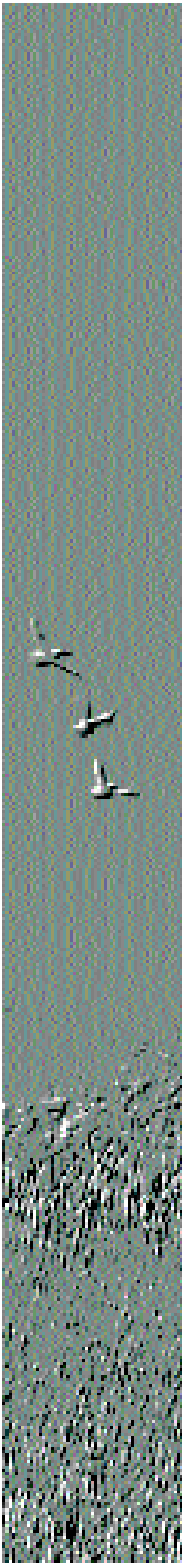


Chapter 4
Water Quality

Introduction

The Las Vegas Wash (Wash) is a unique ecosystem in southern Nevada. Rarely would one expect to find an oasis of water, wildlife and vegetation on the floor of a desert valley, but that is precisely what exists in the south-east part of the Las Vegas Valley. What makes this ecological diversity possible is the perennial flow of water present in the Wash.

The Wash is the primary outlet for water flows from the metropolitan Las Vegas Valley (Valley). The flow in the Wash is defined by one of two general categories; dry weather (base flow) and wet weather flows. Dry weather flows consist of metered flows, including treated wastewater from the three Valley dischargers (Cities of Las Vegas and Henderson, and the Clark County Sanitation District), once-through cooling water from Timet at the Basic Management, Incorporated industrial facility, urban runoff, and intercepted shallow ground water. Wet weather flow consists of storm flow.

Las Vegas Wash Flow Components

Dry weather flows
- *metered flows such as treated wastewater & once-through cooling water*
- *urban runoff*
- *intercepted shallow ground water*

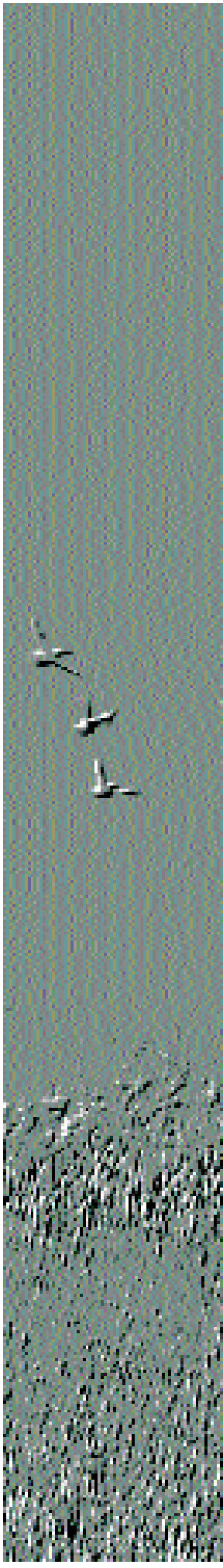
Wet weather flow
- *stormwater*

The water quality in the Wash is typical of most urban waterways and each flow component has a unique characteristic that contributes to the overall water quality in the Wash. Table 4.1 identifies each flow component, describes how the flow reaches the Wash, and discusses the general water quality issues of concern associated with each component. Figure 4.1 spatially shows the various flow components of the Wash in relationship to the Valley.

Type of Flow	How Flow Reaches Wash	General Water Quality Issues of Concern
Treated Wastewater	Water that has been used indoors (homes and businesses, etc.) in the Valley goes to one of the three Valley wastewater treatment plants. The water is treated to federal and state standards and discharged into the Wash or is reused, primarily for landscape irrigation.	Increasing flows contribute to channel erosion and concerns that increasing flows in the future may result in an exceedence of Total Maximum Daily Load standards.
Urban Runoff	Results from the overwatering of landscapes and surface street runoff.	Urban chemicals, such as oil, grease, pesticides, and herbicides, along with nutrients and bacteria from human and animal sources can present water quality concerns in Las Vegas Bay of Lake Mead.
Shallow Ground Water	Shallow ground water, defined as water that is less than 30 feet below land surface in the central and southeast part of the Valley, flows downgradient toward the Wash and becomes part of the flow as intercepted ground water.	The primary concerns regarding shallow ground water include high salinity and the potential for chemical compounds from past industrial practices present in shallow ground water to reach the Wash, and ultimately Las Vegas Bay and Lake Mead. Specific concerns include selenium, perchlorate, and various organics.
Stormwater	Much of the stormwater is held in detention basins for up to 7 days, but eventually reaches the Wash.	Storm events have the capability of significant channel erosion which increases sediment transport. In addition, urban influences such as nutrients, bacteria (coliforms), solvents, oil, grease and pesticides reach the Wash during every storm event.

Table 4.1 - Las Vegas Wash flow components and general effect on water quality.

The water quality issues presented by the Wash have the potential to effect the Las Vegas Bay and generate public concern regarding Lake Mead, which is the largest reservoir on the Colorado River system. Southern Nevada relies on the Colorado River as the primary source for drinking water. Others in the lower Colorado River Basin including Arizona, California, and several Native American Tribes rely on Colorado River water primarily for agriculture uses as well as drinking water. Lake Mead plays an integral role in regulating and protecting the delivery of water to those entities, and southern Nevada has a vested interest in protecting the lake's water quality as much as possible. In addition, flows in the Wash are instrumental in sustaining wetlands and the associated ecosystems that have developed as a result of the perennial flow. Therefore, the water quality issues associated with the Wash require attention.



