Chapter 12. Hydrology and Water Quality

12.1 Overview

This chapter describes water quality, including surface water drainage, stormwater management, groundwater hydrology, and surface and groundwater quality. Applicable regulations are discussed, as well relevant plans, policies, programs, measures, and BMPs adopted by NASA to protect surface water and groundwater quality at ARC. Information presented in this chapter was obtained from the November 2009 NASA ARC ERD (NASA 2009), NADP EIS (Design, Community & Environment 2002), local planning documents, and other sources.

12.2 Regulatory Background

12.2.1 Federal Regulations

12.2.1.1 *Clean Water Act*

The Clean Water Act (CWA) is the primary federal law that protects the quality of the nation's surface waters, including lakes, rivers, and coastal wetlands. It operates on the principle that all discharges into the nation's waters are unlawful unless specifically authorized by a permit; permit review is the CWA's primary regulatory tool.

The sections of the CWA most relevant at ARC are Section 303 (Water Quality Standards and Implementation Plans) and Section 402 (National Pollutant Discharge Elimination System [NPDES]). The EPA has delegated its authority to implement and enforce the provisions of these sections to the individual states. In California, the nine Regional Water Quality Control Boards (RWQCBs) enforce the provisions under guidance from the State Water Resources Control Board (SWRCB). Additional information on the requirements imposed by CWA Sections 303, 401, and 402 is provided in Porter-Cologne.

12.2.1.2 *Drinking Water Act*

The Safe Drinking Water Act of 1974 (Public Law 93-523) is the principal federal law that protects the quality of the nation's drinking water. It empowers EPA to set drinking water standards and to oversee the water providers (cities, water districts, and agencies) that actually implement those standards. It also includes provisions for the protection of surface waters and wetlands, in support of drinking water quality.

In California, EPA delegates some of its implementation authority to the SWRCB, Division of Drinking Water. The SWRCB administers a wide range of regulatory programs that include components aimed at drinking water quality and safety, such as:

- Permitting for water well installation
- Potable water supply monitoring requirements for public drinking water systems and new domestic wells
- Regulations for septic and sewer systems

- Regulations governing generation, handling, and discharge/disposal of hazardous materials and wastes
- Regulations for USTs and solid waste disposal facilities

The following sections of the CFR contain key provisions of the Safe Drinking Water Act.

- 40 CFR, Part 141 (National Primary Drinking Water Regulations) and 40 CFR, Part 142 (National Primary Drinking Water Regulations Implementation): The National Primary Drinking Water Regulations are fundamental health-based standards for drinking water purity. They are enforced nationwide.
- 40 CFR, Part 143 (National Secondary Drinking Water Regulations) The National Secondary Drinking Water Regulations establish standards for drinking water contaminants that primarily affect aesthetic qualities such as taste, odor, and clarity, although they may have health implications at high concentrations. The secondary drinking water standards are not federally enforceable but are intended as guidelines that the states may adopt on a discretionary basis. California has elected to enforce these standards.

12.2.1.3 *National Environmental Policy Act*

NEPA requires federal agencies to include in their decision-making process appropriate and careful consideration of all environmental effects of a proposed action and of possible alternative actions. Measures to avoid or minimize the adverse effects of proposed actions and to restore and enhance environmental quality as much as possible must be developed and discussed where feasible.

12.2.2 **State Regulations**

12.2.2.1 *Porter-Cologne Act and State Implementation of CWA Requirements*

12.2.2.1.1 Overview

The Porter-Cologne Water Quality Control Act, passed in 1969, provides state-level requirements promulgated in the federal CWA. It established the SWRCB and divided the state into nine regions, each overseen by an RWQCB. The SWRCB is the primary state agency responsible for protecting the quality of the state's surface and groundwater supplies, but much of its daily implementation authority is delegated to the nine RWQCBs. ARC is under the jurisdiction of the San Francisco Bay RWQCB.

Consistent with the federal CWA, the Porter-Cologne Act provides for the development and periodic review of water quality control plans (basin plans) that designate beneficial uses of California's major rivers and groundwater basins and establish narrative and numerical water quality objectives for those waters. The purpose of water quality objectives is to protect designated beneficial uses for each basin's waters. To ensure currency, basin plans must be updated every 3 years.

Basin plans are primarily implemented by using the NPDES permitting system to regulate waste discharges so that water quality objectives are met. Basin plans provide the technical basis for determining waste discharge requirements, taking enforcement actions, and evaluating clean water grant proposals.

As described above, the Porter-Cologne Act also assigns responsibility for implementing CWA Sections 401-402 and 303(d) to the SWRCB and RWQCBs.

12.2.2.1.2 San Francisco Bay Basin Water Quality Control Plan

By law, the San Francisco Bay RWQCB is required to develop, adopt, and implement a Basin Plan for the Region San Francisco Bay RWQCB 2014a). The Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) is the Board's master water quality control planning document. It designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater, and also includes programs of implementation to achieve water quality objectives. The current Basin Plan reflects amendments adopted up through July 2013 (San Francisco Bay RWQCB 2014b), including:

- Site-specific objectives for cyanide in San Francisco Bay, adopted in December 2006
- A TMDL for diazinon and pesticide-related toxicity in Bay Area urban creeks, adopted in May 2007
- Site-specific objectives for copper in San Francisco Bay north of the Dumbarton Bridge, adopted in June 2007
- TMDLs for mercury and PCBs in San Francisco Bay, adopted in February 2008
- Water quality objectives for bacterial for waters designated for contact recreation in marine and estuarine waters, adopted in April 2010
- Addition of surface water bodies and beneficial uses, adopted in July 2010

12.2.2.1.2.1 *Beneficial Uses*

Existing and potential beneficial uses of surface and groundwater in the vicinity of ARC are shown in Table 12-1.

Table 12-1. Beneficial Uses of Surface and Ground Waters at NASA Ames

Water Body	Beneficial Use
Wetland Areas of South San Francisco Bay	estuarine habitat fish migration ocean, commercial, and sport fishing preservation of rare and endangered species contact and noncontact water recreation fish spawning wildlife habitat

Water Body	Beneficial Use
South San Francisco Bay	commercial and sport fishing estuarine habitat industrial service supply fish migration navigation preservation of rare and endangered species contact and noncontact water recreation shellfish harvesting wildlife habitat fish spawning
Stevens Creek	cold freshwater habitat freshwater replenishment groundwater recharge fish migration preservation of rare and endangered species contact and noncontact water recreation warm freshwater habitat wildlife habitat fish spawning
Santa Clara Valley Groundwater Basin	municipal and domestic supply industrial process supply industrial service supply agricultural supply
Source: San Francisco Bay RWQCB 2013.	

12.2.2.1.2.2 *Water Quality Objectives*

Table 12-2 shows the water quality objectives that apply to all surface waters in the San Francisco Bay Basin.

Table 12-2. Surface Water Quality Objectives

Parameter	Standard
Bacteria (MPN/100ml)	Fecal coliform Water contact recreation: geometric mean <200; 90th percentile <400 Shellfish harvesting: median <14; 90th percentile <43 Non-contact water recreation: mean < 2000; 90th percentile <4000 Municipal supply: geometric mean < 20 Total coliform Water contact recreation: geometric median <240; no sample <10,000 Shellfish harvesting: median <70; 90th percentile <230 Municipal supply: geometric mean <100 Enterococcus Water contact recreation: geometric mean <35; no sample <104
Bioaccumulation	No detrimental increase in concentrations of toxic substances found in bottom sediments or aquatic life
Biostimulatory Substances	No substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.
Color	Waters shall be free of coloration that causes nuisance or adversely affects beneficial uses.

Parameter	Standard
Dissolved oxygen	Tidal Waters Downstream of Carquinez Bridge: 5.0 mg/L Upstream of Carquinez Bridge: 7.0 mg/L Nontidal waters Cold water habitat: 7.0 mg/L Warm water habitat: 5.0 mg/L
Floating Material	Waters shall be free of floating material that causes nuisance or adversely affects beneficial uses.
Oil and grease	No visible film or coating on the surface that impacts beneficial uses
Population and Community Ecology	Waters shall be free of toxic substances in concentrations that are lethal to or that produce significant alterations in population or community ecology or receiving water biota.
pH	6.5 to 8.5 pH Normal ambient level changes of < 0.5 units
Radioactivity	No radionuclides in the food web to an extent that presents a hazard to human, plant, animal, or aquatic life
Salinity	No increase the total dissolved solids or salinity of waters of the state so as to adversely affect beneficial uses, particularly fish migration and estuarine habitat.
Sediment	Suspended sediment load and discharge rate shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Settleable Material	No substances in concentrations that result in the deposition of material that cause nuisance or adversely affect beneficial uses.
Suspended Material	Waters shall be free of suspended material that causes nuisance or adversely affects beneficial uses.
Sulfide	Waters shall be free from dissolved sulfide concentrations above natural background levels.
Tastes and Odors	No taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to aquatic food products that cause nuisance, or that adversely affect beneficial uses.
Temperature	Natural receiving water temperature must not be altered so as to adversely affect beneficial uses. Maximum not to be increased by more than 5° F (2.8° C) above receiving waters.
Toxicity	No toxic substances in concentrations that are lethal to or that produce other detrimental responses in aquatic organisms. No chronic toxicity shall occur.
Turbidity	Waters shall be free of turbidity that causes nuisance or adversely affects beneficial uses.
Un-Ionized Ammonia	Annual Median: 0.025 Maximum Central Bay and upstream: 0.16 Maximum Lower Bay: 0.4
Notes: MPN = most probable number mg/L = milligrams per liter ml = milliliter Source: San Francisco Bay RWQCB 2013	

The Basin Plan specifically states that the water quality objectives for the Santa Clara Valley groundwater basin are to achieve the following concentrations for waters that provide municipal or domestic water supply.

Taste or odor-producing substances should be present at levels that do not cause nuisance or adversely affect beneficial uses. At a minimum, groundwater designated for use as domestic or municipal supply should not contain concentrations in excess of the secondary maximum contaminant levels (MCLs) specified in Tables 12-3 and 12-4. Chemical constituents should be present below the MCLs summarized in Tables 12-5 and 12-6.

Table 12-3. Secondary Maximum Contaminant Levels

Chemical or Characteristic	Secondary MCL
Aluminum (Aluminum also has a primary MCL of 1 mg/L)	0.2
Color	15 units
Copper	1.0
Corrosivity	Non-corrosive
Foaming agents (MBAs)	0.5
Iron	0.3
Manganese	0.05
Methyl tertiary butyl ether (Also has an action level of 0.013 mg/L and a proposed primary MCL of 0.013 mg/L).	0.005
Odor threshold	3 units
Silver	0.1
Thiobencarb (Bolero) (Also has a primary MCL of 0.07 mg/L).	0.001
Turbidity	5 units
Zinc	5.0
Notes: All values are in milligrams per liter (mg/L), unless otherwise noted. Source: San Francisco Bay RWQCB 2013.	

