APPENDIX E

Village Specific Plan
and Environmental Impact Report

Infrastructure Plan

December 13, 2021

Prepared for

Town of Apple Valley
14955 Dale Evans Parkway
Apple Valley, CA 92307

Prepared by

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Infrastructure Plan Final Draft 12/13/21

A. Administrative Services/General Government

The current limits of the Village Specific Plan are part of the Town of Apple Valley. General government services include the Town Council, Town Manager, Town Clerk, Town Administrative Offices, including Public Services Administration, and Town Attorney. The Town Council consists of five council members with the mayor as presiding officer.

The Town Manager is responsible for the administrative affairs of the Town, including managing Town services and implementing programs and activities as directed by the Town Council. Other managerial responsibilities include monitoring and advising the Council of all state and federal legislation that concern the Town. The Town Manager and staff serve the entire Town, including the Village Specific Plan area.

The Town Clerk maintains the Town's official records, including Town Council official minutes. The Clerk performs duties required by the California Political Reform Act, which created the California Fair Political Practices Commission (FPPC). The Clerk serves as the Town's Election Official and Notary Public, and maintains the Municipal Code. The Clerk's office also serves as a Passport office. The Clerk and staff serve the entire Town.

The Town's General Government offices and services include the following:

- Human Resources Department, including Risk Management
- Public Information Office
- Finance Department
- Animal Services
- Economic and Business Development Department
- Police Department
- Community Development Department, including planning, housing, and code enforcement services
- Parks & Recreation Department
- Public Services Department
- Office of Emergency Preparedness
- Building & Safety Department
- Public Works Department, including street maintenance, wastewater, and grounds maintenance
- Engineering Department
- Environmental & Transit Services
- Apple Valley Golf Course administration

The Community Resource Foundation, a non-profit public benefit corporation, supports and promotes cultural, recreational, and human services needs in Apple Valley.

B. Wastewater Treatment

The Town owns and operates the local wastewater collection system, which serves more than 22,000 residents. The sewer system consists of approximately 145 miles of sewer pipe infrastructure and 8 lift stations.[1] It is relatively new and does not cover the entire Town; approximately 70% of developed residential areas have not been connected to the sewer system and still rely on septic systems.

The Town is a member of the Victor Valley Wastewater Reclamation Authority (VVWRA), a joint powers authority that includes the Town of Apple Valley, City of Hesperia, City of Victorville, and San Bernardino County Service Areas 42 (Oro Grande) and 64 (Spring Valley Lake). Although the Town of Apple Valley maintains ownership, operation, and maintenance of its sewer system, VVWRA maintains regional intercept lines that collect and transport wastewater from Town pipelines to a regional wastewater treatment plant in Victorville. The Victorville wastewater treatment plant treats approximately 10.7 million gallons per day (MGD),[2] and has a design and treatment capacity of 18 MGD. Overall capacity is expected to be expanded to 22 MGD by 2020 and 30 MGD by 2025.[3]

The Apple Valley Subregional Water Reclamation Plant near Brewster Park is a new VVWRA facility that treats a portion of locally generated wastewater, while all solids and other wastewater continue to be treated at the Victorville treatment plant. The new plant produces about one million gallons per day of recycled water to be used for irrigation of the Apple Valley Golf Course and other irrigated spaces.[4]

The local sewer facilities within the Village Specific Plan area are located in Assessment District 2A, which was established in 1982. The area generally includes existing underground sewer lines running in a south to north direction. Properties south of Highway 18 collect sewer in the north-south roads of Manhasset Road, Quinault Road, and Navajo Road. These sewers are collected along Highway 18, connecting to sewers in a north-south direction primarily at Navajo Road, but also Quinault Road north of Highway 18. Sewage from AD 2A flows generally north to the Lift Station VVWRA Nanticoke AD 2, located at the intersection of Standing Rock Road and Nanticoke Road. The Lift Station VVWRA Nanticoke AD 2 pumps the wastewater flows nearly two miles westerly along and parallel to Standing Rock Road to Highway 18 where it flows by gravity to the VVWRA interceptor.

Exhibit B-1 illustrates the Existing Sewer Facilities within the Apple Valley Village Specific Plan area.

The Apple Valley Sewer System Master Plan 2013 evaluated the adequacy of the Town's sewer system based on the assumption that the Town will develop according to land use

1 Town of Apple Valley Sewer System Management Plan (SSMP) Update, September 10, 2019.
2 http://www.vvwra.com, accessed November 12, 2019.
3 "Victor Valley Wastewater Reclamation Authority Sewer Plan, Adopted Policy for Serving the Growth of the Community," August 2005.
4 .Purple Pipe Newsletter, Volume XIII Springs 2018, Victor Valley Wastewater Reclamation Authority.

projections defined in the 2009 General Plan. This report concluded that all three pipeline segments leading to the Lift Station 2A No. 2 are predicted to surcharge due to the lift station's inadequate capacity. Surcharge is anticipated unless additional improvements are installed, in particular the increase of the force main from 4" to 12"[5].

The Town adopted a Sewer Connection Policy in 2006 that requires new development to connect with Town facilities where the development's lots are within one-half mile of existing sewer facilities, which would include the entire Village Specific Plan area. Developments located more than one-half mile from existing facilities are required to install dry sewers or interim "Holding Tank Systems" if approved by the Lahontan Regional Water Quality Control Board (CRWQCB).

The Town and VVWRA assess local and regional sewer connection fees based on the total number of plumbing fixtures. The Town also assesses capacity fees, sewage facilities fees, and Development Impact Fees which are expected to provide adequate funding for extension and maintenance of sewer services to new development.

Exhibit B-2 illustrates the Proposed Sewer Facilities within the Apple Valley Village Specific Plan area. The Town requires new development in the Village to provided sewer facilities and extend sewer infrastructure as development occurs. The sewer improvements will be constructed on an as needed basis as a condition of approval as development occurs.

C. Stormwater Improvements

The Town of Apple Valley Public Works Department is responsible for local drainage management, and the County of San Bernardino Flood Control District ("Flood Control District") is responsible for regional stormwater management within the Village Specific Plan area. The Town defines and manages local facilities through its Master Drainage Plan, which divides the Town and its Sphere of Influence into several subareas and identifies facilities and future needs within each.

Regional stormwater management for the surrounding areas in the Town are provided by the Flood Control District. The Flood Control District implements broad management functions, such as flood control planning, construction of drainage improvements for regional flood control facilities, and watershed and watercourse protection related to those facilities. It has power of taxation, bonded indebtedness, land and water rights acquisition, and cooperative partnerships with local, state, and federal agencies in order to carry out its mandated responsibility. Decisions related to the Flood Control District are made by the San Bernardino County Board of Supervisors. The District is subdivided into several geographic zones; the Town of Apple Valley is fully within District Zone 4.

The Town is required to monitor its Master Drainage Plans every five years to update changes to local and regional drainage and flood conditions. It has established per unit developer impact fees for storm drainage facilities for residential and

[5] Town of Apple Valley Sewer System Master Plan Update, August 2013.

commercial/industrial development to offset the cost of improvements due to increased development.

Exhibit C-1 illustrates the existing drainage flows in the Village area. The elevation of the area within the Village Specific Plan is generally 2,940', and slopes in a northern direction towards at an average slope of 0.3% to a low point in the Apple Valley Dry Lake region. There are no storm drain catch basins or storm drain lines within the current area, largely due to the low slopes and lack of location to drain any storm drain infrastructure to receiving waters within the region. As presented in the Apple Valley Village Corridor Enhancement Plan Drainage Study, "Appendix A" attached, there are two existing trapezoidal channels with an existing capacity of 77 cfs. These channels parallel to the north and south of Highway 18, terminating near a wash on the northwest corner of Central Road and Highway 18.

The reconstruction of the existing frontage roads along Highway 18 would require the need to remove and/or reconstruct the existing trapezoid channels. Two alternatives are presented for the recommended drainage improvements along the Highway 18 corridor from Navajo Road to Central Road.

Alternative 1

Exhibit C-2 illustrates the Alternative 1 recommended drainage improvements for the Highway 18 corridor. The recommended drainage improvements would be to replace the existing channels with larger capacity box culverts in a similar lay out to the existing channels. Typically, Caltrans requires the 25 year storm event to be conveyed under the Highway, so a preliminary box culvert size for an underground storm drain along Highway 18 to replace the existing drainage ditches, is recommended to be a double 6 foot by 6 foot box culvert. Depth of storm drains need to be as shallow as possible due to areas mild slopes. Additional catch basins at intersections of local flooding could enhance the existing system. At its outlet, a bio swale and combination basin and/or drywells would provide for some cleanup of the storm water and mitigate some of the volume.

Alternative 2

This alternative would be to provide upstream improvements, such as detention basins to reduce the drainage flows to the Village area. Exhibit C-3 illustrates the Alternative 2 recommended drainage improvements for the Highway 18 corridor. With the reduced drainage flows, the underground storm drain along Highway 18 to replace the existing drainage ditches, would consist of a 54-inch pipe.

At present there are some drainage devices upstream, but they are too small to have any effect on storm flows, such as the basins at the Community Center at the southeast corner of Navajo Road and Powhattan Road. A few drywells are located in the area upstream to the Village, however drywells are primarily for nuisance flows. Any capacity of storm water captured by drywells would only amount to approximately 0.02% of the storm flows. The construction of upstream basins would reduce the storm flows. Exhibit C-4 illustrates the potential locations of the proposed basins. The best basin opportunity would be along Navajo, west side, just north of Bear Valley Road and since it is about a

mile and one half upstream of the site 40 acres could be used there. Also, there is some vacant land between Ottawa Road and Maccauly Road that looks large enough for a second basin and could work well there. Other locations include the vacant land downstream of the Junior High on Navajo Road downstream along Nomwakett Lane. The biggest drawback to the upstream basins alternative is the sizable areas of the basins needed to provide mitigation. One-hundred-year storm event mitigation could require a total of 110 to 180 acres. Also, basins upstream of Bear Valley Road could provide some benefit in volume reduction and reduce the size of the downstream basins.

The locations and sizing of the proposed detention basins will require additional analysis. The Town Engineering staff has started discussions with the County Flood Control District to examine funding through the allocations to the County Flood Control District Zone 4.

D. Roadway Maintenance

The area includes a small network of primarily paved roadways. Running through the Specific Plan area is Highway 18, a four lane divided road containing an 18' wide median, owned and maintained by Caltrans District 8. From the Village area, the highway turns to the northwest and is a major arterial for the Town, ultimately connecting with Highway 15 in Victorville via D Street and Stoddard Wells Road.

The Village Specific Plan area is bounded by Navajo Road (4-lane median divided, major roadway with 104' ROW) to the west, Central Road (2-lane, major roadway with 104' ROW) to the east, Esaws Ave (2-lane local road) to the north and Ottawa Road (2-lane, secondary road with 88' ROW) to the south.

The remainder of the streets run through the Village area in a grid layout with north-south roads (John Glenn, Pawnee, Hitt) and east-west roads (Powhatan, Arapahoe). All of these roads are designated as Local Commercial Streets with a 66' ROW, developed with crowned asphalt that drain to either curb and gutters, curbs, or drainage ditches.

Aside from Highway 18, which is owned and maintained by Caltrans, the Town is responsible for roadway construction and maintenance. Any future development will be responsible for a fair share of roadway improvements via development impact fees, which have been established as transportation impact fees through the Town's Developer Impact Fee schedule. These are assessed per square foot for commercial and industrial development. Gas taxes, Proposition 42 Traffic Congestion Relief funds, Local Transportation Funds, and Measure I funds are also used for the construction and maintenance of streets and highways.

The area's roads have several deficiencies that could be improved within the right-of-way. The ADA constraints should be addressed first since there are several roads that do not have sidewalks, have non-ADA curb ramps, and have ADA-deficient driveways. In support of pedestrian improvements, additional signage could be installed form improved pedestrian safety. Several of the roads could have additional striping such as centerlines, edge lines, crosswalks, and turn arrows. Furthermore, Class III chevron striping and Class II bike lanes could be installed for improved bicycle access.

E. Public Safety: Police and Emergency Preparedness

Law Enforcement
Law enforcement services are provided by the Town of Apple Valley which contracts with the San Bernardino County Sheriff's Department. The Apple Valley Police/Sheriff Station is located in the Civic Center at 14931 Dale Evans Parkway in Apple Valley. Its staff includes 51 sworn personnel and 13 general employees.[6] In 2018, staffing levels resulted in a ratio of one deputy per 1,987 residents,[7,8] and the Department responded to 67,988 calls for service.[9]

The Department has set a target ratio of 1 deputy per 1,500 residents.[10] The Town expends approximately 43% of its General Fund toward Sheriff services.[11] The Town has established Development Impact Fees to fund additional law enforcement facilities; these are assessed per dwelling unit and per square foot of commercial/industrial development.

Emergency Preparedness
The Town's Public Safety budget includes expenditures for emergency and disaster preparedness, including but not limited to the Emergency Operations Plan, operation of the Emergency Operation Center (EOC) at the Apple Valley Unified School District's Administration Campus, emergency response training and coordination, and public education and drills. Inclusion of this program places the Town in position to receive Federal Emergency Management Assistance (FEMA) reimbursement funds. In the event of an emergency, the Apple Valley EOC reports directly to the County Office of Emergency Services who can assist the Town with requests for state and federal assistance. Funding for the Emergency Preparedness program is through the Town's General Fund, the Apple Valley Fire Protection District, and a Federal Emergency Management Program Grant (EMPG).

Emergency medical services are provided by American Medical Response, AMR, a private company. This is further discussed under the Fire Department section.

F. Fire Department

The Apple Valley Fire Protection District (AVFPD) provides fire protection and emergency response services to a population of nearly 94,000 in a service area covering 206 square miles, including the Town of Apple Valley, and unincorporated land east of Apple Valley.

The District employs 52 full-time and 4 part-time and reserve personnel.[12] In 2018, it

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6 http://wp.sbcounty.gov/sheriff/patrol-stations/apple-valley/, accessed November 12, 2019.
7 https://www.applevalley.org/services/economic-development/commercial/demographics, accessed November 12, 2019.
8 p. 102, "Town of Apple Valley Adopted Budget, Fiscal Year July 1, 2019 – June 30, 2020"
9 p. 101, "Town of Apple Valley Adopted Budget, Fiscal Year July 1, 2019 – June 30, 2020"
10 "Town of Apple Valley General Plan," adopted August 11, 2009.
11 p. 27 & 102, "Town of Apple Valley Adopted Budget, Fiscal Year July 1, 2019 – June 30, 2020"
12 http://avfpd.org/about-us/, accessed November 6, 2019.

responded to more than 13,422 service calls, including fires and medical emergencies.[13] It staffs five fire stations full time, all of which provide paramedic services. The closest station is the headquarters office located within the Village Specific Plan area at 22400 Headquarters Drive. Response times are typically within 6 minutes.[14]

The desired staffing ratio of full-time fire personnel to population is 1:1,500.[15] The District's 2019-20 budget revenues total $13.4 million and expenditures total $12.9 million.[16] Operations are funded through two main revenue sources: property taxes and special tax measures. In 2016, voters approved Measure A, a special tax measure to help fund the District, allowing it to open two previously closed fire stations and reduce response times. The District also receives revenues from Development Impact Fees which are collected by the Town from developers for new development occurring within the District.

Emergency Medical Services

American Medical Response (AMR) Victorville is under contract to San Bernardino County to provide emergency, non-emergency, and stand-by medical services to High Desert communities, including Apple Valley. It responds to approximately 40,000 calls annually and employs an estimated 130 EMTs and Paramedics.[17]

G. Parks and Recreation

The Town of Apple Valley Parks and Recreation Department is responsible for planning, operating, and maintaining parks and recreational facilities within the specific plan area. There are currently 370 acres of parks and open space within 6 mini parks, 2 neighborhood parks, 3 community parks, 2 special use parks, and 4 undeveloped park properties in Apple Valley.[18] The special use parks include the Apple Valley Golf Course and Horsemen's Center. The closest developed park facilities are the James Woody Park (located within the Village area) and the Yucca Loma Park (0.3 miles to the west).

The Town's target parkland standard is 4.5 acres of developed parkland per 1,000 residents.[19] The Town collects Park fees through its Development Impact Fee schedule based on a per residential unit and per square foot commercial/industrial development basis. As authorized by the Quimby Act of 1975, the Town has adopted an ordinance to require dedications of land or in-lieu fees for development of new, or rehabilitation of existing, park facilities. A portion of the 1% property tax allocation it receives from the County is also allocated to parks and recreation.

H. Public Services and Facilities

The Village Specific Plan area is within the service areas of the following public services

13 P. 9, "Apple Valley Fire Protection District 2019-20 Final Budget".
14 http://avfpd.org/fireems/ems-unit/, accessed November 8, 2019.
15 Town of Apple Valley General Plan, 2009.
16 "Apple Valley Fire Protection District 2019-20 Final Budget"
17 http://www.amr.net/home/victorville, accessed November 11, 2019.
18 "Apple Valley Parks and Recreation Master Plan, Final Plan," MIG, Inc., May 2013.
19 Ibid.

providers:

- Domestic Water: The Town is served by several water private water service providers, of which Liberty Utilities and Golden State Water Company are the largest.
- Solid Waste Management: Burrtec Waste Industries
- Sewer: Town of Apple Valley
- Electricity: Southern California Edison
- Natural Gas: Southwest Gas Company
- Telecommunications: Frontier, Charter Spectrum
- Medical Services: St. Mary Medical Center, American Medical Response (AMR)

Domestic Water

Domestic water for existing development is provided by domestic water service lines. Liberty Utilities provides water services to the majority (81%) of the Apple Valley population, including the area within the Village Specific Plan. Liberty pumps 100% of its water from the Alto subarea of the Mojave River Basin groundwater aquifer from 20 wells. It has approximately 20,000 service connections, 470 miles of water pipelines, 11 reservoirs, and 8 booster pump stations.[20] Liberty's 2015 Urban Water Management Plan concluded that it can meet water demands during normal, single dry, and multiple dry years through the year 2040, and groundwater supplies available to Liberty in the Mojave Basin area are considered reliable over the long term.[21]

Exhibit H-1 illustrates the Existing Water Facilities within the Apple Valley Village Specific Plan area.

Exhibit H-2 illustrates the Proposed Water Facilities within the Apple Valley Village Specific Plan area. The Town requires new development in the Village to provide water service and extend water infrastructure as development occurs. The water improvements will be constructed on an as needed basis as a condition of approval as development occurs.

Solid Waste Management

Burrtec Waste Industries provides the Town with solid waste collection and disposal services. Through its contractual agreement with Apple Valley, Burrtec's AVCO Disposal collects non-hazardous solid waste and hauls it to the Victorville Landfill, located at 18600 Stoddard Wells Road. The landfill is operated by San Bernardino County. It has 491 total acres, 341 disposal acres, and is permitted to receive up to 3,000 tons daily.[22] Its remaining capacity is estimated at 81,510,000 cubic yards,[23] and the estimated closing date is October 2047.[24] Solid waste collection and disposal services are provided on a fee basis to residential, commercial, and industrial customers.

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20 "Liberty Utilities Celebrates Completion of $3.5 Million Well Project in Apple Valley," April 16, 2019, California.libertyutilities.com.

21 "Liberty Utilities – Apple Valley, 2015 Urban Water Management Plan," Stetson Engineers, Inc., June 2016.

22 http://calrecycle.ca.gov/SWFFacilities/Directory/36-AA-0045/Detail/, accessed November 12, 2019.

23 Ibid.

24 County of San Bernardino Solid Waste Facility Permit, Facility Number 36-AA-0045, issued June 2, 2010.

AVCO also provides weekly pick up of recyclable materials for residential, commercial and industrial development. Recyclables are sorted at the Victor Valley Materials Recovery Facility (MRF) at 17000 Abbey Lane. The facility is capable of processing 20 tons of material per hour.[25]

Residential household hazardous wastes (HHW), such as pesticides, batteries, medications, paint thinners, electronics, and gasoline and fuels, are accepted at the Apple Valley Public Works Yard at 13450 Nomwaket Road.

The Town participates in the Zero Waste Communities of San Bernardino County (ZWC) collective, as well as the Mojave Desert and Mountain Recycling Joint Powers Authority (JPA) along with Adelanto, Barstow, Big Bear, Needles, Twentynine Palms, Victorville, Yucca Valley, and unincorporated areas of San Bernardino County. The JPA addresses solid waste contracts, facilities, issues, and education for its member cities and some unincorporated areas in the County.

Electricity

The Village area is within the service area of Southern California Edison (SCE), which serves the Town of Apple Valley and High Desert region. SCE has four major SCE 115kV electric transmission corridors in the region, from which power is delivered to local residential, commercial, industrial and institutional customers by means of substations and distribution lines. Substation voltages are 33kV to 115kV. Distribution lines and circuits range from 33kV to 6.9kV.[26] The Town Ordinance No. 14.28.020 requires that all new electric lines of 34.5kV or less in Apple Valley be installed underground.

In the short-term, no immediate increase in demand for electricity is anticipated. Development is expected to occur gradually over time and will contribute to the regional demand for electricity. Developers will be responsible for the cost for extension of electricity facilities and hook ups to properties. As a publicly traded company, SCE has developed a rate structure that includes the expansion of facilities to accommodate growth. The power lines in the Specific Plan area are generally overhead. North of Highway 18, the power lines generally run along the back of lots through an electrical easement, connecting with the back of properties. South of Highway 18, the power lines are generally larger and typically run along the back of lot, but do not have a dedicated easement. Some streets (such as Nomwaket Road) have power lines running along the street set back behind drainage ditches.

Undergrounding power lines in areas where the overhead lines run behind lots without dedicated easements would be technically infeasible. SCE could underground lines through dedicated easement areas, but nothing could be developed on top of these easements and undergrounding would have a high cost/benefit ratio. Undergrounding future power lines will need to be covered by the developer (for private developments) and the City for any public works projects.

[25] http://www.applevalley.org/services/solid-waste-trash/materials-recovery-facility-mrf, accessed November 12, 2019.

[26] Letter of correspondence, Nancy Jackson, Southern California Edison, July 25, 2008.

Natural Gas

Southwest Gas Company (SWG) provides natural gas service to the Town and its planning area through a series of pipelines of differing sizes and pressure capabilities. Transmission, supply, and distribution lines provide service to most portions of the Town and its Sphere of Influence.

SWG has a network of high-pressure natural gas corridors along: Central Road-Quarry Road to Ottawa Road; Thunderbird Road-Central Road to Highway 18 and Quantico Road; Ottawa Road-Central Road to Kiowa Road; Del Oro Road-Kiowa Road to Tussing Ranch Road; Del Oro Road-Kiowa Road to Joshua Road; Bear Valley Road-Kiowa Road to the Mojave River; and Apple Valley Road-Bear Valley Road to Yucca Loma Road. There are high pressure lines (8 inch and 12 inch) along Central Road and an 8 inch line along Ottawa Road in the Specific Plan area. These lines generally are on the border of the study area.

The high-pressure system consists of a combination of 4-inch, 6-inch, 8-inch, and 12-inch high-pressure lines that operate at 240 pounds per square inch (psi). These lines use 36-inch lines with pressure levels ranging from 400 to 700 psi, with pressure reduced at different limiting stations, which then direct the gas to distribution lines. Distribution lines are 2 to 8 inches in diameter, with pressure levels ranging from 175 to 400 psi, and are located within most public rights-of-way. The pressure is reduced again at regulator stations, which transfer natural gas to distribution lines for transportation to homes and businesses. Distribution lines are 2 to 4-inch diameter steel or plastic pipes that operate at 45 to 55 psi.[27]

SWG works closely with developers to accommodate new development through the extension of services and facilities as demand load warrants. New facilities, including natural gas distribution lines and service tees, will need to be constructed to serve new development in the Village area.

