

# CHAPTER 6

## EROSION & STORMWATER

### STUDY TEAM

#### *Objective*

*“How do we stabilize the Las Vegas Wash environment to most effectively reduce erosion and enhance wetlands?”*

#### **Introduction**

The Las Vegas Wash (Wash) has undergone significant erosion and wetland degradation over the past twenty years due to increasing flows resulting from urbanization and large rainfall events. In order to find the most effective means to stabilize the Wash environment, reduce erosion, and enhance wetlands, the coordination committee established the Erosion & Stormwater Study Team (Team).

#### **The Process**

With a myriad of factors leading to degradation of the Wash, such as the dynamic hydraulic and hydrological conditions for base flow and stormwater flows, compounded with numerous regulatory jurisdictions throughout the Wash and Las Vegas Bay, a diverse team of professionals was necessary to adequately address the issues. The Team encompasses a diverse set of backgrounds ranging from hydrology and engineering, to planning, regulatory oversight, and land development.

The Team focused on two items, managing erosion, and developing a strategy to handle storm flows. By considering natural and engineered options for the Wash, the Team formulated the following objective, “How do we stabilize the Las Vegas Wash environment to most effectively reduce erosion and enhance wetlands?” From this objective, the Team developed two goals to accomplish throughout the process:

- Goal One** - Minimize erosion in Las Vegas Wash.
- Goal Two** - Minimize the impact of surface water quality on Las Vegas Wash and Lake Mead.

## Historical Effects of Erosion

In the early part of this century, the area known as the Wash was an ephemeral stream, occasionally carrying high flows due to storm water runoff. As the Las Vegas Valley (Valley) became urbanized, the Wash became the channel used to transport treated wastewater to Lake Mead. The treated wastewater is a rich source of nutrients, and by the late 1970s, increasing flows provided enough water to create over 2,000 acres of wetland habitat in and around the Wash.

Ironically, it was urban flow, including treated wastewater and urban runoff, that resulted in the wetland creation; that now, due to increasing flows resulting from continued population growth in the Valley, coupled with storm events, has resulted in the high rate of vertical and lateral erosion seen today.

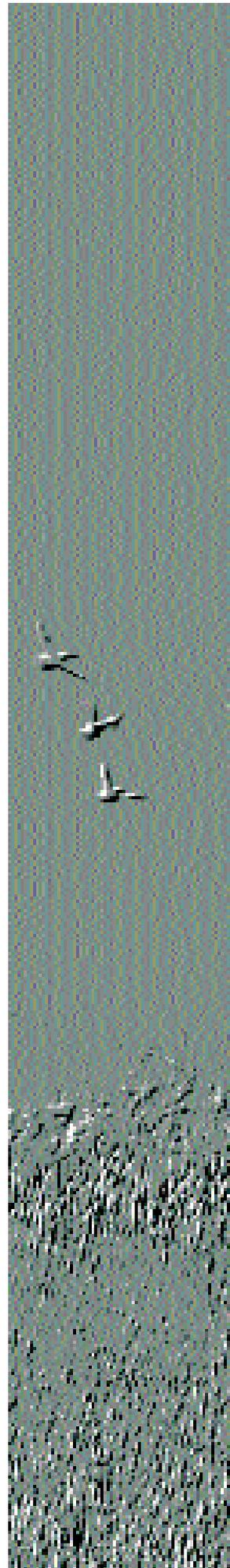
The significant erosion in the Wash has led to habitat degradation and loss, threats to existing infrastructure and high levels of sediment reaching Las Vegas Bay in Lake Mead. Today, few wetlands remain along the reach of the Wash. Sediment transport in the Wash ranges from 50 to 1,600 tons per day, as measured by total suspended solids (TSS). As expected, the variation in sediment load depends upon the time the samples were collected (i.e., higher TSS values when sampled during or immediately after a storm event).

Another component of the sediment equation, which cannot be directly measured, is sediment that drops out at Lake Las Vegas. Lake Las Vegas is a constructed lake that allows the Wash to flow underneath in two 84-inch pipes. Sediment is deposited in the settling basin before the flow enters the pipe intake structure.

## Clark County Regional Flood Control District

The Clark County Regional Flood Control District (CCRFCD) was formed in 1986 with the mission to improve the protection of life and property for existing and future residents of the Las Vegas Valley from the impacts of flooding. The Nevada Legislature authorized the formation of the district in 1985 and the voters approved a 1/4-cent sales tax in 1986. The CCRFCD's first revenues were received in 1987.

Erosion control measures have been included as part of the flood control master plan since first introduced in 1986. These flood control features were adopted from work completed by other organizations and recognized the need to control erosion and enhance wetland opportunities in the Wash. The CCRFCD annually updates project priorities and capital improvement programming on a 10-year horizon. The flood control master plan is updated every five years.



## The Engineering Workshop

One result of Team efforts was a Las Vegas Wash Engineering Workshop that was held on August 30-31, 1999. The workshop brought together engineering professionals from private firms, local and regional public entities, and other parties with an interest in the Wash. The purpose of the workshop was to develop ideas and methods to help stabilize the Wash. Efforts of workshop participants were presented to the Team for review, and later incorporated into the Las Vegas Wash Comprehensive Adaptive Management Plan as recommended actions.

A total of 48 workshop participants met for two days. The workshop focused on priority goals:

1. Develop consensus on issues and desired outcomes of the workshop.
2. Develop an overall stabilization plan for the Wash, with options that could be implemented individually or jointly.
3. Develop specific methods to incorporate into the overall stabilization plan, including types and location of structures, development priorities, and studies that would be necessary to fully understand dynamics of the Wash.

After much technical discussion and brainstorming that considered both short- and long-term horizons, agreement was reached regarding three main issues, listed below, that must be addressed to meet the overall objective of stabilizing the Wash. The complete report developed from the Engineering Workshop can be found in Appendix 6.1.

### Issue 1: Erosion Needs Immediate Attention

In order to successfully implement the Clark County Wetlands Park Master Plan, or any long-term comprehensive management plan, the Wash must be stabilized as soon as possible. The changing topography has caused erosion control structures planned for the Wash to be re-designed several times; and thus, design and implementation of any type of facility or management option has been difficult to achieve.

### Issue 2: Dry Weather Flow Should be Considered Separately from Storm Flows

The Wash is the primary conduit that channels storm flows to Lake Mead. Clark County Regional Flood Control District's Master Plan has estimated



the 100-year flood flow to be 12,700 cubic feet per second (cfs) at “build out.” Build-out flow is modeled at the maximum extent of urbanization of the Valley with associated flood control facilities. Although, 2000-4000 cfs could potentially be “removed” from peak flows by using retention/detention basins, the Wash would still have to pass the majority of storm flows. On the other hand, dry weather flows such as treated wastewater, shallow ground water, and urban runoff, are orders of magnitude less than potential storm flows. Various alternatives and percentages of dry weather flows passing through the Wash can be considered with little effect on design of erosion control structures. For these reasons, dry weather flows should be considered separately from storm flows when designing erosion control.