Table 12-4. Secondary Maximum Contaminant Level Ranges

	Secondary MCL Ranges		
Constituent	**Recommended**	**Upper**	**Short Term**
Total Dissolved Solids	500	1,000	1,500
Or			
Specific conductance (micromhos)	900	1,600	2,200
Chloride	250	500	600
Sulfate	250	500	600
Notes: All values are in milligrams per liter (mg/L), unless otherwise noted. Source: San Francisco Bay RWQCB 2013.			

Table 12-5. Maximum Contaminant Levels for Inorganic Chemicals

Chemical	Maximum Contaminant Level (mg/L)
Aluminum	1
Antimony	0.006
Arsenic	0.05
Asbestos	7 MFL
Barium	1
Beryllium	0.004
Cadmium	0.005
Chloride	250
Cadmium	0.005
Chromium	0.05

Chemical	**Maximum Contaminant Level (mg/L)**
Copper	1
Cyanide	0.15
Fluoride	0.6-1.7
Iron	0.3
Lead	0.05
Manganese	0.05
Mercury	0.002
Nickel	0.1
Nitrate (as NO_3)	45
Nitrate + Nitrite (sum as nitrogen)	10
Nitrite (as nitrogen)	1
Selenium	0.05
Silver	0.1
Sulfate	250
Thallium	0.002
Zinc	5
Notes: mg/L = micrograms per liter. MFL = million fibers per liter; MCL for fibers exceeding 10 micrometers in length. Source: San Francisco Bay RWQCB 2013.	

Table 12-6. Maximum Contaminant Levels for Organic Chemicals

Chemical	Maximum Contaminant Level (mg/L)
(a) Volatile Organic Chemicals	
Benzene	0.001
Carbon tetrachloride	0.0005
1,2-Dichlorobenzene	0.6
1,4-Dichlorobenzene	0.005
1,1-Dichloroethane	0.005
1,2-Dichloroethane	0.0005
1,1-Dichloroethylene	0.006
Cis-1,2-Dichloroethylene	0.006
Trans-1,2-Dichloroethylene	0.01
Dichloromethane	0.005
1,2-Dichloropropane	0.005
1,3-Dichloropropene	0.0005
Ethylbenzene	0.7
Monochlorobenzene	0.07
Styrene	0.1
1,1,2,2-Tetrachloroethane	0.0001
Tetrachloroethylene	0.005
Toluene	0.15
1,2,4-Trichlorobenzene	0.005
1,1,1-Trichloroethane	0.200
1,1,2-Trichloroethane	0.005
Trichloroethylene	0.005
Trichlorofluoromethane	0.15
1,1,2-Trichloro-1,2,2-Trifluoroethane	1.2
Vinyl Chloride	0.0005
Xylenes	1.750

Chemical	Maximum Contaminant Level (mg/L)
(b) Non-Volatile Synthetic Organic Chemicals	
Alachlor	0.002
Atrazine	0.001
Bentazon	0.018
Benzo(a)pyrene	0.0002
Dalapon	0.2
Dinoseb	0.007
Diquat	0.02
Endothall	0.1
Ethylene dibromide	0.00005
Glyphosate	0.7
Heptachlor	0.00001
Heptachlor epoxide	0.00001
Hexachlorocyclopentadiene	0.001
Molinate	0.005
Oxarnyl	0.2
Pentachlorophenol	0.001
Picloram	0.5
Polychlorinated biphenyls	0.0005
Simazine	0.004
Thiobencarb	0.07
(c) Chlorinated Hydrocarbons	
Endrin	0.002
Lindane	0.0002
Methoxychlor	0.03
Toxaphene	0.003
2,3,7,8-TCDD (Dioxin)	3 x 10-8
2,4-D	0.07
2,4,5-TP (Silvex)	0.05
Notes: mg/L = micrograms per liter. MCL is for either a single isomer or the sum of the isomers. Source: San Francisco Bay RWQCB 2013.	

Radionuclide levels should be below the maximum levels specified in Table 12-7.

Table 12-7. Maximum Contaminant Levels for Radioactivity

Constituent	**Maximum Contaminant Level, pCi/l**
Combined Radium-226 and Radium-228	5
Gross alpha particle activity (including Radium-226 but excluding Radon and Uranium)	15
Tritium	20,000
Strontium-90	8
Gross beta particle activity	50
Uranium	20
Notes: pCi/l = pico Curie per liter Source: San Francisco Bay RWQCB 2013.	

12.2.2.2 State Responsibility for CWA Section 303 - Total Maximum Daily Load Program

12.2.2.2.1 Overview

Section 303(d) of CWA established the total maximum daily load (TMDL) process to guide and ensure the application of state water quality standards. A TMDL represents the maximum amount or concentration of a given pollutant allowable in a given water body, based on the nature of the water body and its designated beneficial uses.

To identify water bodies in which TMDLs may be needed, SWRCB maintains a "Section 303(d) list" of water bodies in which water quality is impaired.[7] The most urgent impairments are prioritized for development of TMDL programs, which establish a means of limiting pollutant input. The goal of a TMDL program is to reduce the concentration of a specific contaminant over a specified period. Once a TMDL program has been adopted by the local RWQCB, activities within the watershed that contains the impaired water body are prohibited from increasing the concentration of the contaminant(s) addressed in the TMDL.

12.2.2.2.2 Impaired Water Bodies At and Near NASA Ames

South San Francisco Bay and Stevens Creek are both identified as water quality-impaired on the current 303(d) list (SWRCB 2010). South San Francisco Bay is listed as impaired for chlordane, Dichlorodiphenyltrichloroethane (DDT), diazinon, dieldrin, dioxin compounds, invasive species, furan compounds, mercury, PCBs, and selenium. Stevens Creek is impaired for diazinon. South San Francisco Bay is on the monitoring list for impairment by trash. Stevens Creek is identified as water quality-impaired for diazinon, trash, temperature, and toxicity in 2010.

12.2.2.3 State Responsibility for CWA Section 402 - NPDES Program

12.2.2.3.1 Overview

CWA Section 402, enacted as an amendment to the original act in 1972, regulates discharges of pollutants from point sources to surface waters. It established the NPDES program, overseen by EPA and administered in California by the RWQCBs under the auspices of the SWRCB. Additional amendments to CWA in 1987 created a new subsection of the act (Section 402(p)) devoted to permitting for discharges of stormwater.

The NPDES program provides for two types of permits: general permits (those that cover a number of similar or related activities) and individual permits (those issued on a project-by-project basis). For example, all construction activities affecting more than 1 acre are regulated under the NPDES General Permit for Discharges of Storm Water Runoff associated with Construction Activity.

[7] A stream, lake, or other water body is said to be *impaired* for a pollutant if established water quality standards for that water body are not met despite implementation of technology-based controls on point sources of pollutant input.

12.2.2.3.2 NASA Ames Stormwater Discharge Permit

Each year, ARC (including the airfield) submits a Storm Water Annual Report in accordance with its General Permit (No. CAS000001) for Discharges of Storm Water Associated with Industrial Activities. The Storm Water Annual Report includes information on monitoring observations and results, stormwater sampling results, annual inspection reporting, and the effectiveness of the Storm Water Pollution Prevention Plan (SWPPP). It also provides certification that the SWPPP is being implemented and complies with the requirements of the general permit.

The SWPPP was developed in accordance with good engineering practices to comply with federal Best Available Technology/Best Conventional Pollution Control Technology requirements and to meet the following specific objectives:

- To identify and evaluate sources of pollutants associated with industrial activities that may affect the quality of stormwater discharges and authorized non-stormwater discharges from the facility
- To identify and implement site-specific BMPs to reduce or eliminate pollutants associated with industrial activities in stormwater discharges and authorized non-stormwater discharges

The SWPPP is updated periodically to ensure it addresses all existing and new storm water concerns. It undergoes formal revision approximately every 5 years.

12.2.2.4 *Drinking Water Standards*

Title 22 of the CCR outlines drinking water standards in the State of California. MCLs for various contaminants are made enforceable regulatory standards under the federal Safe Drinking Water Act. MCL standards must be met by all public drinking water systems to which they apply. Primary MCLs can be found in 22 CCR Sections 64431-64444. Specific regulations for lead and copper are in 22 CCR Section 64670 et seq. Secondary MCLs that address the taste, odor, and appearance of drinking water are found in 22 CCR Section 64449.

Drinking water is also regulated pursuant to the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65) (CCR Sections 12000–14000, California Health and Safety Code Sections 25249.5–25249.1365). Among other things, California's Safe Drinking Water and Toxic Enforcement Act prohibits companies from knowingly discharging listed chemicals into sources of drinking water. Government agencies are exempt from its requirements; it does not apply to federal activities at ARC. Nonfederal resident agencies and other nonfederal users at ARC are not exempt.

12.2.2.5 *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California*

The state's Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California (SWRCB 2005) established new standards for a variety of toxic pollutants. The goal of this policy is to establish a standardized approach for permitting discharges of toxic pollutants to non-ocean surface waters in a manner that promotes statewide consistency. Accordingly, the policy is a tool to be used in conjunction with watershed management approaches and, where appropriate, the development of TMDLs to ensure that water quality standards are met and beneficial uses are protected. It applies to discharges of toxic pollutants into California's inland surface waters, enclosed bays, and estuaries subject to regulation under the Porter-Cologne Water Quality Control Act and CWA. Such regulation may occur through the issuance of NPDES permits, the issuance or waiver of waste discharge requirements, or other regulatory approaches.

The SIP establishes implementation provisions for priority pollutant criteria established by EPA through the National Toxics Rule and the California Toxics Rule, and for priority pollutant objectives established by the RWQCBs in their respective basin plans. It also sets forth monitoring requirements for 2,3,7,8-TCDD equivalents and chronic toxicity control provisions, as well as special provisions for certain types of discharges and factors that could affect the application of the SIP such as nonpoint source discharges, site-specific objectives, and categorical and case-by-case exceptions as granted by the SWRCB or applicable RWQCB.

12.2.2.6 *Groundwater Management Act (Assembly Bill 3030)*

California's Groundwater Management Act (Water Code Sections 10750-10756) gives existing local agencies expanded authority over the management of groundwater resources in basins recognized by the Department of Water Resources. Its intent is to promote the voluntary development of groundwater management plans in order to ensure stable groundwater supplies for the future.

The act identifies the required technical components of a groundwater management plan. It also stipulates procedures for adopting a groundwater management plan, including passage of a formal resolution of intent to adopt a plan, and holding a public hearing on the proposed plan. The act also requires agencies to establish rules and regulations to implement an adopted plan, and empowers agencies to raise funds to pay for the facilities needed to manage the basin, such as extraction wells, conveyance infrastructure, recharge facilities, and testing and treatment facilities.

12.2.3 **Local Regulations**

12.2.3.1 *Santa Clara County*

12.2.3.1.1 Santa Clara Valley Urban Runoff Pollution Prevention Program

The Santa Clara Valley Urban Runoff Pollution Prevention Program was created by an association of 13 cities and towns in the Santa Clara Valley, together with Santa Clara County and the Santa Clara Valley Water District. Its mission is to assist in the protection of beneficial uses of receiving waters by preventing pollutants generated by activities in urban service areas from entering runoff, to the extent feasible. The member agencies share a common NPDES Permit for Discharge of Storm Water to South San Francisco Bay. As a condition of the permit, the agencies created an Urban Runoff Management Plan, which identifies the activities various city departments are required to undertake in order to comply with the federal and state requirements of the stormwater permit. The plan includes regulatory, monitoring, and outreach measures, as well as measures designed to restore a natural flow hydrograph in urban streams.