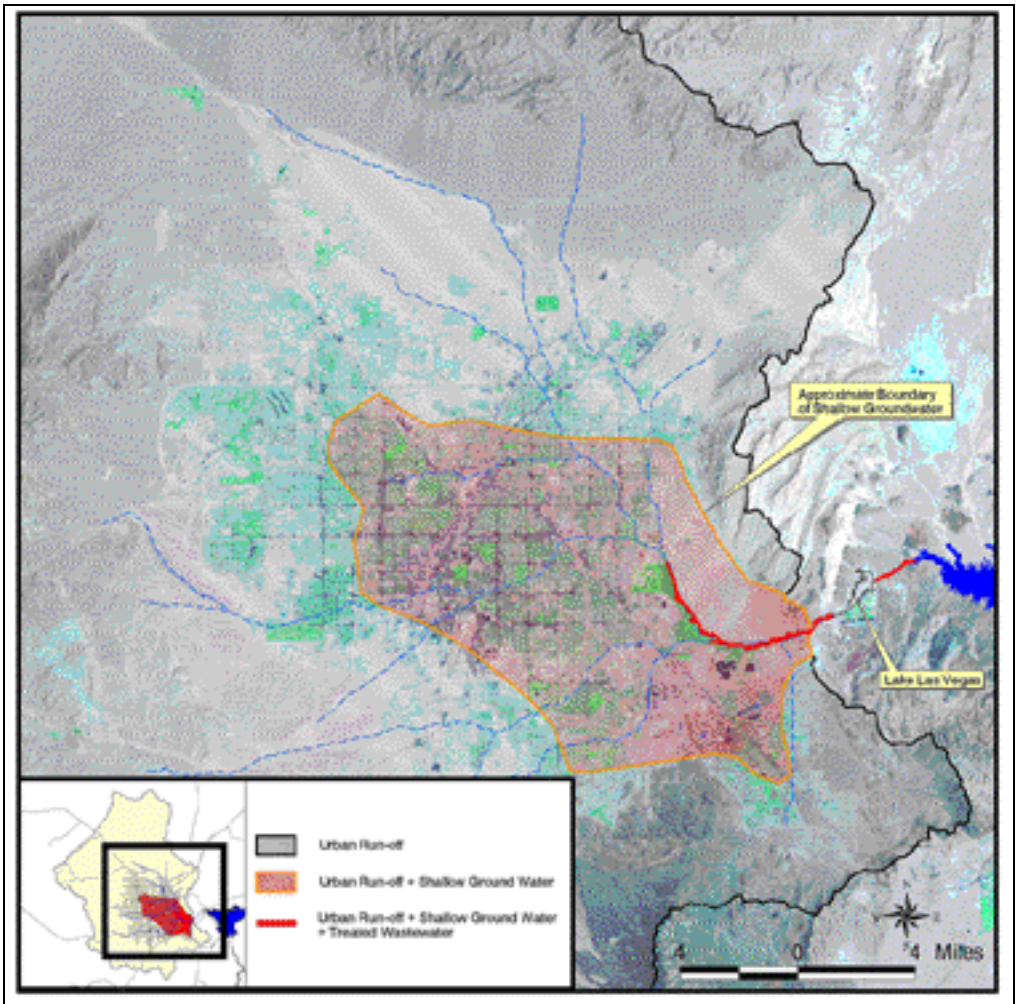


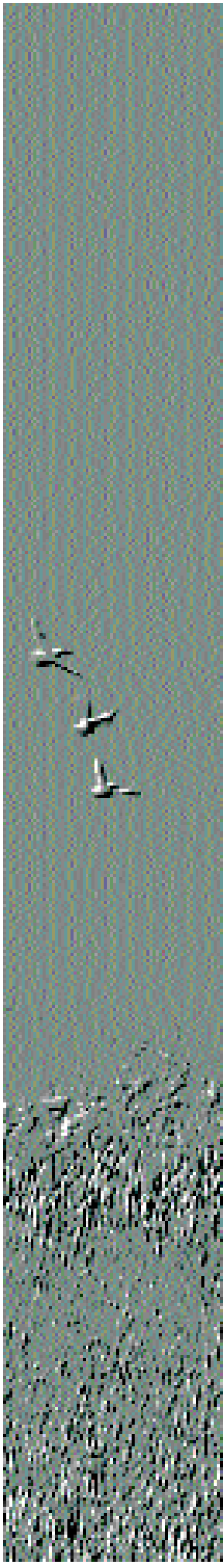
Figure 4.1 - Map showing the spatial influence of various flow components in the Las Vegas Wash.

Water Quality Compliance

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) was passed by Congress in 1974 and has been amended several times since, most recently in 1996. The U.S. Environmental Protection Agency is the lead federal agency that determines the regulations and provides guidance to the administering agency, the Nevada Bureau of Health Protection. The SDWA sets national drinking water standards that must be met by all public water systems.

While the Wash is not a drinking water source and therefore not required to meet SDWA standards, any impact, or potential impact of the Wash on Lake Mead must be evaluated.



Clean Water Act

The Clean Water Act (CWA) mandates that all discharges to surface waters be permitted and meet certain requirements as to quality. The U.S. Environmental Protection Agency (EPA) is the lead federal agency that determines the regulations and provides guidance to the administering agency, the Nevada Division of Environmental Protection (NDEP). The CWA sets national standards for surface water bodies based on uses other than drinking water (i.e., recreation) that must be met by all entities that discharge to a public waterway.

The Wash serves as the receiving waters for three types of flows which fall under the jurisdiction of the CWA:

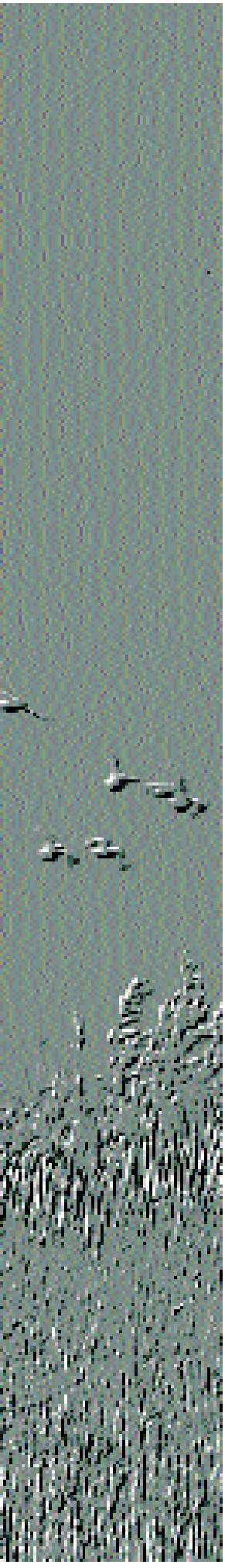
- **Wastewater discharges** – National Pollutant Discharge Elimination System (NPDES) permits are required for all of the treated wastewater that is discharged into the Wash. Each permit specifies the maximum amount of discharge allowed and sets limits for various constituents that may be in the discharge. The permit's limitations are established to insure that water quality standards for the Wash and Lake Mead are met. These standards are set by NDEP, according to CWA requirements, based on the intended use of the water and to prevent degradation of water quality.

