

DID YOU KNOW... THE IMPACT OF ON-SITE SEWAGE SYSTEMS AND ILLICIT DISCHARGES ON THE ROUGE RIVER

by Barry Johnson, P.E., M.S., Camp Dresser & McKee and
Dean Tuomari, Wayne County Department of Environment

The Rouge River National Wet Weather Demonstration Project (Rouge Project) is a national demonstration project whose focus is to clean up the Rouge River, which is located in southeast Michigan. It includes portions of the City of Detroit and 47 communities west and northwest of Detroit. Water quality sampling and modeling of the river has determined that eliminating combined sewer overflows (CSOs) will not assure the Rouge River will meet water quality standards or allow the river to be used for purposes that the public desires. The information in this presentation summarizes what has been found from two non-stormwater contributions to the river: on-site sewage systems and illicit discharges.

DID YOU KNOW...

- On-site sewage disposal systems (OSDS) exist in urban areas.
- OSDS are contributing to surface and groundwater pollution.

Documented failure rates of OSDS in communities in the Rouge River Watershed vary between 17 and 55 percent in surveys conducted in 1994, 1995 and 1997. The two recent studies have evaluated 454 residential OSDS; failure was determined by:

- observation of sewage discharging from the area of the OSDS
- observation of liquid on the ground surface of the disposal field
- identification of a pipe draining sewage from the disposal field area
- heavy vegetation on or near the OSDS and/or

- detection of dye in surface water downstream from the septic tank after the dye was placed in the septic tank.

The requirements for OSDS in Wayne, Oakland and Washtenaw Counties in Michigan addresses installation only, operation and maintenance is the owner's responsibility.

Even surface waters that drain areas not served by sanitary sewers have been found to be unsafe for human contact due to high *E. coli* bacteria counts in the water. These unsewered areas are served by OSDS. Other potential sources of *E. coli* bacteria are illicit discharges in pipes that drain to surface water, wildlife and agriculture operations.

Also, surface water in sewered communities have been found to be unsafe for human contact from high *E. coli* bacteria levels. The sources of *E. coli* bacteria here are CSOs, sanitary sewer overflows and leaking sanitary sewers, illicit connections, wildlife and failing OSDS. Illicit dumping of septage and recreational vehicle waste may also be contributing to the occasional high *E. coli* bacteria counts.

In order to perform the surveys of OSDS it was necessary to identify the locations of OSDS. While local health departments issue permits for installation of OSDS, three of the four health departments in the Rouge River Watershed do not have permits on a computerized database. Local communities do not have records of OSDS. Each of the surveys of OSDS required the development of a database of OSDS.

The 1990 census data on numbers of OSDS by block helped to identify areas served by OSDS and provided the numbers of OSDS in each census block. Information from the utility billings from each community also helped in the development of the database. The information from the database development and the field surveys of OSDS revealed some surprising information to local units of government, including:

- The 1990 census data identified that there are were over 1700 OSDS in the City of Detroit. City officials were surprised at these figures since on-site sewage disposal systems are illegal

in the City of Detroit. Further checking indicated that there were areas in the City not served by sewers, and that there is a City policy requiring payment for sewer connection, but there has not been follow up to verify connection to the sewer.

- Utility billings were screened for three communities in the study area to determine homes that were paying for water but not for sewer. Homeowners who indicated that they were connected to sewers were not surveyed. Through September 1997 the results of the survey revealed the following:

Community A: 64 homes were contacted, homes with city sewer connections - 23, six had failing OSDS (43 OSDS surveyed).

Community B: 238 homes were contacted, homes with city sewer connections - 24, 44 had failing OSDS (214 OSDS surveyed).

Community C: 68 homes were contacted, homes with city sewer connections - 8, 6 had failing OSDS (60 OSDS surveyed).

Summary: 55 of 370 homes contacted reported they are connected to the city sewer but are not paying sewer charges; 56 of the of the 315 homes surveyed had failing OSDS.

- The failure rate for the three communities was 18 percent. This was a higher rate than the communities expected.
- Communities A, B, and C did not know that there were homes connected to a sewer but not being billed for them. While the City of Detroit is not suffering a revenue loss due to the continuation of OSDS in the city, communities A, B, and C are losing revenue and not recovering costs of operation and maintenance of the sewer system.

What techniques have we used to find OSDS problems?

