11.7 Drainage Study

Mammoth Community and Multi-Use Facility
Mammoth Lakes, California

Preliminary Drainage Study

Project 999.3

August 2016

Prepared for:
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August 12, 2016

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Appendix

- The Town of Mammoth Lakes 2005 Storm Drain Master Plan Update, 2005
- Design Manual, Mammoth Lakes Storm Drainage and Erosion Control, Prepared for Mono County Public Works Department, July 1984, Brown and Caldwell and Triad Engineering
- Water Quality Control Plan for the Lahontan Region, North and South Basins, prepared by the State of California, Regional Water Quality Control Board, Lahontan Region

1. Project

This drainage report addresses the hydrologic impacts of the proposed Mammoth Community Multi-Use Facility on the existing conditions at Mammoth Creek Park. The site is located on the west side of Old Mammoth Road between Chateau Road and Mammoth Creek Road in the Town of Mammoth Lakes, California. For the project vicinity see Figures 1 below:

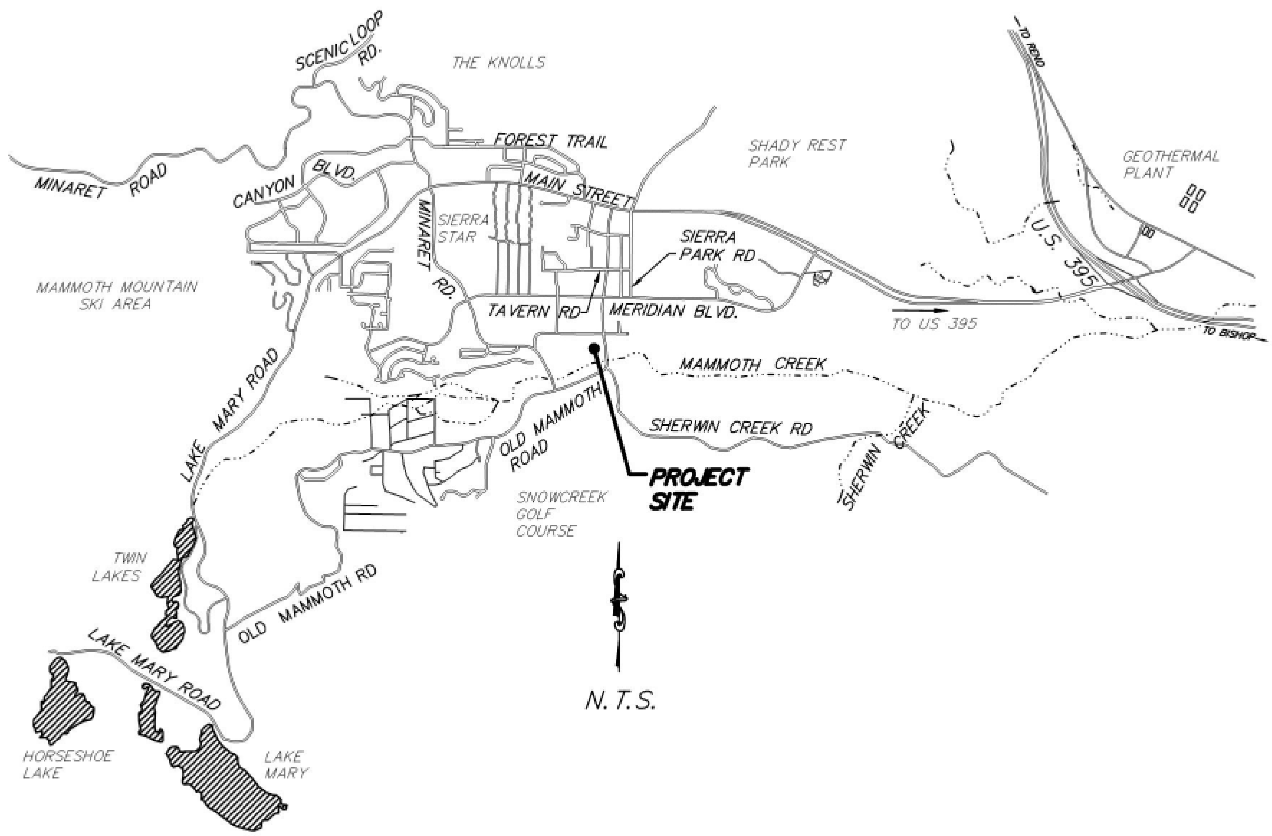


Figure 1 – Site Location

The proposed project includes the relocation of the existing ice-rink facility from the Mammoth Unified School District site near the library and the construction of a new Community Center at the Mammoth Creek Park site. The current playground and bike trail access will remain unchanged. The project proposes to construct Multi-Use Facility with covered 30,000 sf ice rink, recreation, and event area. The new Community Center will include a 13,000 sf building with 2 large conference rooms, an office, 3 small multipurpose rooms, restrooms and locker rooms. The area to the west of the propose

Community Multi-Use Facility will be used as an active Outdoor Recreation Area. The existing parking lot will be extended to accommodate the new facilities.

The total project site, including the existing facilities that will not be disturbed, is approximately 6.4 acres. Within the property, the project area designated to the new facilities is approximately 3.4 acres.

2. Objective

The objective of this study is to determine the expected hydrologic runoff quantities, retention requirements, and appropriate drainage facilities for the proposed Mammoth Community and Multi-Use Facility.

3. Stormwater Management Requirements

Runoff rate calculations are based on the Town of Mammoth Lakes 2005 Storm Drain Master Plan Update (Master Plan)[1]. These calculations are included in Appendix B.

Offsite drainage must be conveyed thought the site to outlet at the pre-development location, unless intercepted by a stormdrain capable of conveying the flows.

Stormwater treatment and retention facilities are designed in accordance with Section 12.08 of the Town Municipal and the Stormwater Master Plan 2015[4].

Town of Mammoth Lakes requires that all stormwater existing the parking areas be treated using an oil/water separator prior to entering retention facilities.

4. Project Background and Observations

The site is located at the existing Mammoth Creek Park. The existing facilities include a playground, AC parking lot, recreation areas with picnic tables, and a restroom. The site is bounded by Old Mammoth Road to the east, residential developments to the north and west, and Mammoth Creek to the south.

The subject site slopes gently from west to east at a grade rate of 2.5%. Ground surface elevations range from approximately 7860' MSL in the northwest corner of the site to approximately 7847' MSL in the northeast. Soils are granular, typical of SCS Type "B" based on Figure 1-7 in the Town of Mammoth Lakes Design Manual[2]. The existing drainage from the offsite multi-family developments to the west of the site sheet flows across the property from west to east. All offsite drainage is tributary to Mammoth Creek.

The areas occupied by the playground, grass and rock recreation area, and the existing parking lot will remain untouched, as well as the access to Mammoth Creek. The rest of the project site is undeveloped area covered by sagebrush, grass, and pine trees, which will house the proposed developments. Refer to Figure A, Appendix A for the existing site conditions.