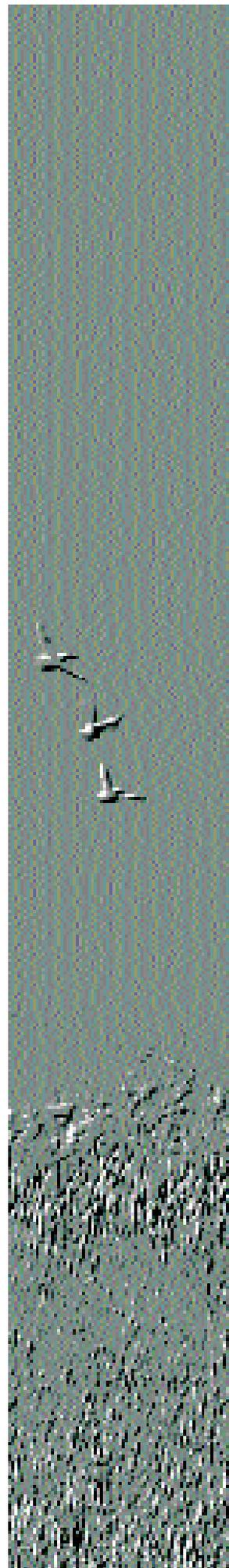
While dry weather flows play a critical role in erosion as the Wash exists today, these flows have little impact on the overall design of the erosion control structures. Dry weather flows destabilize the existing channel because it is not currently at an equilibrium slope. Storm flows cause catastrophic erosion due to the destabilized condition of the channel. Erosion control structures would bring the channel back to equilibrium with respect to flow and gradient. The structures would be designed to pass dry weather flows through a stabilized low flow channel. By reducing the destabilized condition of the channel, erosional effects of the stormwater flows are reduced. A critical factor in the design of these structures is their ability to withstand the stormwater flows. Stormwater flows at the 100-year flood are approximately 30 times higher than dry weather flows. The ability of the erosion control structures to remain in place during these higher flows is of primary concern in their design.

### Issue 3: Re-Establishment of Wetlands Must be Conducted Outside of the Wash Channel

Some wetlands will naturally appear in the channel as a result of water ponding behind installed erosion control structures. Dry weather flows should be maintained to support wetland areas that may form in the channel. However, due to the nature and history of Wash channelization, it is not feasible to establish significantly large areas of wetlands within the Wash channel. Decisions regarding the amount of potential off-stream wetlands need to be determined to better define the amount of wetlands (i.e., acreage) that can be developed.

## **Recommended Actions**

To begin to address the above three issues, the Team developed an overall approach consisting of five recommended actions, including both short- and long-term items. The short-term items are expected to provide needed information to address the permanent or long-term plan. Many of the actions should begin immediately, and several could occur simultaneously.



Because the comprehensive adaptive management plan is designed to be “adaptive,” management of the Wash must remain contingent on decisions and approaches that will evolve as the plan is implemented.

### Action 1: Install Erosion Control Structures

*Entities: Bureau of Reclamation, Clark County, City of Henderson, Clark County Department of Park and Recreation, Clark County Department of Comprehensive Planning, Clark County Regional Flood Control District, Corps of Engineers, Las Vegas Wash Management Entity, Southern Nevada Water Authority, US Fish and Wildlife, USGS*

The Team recommends the development of prototype structures that can be installed quickly and at a lesser expense than permanent structures, to aid in stabilizing the Wash as soon as possible. Conceptual designs include utilization of gabions, sheet pile, cellular coffer dams, inflatable dams, bio-engineered dams (using of vegetation for stabilization), rip-rap filled dams, and geotextile envelopes. Conceptual drawings of some of these of structures are illustrated in Figures 6.1 through 6.8. These designs were taken in part from the General Erosion Techniques compiled in Clark County Comprehensive Planning’s Erosion Mitigation Plan (1989), Appendix A-14 is included as an Appendix 6.2 to this plan.

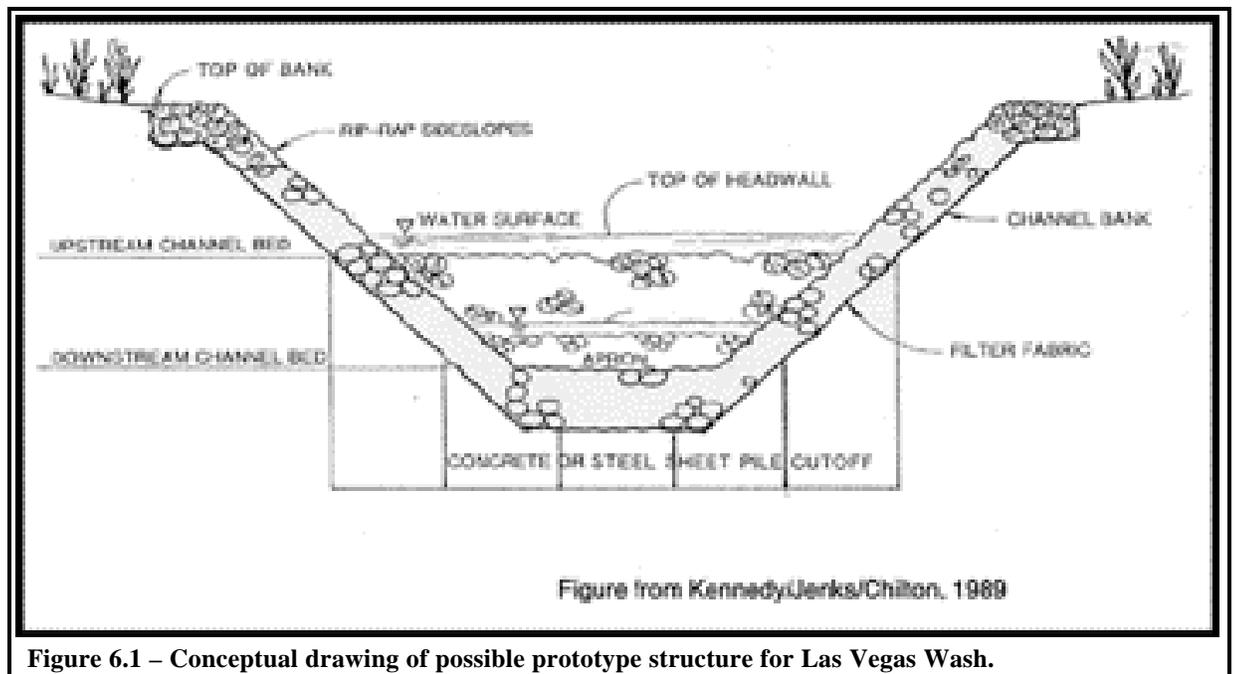


Figure 6.1 – Conceptual drawing of possible prototype structure for Las Vegas Wash.