12.2.3.1.2 Santa Clara County General Plan

Recognizing the importance of maintaining and improving the Santa Clara County's water quality both to ensure continuing water supply and to preserve aquatic and wetland habitat, the County General Plan includes several strategies for water quality protection, such as reducing nonpoint source pollution; restoring wetlands, riparian areas, and other habitats that improve bay water quality; and implementing watershed management planning. Specific County policies relevant to water quality include (Santa Clara County 1994):

- Adequate safeguards for water resources and habitats should be developed and enforced to avoid or minimize water pollution, including organic matter and wastes, pesticides and herbicides, effluent from municipal wastewater treatment plants, chemicals used in industrial and commercial activities and processes, industrial wastewater discharges, hazardous wastes, and nonpoint source pollution
- Multi-jurisdictional, countywide programs and regulatory efforts to address water pollution problems should have the full support and participation of each jurisdiction within Santa Clara County, including federal agencies

The County has also prepared a riparian protection ordinance that would provide for the protection and enhancement of riparian habitat along designated streams in the County.

12.2.3.1.3 City of Mountain View

The Mountain View 2030 General Plan (City of Mountain View 2012) contains the following relevant goals and policies related to water quality.

- Goal INC-8: An effective and innovative stormwater drainage system that protects properties from flooding and minimizes adverse environmental impacts from stormwater runoff.
- Policy INC 8.1: Citywide stormwater system. Maintain the stormwater system in good condition.
- Policy INC 8.2: National Pollutant Discharge Elimination System (NPDES) Permit. Comply with requirements in the Municipal Regional Stormwater NPDES Permit.
- Policy INC 8.3: Cost-effective strategies. Encourage stormwater strategies that minimize additional City administrative and maintenance costs.
- Policy INC 8.4: Runoff pollution prevention. Reduce the amount of stormwater runoff and stormwater pollution entering creeks, water channels and the San Francisco Bay through participation in the Santa Clara Valley Urban Runoff Pollution Prevention Program.

- Policy INC 8.5: Site-specific stormwater treatment. Require post-construction stormwater treatment controls consistent with MRP requirements for both new development and redevelopment projects.
- Policy INC 8.6: Green streets. Seek opportunities to develop green streets and sustainable streetscapes that minimize stormwater runoff, using techniques such as onstreet bio-swales, bio-retention, permeable pavement or other innovative approaches.
- Policy INC 8.7: Stormwater quality. Improve the water quality of stormwater and reduce flow quantities.

12.2.3.1.4 City of Sunnyvale

The City of Sunnyvale General Plan (City of Sunnyvale, 2011a) contains the following relevant goals and policies in Chapter 6, Safety and Noise, and Chapter 7, Environmental Management, related to hydrology, water quality, and flooding.

- Goal EM-10: Reduce runoff and pollutant discharge.
- Policy EM-8.3: Ensure that stormwater control measures and Best Management Practices (BMPs) are implemented to reduce the discharge of pollutants in stormwater to the maximum extent practicable.
- Goal SN-1: Acceptable levels of risk for natural and human-caused hazards.
- Policy SN-1.3: Operate and maintain the storm drainage system at a level to minimize damages and ensure public safety.

The City of Sunnyvale Municipal Code includes requirements to manage water flows and improve the quality of stormwater runoff (Sunnyvale Municipal Code, Chapter 12.60). Requirements include:

- BMPs for erosion control and stormwater management, such as soil/stock pile stabilization, for major projects to achieve measurable reduction in stormwater runoff and manage stormwater quality. Requirements for Low Impact Design, the goal of which is "to reduce runoff and mimic a site's predevelopment hydrology by implementing specific practices to control sources of potential pollution and site design strategies to treat stormwater" design criteria for stormwater treatment measures based on the area of impervious surface present at a site
- A requirement to develop site-specific stormwater management plans, including selection, implementation, and maintenance of stormwater BMPs

12.3 Regional setting

12.3.1 Climate and Precipitation

Like the rest of California's central coast, the South Bay region experiences a Mediterranean-type climate characterized by mild, wet winters and warm, dry summers. Moderated by proximity to the San Francisco Bay and the ocean, temperatures are seldom below freezing. Summer weather is dominated by sea breezes caused by differential heating between the interior valleys and the coast, while winter weather is dominated by storms from the northern Pacific Ocean that produce nearly all the annual rainfall.

Most precipitation in the region falls during the winter, when severe storms are frequent. During December, January, and February, the monthly precipitation is approximately 7 centimeters (2.7 inches), decreasing to 2.5 to 5 centimeters (1 to 2 inches) per month during the early spring. Less precipitation falls during the late spring and summer; from May through September, rainfall averages less than 1.25 centimeters (0.5 inch) per month. The average annual rainfall at ARC is approximately 35 centimeters (13.5 inches).

California experiences weather related to El Niño approximately every 3 to 7 years. An El Niño year results from changes in the distribution of heat and rainfall in the equatorial Pacific Ocean such that seawater warms and the region of thunderstorm activity moves eastward. Depending on the position of the jet stream in northern California, a strong El Niño is often associated with powerful Pacific storms and unusually wet winters in the state. El Niño storms generate high winds, producing record rainfall amounts, and can result in flooding throughout California. The most recent El Niño winter (1997-1998) was typical of this pattern, although according to Palo Alto City records, the 1997-1998 El Niño did not reach 100-year storm levels; the 30 inches that fell is typical of an 80-year storm.

12.3.2 **Surface Water**

12.3.2.1 *Surface Water Drainage*

Surface waters include rivers, streams, and lakes (collectively described as inland surface waters), estuarine waters, and coastal waters. There are three major surface water bodies in the vicinity of ARC: San Francisco Bay, Stevens Creek, and the Guadalupe Slough San Francisco Bay, located approximately 1.6 kilometers (1 mile) north of ARC, is the second-largest bay on the Pacific Coast, with a surface area of approximately 1,090 square kilometers (420 square miles) at mean high water. San Francisco Bay has approximately 445 kilometers (275 miles) of shoreline exclusive of islands, and is bordered by 335 square kilometers (130 square miles) of tidal flats and marshes. It receives surface water and groundwater inflow from the entire San Francisco Basin.

Surface waters of the County drain from the Santa Cruz Mountains in the west to the southern portion of the San Francisco Bay. Principal drainages of the western County are Stevens Creek, San Tomas Aquino Creek, and the Guadalupe River system.

Stevens Creek forms the western boundary of ARC and drains a watershed of 99.33 square kilometers (38.35 square miles). It is a perennial stream, although flow varies seasonally. Along with three other area streams, Stevens Creek receives stormwater discharge from the City of Mountain View storm drain system. Stevens Creek also received treated groundwater from the MEW and NASA sites. Stevens Creek discharges to San Francisco Bay.

Guadalupe Slough is located approximately 3.2 kilometers (2 miles) northeast of ARC and is fed by San Tomas Aquino Creek and the Moffett Channel. The Guadalupe Slough flows year-round, with seasonal variability.

12.3.3 Groundwater

ARC is within the Santa Clara Valley groundwater basin, the largest of 31 identified groundwater basins adjoining the San Francisco Bay. The basin contains 622 square kilometers (240 square miles) of principal aquifers and has a storage capacity of 3.7 trillion liters (3 million acre-feet) in the upper 300 meters (1,000 feet) of subsurface depth. Principal areas of recharge are located.

Groundwater in the Santa Clara Valley drains north toward San Francisco Bay. The main pumping zones are the confined aquifers located at depths of 60 meters (200 feet) or more in the interior portion of the basin, together with the forebay along the elevated edges of the basin. The estimated safe perennial yield of the basin is about 120 billion liters (100,000 acre-feet).

Historically, groundwater was a major supply of municipal, industrial, and agricultural water for the County. Beginning in the 1930s, however, serious overdrafts caused rapidly declining water tables, deteriorating water quality (in part as a result of salt-water intrusion), and marked ground subsidence in parts of the valley. To alleviate these problems, the Santa Clara Valley Water District constructed a series of surface reservoirs in the 1960s to promote artificial recharge of aquifers. Artificial recharge, combined with increased importation of water and control of production rates, allows the water table to rise during average or wetter-than-average years, and decline only slightly in drier-than-average years. Currently, groundwater provides about 50% of the County's total water supply, and subsidence is no longer considered a serious problem.

12.3.4 Water Quality

Geologic processes and land use activities in upstream areas of the drainage basin influence the quality of surface waters. In a natural system, surface water quality depends primarily on the mineral composition of the rocks in the upper headwater areas of the stream. Farther downstream, water quality is influenced by the mineral composition of the materials over which water flows, and by contributions from tributaries. In urban or developed streams, water quality is also affected by input from various types of point and nonpoint pollutant sources.

Point source pollution is discharged from a discrete source, such as the outfall from a pipe. Many types of pollutants can occur in point source discharges, depending on the pollutant source. By contrast, *nonpoint source pollution* is derived from widespread sources or runoff over large areas of land, and has no single location of discharge. Nonpoint source pollutants can enter waterways through urban and/or agricultural runoff, groundwater discharge, and atmospheric deposition. Typical nonpoint source pollutants include inorganic chemicals (salts, metals, and biostimulatory nutrients, such as nitrogen and phosphorus), suspended solids, pesticides, bacteria, oil and grease, and contaminants such as heavy metals that accumulate on the ground surface.

The quality of groundwater stored in aquifers reflects the geology of the basin, the quality of recharge waters, and land uses. Groundwater typically contains an elevated level of minerals or salts, depending on the type of rock or sediment that forms the aquifer. In some cases, the concentrations of minerals or salts are too high for potable uses. Land use factors that can influence groundwater quality include water withdrawals, artificial recharge, consumer waste landfills, underground chemical storage tanks, and various types of accidental chemical spills and releases. These land uses have the potential to contaminate the underground water supply, consequently preventing potable or other water use.

12.4 Existing Site Conditions

12.4.1 Surface Water at NASA Ames

12.4.1.1 *Historic Surface Water Hydrology*

ARC is located in the Stevens Creek watershed. Historically (prior to construction of ARC), surface drainage at the site flowed toward the creek and ultimately north toward San Francisco Bay. Tidal marsh historically covered a larger area, including a portion of the northern area of what is now ARC. Stevens Creek may have had a meandering channel that supported a marsh wetland corridor.

12.4.1.2 *Present Surface Water Hydrology*

The hydrologic network at ARC no longer flows directly to Stevens Creek and its native marshland areas. Historic surface flow pathways have been altered such that drainage channels function to control and remove stormwater runoff from developed areas, as opposed to the natural function that would allow flooding of adjacent lands. Runoff from impervious surfaces, such as paved lots and building roofs, is now collected and diverted to the SWRP and Northern Channel at the north end of the site.

