APWA CENTER FOR SUSTAINABILITY

Sustainable Practices in Public Works

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Contents

Hazard Mitigation Planning: A Tool for Resilience

Contributed by: The APWA Emergency Management Committee (January 2015)

Over the last fifteen years, emergency management at the local level has transformed from strictly reacting to disasters to preparing for and quickly recovering from disasters. Most recently, the emphasis has been placed on resilience, whereby communities are actively taking steps to ensure long-term protection from the effects of natural disasters. Hazard mitigation plans are one tool that a local government can leverage to build a more resilient community.

More and more hazard mitigation planning is happening at the local level and not at the broader, regional scale. This local focus allows for more detailed information to be incorporated into the planning effort, creating an overall more effective tool. Communities know how they were impacted during previous extreme events and are best equipped to identify strategies to reduce their vulnerabilities.

Local hazard mitigation planning is also now going beyond historical trends and actively integrating projected changes in climate that could further exacerbate existing vulnerabilities or create new ones. Climate models are increasingly becoming available at the local level providing data specific to each community. Coupling historical trends with climate projections aids in the development and implementation of effective local strategies to enhance resilience. The results of this process are similar to those of a climate vulnerability assessment, climate adaptation plan, or community resilience plan. Ideally, a local government could meet the needs of both through one planning process. When budgets are tight and resources are limited, leveraging existing tools to deliver on new priorities is essential, providing that the needs of both processes (hazard mitigation and resiliency planning) are met.

Definitions

Hazard mitigation
Sustained action taken to reduce or eliminate the long term risk to human life and property from hazards

(Title 44 Code of Federal Regulations (CFR) §201.2, Definitions

City Resilience
The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt and grow no matter what kinds of chronic stress and acute shoc ks they experience.

(www.100resilientcities.org)

Getting It Done

The following tips will assist in implementing this best practice:

- Integrate multiple planning efforts (i.e. hazard mitigation with comprehensive planning, sustainability planning, vulnerability assessments, etc.)
- Scale down data to local level, but when appropriate assimilate that data back up to a county or regional level
- Engage community and key stakeholders
- Identify and prioritize actions that address vulnerabilities
- Develop indicators of success, including targets (i.e. reduce the number of properties impacted by a severe flooding event 40% by 2020)
- Leverage electronic mapping when possible

Learn more about this and similar practices

Miami-Dade County GreenPrint
http://www.miamidade.gov/greenprint/

The City of San Antonio Hazard Mitigation Plan
http://goo.gl/kzQ3J1

FEMA "Integrating Hazard Mitigation Into Local Planning"
http://goo.gl/esq0Lf

APA Hazard Mitigation
http://goo.gl/NjJ2ZV

The term sustainability encompasses a "long-term" view of economic, environmental and social systems, including the diverse set of public works infrastructure "systems". Modern computer assisted systems allow the development and analysis of numerous solutions for problems, rather than the tradition practice of closely analyzing only two or three alternatives that concentrate on either up-front (construction) cost, or the shortest schedule considerations. But as most public works officials know, over decades of maintenance and up-keep, initial construction is a minor cost of a facility or piece of infrastructure. And because maintenance and upkeep are funded differently than capital costs, it is easy for governing boards to underfund these items, reducing facility life and leading to premature replacement.

Techniques Achieve Full Value/Life Cycle of Assets

There are proven yet underutilized techniques that can help reduce such trends, namely value engineering and life-cycle costing. Both have been used for years to encourage consideration of many alternatives in conceptual and design stages, but seldom for public works projects.

Value engineering specifically encourages the "re-engineering" of projects to minimize costs, materials, time, and resources. Life-cycle cost analysis encourages project owners, designers, and operators to consider the entire life of a project and the cost and resources to keep it in good condition.

Together, these techniques seek to develop projects as efficiently as possible and in a way that maximizes value over a project's entire projected life. By getting the full life out of infrastructure, the need to rebuild using new resources, or to find ways to reuse systems and materials, are both lessened, thereby conserving resources.

How to Implement These Practices

Cities, towns, highway departments, and other organizations can best implement these techniques after a training and educational program for users, which can be facilitated by an experienced consulting firm.

Learn more about this and similar practices

Design, Realization, and Maintenance
http://trid.trb.org/view/2013/C/1251806

Data Driven Decision Making
http://trid.trb.org/view/2011/C/1135023

City of Saskatoon's Green Streets Program
http://trid.trb.org/view/2010/C/1094068

Design for Sustainability
http://trid.trb.org/view/2009/C/982071

Life-Cycle Cost Approach to Infrastructure Cost
http://trid.trb.org/view/2009/C/881745

Maximizing Value of the Built Environment
http://trid.trb.org/view/2007/C/838860

Risk-Based Life Cycle Costing of Infrastructure
http://trid.trb.org/view/2003/C/734430

Toward a New Paradigm
http://trid.trb.org/view/2000/C/656348

Life Cycle Cost Analysis (LCCA)
http://trid.trb.org/view/1999/C/500289

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Materials Management, Technology and Training for Road Maintenance

Contributed by: The APWA Engineering & Technology Committee (January 2015)

Public works and transportation departments tasked with maintaining city, county, state, and federal roadway systems often work around the clock during the winter plowing streets and applying road salt and abrasives to maintain safety for the travelling public. When material supplies run short of demand, agencies may struggle to replace stockpiles or pay increased costs. Insufficient material application can lead to hazardous conditions; higher costs can lead to budget overruns and eventually tax increases. Salt and abrasives can end up in ditches and storm sewer systems, where the run off makes its way to drinking water sources and aquatic environments vulnerable to salt, silt and chemicals.

Federal agencies, such as Environment Canada, have begun requiring agencies to report annual material use volumes and best management practices (BMPs). A study conducted by the University of Waterloo, Ontario and the National Water Research Institute, Assessing the Efficacy of Current Road Salt Management Programs, found that the implementation of BMPs has a positive effect on salt management. Public Works agencies can better prepare and manage snow and ice conditions by better managing winter maintenance materials and their application through the use of technology and implementation of BMPs.

The City of Airdrie in Alberta, Canada, which already had a Salt Management Plan (SMP), thought it could improve on its existing BMPs by using software to control salt application. The city implemented automation technology that was compatible with its existing material spreaders.

Similarly, the City of West Des Moines implemented new technology to dramatically reduce the amount of deicer chemicals used in winter maintenance operations, through:

- enhanced training of winter maintenance personnel,
- utilization of ground speed controlled automated granular and liquid application equipment, and
- utilization of GPS and an automated vehicle location system (AVL).

Expanded Training and Technological Advances

While past training in West Des Moines focused primarily on safe equipment operation and spread rates for each storm, the educational focus has been enhanced to provide operators with spread rate determinations and how storm conditions impact their use, as well as more detail about individual deicer products and when they are not effective and should be minimized.

Automated application equipment, properly calibrated, allows very precise amounts of deicer products to be dispensed, while recording the quantity utilized and allowing the operator to adjust the application rate. In addition to precision and data collection, these systems are ergonomically more comfortable for the operator, as they don't have to be continually turned off and on.

GPC and AVL systems allow agencies to record data from both the truck and the application equipment. Since the AVL system is tied into the spreader control module, data can be stored and viewed live at any given time, allowing the agency to review how much material is being applied, determine if the desired spread rates are being achieved, and coach operations to optimal performance.

City of West Des Moines Sees Results

For three years, West Des Moines has seen reductions of approximately 30-40% over prior years. The combination of enhanced training for operators and utilization of technology has helped the agency to reduce both its budget and impacts to the environment. Staff in West Des Moines actively promote this approach on the national level.

Efficiencies and Improvements Gained in Airdrie

After implementation, the City of Airdrie quickly realized cost savings and operators saw firsthand that more salt didn't mean better road conditions.

- Roads are safer because product is being placed at all critical locations;
- Material usage is reduced because product is only being placed where needed;
- Salt vulnerable areas can be avoided by controlling the width of the material dispensed and where the spreader turns on;
- Service levels are consistent regardless of an operators' skill or knowledge of the roadway;
- Training is reduced because all trucks are preloaded with the routes;
- New roads can be added to routes and additional trucks can be added to the fleet with ease.

Learn more about this and similar practices

New System for Snow Removal
http://goo.gl/nEbMYL

The Environmental Management of Road Salts
http://goo.gl/e6Jo1q

Efficacy of Current Road Salt Management Programs
http://goo.gl/l9wfQT

Automated Systems for Winter Maintenance
http://goo.gl/skOdKq

Energy Conservation and Waste Reduction in Buildings

Contributed by: The APWA Facilities and Grounds Committee (January 2015), The APWA Engineering & Technology Committee (January 2015)

The implementation of energy conservation and waste reduction practices in buildings is a great way for public works departments and city leaders to demonstrate behaviors and practices that citizens can follow. Convenience, educating occupants and visitors, and communicating expectations is critical to user acceptance and successful implementation.

In addition, public works officials, though they may not be significant consumers of energy, may be responsible for energy generation facilities such as hydro-electric or coal and gas powered electric facilities. Modern technology has expanded energy generation sources to include solar, wind, biomass, wave and fuel cells, depending on the area, geography, and climate of a community or region.

