Country Roads & City Streets

WV Transportation Technology Transfer Center

June 2003 College of Engineering & Mineral Resources Vol. 18, No. 2

CULVERT INSPECTION AND REPAIR

By: Marisa DiBiaso, Project Assistant
New Hampshire T² Center

In autumn, water levels are usually low, making it a great time to inspect culverts and perform routine maintenance. This article will cover inspections to determine needed cleaning, repair, or replacement, and methods to minimize erosion.

Inspections

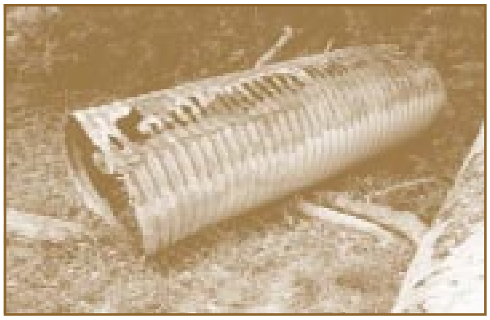
Thorough inspection is essential to effective maintenance. Knowledge of culvert material can predict the types of problems a culvert may have. Each material has specific weaknesses.

- Steel culverts are subject to corrosion and abrasion, and have a shorter life span than other materials.
- Aluminum culverts can sustain abrasion and have less strength.
- Plastic culverts bend easily and are subject to ultraviolet degradation. They are subject to impact damage at low temperatures.
- Concrete is the most durable material, but concrete and reinforcing steel still deteriorate.

Cleaning

Inspections frequently show that culverts require cleaning. During cleaning, certain maintenance tasks should be performed:

- Remove obstructions and clean inside the pipe.
- Examine the culvert for visible cracks, changes in shape, corrosion or abrasion.
- Check upstream for trees, dead branches, and other debris that may obstruct the pipe.
- Cut vegetation that may hinder flow near inlet and outlet.
- Look for evidence of past overflow to indicate whether the culvert is the correct size.
- Remove debris and sediment, or add material to make the ditch bottom level with the culvert invert elevation.



Repairs

Bent or broken culvert ends should be repaired for smooth water flow. Repair headwall cracks, loose mortar, and displaced stones. The chart on page 3 will help with diagnosing other problems and choosing a repair.

Replacements

The most important reason to replace a culvert is to minimize the possibility of structural failure. Weak culverts beneath

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Country Roads and City Streets is a quarterly publication of the West Virginia Transportation Technology Transfer Center (T² Center). The purpose of this newsletter is to provide information that is beneficial to highway construction and maintenance personnel.

The material and opinions contained in this newsletter are those of the West Virginia Transportation Technology Transfer Center, and do not necessarily reflect the views of the Federal Highway Administration or the WV Department of Transportation. Material contained in *Country Roads and City Streets* is a combination of original and borrowed material. Every effort has been made to ensure the integrity and accuracy of this material. However, the WV T² Center does not assume responsibility for any incorrect material.

a road are especially dangerous. Replace a culvert if it cannot handle the expected water flow. Water and debris lines above the culvert indicate a larger culvert is needed. Area residents and town records can indicate water levels of past storms and the maximum level to expect.

Replacing a culvert with one only slightly larger significantly increases the capacity of flow. For example, an 18" culvert has about 50% more capacity than a 15" culvert. Before installing a larger culvert, check culverts downstream to ensure they can handle the increased flow.

Multiple culverts might be necessary if cover is insufficient for a larger culvert. The table in the next column shows the number of smaller diameter culverts equal in water carrying capacity to that of one larger sized culvert. It is based on culverts laid on the same slope. For example, one 24" diameter culvert is equivalent in water carrying capacity to five 12" culverts or two 18" culverts.