The ARC drainage area consists of about 680 hectares (1,690 acres) and is served by two drainage systems (Figure 12-1). The first system, referred to as the western drainage system, encompasses approximately 275 hectares (680 acres) and serves the (NRP area, most of the Ames Campus area, Wesctoat Village military housing, and the Bay View area. The majority of this drainage discharges into the SWRP after passing through a sediment settling basin located within the southern portion of the Eastern Diked Marsh which flows into the SWRP. The Bay View area drainage flows directly into the Western Diked Marsh which discharges into the SWRP. The second drainage system, referred to as the eastern drainage system, encompasses approximately 410 hectares (1,010 acres). This system serves the southeast portion of the NRP area, the Ames Campus facilities next to the runway, the Eastside/Airfield area, and the CANG area. There is no direct connection between the eastern drainage system and the SWRP, and local flooding occurs in the northern part of the airfield during peak rainfall events due to lack of adequate drainage capacity. Storm drainpipe diameters at ARC range from 150 millimeters (6 inches) to 1,070 millimeters (42 inches). Both the western and eastern drainage systems receive input from Caltrans' U.S. Highway 101 (US-101) right-of-way along the south edge of ARC.

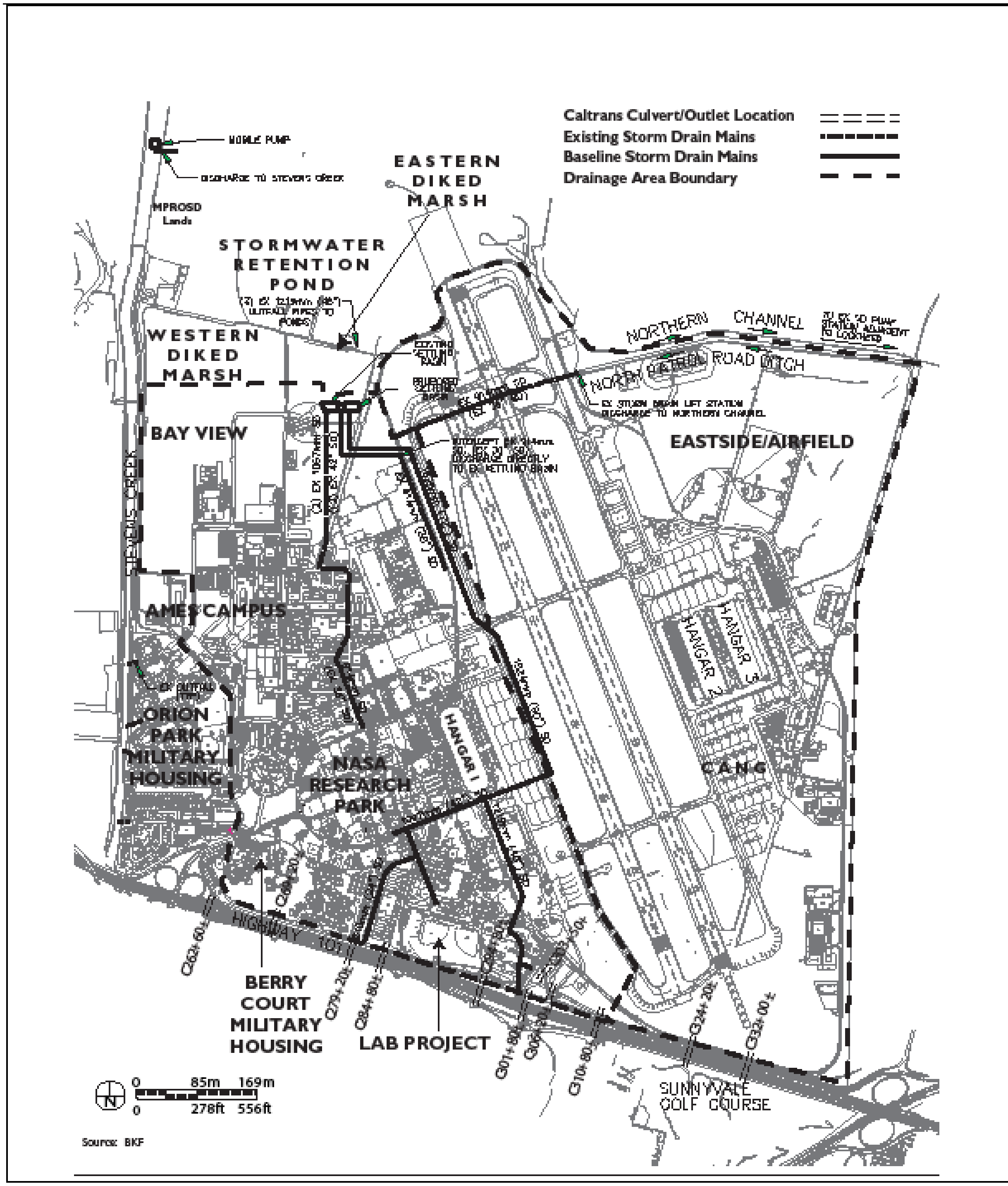

Figure 12-1. Baseline Conditions - Storm Drain System

(Source: NASA 2009)

As discussed in Chapters 14 (*Biological Resources*), the surface drainage systems at ARC support a variety of wildlife habitats. Surface water replenishment, via stormwater, assists in maintaining the nearby wetlands and makes an important contribution to maintenance of ecological diversity in the South Bay and the San Francisco Bay Area.

The following sections describe the western and eastern drainage systems in additional detail.

12.4.1.2.1 Western Drainage System

The western drainage system begins in the Wescoat Village military housing area and NRP area. Eight drainage structures, which serve approximately 14 hectares (35 acres) of the US-101 right-of-way, discharge into the area that is drained by the western drainage system. Stormwater flows north, through Wescoat Village , the NRP area, and Shenandoah Plaza, toward a main junction on the boundary between Shenandoah Plaza and the Ames Campus area, at the intersection of McCord Avenue and Bushnell Road. Stormwater from a small portion of the former Orion Park military housing area flows east toward the same junction. This line passes through Orion Park, the Main Gate area, and the ARC area.

At the McCord Avenue/Bushnell Road junction, all lines discharge into a 910-millimeter (36-inch) main trunk line. From this point, stormwater flows north through the Ames Campus area. Several other storm drain lines in the ARC area discharge directly into this main line at various points.

At the border of the ARC and Bay View areas, the 910-millimeter (36-inch) main line discharges into two 1,070-millimeter (42-inch) pipes, which flow north through the Bay View area toward a settling basin located in the northeastern portion of Bay View. From the settling basin, stormwater is discharged into the Eastern Diked Marsh, located just north of Bay View. From the Eastern Diked Marsh, flow drains to the SWRP via three 1,220-millimeter (48-inch) culverts under North Perimeter Road.

The SWRP has no outfall. During most years, water is removed by evaporation only. In some years, when wet-season flow into the SWRP exceeds the pond's storage capacity, temporary pumps are moved onto the SWRP's western levee and excess water is pumped into Stevens Creek. The capacity of the temporary pumps is less than 0.30 cubic meters per second (10 cubic feet per second), which is much less than the peak runoff of 6.2 cubic meters per second (220 cubic feet per second) from the 2-year storm for the 275-hectare (680-acre) area that discharges into the SWRP. If runoff discharges to the SWRP at a rate exceeding the pumps' capacity, water backs up, inundating the wetlands north of the Bay View area and causing localized flooding in Bay View.

Over the past 20 years, several storm drain studies have been completed, all of which agree that major renovation and rehabilitation of the western drainage system is needed. Some intermediate measures have been taken to protect specific buildings, but significant improvements to the underground system have not been made.

12.4.1.2.2 Eastern Drainage System

The eastern drainage system begins in the southern portion of the Ames Campus area and the southern CANG area. Two manholes in the runway infield contain 300-millimeter (12-inch) storm drain lines that receive local runoff, as well as flow delivered to the southern airfield via two drainage structures that serve approximately 6 hectares (15 acres) of the US-101 right-of-way. The storm drainpipes beneath the airfield restrict and decelerate flow somewhat when they are more than one-quarter full, but this is considered a minor concern because the full-flow velocity is only about 0.61 meters per second (2 feet per second); the more important concern appears to be the potential for trash and debris to accumulate where flow is restricted.

Stormwater from the airfield and the CANG area travels north through several storm drain lines and by overland flow. A small concrete-lined channel that flows west toward the Moffett Field storm drain lift station at the northeast corner of the airfield collects overland runoff from the golf course. This channel is commonly referred to as North Patrol Road Ditch. It is separated from the Northern Channel, which flows east, by a levee. The levee was recently raised to prevent flow in the Northern Channel (downstream of the lift station) from discharging into the smaller channel and flowing back into the lift station.

The southeastern portion of the NRP also contributes to the eastern drainage system via a main line that flows north, near the westernmost portion of the airfield. Several smaller lines from the eastern Ames Campus area enter this line along Zook Road. Just south of North Warehouse Road, the main line reaches its ultimate size of 910 millimeters (36 inches), providing a flow capacity of about 1.1 cubic meters per second (40 cubic feet per second). This is sufficient to convey runoff from an 11-hectare (26-acre) drainage area during a 25-year storm event with no surface ponding. However, the line is presently draining a much larger area and localized flooding can result if rainfall is heavy.

Stormwater from the 910-millimeter (36-inch) main, the high-speed fueling area, and the North Patrol Road Ditch, along with shallow groundwater, discharge into the lift station at B-191. The lift station consists of two 15-kilowatt (20-horsepower) pumps and has a capacity of approximately 45,000 liters per minute (12,000 gallons per minute). From the lift station, water is pumped into the Northern Channel. In addition, two portable pumps, each with a capacity of 19,000 liters per minute (5,000 gallons per minute), are located at intermediate points along North Patrol Road Ditch and discharge directly into the Northern Channel. Therefore, the total peak discharge into the Northern Channel from the site is 83,000 liters per minute (22,000 gallons per minute) or 1.40 cubic meters per second (49 cubic feet per second).

The Northern Channel flows east off of the site to follow the northern boundary of the neighboring Lockheed Martin site. It connects to the easternmost Lockheed pond, adjacent to the Moffett Channel (Sunnyvale West Side Channel), through a 1,220-millimeter (48-inch) culvert. A pump station with three pumps lifts the water into the Moffett Channel where it flows by gravity to Guadalupe Slough and then into San Francisco Bay. This pump station serves an additional 267 hectares (660 acres) of land east of ARC and has a total capacity of 117,000 liters per minute (31,000 gallons per minute) or 1.95 cubic meters per second (69 cubic feet per second).

12.4.1.2.3 Flood Hazards

As identified above, some parts of the stormwater management system at ARC are in need of upgrades. During the El Niño storms of 1998, many basements at ARC flooded, and some buildings had as much as 0.3 to 0.6 meters (1 to 2 feet) of water on the ground floor, including Buildings N-244, N-245, N-246, N-248, and Trailer 20. Structures constructed in the floodplain area in recent years have been built on raised building pads.

12.4.1.3 *Surface Water Quality*

12.4.1.3.1 Overview

Because ARC is at the bottom of the watershed, and since the majority of the Stevens Creek watershed supports urban land uses, surface waters flowing adjacent to ARC reflect water quality typical of urban or developed streams where various types of point- and nonpoint-source pollutants affect water quality.