Energy Efficiencies in Our Public Facilities

Reducing energy consumption helps reduce carbon emissions and saves resources, with the added benefit of saving money. Relying on a broad mix of energy sources can help agencies balance their financial risk resulting from energy market fluctuations.

A few energy reduction recommendations:

- Add motion detectors to infrequently used areas, like conference rooms, to turn lights off when areas are not being used.
- Replace aged lamps and light fixtures (both interior and exterior) with energy saving high efficiency, high performance lighting, like LED, to save energy.
- Turn off electronics (computers, monitors, etc.) at the end of each workday.
- Use waste oil – or capture methane from landfill sites and sewage digesters – to heat buildings

Recycling Practiced Here!

The use of recyclable materials and implementation of recycling initiatives can be a model for the community, and can spur or support broader programs. The increased use of recyclable materials decreases the amount of waste produced, builds market demand for recyclable materials, and can reduce the demand for virgin raw materials.

A few recycling suggestions for public organizations:

- Replace polystyrene foam plates and cups with recyclable products – or better yet, reduce the use of disposable items by encouraging employees to bring in their own cups and utensils.
- Place recycling containers throughout community facilities to increase collection of recyclables, especially by copy machines, meeting rooms, and at employee's desks.
- Store documents electronically and actively discourage printing
- Develop digital forms to replace paper forms.
- Use recycled materials in the construction of buildings and projects.
- Integrate "green" cleaning supplies.

Learn more about this and similar practices

US Environmental Protection Agency
http://www.epa.gov/sustainability/

Sustainability Ideas
http://goo.gl/gR4jEH

Sustainable Practices Science
http://goo.gl/mLFO0u

Energy Star Building Upgrade Manual: Lighting
http://goo.gl/iSxWfP

Industrial Materials Recycling
www.epa.gov/industrialmaterials

Utilizing "Greener" Practices in Parks

Contributed by: The APWA Facilities and Grounds Committee (January 2015)

Most parks are already green places, but municipalities and parks departments across the country can maximize the benefits of these public spaces by implementing these green practices.

Choose Your Plants Appropriately and Reduce Pesticide Use

Utilize native and climate appropriate plants. Native plants, as well as those adapted to the local soil and climate conditions, have a greater resistance to pests and require less water and maintenance.

Reduce pesticide use. Maximize non-chemical landscape practices to remove pests such compost tea spraying for fungus and sheet mulching for weed suppression. Use chemicals only as a last resort effort.

Turn Waste into an Asset

Compost waste materials. Composting improves plant growth and quality of plant material, restores nutrients back to the soil, and decreases waste to the landfill.

Utilize compost. Composting helps break down clay-based soil, helps control weeds, and acts as a natural fertilizer, thus decreasing the chance of manmade fertilizers entering the water stream.

Encourage recycling. Recycling decreases waste to the landfill and reduces the cost and environmental impact of extracting and manufacturing raw materials.

Better Manage Stormwater

Reduce stormwater runoff. Bioswales and other landscape elements can control stormwater by slowing and filtering surface runoff water. This allows for some infiltration on site, supplementing irrigation systems by enhancing soil health and plant root systems.

Learn more about this and similar practices

Green Sports
http://www2.epa.gov/green-sports

Foundation for Sustainable Parks and Recreation
http://www.yourparksyourlegacy.com/

US Environmental Protection Agency
http://www.epa.gov/sustainability/

APA Green Infrastructure
https://goo.gl/b9EtT4

Sustainable Sources
http://sustainablesources.com/

Landscaping to Reduce Energy Consumption in Buildings

Contributed by: The APWA Facilities and Grounds Committee (January 2015)

The careful planning of landscaping around buildings can greatly affect the energy consumed by a facility. In warm weather climates, landscaping can reduce direct sun from heating up building surfaces and prevent reflected light from transferring heat into a building – reducing cooling costs. In cold weather climates, landscaping can block winter winds – reducing heating costs.

Building owners should consult a landscape architect, stormwater engineer, and/or an urban forester when modifying or planning the landscape in order to identify and maximize the potential sustainability and green infrastructure initiatives that can best be utilized.

Proper Choice and Use of Trees Reduce Energy Costs

Shading. Trees can have a canopy large enough to shade roofs and facades, reducing heat gain and cooling costs. The best locations for deciduous trees are on the south and east sides of a building. When these trees drop their leaves in the winter, sunlight can reach the building to help with heating. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Shrubs or small trees can be used to shade air conditioning or heat pump equipment that sits outside

Windbreaks. Evergreen plantings on the north side will slow cold winter winds. The effective zone of protection for a windbreak can be 30 times the height of the trees. However, the maximum protection occurs within 5 – 7 times the tree height.

Landscaping for Better Stormwater Control and Improved Water Quality

Capture water for reuse. Flooding and uncontrolled runoff cause considerable wastewater issues. Consider using rain barrels on municipal buildings and installing rain gardens on municipal properties and encourage citizens to do the same.

Reduce stormwater runoff. Landscape elements such as bioswales, vegetated drainage strips with gently sloped sides, can control stormwater by slowing and filtering surface runoff water. This allows for some infiltration on site, supplementing irrigation systems by enhancing soil health and plant root systems. These can be placed on road rights-of-way as well as other properties.

Learn more about this and similar practices

US Environmental Protection Agency
http://www.epa.gov/sustainability/

Sustainable Sources
http://sustainablesources.com/

Arbor Day Foundation
http://goo.gl/C76AH2

US Department of Agriculture: Bioswales
http://goo.gl/n036hd

Davey: Urban Forestry
http://goo.gl/afLs4s

Urban Forestry Network
http://goo.gl/ZNj4pE

Green Infrastructure
http://goo.gl/caVXFG

Flexible Vehicles

Hydraulic hooklift hoists are mounted on heavy duty trucks to enable a single cab and chassis the flexibility of using many container bodies interchangeably: roll-off containers, water tanks, dumpster bodies, flatbeds, hot patch units, and sand/salt spreaders. Primarily used in conjunction with tilt frame bodies, the system employs a series of hydraulic rams to hook, lift and hoist a container onto the chassis of a truck.

By utilizing one drive train for a multitude of seasons and functions, public works and transportation departments, fire departments, waste removal services, material haulers, landscapers, and general contractors with diverse responsibilities and changing priorities can quickly adapt to the need for transporting materials such as solid waste, recycling, or landscape debris.

The City of Moline, IL began using hooklift hoists in 1996.

Fuel Diversity

"Green Fleet" policies require vehicles that run on cleaner burning fuels, such as flex fuel and bi-fuel vehicles. Every diesel powered vehicle is capable of running on B20 (80% diesel and 20% processed soy bean oil) without conversion issues and inexpensive conversion kits are available for alternative fuels. Flex fuel vehicles can run on a mixture of 15% gasoline and 85% ethanol, as well as conventional gasoline. Bi-fuel vehicles run on two fuels (e.g. compressed natural gas or gasoline). Hybrid vehicles use electricity and gasoline. All these options require consideration of fueling infrastructure (easy for biodiesel and ethanol by modifying existing infrastructure, but may require new infrastructure in the case of compressed natural gas or electricity.

Energy Conservation Applications

During winter months, many public agencies attach block heaters to their diesel-powered dump trucks and equipment (e.g., loaders). When the block heaters are plugged in, they constantly supply heat to the vehicle's block, but this additional heat is only needed when the temperature drops below freezing. Utilizing thermostatically controlled block heaters (adding thermostats to the electric outlets used by the block heaters) allows activation of the block heaters only when the ambient temperature falls below freezing.

Efficiencies and Improvements Gained

Flexible fleet vehicles allow for more rapid responses to service requests and can reduce the number of vehicles required to provide a variety of community services. Relying on a broad mix of energy sources can help agencies balance financial risk resulting from energy and fuel market fluctuations.

Learn more about this and similar practices

Moline, IL Fleet Services Division
http://goo.gl/N57hhl

Hooklift Hoist Manufacturers
http://goo.gl/XLEcTt

Transportation Energy for the Future
http://goo.gl/cHXQFM

Fuel Trends in Route Buses
http://goo.gl/30XBRo

Use of Alternative Fuels and Hybrid Vehicles
http://goo.gl/mB4TnY

The Urban Bus Case
http://dx.doi.org/10.3141/1641-05

Grid-Connected Hybrids
http://goo.gl/F6I7g7

Towards Cleaner Fuels and Buses in Mexico City
http://trid.trb.org/view.aspx?id=887360

Fleet Demand for Alternative-Fuel Vehicles
http://trid.trb.org/view.aspx?id=463123

New York City Fleet Upgrades
http://trid.trb.org/view.aspx?id=848719

Assessment of Hybrid-Drive Bus Fuel Savings
http://trid.trb.org/view.aspx?id=750275

Reducing Fuel Use and Emissions with a 'No Idling, No Top-Off' Policy

Contributed by: The APWA Fleet Services Committee (January 2015)

In 2009, the City of Eugene, Oregon adopted a 'No Idling, No Top-Off' policy for its fleet operations, including all city-owned or leased vehicles and equipment. The practice, applicable to both large and small fleet operations, can reasonably be expected to:

- reduce air pollution from vehicle and equipment exhaust systems,
- promote energy conservation and cost savings,
- reduce noise pollution, and
- reduce wear and tear on equipment.