- **Stormwater flows** – The Clark County Regional Flood Control District, as lead agency, along with Clark County, the City of Henderson, the City of Las Vegas, the City of North Las Vegas, and the Nevada Department of Transportation are co-permittees for the Municipal Stormwater Management NPDES permit currently in place for the urban Valley. The permit allows for discharge of stormwater from Valley washes to the Wash. Although stormwater is not treated prior to entering the Wash, sampling and reporting requirements are set under the Municipal Stormwater Management NPDES permit.

- **Urban runoff** – The Valley's urban runoff is monitored through the Municipal Stormwater Management NPDES permit. Under this permit, dry weather and wet weather sampling and reporting are conducted at each of the wet weather monitoring sites. In addition, the 1998/99 program includes a pilot project conducted by the Conservation District of Southern Nevada to perform a site characterization of a four-square mile area along Flamingo Wash to determine the sources of urban runoff pollutants.

Triennial Review of Water Quality Standards

Section 303 of the CWA requires that states periodically review and, as appropriate, modify water quality standards. The standards are published



under the Nevada Water Pollution Control Regulations (NAC 445A.194 – 445A.201). The Nevada Division of Environmental Protection, Bureau of Water Quality Planning is the lead state agency. One important consideration is that beneficial uses and associated water quality standards on the Wash may need to be revisited as the management plan is implemented and as the Wash changes from a fast-moving erosive stream to a controlled wetland environment.

The Nevada State Environmental Commission, which is responsible for the final approval, first enacted water quality standards for the Wash and Lake Mead in the 1970's. The standards have been amended several times, including most recently in June, 1998.

208 Water Quality Management Plan

The Clark County 208 Water Quality Management Plan for the Valley was amended by County Commissioners in 1997. The document outlines water quality strategies for compliance under the CWA for a twenty year period. Elements considered in the plan include population projections, water resources, air quality relating to assessment of wastewater conditions, non-point source conditions, Wash wetlands, and reuse and reclamation opportunities. The document is subject to approval by NDEP and EPA.

Water Quality Issues of Concern

The fact that the Wash is the outlet for all urban flow in the Valley inherently means that there will be water quality issues associated with the flow. The primary issues of concern, including sediment, selenium, perchlorate, and urban chemicals are discussed in more detail below.

Sediment

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 drops out in the settling basin before the flow enters the pipe intake structure.

The transport of sediment is especially evident in Las Vegas Bay, the receiving water body of the Wash. Some researchers have noted several additional feet of sedimentation in the Bay after major storm events.

On June 17, 1998, the Nevada State Environmental Commission adopted Water Quality Standards (NAC 445A.195) which included a beneficial use

standard for suspended solids of 135 milligrams per liter (mg/l). The standard is defined as the twelve month rolling average of the monthly values and does not apply when flow in the Wash is greater than 110% of average flow as measured at the nearest flow gage. Based on data collected by the Lake Mead Water Quality Forum Sedimentation Subcommittee and by the Dischargers for their discharge permits, the Wash has occasionally exceeded the 135 mg/l total suspended solids standard.

TMDL (total maximum daily load) establishes limits on the total mass of a water quality parameter that is allowed to be discharged into a water body.

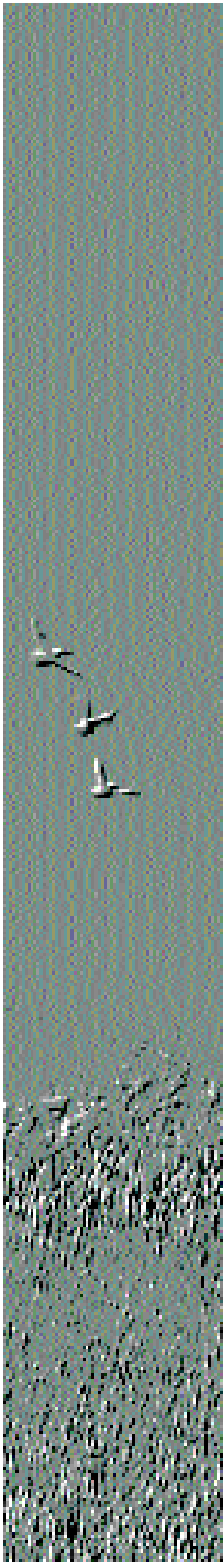
TMDLs

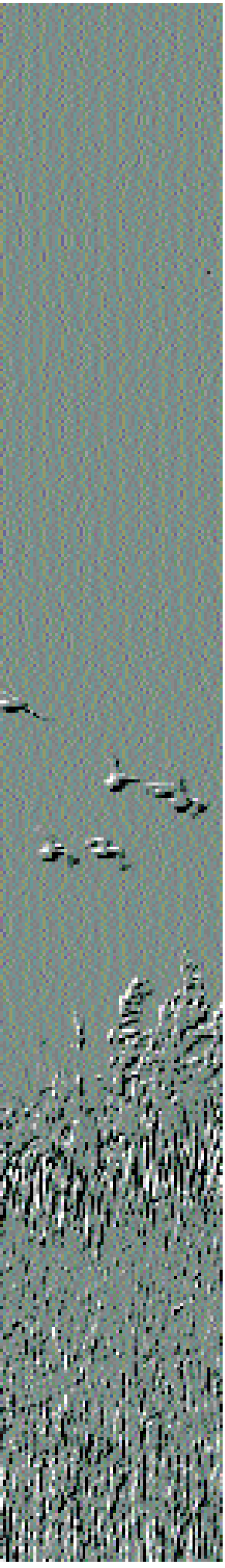
NPDES permits issued in the Valley include regional total maximum daily load (TMDLs) and wasteload allocations for phosphorus and ammonia nitrogen. TMDL is an estimate of the assimilation capacity of a body of water for a particular contaminant. Wasteload allocations are the mass limits of a contaminant allocated to individual treatment plants such that the total mass for all plants does not exceed the established TMDL. The objective of TMDLs is to establish limits on total mass of these nutrients entering Lake Mead via the Wash from all sources rather than establishing concentration limits for individual treatment plants.