Because surface water drainage at ARC has been substantially modified for stormwater management, water quality concerns in this area focus on maintaining compliance with a stormwater discharge permit, as opposed to protection of drinking water, although protection of natural habitat is also addressed. Monitoring the quality of stormwater at ARC is also important to track movement of contaminants and contaminated groundwater.

The ARC Environmental Management Division administers a quarterly storm drainage monitoring program. Low levels of organic compounds have been detected in effluent stormwater, but these are not considered significant. Relatively little runoff from the western portion of ARC is discharged into the San Francisco Bay, and water quality is typically within the regulated acceptable range.

In December 1992, the 930-square meter (10,000-square foot) concrete Stormwater Settling Basin (SWSB) was built northeast of the OARF at ARC. The purpose of the basin is to remove oil, grease, and particulate matter before runoff is discharged to the diked stormwater retention ponds south of the USFWS ponds. NASA removes sediment from the settling basin annually and tests for VOCs and metals to ensure appropriate disposal.

No recent water quality data are available for Stevens Creek. However, because the creek is downstream of urbanized areas, contaminants typical of urban runoff pollutants are likely to be present. RWQCB water quality monitoring for common urban contaminants at 12 locations on Stevens Creek was conducted during 2002 and 2003. Also, continuous (15-min interval) monitoring of temperature, pH, dissolve organics, and conductivity was conducted at four stations in 2002 and 2003.

12.4.1.3.2 Site-Wide Ecological Assessment

For a better understanding of the potential ecological risks associated with chemicals at ARC, the U.S. Navy conducted a Site-Wide Ecological Assessment (SWEA) from 1993 until 1997. As part of this effort, samples of soil, sediment, surface water, air (soil vapor), and organismal tissue were collected for chemical analyses to characterize the exposure risk to various ecological receptors. The Phase I SWEA provided conceptual site models, including a description of habitats, a qualitative evaluation of chemical sources and potential exposure pathways, and an overview of potential plant and animal receptors. The Phase II SWEA presented a quantitative and qualitative ecological risk assessment and provided information to support risk management decisions. Hydrocarbons (quantified as total petroleum hydrocarbons, diesel, motor oil, and "other heavy components") were detected in the samples collected at drainage channels and ditches, including the Eastern Diked Marsh and the SWRP (Site 25).

12.4.2 Groundwater at NASA Ames

12.4.2.1 *Description of Aquifers*

Several aquifers separated by less permeable clay and silt layers are present in the subsurface at ARC. They are divided into two sequences (a shallower unconfined or semi-confined sequence and a deeper confined sequence) separated by a laterally extensive clay layer. The upper aquifer sequence consists of the "A" and "B" aquifers; the lower aquifer sequence consists of the "C" and "Deep" aquifers.

12.4.2.1.1 "A" Aquifer

The "A" aquifer is located between the depths of 1.5 and 20 meters (5 and 65 feet) below ground surface (bgs) and is divided into two zones by a discontinuous low-permeability horizon (aquitard). The A1 aquifer zone extends from a depth of 1.5 to 9 meters (5 to 30 feet) bgs and the A2 aquifer zone[8] from 10 to 20 meters (35 to 65 feet) bgs. The "A" aquifer consists of alluvial channel deposits with the channel axes oriented approximately north-south. The degree of channel continuity has not been determined.

12.4.2.1.2 "B" Aquifer

The "B" aquifer is located between the depths of 21 and 37 meters (70 and 120 feet) bgs and is separated from the "A" aquifer by the A/B aquitard, a locally continuous clay layer that ranges in thickness from 1.5 meters (5 feet) on the west side of ARC to 6 meters (20 feet) on the east side. The depth to the top of the A/B aquitard ranges from 15 meters (50 feet) bgs on the east side of ARC to 21 meters (70 feet) bgs on the west side. Because fewer wells penetrate the "B" aquifer, its stratigraphy is less well understood than that of the "A" aquifer. However, it is generally divided into the B2 and B3 aquifers.

12.4.2.1.3 "C" Aquifer

The "C" aquifer is a confined aquifer located between the depths of 47 and 76 meters (155 and 250 feet) bgs. The "C" aquifer is effectively isolated from the upper aquifers by a 6- to 12-meter (20- to 40-foot)-thick laterally continuous clay layer (the B/C aquitard), which extends from a depth of approximately 37 to 47 meters (120 to 155 feet) bgs. Few wells have penetrated the "C" aquifer, and data to characterize it are limited. However, it is known to consist of relatively thin sand and gravel units interbedded with silts and clays.

12.4.2.2 *Groundwater Flow*

Groundwater in both the "A" and "B" aquifers flows in a north-northeasterly direction toward San Francisco Bay, with a horizontal hydraulic gradient of about 0.003 to 0.007 meters per meter (0.01 to 0.02 feet per foot). The hydraulic conductivity of the "A" aquifer

[8] South of U.S. 101, the A2 aquifer is known as the B1 aquifer zone.

ranges from 2 to 73 meters per day (6 to 240 feet per day). The hydraulic conductivity of the "B" aquifer is lower, at 0.1 to 11 meters per day (0.35 to 36 feet per day). The expected long-term yield from the upper aquifers ranges between 0 and 76 liters (20 gallons) per minute.

The vertical gradient between the "A" and "B" aquifers varies due to differences in confining conditions over individual sand and gravel units, but generally ranges from 0.2 to 0.4 meters (0.50 to 1.1 feet) in the upward direction.

Groundwater in the "C" aquifer also flows north-northeasterly toward San Francisco Bay, but the horizontal hydraulic gradient is substantially less steep than in the "A" and "B" aquifers, averaging about 0.0005 meters per meter (0.001 feet per foot).

The vertical gradient between the "C" aquifer and overlying units is strongly upward, commonly exceeding 5.5 meters (18 feet).

12.4.2.3 *Groundwater Use*

Groundwater in the "A" and "B" aquifers (upper aquifer zones) is not currently used for domestic, municipal, or industrial water supply at ARC, with the exception of a small amount of treated groundwater that is used by the ARC Jet facility cooling towers. The northern portions of the upper aquifers are generally not considered suitable as sources of drinking water because they contain naturally high levels of dissolved solids and other inorganic content. The upper aquifers are also unattractive for use as agricultural supply because of their elevated concentrations of inorganic constituents and salinity and their limited productivity. Water from the upper aquifers may be used for industrial service and industrial process supply, although low yields present a major limitation and many uses are precluded by elevated salt concentrations. This is unlikely to change in the future, in part because other sources of supply are available for industrial uses at ARC. In addition, fresh groundwater in the upper aquifers currently serves to reduce land subsidence and inhibit the intrusion of salt water into the aquifer system, so it is important to avoid repeating the historic pattern of overuse. Water from the "A" aquifer also provides surface water replenishment that assists in maintaining wildlife habitat in nearby wetlands.

Historically, groundwater from the "C" aquifer was used for drinking and agricultural purposes at ARC. The wells associated with these uses were drilled to depths of as much as 305 meters (1,000 feet) bgs. They are no longer in use for supply. Most have been closed, but a few are still used for water quality monitoring. An additional well near Building N-267 that originally provided agricultural supply is no longer in use. Use of the "C" aquifer is currently restricted to preventing land subsidence and saltwater intrusion. Similar concerns will likely dominate both near-term and future use of water from this aquifer.

12.4.2.4 *Groundwater Quality and Groundwater Remediation Efforts*

Since the early 1980s, numerous investigations have been conducted at and around ARC to evaluate soil and groundwater contamination in the area. Activities at the MEW Superfund site, which originates in neighboring Mountain View, the Navy, and ARC, have all contributed to an area of groundwater contamination collectively referred to as the regional plume (Figure 12-2). Additional localized contamination is a legacy of early Navy activities at what is now ARC. The following sections provide additional details on subsurface contamination as it affects groundwater, and past and current groundwater remediation efforts at ARC. A more detailed description of hazardous materials at the ARC site can be found in Chapter 18, *Hazardous Materials*.

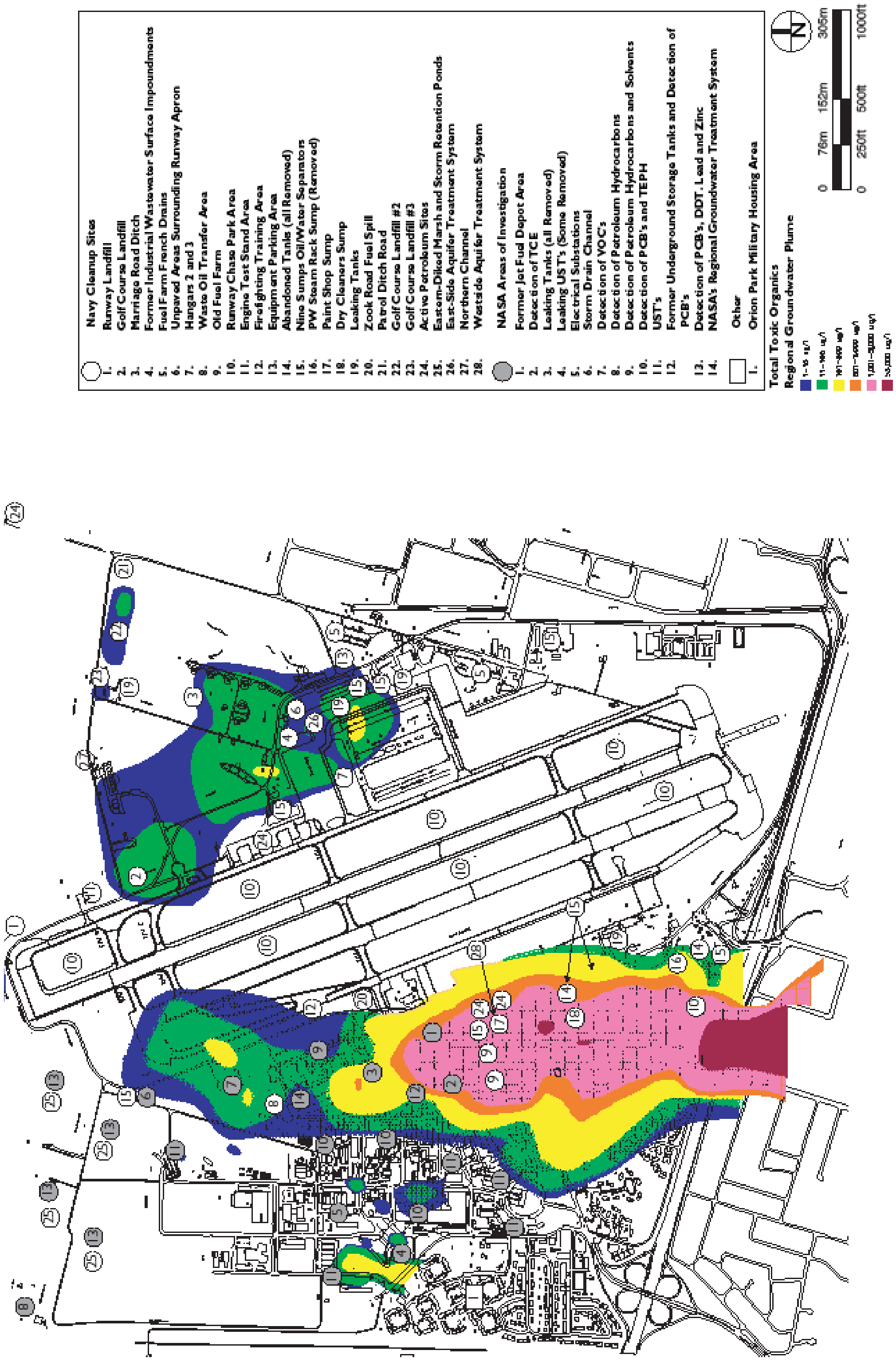

Figure 12-2. Hazardous Materials Sites and Plumes

(Source: NASA 2009)

12.5 Environmental Requirements

The following section describes plans, policies, programs, measures, and BMPs adopted by NASA to protect surface water (including stormwater) and groundwater quality at ARC.