Getting It Done

Under the terms of Eugene's policy:

- Vehicles need to be shut off whenever idling time is expected to exceed 20 seconds
- Vehicles are not to be left idling when unattended
- Engine warm-up periods are not to exceed one minute
- When fueling any vehicle or piece of equipment, operator should not top-off the vehicle past the point that the fuel nozzle overflow safety system shuts down the fueling process

Exceptions to this policy take into account manufacturer's requirements, operational needs such as emergency response or training operations, and specific equipment related issues.

- Public Safety vehicles while on an emergency scene as required to respond to the emergency or when required for training operations.
- During freezing weather conditions or any other time when the health and safety of employees or others may be jeopardized (e.g. the visibility of the driver is impaired and no other method to eliminate the impairment is available).
- Idling while stopped for an official traffic control device or for traffic conditions over which the driver has no control.
- If the vehicle/equipment is not expected to restart due to a mechanical problem.
- For vehicle maintenance and diagnostic purposes.
- If the engine is required to power auxiliary equipment such as a hoist, lift platforms, hydraulic tools, inverters, compactors, medical equipment, specialized public safety radio communication and computer systems, etc.
- Vehicle/equipment manufacturer requires additional idle time for warm up or cool down for proper mechanical or functional operation of the unit.

In order to encourage compliance, the policy was rolled out to the organization with a focus on the desired outcomes and less emphasis on the rules. Building awareness of the benefits, as well as the downside of 'business as usual', helped encourage adoption. Advisory stickers were placed strategically on the dashboards of vehicles and at refueling stations as a reminder to drivers.

An initial concern was the potential for onboard radio and computer systems to draw down the vehicle's battery capacity and render the vehicle unable to be restarted. The Fleet and Radio staff worked with the individual departments to increase onboard battery capacity and install energy-efficient communications equipment. Other real or perceived problems were addressed as they arose.

Efficiencies and Improvements Gained

An analysis of fuel usage after one year indicated overall fuel consumption had declined by about 3.5%, or more than 12,000 gallons. Further analysis in subsequent years has shown fuel consumption remaining relatively steady – good news as public agencies face a dynamic fuel marketplace and volatile pricing. Longer term, reduced hours on City vehicles resulting from the no-idle rule may result in lower periodic maintenance costs and the potential for retaining vehicles longer in the fleet prior to replacement.

Learn more about this and similar practices

Eugene, OR No Idle, No Top Off
http://goo.gl/ocKvWU

Don't Idle, Don't Top Off
http://goo.gl/BVi4Xi

No Idling and No Top-off Policy
http://goo.gl/BVi4Xi

Switching Vehicle Fleets from Petroleum to Synthetic Lubricants

Contributed by: The APWA Fleet Services Committee (January 2015)

In the City of Troy, MI, the testing of vehicles using petroleum vs. synthetic lubricants has shown that the use of synthetic lubricants extends oil change intervals from 2,500-3,000 miles to 18,000-20,000 miles without increasing wear on the main and rod bearings. Switching fire trucks to synthetic oil has increased the time between oil changes from 6 months to, in some cases, 5 years.

The use of synthetic lubricants:

- increases fuel economy (miles per gallon),
- reduces engine temperature,
- decreased purchasing costs,
- decreases staffing costs,
- helps to preserve the environment by requiring less oil and lubricant, and
- reduces disposal costs and the possibility of hazmat spills.

Getting It Done

In the past, all marked and unmarked police vehicles were serviced monthly for an oil change, lube, and safety check. As a test, the City of Troy switched two marked Chevrolet Caprice vehicles to 100% synthetic AMSOIL engine oil and extended the drain intervals to 20,000 miles, with a new oil filter installed at 10,000 miles. The vehicles continued monthly safety inspections but the oil was not drained, only a sample was taken.

When the two test vehicles reached 70,000 miles, the technicians removed the oil pans, as well as the main and rod bearings, to check for wear using a plastic gauge test. The bearings showed very little wear. The same procedure was performed on two cars of the same year, make, and model using petroleum oil. The wear on the two vehicles with petroleum oil, changed monthly at 2,500-3,000 miles, showed slightly more wear in the plastic gauge test, but the results were well within specifications in both cases.

With the help of oil analysis, the city was able to extend oil changes to intervals of 18,000- 20,000 miles with a new filter installed at 9,000-10,000 miles. Troy currently uses AMSOIL synthetic engine, transmission, and rear differential oil in all vehicles serviced out of its City Hall facility.

City of Troy Experience Shows Success/Savings

Savings have been realized due to the decrease in the number of oil filters and quarts of oil purchased and disposed of, and the increase in fuel economy attributed to synthetic oil use. Labor time to complete preventative maintenance services on vehicles has been reduced, allowing up to 50% more vehicles to be serviced daily. The City has become more competitive by reducing labor costs through the reduction in staff by one (1) person. To date, the city has not had to re-build an engine or transmission with the new extended oil change intervals.

CAUTION: Before attempting to extend oil change intervals, oil must be analyzed by a reputable laboratory at reasonable increments, such as every 1,000 miles, to obtain the optimal extended oil change intervals for a fleet.

Learn more about this and similar practices

Synthetic Lubrication and Filtration Products
http://goo.gl/Mpi9bY

Building a Green Team

Contributed by: The APWA Center for Sustainability (January 2015)

Cape May City, New Jersey, a coastal town of just over 4,000 full time residents, was awarded a Small Municipality Champion Award from Sustainable Jersey in 2014. The City's successful sustainability efforts can be attributed in part to how it followed recommendations from the Sustainable Jersey program and established a "Green Team" in 2011. Mayor Dr. Edward J. Mahaney, Jr. credits the Cape May's 21-member "Green Team" with "collectively developing the long term plan and strategies to guarantee the sustainability and resiliency of Cape May."

Getting It Done

The most effective Green Teams are those that have diverse members to incorporate a wide range of perspectives, expertise, and interests. Effective team members should

- have both the influence to advance a program, and the time, skills, and motivation to contribute,
- represent an appropriate cross section of the community,
- include representatives from relevant departments such as facilities, maintenance, purchasing, planning, engineering, health/social services, and recreation, and
- be recruited from the skilled residents, citizens, and businesses, civic, nonprofit, and faith-based organizations in the community.

The Green Team has Been Key to Success

Representing city-wide departments, Cape May's Green Team consists of dedicated city employees including the mayor, city manager, superintendents of water/sewer and public works, and representatives of the zoning, planning and historical boards.

Importantly, the Cape May's Green Team also includes a diverse group of community and business leaders, including two local clergy members, an elementary school teacher, a school board member, an environmental consultant, and the local Chamber president.

All are focused on a goal to sustain Cape May's quality of life over the long term.

Green Team Efforts Contributed to Community Enhancements and Helped to Garner Outside Financial Support

By involving the larger community and organizations like Sustainable Jersey, the City of Cape May was able to enhance its efforts toward sustainability, while bolstering its financial resources. Since Cape May City´s Green Team was established in 2011, the City has accrued over $250,000 in grants and rebates and continues to elevate its efforts and garner more state and federal support. The Green Team has also been instrumental in the City's redevelopment efforts on several tracts of City land which are being repurposed as parks and playing fields.

Learn more about this and similar practices

Cape May City Sustainability
http://goo.gl/hXp5HF

Sustainable Jersey
http://www.sustainablejersey.com/

Sustainability Leaders as Storytellers: Communication Boosts Sustainability Efforts

Contributed by: The APWA Center for Sustainability (January 2015)

Sustainability leaders should recognize that progress in sustainability can be achieved with organizational communication and stakeholder involvement.

Jessica Fisher, Program Coordinator at Denver's Office of Sustainability, believes that better communication is the key to gaining buy-in both with city departments and with the public. "Stories shape our lives, and I'm a huge believer in the idea that a good story, told at the right time, can be extremely powerful. And especially with something like sustainability – a buzzword that few people fully understand – it's vital that leaders learn to tell a better story about their work – about what sustainability is and why we practice it. And most importantly, this story can no longer be about a coming catastrophe, guilt, and sacrifice. But rather, the story needs to focus on prosperity, health, and happiness – both now and in the future. We need to better communicate what are the things that we are working toward, not just what we're working against. Those are the things that resonate with people. That is the story we want to tell. It's the story we need to tell."

Denver Mayor Sets the City-wide Stage with "Everybody Plays"

When Denver's Mayor Michael Hancock resolved that Denver would ramp up the scale of it sustainability efforts, his directive "Everybody Plays" captured his commitment to the City's vision and not just the responsibility of one department.

Mayor Hancock also sent a message by limiting the size of the Office of Sustainability to illustrate that sustainability must infuse the operating practices for each of the city's agencies. Reporting directly to the Mayor, the Office of Sustainability works with city agencies to help them master the methodologies behind sustainability planning and operations, and provide them with assistance in identifying, developing, funding, implementing and evaluating specific sustainability projects.

Building Community Awareness and Support

According to Jessica Fisher, "In Denver, we recognize that our most valuable asset is our people, and that our people love Denver. And so we plan to work with our people to build community involvement and create more momentum for our sustainability efforts."