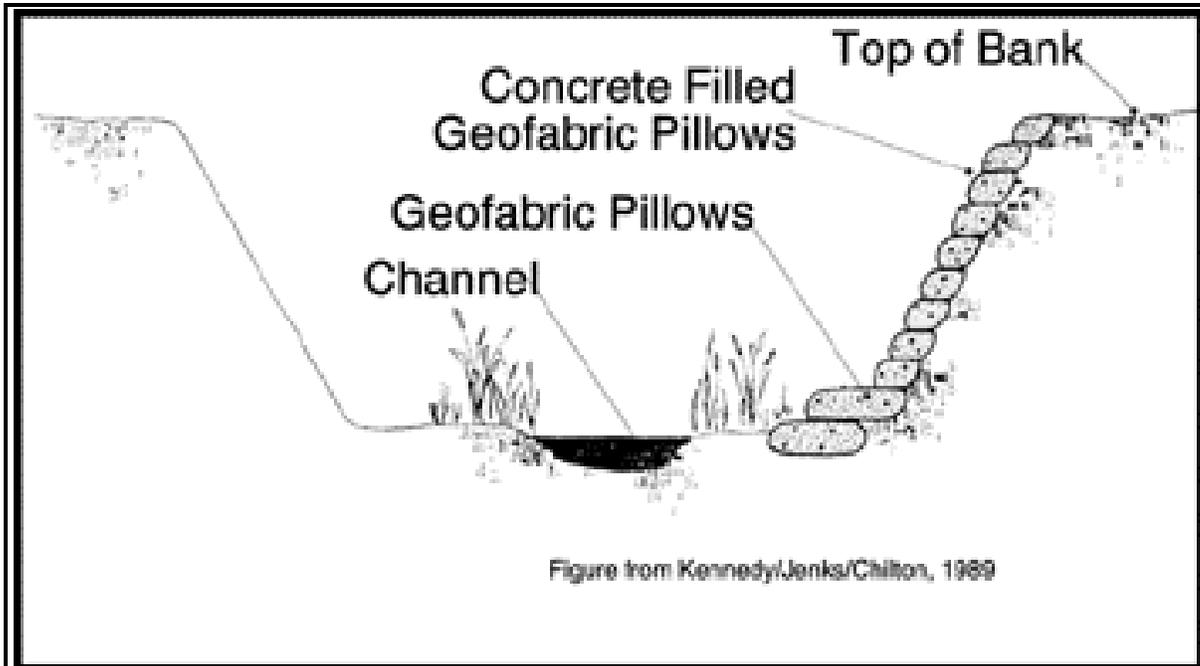


Figure 6.2 – Conceptual drawing of possible prototype structure for Las Vegas Wash.

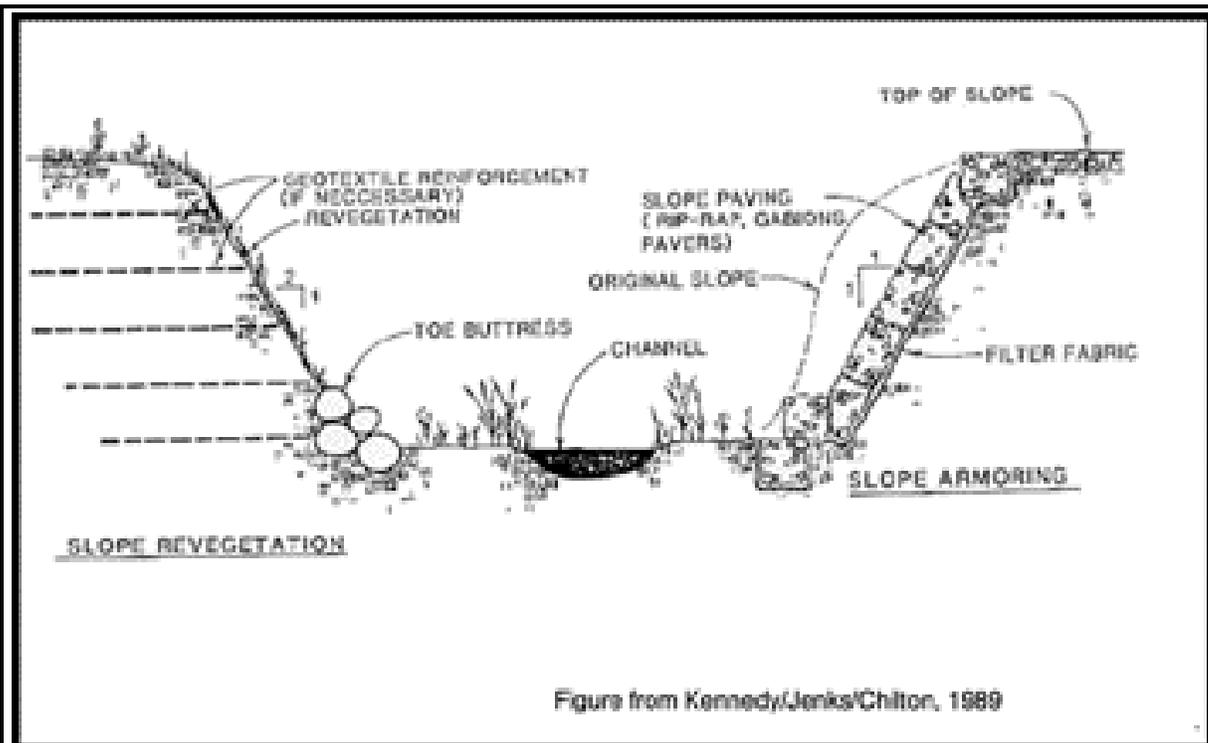
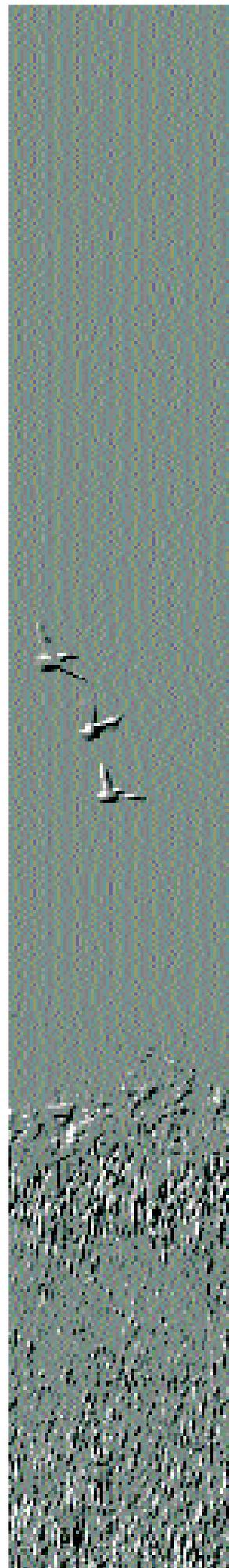


Figure 6.3 – Conceptual drawing of possible prototype structure for Las Vegas Wash.