12.5.1 NASA Procedural Directive 8500.1, NASA Environmental Management

Per NPD 8500.1, it is NASA policy to: maintain compliance with all applicable federal, state, and local environmental requirements; to incorporate environmental risk reduction and sustainable practices to the extent practicable throughout NASA's programs, projects, and activities; and to consider environmental factors throughout the life cycle of programs, projects, and activities (as defined in NPD 7120.4, *NASA Engineering and Program/Project Management Policy*, and related documents), including planning, development, execution, and disposition activities. Examples of environmental factors include consideration of environmental impacts as required by the NEPA and NHPA; the proposed use of hazardous materials; the potential for waste generation; the need to acquire necessary permits, waivers, and authorizations; and the use of environmentally-preferable materials and processes wherever practicable.

12.5.2 NASA Procedural Requirements 8553.1, NASA Environmental Management System

NPR 8553.1 sets forth requirements for the NASA EMS, which functions primarily to: (1) incorporate people, procedures, and work practices into a formal structure to ensure that the important environmental impacts of the organization are identified and addressed; (2) promote continual improvement, including periodically evaluating environmental performance; (3) involve all members of the organization, as appropriate; and (4) actively involve senior management in support of the EMS.

Agencywide, the EMS employs a standardized approach to managing environmental activities that allows for efficient, prioritized system execution, while at the same time helping to improve environmental performance and to maintain compliance with applicable environmental regulations and requirements. NASA's EMS approach involves identifying all activities, products, and services under each NASA center's control, and the environmental aspects associated with each centers' continued engagement in those activities, products, and services. Once identified, priority environmental aspects are assigned a risk ranking (from 1 to 4, based on its severity and frequency of occurrence) and are evaluated on a continual basis as means of highlighting associated positive or negative impacts and setting objectives and targets to reduce environmental risk. Each center's EMS also identifies methods for ensuring compliance by keeping abreast of environmental requirements. This includes requirements by law (EOs, federal regulations, state and local laws) and voluntary commitments made by the center or NASA.

12.5.3 Ames Procedural requirements 8500.1, Ames Environmental Procedural Requirements

APR 8500.1 sets forth general procedural requirements to ensure compliance with applicable federal, state, and local environmental laws; regulations and EOs; and NASA policies and procedures. Organizational directors, division chiefs, branch chiefs, section heads, supervisors, managers, and CORs are responsible for planning, designing, constructing, managing, operating, and maintaining facilities in conformance with applicable regulatory directives, and should obtain environmental review from the Environmental Management Division early in project planning consistent with NASA's NEPA implementing procedures (NPR 8580.1 and EO 12114), NASA policies and procedures for programs and projects (NPR 7120), and NASA regulations related to environmental quality (14 CFR 1216). Program and project managers should coordinate with the Environmental Management Division in a timely manner to ensure that any new or modified programs, projects, and activities comply with regulatory requirements.

12.5.4 Ames Procedural Requirements 8553.1, Ames Environmental Management System

APR 8553.1 sets forth requirements for the Center-level EMS in accordance with NPR 8553.1B, *NASA Environmental Management Systems*. The ARC EMS also includes consideration of the findings of NASA Headquarters' triennial (3-year) Environmental Functional Review and other external EMS audits, as required.

Under the ARC EMS, the Center conducts an annual risk analysis across Center activities to determine which of 16 environmental aspects are of high or medium priority. The Center then identifies objectives (goals) and targets and develops action plans known as Environmental Management Plans to reduce identified risks. Currently, the high- and medium-priority environmental aspects of Center business activities are *Air Emissions*, *Hazardous Material Management*, *Water and Energy Conservation*, and *Other Sustainability Practices*. Objectives associated with these high- and medium-priority environmental aspects include:

- Reducing air (including GHG) emissions through energy efficiency
- Improving hazardous material management
- Improving energy and water efficiency
- Providing for the integration of other sustainability practices into Center activities

12.5.5 Ames Environmental Work Instructions

Ames's EWIs, which replace the previous Ames Environmental Handbook (APR 8800.3), set forth requirements to ensure that programs, projects, and activities at ARC comply with applicable federal, state, and local laws; regulations and EOs; and NASA policies and procedures. Each EWI lists relevant regulatory authorities and documents, assigns individual and organizational responsibilities within ARC, and identifies specific requirements applicable to the work being performed.

The following EWIs are relevant to operations and future development at ARC with the potential to impact water resources.

- EWI 2.1, Drinking Water Management
- EWI 2.2, Industrial Waste Water

- EWI 2.3, Storm Water
- EWI 2-4, Wetlands and Flood Plains (Under revision)
- EWI 3, Tanks
- EWI 3-1, Aboveground Storage Tanks
- EWI 3-2, Underground Storage Tanks
- EWI 3-3, SPCC Plan
- EWI 8, Restoration
- EWI 9, Emergency Response
- EWI 12, Public Involvement
- EWI 14, NEPA and Environmental Justice
- EWI 18, Environmental Requirements for Construction Projects (Under review)

12.5.6 Spill Prevention, Control, and Countermeasures Plan

The current Spill Prevention, Control, and Countermeasures Plan (SPCC) was prepared to identify aboveground storage of petroleum products, standard operating procedures, and detailed emergency response and mitigation actions in the event of a spill. Its specific purposes include:

- Establish procedures, methods, equipment, and other requirements to prevent the discharge of oil from non-transportation related onshore facilities into or upon navigable waters of the United States and adjoining shorelines
- Evaluate existing containment and diversionary structures constructed to control spill occurrences
- Recommend operational changes and facility modifications to minimize the probability of a spill event
- Discuss responsibilities for record keeping, inspections, personnel training, and notifications relative to plan implementation
- The current Spill Prevention, Control, and Countermeasures Plan has been reviewed in May 2013. The plan is required to be revised approximately every five years.

12.5.7 Storm Water Pollution Prevention Program

ARC's SWPPP has two major objectives: (1) to identify the sources of pollutants that affect the quality of stormwater discharges and authorized non-stormwater discharges from the facility, and (2) to describe and ensure the implementation of BMPs to reduce or eliminate pollutants in stormwater discharges and authorized non-stormwater discharges. The program includes the following general BMPs. These practices apply to all industrial and maintenance activities on ARC and have been shown to be effective in preventing pollution.

- Training and supervision

- Process and equipment modification
- Raw material and product substitution or elimination
- Proper construction, demolition, and excavation activities
- Hazardous waste storage and handling
- Spill prevention and response
- Material handling and storage, including outdoor process equipment operations
- Loss prevention and good housekeeping
- Closed-loop recycling of industrial process water

As part of its Annual Report for Storm Water Discharges Associated with Industrial Activities, NASA conducts sampling and inspections to verify the effectiveness of the BMPs. Activities include:

- Stormwater sampling conducted at 12 locations on the site, including the two discharge locations, at least twice a year during the wet season (October through May)
- Visual observations conducted during the wet and dry seasons at the 12 sampling locations to identify any unusual characteristics in the stormwater discharge
- Documenting quarterly visual observations of non-stormwater discharges, if applicable
- Conducting an Annual Comprehensive Site Compliance Evaluation for all potential pollutant sources and areas of industrial activity, as identified in the SWPPP

12.5.8 **Measures to Minimize Impacts on Groundwater**

Although any operation that involves the use of hazardous materials and/or produces hazardous waste has the potential to impact groundwater quality, most operations at ARC are unlikely to affect the quality of the groundwater or impair any of its current or potential beneficial uses, in part because of measures incorporated into ongoing operations at the site. For example, all liquid hazardous materials are stored in secure containers with a secondary containment of 110% of the containers capacity which is in accordance with the County Hazardous Materials Storage Ordinance. (There is a more detailed description of this ordinance in Chapter 18, *Hazardous Materials).* Nonetheless, two program areas have a greater potential to result in groundwater contamination: activities that support aircraft operations, and fuel storage in underground tanks.

In 1992, approximately 9,500 liters (2,500 gallons) of jet fuel were accidentally released during the defueling of a C-130 aircraft. In 1996 and 1997, two additional accidental releases that occurred during fuel transfer activities at the Defense Fuel Supply Point resulted in a total of approximately 3,200 liters (850 gallons) of jet fuel being spilled onto exposed soils. These spills were remediated and NASA has since taken steps to reduce this type of mishap, including establishing written standard operating procedures for fuel transfer activities. However, the potential remains that similar releases may occur in the future. Accordingly, NASA has developed emergency response capabilities to mitigate future releases, minimizing the potential impact on groundwater. No major spills occurred during the years 2012 and 2013.

12.5.9 Best Management Practices for Construction, Demolition, and Excavation Operations

Construction, demolition, and excavation projects generate a great deal of dust, debris, waste materials, and wastewaters that, when improperly managed, can result in prohibited discharges to the storm drainage system. Various construction projects occur at ARC throughout the year. A SWPPP is required in all construction contractor specifications. Furthermore, the California Storm Water Best Management Practice Handbook for Construction Activity is made available to construction contractors working at ARC. Targeted constituents are sediment, heavy metals, toxic materials, floatable materials, oil and grease, petroleum products, and contaminated groundwater.

