APPENDIX 9.6
Preliminary Drainage Study

Mammoth Lakes Police Department
Mammoth Lakes, California

Preliminary Drainage Study

Project 2880

October 2007

Prepared for:
Town of Mammoth Lakes
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EXP. 6/30/09
CIVIL
STATE OF CALIFORNIA

Mammoth Lakes Police Department
Preliminary Drainage Study

INDEX

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

The proposed project is a new facility for the Mammoth Lakes Police Department. The project site is located north of Mammoth Hospital in the north-easterly area of the town of Mammoth Lakes, Mono County, California. The site is approximately two miles west of the intersection of US Hwy 395 and US Hwy 203. More specifically, the site is situated east of Sierra Park Road, between US Hwy 203 and Tavern Road. The site is bounded by Mammoth Mountain R.V. Park to the east. For the project vicinity see Figures 1.1 and 1.2 below:

Figure 1.1

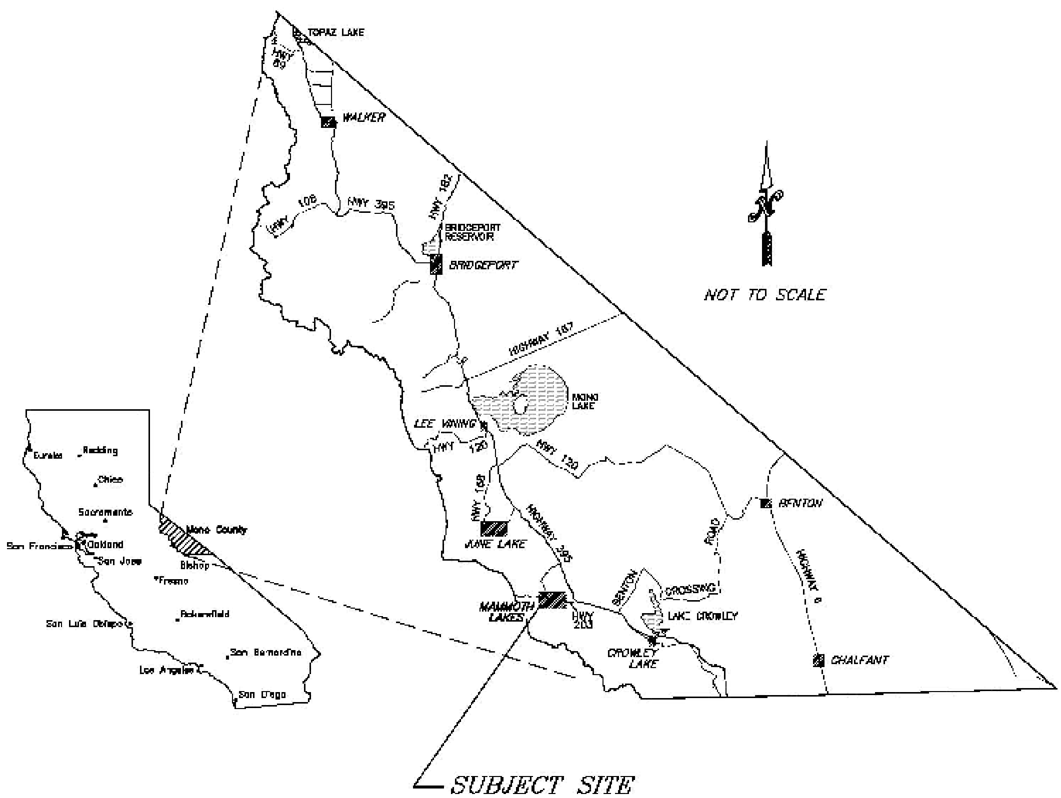
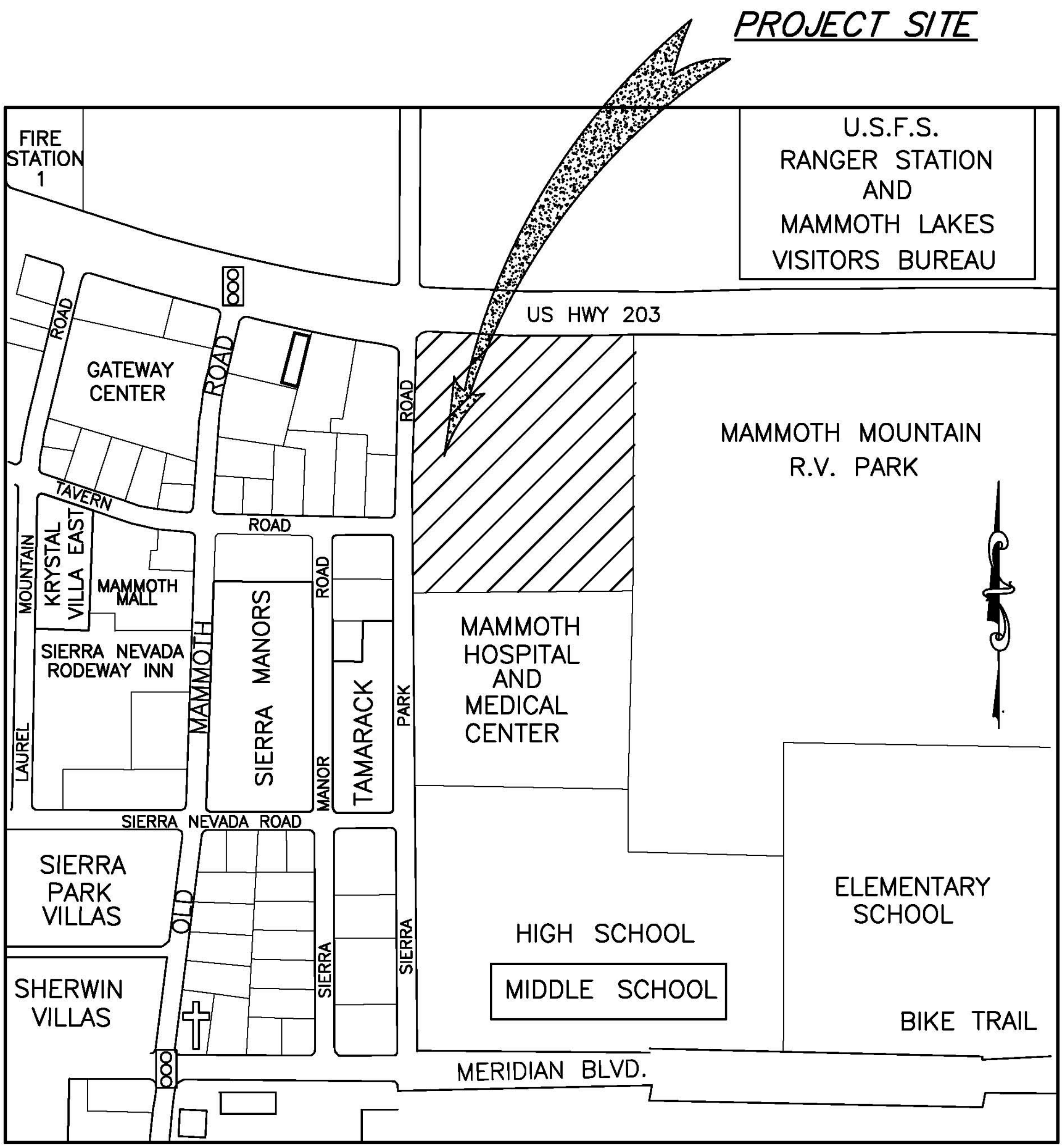