In 1989, the NDEP established TMDLs for phosphorus (434 pounds per day) and ammonia (970 pounds per day). These TMDLs are divided into wasteload allocations among the Dischargers with a portion of the phosphorus TMDL (100 pounds per day) allocated to non-point sources. The phosphorus TMDL is in effect from March 1st through October 31st of each year. The ammonia TMDL is in effect from April 1st through September 30th of each year.

The established TMDLs do not change as a result of increasing wastewater flow. Therefore, treatment technology must be improved to meet the TMDLs. The challenge faced by the Dischargers is developing and implementing the technology necessary to meet the TMDL standards as the amount of wastewater inflow continues to increase.

In 1997, the Dischargers commissioned the Wastewater Needs Assessment Study (NAS) (Appendix 8.1). The goal of the NAS was to develop a thirty-year plan that addresses the long-term needs of the Dischargers and to identify alternative methods to accommodate the existing and projected wastewater flows of the Valley. Recently, the Dischargers governing bodies approved the implementation of the Alternative Discharge Study (Project). The current Project is a recommendation of the NAS effort by the Dischargers and is intended to expand the findings of the NAS with the intent to provide guidance on the engineering, scientific, and environmental solutions for disposal of treated wastewater in a manner that will be acceptable to the Dischargers and the other stakeholders.





Selenium

While background selenium concentrations throughout the Colorado River System and Wash are one to three parts per billion (ppb), concentrations from one urban tributary (Monson Channel) to the Wash have been most recently sampled at 15 ppb. A concentration at this level raises concerns regarding the potential for bioaccumulation within the food chain and may be related to adverse effects on some species of fish and wildlife found in areas with elevated selenium concentrations (e.g., Kesterson).

These elevated selenium concentrations occur in the area of the future entrance to the Clark County Wetlands Park. In order to assess, and eventually mitigate this concern, Clark County is working with the Bureau of Reclamation and Ducks Unlimited to design the constructed wetlands in this area with the idea of blending the Monson Channel water with other sources including effluent and Wash flows.

While it is not anticipated that concerns regarding selenium will delay the enhancement activities planned for the Wash, it is important to better understand the effects of selenium within the ecosystem. One way to do this is by developing a demonstration project that will effectively assess the selenium cycle.

Perchlorate

Perchlorate, detected in the Wash and Lake Mead in 1997, was manufactured by two Valley companies from the 1950's until 1997. Advancement in technology has lowered the detection limit for perchlorate from 400 ppb to four ppb and has resulted in perchlorate being detected at low levels (less than 18 ppb) in the raw and finished drinking water supply from Lake Mead. NDEP has determined that the source of perchlorate in Lake Mead is intercepted shallow ground water in the Wash. High levels of perchlorate have been discovered in shallow ground water surrounding and down gradient from the two companies that manufactured perchlorate in the Valley. High levels have also been detected along the stretch of the Wash where intercepted shallow ground water enters the Wash. Figure 4.2 shows the location of the perchlorate plume extending from the source of contamination at the industrial facilities to the Wash.

For the data that has been collected in the Wash and Lake Mead, the values of perchlorate vary from about 10-20 ppb to about 1,000 ppb depending upon where the samples were collected. For example, the values above the point where the perchlorate plume enters the Wash range from 10-20 ppb. In the area the perchlorate plume intercepts the Wash, the perchlorate value increases to about 1,000 ppb. The values decrease dramatically once the Wash enters Las Vegas Bay due to dilution from the large volume of water in the Bay. Figure 4.2 shows the perchlorate values throughout the Wash, Las Vegas Bay, and the Boulder Basin of Lake Mead.