The proposed development will create approximately 84,230 sf of impervious surface, consisting of 48,250 sf of roof area and 35,980 sf of AC pavement areas. Approximately 17,470 sf of pavers or concrete hardscaping will also be installed to create plaza and walkways. The remaining area of the site is to be landscaped or left in a natural state. See Appendix A, Figure B for the plan view of proposed improvements and Table 1 below for area breakdown:

Table 1 – Area Breakdown

Roofs	48,244 sf
AC Pavement (New)	35,977 sf
AC Pavemnet (Exist)	18,142 sf
Pavers	17,474 sf
Disturbed Natural	61,432 sf
Undisturbed Natural	101,145 sf
Total Project Site	282,414 sf

It is important to note that the property lines do not delineate this project's limits. The project boundaries are based on the disturbance area and defined by the gravel road to the south, Old Mammoth Road to the east, property lines to the north and west.

5. Hydrologic and Hydraulic Analysis

Runoff quantity calculations have been prepared using Excel Spreadsheets. Drainage facilities have been preliminary designed using Hydraflow Express Extension for Autodesk AutoCAD, which utilizes Manning's equations. Calculations are included in Appendices B and C.

In this drainage report "on-site" refers to project area within the property designated to the Mammoth Community and Multi-Use facility (3.4 acres). "Off-site" refers to areas directly adjacent to "on-site". Property lines do not define the difference between the two terms. Refer to Figure A, Appendix A for existing conditions and tributary areas' delineation.

5.1 Off-site drainage

There are two offsite tributary areas, labeled Areas B1 and B2, which contribute sheet flows onto the project site from the north and west. There is a concrete valley gutter in the middle of Meadow Lane, directly west of the project site. This gutter has a very small tributary area and carries very minimal stormwater flows. Base on the existing aerial topographic maps and field observations, no concentrated flows enter the site.

Area B1 is 2.5 acres and includes residential developments adjacent to the Mammoth Creek Park to the north and west. During the 20- and 100-year intensity storms, the runoff quantities are 2.9 cfs and 4.8 cfs, respectively. The offsite stormwater will be conveyed along the north property boundary via an earth swale to the existing 12" inlets on the eastern side of the site.

Area B2 is 5.3 acres located west of the project site. This area also includes the residential development with runoff quantities of 3.5 cfs and 10.1 cfs for the storms of 20- and 100-year intensities, respectively. The stormwater from offsite Area B2 will be conveyed along the southern portion of the site to a level spreader where the water will be allowed to continue to sheet flow toward Mammoth Creek as in existing conditions.

Preliminary calculations showing sizing of the swales are shown in Appendix C.

5.2 On-Site Drainage

On-site drainage is labeled as Area A. The existing 20- and 100-year runoffs for the entire project area are 1.9 cfs and 3.5 cfs, respectively. After the proposed improvements, the 20- and 100-year runoff quantities increase to 4.5 cfs and 7.3 cfs. The increase in stormwater runoff will be attenuated by the required retention facilities as discussed in Section 6 below.

On-site drainage improvements will include inlets at low points, stormdrain pipes, and swales as necessary. The stormwater existing the proposed AC parking lot will be directed to an oil/water separator in the northeast corner before allowed to outlet into proposed retention facility. Stormwater runoff collected from building's roof will be directed to a retention facility proposed just southeast of the improvements. On-site stormdrain facilities will be designed during the grading plan preparation.

6. Retention / Infiltration Facilities

To retain and infiltrate the increase in on-site runoff into the ground, a retention basin system has been preliminary proposed, in conformance with the Water Quality Control Plan for the Lahontan Region3, to contain a 20 year intensity storm for 1 hour, which is assumed to be 1 inch (0.83 feet) * Area (square feet) * C (infiltration coefficient).

Two retention basins (Basin 1 and 2) are proposed for the site, as shown on Figure B, Appendix A. Preliminary, the required storage volume is 3,000 cf and 4,100 cf for Basins 1 and 2, respectively. There is enough on-site area to satisfy these storage requirements.

It should be noted that these basins present a preliminary drainage solution and final design of retention / infiltration facilities will be based on input from the Town of Mammoth Lakes and may include dry wells, alternative locations, etc.

7. Conclusion

This Preliminary Drainage Study demonstrates the technical feasibility of providing adequate offsite and onsite water conveyance, water treatment, and retention.

Drainage facilities have been preliminarily designed to handle the required flows. The criteria followed during the design process addressed issues such as safety, erosion protection and water quality.

The area of disturbance for this project is greater than 1 acre, so this project is subject to the requirements of the National Pollution Discharge Elimination System (NPDES) requirements for construction projects, General Permit number CAS000002, enforced by the State Water Quality Control Board – Lahontan Region. The Owner must submit a Notice of Intent to associate this project with the General Permit, then prepare, have on site and conform to a Storm Water Pollution Prevention Plan (SWPPP) during construction. Though the requirements of permits are not anticipated, work shall conform to conditions of the Army Corp of Engineers, Lahontan Regional Quality Control Board, and State of California Fish and Game.

Any work done in this area shall conform to Federal, State, and local requirements.

Both the on-site and off-site storm drainage facilities must be maintained to continue to work as designed. Particular items requiring maintenance include, but are not limited to, cleaning of the grates, removal of foreign materials from storm drainage pipes, maintenance as necessary to outlet facilities, and repairs as necessary to damaged facilities. Special attention should be paid to any storm drain pipe with the slope of less than 0.5%. This storm drain will required more frequent maintenance due to its low incline. Additionally, snow removal must be performed in a way so as not to restrict drainage collection in gutters, inlets, and flow paths.

