DONALD BREN SCHOOL OF
ENVIRONMENTAL SCIENCE & MANAGEMENT
UNIVERSITY OF CALIFORNIA, SANTA BARBARA

MITIGATION OF IMPAIRED STORMWATER QUALITY IN LOS LAURELES CANYON, TIJUANA, MEXICO

PROJECT MEMBERS:
KAVITA HEYN
RENI KEANE-DENGEL
WILLIAM LEWIS
JENNY PHILLIPS
NICOLE VIRGILIO

PROJECT ADVISORS:
DR. ARTURO A. KELLER
DR. ROBERT WILKINSON

www.bren.ucsb.edu/~tijuana April 2008

PROBLEM STATEMENT

The Tijuana River Watershed is situated on the border between the United States (U.S.) and Mexico (Figure 1). The main population centers within the watershed are San Diego, California and Tijuana, Baja California, Mexico.

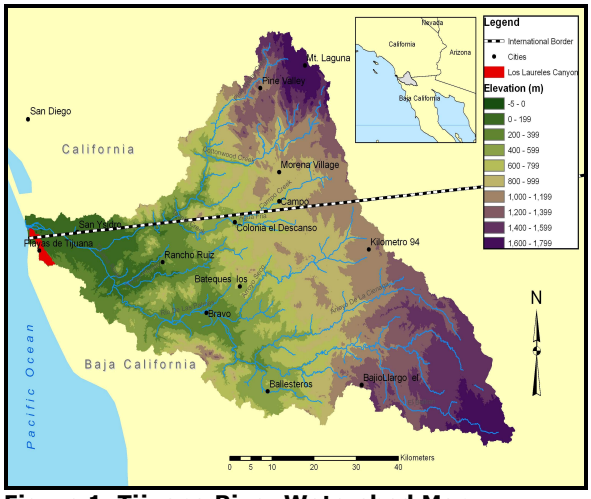

Figure 1. Tijuana River Watershed Map

Rapid urbanization and population growth in these areas over the last fifteen years have led to significant changes in landuse practices (Pauw, 1995). These changes, coupled with the absence of stringent environmental regulation or investment in infrastructure, have reduced water quality in the lower reaches of the watershed.

During storm events, pollutants such as pathogens, sediments, and refuse/debris from both sides of the border are transported through the Tijuana River Estuary and are discharged into the Pacific Ocean (Gersberg *et al.*, 1994). Contaminated waters force seasonal U.S. beach closures, and harmfully impact human health, tourism and ecosystems on both sides of the border.

Despite the significance and scale of the problem, management of pollution in this bi-national watershed has proven to be difficult. Environmental managers currently face a series of challenges in the region, most notably the absence of planned urban development in the outskirts of Tijuana. Canyons in these areas are developing rapidly and contribute substantially to the transborder pollution.

LOS LAURELES CANYON

The Tijuana border region contains twenty-eight north-draining canyons, including Los Laureles Canyon. Los Laureles Canyon was selected as the study area for this project as it is representative of the other urbanized north-draining canyons, and because of its close proximity to the coastal zone. The canyon is rapidly urbanizing with little planned development. Low-income housing is located on steep, unvegetated slopes without sufficient infrastructure to provide running water or sewage treatment (Figures 2 and 3). Consequently, many of the pollutants crossing the border during storm events originate in these developments.

Figure 2. Los Laureles Canyon

Figure 3. Pollutants in Los Laureles Canyon

PROJECT OBJECTIVES

The goal of this project was to identify options for controlling and mitigating pollutants of concern within Los Laureles Canyon. This project examined two research questions:

- *What is the magnitude of the transborder pollution problem originating in Los Laureles Canyon?*
- *What techniques and technologies can reduce the transport of pathogens, sediments, and refuse/debris through the canyon?*

APPROACH

The project approach was as follows:

1. Problem identification

Conducted a comprehensive literature review, performed several site visits, and engaged in stakeholder meetings.