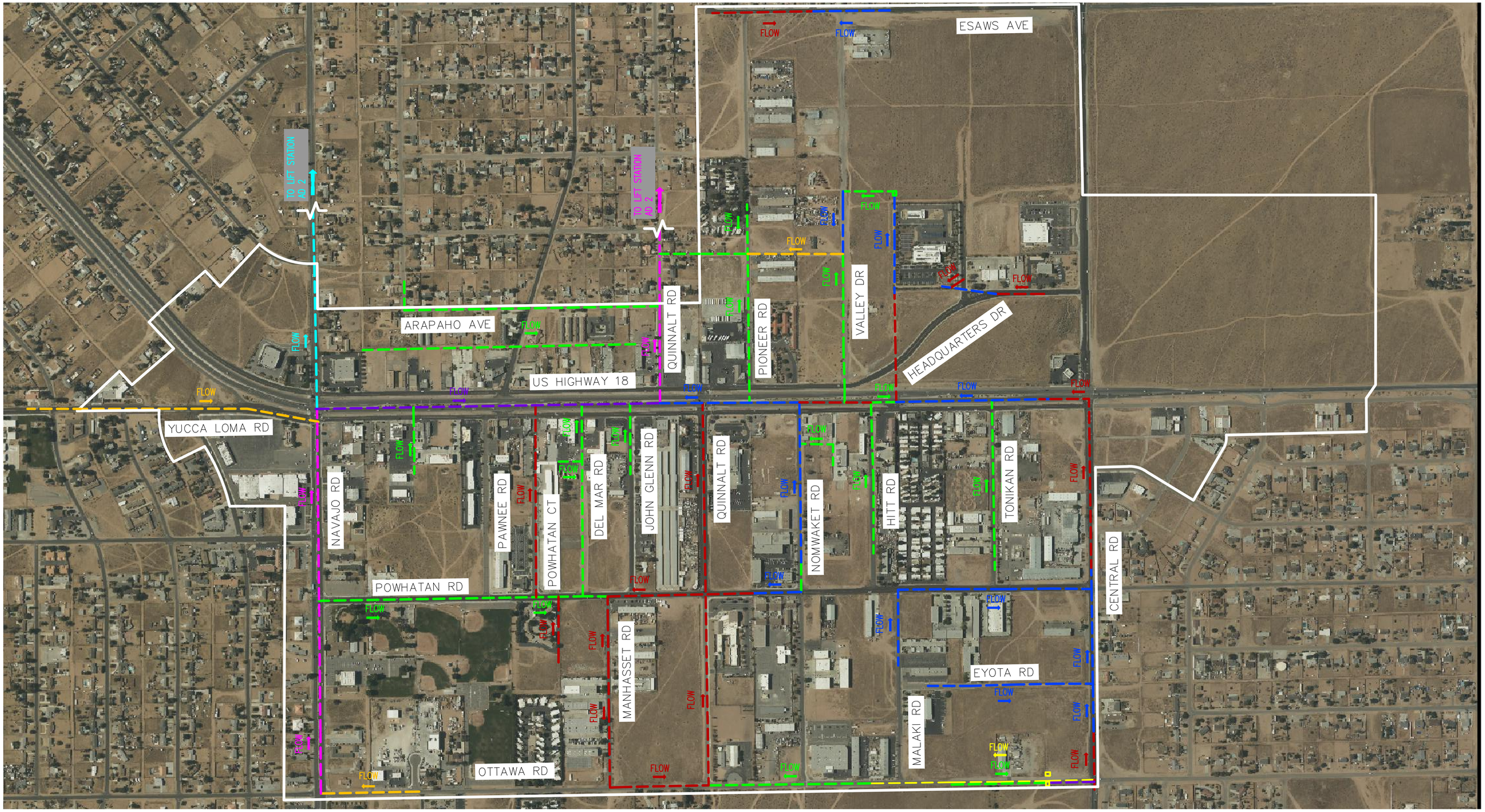
Telecommunications

Frontier and Charter Spectrum provide telecommunications services, including telephone, high-speed Internet service, and cable television, to the high desert region, including the Village area of Apple Valley.

Medical Services

The nearest hospital to the Specific Plan area is St. Mary Medical Center, a licensed 212-bed hospital located at 18300 Highway 18 in Apple Valley (5.3± miles northwest of the Village). Its service area includes more than 372,000 residents in the communities of Apple Valley, Heperia, Lucerne Valley, Adelanto, Victorville, Helendale, and surrounding areas. It is staffed by more than 1,751 employees and has professional relationships with more than 300 doctors.[28] Major programs include a fully accredited cardiovascular surgery program, Level II Neonatal Intensive Care Unit, diagnostic imaging, emergency medicine, and obstetrics.

[27] Personal communication, Kevin Lang, Southwest Gas, April 2008.
[28] "St. Mary Medical Center 2017 Community Health Assessment Report."



LEGEND

- FORCE MAIN WET WELL AND LIFT STATION
- 4" FORCE MAIN
- 6" SEWER LINE
- 8" SEWER LINE
- 10" SEWER LINE
- 12" SEWER LINE
- 15" SEWER LINE
- 18" SEWER LINE
- 21" SEWER LINE

PLAN

SCALE: 1"= 300'

N

18484 Outer Hwy 18 N, Ste225
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DAVID EVANS AND ASSOCIATES INC.

APPLE VALLEY VILLAGE SPECIFIC PLAN

EXISTING SEWER IMPROVEMENTS

EXHIBIT B-1

Drawing Name: P:\TV\DVS00000001\GRADING\EXCEXHIBITS\APPLEVALLEY_SEWERMAP_EXISTING.dwg
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LEGEND

▪	FORCE MAIN WET WELL AND LIFT STATION	━━━	PROP. 8" SEWER LINE	‒ ‒ ‒	EX. 10" SEWER LINE	‒ ‒ ‒	EX. 18" SEWER LINE
		‒ ‒ ‒	EX. 6" SEWER LINE	‒ ‒ ‒	EX. 12" SEWER LINE	‒ ‒ ‒	EX. 21" SEWER LINE
		‒ ‒ ‒	EX. 8" SEWER LINE	‒ ‒ ‒	EX. 15" SEWER LINE	‒ ‒ ‒	EX. 4" FORCE MAIN

PLAN

SCALE: 1"= 300'

N

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Apple Valley, California 92307
Phone: 760.524.9100

APPLE VALLEY VILLAGE SPECIFIC PLAN

PROPOSED SEWER IMPROVEMENTS

EXHIBIT B-2

EXISTING BOX CULVERT TYP.

ROAD

PAWNEE ROAD

EXISTING DRAINAGE DITCHES

QUINNAULT ROAD

PIONEER ROAD

CONFERENCE

CENTER DRIVE

DRIVE

HEADQUARTERS

ROAD

LOW FLOWS

Q_{25}=230cfs

YUCCA LOMA ROAD

HIGHWAY 18

EXISTING SLOTTED DRAIN

ALGONQUIN

POWHATAN ROAD

PAWNEE ROAD

DEL MAR ROAD

JOHN GLENN ROAD

HP

QUINNAULT ROAD

NOWAKET ROAD

HITT ROAD

TONIKAN ROAD

CENTRAL

POWHATAN

ROAD

NAVAJO

Q_{100}=239cfs

EXISTING DRYWELLS

LEGEND

- EXISTING CONCRETE TRAP CHANNELS
- EXISTING DRYWELLS
- DIRECTION OF FLOW
- BOX CULVERT
- HP HIGH POINT

N

NTS

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APPLE VALLEY VILLAGE
SPECIFIC PLAN

EXISTING DRAINAGE FLOWS

EXHIBIT C-1

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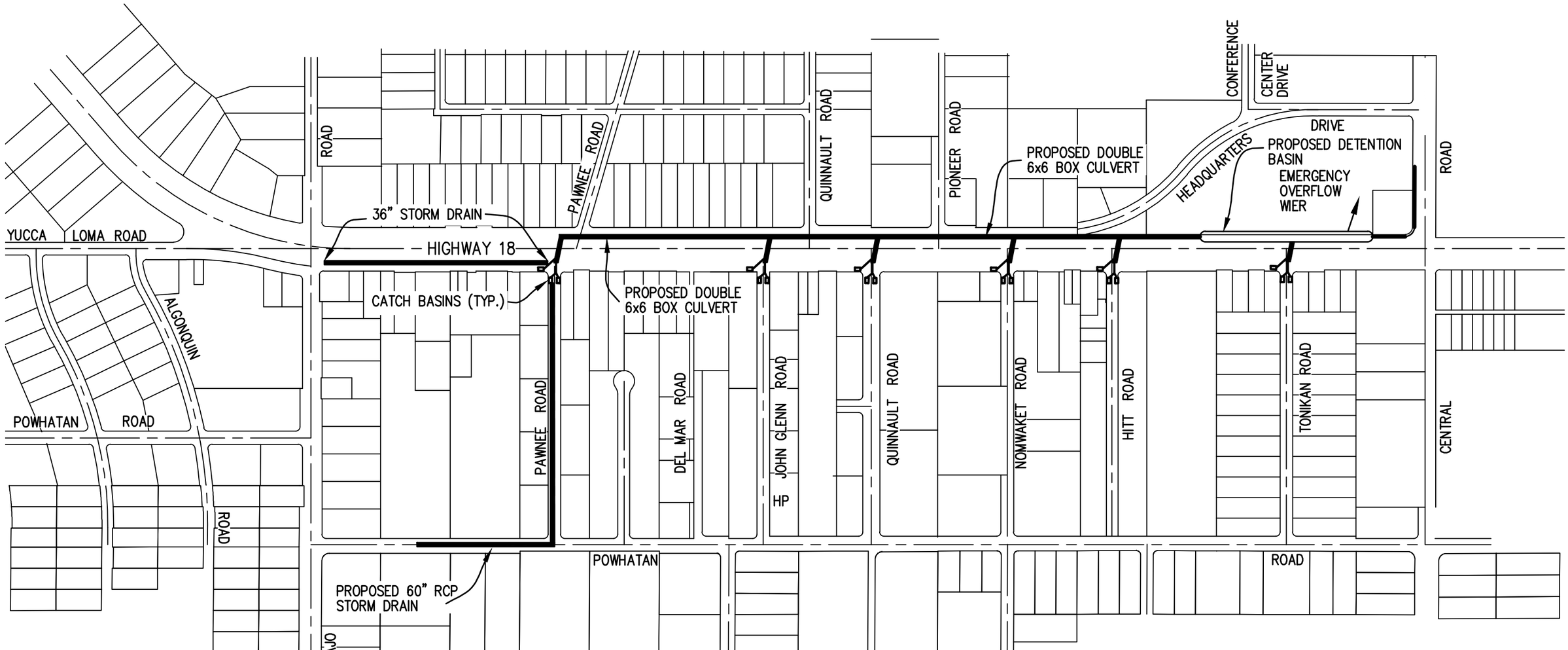

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NTS

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APPLE VALLEY VILLAGE
SPECIFIC PLAN

DRAINAGE CONCEPT
ALTERNATIVE 1

EXHIBIT
C-2

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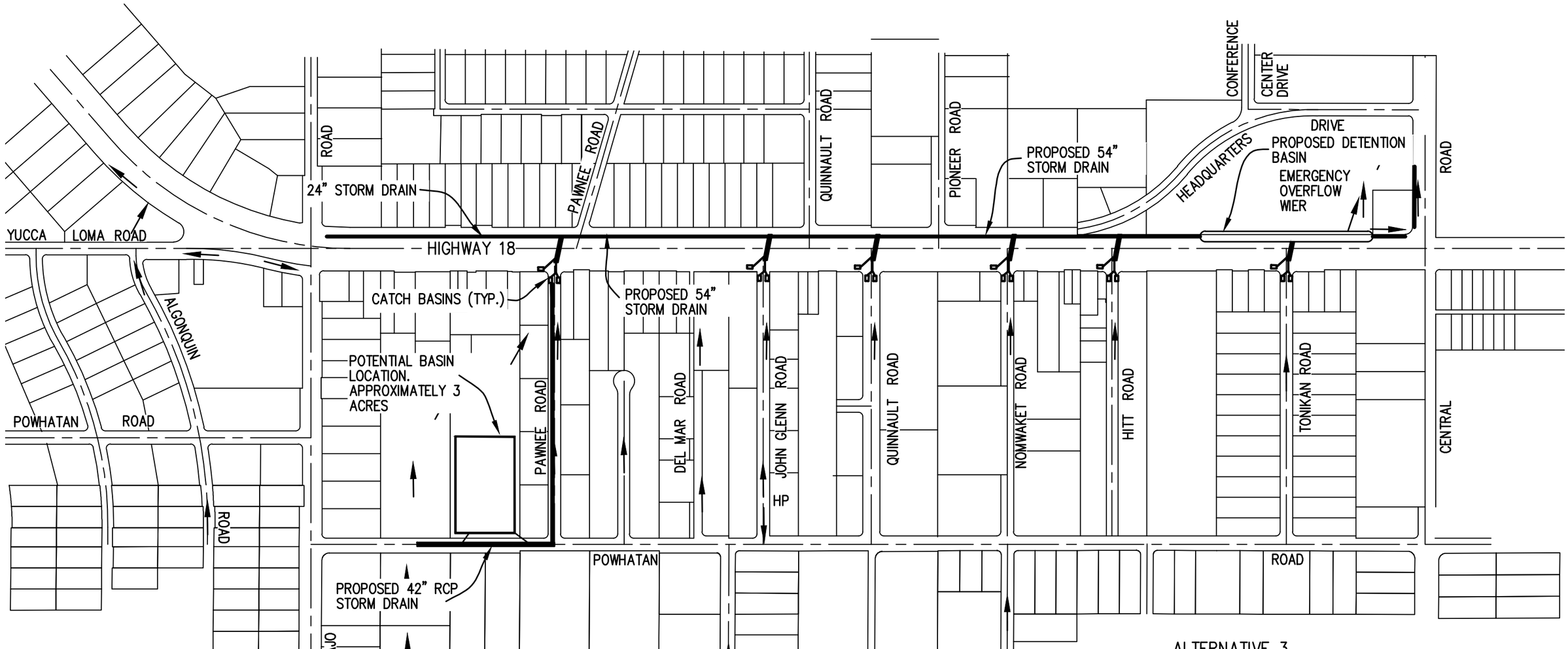

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APPLE VALLEY VILLAGE
SPECIFIC PLAN

DRAINAGE CONCEPT
ALTERNATIVE 2

EXHIBIT
C-3

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APPLE VALLEY VILLAGE
SPECIFIC PLAN

POTENTIAL OFFSITE
BASIN AREAS

EXHIBIT
C-4

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ESAWS AVE
ARAPAHO AVE
US HIGHWAY 18
YUCCA LOMA RD
QUINNALT RD
PIONEER RD
VALLEY DR
HEADQUARTERS DR
PAWNEE RD
POWHATAN CT
DEL MAR RD
JOHN GLENN RD
QUINNALT RD
NOMWAKET RD
HITT RD
TONIKAN RD
CENTRAL RD
POWHATAN RD
NAVAJO RD
MANHASSET RD
EYOTA RD
MALAKI RD
OTTAWA RD

LEGEND

- 4" WATER LINE
- 6" WATER LINE
- 6.63" WATER LINE
- 8" WATER LINE
- 8.63" WATER LINE
- 12" WATER LINE
- 12.75" WATER LINE
- 14" WATER LINE

PLAN

SCALE: 1"= 300'

N

18484 Outer Hwy 18 N, Ste225
Apple Valley, California 92307
Phone: 760.524.9100
DAVID EVANS AND ASSOCIATES INC.

APPLE VALLEY VILLAGE SPECIFIC PLAN

EXISTING WATER IMPROVEMENTS

EXHIBIT H-1

Drawing Name: P:\17\0450000001\GRAPHICS\EXHIBITS\APPLEVALLEY_WATERMAP_EXISTING.dwg
Last Opened: Dec 13, 2021 - 1:23pm by: pat

ESAWS AVE
ARAPAHO AVE
US HIGHWAY 18
YUCCA LOMA RD
QUINNALT RD
PIONEER RD
VALLEY DR
HEADQUARTERS DR
PAWNEE RD
POWHATAN CT
DEL MAR RD
QUINNALT RD
NOMWAKET RD
HITT RD
TONIKAN RD
CENTRAL RD
JOHN GLENN RD
POWHATAN RD
NAVAJO RD
MANHASSET RD
EYOTA RD
MALAKI RD
OTTAWA RD

LEGEND

- 12" PROP. WATER LINE
- 8" EX. WATER LINE
- 12.75" EX. WATER LINE
- 6" EX. WATER LINE
- 8.63" EX. WATER LINE
- 14" EX. WATER LINE
- 6.63" EX. WATER LINE
- 12" EX. WATER LINE
- 4" EX. WATER LINE

PLAN

SCALE: 1"= 300'

N

18484 Outer Hwy 18 N, Ste225
Apple Valley, California 92307
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DAVID EVANS AND ASSOCIATES INC.

APPLE VALLEY VILLAGE SPECIFIC PLAN

PROPOSED WATER IMPROVEMENTS

EXHIBIT H-2

Drawing Name: P:\17\0450000001\GRADING\EXHIBITS\APPLEVALLEY_WATERMAP_PROPOSED.dwg
Last Opened: Dec 13, 2021 - 1:22pm by: pat

APPLE VALLEY VILLAGE CORRIDOR ENHANCEMENT PLAN, TOWN OF APPLE VALLEY

DRAINAGE STUDY

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January 23, 2019
Job No: KOAC00000003

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TABLE OF CONTENTS

Introduction:

The Apple Valley Village Corridor Enhancement Plan (Project) is located within the Town of Apple Valley along Highway 18 between Navajo Road and Central Road, as illustrated on Figure 1 and 2, included in Appendix "A". All the land fronting the Outer Highway 18 streets are approximately 80% developed as primarily commercial business on the south side and approximately 65% on the north side. The rest of the land is vacant. Highway 18 has a landscaped median in the center of the road and medians with concrete channels on each side of the Highway, referred to in this study as outer medians. There are local streets called Outer Highway 18 that are on the other side of the outer medians that serve as access to the businesses. Most of the corridor is 200 feet wide and creates a barrier for pedestrians and cyclists, as well as making access to businesses difficult. There are areas of missing sidewalk and can be awkward to navigate for the local citizens.

The project consists of examining and developing transportation alternatives for motorists, bicyclists, pedestrians, equestrians, and transit users. This will consist of data collection and literature review, public outreach, project analysis and plan development.

The purpose of this drainage study is to provide information as to drainage patterns, identify any current areas of flooding and to obtain the preliminary flow rates and compare them to the Town of Apple Valley Master Plan of Drainage (MPD), and show a complimentary storm drain improvement as part of the Corridor Enhancement Plan.

Site Discussion:

The existing site that is to be studied for improvements is a one mile long strip of Highway 18 and consists of approximately 25 acres. All the land upstream of the Project is partially developed with a small percentage being commercial, some apartments, and the rest is single family homes. The land has an average slope of approximately 0.4% from about 4 miles upstream. Further upstream drainage originates from the Ord Mountains in an area known as the Marianas. The Town of Apple Valley has a Master Plan of Drainage (MPD), which was used as a guide for this drainage study. Appendix "B" of this report includes the excerpts of the MPD that presents the information on the existing hydrologic characteristics of the site.

The project site receives a large amount of storm water due to the large water shed upstream. The MPD shows a large wash near Central Road at the project site with a discharge of 7952 cubic feet per second (cfs) in the one hundred year storm event. In review of the USGS Topography map and aerial photographs there is no evidence of large flows that are typically seen in other areas of the region with flows of this magnitude. It is believed that the BNSF Railroad and Bear Valley Road to the south,

limit the amount of storm water passing underneath those two crossings, therefore, this study limited its upstream review to Bear Valley Road, to examine the more localized flows that impact the site.

Also, it should be noted that upstream drainage MPD Line S-01 diverts at Mohawk Road and runs into the S-08 drainage line that runs northerly along Mohawk Road per the Town's Engineering Dept. This has no effect on this study since the study only took 100 cfs of base flows under Bear Valley at the outflow of drainage from the High School at Navajo Road and 50 cfs of base flows from the two pipes that outlet near Algonquin Road.

The MPD presents a 25 year flows of 191 cfs at Ottawa Road and Navajo and conveying those flows north and west to an existing low flow box culvert under Highway 18, approximately 100 feet west of Navajo Road. Currently those flows do not reach there today. That flow crosses Navajo Road just north of Ottawa Road and flows through and around the Community Center and then north towards the project site area.

In the outer medians, there are existing concrete trapezoidal channels (drainage ditches) that have an existing capacity of approximately 77 cfs. The MPD shows the discharge for those channels to be 230 cfs in the 25 year storm event. The southerly channel captures all the upstream flows along the study area mostly via sheet flows crossing the outer Highway and through several small curb openings. There is a small slotted drain inlet at Hitt Road crossing the outer highway and drains into the channel. From the southerly channel, there are three low flow culvert crossings from the south channel into the north channel, crossing under Highway 18. At the easterly outlet storm water flows east to a small swale in front of the existing gas station located at the northwest corner of Highway 18 and Central Road and overflows flow north, behind the gas station, then northeasterly toward the dry lake bed through mostly vacant land. Figure 3, included in Appendix "A", illustrates the existing drainage flows in the project area.

Soil classification around the project site is Hydrologic Soil Group (HSG) "A" (the east 80%) and "C" (the west 20%). Upstream the soil classifications are "A" and "C". The soil classification boundary limit is based on the USDA Web Soil Survey site, included in Appendix 'C' of this report.

Analysis:

Due to the scope of this drainage study, the large Mariana Wash shown on the MPD crossing the project site just west of Central Road, is not specifically addressed. It is assumed the flows in the drainage basin for this facility identified in the MPD spread out into several smaller flow areas. As such, the drainage reaches the project site via the existing small drainage courses and streets. These drainage courses drain into the existing trapezoid channel (drainage ditches) on the south side. Because the flows spread out the drainage flow for the identified Mariana Wash will not be of the magnitude shown on the MPD. This approach was taken due to the fact that no drainage improvements exist

upstream, with the exception of the small culverts crossing under Bear Valley Road west of Navajo Road and the detention basin and small culverts that exist at Apple Valley High School at the southeast corner of Bear Valley Road and Navajo Road.

The study divides the areas upstream of the site into two. One contributing to the crossing on Navajo just south of the Community Center and the other contributing to the rest of the project site. Those results can be seen in the following table;

				Existing Condition			
	Acreage	25-yr (MPD)	25-Yr	100-Yr	25-yr Volume	100-yr Volume	Comments
	(ac)	(cfs)	(cfs)	(cfs)	(Ac Ft)	(Ac Ft)	
Area A1	487	191	162	239	155	198	Flows cross Navajo and flow through the Community Center, then to project site.
Area A2	963	230	236	374	281	362	Flows toward project site
Pipes crossing Bear Valley Road near Algonquin				25			2-24" pipes
Pipes crossing Bear Valley Road, west of Navajo				25			2-24" pipes. (Did not find where these pipes outlet.)
2- Culverts under Bear Valley road west of Navajo.				100			2 box culverts that drain from the detention basin at Apple Valley High School. In the area of Toltec Drive.

Refer to Appendix D for calculation.

As presented in the table above, there was some base flows added to drainage areas to account for drainage under Bear Valley Road.

To mitigate the existing drainage, storm drain improvements are recommended to be constructed. Three alternatives were studied and are discussed in more detail below under Recommendations.

A storm drain in Navajo Road at Ottawa Road is recommended to alleviate the flooding around the Community Center and conveyed to the culverts along Highway 18 or to the

box culvert west of Navajo Road per the Master Plan of Drainage. This flow can be conveyed into a 60-inch RCP or acceptable alternate.

As part of the Corridor Enhancement, a drainage easement is recommended for the outlet area and the use of landscaped bio swale and or drywell or basin combination to help mitigate the overflows at the outlet, since the drainage facilities provided fronting the gas station are inadequate. Overflows will continue to flow historically east and north.

Methodology:

Bonadiman Civil Design Software, Version 7.0 & 7.1 was used for the 25-year & 100-year Hydrological Analysis for San Bernardino County.

- 25-year AMC II Unit Hydrograph Method
- 100-year AMC III Unit Hydrograph Method
- Soil Type A and C
- Mannings Values Used
- Existing Surface n=0.035
- Proposed Surface n=0.015
- Project is located in the Town of Apple Valley

Drainage boundaries were derived using the Apple Valley Quadrangle Topography Map by USGS, as shown on the hydrology map, provided in Appendix B of this report.

Recommendations

The analysis of the project area and its upstream drainage area reveals very mild slopes and no discernable flow lines. Since existing storm drain improvements upstream are very little, it appears flows do not concentrate or are of the magnitude as in the MPD as to the major washes. In the analysis of the upstream area, the 25-year flows are within 15% or so of the MPD flow rates (not including the Mariana Wash). Three drainage alternatives were reviewed as presented below.

Alternative 1

This alternative is to leave the existing concrete channels in place. Clean up, repair cracked and broken areas, repair drainage openings and replace all hardscape between curb and channel along the outer highways. Additional catch basins at intersections of local flooding could enhance the existing system. At its outlet, a bio swale and combination basin and/or drywells would provide for some cleanup of the storm water and mitigate some of the volume. See Figure 4 in Appendix A.

Alternative 2

This alternative would be to replace the existing channels with larger capacity box culverts in a similar lay out to the existing channels. Typically, Caltrans requires the 25

year storm event to be conveyed under the Highway, so a preliminary box culvert size for an underground storm drain along Highway 18 to replace the existing drainage ditches, is recommended to be a double 6 foot by 6 foot box culvert. Depth of storm drains need to be as shallow as possible due to areas mild slopes. Figure 5 in Appendix "A", illustrates the recommended drainage concept in the project area. At its outlet, the same type as in the first alternative is recommended.