When Denver created its sustainability vision, the City's Office of Sustainability invited an incredibly diverse group of stakeholders to provide input through three large meetings and many more one-on-one conversations with over 100 community members representing over 70 organizations.

Share Your Success Stories

The sharing of sustainability stories can be used to illustrate fiscal, environmental, health, livability and community enhancement benefits and successes.

Denver credits its high sustainability profile as part of the winning strategy that attracted Panasonic's technological and solar energy division to Denver's airport area. Panasonic found Denver, out of 22 U.S. cities, the best suited technologically and the company gravitated to the city's environmental sustainability. The Panasonic is expected to have an $82 million annual economic impact to the city, bring 400 jobs, and be the catalyst that will increase business development around the Denver International Airport. Panasonic has vowed to work with the city to make their campus an example of sustainability.

Learn more about this and similar practices

Denver Office of Sustainability
http://www.denvergov.org/sustainability

Priority Sustainability Actions for Public Works Directors

Contributed by: The APWA International Affairs Committee (March 2015)

At the IPWEA "Sustainability in Public Works" Conference held in Tweed Heads (NSW, Australia) in July 2014, where nearly 70 papers covering a broad range of sustainability topics were presented, the final session of the conference was dedicated to the priorities public works professionals should adopt to make public infrastructure and local communities more sustainable. Adding to the suggestions of university professors and IPWEA staff, conference delegates at the session also proposed sustainability actions and approaches.

Stephen Lees, IPWEA Australasia Director Sustainability, carefully examined the 40 suggestions and 'distilled' them down to five sustainability actions and five sustainability 'approaches'.

Getting It Done

Actions are tasks that can be implemented, whilst 'approaches' are strategies or tactics to help market or strengthen sustainability. Both the five sustainability actions and five sustainability 'approaches' were prioritized on the basis of how frequently the idea behind each was suggested.

The 'distilled' sustainability actions for Public Works Directors, listed in priority order, are:

1. Set, monitor, review and publicly report against challenging sustainability targets covering main resources used for energy, water, materials, waste and GHG emissions.
2. Justify sustainability benefits in public works proposals on economic grounds using 'whole-of-life' costing.
3. Promote more sustainable use of materials in public works by amending procurement policies and practices to explicitly consider environmental and social aspects.
4. Design public works with built-in resilience to cope with increasing risks and challenges of climate change and extreme natural events.
5. Investigate early replacement of all street lights with energy efficient LED lamps.

The 'distilled' sustainability approaches for Public Works Departments, also listed in priority order, are:

1. With help from Council's communications specialists, consult with and engage the local community (including businesses) to develop a shared sustainability vision and encourage the community to communicate its expectations to decision-makers.
2. Adopt a corporate Sustainability policy (if there is none) and make the CEO/GM or a director explicitly accountable for managing Council's sustainability performance, including climate risks, and reflect that accountability in his/her Key Performance Indicators.
3. Promote a common understanding of what sustainability is and its benefits in local government, especially in public works; using 'livability' to highlight community well-being benefits.
4. Start with small sustainability projects that can be learnt from - try new approaches or work with your community to adapt a successful project elsewhere to suit local circumstances.
5. Market sustainability initiatives using sustainability success stories from other cities and by framing objectives in positive and readily-understood terms, such as improving efficiency, minimizing waste, securing water supply and improving transport connections.

Learn more about this and similar practices

Institute of Public Works Engineering Australasia
www.ipwea.org

Public Works and Environmental Education

Contributed by: The APWA Solid Waste Management Committee (January 2015)

It is common practice for public works professionals to speak about public works systems, projects and programs at career fairs, school assemblies or community events.

Some public works agencies employ (or contract) full-time staff with the mission to engage youth and adults in a classroom or continuing education setting as part of a comprehensive environmental program. Professional environmental educators provide knowledge, tools, and connections to helps agencies cultivate relationships between communities and the environment. Nurturing curiosity, contributing to a strong sense of self, and fostering leadership skills among residents is critical to creating a vibrant, healthy and engaged community. In short, by creating lifelong learners, environmental educators build sustainable communities.

Supporting Sustainability Principles

Recognize the Community as a System. Environmental education programs provide community members with knowledge, awareness, and tools to make a positive impact on the environmental and human health of a community, recognizing that community improvements are most effective when initiated and supported by community members.

Provide Efficient Infrastructure. Environmental education programs help agencies teach community members how personal action can take the place of more expensive or intrusive capital projects. At-home composting can minimize the need for a centralized composting facility. Using benign, natural yard care products – or properly applied traditional products – can improve stormwater management and water quality.

Support Concentrated Development. Community members who are educated about environment impacts may be better neighbors and prepared to live in more dense and compact neighborhoods.

Restore and Enhance the Environment. Community action projects, backyard composting, water quality testing, and vegetable gardens make our communities better places to live, work, and play.

Be Fair / Communication and Civic Engagement. Environmental education programs are a great way to connect public works professionals with community members in the places and organizations where residents normally congregate – bringing government to the people (rather than the other way around).

Getting It Done

The Sustainable Resources Division of the Pierce County Public Works and Utilities Department (Tacoma, WA) employs four full-time environmental educators and has provided, or contracted for, environmental education services since 1988.

K-12 Academic Programs. A set of lessons and a community action project provide integrated, hands-on activities customized for each classroom based on grade types, learning ability, what students are learning, or the unique needs of the neighborhood where a school is located. Lessons address:

- composting and worms,
- resource conservation and recycling, and
- water conservation and consumption.

The community action, or service learning, project can last from one to a couple of hours and is the most important component of the program because it encourages students to apply what they have learned.

Community Programs. Community education programs are free to Pierce County volunteer groups, teams, clubs or societies with an interest in initiating environmental progress in their community. Educators encourage groups to consider partnering with a school or youth organization in order to provide a broader benefit to the community and have a larger impact on the environment.

Composting classes for adults are offered on a regular basis throughout the spring and fall. These classes teach adults how to manage food and/or yard waste effectively and inexpensively on their own property. Other classes, offered on a regular basis throughout the county or scheduled and customized by request, are designed to provide

the tools and knowledge needed for creating and living a more environmentally sustainable lifestyle.

Topics include:
- earth-friendly art,
- green cleaning,
- recycling and waste reduction,
- toxics reduction; water conservation, and
- water protection.

Edible Gardens Workshops. Developed in conjunction with the local conservation district, edible garden workshops are held monthly from March to October and teach adults and youth the basics of successful vegetable gardening from seed to putting the garden to bed for the winter.

Efficiencies

In Pierce County, as in other jurisdictions with similar programs, environmental education is a natural evolution of a "traditional" solid waste management program. Successful solid waste managers know that to have an effective program, customers must be educated about where to put their containers, what day to set out which container, what goes into each container, etc.

In the late 1980's, as formal community recycling programs took shape, many jurisdictions included youth outreach programs. Since kids in many households sort recyclables, solid waste agencies figured they could reach parents (customers) through their kids. The result: kids trained to take on more responsibility at home and better informed customers.

Pierce County leaders recognized that teaching about solid waste and recycling in isolation was a missed opportunity to connect residents to a wider range of environmental services offered by public works departments. As Pierce County's program grew to address composting, waste reduction, water quality, and waste water and resource extraction components, efforts were also made to link the K-12 Academic Programs to the state's science curriculum standards.

An Economic Way to Provide Service

The cost of Pierce County's four-person environmental education team is approximately $550,000. With a residential population of nearly 600,000 people and approximately 370,000 tons of garbage disposed per year, program costs average $1.49 per disposed ton (about 1% of the County tipping fee) or $0.92 per capita per year. In the type of "pay as you throw system" implemented in Pierce County, residential and commercial ratepayers can experience disposal fee savings as disposed tonnage declines. Thus, the entire community's contribution to environmental education could be "offset" with just a 1% reduction in the amount of garbage disposed; and that's before considering the positive impact that a more environmentally aware community would have on stormwater and wastewater resources.

Individuals, households and businesses can see even greater savings by implementing waste reduction and resource conservation practices that allow them to reduce the size of garbage cans or collection frequencies. Programs which allow customers to self-select their level of participation and to then incorporate what they learn into a commitment to waste reduction, recycling, and resource conservation, can be "sold" as smart from environmental, organizational, societal, political, and economic perspectives. In programs like this, government incentivizes outcomes but doesn't compel specific behaviors.

Learn more about this and similar practices

Pierce County, WA Environmental Education
www.piercecountywa.org/enviroed

City of Tacoma EnviroChallenger
www.envirochallenger.com

City of Tacoma Arts EnviroChallenger
http://goo.gl/S34m0H

City of Phoenix, ASU "Turning Trash to Resources"

Contributed by: The APWA Solid Waste Committee (January 2015)

The City of Phoenix (population 1.5 million) will soon be "Turning Trash to Resources". Instead of the economic cost of transporting waste to a landfill that has to be managed, the City will divert its waste from the landfill and repurpose it as raw materials for new products or energy – and economic opportunities for local entrepreneurs, inventors and small businesses.

This 'circular economy' effort was spurred by the City's "40 by 20" goal, to divert 40 percent of its waste from the landfill by 2020.