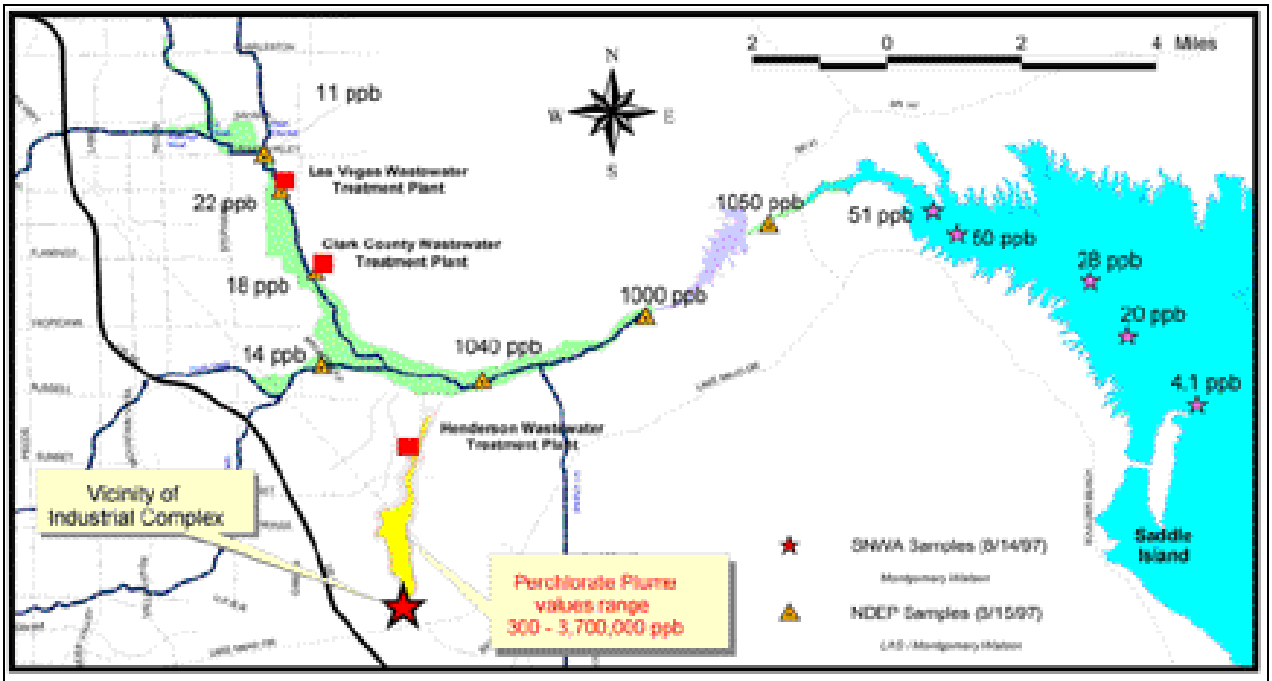


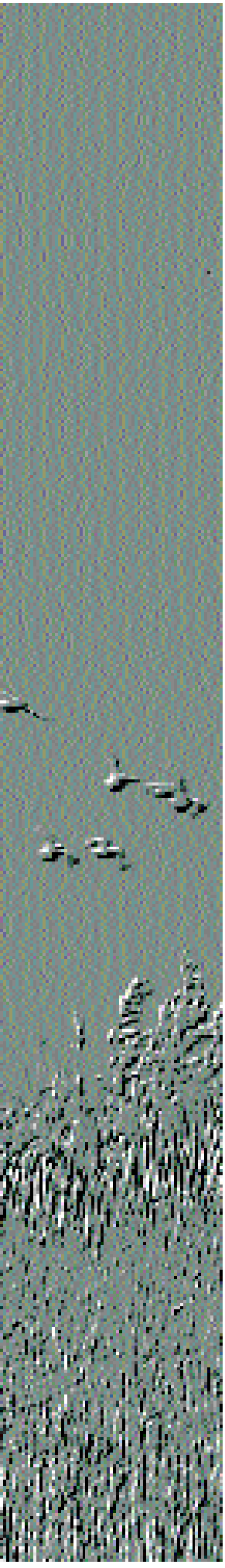
Figure 4.2 - Perchlorate values in Las Vegas Wash, Las Vegas Bay and the Boulder Basin of Lake Mead.

The NDEP has been actively working with the responsible parties to facilitate the removal of perchlorate from the shallow ground water system, which will result in a decrease of values seen in the Wash and Lake Mead. One recent discovery was the presence of a shallow ground water seep of about 350 gallons per minute that, based on mass balance calculations, is estimated to contribute about fifty percent of the total perchlorate load into the Wash. The NDEP has required the responsible parties to focus on this site by intercepting the flow and removing the perchlorate before it reaches the Wash.

The Southern Nevada Water Authority, the NDEP, and the U.S. Bureau of Reclamation (USBR) have conducted water quality sampling on a monthly basis at over twenty locations in the Wash and Lake Mead. The fact that perchlorate is a conservative compound has allowed researchers to use the concentrations detected to better understand the limnological aspects of the lake, and make predictions in order to anticipate the concentrations seen in the raw and finished water supply. In addition, these entities promote the further understanding of the potential health effects of perchlorate, and will continue to sample, characterize, and stay informed as to the most recent research regarding perchlorate.

Urban Chemicals

The category of water quality concerns known as “urban chemicals” is a broad topic that covers any type of chemical that is used in the home or business. This category includes not only those chemicals that have been



disposed of improperly (i.e., on the ground, in the storm drain system), but also includes the chemicals prevalent in every day life. For example, pesticides, solvents, herbicides, gas products, oil, and grease all fall within this category. These chemicals have the potential to reach the Wash as intercepted shallow ground water or as surface flow resulting from overirrigation and storm events.

The U.S. Geological Survey, as part of the National Water-Quality Assessment (NAWQA) Program, has collected and analyzed water quality samples from various shallow ground water (not used for drinking water) monitoring wells in the Valley. The report states that at least one pesticide was detected at low levels (below the maximum contaminant level established for drinking water) in 28 percent of the shallow monitoring wells sampled. The report concludes that urban activities in the Valley have been a primary source of these organic compounds found in the shallow aquifer (Bevans, et al, 1998).

Public education and the development of Best Management Practices can be a successful means of reducing urban pollutants from reaching water ways.

Other Potential Concerns

The lowering of analytical detection limits, combined with a better understanding of flow contribution to the Wash, has led researchers to realize that additional water quality concerns have the potential to materialize in the future. Two general concerns include past industrial practices and current land use practices. Each of these is discussed in more detail below:

- **Past industrial practices** – Prior to environmental law in the 1970's, it was standard practice to dispose of manufacturing byproducts in unlined landfills and lagoons. Many of these past industrial practices took place in the southeast part of the Valley, and as a result, many of these byproducts have reached the shallow ground water aquifer, which then can reach the Wash as intercepted ground water. As discussed in more detail in Chapter 7, and in previous discussions in this chapter, perchlorate and various organic compounds are examples of past land use practices effecting water quality in the Wash.

- **Current land use practices** - Current land use practices contribute to water quality in the Wash primarily as a result of dewatering and non-point sources resulting from an increasing amount of imprevious surface in the Valley and the associated increased runoff associated with it. Chapter 11 provides specific land use recommendations.

Understanding the Influence of Las Vegas Wash on Lake Mead

Gaining the knowledge to develop and implement the management options that are presented in this document begins with fully understanding the water quality of the Wash and it's influence on the water quality of Las Vegas Bay and Lake Mead.