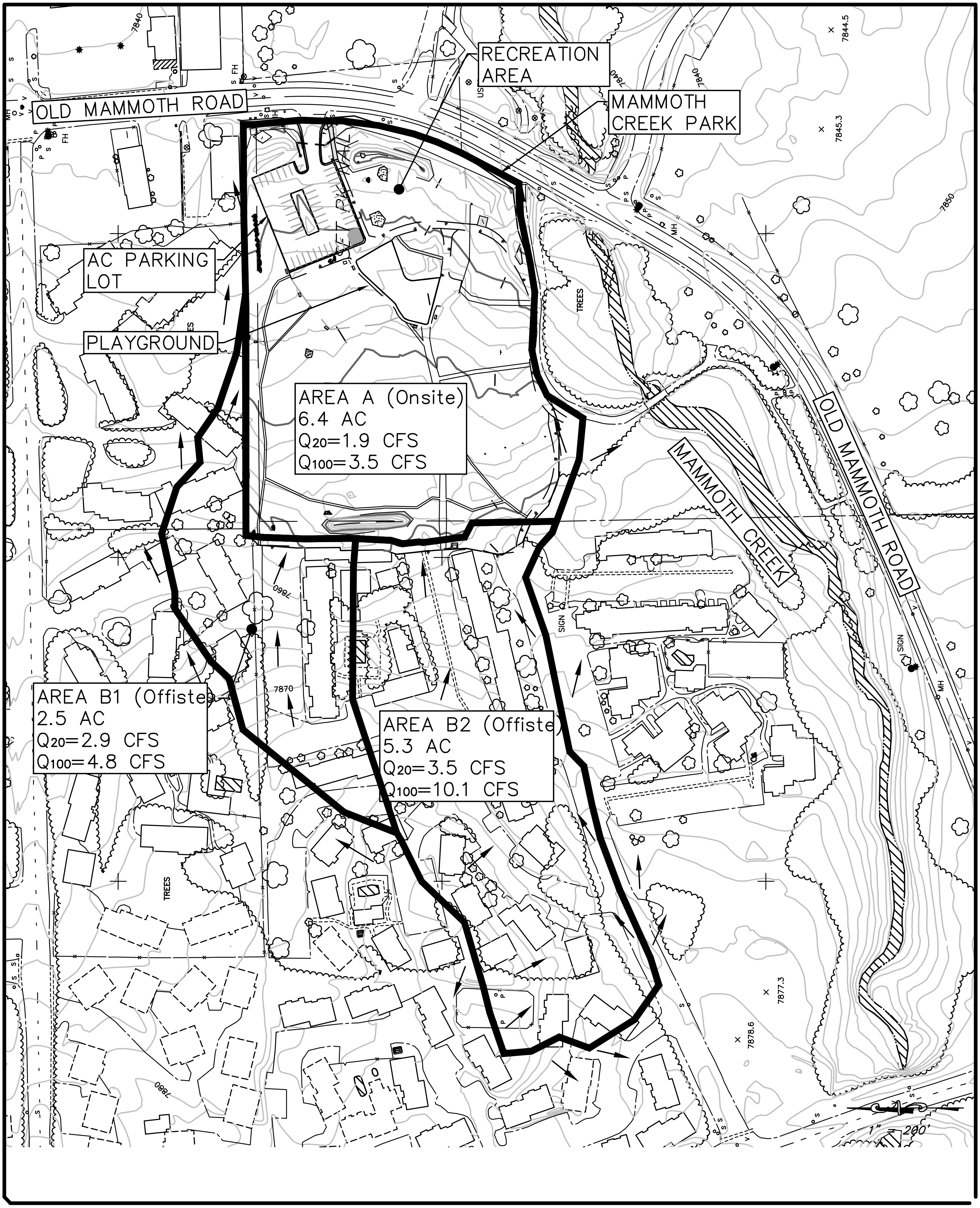
[1]The Town of Mammoth Lakes 2005 Storm Drain Master Update, May 2005, Boyle Engineering Corporation.

[2]Design Manual, Mammoth Lakes Storm Drainage and Erosion Control, Prepared for Mono County Public Works Department, July 1984, Brown and Caldwell and Triad Engineering.

[3]Water Quality Control Plan for the Lahontan Region, North and South Basins, prepared by the State of California, Regional Water Quality Control Board, Lahontan Region.

[4]The Town of Mammoth Lakes Stormwater Master Plan 2015, prepared by NCE.

APPENDIX A – Figures



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08/10/2016

MAMMOTH COMMUNITY AND MULTI-USE FACILITY

CONCEPTUAL DRAINAGE
FIGURE A – EXISTING CONDITIONS

triad/holmes assoc
civil engineering
land surveying

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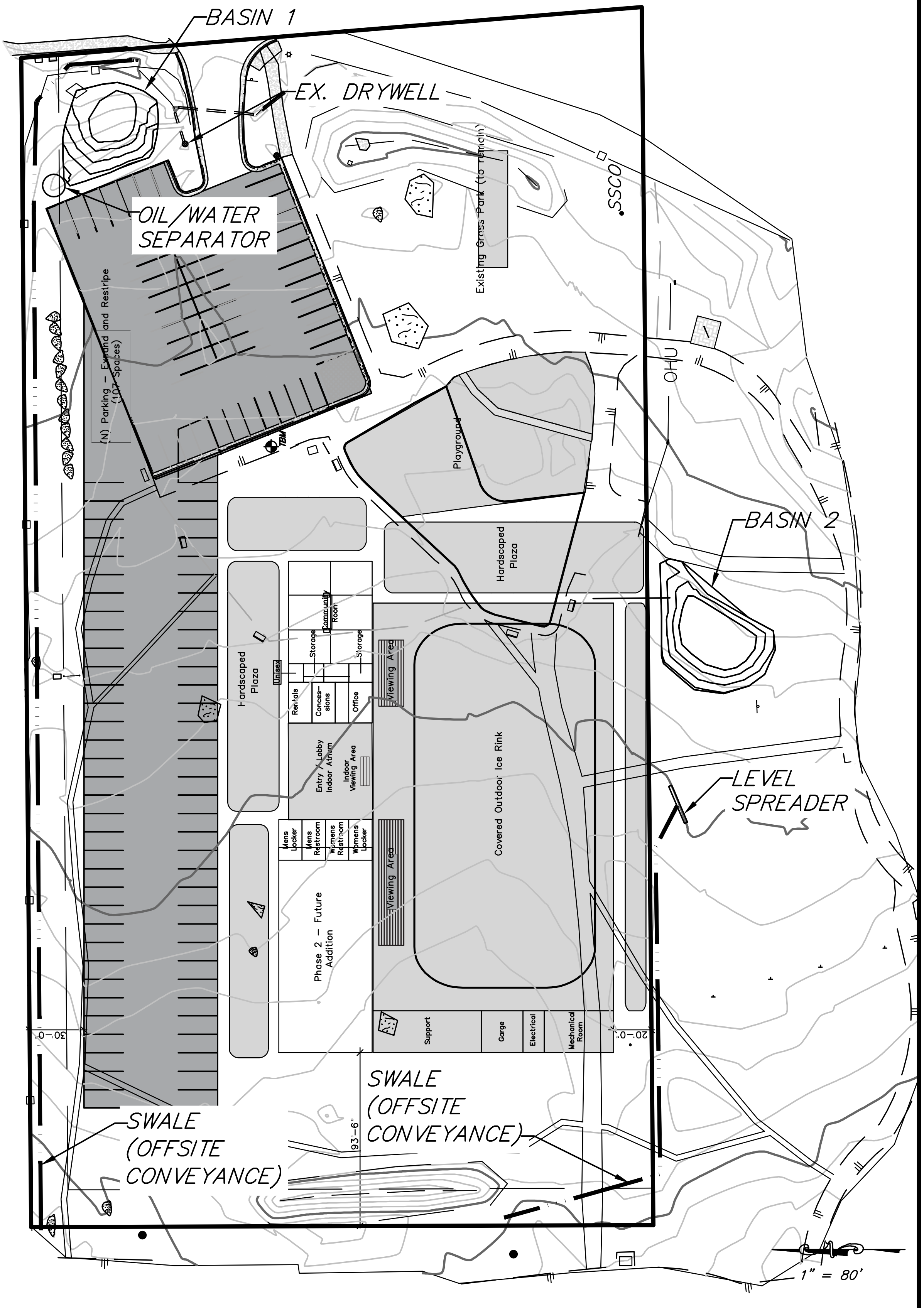

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MAMMOTH COMMUNITY AND MULTI-USE FACILITY