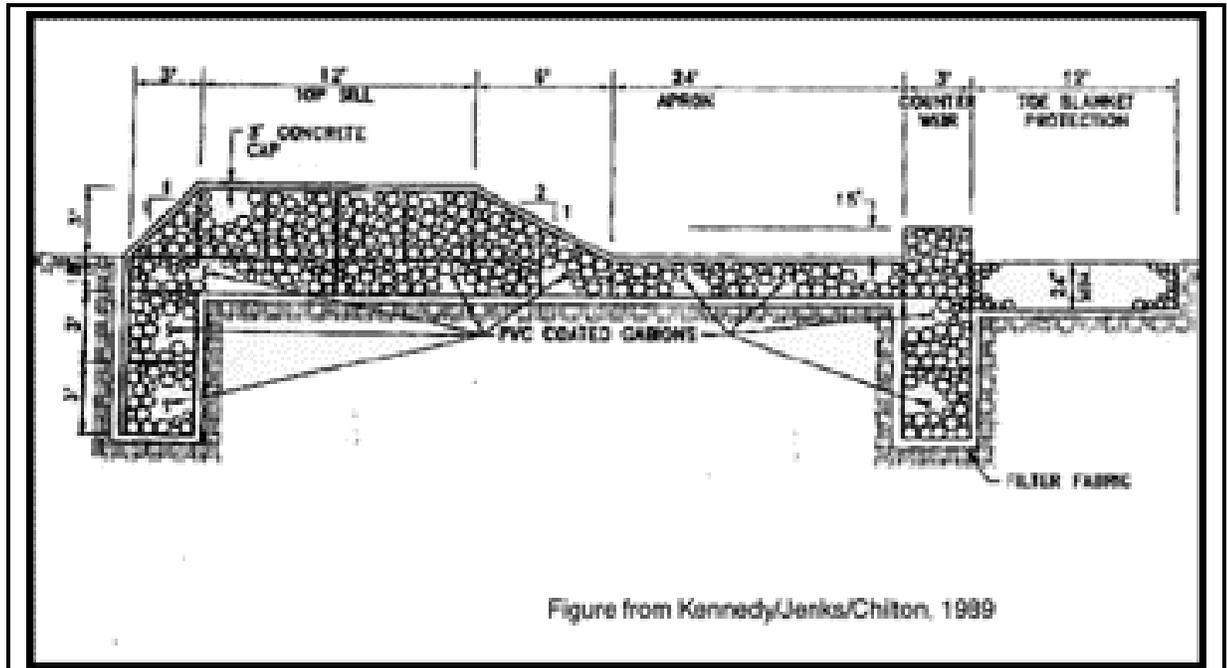


Figure 6.4 – Conceptual drawing of possible prototype structure for Las Vegas Wash.

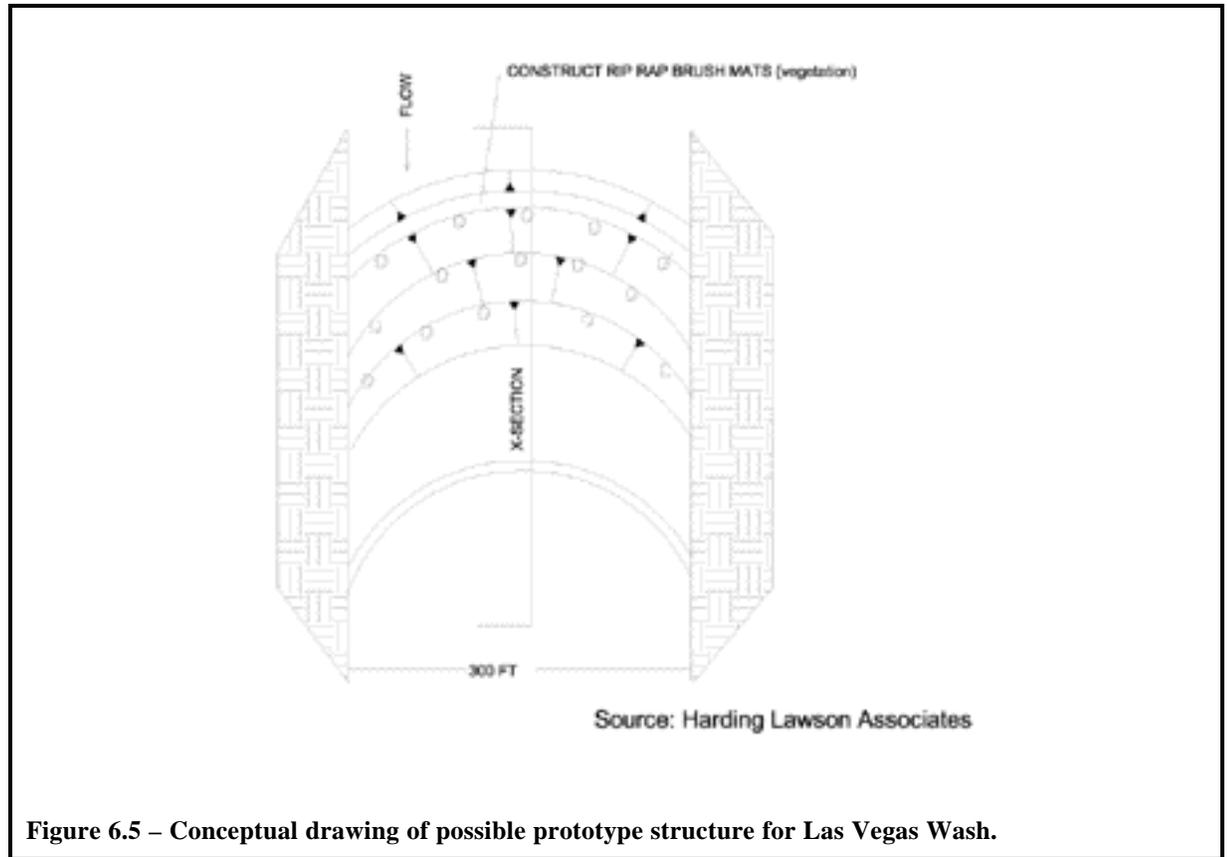


Figure 6.5 – Conceptual drawing of possible prototype structure for Las Vegas Wash.



