td>
<td>Methods in use include frequently measuring the amount of material in the storage tank and periodically monitoring the groundwater for the presence of hazardous materials.</td>
</tr>
<tr>
<td><strong>Solid Waste Management</strong></td>
<td>Waste Generation Rate</td>
<td>About 4.4 pounds of solid waste per person (2001).</td>
</tr>
<tr>
<td><strong>Stormwater Management</strong></td>
<td>Channelization</td>
<td>Actions to move stormwater more rapidly, including making channels straighter and deeper.</td>
</tr>
<tr>
<td></td>
<td>Sedimentation</td>
<td>Deposit of new sediment in a new location by water, wind, ice, or human activity can have detrimental effects on water quality. Often associated with agricultural and construction activity.</td>
</tr>
<tr>
<td></td>
<td>Mitigation Measures</td>
<td>Include preserving vegetation or replanting as soon as possible to stabilize the soil, locating piles of soil away from waterways, minimizing the amount of impervious surface to minimize stormwater runoff, planting buffer strips, or using straw bales to trap sediment.</td>
</tr>
<tr>
<td></td>
<td>Detention Systems</td>
<td>Actions to move stormwater more slowly or provide water quantity control; type of Best Management Practice (BMP) designed to intercept stormwater runoff and temporarily hold the water for gradual release to a stream or storm sewer system. Reduces the peak flow of stormwater discharge and are designed to completely empty out between runoff events. Treatment of water in detention basins is usually limited to the removal of suspended solids and contaminants as settling occurs due to gravity.</td>
</tr>
<tr>
<td></td>
<td>Drainage Ordinance</td>
<td>Establishes rules and regulations related to stormwater drainage and management; typically mandate user fees for residential and commercial stormwater drainage.</td>
</tr>
</tbody>
</table>
Planning for Infrastructure

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</tr>
</thead>
<tbody>
<tr>
<td>Stormwater Management</td>
<td>Retention System</td>
<td>Design to retain stormwater and runoff in a defined area until the surrounding soil can accept it; type of detention facility that maintains a permanent pool of water and has the ability to reduce the peak flow during a flood; designed as either above-ground ponds or as a system of underground piping.</td>
</tr>
<tr>
<td></td>
<td>Grass Pavers</td>
<td>Plastic rings in a flexible grid that are placed on a base of blended sand, gravel, and topsoil, then filled with topsoil and planted with vegetation; provides a load-bearing pervious surface covered with natural grass and vegetation that filter some pollutants from stormwater. Used in low traffic and low-speed areas, such as fire lanes, residential driveways, and maintenance and utility access lanes to allow greater absorption of stormwater than asphalt or concrete.</td>
</tr>
</tbody>
</table>

Current Issues and Trends

- **Infrastructure Finance (Capital and Operating Costs):** States and local jurisdictions are seeking various ways to pay for the capital and operating costs of municipal infrastructure systems. Some of these funding methods include impact fees, user fees, bond programs, special assessment districts, and business improvement districts.

Supplementary Materials

The following supplementary information can assist in understanding the nature of planning for infrastructure:

- APA website, including introductory sections of the APA Policy Guides on Solid and Hazardous Waste Management, Water Resources Management, and Wetlands
- Handbook for Infrastructure Planning
- American Society of Civil Engineers (ASCE) website
Planning for Public Facilities

Planning Tools, Techniques, and Standards

The following tools, techniques, and standards are used by planners engaged in planning for public facilities and services.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Service Area Plans</td>
<td>Regional, countywide, city-wide, or sector plans that identify the area to be served by planned public facilities and services. May be undertaken by local governments (cities and counties), utility authorities, or local or regional agencies. Includes data on current usage of facilities and services and projections of short-term and long-term growth in usage. Identifies estimated cost of facilities and services (capital expenditures and operations and maintenance expenses) along with potential funding sources for supporting the overall system.</td>
</tr>
<tr>
<td>Distribution of Services</td>
<td>Planners should consider the fair distribution and pricing of public facilities and services so all sectors/geographic areas, income levels, ages, and demographic characteristics have an opportunity to use the facilities and services.</td>
</tr>
<tr>
<td>Funding Sources for Public Facilities and Services</td>
<td>State, regional, local, and private organizations employ a variety of funding sources to support the planning, development, and implementation of public facilities and services. Among potential funding sources for capital projects are local jurisdiction property taxes, impact fees, business improvement district revenues, bonds, sales tax revenues, etc. Potential sources of operations and maintenance funds include local jurisdiction property and sales tax revenues, state funding, user fees, special assessment district revenues, etc.</td>
</tr>
</tbody>
</table>

Current Issues and Trends

The following topics represent some key issues and concerns of local communities and planners engaged in planning for public facilities in the US.