CONCEPTUAL DRAINAGE
FIGURE B - PROPOSED CONDITIONS

triad/holmes assoc
civil engineering
land surveying

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APPENDIX B – Hydrologic Calculations

triad/holmes associates
civil engineering
land surveying
mammoth lakes • bishop • redwood city • napa
san luis obispo • lompoc • pleasanton

Town of Mammoth Lakes, 2005 Storm Drain Design Manual, Procedure A

20-YEAR INTENSITY STORM

Area	Exceedence Interval for Design (years)	Acres	Existing: % Natural	Existing: % HD Residential	Existing: % Commercial	Existing: Inensity (cfs/acre)	Existing: Design Q (cfs)	Proposed: % Natural	Proposed: % HD Residential	Proposed: % Commercial	Proposed: Inensity (cfs/acre)	Proposed: Design Q (cfs)
A (Onsite)	Q20	6.37	93%	0%	7%	0.30	**1.94**	53%	0%	47%	0.70	**4.45**
	Q100					0.54	**3.45**				1.14	**7.26**
B1 (Offiste)	Q20	2.52	0%	100%	0%	1.14	**2.87**					
	Q100					1.90	**4.78**					
B2 (Offiste)	Q20	5.30	0%	100%	0%	0.65	**3.45**					
	Q100					1.90	**10.07**					

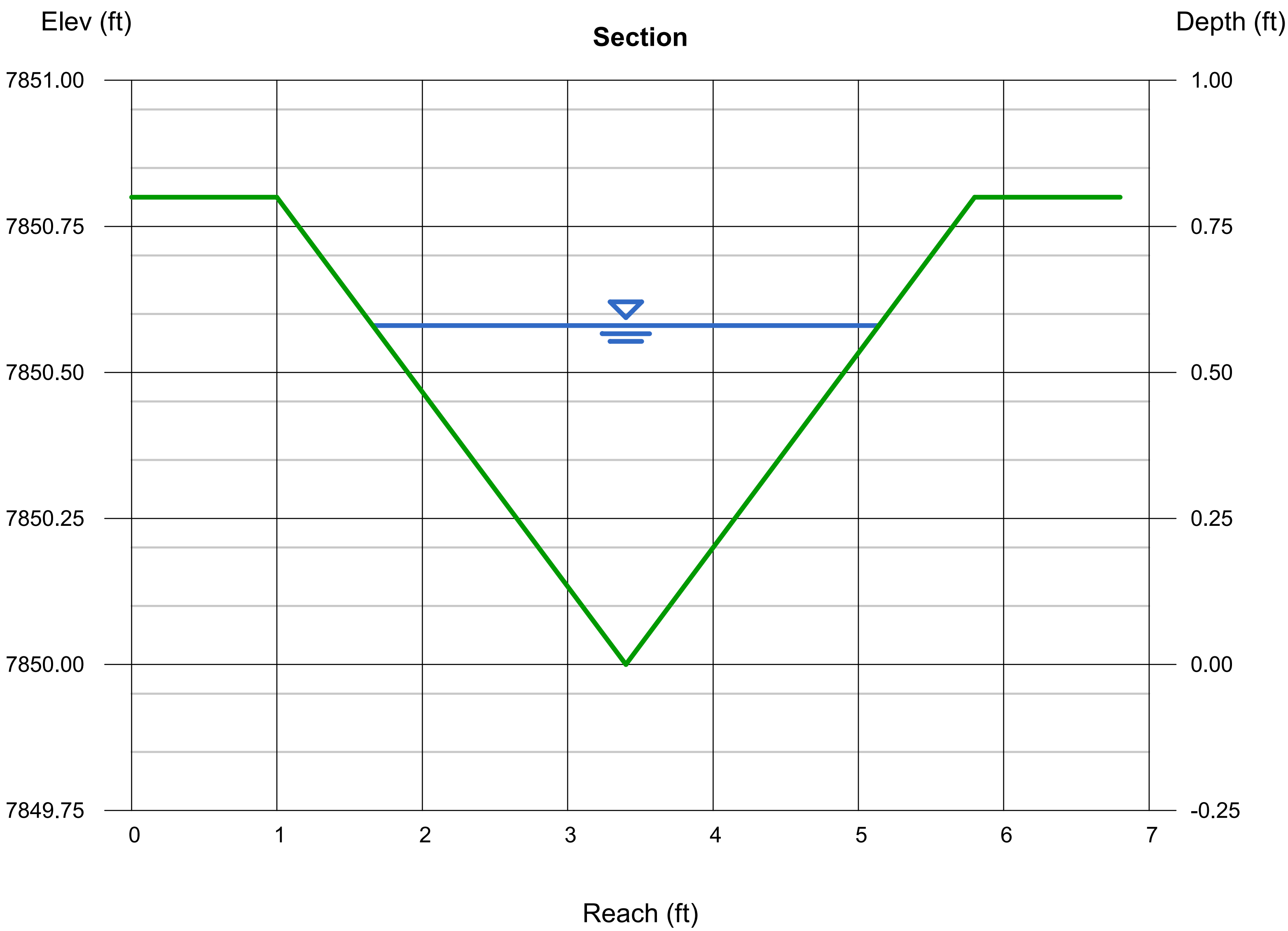
Land Use Type		20-Year	100-Year
Commercial	C	1.22	1.93
High Density Residence	H	1.14	1.90
Natural	N	0.23	0.43
Single Family Residence	S	0.65	1.30