Water Quality Monitoring

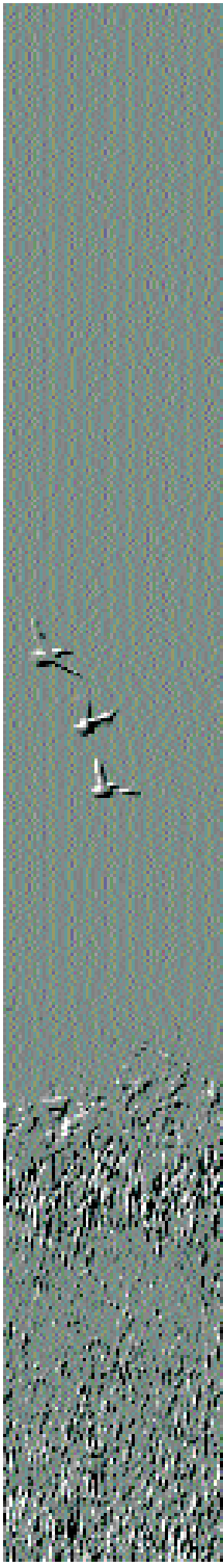
There are currently several monitoring programs in place that have provided a significant understanding of the water quality concerns faced by southern Nevada. The following describes some of these efforts:

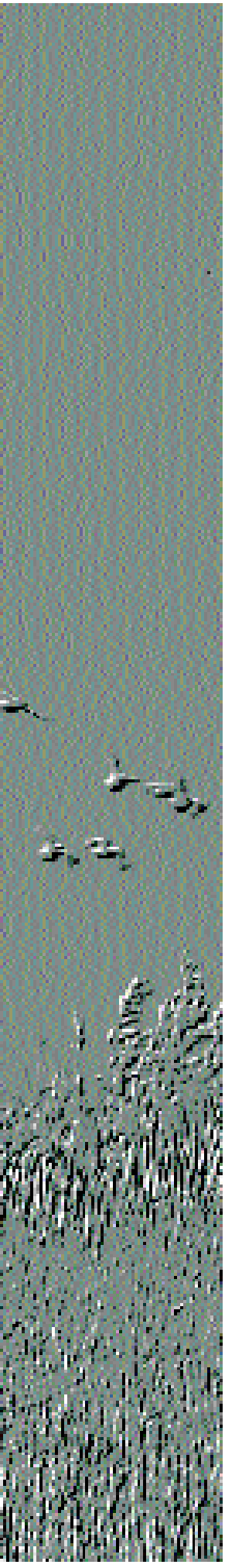
- **Las Vegas Valley Dischargers** – Through a program that includes water quality sampling for compliance and research purposes, the Dischargers have provided a comprehensive set of data on a wide variety of water quality parameters. This data is available for the Wash, Las Vegas Bay, and Lake Mead.

- **U.S. Bureau of Reclamation** – Work by USBR researchers throughout the 1990's has helped us understand the limnology of Lake Mead and the seasonal effects of the Wash on the ecology of Boulder Basin. Figure 4.3 indicates the location of the Boulder Basin in Lake Mead. Their work has four objectives:

    1. To collect trend data on the influence of the Wash on Las Vegas Bay and Lake Mead.
    2. To investigate the status of the limnological conditions of Boulder Basin as a source of drinking water supply.
    3. To perform research into new technology of evaluating limnological features, in particular those related to water quality conditions of reservoirs.
    4. To contribute to the understanding the ecology of Lake Mead as it relates to the operational scheme of the Colorado River system.

A variety of water quality parameters are collected, including temperature, dissolved oxygen, conductivity, pH, turbidity, transparency, plant nutrients, some specific inorganic chemicals, bacteria, as well as parameters that estimate the algal and microscopic animal biomass of Boulder Basin. The results of nearly a decade of sampling has lead to increased understanding of the interaction of the Wash and Lake Mead. Parameters such as conductivity (high Wash values compared with lower Colorado River values) provide a signature of the Wash that can be traced from the Wash and followed as it mixes within the lake. The research has shown that how the Wash behaves once it reaches the lake is dependent on several factors





including time of year, water temperature, and wind.

Figure 4.3 – Map of Lake Mead highlighting the location of the Boulder Basin.

As Wash water enters the lake and forms an intrusion (or plume) there is significant mixing in the inner bay as indicated by its higher overall conductivity versus that of the outer bay. However, the intrusion retains its identity and exists as an underflow for about 4 kilometers (km) into Boulder Basin. This underflow follows the thalweg of the historical stream channel of Las Vegas Creek (now referred to as Las Vegas Wash) until an equilibrium depth is reached below which lake water, due to cooler temperatures, is denser than intrusion water. This occurs at a depth of 40 to 60 meters (m) in late winter. At this depth, the intrusion extends into the basin as an interflow, being supported by the denser water of the hypolimnion, until it has dispersed and mixed to the point it can no longer be detected using standard measurements.

In early spring, the intrusion begins to elevate into the water column, existing as an underflow for a shorter and shorter distance before becoming an interflow. This change is a function of both stratification developing in the reservoir and the warming of inflowing water from the Wash. The Wash conductivity remains relatively stable throughout the year, but the temperature increases from 20° C to nearly 28° C by mid-summer. Although the Las Vegas Wash water is warmer than lake water, it remains underflow due to higher density resulting from salinity. This density gradient is strong enough in both late spring and early fall that water temperature of the intrusion may be 1-2°C higher than that of surface waters for a distance of 2-3 km.

Thalweg refers to the location of any cross section of a reservoir where the old river, creek or wash channel was located before the reservoir was filled. It is then the deepest spot of any particular cross section.

By early summer, the intrusion is located at its shallowest depth of the year as a result of increasing temperature of the inflow and the relatively shallow thermocline in Las Vegas Bay. As the thermocline strengthens, the intrusion is constrained from below by denser cold water, and upward movement is limited by the less dense, warm surface waters which inhibit mixing. Conductivity gradients identifying the intrusion are sharpest at

this time. Depending on conditions, remnants of the intrusion can be measured for at least 8 km from the inflow of the Wash, and on occasion data indicate a band of higher conductivity extending to Hoover Dam. During most of the summer months the peak of the intrusion remains at about 9 meters in depth.