<table>
<thead>
<tr>
<th>Topic</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Lack of Public Funding</td>
<td>In many areas of the US, there is reluctance by the public to fund new infrastructure systems. Funding the rehabilitation and maintenance of these systems is often problematic as well. Many states and local jurisdictions have deferred maintenance on infrastructure systems due to reduced government revenues as a result of the Great Recession, starting in 2008. More reliance on user fees and public/private partnerships to deliver infrastructure systems is growing in the US due to these factors.</td>
</tr>
<tr>
<td>Spatial Mismatch of Housing and Jobs</td>
<td>In some communities, citizens experience difficulties accessing jobs and other important places due to lack of transportation options and other mobility factors. Lack of adequate public transit service for low-income populations cause the range of job opportunities to be decreased due to the spatial characteristics of residential areas and job centers. Even for higher income populations, the percent of household income spent on transportation as a percent of the total is excessive in some communities due to long commutes where housing areas are located long distances from jobs.</td>
</tr>
</tbody>
</table>
Planning for Public Facilities

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Environmental Justice</td>
<td>A concept that is often a major consideration in the planning of public facilities across the US. According to the US Environmental Protection Agency (EPA), environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA has this goal for all communities and persons across this nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work. Environmental justice is often an important consideration in the siting of major public facilities in or near low-income and minority areas if disproportionate burdens may be placed on those populations compared to its benefits.</td>
</tr>
</tbody>
</table>

Supplementary Materials

The following supplementary information can assist in understanding the nature of planning for public facilities and services:

- APA website
- Handbook for Public Facilities Planning
- International City Management Association (ICMA) website
Airport Planning

**Airport Master Planning**

- Short-, medium-, and long-term development plans to accommodate future demand
- Stakeholder involvement
  - Public
  - Airlines
  - Tenants
- Basic components
  - Existing conditions inventory
  - Passenger enplanements/aircraft operations forecast
  - Facility requirements
  - Alternatives development and evaluation
  - Environmental overview and preliminary analysis
  - Implementation plan and phasing schedule
  - Financial plan
- Guided by FAA Advisory Circular 150/5070-6B

**Airside Planning**

- Runways
  - Typically largest land area of airport
  - Orientation/configuration based on wind analysis
  - Number and length based on activity, aircraft types, and takeoff/landing length requirements
  - Location per safety clearance (separation) standards
- Taxiways
  - Safe and efficient flow of aircraft between parking aprons and runways
  - Width and separation standards apply
- Navigational and Communication Aids
  - Approach lights
  - Radar
  - Instrument landing systems
  - Weather instruments
  - Runway/taxiway lights
  - Airport beacon
- Design Guidance
  - FAA Advisory Circular 150/5300-13A
  - ICAO Annex 14 (international non-US airports)

Source: FAA Advisory Circular 150/5300-13A
Airport Planning

Terminal Planning

- 4 basic configurations

- Programming based on forecast peak hour passengers
  - Level of service based on demand and capacity

- Key functions to consider
  - Curbside
  - Ticketing
  - Baggage screening
  - Passenger security screening
  - Gates/hold rooms
  - Concessions
  - Public facilities/circulation
  - Baggage claim

- Guidance
  - TRB – ACRP Report 25
  - IATA
  - FAA Advisory Circular 150/5360-13

Landside Planning

- Access to airport via regional transportation system
  - Highways
  - Rail
Airport Planning

- Airport roads (departures, arrivals, garage, rental)
- Parking
  - Short-term
  - Long-term
  - Employees
- Commercial transportation providers
- On-Airport automated people movers
- Guidance
  - Local Department of Transportation standards
  - Federal Highway Administration

Airspace Planning

- Imaginary 3-D obstacle identification and clearance surfaces for each runway end
- Noise considerations
- Approach and departure procedure development
- Guidance
  - Code of Federal Regulations 12, Part 77 Civil Airport Imaginary Surfaces
  - United States Standard for Terminal Instrument Procedures (TERPS)
  - FAA Advisory Circular 150/5300-18B
  - FAA Advisory Circular 150/5300-13A

Support and Other Facilities

- General aviation
- Cargo
- Airport Traffic Control Tower (ATCT)
- Airport rescue and fire fighting (ARFF)
- Corporate hangars
- Deicing facilities
- Airline maintenance hangars and facilities
- Fuel storage
- Security
Integrating Seaport Considerations into the Planning Process