City of Phoenix Join Forces with ASU and Public and Private Entities

The City is working with Arizona State University's Global Sustainability Solutions Services to design and manage a global waste-to-resource network comprised of professionals and researchers who visualize products, energy and jobs from trash.

The Resource Innovation and Solutions Network (RISN), convenes representatives from both public and private entities to collaborate with sustainability scientists and scholars from ASU's Global Institute of Sustainability to propose real-world projects backed by scientific validity and to grow a global network that solves resource management issues through economy-building jobs and industries. Current and future projects include:

- green organics regionalization,
- regional greenhouse gas emissions inventories,
- multi-family dwelling recycling programs,
- waste assessment tools,
- school district waste reductions and educational programs,
- pre-consumer food waste studies, and
- a Living Building Challenge course at ASU.

The City has designated 88 acres for the RISN campus to be located at its 27th Avenue Transfer Station, one of two transfer stations operated by the city to process waste for more than 350,000 households. This campus will ultimately house the Materials Recovery Facility, a composting facility, waste-to-resource focused businesses and office space for a RISN incubator.

City Envisions Great Return on Investment

As Phoenix attracts innovators with new manufacturing processes and conversion technologies that use trash as a resource, the transfer station will divert more and more volume away from the landfill and into Phoenix's circular economy. Initial studies indicate that innovations from this network could save the city one to three million dollars per year and create new sources of energy, products, manufacturing and recycling.

The City of Phoenix will issue a Call for Innovators (CFI) and an RFP to get input from the private sector on how the city can reshape its waste processes to support a circular economy. The CFI will be used to identify specific business opportunities that will be awarded through future competitive processes, to design the RISN campus based on business needs, and to provide adequate support for the incubator. The RFP is designed to address specialty waste streams.

As a result of the Phoenix's innovation and leadership, a RISN hub is emerging in Lagos, Nigeria, and prompting interest from Haarlemmermeer, Netherlands and Antigua, Guatemala.

Learn more about this and similar practices

ASU Resource Innovation and Solutions Network
https://resourceinnovation.asu.edu/

ASU Walton Sustainability Solutions Initiatives
https://goo.gl/qjZVfi

ASU Global Institute of Sustainability
https://sustainability.asu.edu/

Promoting Bicycling as Part of a Multi-Modal Transportation System

Contributed by: The APWA Transportation Committee (April 2015)

Many cities of all sizes are constructing bicycle infrastructure to support bicycling as part of a multimodal approach to transportation. A Bicycle Master Plan can assist cities in planning and implementing such programs in the most cost effective, useful and practical manner.

Investments in bicycle infrastructure can

- address transportation equity by providing low-cost and more sustainable transportation choices,
- reduce traffic congestion and reduce environmental impacts,
- improve public health,
- maximize transportation investments and reduce maintenance costs, and
- promote economic development

Dollar for dollar, bicycling is one of the most cost-effective transportation modes for both the city and the individual. Providing on-street bicycle access can maximize the use of existing roadway space, and typically requires relatively low-cost pavement markings or signage once installed. A well-connected bicycle network provides individuals with a viable alternative to motor vehicle travel, thereby optimizing roadway capacity for freight, commerce and services while deferring or eliminating the need for costly new road construction. Considering that non-motorized transportation modes essentially have zero impact on air and water quality, promoting their use is an effective strategy for improving air and water quality. In addition, planning and incorporating bicycling facilities meets many state and federal objectives for community health, environmental protection and access and can help obtain grants for additional transportation funding.

Goals

Choice Develop infrastructure that creates viable transportation choices, and accommodates multimodal trips.
Connectivity Complete a connected network of bikeways linking and providing access to all neighborhoods and key destinations.

Economy	Enhance economic vibrancy by creating a bicycle friendly community that is an attractive place to live and work.
Education	Promote user rights and responsibilities of all transportation modes.
Environmental	Health Develop a bicycle network that enables active, healthy lifestyles and sustains a healthy environment.
Equity	Provide bicycling access for all through equity in public engagement, service delivery and capital investment.
Livability	Build a vibrant and healthy community by creating a welcoming environment for bicycle riding.
Mode Shift	Increase the number and percent of bicycle trips citywide by providing a variety of bicycle facility types.
Safety	Promote safe bicycling, driving, and walking behaviors and build appropriate, well-designed facilities that cater to all types of riders.

Getting It Done

The City of Bellingham, Washington, like many U.S. cities, is faced with challenges related to economic development, repair and maintenance of infrastructure, local environmental issues, equitable distribution of basic services, and growing public demand for more transportation choices. In addition, individuals and families are feeling the pressure of rising transportation costs.

The largest contributor to Bellingham's carbon dioxide emissions is the combustion of gasoline and diesel by motor vehicles (48%) and the city aims to reduce greenhouse gas emissions by 70 percent between 2000 and 2020. Bellingham's Climate Action Plan sets reduction targets for vehicle emissions and miles traveled by promoting the development of a multimodal transportation

Promoting Bicycling as Part of a Multi-Modal Transportation System

Contributed by: The APWA Transportation Committee (April 2015)

system. Providing transportation choices that are safe, convenient and offer health and cost savings benefits is a key strategy for shifting people away from using their cars. The plan also includes strategies to expand an existing population of bike riders, by expanding the city's network of cycling infrastructure that will increase safety for riders and encourage more short trips and commutes be made by bicycle.

Efficiencies and Improvements Gained

According to a study by the League of American Bicyclists, there are many economic benefits to bicycling infrastructure investment.

In urban areas, where cars and bicyclists travel at similar speeds, bike lanes can accommodate 7 to 12 times as many people per meter of lane per hour than car lanes and bicycles cause less wear on the pavement. The cost of a bike lane varies depending on the location, the condition of the pavement, lane-painting expenses, changing traffic-light signalization, and other factors, but can cost as little as $5,000 a mile. It is most cost-effective to create a bike lane when an existing road is being repaired or a new road is put in.

Community Engagement is an important part of the process, so don't underestimate the importance of this part of your plan.

Learn more about this and similar practices

Bicycling Means Business
http://goo.gl/wUuh9T

The Benefits of Bicycle Infrastructure Investments
http://goo.gl/ze7Z3n

Bellingham, WA Bicycle Master Plan
http://goo.gl/OP0lRs

Baltimore Master Bike Plan
http://goo.gl/53RVOP

Seattle Bicycle Master Plan
http://goo.gl/Up34MP

Cleveland Bikeway Master Plan
http://goo.gl/WBwknm

Minneapolis Bicycle Master Plan
http://goo.gl/bA1Jgi

San Diego Bicycle Master Plan
http://goo.gl/vWZzW1

Los Angeles Bicycle Plan (2010)
http://goo.gl/kY3ZcY

Greenville, SC Bicycle Master Plan
http://www.greenvillesc.gov/544/Bikeville

San Diego Mobility Management
http://goo.gl/vWZzW1

Sustainable Road Improvement Methods

Contributed by: The APWA Transportation Committee (April 2015), The APWA Center for Sustainability (June 2015)

Public works departments can reduce environmental impacts while improving their road networks by implementing such construction technologies as warm mix asphalt pavement, increased use of reclaimed asphalt binder in asphalt pavements, and in-place recycling.

The Public Works Department for the City of Eugene, OR manages 1,257 lane miles of improved streets through rehabilitation techniques ranging from 2" deep inlay, to in-place recycling of existing base or subgrade, to full depth reconstruction. Eugene's pavement related capital improvements totaled approximately $15 million in 2013.

Warm Mix Asphalt

Warm mix asphalt pavement is similar to conventional hot mix asphalt pavement but, through a special mixing or water foaming process at retrofitted plants, is produced at a temperature approximately 50 to 100 degrees cooler. This reduction in temperature has several advantages:

- **Reduces energy consumption** to produce asphalt concrete, lowering costs and greenhouse gas emissions. The National Cooperative Highway Research Program (NCHRP) estimates that energy is reduced 30% at an asphalt batch plant when producing warm mix asphalt concrete compared to hot mix asphalt, lowering costs and greenhouse gas emissions (12 pounds of CO2 savings per ton of pavement).
- **Reduces off-gassing (smoke)** of asphalt concrete by keeping temperature under the boiling point of "light oils" in the liquid asphalt, benefiting construction workers and the public.
- **Slows the aging process** because the light oils are not boiled off and the liquid asphalt coating the rock particles is slightly thicker.
- **Provides a longer life product** by reducing the oxidation caused during high temperature production that causes premature aging of the asphalt, which should provide a longer life product.

The use of warm mix asphalt pavement was first made optional on Eugene projects in 2009 and became a standard specified material in 2010. Warm mix asphalt is now specified for all Eugene paving projects in place of conventional hot mix asphalt and approximately 44,000 tons of warm mix asphalt was placed in 2014.

Asphalt Binder Replacement with Reclaimed Materials

In Eugene, the use of reclaimed asphalt pavement (RAP) – up to 30% – has been specified in pavement projects for more than 20 years. Using typical materials properties,

the 30% (by weight) RAP content replaces approximately 25% of the virgin binder content of typical asphalt pavement. In 2013, approximately 13,000 tons of RAP were incorporated into Eugene pavement projects and the city conducted a test project to increase binder replacement content to 35% (combination of RAP and up to 5% reclaimed asphalt shingles). Adjustments were made to the grade of cement used to compensate for the stiffer mix, and the resulting decrease in virgin asphalt binder and increase in reclaimed material may lead to cost savings for the city. Using more reclaimed materials reduces the production and use of virgin construction materials and, depending on the mix design of the pavement, reduces landfilling of asphalt materials.