APPENDIX C – Hydraulic Calculations

Channel Report

Swale Area B1

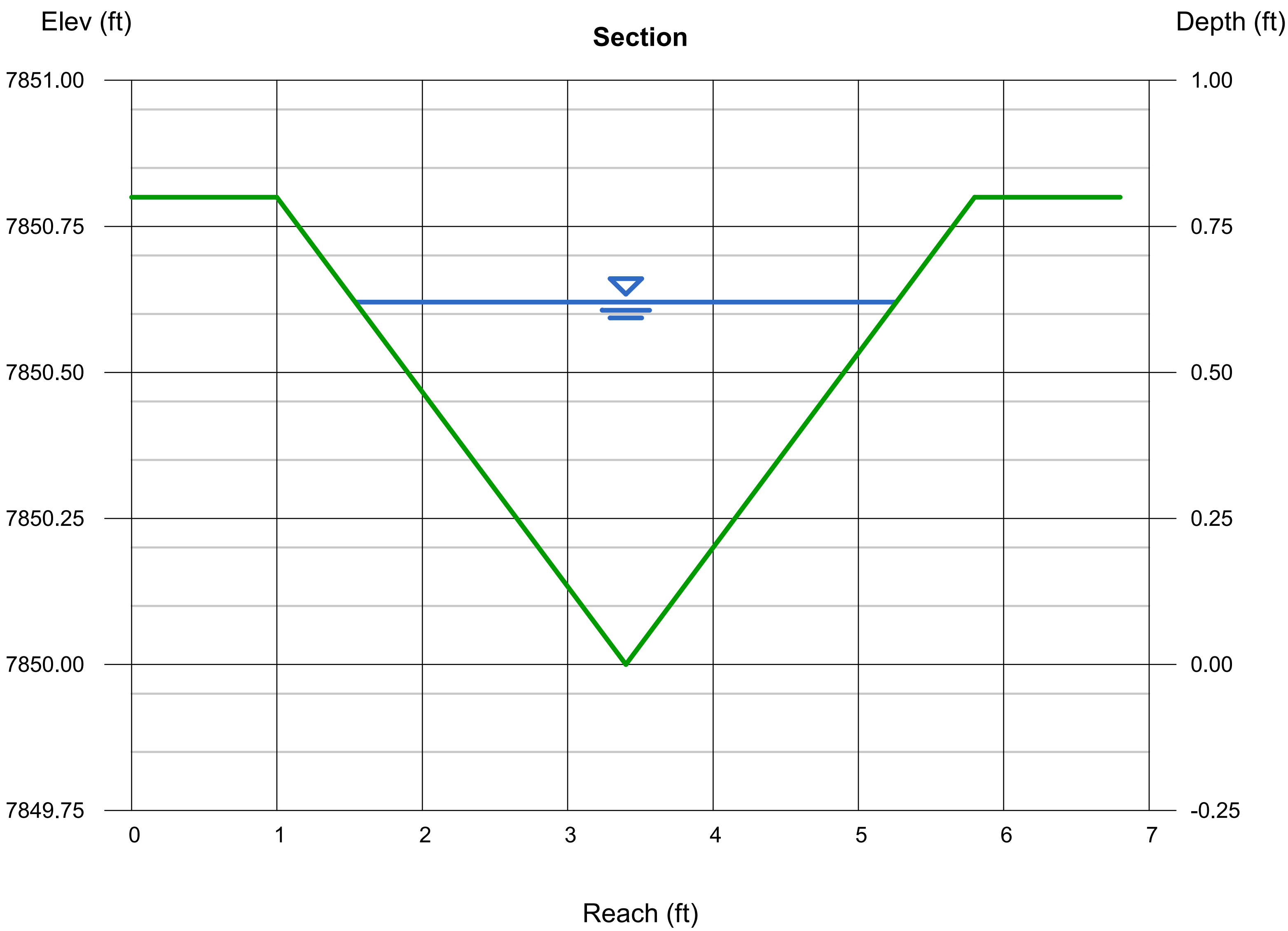
Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 0.58
Total Depth (ft)	= 0.80	Q (cfs)	= 2.900
		Area (sqft)	= 1.01
Invert Elev (ft)	= 7850.00	Velocity (ft/s)	= 2.87
Slope (%)	= 2.70	Wetted Perim (ft)	= 3.67
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.57
		Top Width (ft)	= 3.48
Calculations		EGL (ft)	= 0.71
Compute by:	Known Q		
Known Q (cfs)	= 2.90		



Channel Report

Swale Area B2

Triangular		**Highlighted**	
Side Slopes (z:1)	= 3.00, 3.00	Depth (ft)	= 0.62
Total Depth (ft)	= 0.80	Q (cfs)	= 3.500
		Area (sqft)	= 1.15
Invert Elev (ft)	= 7850.00	Velocity (ft/s)	= 3.04
Slope (%)	= 2.70	Wetted Perim (ft)	= 3.92
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.62
		Top Width (ft)	= 3.72
Calculations		EGL (ft)	= 0.76
Compute by:	Known Q		
Known Q (cfs)	= 3.50		



APPENDIX D – Retention/ Infiltration Calculations

Tributary Areas

Roofs	48,244 sf
AC Pavement (New)	35,977 sf
AC Pavemnet (Exist)	18,142 sf
Pavers	17,474 sf
Disturbed Natural	61,432 sf
Undisturbed Natural	101,145 sf
Total Project Site	282,414 sf

Storage Volume Calculation

Input:

Rainfall Quantity	1 in	=	0.083 ft
Percolation Rate	0.0 in/hr	=	0.000 ft/hr

Tributary Area

	Area A1			Area A2	
	Area		Runoff Coefficient	Area	
Roof Area	0,000 sf	0%	0.95	48,244 sf	85%
AC Pavement	35,977 sf	80%	0.90	0,000 sf	0%
Pavers	9,092 sf	20%	0.40	8,382 sf	15%
Total Area	45,069 sf		**0.80**	56,626 sf	

Total Impervious Area 35,977 sf 48,244 sf 84,221 sf

17,474 sf

Average Volume = Total Area * Average Runoff Coefficient * Rainfall

Storage Sizing Calculations

	Volume Required	Depth Retention	Area Provided	**Volume Provided**
Basin 1	**3,001 cf**	3.0 ft	2,190 sf	**3,129 cf**
Basin 2	**4,099 cf**	1.5 ft	2,865 sf	**4,406 cf**

APPENDIX E – References

B. Procedure A Development

Two types of rare event precipitation-runoff conditions pertain to the meteorological characteristics of the Town and need to be considered jointly. They are subject to two physically distinct events: a rainfall-only condition and the rainfall-on-snow condition, referred to as the summer and winter conditions, respectively. The idea that one should consider each condition separately and then choose the most extreme result is a sound one and will be adopted in this study as well.

The methodology used to determine peak flows is based on the Rational Formula

$$Q = CiA$$

Where:

Q	=	the discharge measured in cfs
C	=	the runoff coefficient, having no physical dimensions
i	=	the rainfall intensity measured in inches per hour
A	=	the area of the watershed basin measured in acres

The above formula is simply a version of the "continuity equation" in the study of hydraulics. Any consistent set of units may be chosen, however the customary units for Q, i, and A are cubic feet per second (cfs), inches per hour (in/hr), and acres (ac) respectively. For this particular choice of units, the product CiA is to be multiplied by a small correction factor of 1.008, which is often neglected in view of the probabilistic nature of hydrologic calculations mentioned above.

It was observed from the 1984 study that flows within the local storm drains experience little attenuation. In other words, individual hydrographs from individual storm drains have nearly coincidental (in time) peaks when a flow confluence occurs. This finding from the 1984 study helps to provide a simple way to determine peak discharge values. Additionally, the assumption of no attenuation is a conservative one.

While it is true that any point on a stream has a watershed area associated with it, one should not compare watersheds having widely ranging area values. Former procedures specified in the 1984 study allow for areas within the town to have an area anywhere between 0 and 1,600 acres, which is too much of a variation. Problems with comparing a 10 acre subarea with a 1000 acre subarea are obvious in that calculated times of concentrations (t_c) would be vastly different. Hence for this updated study a standard of 40-80 acres is taken as the range of watershed size used to apply cfs/acre peak values[3]. In practice, developers within subareas (if more than one subarea is involved a weighted average should be taken) of this order of magnitude can design systems for their projects using the cfs/acre values that are called out in this study (see **Table 3-1A**).

Another fact that applies to storm drains in the Town is that peak flows within the local storm drain system occur at a time much earlier than offsite flows in major streams. Hence, storm drain design in the Town is mainly independent of offsite drainage and drainage methodology (with the exception of conveyance structures that route large offsite watersheds). For those properties that are affected by large offste watersheds, a reduction factor may be applied, as shown in **Table 3-1B**.