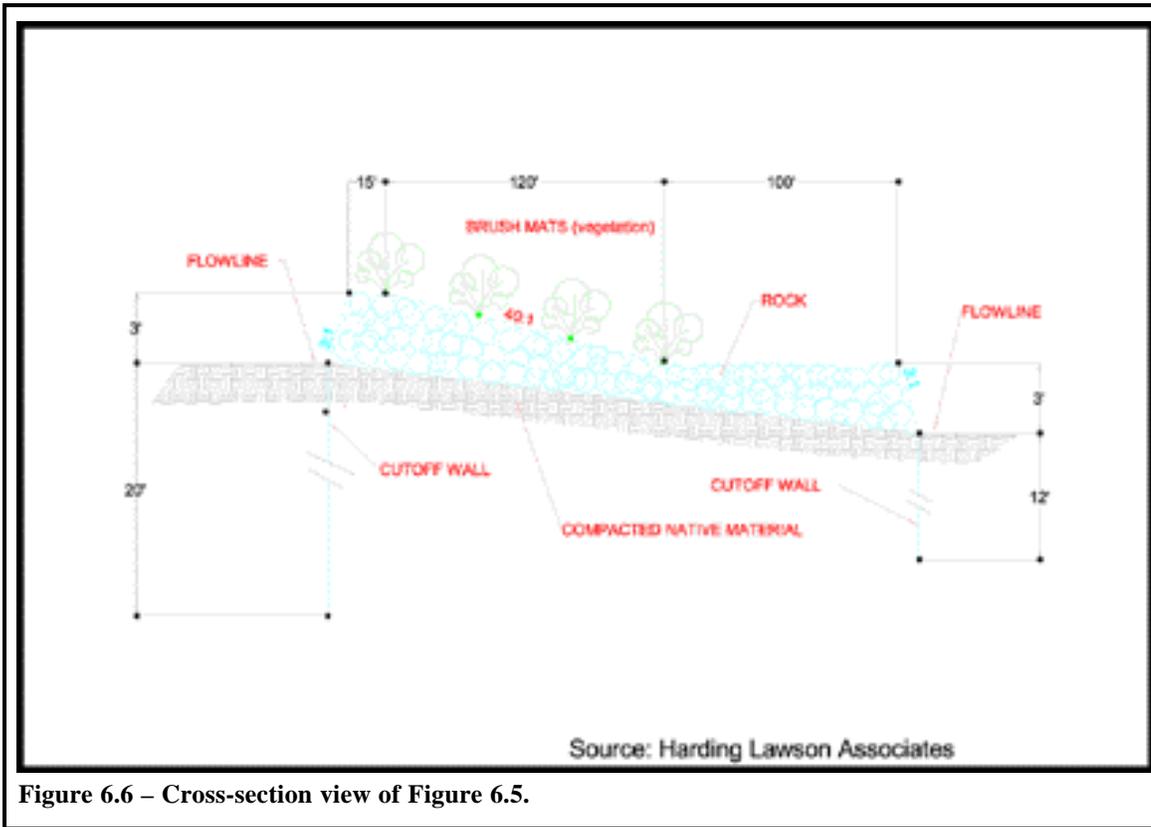


Figure 6.6 – Cross-section view of Figure 6.5.

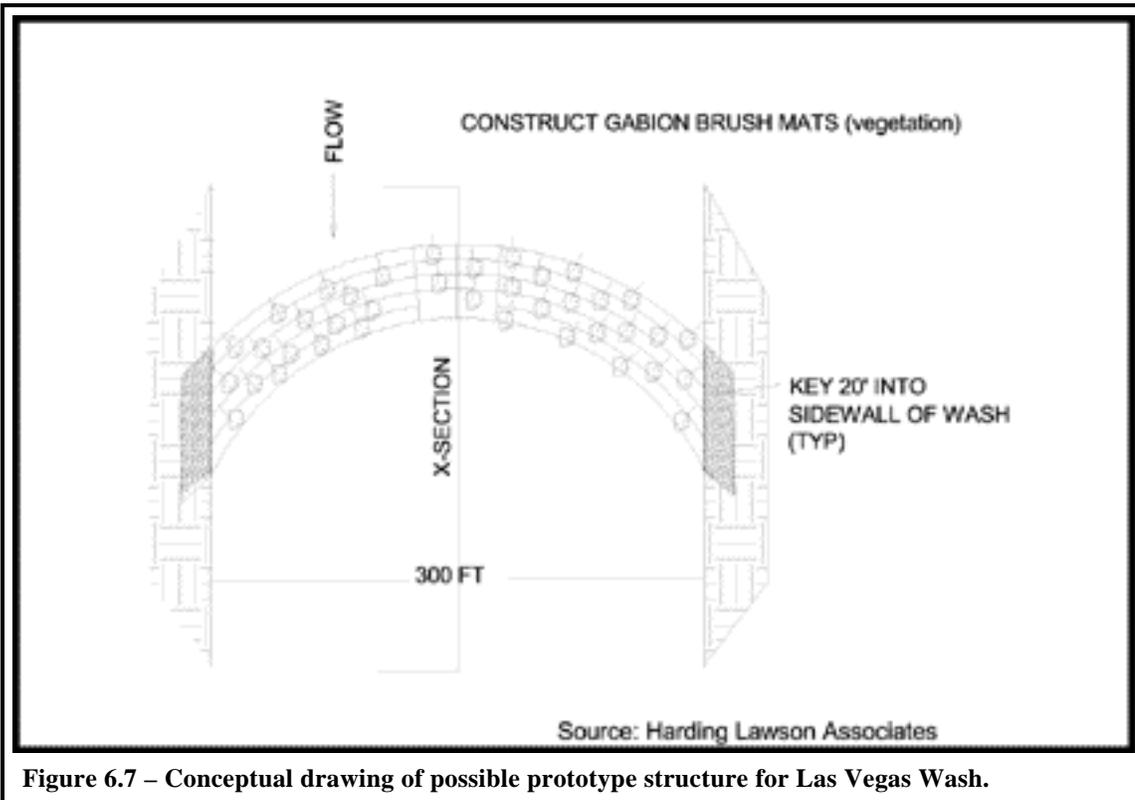
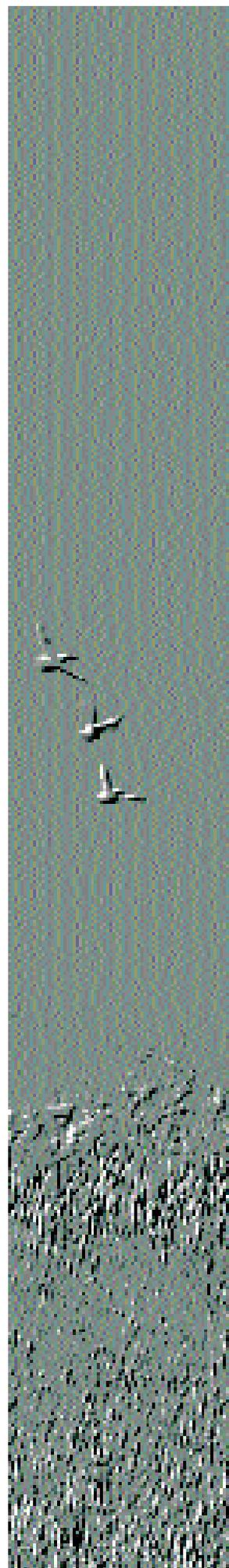
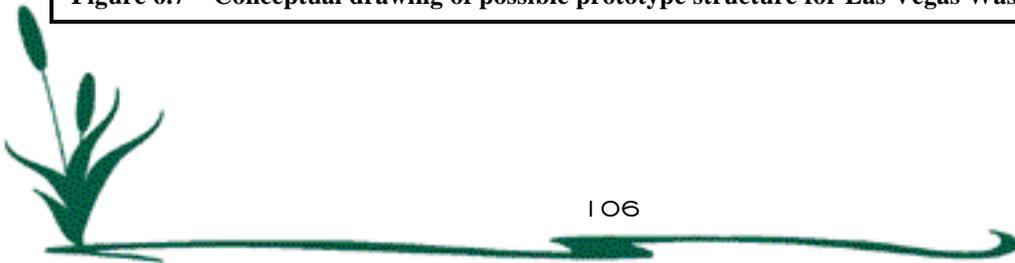