Eugene's Greenhouse Gas calculator "G4C" (created by Good Company) calculates approximately 34% in greenhouse gas savings when warm mix asphalt with 30% reclaimed asphalt pavement (RAP) is used in place of conventional asphalt. Since 2009, Eugene has placed approximately 361,000 tons of warm mix asphalt concrete, resulting in an approximate greenhouse gas reduction of 8,700 Metric Tons CO2 emissions.

In Place Recycling and Full Depth Reclamation (FDR)

Design teams on many street widening projects leave existing pavement in place for cost efficiency and add new pavement in areas where the pavement is widened. Generally, a two-inch asphalt overlay is designed over the entire pavement (both old and new sections), but this does not address long-term maintenance costs due to reflective cracking. If existing pavement is in poor condition, already-developed cracks will reflect through the new overlay, causing the new pavement to deteriorate quickly.

Hot in-place recycling (HIR) involves existing pavement being heated and softened, and then scarified/milled to a specified depth (¾ in to 2 in). New hot mix asphalt (HMA) and/or recycling agent may be added to the scarified RAP material and a new wearing surface applied. Cold in-place recycling (CIR) involves reuse of existing pavement material without the application of heat. Except for asphalt emulsion added as a recycling agent or binder, no transportation of materials is required.

Eugene estimated that using in-place recycling on three street projects in 2013 eliminated the need to excavate and haul away 9,700 cubic yards of material, as well as 17,000 tons of new base rock to the site, saving over 1,300 truck trips.

Eugene uses full depth reclamation (FDR), a type of CIR, in which all of an asphalt pavement section and a predetermined amount of underlying base material is reconstructed and treated to produce a stabilized base course. The process involves four steps:

1. Pulverization, using a large piece of equipment called a "reclaimer", of the existing asphalt, base rock and subgrade soils
2. Introduction of different types of stabilization additives such as asphalt emulsions (like foam bitumen) and/or chemical agents (like calcium chloride, portland cement, fly ash, and lime) to obtain an improved base
3. Compaction to produce a strong and durable base
4. Application of a new asphalt or concrete top wearing course

The advantages of FDR are:

- Saves money upfront and maintenance costs in the long term. Typically, the cost of pavement construction using FDR is 30 to 60 percent less than the traditional method.
- Performs faster than the conventional method, which allows more control over both vehicular and pedestrian traffic.
- Eliminates hauling of old material to landfills, since old asphalt and base course is recycled. If old asphalt and base materials are not recycled they must be disposed of or stockpiled, increasing transportation costs and occupying valuable landfill space. In some states, old asphalt can no longer be transferred to landfills. Environmental laws are becoming stricter causing higher landfill costs.
- Reduces the use of base course and asphalt compared to remove-and-replace construction techniques. As a result, it reduces extraction of natural resources for aggregate and oil materials. There is a shortage of good quality aggregate in most states. They sometimes come from distant quarries at great expense.
- Produces a stable base which may reduce the asphalt pavement thickness needed to meet the structural requirements of the pavement. Consequently, oil consumption and air pollution is minimized from manufacturing and hauling in less asphalt material.
- Constructed properly, a uniformly pulverized and cemented base will experience a minimum amount of distress, so no reflective cracks will transfer distress from the underlain layer to the new paved section.
- Durability of the road base subjected to wetting/drying and freezing/thawing cycles is a critical challenge in wet climates where deeply penetrating freeze-thaw patterns can cause damage to the base and the pavement. FDR has been found to eliminate heaving and allows for roads to be operable in cold-weather conditions.
- Traffic can be allowed to flow in low volumes on one side of the road while construction continues on the other side. For high traffic volumes, a surface treatment can be applied to act as a curing layer and allow traffic to flow until the roadway is ready for final asphalt pavement. In addition, truck traffic for hauling asphalt and CSBS and disposal of excavated materials can be minimized, helping to manage local traffic more effectively.

The City of Lynnwood, WA used FDR to construct a two-phased road improvement project on Olympic View Drive in the cities of Lynnwood and Edmonds, saving the city construction time and costs, while benefiting the environment.

Learn more about this and similar practices

City of Gresham, OR
http://goo.gl/WAzofb

Portland Cement Association
http://goo.gl/jf6PMz

Texas DOT
http://goo.gl/apAQBs

FHWA
http://goo.gl/DnophU

Pavement Preservation and Maintenance Plans

Contributed by: The APWA Center for Sustainability (June 2015)

All streets age and gradually decline until they require rehabilitation. Pavement Preservation and Maintenance Plans are based on street maintenance methods and reconstruction schedules contingent on a pavement type and Overall Condition Index (OCI). In an ideal network scenario, every street segment would be rated above 70 OCI, but this can be a challenge to maintain. A realistic goal is to maintain streets so they don't fall into the expensive 'reconstruction' category and to expend resources early and consistently to preserve the conditions of streets, since it costs more to rebuild streets than to maintain them. Eugene, OR uses a pavement management system to track the condition of its streets and in 2013, as part of the city's Pavement Preservation Program, 8.3 lane miles of streets in the city were rehabilitated to keep from falling into the reconstruction category,.

A balanced network where most segments have an OCI between 60 and 80 (with scheduled maintenance); a small percentage below 60 (with planned rebuild); and a small percentage above 80 (allowed to decline before maintenance) should result in an average Network OCI between 60 and 70 over 20 years within a reasonable budget.

When the City of Arlington, Texas developed a Pavement Maintenance Plan in 2006 for its 3,000 lane miles of city-owned streets, maintenance was conducted based on a "best first" approach and an OCI below 70 required a street to be reconstructed. This meant giving priority to Arlington's best streets and forced declining streets to fall into disrepair to the point of requiring reconstruction, which funding did not support.

Getting It Done

Since Arlington uses a work order and asset management software system, the city was able to model and analyze various scenarios, altering the targeted network OCI and budget to determine productive and financially acceptable modifications. Their baseline for comparison was a perfect network – new streets and an unlimited maintenance budget – which allowed the city to see its cost constraints.

The city's analysis and experience determined that 50 OCI was a more realistic rating to trigger a rebuild, at a cost four to five times lower than rebuilding at 70 OCI. This extends the life of a street and maximizes maintenance dollars. The city also determined that a "worst first" approach was preferable on a temporary basis and would enable the city to focus on declining streets before they fell into rebuild status.

Arlington's analysis of lane miles affected by the change in focus predicted that over eight years the city's failing streets would be brought up to an acceptable standard with a consistent average network OCI between 60 and 70. The city's models are reviewed quarterly to confirm that lane miles under 50 OCI are decreasing. After the projected eight years, the city would reevaluate, perhaps resurrecting its "best first" approach.

Funding and Financing

Financial stability is achieved through the efficient use of public funds – rehabilitating streets before they need more expensive repairs, reducing expensive maintenance costs resulting from streets in poor condition and leveraging other funding sources to maximize the value of the work performed. It is critical that funding aligns with network maintenance goals. Arlington's change in approach required a new funding methodology.

Street Bonds

Bonds may be designed so that funds can be used for construction only, as was the case in Arlington. Consider a street bond program that includes repairs and maintenance. In Eugene, successful passage of two 5-year bond measures for street repairs are evidence that the city's Pavement Preservation Program has garnered community support for its goals.

Street Maintenance Sales Tax

Arlington's street maintenance sales tax ($12M - $14M per year) historically funded maintenance on streets with an OCI above the trigger. The change in approach required sales tax funding to be used on some streets with an OCI below the trigger, provided that the concrete is in good repair and the curb and gutters are salvageable. The city earmarks $8M - $9M for special projects.

Street Maintenance General Fund

Street maintenance dollars allocated from the general fund account for approximately $1.5M per year for maintenance of Arlington's street network. With the right case study, Arlington could position itself to receive an increase in street maintenance funding.

Leveraging Funds

In Eugene, the use of Pavement Preservation Program funds is limited to the rehabilitation of the driving surface of streets, as well as to preserve integral elements such as curbs, gutters, sidewalks, on-street bike lanes, traffic signals, street lights, medians, and traffic calming devices. However, coordinating Pavement Preservation and Maintenance Plans with wastewater and stormwater system maintenance plans can help leverage utility funds, local gas taxes, transportation system development charges, or state and federal grants. Conducting maintenance and making repairs to systems that underlie a city's street system in coordination with pavement preservation projects can be cost-effective and preclude emergency repairs that require cutting new pavement.

Making the Case

Using its analysis, Arlington was able to predict the cost of repairs and rebuilds, based on lane mile segments with an OCI under 50, and prescribed maintenance techniques for specific pavement classifications. Estimating the need for an additional $10M annually to support its change in approach, the city used its analysis to make a case to City Council for adding maintenance funds, beginning in 2015, in conjunction with a scheduled bond election in 2014.

Lessons Learned

Teamwork

It was beneficial to assemble a Street Infrastructure Committee that included all stakeholders and decision makers who could provide perspective on the planning parameters, history and goals so that resolutions could be made expediently. Weekly meetings were crucial during the initial phases of the project.