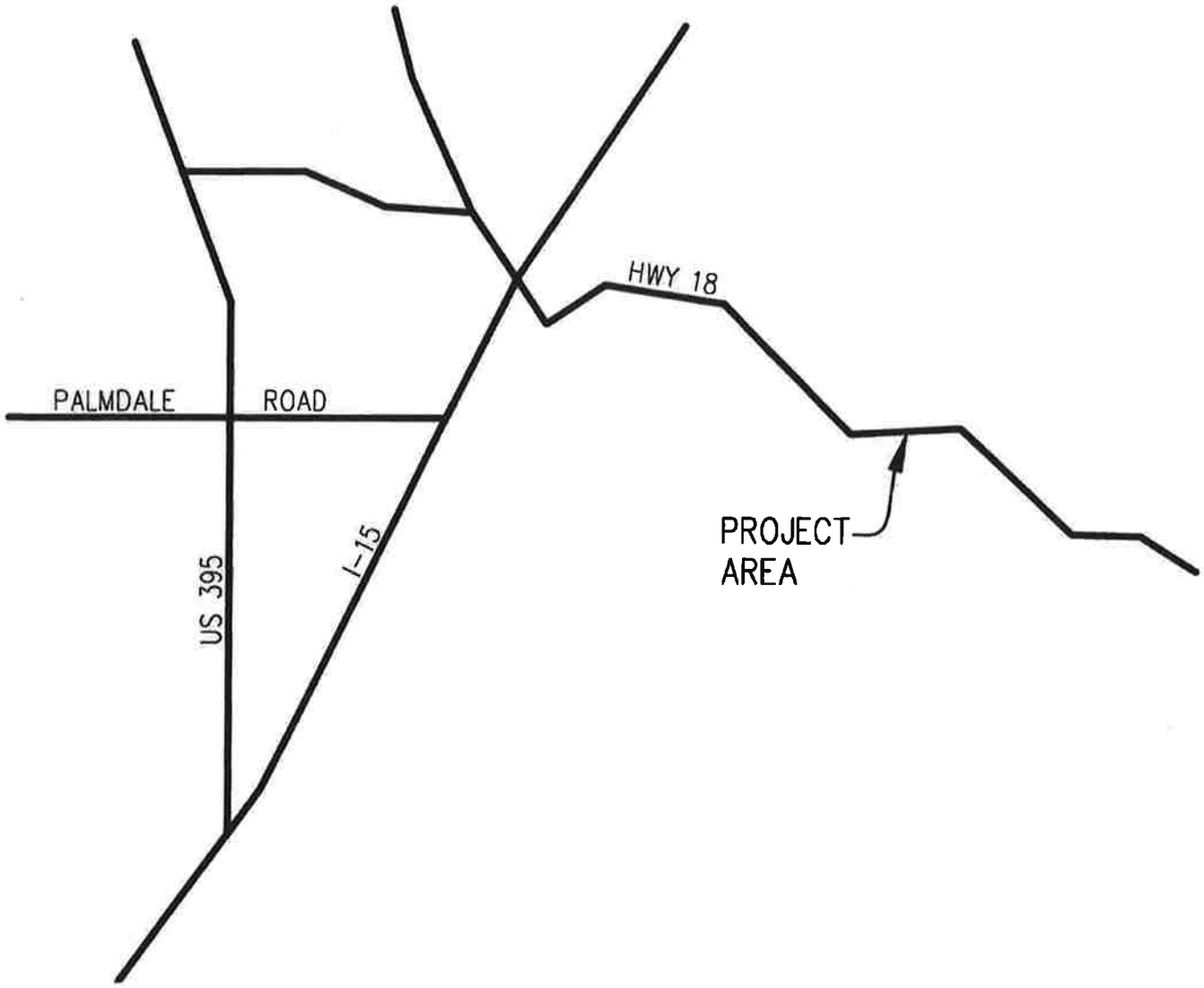
Alternative 3

This alternative would be to provide upstream improvements, such as detention basins to reduce the flows getting to the Village area. At present there are some drainage devices upstream, but they are too small to have any effect on storm flows. Such as the basin the Community Center. From casual observations, that basin does not detain much and is only about an acre in size. A few drywells were also observed, however, drywells are primarily for nuisance flows. Any capacity of storm water captured by drywells wouldn't even amount to 0.02% of the storm flows. As can be seen from the table the storm water volumes for A1 and A2 are quite large and would require large basins. In Area A1, most of that watershed is built out. The only basin opportunity would be along Navajo, west side, just north of Bear Valley Road and since it is about a mile and one half upstream of the site, not the most desirable location, but 40 acres could be used there. Also, there is some vacant land between Ottawa Road and Maccauly Road that looks large enough for a second basin and could work well there. In the A2 area, there is vacant land downstream of the Junior High on Navajo Road that would be a good site and downstream along Nomwakett Lane. See Figure 6 and 7 in Appendix A. The biggest drawback to the basins is sizable area needed to provide mitigation. One hundred year storm event mitigation would require 40-66 acres in area A1 and 73-121 acres in area A2. Even in the 10 year event, large areas would be needed for upstream basins. For area A1, 25-42 acres would be needed and for area A2, 46-76 acres would be needed. The range in size is based on 3' to 5' basin depths. Also, basins upstream of Bear Valley Road could provide some benefit in volume reduction and reduce the size of the downstream basins.

In summary, three alternatives were examined. It may be that a combination of the three alternatives would be an acceptable solution rather than just one alone. This would need to be studied in further detail once the ultimate section of the roadway is determined.

APPENDIX 'A'

- Figure 1 – Vicinity Map
- Figure 2 – Project Area
- Figure 3 – Existing Drainage Flows
- Figure 4 – Drainage Concept, Alternate 1
- Figure 5 – Drainage Concept, Alternate 2
- Figure 6 – Drainage Concept, Alternate 3
- Figure 7 – Potential basins sites upstream of the site



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NTS

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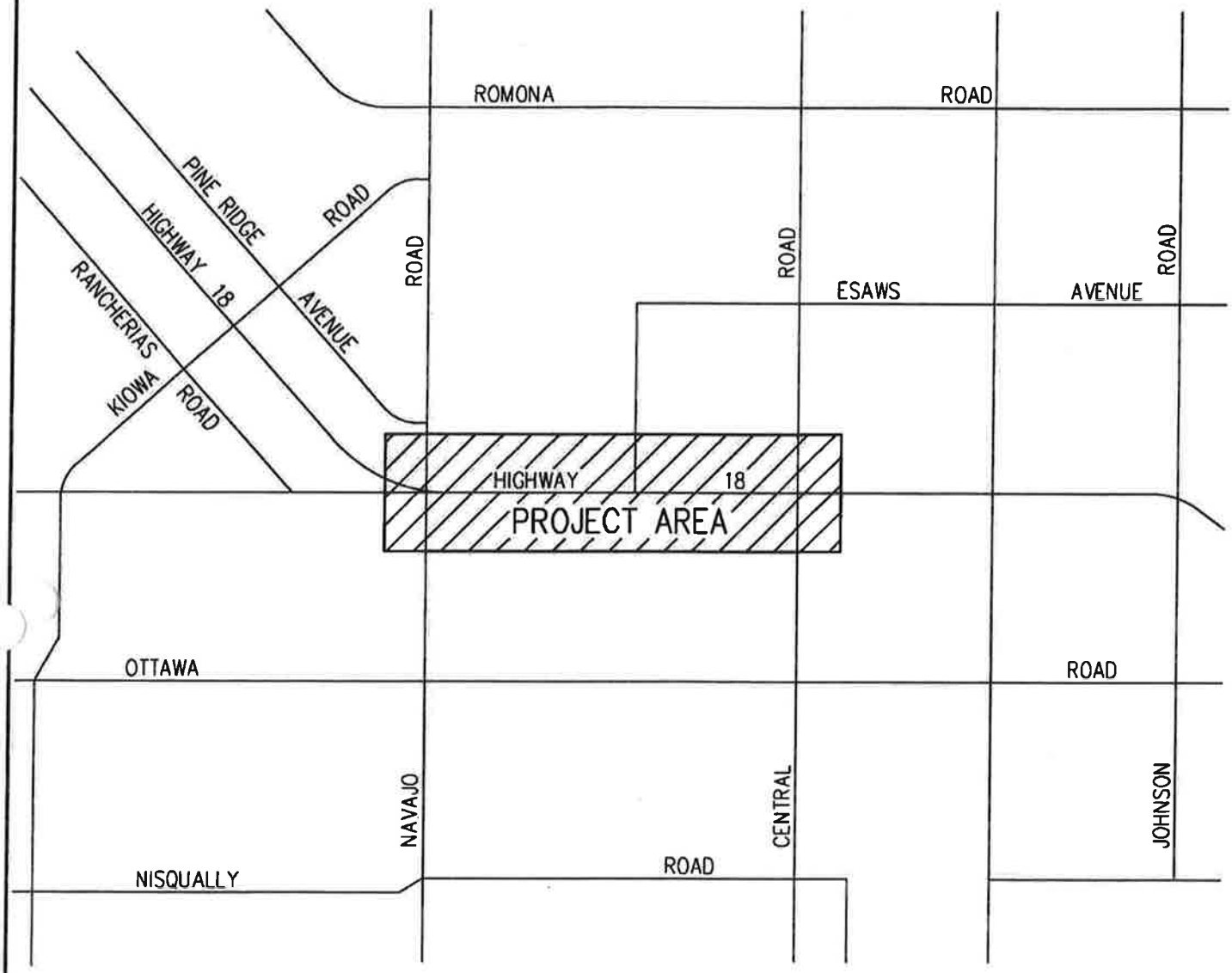
APPLE VALLEY VILLAGE
CORRIDOR ENHANCEMENT PLAN

FIGURE 1
DRAINAGE STUDY
VICINITY MAP



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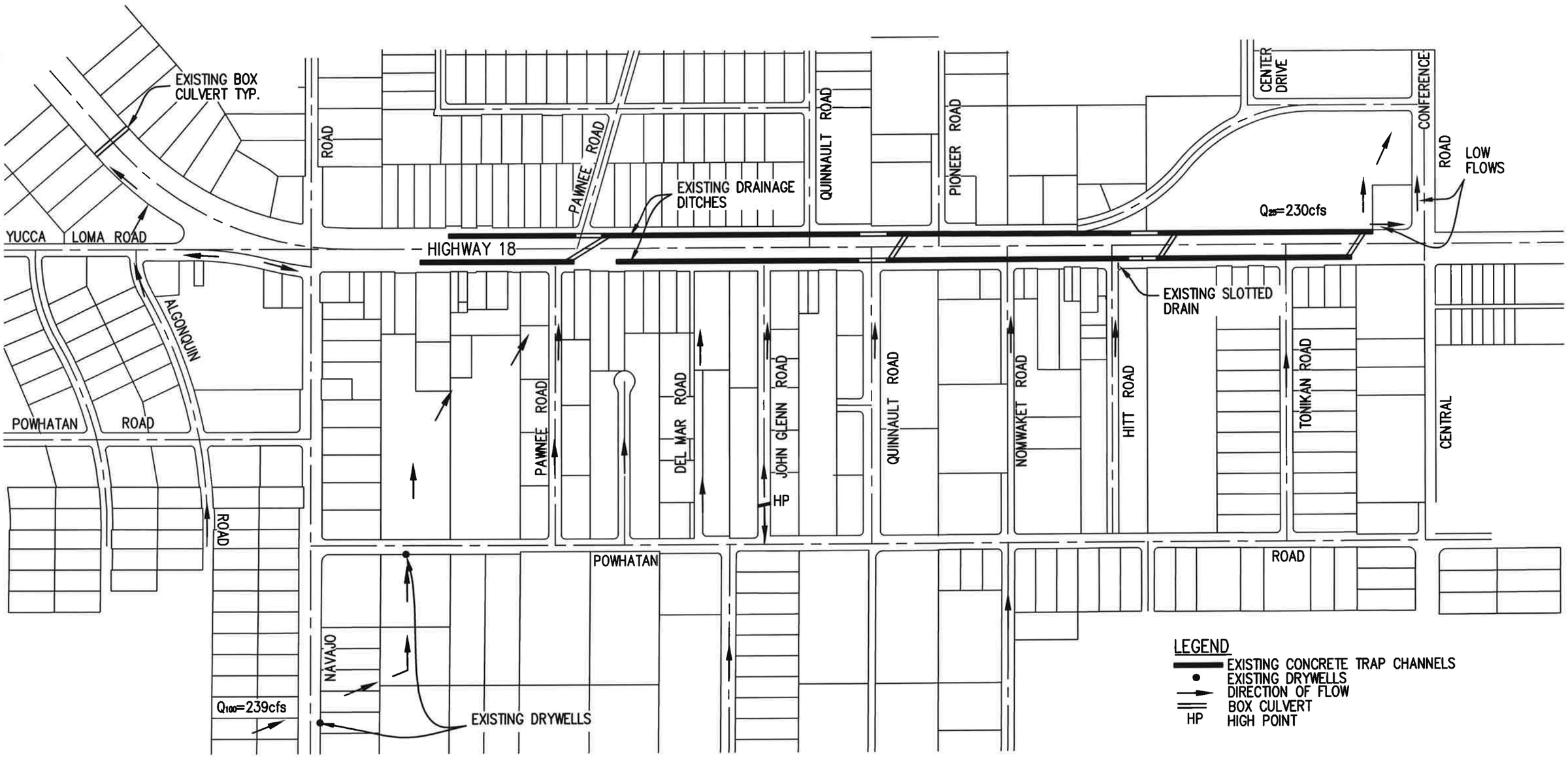
APPLE VALLEY VILLAGE
CORRIDOR ENHANCEMENT PLAN

FIGURE 2
DRAINAGE STUDY
PROJECT AREA



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APPLE VALLEY VILLAGE
CORRIDOR ENHANCEMENT PLAN

FIGURE 3
DRAINAGE STUDY
EXISTING DRAINAGE FLOWS

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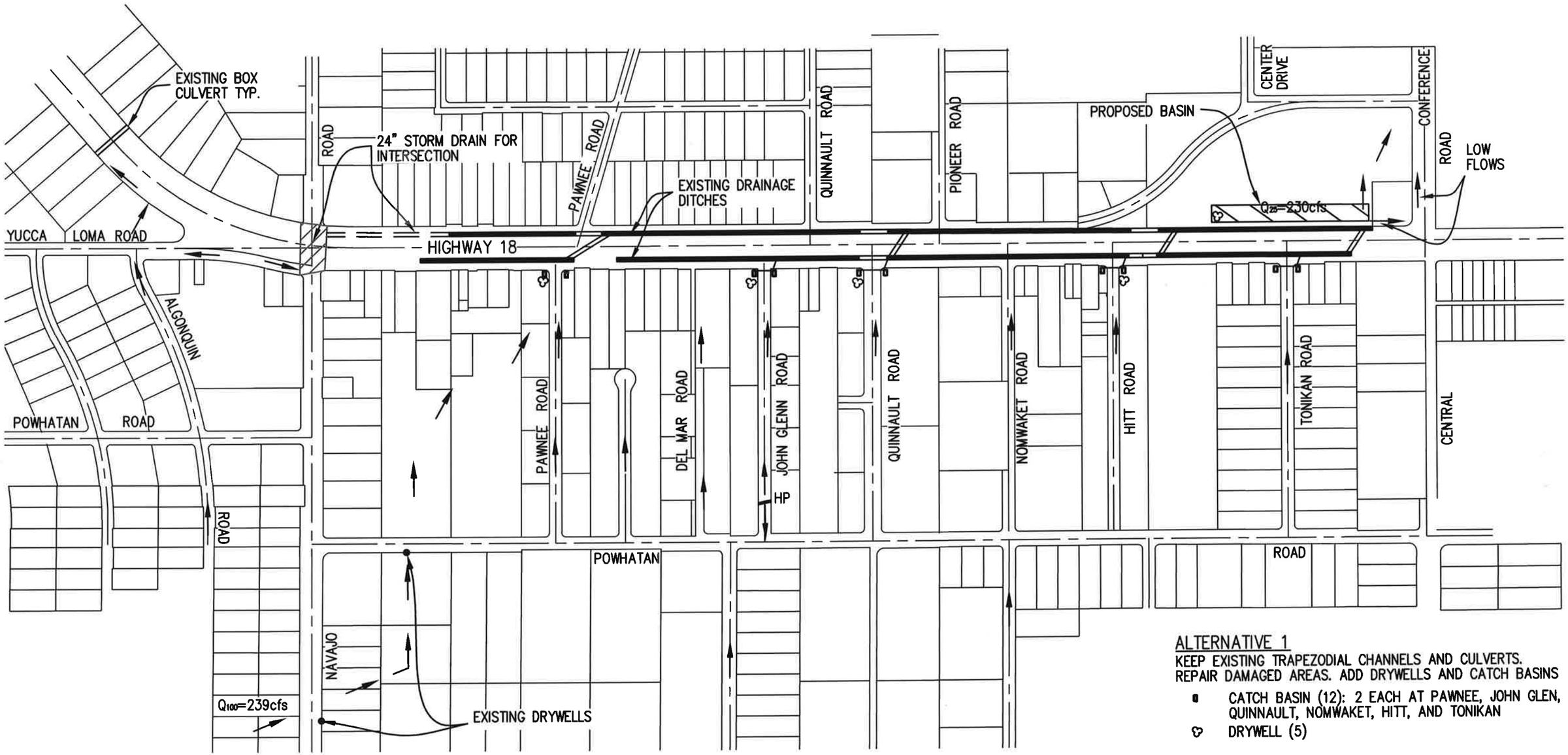

ALTERNATIVE 1

KEEP EXISTING TRAPEZODIAL CHANNELS AND CULVERTS.
REPAIR DAMAGED AREAS. ADD DRYWELLS AND CATCH BASINS

- CATCH BASIN (12): 2 EACH AT PAWNEE, JOHN GLEN, QUINNAULT, NOMWAKET, HITT, AND TONIKAN
- DRYWELL (5)

N

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APPLE VALLEY VILLAGE CORRIDOR ENHANCEMENT PLAN

FIGURE 4
DRAINAGE CONCEPT
ALTERNATIVE 1

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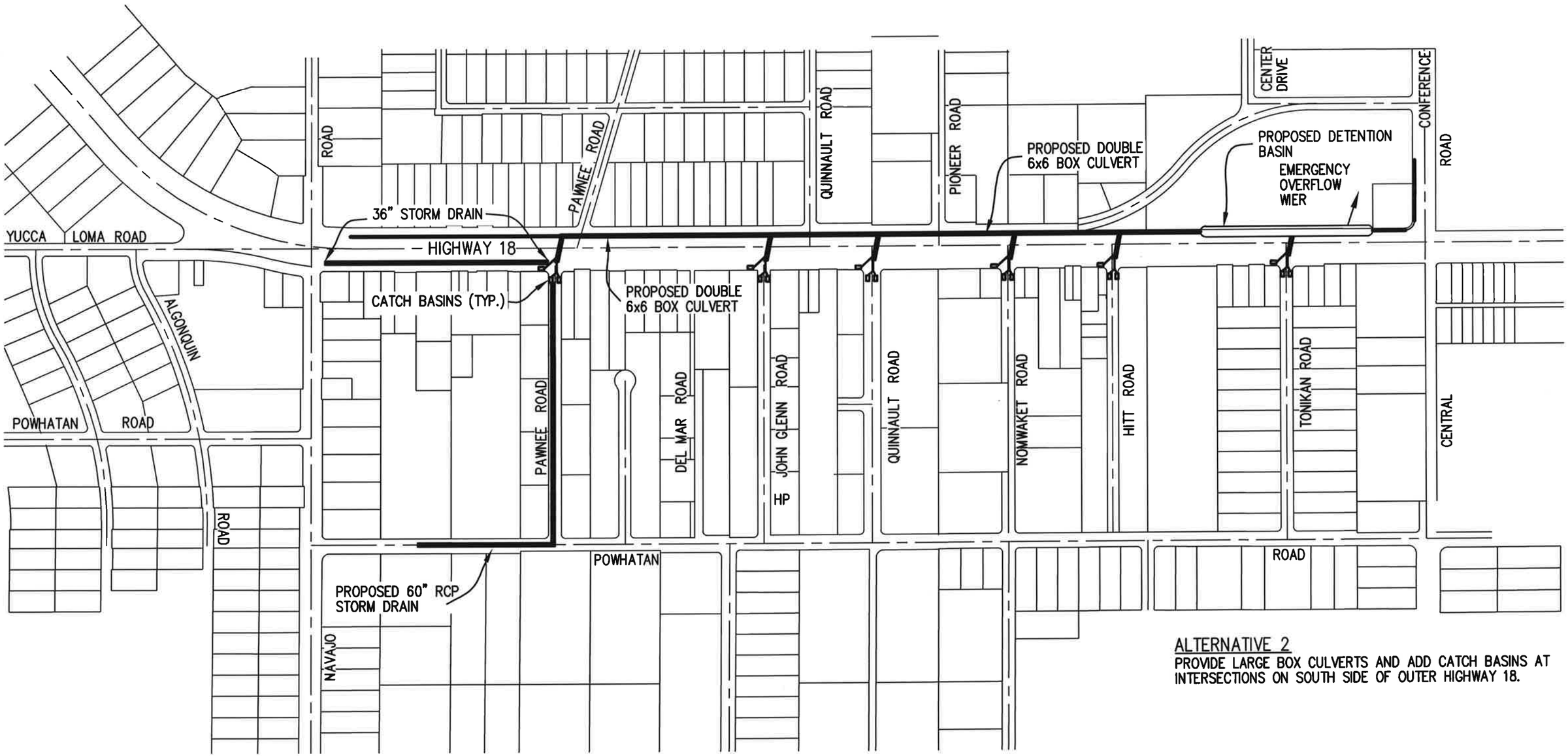

ALTERNATIVE 2

PROVIDE LARGE BOX CULVERTS AND ADD CATCH BASINS AT INTERSECTIONS ON SOUTH SIDE OF OUTER HIGHWAY 18.

N

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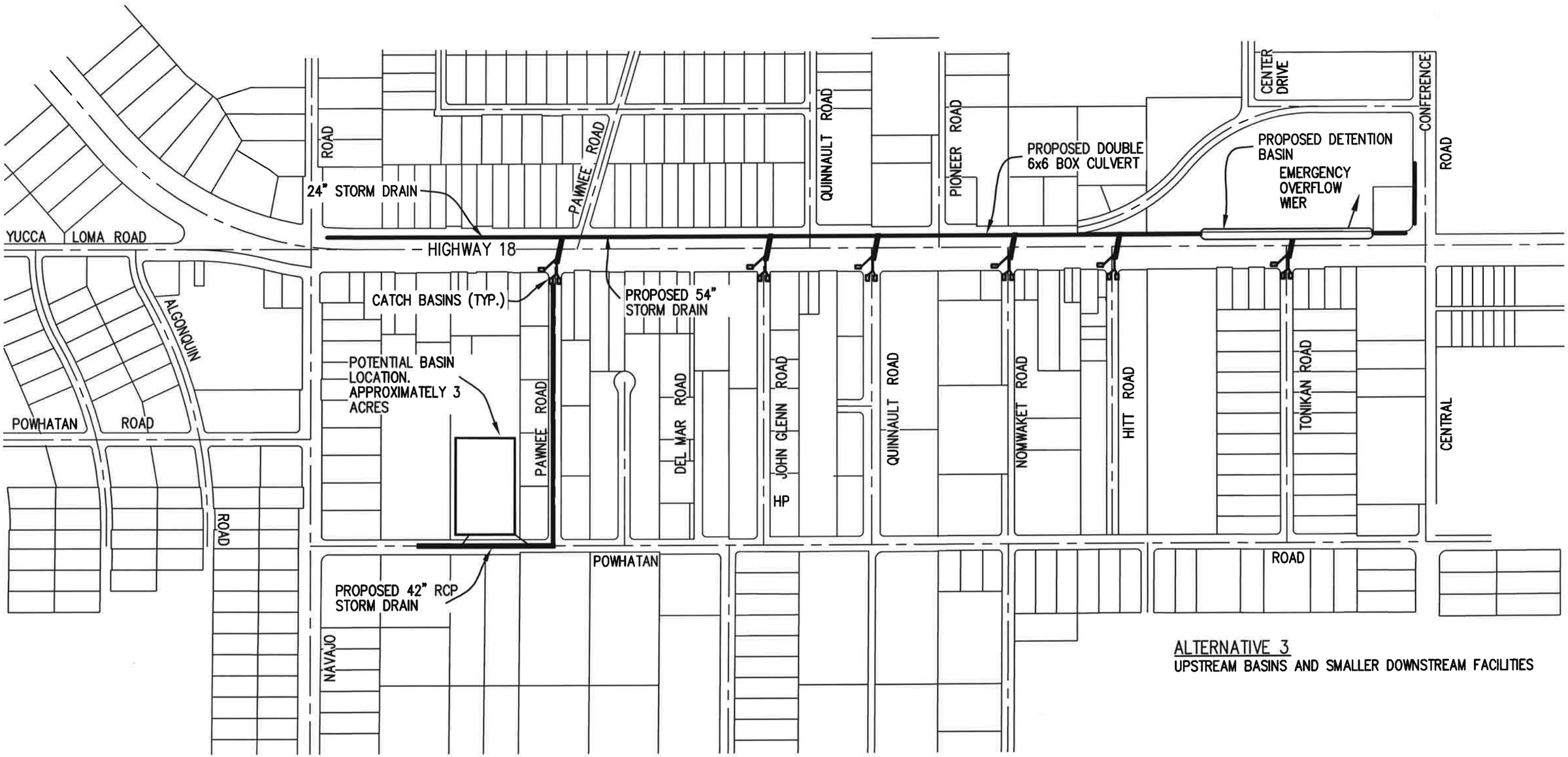
APPLE VALLEY VILLAGE CORRIDOR ENHANCEMENT PLAN