Figure 6.7 – Conceptual drawing of possible prototype structure for Las Vegas Wash.



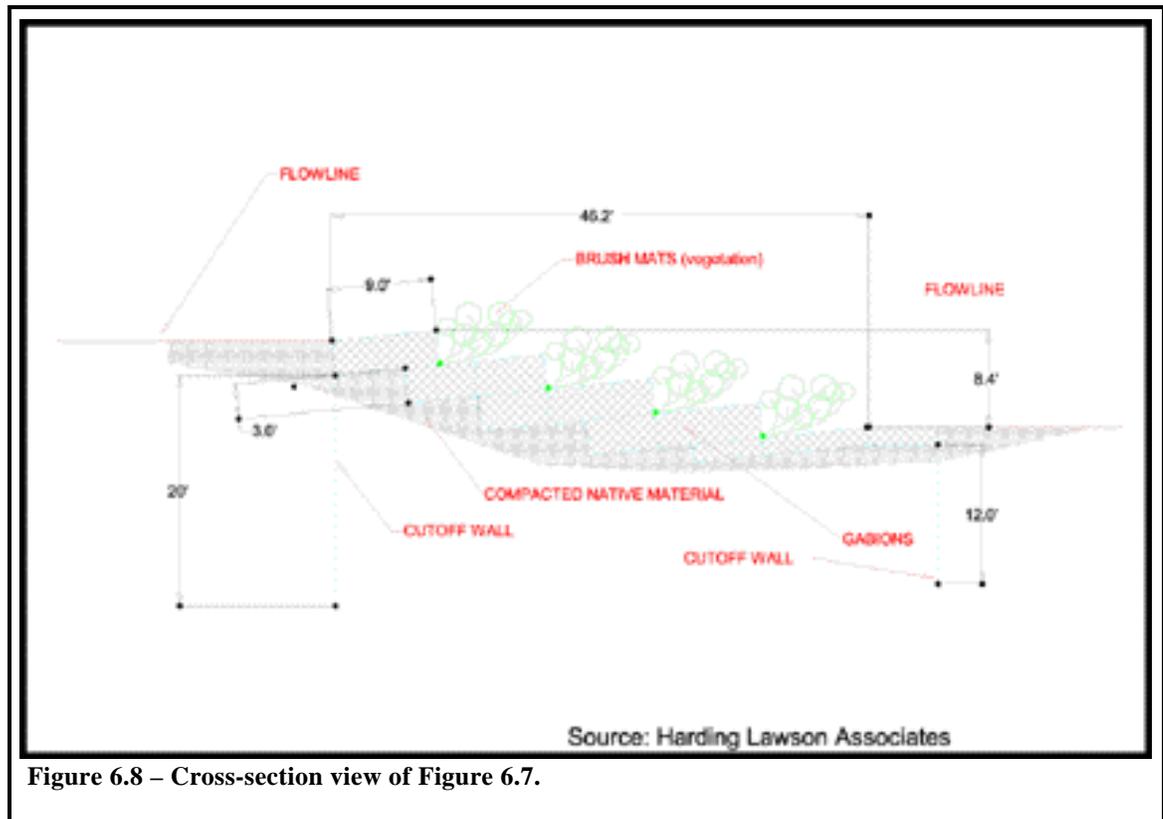


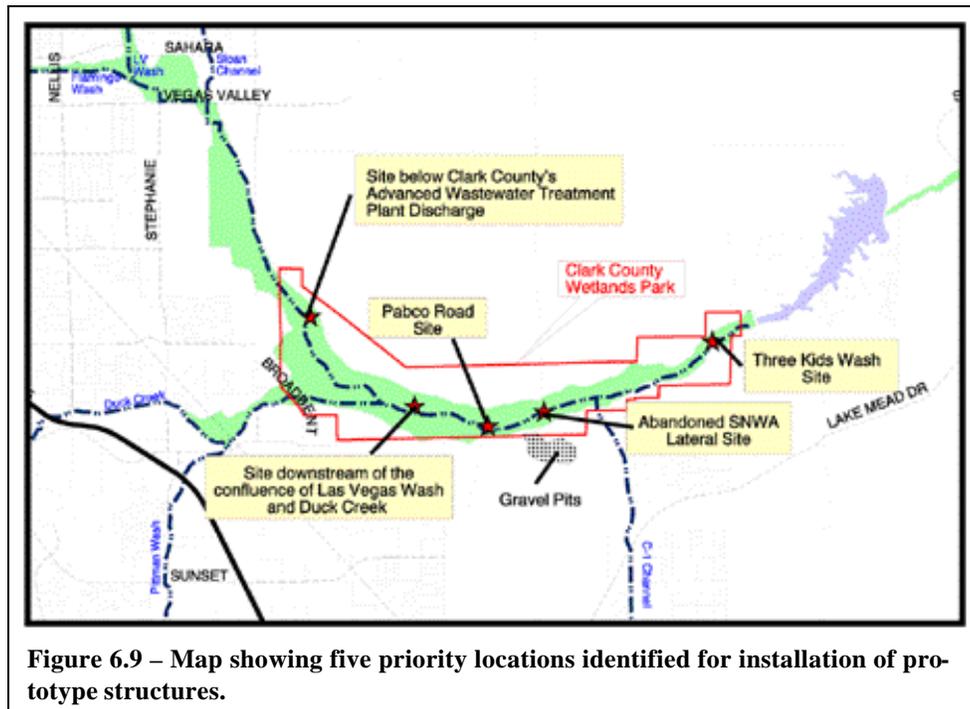
Figure 6.8 – Cross-section view of Figure 6.7.