In order to develop a "cfs/acre" approach in lieu of a detailed hydrograph for storm drain flows, a lower bound for cfs/acre value within the Mammoth Basin was first established for comparative purposes. By the term "lower bound", we mean that the estimates made by the following analysis are expected to be less than cfs/acre values that actually apply within the Town for the purpose of pipe design. Such an estimate has some value, since it acts as a safeguard against the use of values that would result in the design of conveyance systems that are inadequate for a given return period.

From the Federal Emergency Management Agency (FEMA) Flood Insurance study [6], it was estimated that the 100-year[4] discharge rate for Mammoth Creek was 640 cubic feet per second (cfs) for a tributary watershed area of 13.12 square miles (8,397 acres) at a stream location taken 650 feet downstream of Old Mammoth Road. Hence for this

[3] This standard is used in several communities within the State of California, including Los Angeles [5] and Ventura Counties.

[4] A 10-year storm is defined as a storm event that is equaled or exceeded every 10 years on average. Another way to define a 10-year storm is to say that the probability of an event of having a 10-year magnitude or more has a 1/10 chance in a given year. Likewise, a 100-year storm is defined as a storm that is equaled or exceeded every 100 years on average. The 100-year storm can alternatively be defined by saying that the probability of an event of having a 100-year magnitude or more has a 1/100 chance in a given year [7].

watershed, a cfs/acre ratio is equal to 640/8397 ≈ 0.076 cfs/acre for 100-year conditions. This value is clearly low since it includes an extremely large and predominantly natural watershed (consisting of subareas including portions of the Town) subject to the attenuation process. From the same study, it was estimated that the 100-year discharge rate for Mammoth Creek increased from 350 cfs to 610 cfs between Waterford Street upstream and a point 650 feet upstream of Minaret Road downstream. The increase in the watershed area between these two stations is given as 0.49 square miles (314 acres) and lies within the Town. For this watershed from Waterford Street to 650 feet upstream of Minaret Road, the cfs/acre ratio is equal to (610 – 350)/314 ≈ 0.828 cfs/acre for 100-year conditions.

Next, a statistical analysis was made of the cfs/acre data contained in the 1984 study. Not surprisingly, a strong dependence (on cfs/acre rates) was found on the degree of natural land cover. This data was applied to the individual subareas delineated in this study for the purpose of obtaining a reasonable estimate of cfs/acre value for particular land use types, and were adjusted for consistency. These values were conservatively estimated to be those as given in **Table 3-1** below:

Table 3-1A. Applicable cfs/acre Values by Land Use Type

Land Use Type	20-Year	100-Year
Natural	0.23	0.43
Single Family Residence	0.65	1.30
High Density Residence	1.14	1.90
Commercial	1.22	1.93

Table 3-1B. Reduction Factors for Large Basins

Drainage Area (acres)	Reduction Factor
80	1.00
100	0.97
200	0.88
500	0.77
1,000	0.69
2,000	0.63
5,000	0.55
7,744	0.52

The values for the tables above were determined primarily for the purpose of determining the discharge values within the elements of the storm drain system as outlined in Section 5.

C. Procedure B Development

Procedure B is intended for use in larger, natural areas. A flow-frequency analysis approach was adopted, based on the flow data available and the ease with which it could be applied. Sufficient concurrent precipitation and runoff data were not available to develop a hydrograph method with reasonable accuracy.

The flow out of a large, natural basin in the Mammoth Lakes area has two principal components--snowmelt and rain flood flows. In general, flow records indicate that the peak flows in Mammoth Creek at Highway 395 are produced by snowmelt. Extreme rainfall events may produce short-term peaks on an annual hydrograph, which is dominated by flows produced by snowmelt. This situation is typical of major basins on the eastern side of the Sierra Nevada.

The mean daily flow records for Hot Creek at Highway 395 were used to develop the flow-frequency relationships. Snowmelt flows were segregated from rain flood flows by plotting flow-frequency relationships separately for rainy and non-rainy periods.