Good Base Data

It was necessary to create a good, solid base of data which could be reproduced to track progress. Inevitably, when running several scenarios a single change resulted in complete implosion of the data. Being able to retrace its steps allowed Arlington to identify flaws and begin again.

Efficiencies and Improvements Gained

Arlington's changed approach allowed the city to stretch its funding, address failing streets at a lesser cost and extend the life of the pavement.

Learn more about this and similar practices

Eugene Pavement Preservation Program
http://goo.gl/7Sg4ll

Deploying Advanced Metering Infrastructure (AMI)

Contributed by: The APWA Water Resources Management Committee (January 2015)

Over the past decade municipal and private water utilities have turned to the next generation of field tested and proven water metering - Advanced Meter Infrastructure (AMI). The ability to gather customer water consumption data on an hourly basis, as opposed to monthly or bi-monthly data collection, allows utilities to:

- forecast customer water demand, thus improving water production,
- extend the life of infrastructure by lowering main pressure during non-peak water demand periods,
- provide customers with real-time water consumption data and water conservation tips,
- reduce system-wide energy consumption and carbon footprint,
- improve leak detection,
- eliminate meter reading tasks and deploy manpower and vehicles to higher priority system maintenance tasks, and
- prioritize maintenance needs by modeling system performance.

Additional benefits and improved customer service can be realized with a secure customer web portal that streamlines billing and remittance management.

Automatic Water Metering Increases Efficiency, Improves Sustainability

A northern California municipality faced with an aged meter infrastructure deployed AMI and in its first year of operation realized a reduction in labor costs and associated vehicle expenditures, as well as a decrease in water losses of just under 20%. In addition, the municipality realized a 12.5% increase in billing revenue as a result of more accurate meter reading equipment and the increased accuracy of the Customer Information System (CIS/billing). This allowed the utility to forego a planned and approved rate increase and continues to generate operational savings and increased revenue.

Goals

Equity Accurate and trustworthy billing through the sharing of water consumption data with the customer.

Livability Well-managed and resilient water utility operations through intelligent water consumption and management.

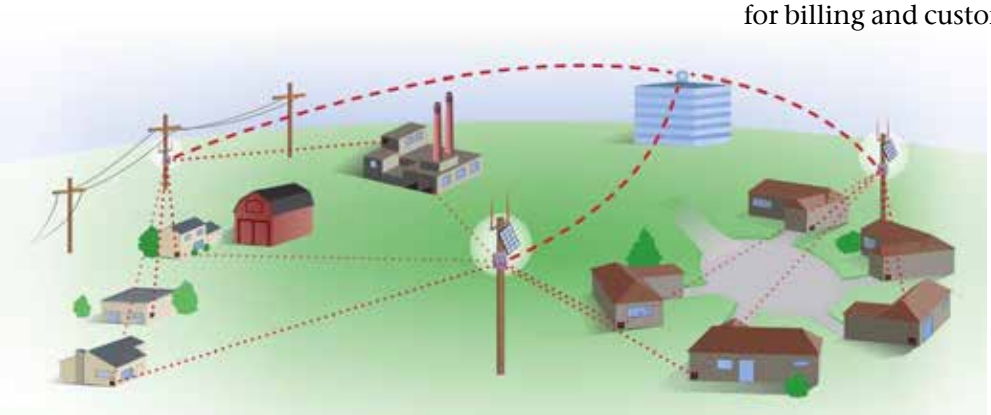
Safety Reduced employee injuries associated with performing meter reading (from vehicle operation; long periods of frequent bending, stooping, walking; and interaction with dogs, insects and snakes).

Smart Technology Improves Service Delivery and Customer Care

Web-enabled mobile devices, social media and cloud-based communications have transformed the way water agencies deliver services and interact with their customers.

- Customers can notify agencies instantaneously about service disruptions and faulty infrastructure.
- Agencies can effectively disseminate critical information about routine and emergency activities to customers.
- Work orders can be routed efficiently to field crews according to their location, enabling rapid response times.
- Work crews have access to, and can update, information stored centrally about asset location, condition, and performance.
- Customers can track the status of work requests in real time.
- Payments linked to central billing and collection databases avoid labor-intensive 'turn-off/turn-on' trips.

In addition, smart meters enable automated, labor-free two-way monitoring, communication, and control for both providers and customers, including usage patterns for billing and customer awareness.



Learn more about this and similar practices

The Water Resources Utility of the Future
http://goo.gl/KpXa1i

Smart Meter Technologies
http://goo.gl/WiMtjk

Grass Valley, CA Replacing Water Meters
http://goo.gl/BKsz6X

Adelanto, CA Selects End-to-End Services Contract
http://goo.gl/0mfDs1

Kennedale, TX Customer Information System (CIS)
http://goo.gl/ub1pcs

Odessa, TX Advanced Metering Infrastructure (AMI)
http://goo.gl/pcPFYe

Cedar Hill, TX Digital Water Meter Technology
http://goo.gl/hVDa8g

Cedar Hill, TX Makes Water Conservation Investment
http://goo.gl/eit6BB

Using Pervious Surfaces to Reduce Stormwater and Increase Groundwater Recharge

Contributed by: The City of Dubuque, Iowa (January 2015), The APWA Transportation Committee (April 2015)

Stormwater discharge regulation is consistently becoming more stringent at both the state and federal level in order to limit pollutants in surface and groundwater. Conventional stormwater management techniques have had limited success meeting the Clean Water Act's Total Maximum Daily Load (TMDL) for pollutants and many municipalities are turning to low-impact development (LID) approaches to support development projects. One strategy – using porous pavement – involves modifications to existing concrete and asphalt mixes or utilizing proprietary surface grids or modular units to replace impervious surfaces for transportation projects or surface parking.

Using pervious surfaces to restore hydrologic functions can:

- improve pollutant and total suspended solids TSS removal levels, reducing negative downstream impacts,
- allow rainwater to infiltrate into the ground where it falls, recharging groundwater sources,
- reduce runoff and localized flooding,
- reduce conveyance infrastructure, allowing for smaller piped systems and less system maintenance,
- be as cost-effective as traditional pipe and centralized treatment infrastructure, and
- provide safe travel routes for bicycles, automobiles, trucks, and pedestrians.

Goals

Community Health	Support community recreation and native species survival through improved surface water quality.
Economy	Reduce long-term maintenance of costly large pipe, treatment and detention infrastructure.
Education	Promote user rights and responsibilities of all transportation modes.
Environmental Health	Help agencies meet TMDL requirements by reducing pollutant loads into surface and groundwater.
Equity	Maximize efficiency of transportation budgets by increasing the allowable footprints for all types of modes while simplifying related permitting
Safety	Reduce stormwater concentrations on roadways, bicycle facilities and sidewalks.

Efficient and Cost Effective

According to the EPA, porous concrete can have substantial reductions in both runoff flows and pollutant loads. Agencies incorporating porous surfaces report that they are within 20-30% of the costs of a standard concrete sidewalk. Maintenance procedures are now institutionalized and updated as needed.

"In street improvement projects where impervious surfaces can drive large pipe and treatment facilities, use of porous surfaces can substantially reduce the actual stormwater and pollutants while promoting groundwater recharge. Long term maintenance is comparable to traditional facilities once staff training has been completed."

Porous surfaces can be found extensively all over the world. Midwest cities like Minneapolis, MN and Ionia, MI have shown that these surfaces can perform and endure in harsh winter conditions. The operations department for the City of Bellingham WA can install grid style systems in-house for parking at key city facilities. As with any new product or procedure, contractor and inspector engagement is an important part of the process.

Using Pervious Surfaces to Reduce Stormwater and Increase Groundwater Recharge

Contributed by: The City of Dubuque, Iowa (January 2015), The APWA Transportation Committee (April 2015)

Getting It Done

The City of Dubuque is located in the tri-state area directly adjacent to Iowa, Illinois and Wisconsin and all of the city's stormwater eventually makes its way to the Mississippi river. Since 2009, Dubuque has implemented a plan to reconstruct downtown alleys using permeable pavement. The Bee Branch Watershed Green Infrastructure Project program grew out of a sustainability initiative by the city council in 2006 and led to the reconstruction of one or two alleys annually. In 2012, the Iowa Department of Natural Resources, in conjunction with the Iowa Finance Authority, launched a pilot program that allowed Dubuque to use State Revolving Fund (SRF) monies on clean water projects. Dubuque used this pilot program to re-structure its $65,000,000 loan for a new state-of-the-art wastewater treatment plant so that a portion of the loan interest – $9.4 million – could be used toward reconstructing 73 alleys over a three year period. Twenty three (23) alleys were reconstructed in 2014 using interlocking concrete pavers.

In 2012 the State of Iowa also authorized a Flood Mitigation Program, administered by the Iowa Department of Homeland Security, funded by a portion of sales tax revenues. The program provides funding to cities and counties on a competitive basis to implement long-term flood mitigation projects. Specifically, the funds are an annual sales tax increment, or a percentage of the increase in sales tax revenue generated within the city or county. In 2013 the City of Dubuque received notice that it was awarded $98.5 million from the Iowa Flood Mitigation Board for a multi-phased flood mitigation project for the Bee Branch Watershed. As part of this project, an additional $48 million (approximately) will be used to reconstruct roughly 240 alleys over twenty years using permeable pavement.