Also required are engineering analyses to identify potential sites for installation of prototype structures. Preliminary studies have been conducted to prioritize locations of erosion control structures. Studies conducted by Clark County Comprehensive Planning (1989), Lake Las Vegas (1991) and SNWA (1999) identified potential sites for approximately 15 erosion control structures that would promote the stabilization of the channel and reduce the occurrence of catastrophic erosional events.

In addition, priority sites for either, or both, prototype and/or permanent structures should be identified. Five priority locations that could potentially be incorporated into ongoing construction efforts are shown in Figure 6.9, and include:

- 1) A site downstream of Clark County's Advanced Wastewater Treatment Plant discharge
- 2) A site downstream from the confluence of Duck Creek and the Wash
- 3) The site of the Pabco Road Erosion Control Structure
- 4) The site of the abandoned SNWA Lateral
- 5) A site near Three Kids Wash (also the site of a future SNWA Lateral)





Eight other potential sites identified by SNWA in April 1999 were selected based on a variety of criteria, including active headcut location, property ownership, and suitability of the site for regulatory permitting and construction. These potential sites are shown in Figure 6.10 and described as:

- 1) 2,000 feet upstream from the Lake Las Vegas intake
- 2) 3,500 feet upstream from the Lake Las Vegas intake
- 3) 5,000 feet upstream from the Lake Las Vegas intake
- 4) 6,900 feet upstream from the Lake Las Vegas intake
- 5) 7,650 feet upstream from the Lake Las Vegas intake
- 6) 6,800 feet downstream from Pabco Road
- 7) 6,100 feet downstream from Pabco Road
- 8) 3,250 feet upstream of Pabco Road.

One example of cooperation among coordination committee members has been the excavation of a road-cut at Lake Las Vegas, that has resulted in the opportunity for construction of a structure just upstream from Three Kids Wash. Large amounts of large diameter rock, suitable for erosion control structure construction, have recently been excavated by the Sunset Road extension project. Rather than hauling the materials off, Lake Las Vegas has offered to place the rock at the structure site. Cooperation of regulatory agencies, along with financial assistance and coordination by SNWA, enabled the coordination committee to take advantage of this opportunity and get the rock set in place in just under three weeks. In the future it will be necessary to identify locations and methods for the installation of more permanent structures as opportunities arise.

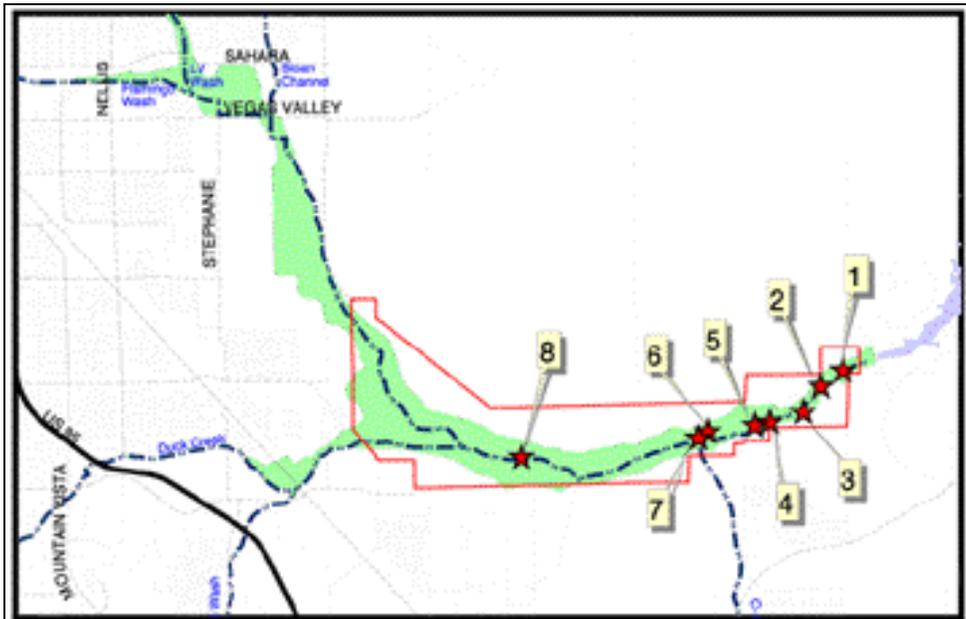


Figure 6.10 – Eight potential erosion control structure sites.

## Action 2: Obtain Topography and Geophysical Data

*Entities: Bureau of Reclamation, Clark County, City of Henderson, Clark County Department of Park and Recreation, Clark County Department of Comprehensive Planning, Clark County Regional Flood Control District, Corps of Engineers, Las Vegas Wash Management Entity, Southern Nevada Water Authority, US Fish and Wildlife, USGS*

The Team realized that to effectively design and locate structures, an accurate topographic description of the Wash is required. The Team recommended obtaining updated topography, in one to two foot contours of the Wash, and establish permanent ground control to facilitate future topographic updates as needed. Currently, design alternatives are being considered for a future pipeline crossing of the Wash in the area Three Kids Wash. Updated topography was planned for this effort in the vicinity of the pipeline alignment. SNWA recognized this opportunity and amended the work plan to generate updated topography for the entire Wash from the Clark County Advanced Wastewater Treatment Plant to the Las Vegas Bay at Lake Mead.