FIGURE 5
DRAINAGE CONCEPT
ALTERNATIVE 2

Drawing Name: P:\K\KOAC00000003\0400CAD\EC\SHEETS\VICINITY MAP.dwg



ALTERNATIVE 3
UPSTREAM BASINS AND SMALLER DOWNSTREAM FACILITIES

N
NTS

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APPLE VALLEY VILLAGE CORRIDOR ENHANCEMENT PLAN

FIGURE 6
DRAINAGE CONCEPT
ALTERNATIVE 3

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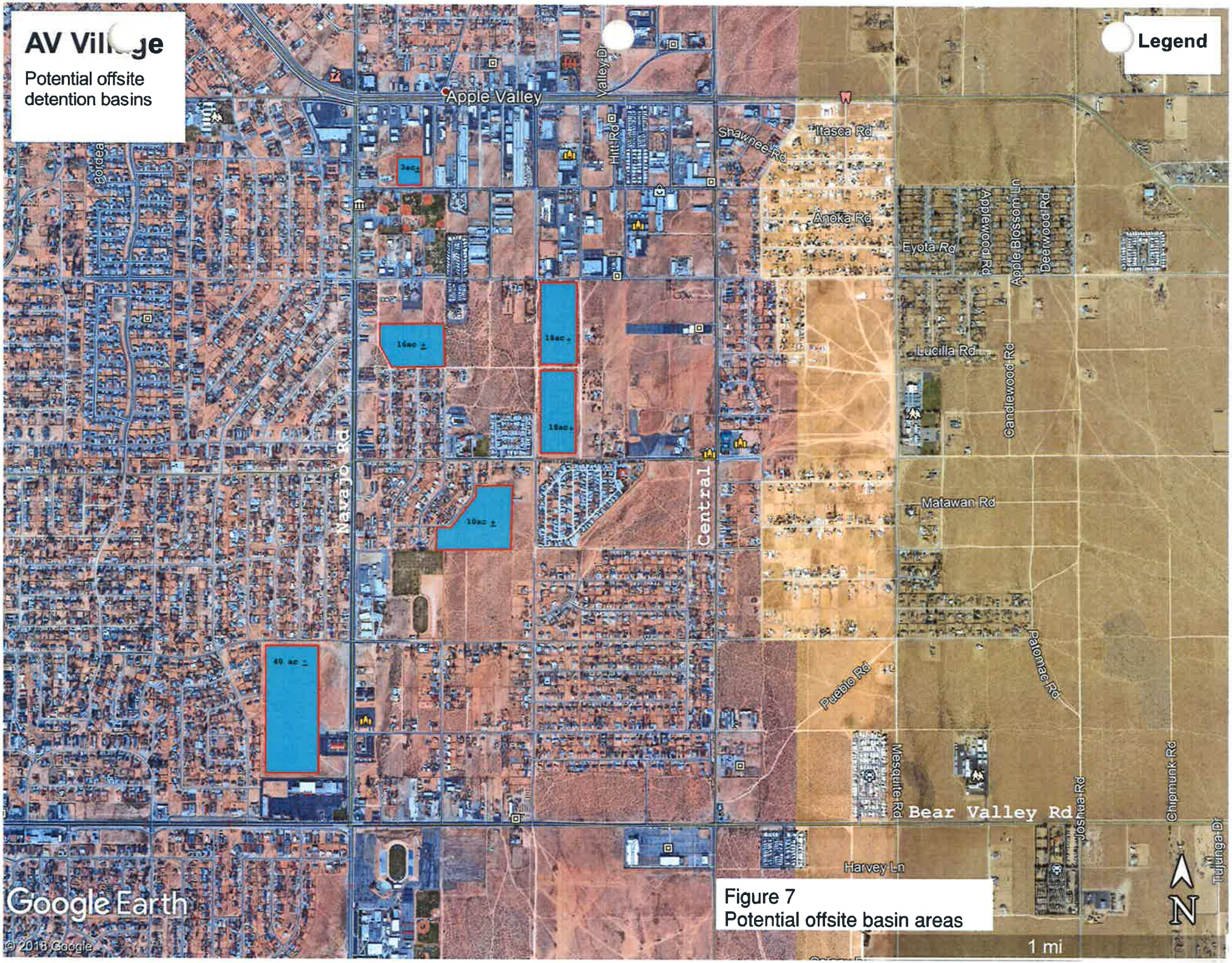
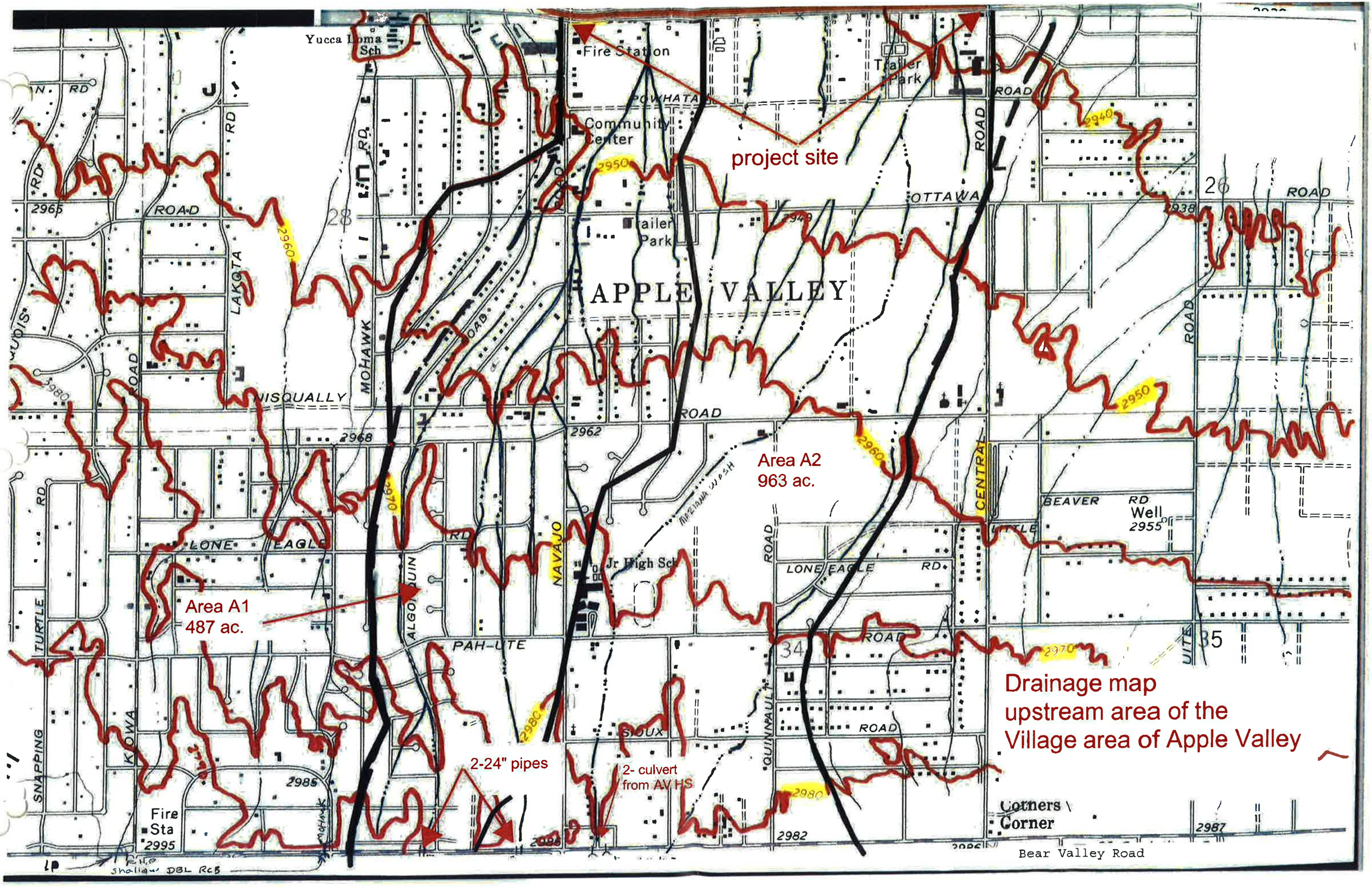


Figure 7
Potential offsite basin areas

APPENDIX 'B'

- Existing Condition Hydrology Map
- Apple Valley Master Plan of Drainage


project site
Area A2
963 ac.
Area A1
487 ac.
2-24" pipes
2- culvert
from AV HS
Drainage map
upstream area of the
Village area of Apple Valley
APPLE VALLEY
Yucca Loma Sch
Fire Station
Trailer Park
Community Center
Jr High Sch
Well
Fire Sta
Corners Corner
Bear Valley Road
ROAD
LONE EAGLE RD
PAH-UTE
SIOUX
OTTAWA
BEAVER RD
MOHAWK
NAVAJO
ALGONQUIN
LAKOTA
TURTLE
SNAPPING
KIOWA
QUINNAULT
CENTRAL
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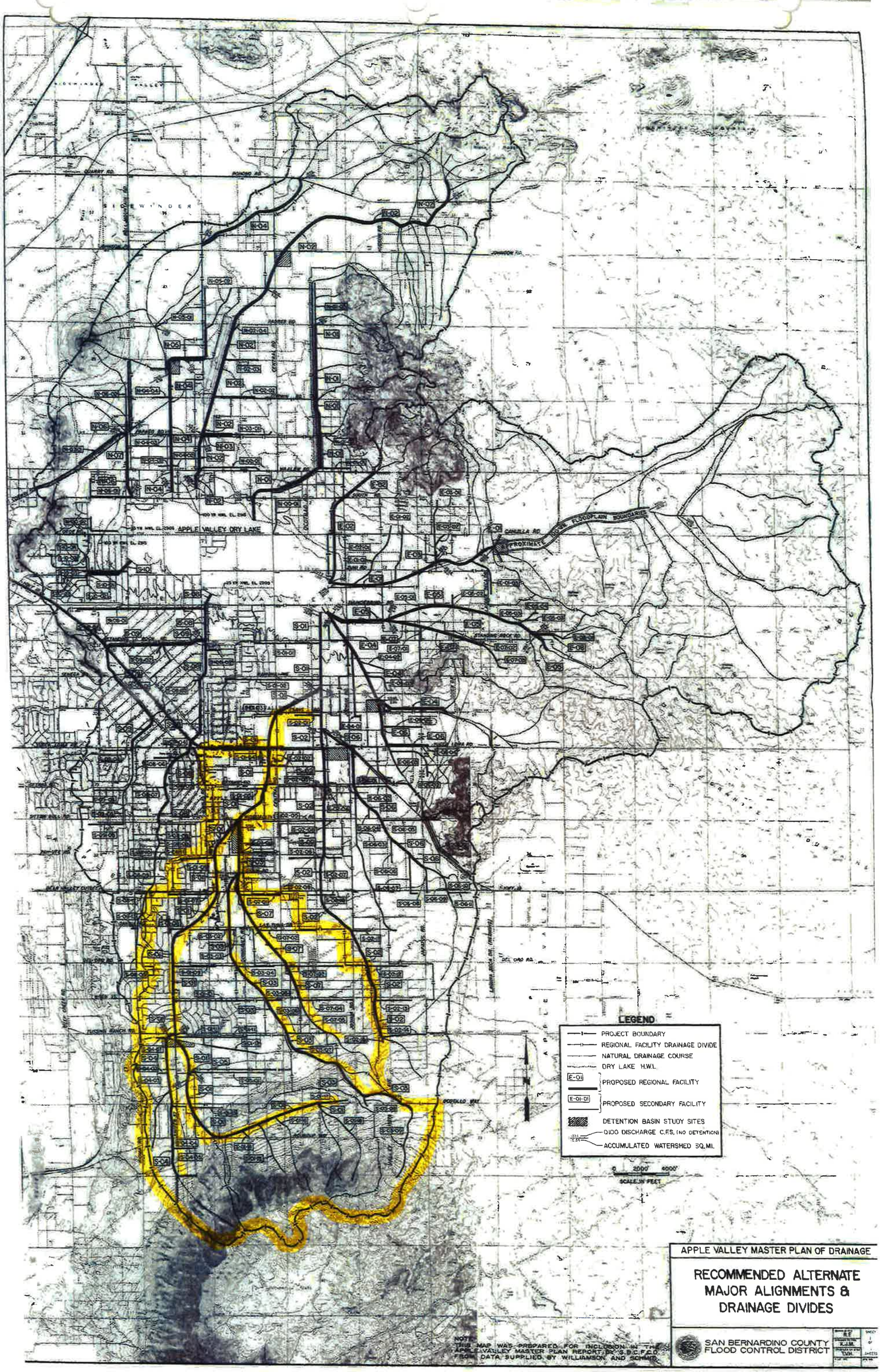
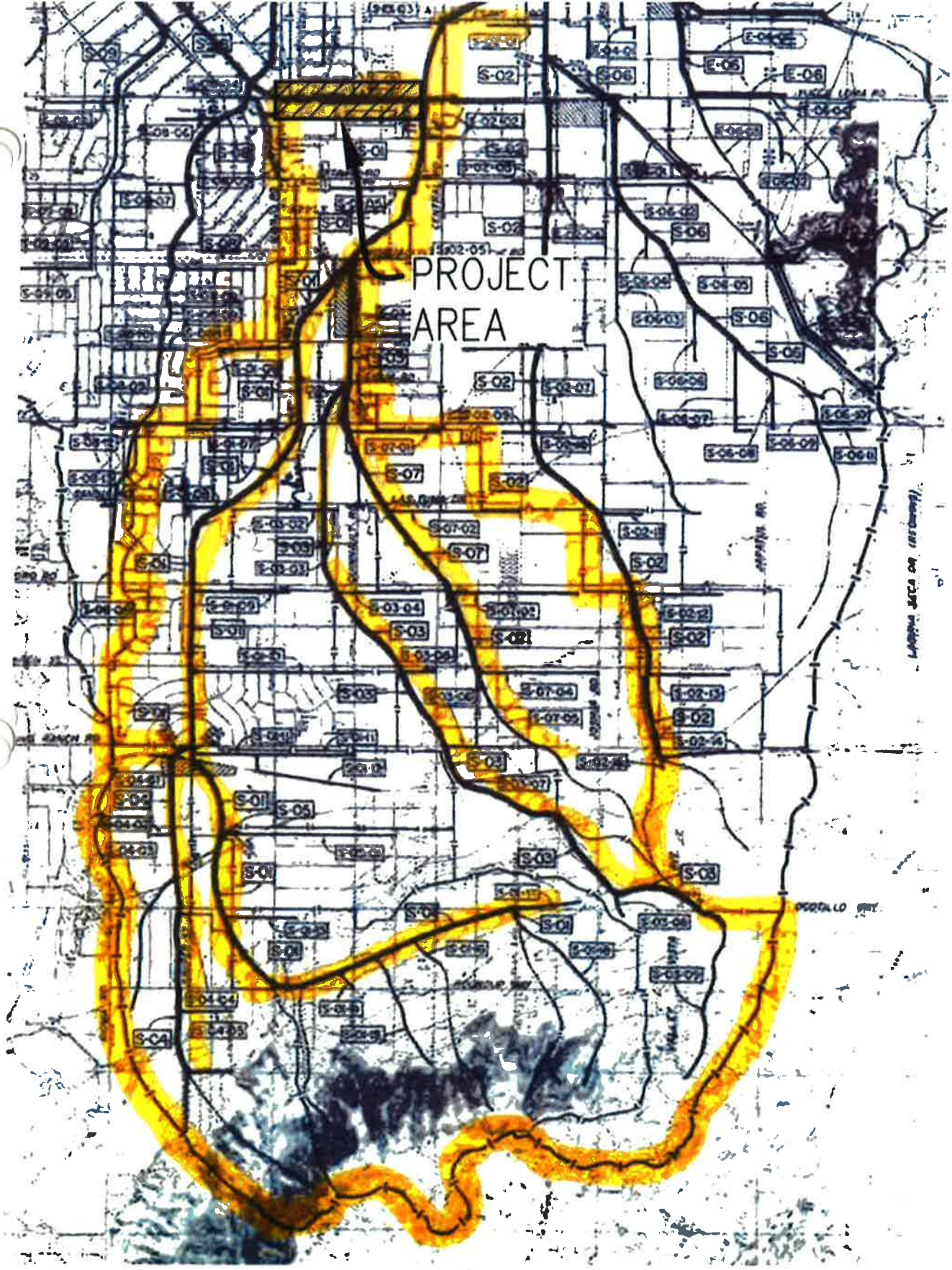


APPLE VALLEY MASTER PLAN OF DRAINAGE

RECOMMENDED ALTERNATE MAJOR ALIGNMENTS & DRAINAGE DIVIDES

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT



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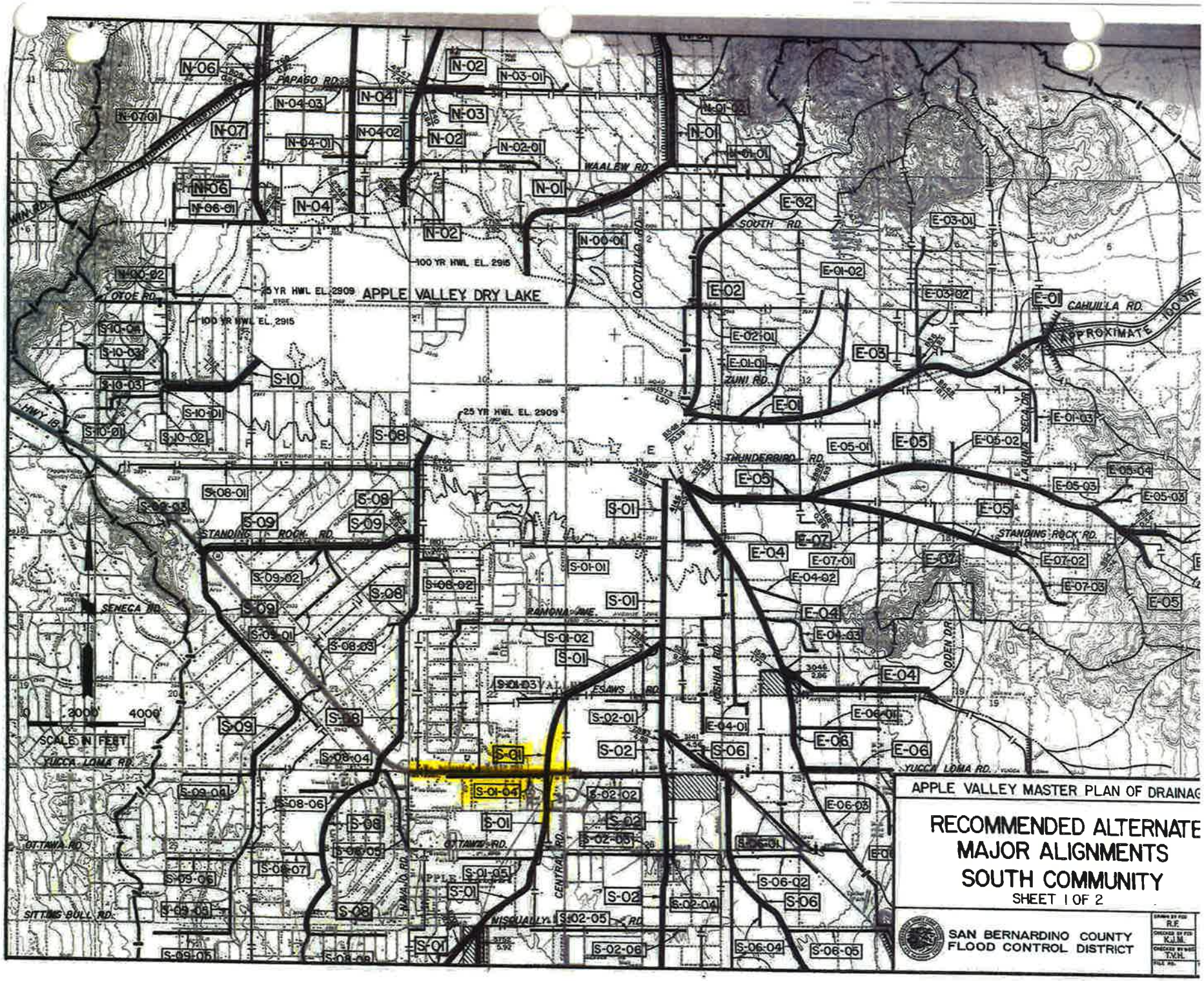
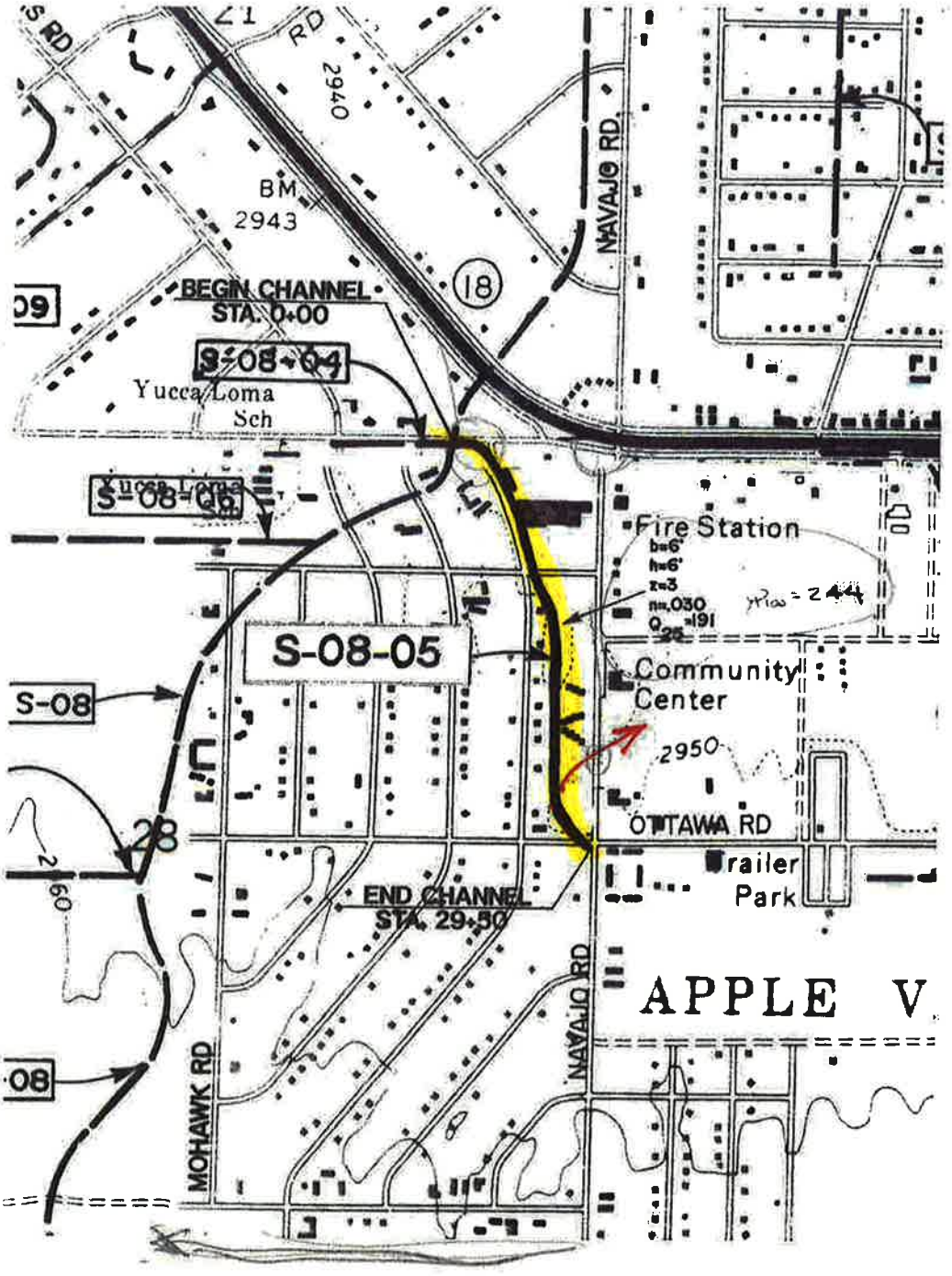
APPLE VALLEY VILLAGE
CORRIDOR ENHANCEMENT PLAN