Through the problem identification process it was determined that sewage was the main source of pathogen loading in the canyon, and stormwater was the main transport mechanism for pathogens, sediment and refuse/debris.

Based on this information, it was evident that sewage management alone would only address pathogen loading and fail to mitigate the transport of pollutants in stormwater. Therefore, this project analyzed *both* sewage and stormwater management options.

2. Analysis of sewage management options

Employed a watershed model to identify baseline pathogen loading, using fecal coliform as a proxy. The model was also used to simulate three sewage management scenarios to determine the potential for pathogen reduction.

3. Analysis of stormwater management options

Investigated appropriate stormwater Best Management Practices (BMPs) for Los Laureles Canyon. Conducted internet survey of BMP users and manufacturers to further inform BMP selection.

4. Formulation of recommendations

Developed recommendations together with stakeholders to ensure viable and site-specific pollution control options.

WATERSHED MODELING AND RESULTS

The Watershed Analysis Risk Management Framework (WARMF) model was implemented to simulate the fate and transport of pollutants of concern through Los Laureles Canyon.

Hydrology

The hydrology of the canyon is flashy due to the Mediterranean climate, with distinct wet and dry seasons (Figure 4).

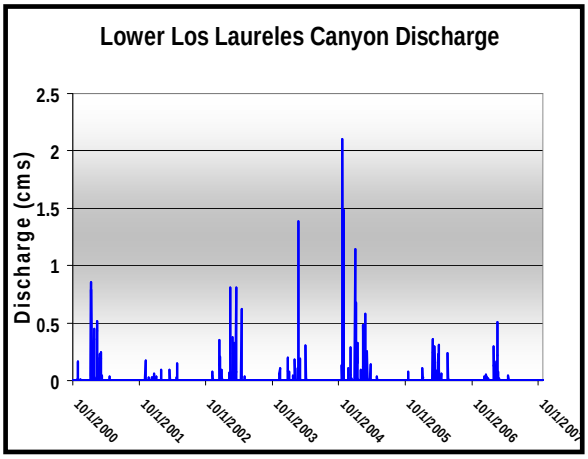

Figure 4. Los Laureles Canyon hydrograph

Fecal Coliform Loading

Pathogen loading is derived from sewage and is therefore closely associated with population. Pathogen loading currently

occurs in all sub-basins of Los Laureles Canyon (Figure 5).

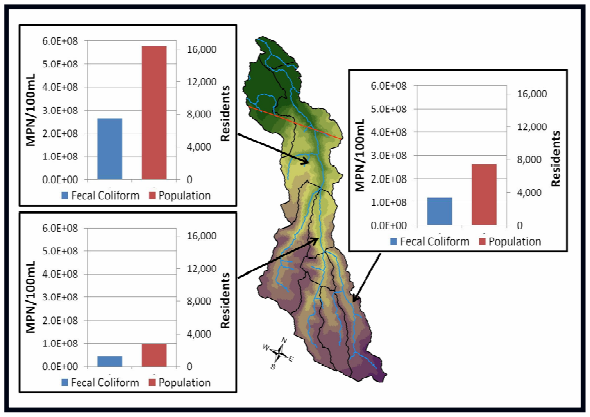

Figure 5. Fecal coliform loading and population

Sewage Management

Four sewage management scenarios were modeled to determine pathogen reduction.

- **Baseline** – No sewage management
- **SB Sewer** – Sewering of one upper basin community (San Bernardo)
- **LL Septic** – Septic systems throughout the canyon
- **LL Sewer** – Sewer lines throughout the canyon

Figure 6 illustrates the model results of each of the above scenarios. In order to come into compliance with the Mexican federal government basin water quality objective, simulations suggest that it will be necessary to sewer the entire canyon. However, this is a longer-term solution and is economically, technically and politically challenging. Therefore, stormwater management is necessary for immediate pollutant transport mitigation.