Geophysical studies to define bedrock and geologic structures are needed to design long-term structures. The United States Geological Survey, with support of the Las Vegas Valley Water District, has recently published results of gravity and seismic reflection data indicating structure and depth to bedrock of the Las Vegas Valley Shear Zone and the Las Vegas Basin. Results of this study indicate that bedrock occurs at depths of 1,500 to over 3,000 feet below land surface along most of the Wash (Langeheim, 1998).



Future work required includes identification and establishment of permanent locations for cross sections for continued monitoring and evaluation. Also necessary is the establishment of permanent datums to monitor changes in channel geometry, which is essential for determination of most effective stabilization techniques.

**Action 3: Conduct Sediment Transport Modeling**

*Entities: Bureau of Reclamation, Clark County, City of Henderson, Clark County Department of Park and Recreation, Clark County Department of Comprehensive Planning, Clark County Regional Flood Control District, Corps of Engineers, Las Vegas Wash Management Entity, Southern Nevada Water Authority, US Fish and Wildlife, USGS*

Sediment transport modeling, in conjunction with storm flow analysis, is another action necessary to fully understand the sediment transport dynamics of the Wash. A study of this type would likely include compilation of available stream hydraulics, hydrology and geologic information of the Wash, development of preliminary stabilization techniques, development of computer model of Wash stream hydraulics and channel scouring and modeling of stabilization measures. Results of this study would include analyses of effectiveness of various stabilization techniques and determination of the best overall stabilization approach. Effectiveness of these elements would be modeled for a 100-yr flood and likely flood series over a 100-yr time span. The short-term changes are computed using the 100-yr flood, which generally is the design criterion. The long-term impacts are simulated using the flood series that can be expected in a 100-yr time span. Proposals for this work are currently being reviewed.

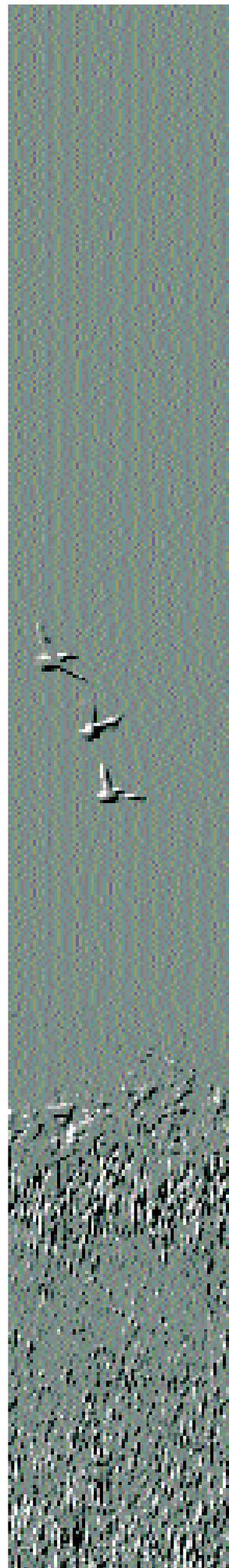
**Action 4: Establish Off-Stream Wetlands with Alternate Discharge Considerations**

*Entities: Bureau of Reclamation, Clark County, City of Henderson, Clark County Department of Park and Recreation, Clark County Department of Comprehensive Planning, Clark County Regional Flood Control District, Corps of Engineers, Las Vegas Wash Management Entity, Southern Nevada Water Authority, US Fish and Wildlife, USGS*

Continue to work with the City of Henderson, City of Las Vegas, and the Clark County Sanitation District and their consultant, Black & Veatch, to help define alternate discharge options and distribution of future flows in the Wash and off-stream wetland facilities. This is discussed in more detail in Chapter 8, Alternate Discharge.

**Action 5: Evaluate Stormwater Detention/Retention Basins**

*Entities: Bureau of Reclamation, Clark County, City of Henderson, Clark County Department of Park and Recreation, Clark*



*County Department of Comprehensive Planning, Clark County Regional Flood Control District, Corps of Engineers, Las Vegas Wash Management Entity, Southern Nevada Water Authority, US Fish and Wildlife, USGS*

To determine the feasibility of capturing stormwater, the Team recommends investigating the possibility of using abandoned gravel pits near the abandoned SNWA Lateral site and the Three Kids Wash site, as shown in Figure 6.11, for skimming peak stormwater flows. In addition, the investigation and evaluation of potential sites for storm water detention/retention basins further upstream, which were noted as preferable locations in the Engineering Workshop should be identified.

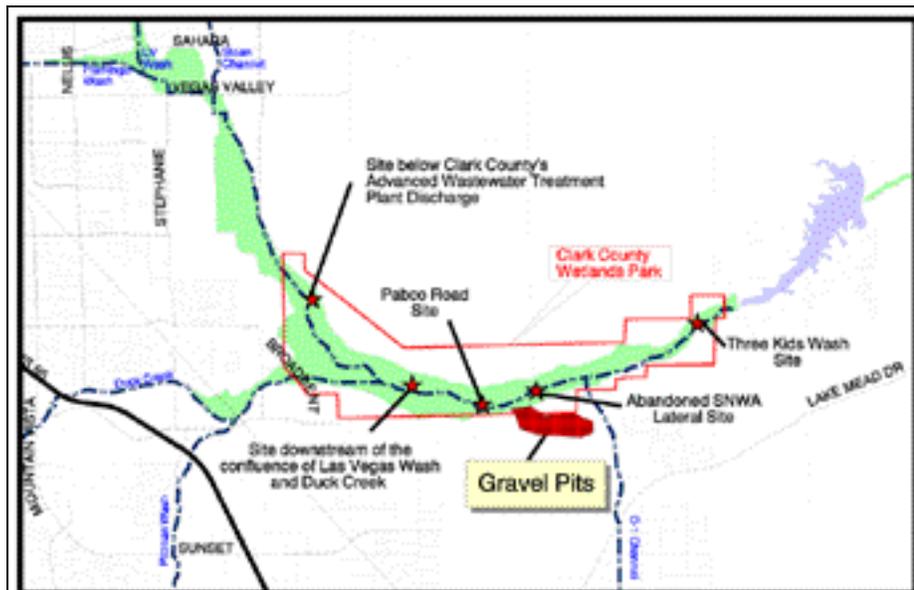


Figure 6.11 - Location of gravel pits that could potentially be used for stormwater capture.

## Appendices

- 6.1 Las Vegas Wash Engineering Workshop
- 6.2 Erosion Mitigation Plan, Appendix A-14 (General Erosion Control Techniques)

## Reference

Langeheim, et. al., (1998). Thickness of Cenozoic Deposits and Location and Geometry of the Las Vegas Valley Shear Zone, Nevada, Based on Gravity, Seismic Reflection and Aeromagnetic Data, U.S. Geological Survey, OFR 98-579.