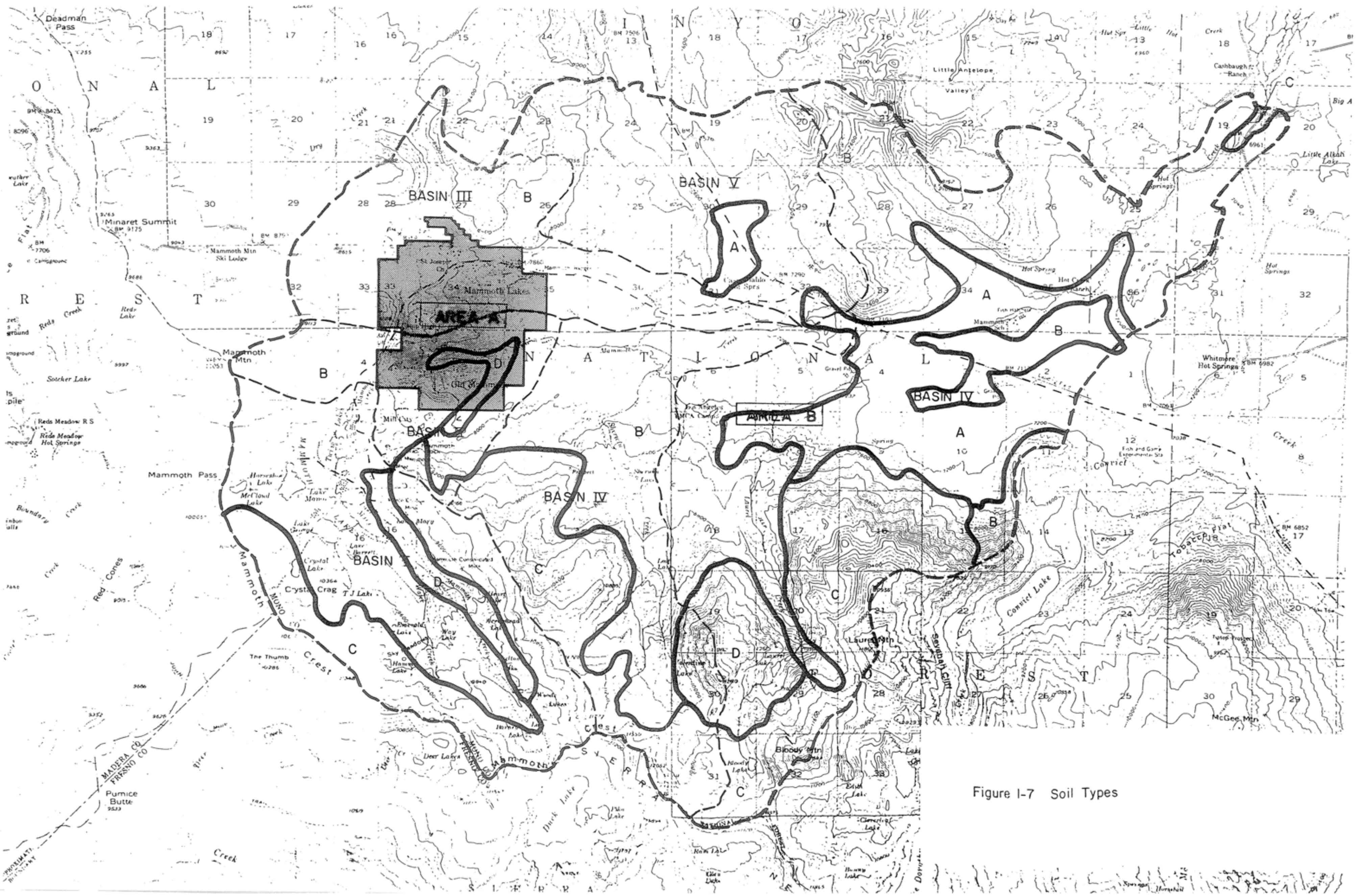


Figure I-7 Soil Types

4.8 LAND DEVELOPMENT

The construction and maintenance of urban and commercial developments can impact water quality in many ways. Construction activities inherently disturb soil and vegetation, often resulting in accelerated erosion and sedimentation. Stormwater runoff from developed areas can also contain petroleum products, nutrients, and other contaminants.

This section contains a discussion of the potential water quality impacts expected to result from land development activities, followed by control measures to reduce or offset water quality impacts from such activities.

Construction Activities and Guidelines

Construction activities often produce erosion by disturbing the natural ground surface through scarifying, grading, and filling. Floodplain and wetland disturbances often reduce the ability of the natural environment to retain sediment and assimilate nutrients. Construction materials such as concrete, paints, petroleum products, and other chemicals can contaminate nearby water bodies. Construction impacts such as these are typically associated with subdivisions, commercial developments, and industrial developments.

Control Measures for Construction Activities

The Regional Board regulates the construction of subdivisions, commercial developments, industrial developments, and roadways based upon the level of threat to water quality. The Regional Board will request a Report of Waste Discharge and consider the issuance of an appropriate permit for any proposed project where water quality concerns are identified in the California Environmental Quality Act (CEQA) review process. Any construction activity whose land disturbance activities exceed five acres must also comply with the statewide general NPDES permit for stormwater discharges (see "Stormwater" section of this Chapter).

The following are guidelines for construction projects regulated by the Regional Board, particularly for projects located in portions of the Region where erosion and stormwater threaten sensitive watersheds. The Regional Board recommends that each county within the Region adopt a grading/erosion control ordinance to require implementation of these same guidelines for all soil disturbing activities:

1. Surplus or waste material should not be placed in drainageways or within the 100-year floodplain of any surface water.

2. All loose piles of soil, silt, clay, sand, debris, or other earthen materials should be protected in a reasonable manner to prevent any discharge to waters of the State.

3. Dewatering should be performed in a manner so as to prevent the discharge of earthen material from the site.

4. All disturbed areas should be stabilized by appropriate soil stabilization measures by October 15th of each year.

5. All work performed during the wet season of each year should be conducted in such a manner that the project can be winterized (all soils stabilized to prevent runoff) within 48 hours if necessary. The wet season typically extends from October 15th through May 1st in the higher elevations of the Lahontan Region. The season may be truncated in the desert areas of the Region.

6. Where possible, existing drainage patterns should not be significantly modified.

7. After completion of a construction project, all surplus or waste earthen material should be removed from the site and deposited in an approved disposal location.

8. Drainage swales disturbed by construction activities should be stabilized by appropriate soil stabilization measures to prevent erosion.

9. All non-construction areas should be protected by fencing or other means to prevent unnecessary disturbance.

10. During construction, temporary protected gravel dikes, protected earthen dikes, or sand bag dikes should be used as necessary to prevent discharge of earthen materials from the site during periods of precipitation or runoff.

11. Impervious areas should be constructed with infiltration trenches along the downgradient sides to dispose of all runoff greater than background levels of the undisturbed site. Infiltration trenches are not recommended in areas where infiltration poses a risk of ground water contamination.

12. Infiltration trenches or similar protection facilities should be constructed on the downgradient side of all structural drip lines.

13. Revegetated areas should be continually maintained in order to assure adequate growth and root development. Physical erosion control facilities should be placed on a routine maintenance and inspection program to provide continued erosion control integrity.

14. Waste drainage waters in excess of that which can be adequately retained on the property should be collected before such waters have a chance to degrade. Collected water shall be treated, if necessary, before discharge from the property.

15. Where construction activities involve the crossing and/or alteration of a stream channel, such activities should be timed to occur during the period in which stream flow is expected to be lowest for the year.

16. Use of materials other than potable water for dust control (i.e., reclaimed wastewater, chemicals such as magnesium chloride, etc.) is strongly encouraged but must have prior Regional Board approval before its use.

Specific Policy and Guidelines for Mammoth Lakes Area

To control erosion and drainage in the Mammoth Lakes watershed at an elevation above 7,000 feet (Figure 4.8-1), the following policy and guidelines apply:

Policy:

A Report of Waste Discharge is required not less than 90 days before the intended start of construction activities of a **new development** of either (a) six or more dwelling units, or (b) commercial developments involving soil disturbance on one-quarter acre or more.

The Report of Waste Discharge shall contain a description of, and time schedule for implementation, for both the **interim erosion control measures** to be applied during project construction, and **short- and long-term erosion control measures** to be employed after the construction phase of the project. The descriptions shall include appropriate engineering drawings, criteria, and design calculations.

Guidelines:

1. Drainage collection, retention, and infiltration facilities shall be constructed and maintained to prevent transport of the runoff from a 20-year, 1-hour design storm from the project site. A 20-year, 1-hour design storm for the Mammoth Lakes area is equal to 1.0 inch (2.5 cm) of rainfall.

2. Surplus or waste materials shall not be placed in drainageways or within the 100-year flood plain of surface waters.

3. All loose piles of soil, silt, clay, sand, debris, or earthen materials shall be protected in a reasonable manner to prevent any discharge to waters of the State.

4. Dewatering shall be done in a manner so as to prevent the discharge of earthen materials from the site.

5. All disturbed areas shall be stabilized by appropriate soil stabilization measures by October 15 of each year.

6. All work performed between October 15th and May 1st of each year shall be conducted in such a manner that the project can be winterized within 48 hours.

7. Where possible, existing drainage patterns shall not be significantly modified.

8. After completion of a construction project, all surplus or waste earthen material shall be removed from the site and deposited at a legal point of disposal.

9. Drainage swales disturbed by construction activities shall be stabilized by the addition of crushed rock or riprap, as necessary, or other appropriate stabilization methods.

10. All nonconstruction areas shall be protected by fencing or other means to prevent unnecessary disturbance.

11. During construction, temporary erosion control facilities (e.g., impermeable dikes, filter fences, hay bales, etc.) shall be used as necessary to prevent discharge of earthen materials from the site during periods of precipitation or runoff.

12. Revegetated areas shall be regularly and continually maintained in order to assure adequate growth and root development. Physical erosion control facilities shall be placed on a routine maintenance and inspection program to provide continued erosion control integrity.

13. Where construction activities involve the crossing and/or alteration of a stream channel, such activities shall be timed to occur during the period in which streamflow is expected to be lowest for the year.