Overview of Port Cities

- The role of ports in US cities has evolved. Most seaports are located in or near the city core. Before the advent of the automobile, cities organized around ports, as the ports served as the major economic driver and as a major employment center for port cities.
- Port activity reached its height in the mid-20th century. Up to this time, ports predominantly served as markets for international staple goods of value. Harbors were an integral part of the city. Merchants lived near the ports and stored their goods there. They also traded their goods and conducted business at the ports.
- Then, between the 1960s and 1990s, there was somewhat of a retreat for port cities due to technological developments such as larger ships and the introduction of containers, deep-water harbors outside of old port areas, and increased container storage space (former ports near inner cities were abandoned and are now being gentrified and reimagined into residential and commercial spaces).
- Since the 1990s, there has been a renewal of port cities reinforced by globalization, networking, and intermodalism. Ports are more than passenger and cargo gateways. They are an integrated node in the transportation chain. Containers have allowed single commodity-driven ports to thrive as diversified economic bases with the ability to handle a variety of goods/materials. The world is becoming “smaller” due to technology.

Importance of Planning with Ports

- About 150 state and local seaport agencies, navigation districts, and port authorities compose the port public sector.
- Besides maritime activities, ports may also have jurisdiction over airports, bridges, industrial parks, public recreational facilities, etc.
- Ports undertake community or regional economic development projects beyond those of direct benefit to the port itself.

Panama Canal Expansion

- The expansion of the Panama Canal, expected to be completed in 2015, will shift global trade patterns. The expansion of the canal will allow larger and more ships to serve markets on the eastern seaboard of the US ocean-going vessels that called on west-coast ports to unload goods that were then transported by rail to eastern US markets will now be able to call on ports in the Gulf of Mexico and the east coast of the United States.
- The larger post-Panamax ships that require deeper channels to serve the ports will call on ports such as New York, Norfolk, and Miami (currently dredging its channels). Increased trade activity at many other ports is anticipated as more cargo ships will serve these markets due to the increased volume of ships using the Panama Canal to serve the southern and eastern US markets. Investments in transportation infrastructure, such as cranes that can serve the larger ships as well as roadway and rail improvements, to maintain accessibility to US ports will be required.
Planning Challenges

- Because ports were mostly developed near city centers, there are inherent conflicts between land uses and the activities that occur within them. Ports are economic generators with intense industrial uses that require a high level of accessibility and intermodal transshipment for trucks, freight rail, pipelines, and waterborne vessels. This high level of freight activity often competes with other desirable waterborne vessels. This high level of freight activity often competes with other desirable waterfront land uses such as residential, retail, office, parks, and mixed-use developments that are community assets creating a higher quality of life in port cities.

- These conflicts require thoughtful policies, strategies, and investments that seek to balance the infrastructure needs of ports with the quality of life goals of the port communities. Transportation strategies that include good roadway design that consider the freight, commuter, and pedestrian needs within corridors are becoming increasingly important to serve the economic and livability goals of port cities.
Functional Areas of Practice – Suggested Reading List
Lesson 4 – Infrastructure, Transportation, Facilities & Services

Section 1: Transportation Planning

APA PAS Reports
- PAS 532 - Parking Cash Out. 2005
- PAS 546/547 - The Transportation/Land Use Connection. 2007
- PAS 557 - Transportation Infrastructure. 2009
- PAS 559 - Complete Streets. 2010
- PAS 562 - Planners and Planes: Airports and Land-Use Compatibility. 2010

APA Zoning Practice
- 2004-8: Driving Growth Through Transit-oriented Development
- 2006-1: The Practice of Parking Requirements (Smart Parking)
- 2011-2: Rethinking Corridors
- 2013-2: Complete the Streets

APA PAS Quick Notes
- QN16 – Transportation Planning. 2008
- QN21 – Planning for Transit-Oriented Development. 2009
- QN29 – Bicycle and Pedestrian Planning. 2010

Planning and Urban Design Standards
- “Current Federal Transportation Laws”; pp. 579-580
- “Metropolitan Planning Organizations” (Air Quality); p. 102
- “Traffic Impact Studies”; pp. 521-523
- “Transit Impact Studies”; pp. 524-525
- “Transit-Oriented Development”; pp. 450-452
- “TRANSPORTATION”; pp. 219-299
  - “Airport & Land-Use Interface”; pp. 287-294
  - “Airspace & Landside”; pp. 295-299
  - “Hierarchy of Streets and Roads”; pp. 226-228
  - “Multimodal Trails”; pp. 261-264
  - “Parking Ratios”; pp. 245-246
  - “Parking Space Dimensions”; pp. 253-254
  - “Pedestrian-Friendly Streets”; pp. 242-244
  - “Street Networks & Street Connectivity: pp. 229-232
  - “Traffic Calming”; pp. 238-241
  - “Vehicle Turning Radii”; pp. 236-237
- “Transportation and Land-Use Connection”; pp. 613-615
- “Transportation Plans”; pp. 27-30