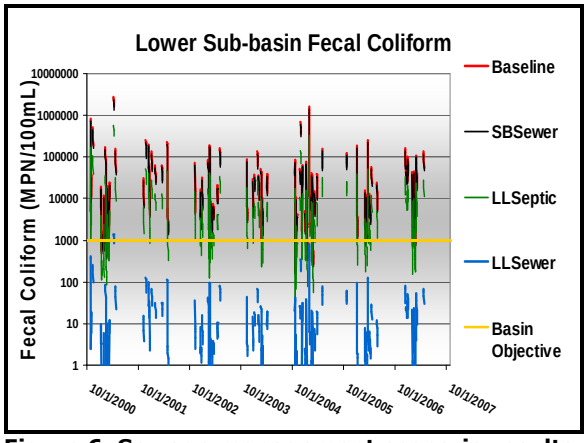

Figure 6. Sewage management scenario results

Stormwater Management

There are several BMP options for reducing pollutant transport. These options take into account the site-specific physical conditions, as well as the political, economic, and social setting within Los Laureles Canyon.

Erosion Control

Erosion control is important for stabilizing the easily erodible canyon walls. Low cost erosion control structures including tire retaining walls (Figure 7) and terracing can provide significant erosion control in Los Laureles Canyon.

Figure 7. Tire retaining wall structures

Channel Stabilization

Currently much of the channel that runs through Los Laureles Canyon is not reinforced and can erode during storm events, potentially harming humans and impairing the environment. Grade control and channel stabilization techniques (Figure 8) decrease stormwater velocity and erosion, preventing channel alteration.

Figure 8. Riprap channel stabilization

Water Quality Mitigation

The selection of water quality control and mitigation BMPs was limited to

technologies that do not require existing infrastructure, are low cost, low maintenance, multi-use, and tamper resistant. Detention basins, infiltration basins, and vegetated swales (Figure 9) were identified as three technologies that will trap sediment as well as refuse, and may reduce pathogen transport by promoting stormwater infiltration. These BMPs can be implemented in 'treatment trains' or at effective individual locations throughout the canyon.

Figure 9. Vegetated swale (CASQA, 2003)

COMMUNITY ACTIONS

Engaging Los Laureles Canyon residents (Figure 10) through stakeholder involvement is an integral component for mitigating stormwater pollution. Current and future community actions which can be initiated and expanded include:

- Permeable paver project
- Rainwater collection system
- Native seed-start program
- Erosion control flyer
- Tire retaining wall workshops

Figure 10. Children in Los Laureles Canyon

RECOMMENDATIONS

The recommendations provided below are based on project results and analysis, and require different time horizons, resources and political commitments. A multi-tiered approach, working together with stakeholders and Los Laureles Canyon residents, is advocated.

Short-term recommendations

1. Collection of additional water quality and hydrology data.
2. Continue current community actions and initiate additional local projects.

Medium-term recommendations

1. Pilot stormwater BMP projects.
2. Sewer the community of San Bernardo.
3. Financial and technical resource identification.

Long-term recommendations

1. Full-scale BMP implementation.
2. Canyon-wide sewering.
3. Landuse planning.
4. Transborder watershed management.

REFERENCES

Pauw, Ted. (1995). "Tijuana River Pollution." *TED Case Studies: An Online Journal*, 4(2) 210.

Gersberg, R. M., Dodge, D., Parsons, L., and Zedler, J.B. (1994). "Microbial Water Quality of the Tijuana Estuary." *Border Health Journal,* 16-26.

ACKNOWLEDGEMENTS

Dr. Arturo A. Keller, Project Advisor

Dr. Robert Wilkinson, Project Advisor

Bart Christensen, SWRCB Border Division

Oscar Romo, NOAA Coastal Training Program Coordinator

Mayda Winter, City of Imperial Beach

Laura Peters, SWRCB Clean Beaches Program

Douglas Linden, U.S. EPA Region 9 Border Division

Harry Johnson and SDSU TRW Program