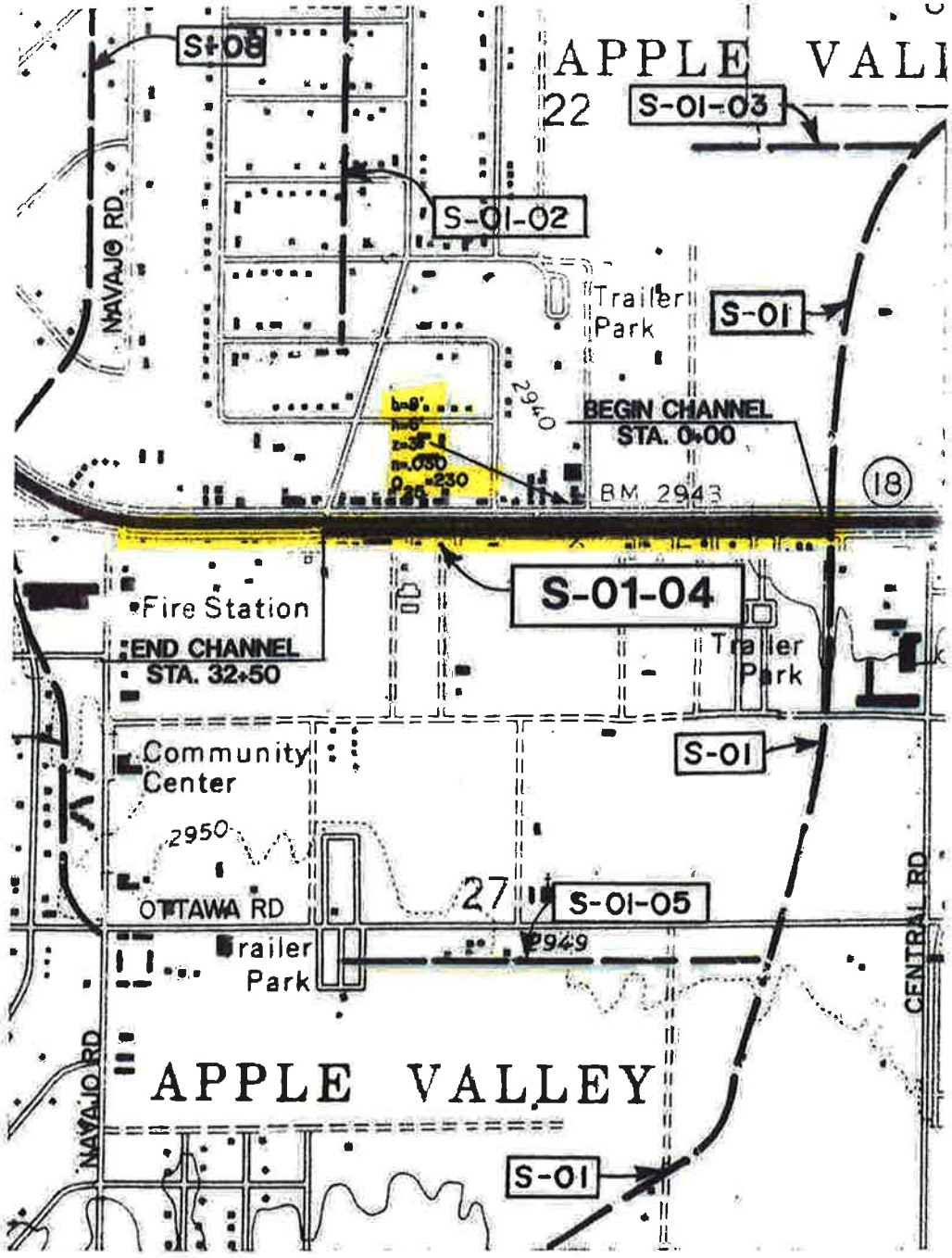
FIGURE 3
DRAINAGE STUDY
MASTER PLAN OF DRAINAGE


APPLE VALLEY DRY LAKE
100 YR HWL EL. 2915
25 YR HWL EL. 2909
APPROXIMATE 100 YR
PAPAGO RD.
WAALEW RD.
SOUTH RD.
OTOE RD.
CAHUILLA RD.
ZUNI RD.
THUNDERBIRD RD.
STANDING ROCK RD.
SENECA RD.
RAMONA AVE.
ESAWS RD.
YUCCA LOMA RD.
OTTAWA RD.
SITTING BULL RD.
MISQUALTY RD.
CENTRAL RD.
APPLE RD.
HWY 18
SCALE IN FEET
2000'
4000'
APPLE VALLEY MASTER PLAN OF DRAINAG
RECOMMENDED ALTERNATE
MAJOR ALIGNMENTS
SOUTH COMMUNITY
SHEET 1 OF 2
SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT



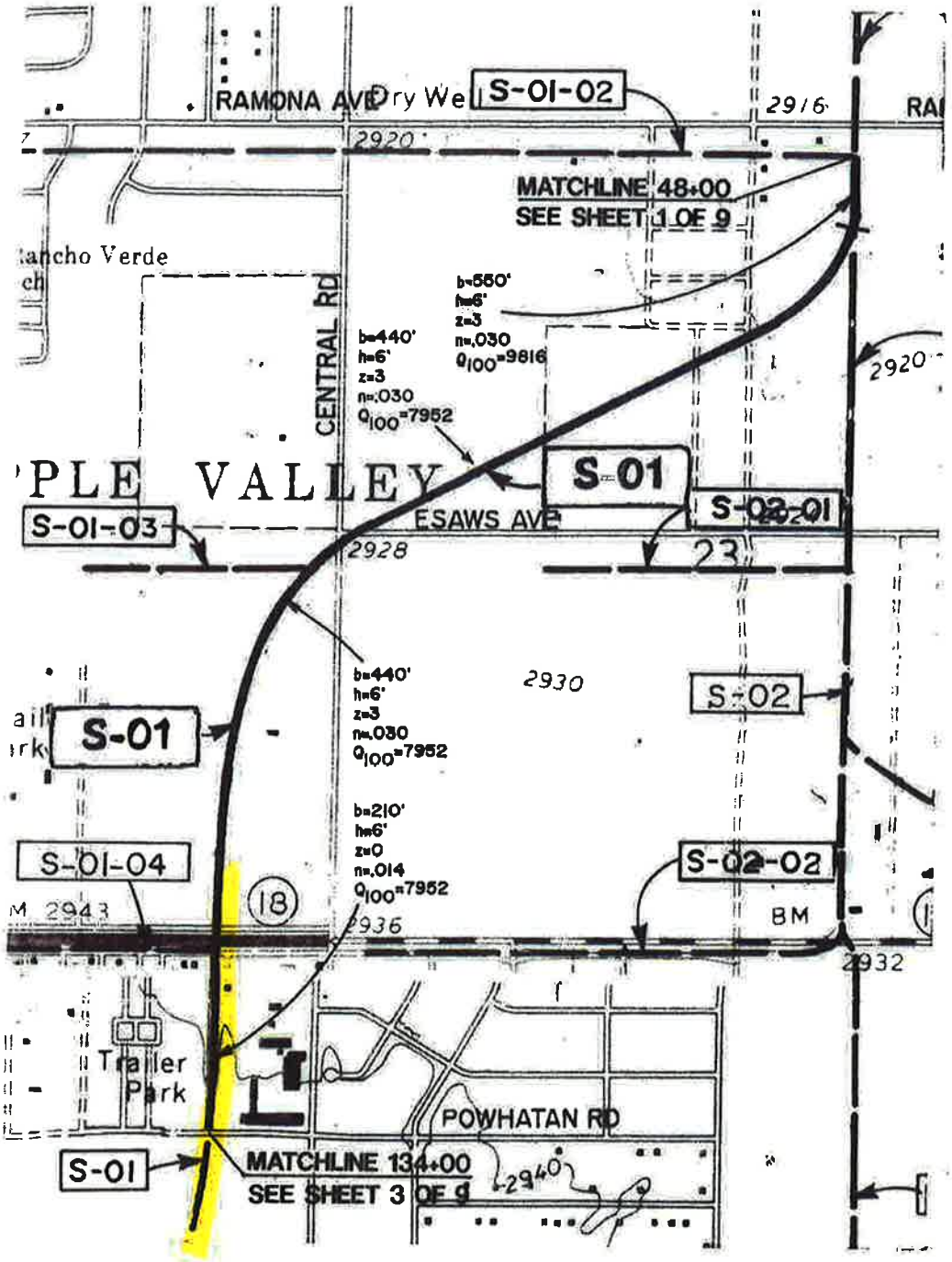
LEGEND	WATERSHED BOUNDARY	.....	DRY LAKE H.W.L.
	PROPOSED FACILITY	TTTTTT	LEVEE
	FACILITY SHOWN ELSEWHERE	—···—	N.D.C.

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE S-08-05 SHEET 1 OF 1	SCALE 1"=1000' WILLIAMSON & SCHMID



LEGEND			
	WATERSHED BOUNDARY		DRY LAKE H.W.L.
	PROPOSED FACILITY		LEVEE
	FACILITY SHOWN ELSEWHERE		N.D.C.

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE S-01-04 SHEET 1 OF 1	SCALE 1"=1000' WILLIAMSON & SCHMID



LEGEND			
	WATERSHED BOUNDARY		DRY LAKE H.W.L.
	PROPOSED FACILITY		LEVEE
	FACILITY SHOWN ELSEWHERE		N.D.C.

APPLE VALLEY MASTER PLAN OF DRAINAGE	COMPREHENSIVE STORM DRAIN PLAN LINE S-01 SHEET 2 OF 9	SCALE 1"=1000' WILLIAMSON & SCHMID

APPENDIX 'C'

Reference Documents

San Bernardino County Hydrology Manual Reference Material

NOAA 14 Point Precipitation Frequency Estimates
USDA Web Soil Survey Hydrologic Soils Group
Antecedent Moisture Condition Map

Flow Master Hydraulic Calculations

NOAA Atlas 14, Volume 6, Version 2
Location name: Apple Valley, California, USA*
Latitude: 34.4839°, Longitude: -117.1823°
Elevation: 2966.46 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.076 (0.063-0.093)	0.108 (0.089-0.132)	0.153 (0.126-0.188)	0.192 (0.157-0.238)	0.249 (0.196-0.318)	0.295 (0.228-0.385)	0.345 (0.260-0.461)	0.398 (0.292-0.548)	0.476 (0.335-0.682)	0.539 (0.367-0.800)
10-min	0.109 (0.090-0.133)	0.155 (0.128-0.190)	0.220 (0.181-0.270)	0.275 (0.225-0.341)	0.356 (0.281-0.456)	0.423 (0.327-0.552)	0.494 (0.373-0.661)	0.571 (0.419-0.786)	0.682 (0.480-0.978)	0.773 (0.526-1.15)
15-min	0.131 (0.109-0.161)	0.187 (0.154-0.229)	0.266 (0.218-0.326)	0.333 (0.272-0.412)	0.431 (0.340-0.552)	0.511 (0.395-0.668)	0.597 (0.451-0.800)	0.691 (0.507-0.950)	0.825 (0.581-1.18)	0.935 (0.636-1.39)
30-min	0.179 (0.148-0.219)	0.255 (0.211-0.313)	0.362 (0.298-0.445)	0.454 (0.370-0.562)	0.588 (0.464-0.752)	0.697 (0.539-0.911)	0.815 (0.615-1.09)	0.942 (0.691-1.30)	1.13 (0.792-1.61)	1.27 (0.868-1.89)
60-min	0.223 (0.184-0.273)	0.318 (0.262-0.389)	0.450 (0.370-0.553)	0.565 (0.461-0.699)	0.731 (0.577-0.935)	0.867 (0.670-1.13)	1.01 (0.764-1.36)	1.17 (0.859-1.61)	1.40 (0.985-2.01)	1.59 (1.08-2.35)
2-hr	0.321 (0.265-0.393)	0.435 (0.359-0.533)	0.595 (0.489-0.730)	0.731 (0.596-0.905)	0.927 (0.732-1.19)	1.09 (0.840-1.42)	1.25 (0.947-1.68)	1.44 (1.05-1.98)	1.69 (1.19-2.43)	1.90 (1.30-2.82)
3-hr	0.393 (0.324-0.481)	0.524 (0.432-0.642)	0.706 (0.580-0.867)	0.861 (0.702-1.07)	1.08 (0.854-1.38)	1.26 (0.974-1.65)	1.45 (1.09-1.94)	1.65 (1.21-2.27)	1.94 (1.36-2.78)	2.17 (1.47-3.21)
6-hr	0.543 (0.449-0.665)	0.714 (0.589-0.875)	0.947 (0.779-1.16)	1.14 (0.934-1.42)	1.42 (1.12-1.82)	1.65 (1.27-2.15)	1.88 (1.42-2.52)	2.13 (1.56-2.93)	2.47 (1.74-3.55)	2.75 (1.87-4.08)
12-hr	0.710 (0.587-0.869)	0.934 (0.771-1.15)	1.24 (1.02-1.52)	1.49 (1.22-1.85)	1.84 (1.46-2.36)	2.12 (1.64-2.77)	2.41 (1.82-3.23)	2.72 (1.99-3.74)	3.14 (2.21-4.50)	3.47 (2.36-5.15)
24-hr	0.942 (0.835-1.08)	1.25 (1.11-1.44)	1.67 (1.47-1.93)	2.01 (1.76-2.34)	2.48 (2.10-2.99)	2.85 (2.37-3.50)	3.23 (2.62-4.07)	3.63 (2.86-4.70)	4.17 (3.16-5.63)	4.60 (3.36-6.43)
2-day	1.14 (1.01-1.32)	1.55 (1.37-1.79)	2.09 (1.84-2.41)	2.52 (2.21-2.94)	3.12 (2.64-3.76)	3.58 (2.97-4.40)	4.05 (3.28-5.10)	4.53 (3.57-5.87)	5.19 (3.92-7.00)	5.70 (4.16-7.95)
3-day	1.25 (1.11-1.44)	1.72 (1.52-1.98)	2.33 (2.06-2.69)	2.82 (2.47-3.29)	3.49 (2.96-4.21)	4.01 (3.33-4.93)	4.53 (3.67-5.71)	5.07 (3.99-6.56)	5.79 (4.38-7.82)	6.36 (4.64-8.88)
4-day	1.32 (1.17-1.52)	1.82 (1.62-2.10)	2.48 (2.19-2.87)	3.02 (2.64-3.51)	3.74 (3.17-4.50)	4.29 (3.56-5.27)	4.85 (3.93-6.11)	5.43 (4.28-7.03)	6.20 (4.69-8.37)	6.80 (4.97-9.50)
7-day	1.44 (1.27-1.65)	1.97 (1.74-2.27)	2.68 (2.36-3.09)	3.26 (2.85-3.80)	4.05 (3.44-4.88)	4.67 (3.87-5.74)	5.29 (4.29-6.67)	5.94 (4.68-7.69)	6.82 (5.16-9.21)	7.51 (5.49-10.5)
10-day	1.51 (1.34-1.74)	2.07 (1.83-2.38)	2.81 (2.49-3.25)	3.43 (3.01-4.00)	4.28 (3.63-5.16)	4.95 (4.11-6.08)	5.63 (4.56-7.09)	6.34 (4.99-8.20)	7.31 (5.53-9.86)	8.07 (5.90-11.3)
20-day	1.71 (1.52-1.97)	2.34 (2.08-2.70)	3.21 (2.84-3.71)	3.94 (3.45-4.58)	4.95 (4.20-5.96)	5.75 (4.78-7.07)	6.58 (5.34-8.29)	7.45 (5.87-9.65)	8.65 (6.54-11.7)	9.59 (7.01-13.4)
30 day	1.92 (1.70-2.21)	2.64 (2.34-3.04)	3.63 (3.20-4.19)	4.46 (3.91-5.19)	5.64 (4.78-6.79)	6.57 (5.45-8.08)	7.54 (6.11-9.49)	8.55 (6.74-11.1)	9.96 (7.53-13.4)	11.1 (8.08-15.4)
45-day	2.30 (2.04-2.64)	3.15 (2.79-3.63)	4.33 (3.83-5.00)	5.34 (4.67-6.21)	6.77 (5.73-8.15)	7.91 (6.57-9.72)	9.10 (7.37-11.5)	10.3 (8.15-13.4)	12.1 (9.13-16.3)	13.4 (9.82-18.8)
60-day	2.49 (2.21-2.86)	3.40 (3.01-3.92)	4.68 (4.13-5.40)	5.76 (5.05-6.71)	7.32 (6.20-8.81)	8.57 (7.11-10.5)	9.88 (8.00-12.4)	11.2 (8.86-14.6)	13.2 (9.95-17.8)	14.7 (10.7-20.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

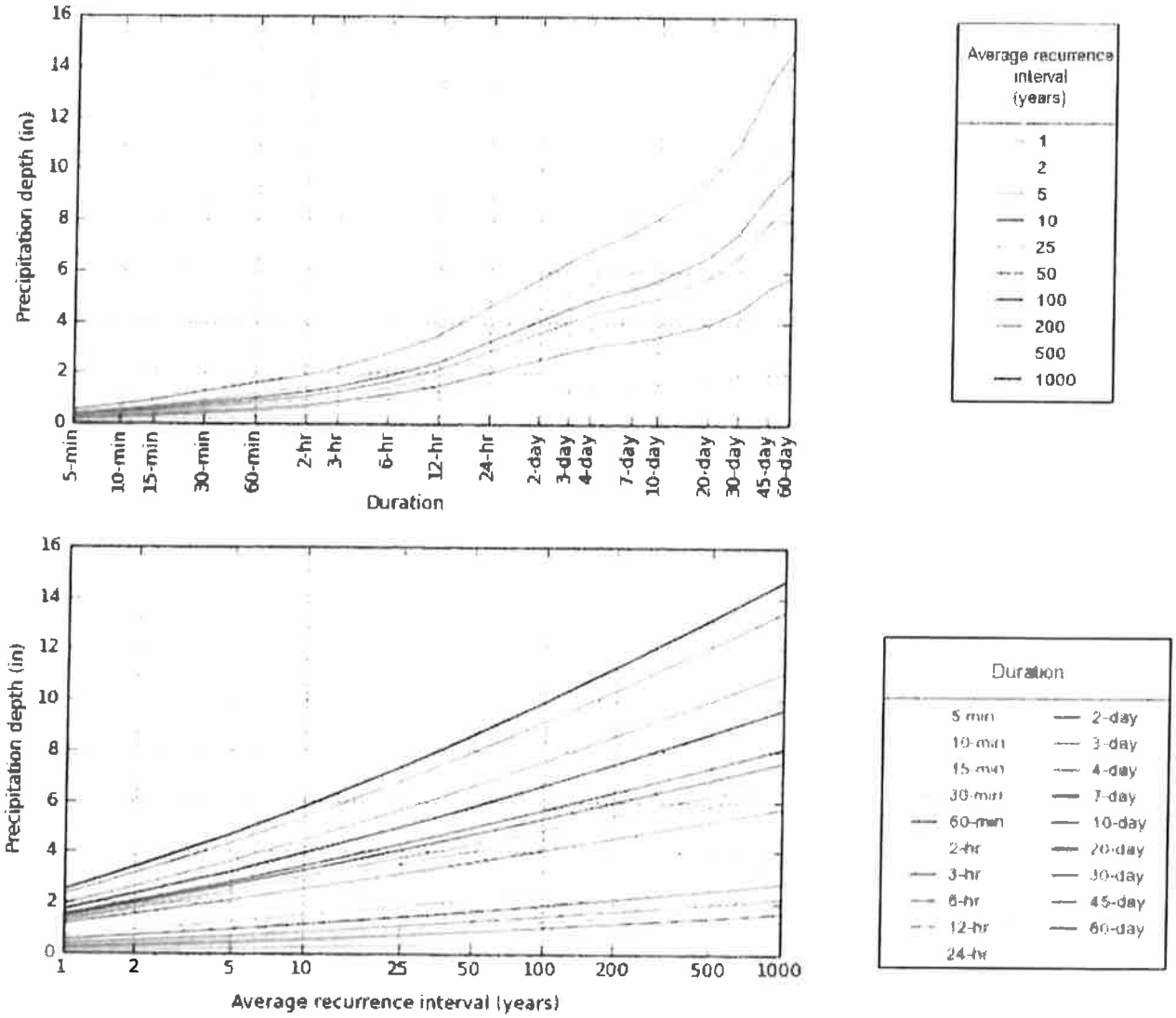
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.4839°, Longitude: -117.1823°



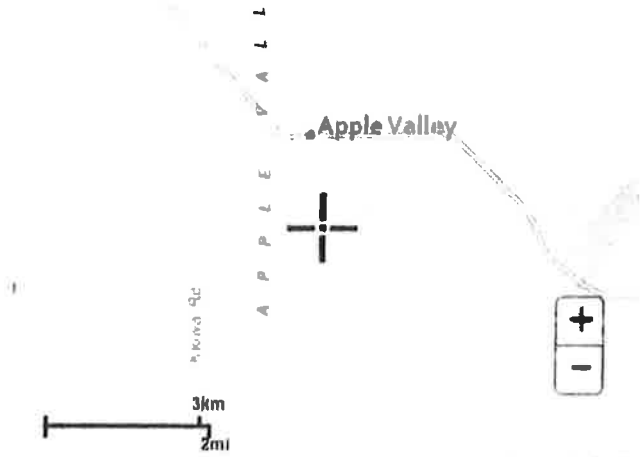
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Apr 25 21:19:57 2018

Back to Top

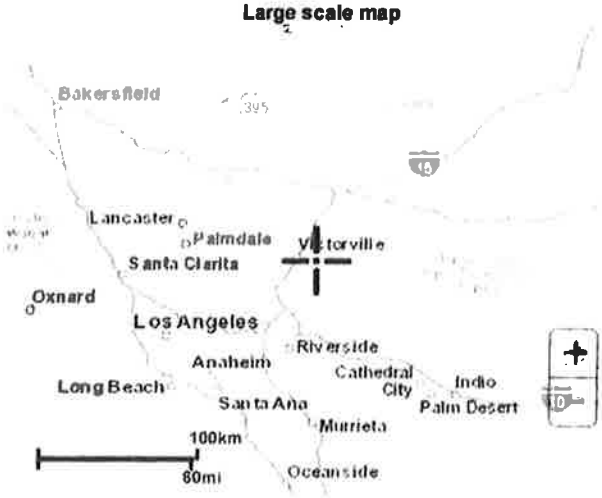
Maps & aerials

Small scale terrain

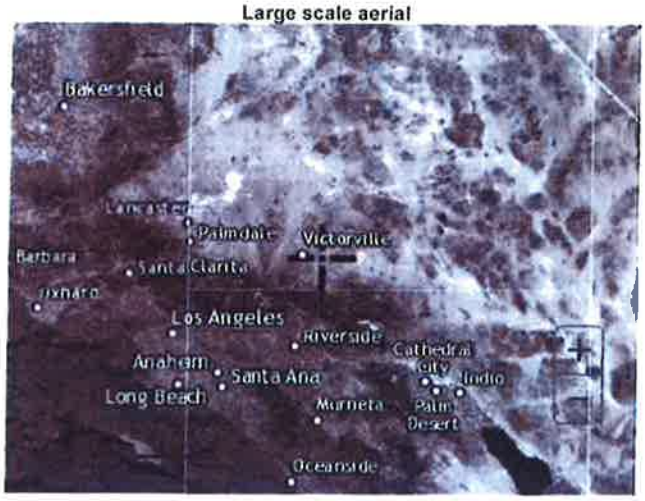


Large scale terrain

Large scale map



Large scale aerial

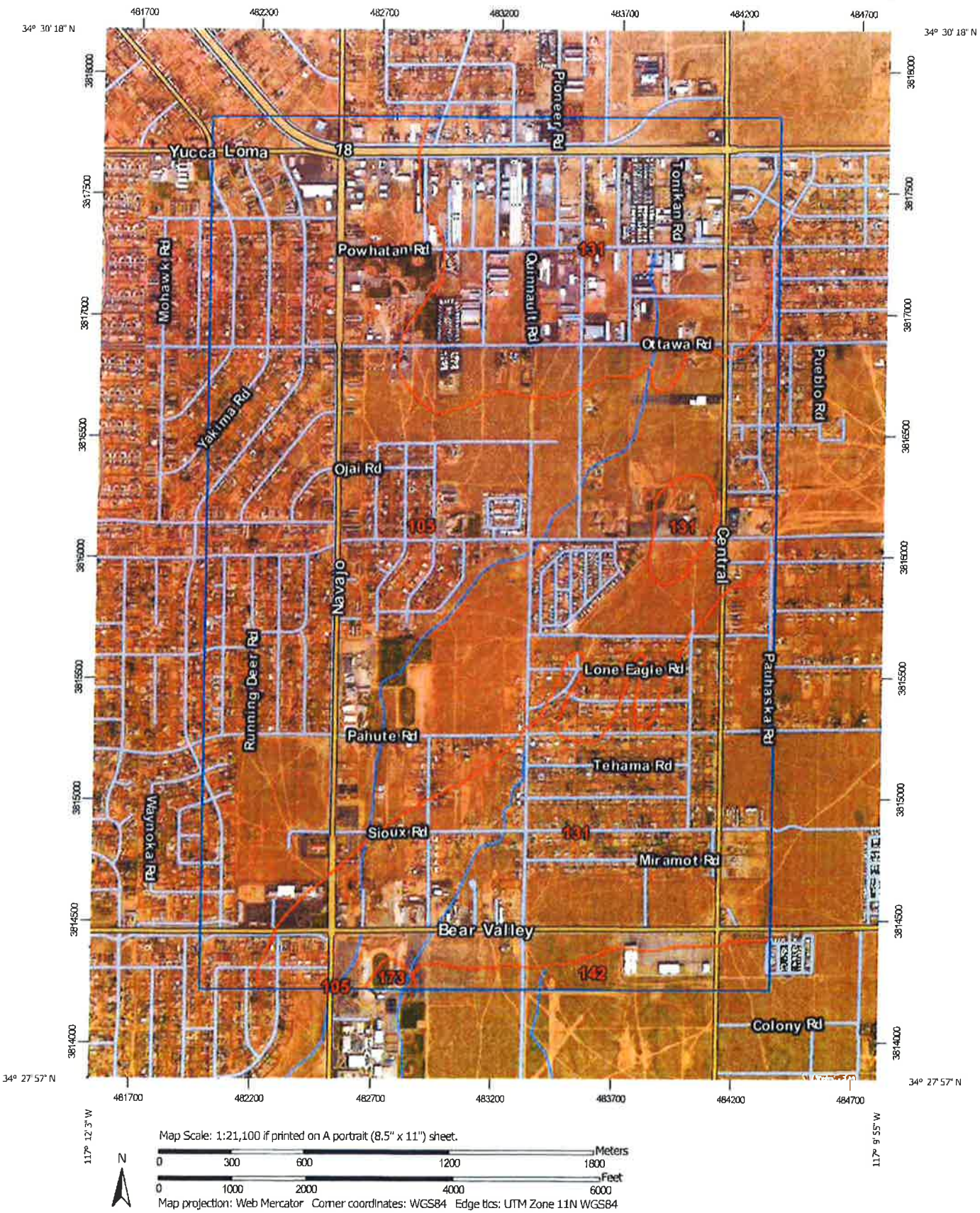


Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Soil Map—San Bernardino County, California, Mojave River Area
(Apple Valley Village area and upstream)



MAP LEGEND

Area of Interest (AOI)
- Area of Interes: (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County, California, Mojave River Area
Survey Area Data: Version 9, Sep 11, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Feb 1, 2015—Feb 4, 2015