1. A grant was funded by the Rouge Program Office to Wayne County to survey homes in one of the tributaries that drain to an area that was planned to be used for canoeing. Canoeing has been discouraged in the Rouge River due to the high *E. coli* bacteria

counts. Through October 31, 1997, 427 homes have been visited and a visual survey of the property has been done to identify signs of OSDS problems. Seventy-three of the systems have been described as failing or potentially failing for a failure rate of 17 percent. Typical descriptions from the field notes are:

- Sewage backup in the home
- Gray water discharging to the ground surface
- Standing water on top of gravel seepage field
- Mushy area, associated with back end of apparent seepage field
- Illicit connection and undersized septic tank (100 gallons) drained by a trench type (long single perforated pipe) seepage field.
- Black sludge residue and toilet paper debris around surface of the septic tank covering
- Growth of cattails, wet marsh on the face of the downward sloping hill.

2. Another study, funded in the Oakland County portion of the Rouge River Watershed included stream sampling for fecal coliform, *E. coli* bacteria, and benthic macroinvertebrates, along with dye testing of septic tanks.
 - a. Of the 49 surface water sampling sites, 43 percent had a daily geometric mean for *E. coli* bacteria of 1000 or more per 100 ml. of sample.
 - b. The macroinvertebrate study was done to indicate water quality of the streams in the survey area. A scale has been developed to rate macroinvertebrate and water quality. The results in the study area ranged from 7 which indicates poor water quality to 20 which is considered good water quality.
 - c. Dye testing in 1994 found 52.3 percent of the homes tested had discharges to the river.
 - d. An optical brightener test was done at the river sites where dye was collected. These were all negative. The brightener test has been used to detect laundry waste in coastal areas.
 - f. Dye testing in 1995 found a 39.3 percent failure rate for OSDS in the communities surveyed.

Future Direction

The future direction of this effort is to establish an on-site sewage management program in each community in cooperation with the local health departments. Encouragement is being provided to communities to address on-site sewage systems in their application for a general stormwater permit issued by the State of Michigan as part of the National Pollutant Discharge Elimination System (NPDES) program. The problems of septage disposal are also being addressed with the disposal facilities and septage haulers.

Costs

Information on the cost of these studies includes the amount spent by the agencies to do the investigation, report writing, documentation and administration to comply with grant requirements. Additional costs were realized by homeowners to correct failing OSDS or to connect to available sewers, and by communities to extend sewers to problem areas. Grant expenditures for the Wayne County OSDS survey were \$105,000, and \$61,000 for the Oakland County survey of OSDS.

DID YOU KNOW...

When one illicit connection was found, there was usually a second one found at the same site.

From 1987 through December of 1996, Wayne County investigated approximately 3,340 businesses and industries for illicit connections to the storm sewer system. Approximately 9 percent of the 3,340 facilities inspected were found to have illicit connections. The elimination of these improper discharges has diverted raw sewage and other pollutants from the river to the wastewater treatment plant. A method to prioritize the investigation was developed based on the Standard Industrial Classification (SIC) of businesses. Other findings have included:

- An average of 2.6 improper connections were found at businesses that had an illicit connection.

- The majority of illicit connections in non-residential facilities were drains connected to storm sewers. Drains include floor drains, trench drains, interior catch basins, oil separators, machine process water and sump pumps. The categories of illicit connections found were: floor drains (46 percent), sinks (20 percent), horse washing-washing machines (15 percent), toilets (11 percent), and a variety of others (8 percent).
- The prioritization method for businesses was successful in locating illicit connections. It was not helpful in locating illicit discharges of *E. coli*.
- The use of aerial, infrared and thermal photography to locate discharges that have a higher temperature than that of the stream or locations where algae might be concentrated is in the experimental phase. The aerial infrared experiment also examines soil temperatures, land surface moisture and vegetative growth. The assumption is that a failing OSDS would have more moisture in the surface soil, the area would be warmer and vegetation would grow faster than the surrounding area. These differences should be visible in the digital data. Analysis of data collected has been hampered by resources and field work needed to develop computer references.
- There was no definite correlation to date between field tests for ammonia, anionic surfactants (a test to detect detergents) and *E. coli*.
- Visual observations from field crews and the public has identified significant improper discharges to the river.
- Stable isotopes of oxygen and hydrogen have been used to determine the signature or groundwater, precipitation and sanitary sewer water. This can be used to distinguish sanitary sewer water in a discharge.
- Visual observations of manholes and outfalls and testing of the liquid flow in manholes has found 160 manholes and outfalls that have suspicious discharges.
- Projections have been made of illicit connections for the Rouge River Watershed based on these findings. The estimated number of potential illicit violations in the entire watershed is 5,260.