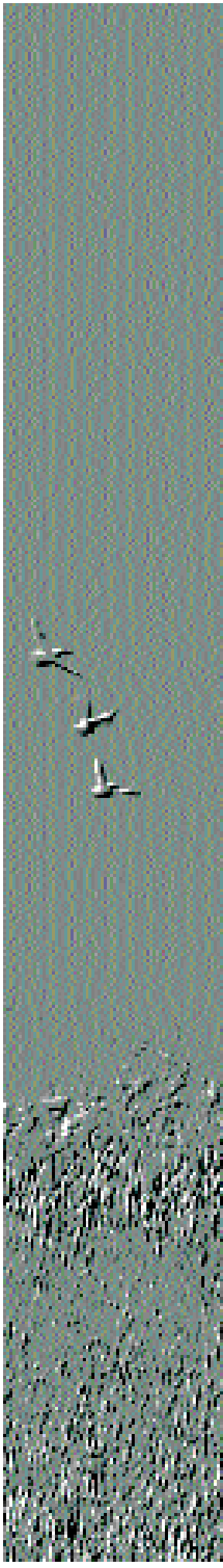
At the end of summer (usually September) the intrusion sinks as the thermocline is depressed due to epilimnetic cooling. As stratification breaks down in the fall and the inflowing waters begin to cool, the intrusion moves deeper into the former hypolimnetic waters, and the seasonal cycle begins to repeat.

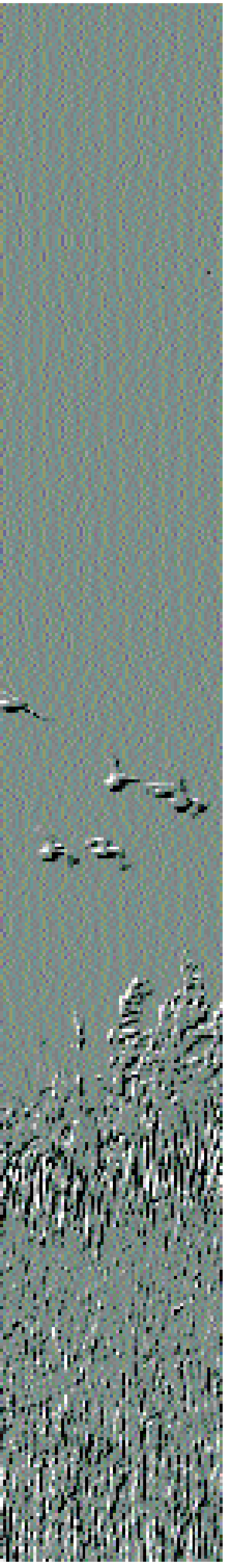
Related and very recent investigations by USBR scientists indicate that the Wash enters and flows as a plume at an estimated average rate of 5 to 8 centimeters per second, and that the average time it takes water flowing in the "plume" to travel from the Wash inflow to a point near Saddle Islands is 48.5 hours.

USBR scientists, for more than 12 years, have continuously monitored water quality of the Wash from just above the City of Las Vegas treatment facility to a point below the North Shore Road bridge. Prior to the ongoing program, monitoring was done on a frequent basis for more than 10 years. These data, which continue to be collected on a quarterly basis, are done under the authority of the Colorado River Basin Salinity Control Act of 1974. Data clearly depict the dramatic change in the patterns of water quality based upon, 1) the erosion of the Wash and resulting significant reduction in time of travel in the Wash, 2) the effects of increasing population, 3) changes installed in treatment of effluent by the dischargers (i.e. removal of phosphorus, conversion of nitrogen from ammonia to nitrate) and 4) the influence of periodic flooding.

- **Southern Nevada Water Authority (SNWA)** – The SNWA conducts water quality monitoring for compliance and research purposes. Long-term sampling has resulted in water quality data that dates back to the 1970's. Since 1997, a comprehensive sampling program has been underway throughout the Boulder Basin that collects water samples from the lake surface to lake bottom. This data will be used in a three-dimensional model to help researchers better understand the limnology of the Boulder Basin and the influence of the Wash on the entire basin. The SNWA has also coordinated and developed a water quality database that provides for the centralization of data from several entities into an internet-based application that contains more than 500,000 cells of data.

- **Municipal Stormwater Quality Management Program** - The Las Vegas Valley Stormwater Quality Management Committee, of which the Clark County Regional Flood Control District is the lead agency, pro-





vides a report each year detailing the findings of monitoring and sampling efforts required under the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit. The current Annual Report (1997-1998) outlines program requirements, recommended changes for the following permit year, and water quality data collected for the year. The monitoring under this program began in 1991.

Interagency Coordination

Over the past several years, entities involved in water quality issues for southern Nevada realized that a coordinated effort was the preferred method to share information and identify needs for the future. In addition to the Coordination Committee, other efforts are underway to ensure that the water quality issues facing the Valley are identified and addressed.

- **Water Quality Database** – The Las Vegas Water Quality Interagency Database (www.lvwaterquality.org) is an example of using state-of-the art technology to manage and access large data sets. This internet-based application has helped to centralize water quality data from federal, state, and local entities, while at the same time, providing the public with an easy-to-use tool to understand water quality data in our community. The site consists of two sections, one for water quality professionals who can query large datasets and obtain results in an easy to read, downloadable fashion within a few seconds. The second section is designed with the general public in mind and focuses on education while enabling the public to query the water quality database and graph the results. The database is intended to be used as a research tool and an educational outreach mechanism for the local community. The database was developed, and is currently maintained by the Las Vegas Wash Project Coordination Team. The site currently includes data from the Bureau of Reclamation, City of Henderson, City of Las Vegas, Clark County Regional Flood Control District, Clark County Sanitation District, and the Southern Nevada Water Authority.

- **Lake Mead Water Quality Forum (Forum)** – The Forum was established in 1997 and is facilitated by the Nevada Division of Environmental Protection. The Forum is comprised of local, state, and federal agencies with an interest in Lake Mead environmental issues and water quality. The purpose of this group is to provide a mechanism to keep the stakeholders of the Wash and Lake Mead informed as to the water quality issues and ongoing studies. The Forum has also initiated several technical studies that investigated topics such as, sediment volume from the Wash, whether there was a need for a fish consumption advisory, and the potential for bacteria after a storm event to impact designated water uses on Lake Mead.

- **Interagency Technical Committee** – This group meets monthly on issues related to Lake Mead and the Wash monitoring activities. Studies are conducted to improve and standardize sampling and analytical procedures and to insure reliability of data generated by all participants. This group has taken on the formidable task of developing a common nomenclature for the 100+ sampling locations throughout the Lake Mead system. The participants of this group include representatives from the Bureau of Reclamation, City of Henderson, City of Las Vegas, Clark County Sanitation, and the Southern Nevada Water Authority.