MULTIPLE CULVERT INSTALLATION

Diam	12"	15"	18"	21"	24"
12"	1				
15"	1.7	1			
18"	2.5	1.5	1		
21"	3.6	2.2	1.4	1	
24"	5	3	2	1.4	1

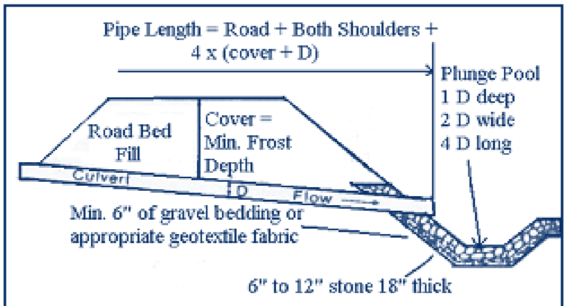
PLUNGE POOL DESIGN

Culvert Diam. (ft.)	Depth (ft.)	Width (ft.)	Length (ft.)
1.0	1.0	2.0	4.0
1.5	1.5	3.0	6.0
2.0	2.0	4.0	8.0
2.5	2.5	5.0	10.9

Erosion

Water exiting the culvert can erode the ground at the outlet. The greater the velocity of flow, the greater the erosion. Erosion at the outlet of an upstream culvert will loosen sediment and debris, which can build up in ditches and inside a culvert downstream. Buildup slows the flow.

Ultimately sediment is carried into streams, ponds, or lakes. A solution for low velocities is to plant vegetation. For higher velocities, crews should construct a stone splash pad or plunge pool at the outlet. Typically, for culverts with a diameter of 30 inches or less, the depth of the plunge pool should equal the diameter of the culvert.



Plunge Pool

Inspection determines whether culvert cleaning, repairs, or replacement are needed. Where necessary, obtain a wetlands permit before performing maintenance. If replacement is necessary, it is important to choose a culvert the right size for the location and water flow. Regular maintenance, such as removing sediment and debris, is essential to keep the culverts working properly.

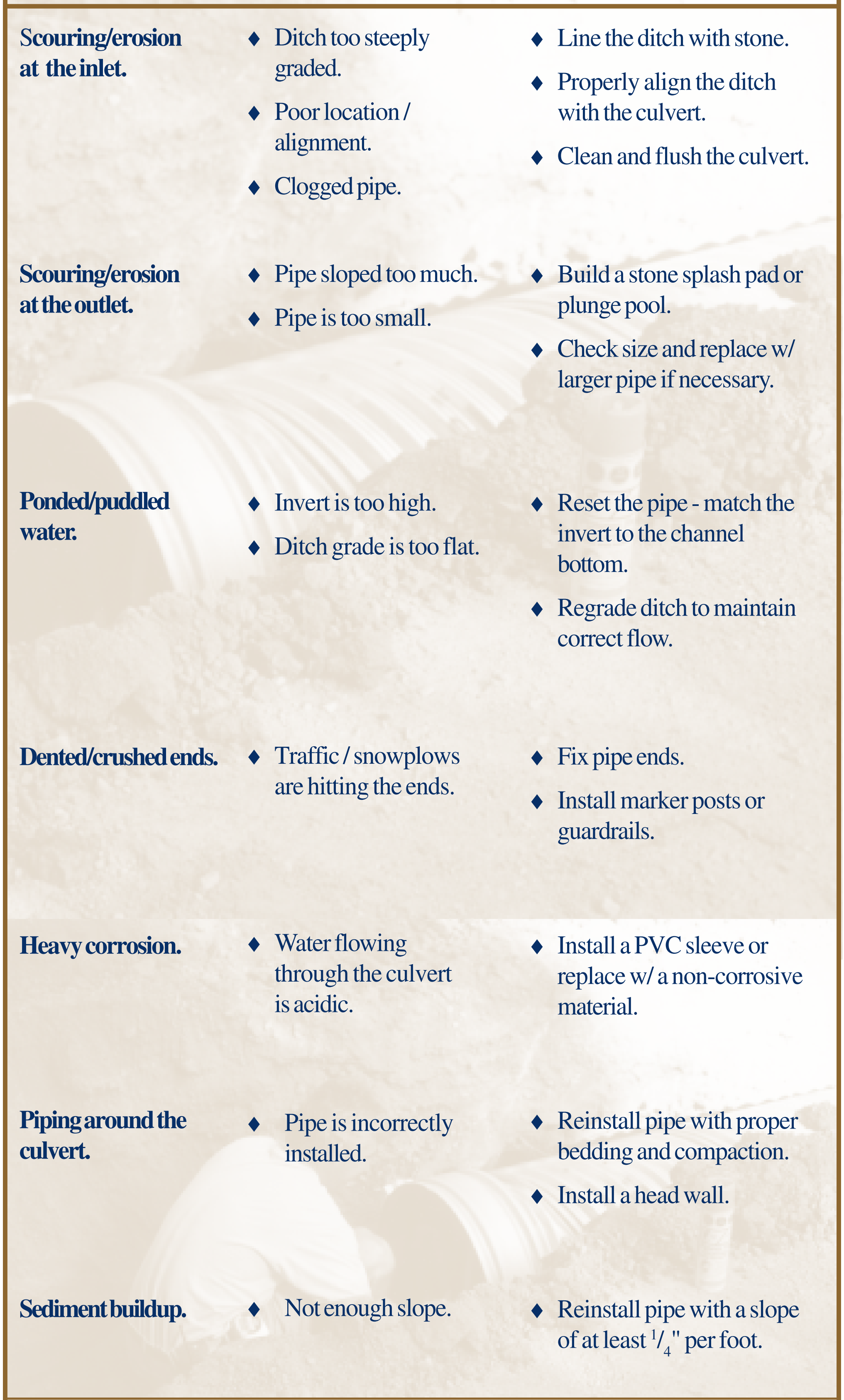
Sources:

Culvert Installation and Maintenance. A Series of Quick Guides for New Hampshire Towns. UNH Technology Transfer Center.

Inspect and Maintain Culverts. Illinois Interchange Illinois LTAP. Vol. 4, Number 4, Fall 1996.

Drainage, Drainage, Drainage. UNH Technology Transfer Center. Durham, NH. January 1996.

COMMON CULVERT PROBLEMS AND SOLUTIONS



WHAT YOU OBSERVE	WHAT MAY BE THE REASON	HOW TO FIX IT
Scouring/erosion at the inlet.	♦ Ditch too steeply graded. ♦ Poor location / alignment. ♦ Clogged pipe.	♦ Line the ditch with stone. ♦ Properly align the ditch with the culvert. ♦ Clean and flush the culvert.
Scouring/erosion at the outlet.	♦ Pipe sloped too much. ♦ Pipe is too small.	♦ Build a stone splash pad or plunge pool. ♦ Check size and replace w/ larger pipe if necessary.
Ponded/puddled water.	♦ Invert is too high. ♦ Ditch grade is too flat.	♦ Reset the pipe - match the invert to the channel bottom. ♦ Regrade ditch to maintain correct flow.
Dented/crushed ends.	♦ Traffic / snowplows are hitting the ends.	♦ Fix pipe ends. ♦ Install marker posts or guardrails.
Heavy corrosion.	♦ Water flowing through the culvert is acidic.	♦ Install a PVC sleeve or replace w/ a non-corrosive material.
Piping around the culvert.	♦ Pipe is incorrectly installed.	♦ Reinstall pipe with proper bedding and compaction. ♦ Install a head wall.
Sediment buildup.	♦ Not enough slope.	♦ Reinstall pipe with a slope of at least $^1/_4$" per foot.

Thank you to the University of New Hampshire Technology Transfer Center for granting permission to reproduce the culvert information found on pages 1 - 3 of this newsletter edition.

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The West Virginia T^2 Center is a part of the nationwide Local Technical Assistance Program (LTAP), which is funded by the Federal Highway Administration. The Center also receives funding from the West Virginia Department of Transportation.

Mission:

The mission of the West Virginia T^2 Center is to foster a safe and efficient transportation system. The T^2 Center's mandate is to improve the transportation system by improving the professional skills of those involved in highway design, construction and maintenance, and to act as a resource for them by keeping up-to-date training libraries and constantly seeking/developing new technologies.