It is estimated that 51 million gallons of liquid will be discharged from these illicit connections. Field work performed during dry weather, 72 hours without precipitation, identified 160 manholes and outfalls that had an ammonia reading of 1.0 or greater or had visual conditions that

were cause for further investigation. All of these manholes were investigated for ammonia, anionic surfactants and *E. coli*. The bacteria results found 16 locations with *E. coli* bacteria counts over 5,000 per 100 ml. These 16 locations will have a detailed investigation to try and locate the source of the high *E. coli* bacteria. Since many of the areas with suspicious discharges are residential areas, it will require a different but similar approach to investigation. Municipalities will be requested to participate in finding improper connections. The use of equipment to televise sewers, or smoke testing are possible methods that may be used.

Work being performed in 1997-98 will focus on locating sources of *E. coli* bacteria that are impacting on the Rouge River from Nankin Dam to Merriman Road, a distance of approximately 1.5 miles; this is a prime area for recreational uses. Recreational use would be significantly increased if the river was safe for human contact. The work began at the 16 manholes/outfalls with high *E.coli* bacteria counts. The manholes upstream of the sampling sites will be tested until a source(s) can be identified, that source will then be dye tested to confirm it is the cause of the high *E. coli* counts. Sampling of Tonquish Creek and its tributaries that drain into the proposed canoeing will be done during dry weather to determine if this same process will be needed on this creek.

An example of going upstream to find a pollution source was an investigation on a storm sewer relief drain. An 11-foot storm sewer had been under suspicion for several years. In 1997 samples from manholes were taken upstream from the discharge point. One of the laterals that connects to the sewer had *E. coli* bacteria results of 8,160 and 9,600 per 100 ml of sample in June 1997. When the results were calculated at that level, additional samples were taken 5 days after the confirmed sample of 9,600 per 100 ml had been taken. The sample results going upstream in the storm sewer where the 9,600 result was found were: 12,560, 24,000, 160,000 and 9,600 per 100 ml. A lateral of this sewer had a result of 4,800 *E. coli* per 100 ml. The manhole where the 160,000 result was found the “hot spot.” **Figure 1** shows the samples of the survey results.

The results of this sampling activity were shared with the city who decided to have the sewer televised. However, the tapes did not show any suspicious connections. Plans were made to begin dye testing at homes located next to the storm sewer. Before beginning the process of dye testing, a sample was taken to have current information. The results of that sampling activity indicated less than 8 *E. coli* bacteria per 100 ml. After discussion with the city it was agreed to postpone the dye testing and instead inform the residents of the sampling activities that had taken place on their street. At this point it was felt that the high *E. coli* may have been due to dumping of waste into the sewer. A letter was sent to residents asking them to let the city or county personnel know of anything they may have knowledge of that could have resulted in the high *E. coli* counts. As a result of these sampling activities and this investigation, and community interest, sampling continues on a monthly basis on this street.

Future areas to be checked will be developed based on complaints, and a review of manhole and outfall sampling to determine contributing conveyances, and instream/in sewer sampling to localize the area. Results of the manhole sampling have found 16 that have *E. coli* bacteria counts over 5,000 per 100 ml. Utilizing the Rouge Project GIS, maps have been prepared for tracking sampling of manholes and outfalls, and other data to illustrate results, and help to prioritize further investigations. These will be helpful in showing municipalities the areas that need to be investigated.

Future Direction

The future direction of illicit connection/discharges is to have each community in the Rouge River Watershed commit to actively exploring illicit connections/discharges in their community. Grants and assistance from county agencies are available to communities and agencies. As part of an application for a General Stormwater Permit from the State of Michigan under the NPDES program, a community is required to develop an Illicit Discharge Elimination Plan. The Rouge Project is assisting communities in the preparation of these applications. Elements of the Illicit Discharge Elimination Plan that are recommended to be included are: a legal basis for the program, how problem areas will be identified, how the sources will be pinpointed, and how to achieve correction and evaluation and reporting.

Costs

The budget for the illicit detection investigations program in 1996-97 was \$735,151. The budget for the 1997-98 program is \$599,041. These costs include more than field work, the project has also included trials of different methods of investigation and testing and subcontracting for special studies. There is also a significant cost for grant administration that is included. Not included in this budget are costs likely to be incurred by businesses to correct illicit connections or the cost to communities to televise sewers to locate illicit connections. The 1997-98 program provides for 9 full-time equivalent employees. Of the 9 employees, 6 are performing investigations, and water sampling.

Figure 1

E. coli Results June 11 –18, 1997
Farmington Relief Sewer