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI	
105	BRYMAN LOAMY FINE SAND, 0 TO 2 PERCENT SLOPES	1,177.4	55.7%	HSG = C
131	HELENDALE LOAMY SAND, 0 TO 2 PERCENT SLOPES	881.1	41.7%	HSG = A
142	LUCERNE SANDY LOAM, 0 TO 2 PERCENT SLOPES	51.8	2.4%	HSG = A
173	WASCO SANDY LOAM, COOL, 0 TO 2 PERCENT SLOPES	4.6	0.2%	HSG = A
Totals for Area of Interest		**2,114.9**	**100.0%**	

Figure ADD-1
Antecedent Moisture Condition (AMC)

5-day Rainfall - NOAA Atlas 14
(50% of Total Rainfall Prior to Peak)*

*1/2 (11-day - 1-day) =
1/2 ({[10-day] + (1/10 ([20-day] - [10-day]))) - [1-day])

5 0 5 10 15
Miles

Growing Season
AMC I
AMC II
AMC III

6'x6' DBL BOX
Q = 432 cfs

Box along Hwy 18 alternate size

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Height	6.00	ft
Bottom Width	6.00	ft
Discharge	216.00	ft³/s

Results

Normal Depth	5.83	ft
Flow Area	34.98	ft²
Wetted Perimeter	17.66	ft
Hydraulic Radius	1.98	ft
Top Width	6.00	ft
Critical Depth	3.43	ft
Percent Full	97.2	%
Critical Slope	0.00384	ft/ft
Velocity	6.18	ft/s
Velocity Head	0.59	ft
Specific Energy	6.42	ft
Froude Number	0.45	
Discharge Full	184.72	ft³/s
Slope Full	0.00073	ft/ft
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	97.15	%
Downstream Velocity	Infinity	ft/s

Box along Hwy 18 alternate size

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	5.83	ft
Critical Depth	3.43	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.00384	ft/ft

Cross Section for Box Pipe - 1

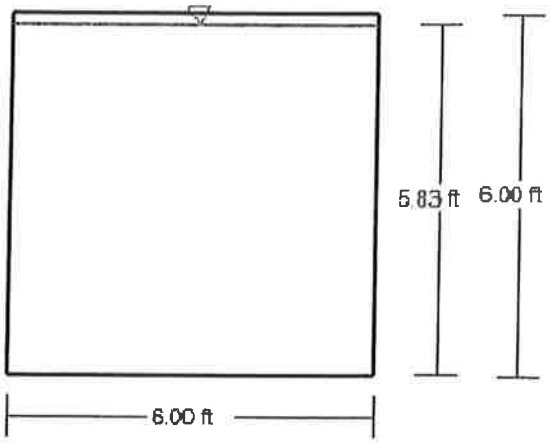
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Normal Depth	5.83	ft
Height	6.00	ft
Bottom Width	6.00	ft
Discharge	216.00	ft³/s

Cross Section Image



V: 1
H: 1

4'x9' DBL BOX

Worksheet for Box Pipe - 1

Project Description

DOUBLE BOX
Q = 432 cfs

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Normal Depth	3.80	ft
Height	4.00	ft
Bottom Width	9.00	ft

Results

Discharge	216.83	ft^3/s
Flow Area	34.20	ft^2
Wetted Perimeter	16.60	ft
Hydraulic Radius	2.06	ft
Top Width	9.00	ft
Critical Depth	2.62	ft
Percent Full	95.0	%
Critical Slope	0.00281	ft/ft
Velocity	6.34	ft/s
Velocity Head	0.62	ft
Specific Energy	4.42	ft
Froude Number	0.57	
Discharge Full	175.12	ft^3/s
Slope Full	0.00065	ft/ft
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	95.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for Box Pipe - 1

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	3.80	ft
Critical Depth	2.62	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.00281	ft/ft

Cross Section for Box Pipe - 1

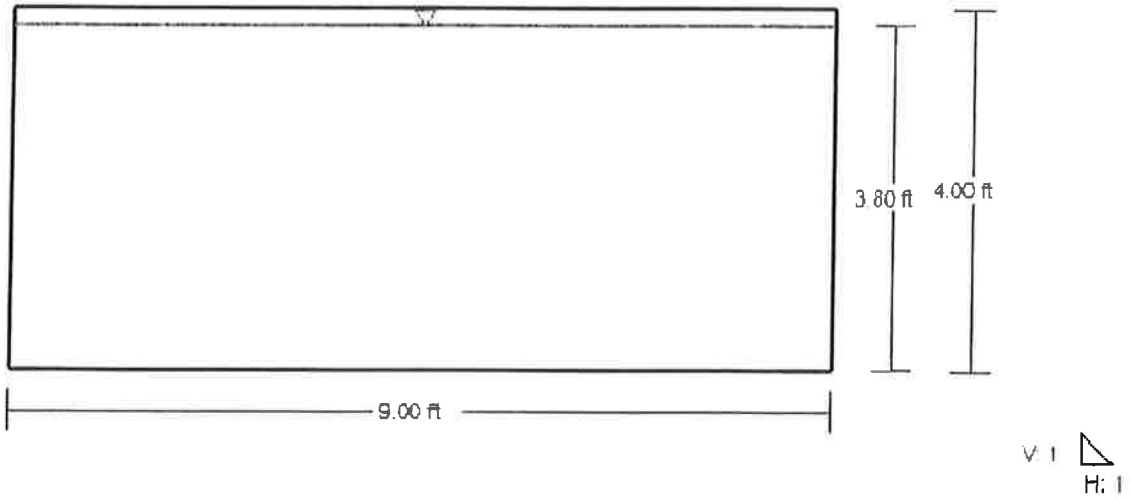
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Normal Depth	3.80	ft
Height	4.00	ft
Bottom Width	9.00	ft
Discharge	216.83	ft^3/s

Cross Section Image



4'x6' DBL BOX

Worksheet for Box Pipe - 1

Q = 256 cfs

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Normal Depth	3.80	ft
Height	4.00	ft
Bottom Width	6.00	ft

Results

Discharge	125.99	ft^3/s
Flow Area	22.80	ft^2
Wetted Perimeter	13.60	ft
Hydraulic Radius	1.68	ft
Top Width	6.00	ft
Critical Depth	2.39	ft
Percent Full	95.0	%
Critical Slope	0.00343	ft/ft
Velocity	5.53	ft/s
Velocity Head	0.47	ft
Specific Energy	4.27	ft
Froude Number	0.50	
Discharge Full	106.12	ft^3/s
Slope Full	0.00071	ft/ft
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	95.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for Box Pipe - 1

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	3.80	ft
Critical Depth	2.39	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.00343	ft/ft

Cross Section for Box Pipe - 1

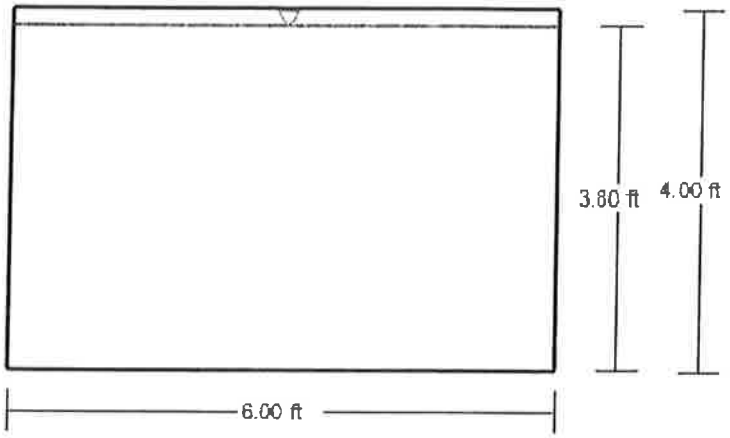
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00100	ft/ft
Normal Depth	3.80	ft
Height	4.00	ft
Bottom Width	6.00	ft
Discharge	125.99	ft³/s

Cross Section Image



V: 1
H: 1

Circular Pipe from Ottawa@Navajo to Hwy 18

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00100	ft/ft
Normal Depth	4.90	ft
Diameter	5.00	ft

Results

Discharge	87.02	ft^3/s
Flow Area	19.54	ft^2
Wetted Perimeter	14.29	ft
Hydraulic Radius	1.37	ft
Top Width	1.40	ft
Critical Depth	2.65	ft
Percent Full	98.0	%
Critical Slope	0.00369	ft/ft
Velocity	4.45	ft/s
Velocity Head	0.31	ft
Specific Energy	5.21	ft
Froude Number	0.21	
Maximum Discharge	88.59	ft^3/s
Discharge Full	82.35	ft^3/s
Slope Full	0.00112	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	98.00	%
Downstream Velocity	Infinity	ft/s

Circular Pipe from Ottawa@Navajo to Hwy 18

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	4.90	ft
Critical Depth	2.65	ft
Channel Slope	0.00100	ft/ft
Critical Slope	0.00369	ft/ft

APPENDIX 'D'

Unit Hydrograph Method Analysis

25-Year Storm Event

100-Year Storm Event

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/27/18

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4014

A1
25 year

Storm Event Year = 25

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 25		
487.00	1	0.73
Rainfall data for year 25		
487.00	6	1.42
Rainfall data for year 25		
487.00	24	2.48

++

******** Area-averaged max loss rate, Fm ********

SCS curve NO.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
83.0	83.0	487.00	1.000	0.318	0.600	0.191

Area-averaged adjusted loss rate Fm (In/Hr) = 0.191

********* Area-Averaged low loss rate fraction, Yb **********

Area	Area	SCS CN	SCS CN	S	Pervious

(Ac.)	Fract	(AMC2)	(AMC2)		Yield Fr
292.20	0.600	83.0	83.0	2.05	0.420
194.80	0.400	98.0	98.0	0.20	0.908

Area-averaged catchment yield fraction, Y = 0.615
Area-averaged low loss fraction, Yb = 0.385
++
Watercourse length = 9580.00(Ft.)
Length from concentration point to centroid = 4802.00(Ft.)
Elevation difference along watercourse = 42.00(Ft.)
Mannings friction factor along watercourse = 0.200
Watershed area = 487.00(Ac.)
Catchment Lag time = 3.196 hours
Unit interval = 10.000 minutes
Unit interval percentage of lag time = 5.2144
Hydrograph baseflow = 50.00(CFS)
Average maximum watershed loss rate(Fm) = 0.191(In/Hr)
Average low loss rate fraction (Yb) = 0.385 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.249(In)
Computed peak 30-minute rainfall = 0.588(In)
Specified peak 1-hour rainfall = 0.731(In)
Computed peak 3-hour rainfall = 1.080(In)
Specified peak 6-hour rainfall = 1.420(In)
Specified peak 24-hour rainfall = 2.480(In)

Note: user specified rainfall values used.
Rainfall depth area reduction factors:
Using a total area of 487.00(Ac.) (Ref: fig. E-4)

5-minute factor = 0.977 Adjusted rainfall = 0.243(In)
30-minute factor = 0.977 Adjusted rainfall = 0.575(In)
1-hour factor = 0.977 Adjusted rainfall = 0.714(In)
3-hour factor = 0.997 Adjusted rainfall = 1.077(In)
6-hour factor = 0.998 Adjusted rainfall = 1.418(In)
24-hour factor = 0.999 Adjusted rainfall = 2.478(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 2944.83 (CFS))	
1	0.229	6.756
2	0.688	13.513
3	1.223	15.745
4	2.066	24.829
5	2.951	26.057
6	4.113	34.206
7	5.406	38.082
8	6.849	42.498
9	8.592	51.347
10	10.479	55.543
11	13.541	90.186
12	16.879	98.282
13	21.245	128.583
14	26.585	157.242
15	31.757	152.333
16	36.285	133.338
17	40.722	130.644

18	44.402	108.374
19	47.739	98.276
20	50.865	92.043
21	53.586	80.140
22	56.233	77.960
23	58.353	62.414
24	60.355	58.961
25	62.159	53.131
26	63.786	47.910
27	65.363	46.442
28	66.757	41.041
29	68.130	40.438
30	69.418	37.935
31	70.670	36.854
32	71.848	34.704
33	72.894	30.793
34	73.925	30.356
35	74.862	27.605
36	75.780	27.025
37	76.675	26.361
38	77.551	25.797
39	78.388	24.647
40	79.088	20.618
41	79.776	20.269
42	80.465	20.269
43	81.153	20.269
44	81.796	18.936
45	82.361	16.625
46	82.924	16.584
47	83.487	16.584
48	84.050	16.581
49	84.578	15.562
50	85.079	14.741
51	85.580	14.741
52	86.080	14.741
53	86.578	14.657
54	87.018	12.954
55	87.435	12.285
56	87.852	12.285
57	88.269	12.285
58	88.675	11.949
59	89.003	9.649
60	89.316	9.213
61	89.628	9.213
62	89.941	9.213
63	90.249	9.074
64	90.543	8.632
65	90.835	8.599
66	91.127	8.599
67	91.419	8.599
68	91.695	8.125
69	91.945	7.380
70	92.195	7.371
71	92.446	7.371
72	92.696	7.369
73	92.934	7.014
74	93.164	6.756
75	93.393	6.756
76	93.622	6.756
77	93.850	6.692
78	94.040	5.608
79	94.217	5.221
80	94.395	5.221

81	94.572	5.221
82	94.749	5.221
83	94.927	5.221
84	95.104	5.221
85	95.281	5.221
86	95.458	5.221
87	95.625	4.919
88	95.763	4.047
89	95.898	3.992
90	96.034	3.992
91	96.170	3.992
92	96.305	3.992
93	96.441	3.992
94	96.576	3.992
95	96.712	3.992
96	96.847	3.985
97	96.957	3.248
98	97.051	2.764
99	97.145	2.764
100	97.239	2.764
101	97.333	2.764
102	97.427	2.764
103	97.521	2.764
104	97.615	2.764
105	97.708	2.764
106	97.797	2.595
107	97.853	1.675
108	97.906	1.536
109	97.958	1.536
110	98.010	1.536
111	98.062	1.536
112	98.114	1.536
113	98.166	1.536
114	98.218	1.536
115	98.271	1.536
116	98.327	1.670
117	98.390	1.842
118	98.452	1.843
119	98.515	1.843
120	98.578	1.843
121	98.640	1.843
122	98.703	1.843
123	98.765	1.843
124	98.828	1.843
125	98.890	1.843
126	98.953	1.843
127	99.016	1.843
128	99.078	1.843
129	99.141	1.843
130	99.203	1.843
131	99.266	1.843
132	99.328	1.843
133	99.391	1.843
134	99.454	1.843
135	99.508	1.589
136	99.541	0.986
137	99.574	0.960
138	99.606	0.960
139	99.639	0.960
140	99.671	0.960
141	99.704	0.960
142	99.737	0.960
143	99.769	0.960

144	99.802	0.960
145	99.834	0.960
146	99.867	0.960
147	99.899	0.960
148	99.932	0.960
149	99.965	0.960
150	100.000	0.480

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.3393	0.0959
2	0.4730	0.0610
3	0.5746	0.0481
4	0.6289	0.0258
5	0.6746	0.0220
6	0.7143	0.0193
7	0.7567	0.0207
8	0.7954	0.0190
9	0.8312	0.0176
10	0.8645	0.0164
11	0.8959	0.0154
12	0.9255	0.0146
13	0.9536	0.0139
14	0.9804	0.0132
15	1.0060	0.0127
16	1.0305	0.0122
17	1.0541	0.0117
18	1.0769	0.0113
19	1.1002	0.0116
20	1.1229	0.0112
21	1.1448	0.0109
22	1.1661	0.0106
23	1.1869	0.0103
24	1.2071	0.0100
25	1.2268	0.0098
26	1.2461	0.0096
27	1.2649	0.0093
28	1.2833	0.0091
29	1.3013	0.0089
30	1.3189	0.0088
31	1.3362	0.0086
32	1.3531	0.0084
33	1.3697	0.0083
34	1.3860	0.0081
35	1.4021	0.0080
36	1.4178	0.0078
37	1.4336	0.0078
38	1.4491	0.0077
39	1.4643	0.0076
40	1.4793	0.0075
41	1.4941	0.0074
42	1.5087	0.0073
43	1.5231	0.0072
44	1.5372	0.0071
45	1.5512	0.0070
46	1.5650	0.0069
47	1.5786	0.0068
48	1.5921	0.0067
49	1.6054	0.0066
50	1.6185	0.0065
51	1.6314	0.0065
52	1.6442	0.0064
53	1.6569	0.0063

54	1.6694	0.0062
55	1.6818	0.0062
56	1.6941	0.0061
57	1.7062	0.0060
58	1.7182	0.0060
59	1.7301	0.0059
60	1.7418	0.0059
61	1.7535	0.0058
62	1.7650	0.0057
63	1.7764	0.0057
64	1.7877	0.0056
65	1.7989	0.0056
66	1.8100	0.0055
67	1.8210	0.0055
68	1.8319	0.0054
69	1.8427	0.0054
70	1.8534	0.0053
71	1.8641	0.0053
72	1.8746	0.0053
73	1.8850	0.0052
74	1.8954	0.0052
75	1.9057	0.0051
76	1.9159	0.0051
77	1.9260	0.0050
78	1.9360	0.0050
79	1.9460	0.0050
80	1.9559	0.0049
81	1.9657	0.0049
82	1.9754	0.0049
83	1.9851	0.0048
84	1.9947	0.0048
85	2.0042	0.0048
86	2.0137	0.0047
87	2.0231	0.0047
88	2.0324	0.0047
89	2.0417	0.0046
90	2.0509	0.0046
91	2.0601	0.0046
92	2.0692	0.0045
93	2.0782	0.0045
94	2.0872	0.0045
95	2.0961	0.0045
96	2.1050	0.0044
97	2.1138	0.0044
98	2.1225	0.0044
99	2.1312	0.0043
100	2.1399	0.0043
101	2.1485	0.0043
102	2.1570	0.0043
103	2.1655	0.0042
104	2.1739	0.0042
105	2.1823	0.0042
106	2.1907	0.0042
107	2.1990	0.0041
108	2.2072	0.0041
109	2.2155	0.0041
110	2.2236	0.0041
111	2.2317	0.0041
112	2.2398	0.0040
113	2.2479	0.0040
114	2.2559	0.0040
115	2.2638	0.0040
116	2.2717	0.0040

117	2.2796	0.0039
118	2.2874	0.0039
119	2.2952	0.0039
120	2.3030	0.0039
121	2.3107	0.0039
122	2.3183	0.0038
123	2.3260	0.0038
124	2.3336	0.0038
125	2.3411	0.0038
126	2.3487	0.0038
127	2.3562	0.0037
128	2.3636	0.0037
129	2.3710	0.0037
130	2.3784	0.0037
131	2.3858	0.0037
132	2.3931	0.0037
133	2.4004	0.0036
134	2.4077	0.0036
135	2.4149	0.0036
136	2.4221	0.0036
137	2.4292	0.0036
138	2.4364	0.0036
139	2.4435	0.0035
140	2.4505	0.0035
141	2.4576	0.0035
142	2.4646	0.0035
143	2.4715	0.0035
144	2.4785	0.0035

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0069	0.0027	0.0043
2	0.0070	0.0027	0.0043
3	0.0070	0.0027	0.0043
4	0.0071	0.0027	0.0044
5	0.0071	0.0027	0.0044
6	0.0072	0.0028	0.0044
7	0.0072	0.0028	0.0044
8	0.0073	0.0028	0.0045
9	0.0073	0.0028	0.0045
10	0.0074	0.0028	0.0045
11	0.0074	0.0029	0.0046
12	0.0075	0.0029	0.0046
13	0.0075	0.0029	0.0046
14	0.0076	0.0029	0.0047
15	0.0076	0.0029	0.0047
16	0.0077	0.0030	0.0047
17	0.0078	0.0030	0.0048
18	0.0078	0.0030	0.0048
19	0.0079	0.0030	0.0048
20	0.0079	0.0031	0.0049
21	0.0080	0.0031	0.0049
22	0.0081	0.0031	0.0050
23	0.0081	0.0031	0.0050
24	0.0082	0.0032	0.0050
25	0.0083	0.0032	0.0051
26	0.0083	0.0032	0.0051
27	0.0084	0.0032	0.0052
28	0.0085	0.0033	0.0052
29	0.0085	0.0033	0.0053
30	0.0086	0.0033	0.0053

31	0.0087	0.0034	0.0053
32	0.0088	0.0034	0.0054
33	0.0089	0.0034	0.0054
34	0.0089	0.0034	0.0055
35	0.0090	0.0035	0.0056
36	0.0091	0.0035	0.0056
37	0.0092	0.0035	0.0057
38	0.0093	0.0036	0.0057
39	0.0094	0.0036	0.0058
40	0.0095	0.0037	0.0058
41	0.0096	0.0037	0.0059
42	0.0097	0.0037	0.0060
43	0.0098	0.0038	0.0060
44	0.0099	0.0038	0.0061
45	0.0100	0.0039	0.0062
46	0.0102	0.0039	0.0062
47	0.0103	0.0040	0.0063
48	0.0104	0.0040	0.0064
49	0.0105	0.0041	0.0065
50	0.0107	0.0041	0.0066
51	0.0108	0.0042	0.0066
52	0.0110	0.0042	0.0067
53	0.0111	0.0043	0.0068
54	0.0113	0.0043	0.0069
55	0.0114	0.0044	0.0070
56	0.0116	0.0045	0.0071
57	0.0118	0.0045	0.0072
58	0.0119	0.0046	0.0073
59	0.0121	0.0047	0.0075
60	0.0123	0.0047	0.0076
61	0.0125	0.0048	0.0077
62	0.0127	0.0049	0.0078
63	0.0130	0.0050	0.0080
64	0.0132	0.0051	0.0081
65	0.0134	0.0052	0.0083
66	0.0137	0.0053	0.0084
67	0.0140	0.0054	0.0086
68	0.0143	0.0055	0.0088
69	0.0146	0.0056	0.0090
70	0.0149	0.0057	0.0092
71	0.0152	0.0059	0.0094
72	0.0156	0.0060	0.0096
73	0.0158	0.0061	0.0097
74	0.0162	0.0062	0.0099
75	0.0166	0.0064	0.0102
76	0.0171	0.0066	0.0105
77	0.0176	0.0068	0.0108
78	0.0182	0.0070	0.0112
79	0.0188	0.0072	0.0116
80	0.0195	0.0075	0.0120
81	0.0202	0.0078	0.0124
82	0.0210	0.0081	0.0129
83	0.0220	0.0085	0.0135
84	0.0230	0.0089	0.0141
85	0.0228	0.0088	0.0140
86	0.0241	0.0093	0.0148
87	0.0256	0.0099	0.0157
88	0.0274	0.0106	0.0169
89	0.0296	0.0114	0.0182
90	0.0323	0.0124	0.0199
91	0.0358	0.0138	0.0220
92	0.0404	0.0156	0.0249
93	0.0398	0.0153	0.0244

94	0.0495	0.0191	0.0305
95	0.1015	0.0318	0.0697
96	0.1688	0.0318	0.1370
97	0.3043	0.0318	0.2725
98	0.0505	0.0194	0.0310
99	0.0406	0.0157	0.0250
100	0.0324	0.0125	0.0199
101	0.0275	0.0106	0.0169
102	0.0241	0.0093	0.0148
103	0.0230	0.0089	0.0141
104	0.0210	0.0081	0.0129
105	0.0195	0.0075	0.0120
106	0.0182	0.0070	0.0112
107	0.0171	0.0066	0.0105
108	0.0162	0.0062	0.0099
109	0.0156	0.0060	0.0096
110	0.0149	0.0057	0.0092
111	0.0143	0.0055	0.0088
112	0.0137	0.0053	0.0084
113	0.0132	0.0051	0.0081
114	0.0127	0.0049	0.0078
115	0.0123	0.0047	0.0076
116	0.0119	0.0046	0.0073
117	0.0116	0.0045	0.0071
118	0.0113	0.0043	0.0069
119	0.0110	0.0042	0.0067
120	0.0107	0.0041	0.0066
121	0.0104	0.0040	0.0064
122	0.0102	0.0039	0.0062
123	0.0099	0.0038	0.0061
124	0.0097	0.0037	0.0060
125	0.0095	0.0037	0.0058
126	0.0093	0.0036	0.0057
127	0.0091	0.0035	0.0056
128	0.0089	0.0034	0.0055
129	0.0088	0.0034	0.0054
130	0.0086	0.0033	0.0053
131	0.0085	0.0033	0.0052
132	0.0083	0.0032	0.0051
133	0.0082	0.0032	0.0050
134	0.0081	0.0031	0.0050
135	0.0079	0.0031	0.0049
136	0.0078	0.0030	0.0048
137	0.0077	0.0030	0.0047
138	0.0076	0.0029	0.0047
139	0.0075	0.0029	0.0046
140	0.0074	0.0028	0.0045
141	0.0073	0.0028	0.0045
142	0.0072	0.0028	0.0044
143	0.0071	0.0027	0.0044
144	0.0070	0.0027	0.0043