Overall Goal:

The Center's overall goal is to improve the transportation system by focusing on professional training, technical assistance, and information dissemination.

To achieve this goal, the WV T^2 Center does the following:

- Provides on-site training and demonstrations
- Publishes a quarterly newsletter
- Maintains a video and publications library
- Provides technical assistance via e-mail, telephone, fax, mail, or site visits

ROADS SCHOLAR II PROGRAM IS IN THE WORKS......

The WV T^2 Center is pleased to announce that we are beginning to offer Roads Scholar II Courses. The Pedestrian and Bicycle Accommodation Course and the Traffic Calming Course are two of the programs being offered as part of our new Roads Scholar II Program. At this time, the program is still in the development stage. New classes will be added, and like the Roads Scholar Program, participants will have the opportunity to "graduate" from this program.

The RS II Program is designed for local, state, and private sector transportation personnel in higher-level supervisory and management positions. Elected officials, engineers, planners, consultants, and contractors are just a few of the individuals who can benefit from participating in the RS II Program. Each RS II Course will have a cost associated with it. This is to cover items such as staff travel, instructor fees, course materials, meals, and graduation items. We will do our best to keep the costs of our training reasonable so all who want to attend have the opportunity to do so. We also understand the additional budget constraints that state and local agencies are facing, and with this in mind, have established a lower fee structure for these agencies.

The RS II Program is not a certification or degree program in Roadway Technology, but those who participate receive excellent training in up-to-date practices. Like the RS Program, sessions will be offered at different locations around the state, and we always welcome suggestions for other courses.

The RS II Program is still very much a work in progress, with lots of details that need worked out. Please be patient with us as we develop this program to better meet your training needs.

ADDITIONAL UPCOMING EVENTS

TUESDAY, AUGUST 12, 2003
ROADS SCHOLAR II SURVEYING COURSE
JACKSON'S MILL, WV

The RS II Surveying Course combines classroom learning in the morning with practical exercises in the afternoon. Taught by Darrell Dean, Ph.D, participants will walk away with the concepts of accurate surveying.

WEDNESDAY, SEPTEMBER 17, 2003
SNOW AND ICE CONTROL WORKSHOP
JACKSON'S MILL, WV

This is a full-day workshop, with lunch included. This year's program includes the ever popular instructor, Alan Gesford, and we are pleased to announce that Steve Jenkins of the Montana T^2 Center will be presenting a three-hour winter survival course as part of this workshop.

March 22-24, 2004
Roadway Management Conference 2004
Newark, DE

The 2004 RMC will be our 12th annual! The 2004 Conference is being hosted by the Delaware T^2 Center and will be held in Newark, DE. We are in the preliminary stages of setting the program, so if you have any suggestions for topics or speakers that you would like to see, please let us know.