The following BMPs are applicable to all construction, demolition, and excavation activities at ARC that could potentially release pollutants to the storm water. Requirements of these BMPs are:

- Each job site should be managed in such a manner to avoid discharges of prohibited substances to the storm drain system
- Routine inspection of job site should be performed to ensure that construction, demolition, and excavation materials (liquid or solid) are not entering the storm drain system
- Keep the job site tidy and clean up debris regularly
- Placement of cleaning equipment or tools over catch basins is prohibited
- Storm drain catch basins should be covered to prevent pollutants and sediments from entering the storm drain system

Special precautions should be employed if rain is forecasted or if water is applied. These precautions should include, but are not limited to:

- Increased monitoring frequency for storm drains and rectifying ongoing releases or identifying and preventing any possible release
- Reduction in activities that cause material to encounter rainwater
- Following all construction, demolition, and excavation activities; the job site should be swept to remove debris and residue. Catch basins should be vacuumed or cleaned to remove sediment and debris

- Construction, demolition, and excavation materials (gravel, sand, lumber, cement, chemicals, contaminated equipment, etc.) should be stored under a roof or structure or covered with a tarp or plastic visqueen. Covered items should be secured with ropes, sandbags, or bricks to prevent or minimize contact with rainwater. For large piles of soil or other construction materials where tarps or other covers are not feasible, placement of filtering media (for example, straw bales, rocks, and silt fences) around the base of each pile or at the storm drain inlet is required to remove these materials from rainwater runoff. Do not store items near catch basins
- Wet concrete and concrete cutting waters should be conducted to prevent discharge to the storm drains. Blocking or plugging drains in the vicinity may be warranted. This can be done in a number of ways, such as placing weighted plastic visqueen over drains or using sandbags or spill control absorbent socks
- Residual concrete and concrete/asphalt cutting effluent from equipment and machinery should not be discharged to the storm drain. Estimate the amount of wastewater that will be generated and arrange to have a storage container (tank) available. Properly dispose of wastewater off site
- Outdoor concrete work should be postponed if rain is forecasted unless precautions are taken to prevent discharge of wet concrete and other construction debris to the storm drain
- During paint scraping operations, use impermeable ground cloths, such as plastic sheeting, to collect dust, and paint chips
- Use impermeable ground cloths while painting. Place in-use paint buckets in a pan or over plastic sheeting to ensure that accidental spills are not discharged to the storm drain
- Mixing of paint should take place indoors or in a place that is not exposed rain or wind
- At the end of the workday, store paint buckets and other equipment away from contact with stormwater in a secured, secondarily contained area
- Treat a paint spill as a chemical spill. Capture the material before it flows to the storm drain. Clean it up promptly. Report the event to ARC's Environmental Management Division, Code JQ , at 650-604- 0237, or call 911 for large spills
- Outdoor sandblasting should comply with the following:
- Tarpaulins or ground cloths should be placed beneath the work area to capture the blasting medium and particles from the surface being cleaned
- Consider curtailing sandblasting on a windy day or, if rain is forecast, to minimize the amount of area that will require clean up and to avoid sand waste from being washed into the storm drain
- Vacuum the work area when job is complete

- If sandblasting paint containing lead, cadmium, or other toxic contaminants, comply with the following:
- Obtain approval from ARC's Environmental Management Division at 650-604-0237and the Occupational Safely, Health, and Medical Services Office at 650-604-5602
- Follow measures outlined in "Outdoor Sandblasting" listed above
- Perform air monitoring is required
- Follow Occupational Safety and Health Administration(OSHA) regulations for worker safety
- For broken lines that contain substances other than potable water, the operator shall immediately notify the ARC's Environmental Management Division and initiate the following actions immediately:
- Berm the area to prevent runoff to the storm drain
- Immediately block off adjacent storm drain catch basins

12.5.10 **Good Housekeeping Best Management Practices**

Good housekeeping BMPs are designed to maintain a clean and orderly work environment. Often the most effective first step toward preventing pollution in stormwater from industrial sites simply involves using good common sense to improve the facility's basic housekeeping methods. Poor housekeeping can result in more waste being generated than necessary and an increased potential for stormwater contamination. A clean and orderly work area reduces the possibility of accidental spills caused by mishandling of chemicals and equipment, thereby reducing safety hazards. Well-maintained material and chemical storage areas should minimize discharges of materials/pollutants that could contaminate stormwater. Simple procedures can be used to promote good housekeeping, including improved operation and maintenance of industrial machinery and processes, material storage practices, material inventory controls, routine and regular clean-up schedules, maintaining well organized work areas, and educational programs.

ARC's policy is that managers, including line supervisors, are responsible for ensuring that personnel are educated in proper environmental hazards management, including stormwater pollution prevention. These BMPs are applicable to all industrial activities at ARC.

Targeted constituents of these BMPs are sediments, nutrients, floatable materials, oxygen-demanding substances, heavy metals, toxic materials, and oil and grease.

Requirements of the Good Housekeeping BMPs are as follows:

- Conduct formal monthly inspections of all buildings and surrounding areas to ensure the following:
- Outside areas are cleaned and organized
- Drips, leaks, or evidence of such, from equipment or pipes are contained

- Adequate space exists in work areas to minimize spill potential
- Garbage is removed regularly
- Walkways and passageways are easily accessible
- Walkways and passageways are free of materials that could be spilled
- Evidence is noted of dust from painting, sanding, or other industrial activities
- Cleanup procedures for spilled materials exist

An inspection log should be maintained in order to feed other environmental reporting requirements at ARC. Moreover, a formal annual inspection of ARC is conducted by the Environmental Management Division to verify industrial activities in the SWPPP and identify new activities and BMPs.

- Conduct an annual inventory of chemical substances, including hazardous materials and pollutants present on site. This inventory shall meet the requirements of the Santa Clara County Hazardous Materials Storage Ordinance inventory of chemicals and toxic substances
- Maintain a current file of all Material Safety Data Sheet (MSDS) for chemicals and toxic substances
- Label chemical containers in accordance with OSHA, EPA, U.S. Department of Transportation, and other applicable federal, state, and local requirements
- Maintain dry and clean floors and ground surfaces by using brooms, shovels, vacuum cleaners, and cleaning machines
- Regularly pickup and dispose of garbage, debris, and waste material
- Make sure equipment is working properly
- Routinely inspect for leaks or conditions that could lead to discharges of chemicals or contact of stormwater with raw materials, intermediate materials, waste materials, or products
- Ensure that all employees understand spill cleanup procedures.
- Improper storage can result in the release of materials and chemicals that can cause stormwater runoff pollution. Proper storage techniques include:
    - Providing adequate aisle space to facilitate material transfer and easy access for inspections
    - Storing containers, drums, and bags away from direct traffic routes to prevent accidental improper weight distribution of containers
    - Stacking containers according to manufacturer's instructions to avoid damaging the containers from improper weight distribution
    - Storing containers on pallets or similar devices to prevent container corrosion, which can result from moisture on the ground

- Maintain an up-to-date inventory of all materials (hazardous and non-hazardous). This inventory will reduce additional material costs caused by overstocking. Inventorying also enables the tracking of materials stored and handled on site and identifies which materials and activities pose the most risk to the environment
- During inventory of hazardous materials, clearly mark those that require special handling, storage, use, and disposal considerations
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area
- Cover materials of particular concern, such as hazardous materials or sand piles that must remain outdoors, particularly during the rainy, season
- Educate employees who are doing the work
- Inform onsite contractors of ARC policy. Include appropriate provisions in their contract to ensure proper housekeeping and disposal practices are implemented
- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids
- Do not dump waste liquids down the storm drain
- Advise concrete truck drivers to not wash their truck over the storm drain
- Placement of cleaning equipment or tools over catch basins is prohibited

12.5.11 **Best Management Practices for Material Handling and Storage**

Material handling and storage BMPs include procedures to minimize the potential for spills and leaks and to minimize exposure of significant materials to stormwater and authorized non-stormwater discharges. Accidental releases of materials from underground liquid storage tanks, aboveground storage tanks, drums, containers, and dumpsters present the potential for contaminated stormwaters with many different pollutants. Materials spilled, leaked, or released from storage containers and dumpsters may accumulate in soils or on the surfaces where they may be transported by stormwater runoff. Currently, hazardous materials are stored outdoors at ARC in secondarily contained and roofed chemical storage facilities or lockers. Standard Operating Procedures prohibit materials from contacting stormwater runoff in the event of an accident or spill.

These BMPs also address the loading and unloading of materials, which usually takes place outside at the NASA Ames Supply Support Facility at N-255, and the CANG Facilities 681 and 682. Loading or unloading of materials occurs in two ways: materials in containers or direct liquid transfer. Materials leaked, spilled, or lost during loading/unloading may collect in the soil or on other surfaces and be carried away by runoff or when the area is cleaned. Rainfall may wash pollutants from machinery used to unload or move materials. The loading or unloading may involve rail or truck transfer.

Targeted constituents of these BMPs include floatable materials, oxygen demanding substances, heavy metals, toxic materials, and oil and grease.

These BMPs are applicable to all industrial activities at ARC, in particular those areas where containers storing liquid materials are located outside of buildings. It should be noted that the storage of reactive, ignitable, or flammable liquids must comply with the California Health and Safety Code, the Santa Clara County Hazardous Materials Storage Ordinance, and the local fire code.

Requirements of the Material Handling and Storage BMPs are as follows:

- Prevent or reduce the discharge of pollutants to stormwater from outdoor container storage areas by storing hazardous substances in chemical storage lockers or facilities, installing safeguards against accidental releases, providing secondary containment, conducting weekly inspections of hazardous waste, monthly inspections of hazardous materials, and training employees in standard operating procedures and small spill cleanup techniques
- Protect materials from rainfall, runoff, and wind dispersal by implementing controls such as:
- Store materials indoors or in a chemical storage locker
- Cover the storage area with a roof
- Minimize storm water run-on by enclosing the area or providing a berm
- Storage of oil and hazardous materials must meet specific federal, state, and local standards, including:
- A Spill Prevention Control and Countermeasure Plan (SPCC)
- Secondary containment, integrity, and leak detection monitoring
- Emergency preparedness plans
- Operator must be trained in proper storage
- All hazardous materials storage areas must be inspected monthly; hazardous waste accumulation areas must be inspected weekly. Hazardous materials and hazardous waste inspections must be documented. Documentation must be kept on file for a period of five years. Inspections must include the following questions:
- Are all materials correctly segregated?
- Are hazardous materials/waste storage areas clearly identified, describing hazard class(es) of materials in storage?
- Are all containers (and secondary containment, if needed) labeled to identify the material/waste hazard?
- Is the secondary containment free of liquid or debris?
- Are all containers in good condition?
- Are Material Safety Data Sheets available for all hazardous materials in inventory?
- Hazardous materials shall be properly stored:

- Hazardous materials should be placed in a designated area
- The designated storage area should be covered with a roof
- Designated areas should be paved, free of cracks and gaps, and liquid tight in order to contain leaks and spills
- Liquid materials should be secondarily contained to hold 10% of the volume of all the containers or 110% of the volume of the largest container, whichever is greater
- Drums stored in an area where unauthorized persons may gain access must be secured to prevent accidental spillage, pilferage, or any unauthorized use
- Employees trained in emergency spill cleanup procedures should be present where dangerous waste, liquid chemicals, or other wastes are loaded or unloaded

Using engineering safe guards and thus reducing accidental releases of pollutants can prevent operator errors. Safeguards include:

- Overflow protection devices on tank systems to warn the operator to automatically shut down transfer pumps when the tank reaches full capacity
- Protective guards (bollards) around tanks and aboveground piping to prevent vehicle or forklift damage
- Clearly tagging or labeling all valves to reduce human error

Weekly inspections of tanks should be conducted to include:

- A check for external corrosion and structural failure
- A check for spills and overfills due to operator error
- A check for failure of piping system (pipes, pumps, flanges, coupling, hoses, and valves)
- A check for leaks or spills during pumping of liquids or gases from truck or railcar to a storage facility or vice versa
- Visual inspection of new tank or container installation, loose fittings, loose valves, poor welding, and improper or poorly fitted gaskets
- Inspection of tank foundations, connections, coatings, tank walls, and exposed piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system

Proper use of pesticides and fertilizers will reduce the risk of loss to storm water. In addition:

- Pesticide applicators must be licensed with the California Department of Pesticide Regulation and county agricultural commissioners
- No person shall pollute water supplies or waterways while loading, mixing, or applying pesticides on ARC property