Land Development/Urban Runoff Control Actions for Susan River Watershed

1. To protect riparian vegetation and wetlands from land disturbance activities, the Regional Board shall recommend that Lassen County and the City of Susanville require new development or any land disturbing activities to include buffer strips of undisturbed land, especially along the Susan River and its tributaries.

2. The Regional Board, with assistance from the City of Susanville and the California Department of Transportation (Caltrans), should conduct monitoring of the Susan River and Piute Creek within the City of Susanville to assess impacts from urban runoff. Control measures should be planned and implemented based on the results of the monitoring. The monitoring plan should be developed to identify nonpoint sources needing control. Monitoring proposals will be submitted by the Regional Board, and work will be conducted as resources allow and as the Susan River gains priority.

3. The Regional Board shall encourage and assist other agencies in watershed restoration efforts along the Susan River.

4. The Regional Board shall encourage the City of Susanville and Lassen County to adopt a comprehensive grading ordinance. These ordinances should require, for all proposed land disturbing activities, the use of Best Management Practices to reduce erosion and stormwater runoff, including but not limited to temporary and permanent erosion control measures.

5. The Regional Board shall encourage the City of Susanville, Lassen County and Caltrans to implement Best Management Practices to reduce erosion and stormwater runoff when constructing and maintaining roads, both paved and unpaved, under their jurisdiction.

Road Construction and Maintenance

Road construction activities often involve extensive earth moving, including clearing, scarifying, excavating for bridge abutments, disturbing or modifying floodplains, cutting, and filling. Additionally, the potential for land disturbance exists from construction materials, equipment maintenance, fuel storage facilities, and general equipment use.

Once constructed, impervious road surfaces create another source of water pollution. Oils, greases, and other petroleum products, along with such toxic materials as battery acid, antifreeze, etc., may be deposited along the road surfaces. These contaminants become suspended or dissolved in any stormwater runoff that is generated on the road surfaces. Unless otherwise treated, these contaminants will flow toward local surface or ground waters. (See "Stormwater" section of this Chapter.)

Road maintenance can be potentially threatening to water quality in a number of ways. Below-grade culverts slowly fill with sediment and are cleaned out periodically, sometimes by flushing accumulated sediment into downstream drainageways. Grading of shoulders and drainageways can detach sediments and increase the risk of erosion into nearby surface waters. Road surfaces may be repainted or resealed with materials that harden quickly, but which can be washed off while still fresh by stormwater runoff.

In the winter, roads are often snowy, icy, or wet. To reduce winter road hazards, maintenance crews may remove the snow or ice, apply sand to provide added traction, and/or apply deicing chemicals to melt the snow and ice. Sand is rapidly dissipated or crushed by the traffic, and must be replaced frequently. Great quantities of sediment enter drainageways and/or surface waters due to this practice. Snow may be removed mechanically via snowplow or snowblower. This practice is not particularly detrimental to water quality in itself, but the snow often carries substances from the roadway when removed. Sediments, chemical deicers, and vehicle fluids may travel much farther than they would otherwise, possibly reaching area surface waters. Ice and small accumulations of snow may be removed with chemical deicers. The deicer in widest use is rock salt (sodium chloride), due to its low cost, high availability, and predictable results.

Winter road maintenance was brought to the forefront in 1989 when significant numbers of roadside trees in the Lake Tahoe Basin suddenly started dying. The public outcry caused many environmental groups and regulatory agencies, including the Regional Board, to look more closely at what had been a more or less unscrutinized, unregulated process in the past. Data began to show that Caltrans was using very high amounts of salt each winter, and the figure seemed to increase from one year to the next. The consensus of the various regulatory agencies was that Caltrans should reduce salt use, explore various alternate deicers, and monitor the impacts of salt applications on soil, water, and vegetation. Salt use decreased significantly from 1989-1992, due to more careful application procedures and to drought conditions.

At least three alternate deicers have been explored: calcium magnesium acetate, potassium acetate, and magnesium chloride with corrosion inhibitors. These products have shown some promise, but further study is required. The cost to switch to an alternate deicer will be significant. The road departments are unwilling to make the switch unless an alternate deicer is demonstrably better environmentally, will not require too much adjustment on the part of the maintenance crews and equipment, and will actually do an effective and predictable job when applied.

However, Caltrans' monitoring of vegetation showed minimal and temporary salt accumulation within the vegetation. During the spring, any salt that had accumulated in the vegetation was flushed out from the plant material. The impacts of chemical deicers on fish and wildlife within the Lahontan Region have not been studied.

Control Measures for Road Construction and Maintenance

(Additional control measures for roads are included in the "Stormwater" section of this Chapter.)

The Regional Board regulates road construction and maintenance projects within the Lahontan Region, concentrating efforts on major construction and construction in sensitive areas. Major construction projects and those projects in sensitive areas are most often regulated under individual WDRs, and are routinely inspected. Less significant projects may be issued conditional waivers of WDRs. The Regional Board has also adopted road maintenance waste discharge requirements for some county governments in the Region. Road construction and maintenance in the Lake Tahoe Basin is also regulated under municipal NPDES Stormwater Permits (see Chapter 5).

For all road projects, the Board requires that construction be conducted in a manner which is protective to water quality, and that, at the end of a given project, the site be restabilized and revegetated. These requirements are detailed in a Management Agency Agreement with Caltrans regarding the implementation of BMPs. Additionally, all road projects are to be in compliance with the Caltrans Statewide 208 Plan (CA Dept. of Transportation 1980), which was approved by the State Board in 1979. This Plan contains a commitment to implement BMPs, but does not include great detail on the BMPs themselves. The State Board should encourage Caltrans to update its 208 plan to provide such detail, with particular attention to:

- stormwater/erosion control along existing highways
- erosion control during highway construction and maintenance

- reduction of direct discharges (e.g., through culverts)
- reduction of runoff velocity
- infiltration, detention and retention practices
- management of deicing compounds, fertilizer, and herbicide use
- spill cleanup measures
- treatment of toxic stormwater pollutants

Since much of the implementation of BMPs on highways is done by Caltrans' contractors, the selection of qualified contractors and ongoing education of construction and maintenance personnel on BMP techniques are particularly important.

In the Lake Tahoe Basin, all governmental agencies assigned to maintain roads are required to bring all roads in the Lake Tahoe Basin into compliance with current "208" standards within a specified time schedule. That is, all existing facilities must be retrofitted to handle the stormwater runoff from the 20-year, 1-hour storm, and to restabilize all eroding slopes. The twenty-year time frame for this compliance process ends in 2008.

The Regional Board should allow salt use to continue as one component of a comprehensive winter maintenance program. However, the Regional Board should continue to require that it be applied in a careful, well-planned manner, by competent, trained crews. Should even the "proper" application of salt be shown to cause adverse water quality impacts, the Regional Board should then require that it no longer be used in environmentally sensitive areas, such as the Lake Tahoe Basin. Similarly, should an alternate deicer be shown to be effective, environmentally safe, and economically feasible, its use should be encouraged in lieu of salt.

Figure 4.8-1
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