UPCOMING JULY 9 COURSES

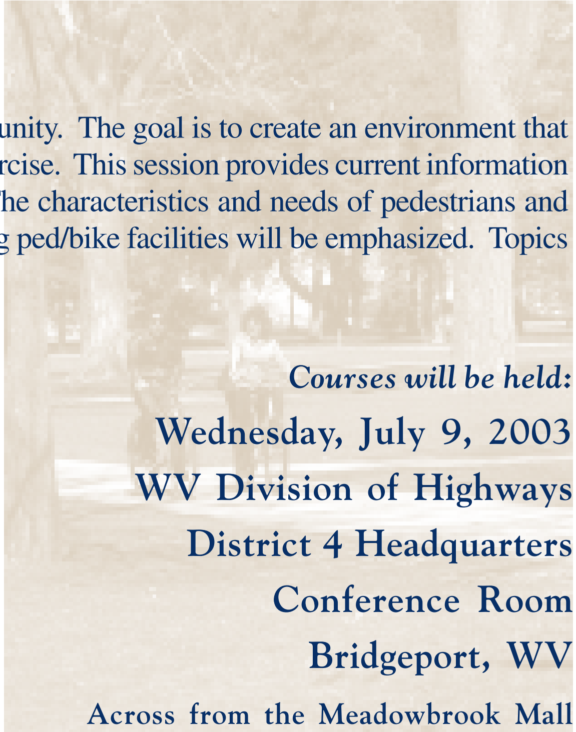
PEDESTRIAN AND BICYCLE ACCOMMODATION

Ron Eck, Instructor

8:30 AM to 12:00 NOON

Today walkability and bikeability are viewed as signs of a livable community. The goal is to create an environment that encourages people to walk and bike for transportation, recreation and exercise. This session provides current information on the design of safe and successful pedestrian and bicycle facilities. The characteristics and needs of pedestrians and bicyclists and the importance of an interdisciplinary approach to planning ped/bike facilities will be emphasized. Topics covered include:

- Walkways, sidewalks and public spaces
- Off-road trails
- Signs and markings
- Intersections and mid-block crossings
- Bike lanes and shared roadways
- Bike parking and storage
- Accessibility



Courses will be held:

Wednesday, July 9, 2003
WV Division of Highways
District 4 Headquarters
Conference Room
Bridgeport, WV
Across from the Meadowbrook Mall

TRAFFIC CALMING

Ron Eck, Instructor

1:00 PM to 4:00 PM

Public officials face a growing number of complaints about high speeds and volumes (cut-through traffic) of traffic in residential neighborhoods. New geometric design features and traffic control strategies to provide safer, more livable neighborhoods will be described, including residential area traffic circles, bulb-outs, medians, speed humps and diverters. Impacts of these features and liability and legal issues will be reviewed. Citizen participation, necessary supporting policies and regulations and funding approaches will also be covered. This session should be of interest to engineers, administrators, and public safety officials responsible for traffic management in residential areas. Planners and designers involved in neighborhood revitalization efforts should also find the session of interest.

Instructor:

The instructor for this workshop is Ron Eck, P.E. Ron is a Professor of Civil Engineering at West Virginia University and is the Director of the West Virginia T^2 Center. He has been involved in traffic engineering, including pedestrian/bicycle transportation and residential traffic management, for over 25 years.

Who Should Attend:

Public officials, engineers, planners, inspectors, contractors, higher-level supervisors, consultants, MPO's, homeowner associations, and those involved in wellness programs, including walking trails.

Professional Development Hours (PDHs):

The Pedestrian and Bicycle Accommodation Course counts for 3.5 pdhs.
The Traffic Calming Course counts for 3.0 pdhs.

Cost and Registration Information:

For **state and other public sector** individuals, the cost is **$30** per course or **$50** to attend both courses. For **private sector** individuals, the cost is **$50** per course or **$90** to attend both courses. Lunch is on your own. To enroll, contact Kim at 304-293-3031 x 2612, via fax at 304-293-7109, or at kcarr@wvu.edu.

RECENT EVENTS

During the past few months, Center staff have been busy conducting various workshops and courses around the state. Back in March, the WV T^2 Center hosted the 11th Annual Roadway Management Conference in Wheeling, at Oglebay Resort. Over 250 individuals involved with transportation issues attended. Live demonstrations of products and equipment, such as asphalt stamping, were a part of this conference, in addition to the classroom sessions. Attendees who arrived early Monday morning were able to witness Tim Ard of Forest Applications Training, Inc, carve an eagle out of a log – all with a chainsaw! The detail was amazing! Next year's Roadway Management Conference will be held March 2004 in Newark, DE. Keep watching the newsletter for more details.

In May, Mike taught a full-day workshop, Drainage: The Key to Roads That Last, in four separate locations – Clarksburg, Vienna, Beckley, and Huntington. By the time you receive this newsletter, he will also have taught two additional workshops, Dealing with People/Successful Supervision and Equipment Operation and Worker Safety, in these same locations.