Local Planning: Contemporary Principles & Practice
- “Access & transportation planning”; pp. 360-361
- “Build new transit alternatives”; pp. 167-169
- “Pedestrian & bicycle planning”; pp. 366-374
• “Regional Councils & Metropolitan Planning Organizations;
  o pp. 180-181
• “Regional transportation & development in Atlanta”; pp. 183-184
• “Twelve Ideas for improving mobility”; pp. 364-366
• “Transit-Oriented Development”; pp. 374-377

APA Links
APAGuides
https://www.planning.org/research/streets/
http://www.planning.org/adopter/adopted/surfacetranportation.htm

APACompleteStreets
http://www.planning.org/research/streets/

Tuesdays at APA Podcast
• Rethinking Federal Transportation Policy (SAFETEA-LU, MAP-21)
https://www.planning.org/tuesdaysatapa/2014/dc/apr.htm
• Complete Streets: Closing the Gap between Policy and Practice
https://www.planning.org/tuesdaysatapa/2013/dc/nov.htm

Airports in the Region
http://www.planning.org/resources/ontheradar/airports/
Traffic Calming
http://www.planning.org/planning/2009/nov/trafficcalming.htm

NON-APA Links (Subject to Change)
• Complete Street fundamentals
http://www.smartgrowthamerica.org/complete-streets/complete-streets-fundamentals
• MAP-21 Summary
http://www.fhwa.dot.gov/map21/summaryinfo.cfm
• Introduction to MPOs
• MPOs, Clean Air Act & SIPs
• California Airport Land-Use Planning Handbook
http://www.dot.ca.gov/hq/planning/aeronaut/documents/alucp/AirportLandUsePlanningHan-
dbook.pdf
Section 2: Planning for Infrastructure

APA PAS Reports
- PAS 542 - Planning for Onsite and Decentralized Wastewater Treatment. 2006
- PAS 569 - Planning and Broadband: Infrastructure, Policy, and Sustainability. 2012
- PAS 571 - Green Infrastructure: A Landscape Approach. 2013

APA Zoning Practice
- 2005-5: How Thirsty is Your Community? (Water Conservation)
- 2006-11: Integrating Stormwater Regulation and Urban Design (Watershed Planning)
- 2010-9: Regulating Green: Is Your Municipality Promoting Green Infrastructure?
- 2011-8: Federal Cell Tower Zoning: Key Points and Practice Suggestions

APA PAS Quick Notes
- QN23 – Low-impact Development. 2009
- QN27 – Green Infrastructure. 2010

Planning and Urban Design Standards
- “UTILITIES”; pp. 300-358
  - Stormwater; pp. 336-344
  - Telecommunications; pp. 355-358
  - Waste Management; pp. 300-320
  - Wastewater; pp. 324-333
  - Water Conservation, Supply, Treatment & Distribution; pp. 345-352

Local Planning: Contemporary Principles & Practice
- “Financial tools for public capital investment”; pp. 86-88
- “Financing public infrastructure”; pp. 332-335
- “Infrastructure planning”; pp. 356-359
- “The urban watershed”; pp. 388-392
- “Water in the urban environment”; pp. 392-400

APA Links
APA Policy Guides
- Waste Management
  https://www.planning.org/policy guides/adopted/wastemgmt.htm
- Water Resources Management
  https://www.planning.org/policy guides/adopted/waterresources.htm


Tuesdays at APA Podcast
- Prioritizing Water Supply Planning in the Chicago Region
  https://www.planning.org/tuesdaysatapa/2013/chicago/sep.htm

Pipeline Safety
  http://www.planning.org/planning/2012/aug/pipelinesafety.htm
Section 3 – Planning for Public Services

APA Zoning Practice
- 2010-1: A Sound Approach to Regulating Social Service Facilities
- 2011-5: Land-Use Compatibility near Military Bases: A Planner’s Perspective

Planning and Urban Design Standards
- “Community Facilities Plans”; pp. 36-37
- “Elementary, Middle & High Schools”; pp. 203-206
- “Fire and Rescue Stations”; pp. 207-209
- “Medical Facilities”; pp. 214-218
- “Military Base Closure and Conversion”; pp. 631-632
- “Park-School”; pp. 369-370
- “Police Stations”; pp. 210-213

APA Links
Medical Districts
http://www.planning.org/planning/2006/apr/medical.htm

NON-APA Links (Subject to Change)
- Library Facilities planning
  http://www.statelibrary.sc.gov/facilities-planning