Characterization of Las Vegas Wash Water Quality

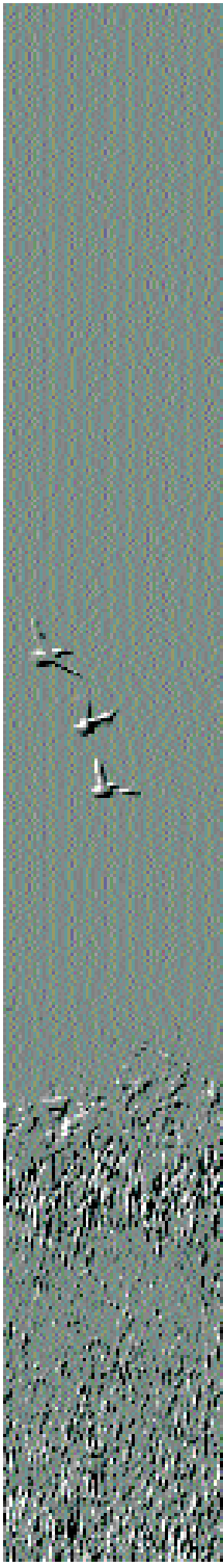
The overall water quality in the Wash is clearly dependent upon the quality of the individual flow components. For example, the quality of Wash water, when looked at without the contribution of the treated wastewater (effluent), is typical of an urban area; high in total dissolved solids and containing low levels of oil, grease, pesticides, and herbicides (Clark County Regional Flood Control Stormwater Monitoring Program). Once the effluent component is added, the values decrease due to the dilution effect of the large volumes of effluent, and more closely resemble Colorado River water.

The water quality parameter that best demonstrates the dilution effect that occurs once the treated wastewater flow enters the Wash is total dissolved solids (TDS). Table 4.2 shows the TDS values of four sample locations; two sites without the influence of effluent and two sites downstream from the treated wastewater entering the Wash. Figure 4.4 locates the samples sites presented in Table 4.2.

Site Name	Flow Components	Total Dissolved Solids Range (mg/l) (data values from 1995-1996)
FW – 1	Urban runoff + Shallow ground water	3300 – 3800
DC – 1		5300 – 6800
LW8.85	Urban runoff + Shallow ground water + Effluent	990 – 1600
LW3.7		1200 – 1900

Table 4.2 - Total dissolved solids values with and without influence of effluent contribution (from *www.lvwaterquality.org/agency*).

Understanding the individual flow components and their effect on the overall water quality in the Wash will aid researchers in developing and implementing the various elements of the Las Vegas Wash Comprehensive Adaptive Management Plan.



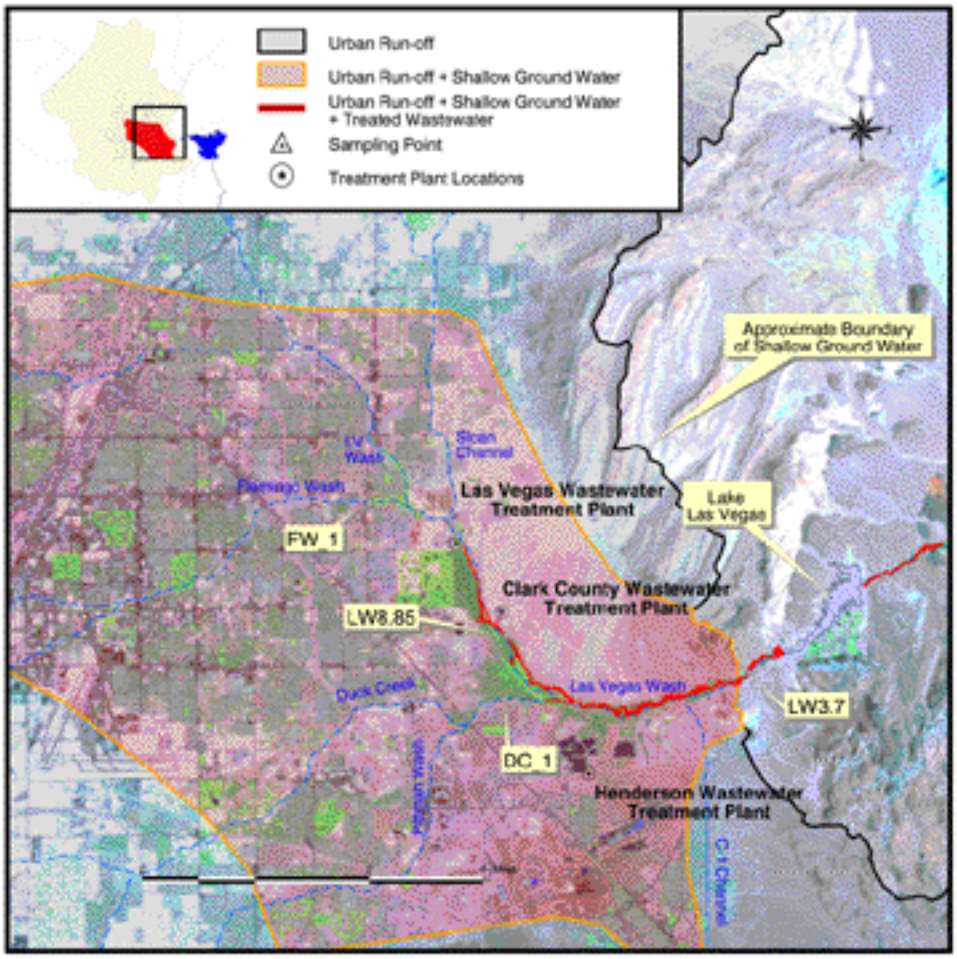


Figure 4.4 – Sample sites indicating influence of urban run-off, shallow ground water, and treated wastewater.

Summary

The work being done through the interagency coordination efforts in the Valley, including the Lake Mead Water Quality Forum, the Interagency Technical Committee, and the Las Vegas Wash Coordination Committee, have provided us with an opportunity to better understand the effects of urban flows on the Wash and Lake Mead. Through this understanding has come the realization that the Wash water quality concerns we face as a community effect not only southern Nevada, but also the downstream users of the Colorado River, and that a comprehensive approach to mitigating the concerns and managing the resource is necessary.