In addition to our Roads Scholar Courses, the Center has been very busy putting on Walkable Community Workshops. Ron Eck, Director of the T^2 Center and a leading proponent of Walkable Communities, is the main presenter for these workshops, On April 29, The Center held a Walkable Communities Workshop for Greenbrier County in Lewisburg. May 8 took Center staff to the City of Oak Hill to present a workshop. In April, the City of Oak Hill began a Rail Trail Information Series, which is a series of seminars focusing on the community of Oak Hill and the development of a rail trail. The series was designed to create public awareness of the issues involved with developing a rail trail and to also allow the public to voice any concerns. The Walkable Community Workshop presented by Ron Eck was the second seminar in this series. The next Walkable Communities Workshop was held in Sistersville on May 19. This workshop helped attendees recognize how a "Walkable Community" can benefit the City, not only aesthetically but economically as well. Our May Walkable Communities Workshops wrapped up on May 22, with the City of Weirton. After learning the main components that make up a Walkable Community, the attendees began thinking of steps they could take to improve the walkability of their community. The Center would also like to say a special thank you to Ed Grace, who is a member of the WV T^2 Center Advisory Board and who was instrumental in bringing this workshop to his home community.

The following page will provide you with additional information on the Walkable Communities Workshop. If you are interested in scheduling one of these workshops, or would like more information, please let us know.

The past few months have been busy, but that's the way we like it. Stay tuned for additional training opportunities........

During the break-out portion of the Greenbrier County Walkable Communities Workshop in Lewisburg, this was one of several groups discussing ideas for improving walkability in their community.

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WALKABLE COMMUNITIES WORKSHOP

A program of the West Virginia Transportation Technology Transfer Center

THE WALKABLE COMMUNITIES WORKSHOP

Designed to address the concern of developing safe, pedestrian-friendly communities. Objectives of the workshop are to:

- Increase awareness about pedestrian safety and walkability
- Generate a commitment to do something about pedestrian issues and problems
- Structure commitment into a realistic plan of action

The workshop is primarily a motivational and organizational session, not a training session. However, information about resources and technical assistance will be provided.

HOW CAN I BRING THE WORKSHOP TO MY COMMUNITY?

Any West Virginia community is eligible for this workshop and is invited to apply. While there is no formal application, we do ask you to submit written materials showing broad-based community support, and a statement of the objectives anticipated from hosting a workshop. After we have reviewed the materials, we will contact you.

WHAT DOES IT COST?

There is no fee for West Virginia communities. However, the community is asked to provide a meeting room and light refreshments.

TYPICAL WORKSHOP AGENDA

- **The Pedestrian Safety Problem**
- **The Walkability Problem**
- **Vision of a Walkable Community**
- **Local Problem Identification**
- **Organizing for Success**
- **Where Do We Go From Here**
- **Resources Available**

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IN BRIEF WITH RON ECK, DIRECTOR WV T^2 CENTER

Our Roads Scholar II (RS II) program kicks off this summer with courses on pedestrian and bicycle accommodation, traffic calming and surveying. We expect the project management course to be offered in the fall. There are a number of differences from our original Roads Scholar program. As can be seen from the initial course offering, the breadth of topics will be broader and go beyond the "hard side" subjects of pavements, drainage and traffic control devices. We will be making greater use of practitioners (perhaps even using some of our Roads Scholar graduates) as instructors in these courses. Combining the expenses this entails with the budget constraints that everyone is facing right now, we will need to charge registration fees for the RS II courses. Be assured that we will make every effort to keep these fees as low as possible, especially for public agencies.

If certain details about the program seem to be missing, you are correct. Several new courses are still being developed. Participants will have the opportunity to "graduate" from the program, just like the original Roads Scholar Program. However, those requirements (and the perks that go along with the "diploma") have not been established yet. The Center's Advisory Board is providing valuable guidance to us in developing the program. As soon as the details are finalized, descriptive material will be distributed.

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- ☐ **Road Crew**
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- ☐ **City Engineers**
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- ☐ **Others**