Total soil rain loss = 0.83(In)
Total effective rainfall = 1.65(In)
Peak flow rate in flood hydrograph = 161.90(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 10 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	50.0	100.0	150.0	200.0
0+10	0.6891	50.03	V	Q			
0+20	1.3790	50.09	V	Q			
0+30	2.0698	50.15	V	Q			
0+40	2.7621	50.26	V	Q			
0+50	3.4560	50.37	V	Q			
1+ 0	4.1519	50.52	V	Q			
1+10	4.8501	50.69	V	Q			
1+20	5.5509	50.88	V	Q			
1+30	6.2547	51.10	V	Q			
1+40	6.9620	51.34	V	Q			
1+50	7.6746	51.74	V	Q			
2+ 0	8.3932	52.17	V	Q			
2+10	9.1196	52.73	V	Q			
2+20	9.8554	53.42	V	Q			
2+30	10.6006	54.10	V	Q			
2+40	11.3539	54.69	V	Q			
2+50	12.1154	55.28	V	Q			
3+ 0	12.8837	55.78	V	Q			
3+10	13.6583	56.24	V	Q			
3+20	14.4390	56.67	V	Q			
3+30	15.2249	57.06	V	Q			
3+40	16.0162	57.44	V	Q			
3+50	16.8118	57.76	V	Q			
4+ 0	17.6116	58.07	V	Q			
4+10	18.4153	58.35	V	Q			
4+20	19.2226	58.61	V	Q			
4+30	20.0336	58.87	V	Q			
4+40	20.8478	59.11	V	Q			
4+50	21.6653	59.35	V	Q			
5+ 0	22.4860	59.58	V	Q			
5+10	23.3098	59.81	V	Q			
5+20	24.1367	60.03	V	Q			
5+30	24.9664	60.24	V	Q			
5+40	25.7990	60.45	V	Q			
5+50	26.6343	60.64	V	Q			
6+ 0	27.4724	60.84	V	Q			
6+10	28.3132	61.04	V	Q			
6+20	29.1567	61.24	V	Q			
6+30	30.0029	61.44	V	Q			
6+40	30.8517	61.62	V	Q			
6+50	31.7029	61.80	V	Q			
7+ 0	32.5567	61.99	V	Q			
7+10	33.4131	62.17	V	Q			
7+20	34.2720	62.36	V	Q			
7+30	35.1334	62.54	V	Q			
7+40	35.9973	62.72	V	Q			
7+50	36.8637	62.90	V	Q			
8+ 0	37.7327	63.09	V	Q			
8+10	38.6043	63.28	V	Q			
8+20	39.4784	63.46	V	Q			
8+30	40.3552	63.65	V	Q			
8+40	41.2346	63.85	V	Q			
8+50	42.1168	64.05	V	Q			
9+ 0	43.0017	64.24	V	Q			
9+10	43.8892	64.43	V	Q			
9+20	44.7795	64.63	V	Q			
9+30	45.6726	64.84	V	Q			
9+40	46.5685	65.05	V	Q			
9+50	47.4673	65.25	V	Q			
10+ 0	48.3689	65.46	V	Q			

			A125
10+10	49.2734	65.67	
10+20	50.1809	65.89	
10+30	51.0915	66.11	
10+40	52.0052	66.33	
10+50	52.9221	66.57	
11+ 0	53.8424	66.81	
11+10	54.7660	67.06	
11+20	55.6932	67.31	
11+30	56.6239	67.57	
11+40	57.5583	67.84	
11+50	58.4965	68.11	
12+ 0	59.4387	68.40	
12+10	60.3849	68.70	
12+20	61.3353	69.00	
12+30	62.2901	69.32	
12+40	63.2494	69.65	
12+50	64.2135	69.99	
13+ 0	65.1824	70.34	
13+10	66.1563	70.71	
13+20	67.1355	71.09	
13+30	68.1203	71.49	
13+40	69.1109	71.92	
13+50	70.1076	72.36	
14+ 0	71.1107	72.83	
14+10	72.1206	73.32	
14+20	73.1376	73.83	
14+30	74.1620	74.38	
14+40	75.1945	74.96	
14+50	76.2357	75.59	
15+ 0	77.2862	76.27	
15+10	78.3472	77.03	
15+20	79.4197	77.86	
15+30	80.5047	78.77	
15+40	81.6037	79.79	
15+50	82.7218	81.17	
16+ 0	83.8698	83.35	
16+10	85.0696	87.10	
16+20	86.3189	90.70	
16+30	87.6100	93.73	
16+40	88.9588	97.93	
16+50	90.3480	100.85	
17+ 0	91.7959	105.12	
17+10	93.2914	108.58	
17+20	94.8426	112.62	
17+30	96.4726	118.33	
17+40	98.1953	125.07	
17+50	100.0839	137.11	
18+ 0	102.0782	144.79	
18+10	104.2241	155.80	
18+20	106.4542	161.90	
18+30	108.6366	158.45	
18+40	110.7294	151.94	
18+50	112.7593	147.37	
19+ 0	114.6776	139.27	
19+10	116.5262	134.21	
19+20	118.3145	129.83	
19+30	120.0311	124.63	
19+40	121.6958	120.85	
19+50	123.2812	115.10	
20+ 0	124.8252	112.09	
20+10	126.3240	108.81	
20+20	127.7844	106.03	
20+30	129.2168	103.99	

20+40	130.6152	101.52	VQ
20+50	131.9942	100.12	VQ
21+ 0	133.3497	98.41	Q|
21+10	134.6846	96.91	QV
21+20	135.9951	95.14	QV
21+30	137.2797	93.26	Q V
21+40	138.5481	92.09	Q V
21+50	139.7963	90.62	Q V
22+ 0	141.0321	89.72	Q V
22+10	142.2553	88.80	Q |V
22+20	143.4642	87.77	Q |V
22+30	144.6549	86.45	Q |V
22+40	145.8237	84.86	Q |V
22+50	146.9837	84.21	Q |V
23+ 0	148.1356	83.63	Q | V
23+10	149.2774	82.90	Q | V
23+20	150.4049	81.85	Q | V
23+30	151.5183	80.83	Q | V
23+40	152.6253	80.37	Q | V
23+50	153.7260	79.91	Q | V
24+ 0	154.8192	79.36	Q | V

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/27/18

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4014

Area A1
100 year, 24 hour

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
487.00	1	1.01
Rainfall data for year 100		
487.00	6	1.88
Rainfall data for year 100		
487.00	24	3.23

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
83.0	95.8	487.00	1.000	0.083	0.600	0.050

Area-averaged adjusted loss rate Fm (In/Hr) = 0.050

********* Area-Averaged low loss rate fraction, Yb **********

Area	Area	SCS CN	SCS CN	S	Pervious

A1100

(Ac.)	Fract	(AMC2)	(AMC3)		Yield Fr
292.20	0.600	83.0	95.8	0.44	0.854
194.80	0.400	98.0	98.0	0.20	0.928

Area-averaged catchment yield fraction, Y = 0.883
Area-averaged low loss fraction, Yb = 0.117
++
Watercourse length = 9580.00(Ft.)
Length from concentration point to centroid = 4802.00(Ft.)
Elevation difference along watercourse = 42.00(Ft.)
Mannings friction factor along watercourse = 0.200
Watershed area = 487.00(Ac.)
Catchment Lag time = 3.196 hours
Unit interval = 10.000 minutes
Unit interval percentage of lag time = 5.2144
Hydrograph baseflow = 50.00(CFS)
Average maximum watershed loss rate(Fm) = 0.050(In/Hr)
Average low loss rate fraction (Yb) = 0.117 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.345(In)
Computed peak 30-minute rainfall = 0.815(In)
Specified peak 1-hour rainfall = 1.010(In)
Computed peak 3-hour rainfall = 1.450(In)
Specified peak 6-hour rainfall = 1.880(In)
Specified peak 24-hour rainfall = 3.230(In)

Note: user specified rainfall values used.
Rainfall depth area reduction factors:
Using a total area of 487.00(Ac.) (Ref: fig. E-4)

5-minute factor = 0.977 Adjusted rainfall = 0.337(In)
30-minute factor = 0.977 Adjusted rainfall = 0.796(In)
1-hour factor = 0.977 Adjusted rainfall = 0.987(In)
3-hour factor = 0.997 Adjusted rainfall = 1.446(In)
6-hour factor = 0.998 Adjusted rainfall = 1.877(In)
24-hour factor = 0.999 Adjusted rainfall = 3.228(In)

U n i t H y d r o g r a p h
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Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 2944.83 (CFS))	
1	0.229	6.756
2	0.688	13.513
3	1.223	15.745
4	2.066	24.829
5	2.951	26.057
6	4.113	34.206
7	5.406	38.082
8	6.849	42.498
9	8.592	51.347
10	10.479	55.543
11	13.541	90.186
12	16.879	98.282
13	21.245	128.583
14	26.585	157.242
15	31.757	152.333
16	36.285	133.338
17	40.722	130.644

18	44.402	108.374
19	47.739	98.276
20	50.865	92.043
21	53.586	80.140
22	56.233	77.960
23	58.353	62.414
24	60.355	58.961
25	62.159	53.131
26	63.786	47.910
27	65.363	46.442
28	66.757	41.041
29	68.130	40.438
30	69.418	37.935
31	70.670	36.854
32	71.848	34.704
33	72.894	30.793
34	73.925	30.356
35	74.862	27.605
36	75.780	27.025
37	76.675	26.361
38	77.551	25.797
39	78.388	24.647
40	79.088	20.618
41	79.776	20.269
42	80.465	20.269
43	81.153	20.269
44	81.796	18.936
45	82.361	16.625
46	82.924	16.584
47	83.487	16.584
48	84.050	16.581
49	84.578	15.562
50	85.079	14.741
51	85.580	14.741
52	86.080	14.741
53	86.578	14.657
54	87.018	12.954
55	87.435	12.285
56	87.852	12.285
57	88.269	12.285
58	88.675	11.949
59	89.003	9.649
60	89.316	9.213
61	89.628	9.213
62	89.941	9.213
63	90.249	9.074
64	90.543	8.632
65	90.835	8.599
66	91.127	8.599
67	91.419	8.599
68	91.695	8.125
69	91.945	7.380
70	92.195	7.371
71	92.446	7.371
72	92.696	7.369
73	92.934	7.014
74	93.164	6.756
75	93.393	6.756
76	93.622	6.756
77	93.850	6.692
78	94.040	5.608
79	94.217	5.221
80	94.395	5.221

81	94.572	5.221
82	94.749	5.221
83	94.927	5.221
84	95.104	5.221
85	95.281	5.221
86	95.458	5.221
87	95.625	4.919
88	95.763	4.047
89	95.898	3.992
90	96.034	3.992
91	96.170	3.992
92	96.305	3.992
93	96.441	3.992
94	96.576	3.992
95	96.712	3.992
96	96.847	3.985
97	96.957	3.248
98	97.051	2.764
99	97.145	2.764
100	97.239	2.764
101	97.333	2.764
102	97.427	2.764
103	97.521	2.764
104	97.615	2.764
105	97.708	2.764
106	97.797	2.595
107	97.853	1.675
108	97.906	1.536
109	97.958	1.536
110	98.010	1.536
111	98.062	1.536
112	98.114	1.536
113	98.166	1.536
114	98.218	1.536
115	98.271	1.536
116	98.327	1.670
117	98.390	1.842
118	98.452	1.843
119	98.515	1.843
120	98.578	1.843
121	98.640	1.843
122	98.703	1.843
123	98.765	1.843
124	98.828	1.843
125	98.890	1.843
126	98.953	1.843
127	99.016	1.843
128	99.078	1.843
129	99.141	1.843
130	99.203	1.843
131	99.266	1.843
132	99.328	1.843
133	99.391	1.843
134	99.454	1.843
135	99.508	1.589
136	99.541	0.986
137	99.574	0.960
138	99.606	0.960
139	99.639	0.960
140	99.671	0.960
141	99.704	0.960
142	99.737	0.960
143	99.769	0.960

144	99.802	0.960
145	99.834	0.960
146	99.867	0.960
147	99.899	0.960
148	99.932	0.960
149	99.965	0.960
150	100.000	0.480

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.4701	0.1330
2	0.6556	0.0845
3	0.7964	0.0667
4	0.8706	0.0352
5	0.9328	0.0299
6	0.9869	0.0262
7	1.0413	0.0265
8	1.0907	0.0242
9	1.1363	0.0223
10	1.1787	0.0208
11	1.2184	0.0195
12	1.2558	0.0184
13	1.2912	0.0175
14	1.3249	0.0166
15	1.3570	0.0159
16	1.3878	0.0152
17	1.4174	0.0146
18	1.4458	0.0141
19	1.4756	0.0147
20	1.5043	0.0143
21	1.5322	0.0138
22	1.5593	0.0134
23	1.5857	0.0131
24	1.6113	0.0127
25	1.6362	0.0124
26	1.6606	0.0121
27	1.6844	0.0118
28	1.7076	0.0115
29	1.7303	0.0113
30	1.7526	0.0111
31	1.7743	0.0108
32	1.7957	0.0106
33	1.8166	0.0104
34	1.8372	0.0102
35	1.8573	0.0100
36	1.8771	0.0099
37	1.8974	0.0101
38	1.9173	0.0099
39	1.9368	0.0097
40	1.9561	0.0096
41	1.9751	0.0095
42	1.9938	0.0093
43	2.0122	0.0092
44	2.0304	0.0091
45	2.0483	0.0089
46	2.0660	0.0088
47	2.0834	0.0087
48	2.1007	0.0086
49	2.1177	0.0085
50	2.1345	0.0084
51	2.1511	0.0083
52	2.1674	0.0082
53	2.1837	0.0081

54	2.1997	0.0080
55	2.2155	0.0079
56	2.2312	0.0078
57	2.2467	0.0077
58	2.2620	0.0076
59	2.2772	0.0076
60	2.2922	0.0075
61	2.3071	0.0074
62	2.3218	0.0073
63	2.3364	0.0073
64	2.3508	0.0072
65	2.3651	0.0071
66	2.3792	0.0071
67	2.3933	0.0070
68	2.4072	0.0069
69	2.4210	0.0069
70	2.4346	0.0068
71	2.4482	0.0068
72	2.4616	0.0067
73	2.4749	0.0066
74	2.4881	0.0066
75	2.5012	0.0065
76	2.5142	0.0065
77	2.5271	0.0064
78	2.5399	0.0064
79	2.5526	0.0063
80	2.5651	0.0063
81	2.5776	0.0062
82	2.5900	0.0062
83	2.6023	0.0061
84	2.6146	0.0061
85	2.6267	0.0061
86	2.6387	0.0060
87	2.6507	0.0060
88	2.6626	0.0059
89	2.6743	0.0059
90	2.6861	0.0058
91	2.6977	0.0058
92	2.7092	0.0058
93	2.7207	0.0057
94	2.7321	0.0057
95	2.7435	0.0057
96	2.7547	0.0056
97	2.7659	0.0056
98	2.7770	0.0055
99	2.7881	0.0055
100	2.7990	0.0055
101	2.8100	0.0054
102	2.8208	0.0054
103	2.8316	0.0054
104	2.8423	0.0054
105	2.8530	0.0053
106	2.8636	0.0053
107	2.8741	0.0053
108	2.8846	0.0052
109	2.8950	0.0052
110	2.9053	0.0052
111	2.9156	0.0051
112	2.9259	0.0051
113	2.9361	0.0051
114	2.9462	0.0051
115	2.9563	0.0050
116	2.9663	0.0050

117	2.9763	0.0050
118	2.9862	0.0050
119	2.9961	0.0049
120	3.0059	0.0049
121	3.0157	0.0049
122	3.0254	0.0049
123	3.0351	0.0048
124	3.0447	0.0048
125	3.0543	0.0048
126	3.0638	0.0048
127	3.0733	0.0047
128	3.0827	0.0047
129	3.0921	0.0047
130	3.1015	0.0047
131	3.1108	0.0046
132	3.1200	0.0046
133	3.1293	0.0046
134	3.1384	0.0046
135	3.1476	0.0046
136	3.1567	0.0045
137	3.1657	0.0045
138	3.1748	0.0045
139	3.1837	0.0045
140	3.1927	0.0045
141	3.2016	0.0044
142	3.2104	0.0044
143	3.2192	0.0044
144	3.2280	0.0044

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0088	0.0010	0.0078
2	0.0088	0.0010	0.0078
3	0.0089	0.0010	0.0079
4	0.0090	0.0010	0.0079
5	0.0090	0.0011	0.0080
6	0.0091	0.0011	0.0080
7	0.0091	0.0011	0.0081
8	0.0092	0.0011	0.0081
9	0.0093	0.0011	0.0082
10	0.0093	0.0011	0.0082
11	0.0094	0.0011	0.0083
12	0.0095	0.0011	0.0084
13	0.0095	0.0011	0.0084
14	0.0096	0.0011	0.0085
15	0.0097	0.0011	0.0085
16	0.0097	0.0011	0.0086
17	0.0098	0.0011	0.0087
18	0.0099	0.0012	0.0087
19	0.0100	0.0012	0.0088
20	0.0101	0.0012	0.0089
21	0.0101	0.0012	0.0090
22	0.0102	0.0012	0.0090
23	0.0103	0.0012	0.0091
24	0.0104	0.0012	0.0092
25	0.0105	0.0012	0.0093
26	0.0106	0.0012	0.0093
27	0.0107	0.0012	0.0094
28	0.0108	0.0013	0.0095
29	0.0108	0.0013	0.0096
30	0.0109	0.0013	0.0097

31	0.0110	0.0013	0.0098
32	0.0112	0.0013	0.0099
33	0.0113	0.0013	0.0099
34	0.0114	0.0013	0.0100
35	0.0115	0.0013	0.0101
36	0.0116	0.0014	0.0102
37	0.0117	0.0014	0.0103
38	0.0118	0.0014	0.0105
39	0.0120	0.0014	0.0106
40	0.0121	0.0014	0.0107
41	0.0122	0.0014	0.0108
42	0.0124	0.0014	0.0109
43	0.0125	0.0015	0.0110
44	0.0126	0.0015	0.0112
45	0.0128	0.0015	0.0113
46	0.0129	0.0015	0.0114
47	0.0131	0.0015	0.0116
48	0.0133	0.0015	0.0117
49	0.0134	0.0016	0.0119
50	0.0136	0.0016	0.0120
51	0.0138	0.0016	0.0122
52	0.0140	0.0016	0.0123
53	0.0142	0.0017	0.0125
54	0.0144	0.0017	0.0127
55	0.0146	0.0017	0.0129
56	0.0148	0.0017	0.0131
57	0.0150	0.0018	0.0133
58	0.0153	0.0018	0.0135
59	0.0155	0.0018	0.0137
60	0.0158	0.0018	0.0139
61	0.0160	0.0019	0.0142
62	0.0163	0.0019	0.0144
63	0.0166	0.0019	0.0147
64	0.0169	0.0020	0.0149
65	0.0172	0.0020	0.0152
66	0.0176	0.0020	0.0155
67	0.0179	0.0021	0.0158
68	0.0183	0.0021	0.0162
69	0.0187	0.0022	0.0165
70	0.0191	0.0022	0.0169
71	0.0196	0.0023	0.0173
72	0.0201	0.0023	0.0177
73	0.0198	0.0023	0.0175
74	0.0204	0.0024	0.0180
75	0.0209	0.0024	0.0185
76	0.0216	0.0025	0.0190
77	0.0222	0.0026	0.0196
78	0.0230	0.0027	0.0203
79	0.0238	0.0028	0.0210
80	0.0247	0.0029	0.0218
81	0.0256	0.0030	0.0226
82	0.0267	0.0031	0.0236
83	0.0279	0.0033	0.0246
84	0.0293	0.0034	0.0258
85	0.0284	0.0033	0.0251
86	0.0302	0.0035	0.0266
87	0.0322	0.0037	0.0284
88	0.0345	0.0040	0.0305
89	0.0374	0.0044	0.0330
90	0.0410	0.0048	0.0362
91	0.0456	0.0053	0.0403
92	0.0517	0.0060	0.0457
93	0.0541	0.0063	0.0478

94	0.0676	0.0079	0.0597
95	0.1408	0.0083	0.1325
96	0.2340	0.0083	0.2257
97	0.4216	0.0083	0.4134
98	0.0688	0.0080	0.0608
99	0.0520	0.0061	0.0460
100	0.0411	0.0048	0.0363
101	0.0346	0.0040	0.0306
102	0.0302	0.0035	0.0267
103	0.0293	0.0034	0.0259
104	0.0267	0.0031	0.0236
105	0.0247	0.0029	0.0218
106	0.0230	0.0027	0.0203
107	0.0216	0.0025	0.0191
108	0.0204	0.0024	0.0180
109	0.0201	0.0023	0.0177
110	0.0191	0.0022	0.0169
111	0.0183	0.0021	0.0162
112	0.0176	0.0020	0.0155
113	0.0169	0.0020	0.0149
114	0.0163	0.0019	0.0144
115	0.0158	0.0018	0.0139
116	0.0153	0.0018	0.0135
117	0.0148	0.0017	0.0131
118	0.0144	0.0017	0.0127
119	0.0140	0.0016	0.0123
120	0.0136	0.0016	0.0120
121	0.0133	0.0015	0.0117
122	0.0129	0.0015	0.0114
123	0.0126	0.0015	0.0112
124	0.0124	0.0014	0.0109
125	0.0121	0.0014	0.0107
126	0.0118	0.0014	0.0105
127	0.0116	0.0014	0.0102
128	0.0114	0.0013	0.0100
129	0.0112	0.0013	0.0099
130	0.0109	0.0013	0.0097
131	0.0108	0.0013	0.0095
132	0.0106	0.0012	0.0093
133	0.0104	0.0012	0.0092
134	0.0102	0.0012	0.0090
135	0.0101	0.0012	0.0089
136	0.0099	0.0012	0.0087
137	0.0097	0.0011	0.0086
138	0.0096	0.0011	0.0085
139	0.0095	0.0011	0.0084
140	0.0093	0.0011	0.0082
141	0.0092	0.0011	0.0081
142	0.0091	0.0011	0.0080
143	0.0090	0.0010	0.0079
144	0.0088	0.0010	0.0078

Total soil rain loss = 0.31(In)
Total effective rainfall = 2.92(In)
Peak flow rate in flood hydrograph = 239.43(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 10 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	75.0	150.0	225.0	300.0
0+10	0.6894	50.05	V Q				
0+20	1.3803	50.16	V Q				
0+30	2.0729	50.28	V Q				
0+40	2.7681	50.48	V Q				
0+50	3.4662	50.68	V Q				
1+ 0	4.1680	50.95	V Q				
1+10	4.8740	51.25	V Q				
1+20	5.5846	51.59	V Q				
1+30	6.3008	52.00	V Q				
1+40	7.0232	52.44	V Q				
1+50	7.7554	53.16	V Q				
2+ 0	8.4984	53.94	V Q				
2+10	9.2556	54.97	V Q				
2+20	10.0300	56.22	V Q				
2+30	10.8212	57.45	V Q				
2+40	11.6274	58.53	V Q				
2+50	12.4484	59.60	V Q				
3+ 0	13.2818	60.51	V Q				
3+10	14.1267	61.34	V Q				
3+20	14.9826	62.13	V Q				
3+30	15.8481	62.84	V Q				
3+40	16.7233	63.53	V Q				
3+50	17.6064	64.11	V Q				
4+ 0	18.4971	64.67	V Q				
4+10	19.3950	65.19	V Q				
4+20	20.2996	65.67	V Q				
4+30	21.2106	66.14	V Q				
4+40	22.1277	66.58	V Q				
4+50	23.0508	67.02	V Q				
5+ 0	23.9797	67.44	V Q				
5+10	24.9143	67.86	V Q				
5+20	25.8546	68.26	V Q				
5+30	26.8000	68.64	V Q				
5+40	27.7507	69.02	V Q				
5+50	28.7064	69.38	V Q				
6+ 0	29.6671	69.75	V Q				
6+10	30.6329	70.11	V Q				
6+20	31.6036	70.48	V Q				
6+30	32.5793	70.84	V Q				
6+40	33.5596	71.17	V Q				
6+50	34.5445	71.50	V Q				
7+ 0	35.5341	71.85	V Q				
7+10	36.5285	72.19	V Q				
7+20	37.5276	72.53	V Q				
7+30	38.5312	72.86	V Q				
7+40	39.5394	73.20	V Q				
7+50	40.5522	73.54	V Q				
8+ 0	41.5699	73.88	V Q				
8+10	42.5923	74.23	V Q				
8+20	43.6194	74.57	V Q				
8+30	44.6514	74.92	V Q				
8+40	45.6883	75.28	V Q				
8+50	46.7303	75.64	V Q				
9+ 0	47.7772	76.00	V Q				
9+10	48.8290	76.37	V Q				
9+20	49.8860	76.74	V Q				
9+30	50.9482	77.11	V Q				
9+40	52.0157	77.50	V Q				
9+50	53.0884	77.88	V Q				
10+ 0	54.1663	78.26	V Q				