Reducing Water Quantity

There is a direct correlation between impervious area and runoff generated as a result of a rainstorm. Dubuque's Bee Branch Creek watershed represents a drainage area of approximately 6.5 square miles, including the City's most developed areas, where over 50% of Dubuque residents either live or work. Since 1999, the City has had six presidential disaster declarations due to flooding, with total damage estimated to be almost $70 million. Based on a 2009 Federal Emergency Management Agency (FEMA) study, 1,373 homes and businesses in the watershed are prone to flooding, including 70 businesses that employ over 1,400 people and have over $500 million in annual sales.

All of the alleys in the Bee Branch Watershed are located over soils with permeability rates conducive to accepting stormwater (0.5 inches per hour). Converting to pervious surfaces, which also reduces directly connected impervious areas, will result in runoff reductions of up to 80% within the watershed.

Many of Dubuque's alleys were originally paved with clay brick in the late 1800's and early 1900's and will be reconstructed using interlocking concrete pavers that are easy to maintain and look historically appropriate.

Improving Water Quality

The green alleys will provide a way to filter the initial storm runoff before it reaches the Mississippi. All of the alleys are designed to retain, at minimum, the water quality volume (1.25") of runoff for their respective drainage areas. City of Dubuque staff used computer models to simulate the water quality benefit of the proposed Bee Branch Watershed Green Infrastructure Project. P8 was used to determine the expected pollutant loading and runoff volume, while WinSLAMM was used to determine the pollutant removal and volume abstraction percentages. WinSLAMM was chosen because it includes a specific calculation routine for pervious pavement, and is based on actual field observations, with minimal reliance on theoretical processes that have not been adequately documented or confirmed in the field. Based on these models it is expected that TSS loading to the Mississippi River will be reduced by approximately 67% in the Green Infrastructure Project area.

The City of Dubuque Sees Results

Since 2009, the city has seen reduced runoff from the reconstructed alleys, which also tend to look cleaner and clear of snow faster than conventionally paved alleys. As part of reconstruction, many of the alleys were outfitted with water sampling ports, which the DNR and the City are using to monitor water levels and water quality.

Learn more about this and similar practices

Pervious Concrete Pavement
http://goo.gl/euOQzB

Pervious Concrete Pavement Maintenance
http://goo.gl/x5uuO8

Sustainable Dubuque
www.sustainabledubuque.org

Washentaw County, MI Porous Fact Sheet
http://goo.gl/gCqahM

NAPA
http://goo.gl/Te1RT

Concrete Network
http://goo.gl/HOS6eJ

City of Scottsdale
http://goo.gl/7NVFKB

Rainwater Harvesting for Non-Potable Water Uses

Contributed by: The APWA Small Cities/Rural Communities (January 2015)

The Transportation and Public Works Department of Athens-Clarke County, Georgia, completed as a demonstration project for the Department's stormwater management program and to reduce the budget cost from water utility fees. The Department installed four (4) 2,000 gallon tanks on the downspouts of the equipment barn at its Streets and Drainage Service Center in order to capture rainwater for non-potable uses, including for Concrete Saws, VacTrucks, Water Trucks and Irrigation.

The project provides an example of a how a simple concept like a residential rain barrel can be utilized in larger scale application for Public Works use.

Efficiencies and Improvements Gained

The total material cost was $5,428.00. Labor and equipment was provided by in-house staff. The project paid for itself in 12 months saving $5,604.00 in water utility fees.

Learn more about this and similar practices

Athens-Clarke County Stormwater Management
http://goo.gl/iUpWNZ

Implementing Green Infrastructure

Contributed by: APWA Center for Sustainability (May 2015)

Green infrastructure uses natural hydrologic features to manage water and provide environmental and community benefits by preserving open space, improving water quality, mitigating flood risk and enhancing natural habitats.

The City of Los Angeles Bureau of Sanitation Watershed Protection Division implemented green infrastructure design in the construction of the Humboldt Stormwater Greenway Project, approximately one acre located at a previously vacant property in the northeastern Lincoln Heights neighborhood. Prior to project construction, a storm drain traversed the site delivering untreated runoff with high levels of pollution (including oil, grease, metals, gasoline, suspended solids, pathogens and other toxins) to the Los Angeles River. The project was identified by the Watershed Protection Division's Cleaner Rivers through Effective Stakeholder (CREST) bacterial study as ideal to reduce the discharge of elevated levels of dry-weather bacteria into the Los Angeles River and was funded as a Supplemental Environmental Project (SEP) with a total budget of approximately 4.4 million dollars.

Getting It Done

The Humboldt Stormwater Greenway Project involved daylighting the existing storm drain system and constructing an above-ground detention basin to capture and treat dry-weather runoff, as well as first-flush runoff (the first 3/4-inch of wet-weather runoff), while also limiting stormwater flows from approximately 3.5 acres of adjacent land.

Stormwater is treated through sedimentation seaparation, solar exposure (UV) and biofiltration. First, sediment containing metals and other pollutants is separated from incoming stormwater using a hydrodynamic separator. Stormwater is then treated with sunlight and biological organisms in an open boulder-lined forebay that contains a water surface skimmer and solar recirculation pumps. Any overflows from this water feature enter a larger dry-basin and filter down through soil, plant roots and a stone infiltration gallery, which contains the media for the biofiltration process. Once the subsurface channel (approximately 370 feet long) is filled, higher volumes rise above the ground and fill the basin. The basin and the associated storage and filtration structures are designed to detain approximately 50,000 cubic feet of runoff, allowing evaporation and reuse of treated runoff and slowing peak flows downstream.

Efficiencies and Improvements Gained

Ecological Integrity

- Stormwater runoff has been reduced and improved through treatment and use for landscape irrigation.
- Biodiversity has been encouraged by planting a variety of plants and trees.
- Urban heat has been reduced by planting native shade trees.

Economic Security, Health and Wellbeing

- Increased park space provides a recreational facility to support the community and encourage outdoor activities.

Efficient Services and Infrastructure

- A constructed pathway connecting adjacent streets encourages alternative modes of transportation, such as cycling and walking.
- Flooding conditions for surrounding streets and intersections have been alleviated.

Lessons Learned

- Allocate time and contingencies along rail and/or utility corridors to deal with undocumented obstructions and field conditions.
- Partner early (preferably before construction) with recycled water purveyors (agencies) to resolve supply connection details, line sizes, connection schedules, and responsibilities for project-related vs. distribution-related connections.
- If space exists, focus on vegetated dry basin and open water storage solutions – in contrast to cisterns, concrete vaults, and other hardened, underground, or enclosed structures – to achieve volumetric reductions of stormwater and pollutants while also providing greater cost efficiency and a wider range of recreational, aesthetic and environmental enhancements.

Learn more about this and similar practices

Green Infrastructure
http://goo.gl/caVXFG

Water Quality Credit Trading

Contributed by: APWA Center for Sustainability (May 2015)

Water quality credit trading (WQCT) is a policy tool designed to reduce water pollution, especially from nutrients like nitrogen and phosphorus, by letting emitters in a watershed trade "pollution reduction credits" to find the most cost-efficient way of improving water quality. In contrast to traditional water pollution regulations that mandate pollution according to site and source, WQCT is based on the idea that the costs of achieving pollution-reduction goals in a watershed are minimized if sources are allowed to trade pollution reductions according to their pollution-abatement costs.

The City of Gainesville, FL, in collaboration with the St. Johns River Water Management District, initiated a WQCT program in 2002 to facilitate redevelopment of properties within the City's urban core, where land area is at a premium and on-site water quality treatment was an impediment to redevelopment. Under Gainesville's 'Credit Basin Program', the city used Stormwater Management Utility (SMU) funds to purchase land for master stormwater facilities and to construct credit basins. The quantity of nutrient removal achieved by each basin is calculated and developers can then buy credits to meet stormwater quality requirements, without building expensive underground treatment systems or stormwater basins on valuable real estate. The city recovers the capital costs expended on its master facilities and credit basins, while providing water quality improvement without compromising opportunities for development and growth.

Getting It Done

The City's first credit basin, located at the SW 5th Avenue Stormwater Park, opened in 2002 providing properties in the Tumblin Creek Watershed the opportunity to purchase credits. Phase 1 of the Depot Park Credit Basin opened in 2008, available to properties in the Sweetwater Branch Watershed; completion of Phase 2 is scheduled for 2015. The City also opened the Duval Regional Stormwater Park in 2008, providing water quality treatment for part of Northeast Gainesville. Due to high existing and expected demand in the Tumblin Creek Watershed, in part related to the University of Florida's Innovation District redevelopment, the City is currently developing a fourth credit basin that will provide additional credit opportunities.

The program has aided in the redevelopment of 18 properties within the associated watersheds.

Learn more about this and similar practices

Gainesville Depot Park Brownfield
http://goo.gl/xRkaR0

Gainesville Community Redevelopment Agency
http://goo.gl/1uqBkW

Water Quality Credit Trading: General Principles
https://edis.ifas.ufl.edu/fe824