- No person shall transport, handle, store, load, apply, or dispose of any pesticide, container, or apparatus in such a manner as to pollute water supplies or waterways, or cause damage or injury to land, humans, plants, or animals
- Pesticides/fertilizers should not be applied during the wet season as they may be carried from the site by the next storm
- Avoid over-watering not only to conserve water but to avoid the discharge of water that may have become contaminated with nutrients and pesticides
- Store pesticides and application equipment in a responsible manner
- Properly dispose of the used containers

Stormwater from parking lots may contain undesirable concentrations of oil, grease, suspended particulates, and metals such as copper, lead, cadmium, and zinc, as well as the petroleum byproducts of engine combustion. Deposition of air particulates, generated by the facility or by adjacent industries, may contribute significant amounts of pollutants. Therefore, the following maintenance operations shall occur:

- Sweeping of main streets shall be conducted monthly and sweeping of parking lots shall be conducted quarterly. Sweeping should be conducted with a vacuum sweeper, rather than a mechanical brush sweeping device, which is not as effective at removing the fine particulates
- Cleaning of catch basins and building laterals shall be conducted annually. Maintain painted stencils that mark storm drain inlets "No Dumping! Flows to Bay." This stencil will minimize inadvertent dumping of liquid wastes;
- Debris shall be disposed of off center at an approved landfill site

Prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials through implementation of the following:

- When materials are received, they shall remain in the travel path only for a time reasonably necessary to transport the materials but no longer than 24 hours
- Use a written operations plan that describes procedures for loading and/or unloading
- Have an emergency spill cleanup plan readily available
- Employees trained in spill containment and cleanup should be present during the loading/unloading
- Establish depots of cleanup materials next to or near each loading/unloading area and train employees in their use
- Park delivery vehicles so that spills or leaks can be contained
- Cover the loading/unloading docks to reduce exposure of materials to rain

12.5.11.1 *Best Management Practices for Outdoor Process Equipment Operations and Maintenance*

Outdoor equipment includes rooftop cooling towers or air conditioners, rooftop air vents for industrial equipment, outdoor air compressors, and other service equipment. Indoor wet processes include areas where leaks or discharges may discharge to outdoor areas, and material transfer areas, such as loading areas, where forklifts or trucks may carry pollutants outdoors on their tires. Ordinary precautions, such as those below, may suffice for smaller equipment.

Targeted constituents of these BMPs include oil and grease, heavy metals, and antifreeze.

These BMPs are applicable to all areas with outside process equipment at ARC. Requirements are as follows:

- Inspect equipment on a regular basis for leaks malfunctions, staining on and around the equipment, and other evidence of leaks and discharges
- Assign the inspector the responsibility of reporting a spill
- Develop a routine for taking actions on reporting, cleaning up the spill, and repairing the leak to prevent future spills
- If absorbent material is used on a spill, sweep and dispose of material in a timely manner
- Place equipment on an impermeable surface or install a drip pan beneath potential leak points
- Construct a simple roof to minimize the amount of rainwater that contacts the equipment and install a berm to prevent runon and runoff
- Air compressors and other equipment produce small quantities of automatic blowdown water, which commonly contains lubricating oil or other potential pollutants. Blowdown water may not be discharged to any impermeable outside areas or to the storm drain system. Blowdown water must be discharged to the sanitary sewer or to a permeable area (for example, landscaping area)
- Electrical equipment should be managed to:
- Take care in tapping oil-containing equipment. Avoid drips and leaks whenever possible
- Place an absorbent pad with the impervious lining side down under electrical equipment prior to tapping. The absorbent material will retain small drips with impervious backing in limiting leakage
- Properly dispose of oil-contaminated materials. Any PCB-contaminated absorbent materials must be bagged, labeled, and disposed of in accordance with 40 CFR 761
- For all PCB-containing electrical equipment, follow NASA Ames Procedures for PCB Management. If you have any questions regarding the PCB Program, call the NASA Environmental Management Division at 650-604-0237.

12.5.11.2 *Best Management Practices for Spill Response and Prevention*

Spill response and prevention BMPs include spill cleanup procedures and necessary cleanup equipment based upon the quantities and locations of significant materials that may spill or leak. Spills and leaks together are one of the largest industrial sources of stormwater pollutants, and in most cases are avoidable. The most common causes of unintentional releases and spills include:

- Lack of awareness regarding proper hazardous materials handling procedures
- External corrosion and structural failure of storage containers
- Improper equipment or facility installation
- Spills and overfills due to operator error
- Failure of piping systems (pipes, pumps, couplings, hoses, and valves)
- Leaks during pumping of liquids or gases from trucks to a storage facility and vice-versa

Establishing standard operating procedures, such as safety and spill prevention procedures, along with proper employee training can reduce these accidental releases. Avoiding spills and leaks is preferable to cleaning them up after they occur, not only from an environmental standpoint, but also because spills cause increased operating costs and lower productivity.

Targeted constituents of these BMPs include floatable materials, heavy metals, toxic materials, and oil and grease.

These BMPs are applicable to all industrial activities at ARC. Requirements for implementation are as follows:

- Hazardous materials are segregated according to hazard class, stored in secondary containment to prevent accidental release, labeled according to the container's contents and the material's hazard, and accurately inventoried for reporting to the NASA Environmental Management Division, and to federal, state, and local regulatory agencies
- Hazardous materials storage areas are equipped with emergency spill response equipment appropriate to the types of materials in use and storage
- The hazardous materials storage areas are inspected monthly to ensure storage requirements are being satisfied
- It is the responsibility of managers and supervisors at ARC to ensure employee training in these areas:
- Safe handling of hazardous materials in the employee's work place, including spill response, segregation, and secondary containment
- Proper disposal of hazardous waste, including sewer discharge prohibitions, pickup procedures, and Emergency Response and First Responder Training

Building Emergency Action Plans are available at each building and include a Hazardous Substance Plan. The Hazardous Substance Plan details the chemical inventory of the building, hazardous substance spill procedure, and hazardous chemicals training.

- The NASA Ames Site Contingency Plan is the guideline for emergency response to incidents involving hazardous waste and/or hazardous waste constituents. The emergency coordination and notification for incidents involving hazardous waste shall be in accordance with federal, state, and local statutory and regulatory requirements. Contact the Environmental Management Division at 650-604-0237 for additional information.
- In the event of a spill near a storm drain: block, dike, divert, and/or cover the storm drain to prevent a release from entering the stormwater system.
- In the event of a spill that cannot be cleaned up by two people within 0.5 hour with cleanup materials available on the scene, call Ames Dispatch at 911 or 650-604-5555 immediately.

12.5.11.3 *Waste Handling and Recycling Best Management Practice*

Waste handling and recycling BMPs include the procedures or processes to handle, store, or dispose of waste or recyclable materials. Hazardous waste is accumulated at NASA Ames Facility N-265, and NRP Building 950. The containment structure at the accumulation areas prohibits materials from contacting stormwater runoff. Rainwater captured within the containment structures is pumped to portable holding tanks and the water is determined to be hazardous or non-hazardous. The water is either discharged to the sanitary sewer system or managed as a hazardous waste, as determined from the characterization.

Targeted constituents of these BMPs include heavy metals, toxic materials, floatable materials, oxygen demanding substances, and oil and grease.

These BMPs are applicable to all industrial activities at ARC and require the following measures.

- Prevent or reduce the discharge of pollutants to stormwater from outdoor container storage areas by storing hazardous waste in chemical storage lockers or facilities, installing safeguards against accidental releases, providing secondary containment, conducting weekly inspections, and training employees in standard operating procedures and small spill cleanup techniques
- Protect materials from rainfall, runoff, and wind dispersal by implementing controls such as:
    - Store materials indoors or in a chemical storage locker;
    - Cover the storage area with a roof; and
    - Minimize stormwater runon by enclosing the area or providing a berm.
- Storage of waste oil and hazardous materials must meet specific federal, state, and local standards, including:

- A SPCC
- Secondary containment, integrity, and leak-detection monitoring
- Emergency preparedness plans

Waste materials and recyclables are segregated according to hazard class, stored in secondary containment to prevent accidental release, labeled according to the container's contents and the material's hazard, and accurately inventoried for reporting to the NASA Environmental Management Division and to federal, state, and local regulatory agencies

- Waste materials and recyclables storage areas are equipped with emergency spill response equipment appropriate to the types of materials
- The waste materials and storage areas are inspected weekly to ensure that storage requirements are being satisfied. Hazardous waste inspections must be documented. Documentation must be kept on file for a period of five years. Inspections must include the following questions:
    - Are all materials correctly segregated?
    - Are hazardous waste storage areas clearly identified, describing hazard class(es) of materials in storage?
    - Are all containers (and secondary containment, if needed) labeled to identify the waste material and hazard class?
    - Are all containers intact and in good condition?

It is the responsibility of managers and supervisors at ARC to ensure employee training in these areas:

- Safe handling of hazardous wastes in the employee's work place, including spill response, segregation, and secondary containment
- Proper disposal of hazardous waste, including sewer discharge prohibitions and pickup procedures
- Emergency Response and First Responder training

Building Emergency Action Plans are available at each building and include a Hazardous Substance Plan. The Hazardous Substance Plan details the chemical inventory of the building, hazardous substance spill procedure, and hazardous chemicals training.

The NASA-Ames Research Center Site Contingency Plan is the guideline for emergency response to incidents involving hazardous waste and/or hazardous waste constituents. The emergency coordination and notification for incidents involving hazardous waste shall be in accordance with federal, state, and local statutory and regulatory requirements. Contact the NASA Environmental Management Division, Code JQ, at 605-604- 0237.

12.5.12 NASA Ames Development Plan Final Programmatic Environmental Impact Statement

The NADP EIS identifies the following mitigation measures to address potential hydrology and water quality impacts from build out of NADP Mitigated Alternative 5.

12.5.12.1 *Mitigation Measure HAZ-1*

NASA's development partners would work with the Remediation Project Manager within the Office of Environmental Services during site planning and would implement the guidelines and recommendations in the Environmental Issues Management Plan (EIMP) to ensure that none of the proposed construction, demolition, and infrastructure improvement projects would expose personnel to unacceptable levels of contaminated soil or groundwater. Where the Remediation Project Manager determined that there would be a possible risk of exposure to people or clean soil or groundwater, the proposed design would be altered to prevent such exposure if feasible. If it were not feasible to avoid exposure, protective measures would be undertaken to minimize the risk of exposure as described in the EIMP.

12.5.12.2 *Mitigation Measure BIO-18*

Potentially contaminated runoff would be managed using stormwater BMPs. Swales would be constructed adjacent to wetlands in upland areas to intercept and filter any runoff before it reaches the wetland. Construction of swales would be permitted within the 61-meter (200-foot) buffer zone around wetlands, but not within the wetlands themselves.

12.5.12.3 *Mitigation Measure BIO-19*

To minimize impacts on wetlands, construction would be avoided in the jurisdictional wetlands along the northern boundary of the Bay View area and within 61 meters (200 feet) of these wetlands. Fill activities and other disturbances would be minimized in jurisdictional wetlands elsewhere.