			A1100
10+10	55.2497	78.65	V Q
10+20	56.3386	79.06	V Q
10+30	57.4332	79.47	V Q
10+40	58.5336	79.89	V Q
10+50	59.6400	80.33	V Q
11+ 0	60.7526	80.77	V Q
11+10	61.8715	81.23	V Q
11+20	62.9970	81.71	V Q
11+30	64.1291	82.19	V Q
11+40	65.2680	82.69	V |Q
11+50	66.4141	83.20	V |Q
12+ 0	67.5675	83.74	V |Q
12+10	68.7285	84.29	V |Q
12+20	69.8973	84.85	V |Q
12+30	71.0741	85.44	V |Q
12+40	72.2592	86.04	V|Q
12+50	73.4530	86.67	V|Q
13+ 0	74.6557	87.31	V|Q
13+10	75.8676	87.99	V|Q
13+20	77.0892	88.69	V|Q
13+30	78.3209	89.42	V|Q
13+40	79.5632	90.19	V| Q
13+50	80.8165	90.99	V Q
14+ 0	82.0813	91.83	V Q
14+10	83.3580	92.69	V Q
14+20	84.6470	93.58	V Q
14+30	85.9491	94.54	V Q
14+40	87.2654	95.56	V Q
14+50	88.5972	96.68	VQ
15+ 0	89.9458	97.91	|V Q
15+10	91.3131	99.27	|V Q
15+20	92.7012	100.78	|V Q
15+30	94.1124	102.45	|V Q
15+40	95.5498	104.36	|V Q
15+50	97.0228	106.94	| V Q
16+ 0	98.5492	110.81	| V Q
16+10	100.1602	116.96	| V Q
16+20	101.8542	122.99	| V Q
16+30	103.6197	128.17	| V Q
16+40	105.4808	135.11	| V Q
16+50	107.4127	140.26	| V Q
17+ 0	109.4427	147.37	| V Q|
17+10	111.5568	153.48	| V Q
17+20	113.7676	160.51	| V Q
17+30	116.1155	170.46	| V Q
17+40	118.6204	181.86	| V Q
17+50	121.3893	201.02	| V Q
18+ 0	124.3348	213.84	| V Q
18+10	127.5113	230.62	| V Q
18+20	130.8092	239.43	| V Q
18+30	134.0321	233.98	| V Q
18+40	137.1114	223.56	| V Q
18+50	140.0836	215.78	| V Q
19+ 0	142.8796	202.99	| V Q
19+10	145.5591	194.53	| V Q
19+20	148.1378	187.21	| V Q
19+30	150.5984	178.64	| V Q
19+40	152.9703	172.20	| V Q
19+50	155.2160	163.04	| V Q
20+ 0	157.3906	157.88	| V Q
20+10	159.4908	152.47	| VQ
20+20	161.5271	147.83	| QV
20+30	163.5154	144.36	| QV

20+40	165.4481	140.31	Q V
20+50	167.3465	137.82	Q V
21+ 0	169.2049	134.92	Q |V
21+10	171.0272	132.30	Q |V
21+20	172.8086	129.33	Q |V
21+30	174.5471	126.21	Q |V
21+40	176.2571	124.15	Q | V
21+50	177.9335	121.71	Q | V
22+ 0	179.5876	120.08	Q | V
22+10	181.2191	118.45	Q | V
22+20	182.8253	116.61	Q | V
22+30	184.4009	114.39	Q | V
22+40	185.9411	111.82	Q | V
22+50	187.4649	110.63	Q | V
23+ 0	188.9737	109.54	Q | V
23+10	190.4644	108.23	Q | V
23+20	191.9311	106.48	Q | V
23+30	193.3745	104.79	Q | V
23+40	194.8061	103.94	Q | V
23+50	196.2259	103.07	Q | V
24+ 0	197.6322	102.10	Q | V

U n i t H y d r o g r a p h A n a l y s i s

Study date 04/27/18

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4014

Area A2
25 year, 24 hour
AV Village

Storm Event Year = 25

Antecedent Moisture Condition = 2

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 25		
963.00	1	0.73
Rainfall data for year 25		
963.00	6	1.42
Rainfall data for year 25		
963.00	24	2.48

++

******** Area-averaged max loss rate, Fm ********

SCS curve NO.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
74.0	74.0	963.00	1.000	0.469	0.600	0.282

Area-averaged adjusted loss rate Fm (In/Hr) = 0.282

********* Area-Averaged low loss rate fraction, Yb **********

Area	Area	SCS CN	SCS CN	S	Pervious

AVA2

(Ac.)	Fract	(AMC2)	(AMC2)		Yield Fr
577.80	0.600	74.0	74.0	3.51	0.241
385.20	0.400	98.0	98.0	0.20	0.908

Area-averaged catchment yield fraction, Y = 0.507
Area-averaged low loss fraction, Yb = 0.493
++
Watercourse length = 12500.00(Ft.)
Length from concentration point to centroid = 6250.00(Ft.)
Elevation difference along watercourse = 48.00(Ft.)
Mannings friction factor along watercourse = 0.200
Watershed area = 963.00(Ac.)
Catchment Lag time = 4.008 hours
Unit interval = 30.000 minutes
Unit interval percentage of lag time = 12.4737
Hydrograph baseflow = 100.00(CFS)
Average maximum watershed loss rate(Fm) = 0.282(In/Hr)
Average low loss rate fraction (Yb) = 0.493 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.249(In)
Computed peak 30-minute rainfall = 0.588(In)
Specified peak 1-hour rainfall = 0.731(In)
Computed peak 3-hour rainfall = 1.080(In)
Specified peak 6-hour rainfall = 1.420(In)
Specified peak 24-hour rainfall = 2.480(In)

Note: user specified rainfall values used.
Rainfall depth area reduction factors:
Using a total area of 963.00(Ac.) (Ref: fig. E-4)

5-minute factor = 0.955	Adjusted rainfall = 0.238(In)
30-minute factor = 0.955	Adjusted rainfall = 0.561(In)
1-hour factor = 0.955	Adjusted rainfall = 0.698(In)
3-hour factor = 0.994	Adjusted rainfall = 1.074(In)
6-hour factor = 0.997	Adjusted rainfall = 1.416(In)
24-hour factor = 0.999	Adjusted rainfall = 2.477(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 1941.05 (CFS))	
1	0.549	10.653
2	2.143	30.950
3	4.734	50.279
4	8.369	70.564
5	14.424	117.535
6	24.752	200.464
7	36.503	228.099
8	45.873	181.876
9	53.133	140.922
10	58.804	110.062
11	63.163	84.628
12	66.770	70.001
13	69.921	61.163
14	72.679	53.530
15	75.033	45.691
16	77.181	41.707
17	79.067	36.608

18	80.714	31.965
19	82.222	29.271
20	83.570	26.153
21	84.848	24.816
22	86.046	23.246
23	87.152	21.482
24	88.150	19.374
25	89.036	17.188
26	89.785	14.533
27	90.511	14.095
28	91.209	13.560
29	91.864	12.701
30	92.463	11.625
31	93.040	11.197
32	93.588	10.655
33	94.083	9.601
34	94.507	8.238
35	94.932	8.232
36	95.356	8.232
37	95.737	7.405
38	96.062	6.301
39	96.386	6.295
40	96.710	6.295
41	96.993	5.483
42	97.218	4.365
43	97.442	4.358
44	97.667	4.358
45	97.850	3.561
46	97.976	2.430
47	98.100	2.421
48	98.225	2.421
49	98.360	2.617
50	98.509	2.903
51	98.659	2.905
52	98.809	2.905
53	98.958	2.905
54	99.108	2.905
55	99.258	2.905
56	99.407	2.905
57	99.529	2.364
58	99.608	1.523
59	99.686	1.513
60	99.764	1.513
61	99.842	1.513
62	99.920	1.513
63	100.000	0.757

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.5615	0.0470
2	0.6980	0.0188
3	0.8183	0.0181
4	0.9160	0.0152
5	0.9997	0.0132
6	1.0738	0.0118
7	1.1419	0.0109
8	1.2044	0.0101
9	1.2623	0.0094
10	1.3164	0.0088
11	1.3674	0.0083
12	1.4157	0.0079
13	1.4622	0.0076
14	1.5066	0.0073

15	1.5491	0.0070
16	1.5900	0.0067
17	1.6294	0.0065
18	1.6674	0.0062
19	1.7042	0.0060
20	1.7398	0.0059
21	1.7744	0.0057
22	1.8080	0.0055
23	1.8408	0.0054
24	1.8726	0.0053
25	1.9037	0.0051
26	1.9341	0.0050
27	1.9638	0.0049
28	1.9928	0.0048
29	2.0212	0.0047
30	2.0491	0.0046
31	2.0764	0.0045
32	2.1032	0.0044
33	2.1294	0.0043
34	2.1552	0.0043
35	2.1806	0.0042
36	2.2055	0.0041
37	2.2300	0.0041
38	2.2542	0.0040
39	2.2779	0.0039
40	2.3013	0.0039
41	2.3244	0.0038
42	2.3471	0.0038
43	2.3695	0.0037
44	2.3916	0.0037
45	2.4133	0.0036
46	2.4348	0.0036
47	2.4561	0.0035
48	2.4770	0.0035

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0210	0.0103	0.0107
2	0.0214	0.0105	0.0109
3	0.0218	0.0108	0.0111
4	0.0223	0.0110	0.0113
5	0.0228	0.0112	0.0116
6	0.0233	0.0115	0.0118
7	0.0238	0.0117	0.0121
8	0.0244	0.0120	0.0124
9	0.0250	0.0123	0.0127
10	0.0257	0.0126	0.0130
11	0.0264	0.0130	0.0134
12	0.0271	0.0134	0.0138
13	0.0279	0.0138	0.0142
14	0.0288	0.0142	0.0146
15	0.0298	0.0147	0.0151
16	0.0309	0.0152	0.0157
17	0.0320	0.0158	0.0163
18	0.0333	0.0164	0.0169
19	0.0348	0.0171	0.0176
20	0.0364	0.0179	0.0185
21	0.0382	0.0188	0.0194
22	0.0404	0.0199	0.0205
23	0.0428	0.0211	0.0217
24	0.0458	0.0225	0.0232

25	0.0487	0.0240	0.0247
26	0.0531	0.0261	0.0269
27	0.0587	0.0289	0.0298
28	0.0661	0.0326	0.0336
29	0.0756	0.0372	0.0384
30	0.0927	0.0457	0.0470
31	0.1173	0.0578	0.0595
32	0.3125	0.1408	0.1718
33	0.3884	0.1408	0.2477
34	0.0872	0.0430	0.0443
35	0.0637	0.0314	0.0323
36	0.0516	0.0254	0.0262
37	0.0448	0.0221	0.0227
38	0.0397	0.0195	0.0201
39	0.0359	0.0177	0.0182
40	0.0329	0.0162	0.0167
41	0.0305	0.0150	0.0155
42	0.0285	0.0141	0.0145
43	0.0269	0.0132	0.0136
44	0.0254	0.0125	0.0129
45	0.0242	0.0119	0.0123
46	0.0231	0.0114	0.0117
47	0.0221	0.0109	0.0112
48	0.0213	0.0105	0.0108

Total soil rain loss = 1.16(In)
Total effective rainfall = 1.32(In)
Peak flow rate in flood hydrograph = 235.84(CFS)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 30 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	75.0	150.0	225.0	300.0
0+30	4.1369	100.11	V	Q			
1+ 0	8.2876	100.45	V	Q			
1+30	12.4607	100.99	V	Q			
2+ 0	16.6657	101.76	V	Q			
2+30	20.9240	103.05	V	Q			
3+ 0	25.2730	105.25	V	Q			
3+30	29.7269	107.78	V	Q			
4+ 0	34.2675	109.88	V	Q			
4+30	38.8787	111.59	V	Q			
5+ 0	43.5485	113.01	V	Q			
5+30	48.2674	114.20	V	Q			
6+ 0	53.0303	115.26	V	Q			
6+30	57.8348	116.27	V	Q			
7+ 0	62.6790	117.23	V	Q			
7+30	67.5610	118.14	V	Q			
8+ 0	72.4807	119.06	V	Q			
8+30	77.4376	119.96	V	Q			
9+ 0	82.4315	120.85	V	Q			
9+30	87.4635	121.77	V	Q			
10+ 0	92.5346	122.72	V	Q			
10+30	97.6467	123.71	V	Q			
11+ 0	102.8024	124.77	V	Q			
11+30	108.0044	125.89	V	Q			
12+ 0	113.2560	127.09	V	Q			

			AVA2
12+30	118.5611	128.38	V | Q
13+ 0	123.9244	129.79	V | Q
13+30	129.3529	131.37	V| Q
14+ 0	134.8558	133.17	V| Q
14+30	140.4448	135.25	V Q
15+ 0	146.1358	137.72	V Q
15+30	151.9543	140.81	V Q
16+ 0	157.9804	145.83	V Q|
16+30	164.3720	154.68	|V Q
17+ 0	171.2252	165.85	| V | Q
17+30	178.5591	177.48	| V | Q
18+ 0	186.5081	192.37	| V | Q
18+30	195.3951	215.06	| V | Q
19+ 0	205.1407	235.84	| V | Q
19+30	214.8431	234.80	| V | Q
20+ 0	223.8427	217.79	| V | Q
20+30	232.1852	201.89	| V | Q
21+ 0	239.9787	188.60	| V | Q
21+30	247.3355	178.03	| V | Q
22+ 0	254.3891	170.70	| V | Q
22+30	261.2098	165.06	| V | Q
23+ 0	267.8209	159.99	| V|Q
23+30	274.2501	155.59	| VQ
24+ 0	280.5331	152.05	| Q

AVA2100

Unit Hydrograph Analysis

Study date 04/27/18

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

Program License Serial Number 4014

Area A2
100 year, 24 hour
AV Village

Storm Event Year = 100

Antecedent Moisture Condition = 3

English (in-lb) Input Units Used

English Rainfall Data (Inches) Input Values Used

English Units used in output format

Area averaged rainfall intensity isohyetal data:

Sub-Area (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 100		
963.00	1	1.01
Rainfall data for year 100		
963.00	6	1.88
Rainfall data for year 100		
963.00	24	3.23

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve NO.(AMC 3)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
74.0	90.2	963.00	1.000	0.189	0.600	0.113

Area-averaged adjusted loss rate Fm (In/Hr) = 0.113

********* Area-Averaged low loss rate fraction, Yb **********

Area	Area	SCS CN	SCS CN	S	Pervious

AVA2100

(Ac.)	Fract	(AMC2)	(AMC3)		Yield Fr
577.80	0.600	74.0	90.2	1.09	0.686
385.20	0.400	98.0	98.0	0.20	0.928

Area-averaged catchment yield fraction, Y = 0.782
Area-averaged low loss fraction, Yb = 0.218
++
Watercourse length = 12500.00(Ft.)
Length from concentration point to centroid = 6250.00(Ft.)
Elevation difference along watercourse = 48.00(Ft.)
Mannings friction factor along watercourse = 0.200
Watershed area = 963.00(Ac.)
Catchment Lag time = 4.008 hours
Unit interval = 30.000 minutes
Unit interval percentage of lag time = 12.4737
Hydrograph baseflow = 100.00(CFS)
Average maximum watershed loss rate(Fm) = 0.113(In/Hr)
Average low loss rate fraction (Yb) = 0.218 (decimal)
DESERT S-Graph Selected
Computed peak 5-minute rainfall = 0.345(In)
Computed peak 30-minute rainfall = 0.815(In)
Specified peak 1-hour rainfall = 1.010(In)
Computed peak 3-hour rainfall = 1.450(In)
Specified peak 6-hour rainfall = 1.880(In)
Specified peak 24-hour rainfall = 3.230(In)

Note: user specified rainfall values used.
Rainfall depth area reduction factors:
Using a total area of 963.00(Ac.) (Ref: fig. E-4)

5-minute factor = 0.955	Adjusted rainfall = 0.329(In)
30-minute factor = 0.955	Adjusted rainfall = 0.778(In)
1-hour factor = 0.955	Adjusted rainfall = 0.964(In)
3-hour factor = 0.994	Adjusted rainfall = 1.442(In)
6-hour factor = 0.997	Adjusted rainfall = 1.874(In)
24-hour factor = 0.999	Adjusted rainfall = 3.226(In)

U n i t H y d r o g r a p h

++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))
	(K = 1941.05 (CFS))	
1	0.549	10.653
2	2.143	30.950
3	4.734	50.279
4	8.369	70.564
5	14.424	117.535
6	24.752	200.464
7	36.503	228.099
8	45.873	181.876
9	53.133	140.922
10	58.804	110.062
11	63.163	84.628
12	66.770	70.001
13	69.921	61.163
14	72.679	53.530
15	75.033	45.691
16	77.181	41.707
17	79.067	36.608

18	80.714	31.965
19	82.222	29.271
20	83.570	26.153
21	84.848	24.816
22	86.046	23.246
23	87.152	21.482
24	88.150	19.374
25	89.036	17.188
26	89.785	14.533
27	90.511	14.095
28	91.209	13.560
29	91.864	12.701
30	92.463	11.625
31	93.040	11.197
32	93.588	10.655
33	94.083	9.601
34	94.507	8.238
35	94.932	8.232
36	95.356	8.232
37	95.737	7.405
38	96.062	6.301
39	96.386	6.295
40	96.710	6.295
41	96.993	5.483
42	97.218	4.365
43	97.442	4.358
44	97.667	4.358
45	97.850	3.561
46	97.976	2.430
47	98.100	2.421
48	98.225	2.421
49	98.360	2.617
50	98.509	2.903
51	98.659	2.905
52	98.809	2.905
53	98.958	2.905
54	99.108	2.905
55	99.258	2.905
56	99.407	2.905
57	99.529	2.364
58	99.608	1.523
59	99.686	1.513
60	99.764	1.513
61	99.842	1.513
62	99.920	1.513
63	100.000	0.757

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.7782	0.0652
2	0.9644	0.0256
3	1.1187	0.0232
4	1.2429	0.0192
5	1.3486	0.0166
6	1.4417	0.0148
7	1.5284	0.0139
8	1.6076	0.0128
9	1.6809	0.0119
10	1.7493	0.0111
11	1.8136	0.0105
12	1.8743	0.0099
13	1.9340	0.0098
14	1.9910	0.0093

15	2.0455	0.0089
16	2.0979	0.0086
17	2.1483	0.0083
18	2.1970	0.0080
19	2.2440	0.0077
20	2.2895	0.0075
21	2.3337	0.0073
22	2.3766	0.0071
23	2.4184	0.0069
24	2.4590	0.0067
25	2.4987	0.0065
26	2.5374	0.0064
27	2.5751	0.0062
28	2.6121	0.0061
29	2.6482	0.0060
30	2.6836	0.0058
31	2.7183	0.0057
32	2.7523	0.0056
33	2.7857	0.0055
34	2.8185	0.0054
35	2.8507	0.0053
36	2.8823	0.0052
37	2.9134	0.0051
38	2.9440	0.0051
39	2.9741	0.0050
40	3.0037	0.0049
41	3.0329	0.0048
42	3.0617	0.0048
43	3.0901	0.0047
44	3.1180	0.0046
45	3.1456	0.0046
46	3.1728	0.0045
47	3.1996	0.0044
48	3.2261	0.0044

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0266	0.0058	0.0208
2	0.0271	0.0059	0.0212
3	0.0276	0.0060	0.0216
4	0.0282	0.0061	0.0221
5	0.0288	0.0063	0.0226
6	0.0295	0.0064	0.0231
7	0.0302	0.0066	0.0236
8	0.0309	0.0067	0.0242
9	0.0317	0.0069	0.0248
10	0.0326	0.0071	0.0255
11	0.0335	0.0073	0.0262
12	0.0345	0.0075	0.0270
13	0.0355	0.0077	0.0278
14	0.0367	0.0080	0.0287
15	0.0379	0.0083	0.0297
16	0.0393	0.0086	0.0308
17	0.0408	0.0089	0.0320
18	0.0425	0.0092	0.0333
19	0.0444	0.0097	0.0347
20	0.0465	0.0101	0.0364
21	0.0489	0.0106	0.0383
22	0.0517	0.0112	0.0405
23	0.0549	0.0119	0.0430
24	0.0588	0.0128	0.0460

25	0.0613	0.0133	0.0480
26	0.0670	0.0146	0.0524
27	0.0743	0.0162	0.0581
28	0.0841	0.0183	0.0658
29	0.0951	0.0207	0.0744
30	0.1176	0.0256	0.0920
31	0.1535	0.0334	0.1201
32	0.4322	0.0566	0.3756
33	0.5330	0.0566	0.4764
34	0.1104	0.0240	0.0864
35	0.0809	0.0176	0.0633
36	0.0651	0.0142	0.0510
37	0.0575	0.0125	0.0450
38	0.0508	0.0110	0.0397
39	0.0458	0.0100	0.0359
40	0.0420	0.0091	0.0328
41	0.0389	0.0085	0.0304
42	0.0363	0.0079	0.0284
43	0.0341	0.0074	0.0267
44	0.0323	0.0070	0.0253
45	0.0307	0.0067	0.0240
46	0.0293	0.0064	0.0229
47	0.0280	0.0061	0.0219
48	0.0269	0.0059	0.0211

Total soil rain loss = 0.60(In)
Total effective rainfall = 2.62(In)
Peak flow rate in flood hydrograph = 373.78(CFS)

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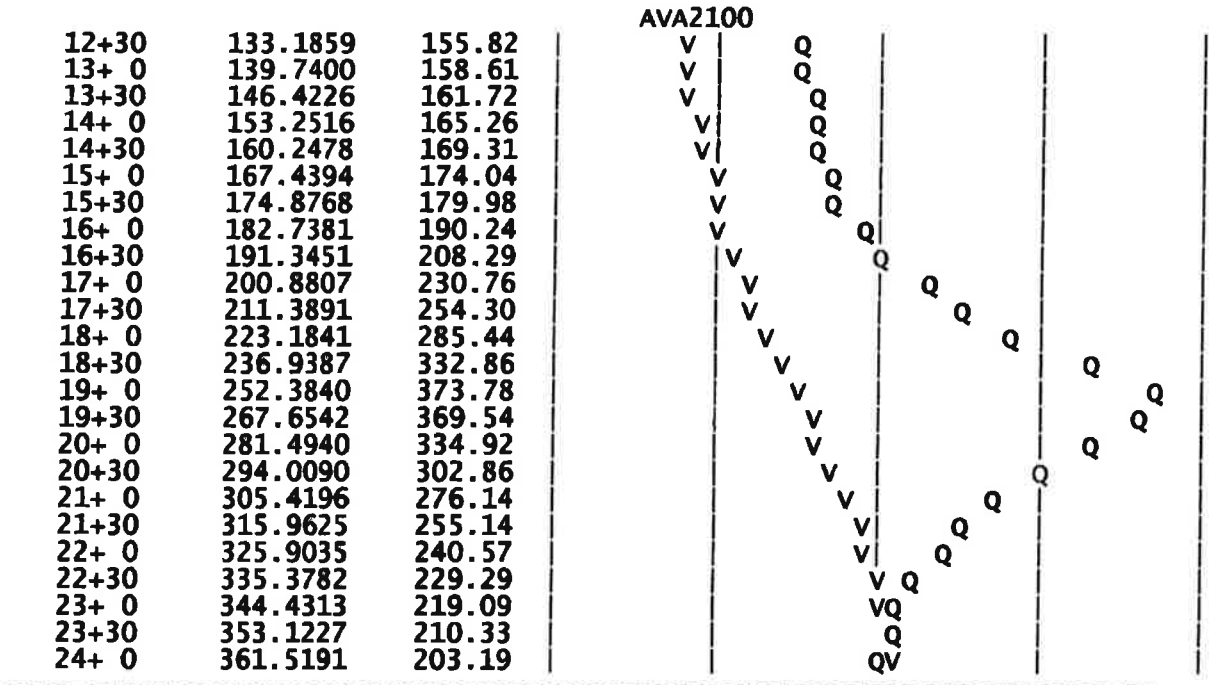
24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 30 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	100.0	200.0	300.0	400.0
0+30	4.1414	100.22	V	Q	|	|	|
1+ 0	8.3095	100.87	V	Q	|	|	|
1+30	12.5215	101.93	V	Q	|	|	|
2+ 0	16.7957	103.44	V	Q	|	|	|
2+30	21.1738	105.95	V	Q	|	|	|
3+ 0	25.7289	110.24	V	Q	|	|	|
3+30	30.4887	115.19	V	Q	|	|	|
4+ 0	35.4178	119.28	V	Q	|	|	|
4+30	40.4848	122.62	V	Q	|	|	|
5+ 0	45.6666	125.40	V	Q	|	|	|
5+30	50.9446	127.73	V	Q	|	|	|
6+ 0	56.3089	129.82	V	Q	|	|	|
6+30	61.7550	131.79	V	Q	|	|	|
7+ 0	67.2792	133.68	V	Q	|	|	|
7+30	72.8778	135.49	V	Q	|	|	|
8+ 0	78.5508	137.29	V	Q	|	|	|
8+30	84.2973	139.07	V	Q	|	|	|
9+ 0	90.1173	140.84	V	Q	|	|	|
9+30	96.0126	142.67	V	Q	|	|	|
10+ 0	101.9854	144.54	V	Q	|	|	|
10+30	108.0399	146.52	V	Q	|	|	|
11+ 0	114.1811	148.62	V	Q	|	|	|
11+30	120.4146	150.85	V	Q	|	|	|
12+ 0	126.7470	153.24	V	Q	|	|	|


AVA2100
12+30 133.1859 155.82
13+ 0 139.7400 158.61
13+30 146.4226 161.72
14+ 0 153.2516 165.26
14+30 160.2478 169.31
15+ 0 167.4394 174.04
15+30 174.8768 179.98
16+ 0 182.7381 190.24
16+30 191.3451 208.29
17+ 0 200.8807 230.76
17+30 211.3891 254.30
18+ 0 223.1841 285.44
18+30 236.9387 332.86
19+ 0 252.3840 373.78
19+30 267.6542 369.54
20+ 0 281.4940 334.92
20+30 294.0090 302.86
21+ 0 305.4196 276.14
21+30 315.9625 255.14
22+ 0 325.9035 240.57
22+30 335.3782 229.29
23+ 0 344.4313 219.09
23+30 353.1227 210.33
24+ 0 361.5191 203.19