Figure 1.2



The property is approximately 10 acres. Within the property, the project area designated to the police department facility is 2.77 acres. The site is currently undeveloped. The property has street frontage on two sides, Sierra Park Road to the west, and State Highway 395 to the north. The project site is zoned CG (commercial general).

The proposed development consists of extending Tavern Road, placing a drive entrance from the extension of Tavern Road, placing a drive entrance from Sierra Park Road, a police department structure including underground parking, and surface parking both north and south of the structure. Other proposed site features include a ramp down to a sallyport at the underground parking level in front of the building, a plaza area south of the building, and an entrance to underground parking northwest of the building. The area bounded by the two proposed drive entrances, Sierra Park Road, and the proposed police department structure will remain green space, saving existing pine trees of varying size.

2. Objective

The objective of this study is to determine the expected hydrologic runoff quantities and preliminary drainage facilities for the proposed Police Department and adjacent Sierra Park Road.

3. Assumptions

Off-site runoff rate calculations for the 100-year intensity storm are based on the Town of Mammoth Lakes 2005 Master Plan Update (Master Plan) [1]. On-site drainage facilities including inlets, storm drain pipes, a slotted drain, earth swales, infiltration ponds, and storm drain manholes shall be designed for 20-year storm intensity. Hydrology calculations are included in Appendix B.

Retention facilities have been designed to contain 1 hour of a 20 year intensity storm, which is assumed to be 1 inch (0.83 feet) * Area (square feet) * C (infiltration coefficient). Because the retention facilities will be designed to contain the first flush or contaminated runoff, the conveyance systems shall be designed to contain the maximum peak flows without reduction for retention. There will be some reduction in peak flow due to these retention systems, so the conveyance systems have been conservatively sized.

4. Project Background and Observations

The project proposes approximately 52,877 sf of impervious surfaces including 13,989 sf of roof area and 38,888 sf of pavement areas. The remaining area of the site (67,784 sf) is to be landscaped or left in a natural state. See Appendix A, Figure 1 for the plan view of proposed improvements.

In addition to the Police Department development, improvements to Sierra Park Road will be within the scope of work for this drainage study. Currently, a 42” Storm Drain discharges to a cobble swale that runs outside the length of the property line. This swale conveys runoff to two 48” CMP culverts that direct flow under US Hwy 203. Three existing storm drain pipes that convey runoff from the west (not part of this project) also discharge to the cobble swale. Recent improvements to the easterly side of Sierra Park Road have taken place in conjunction with Mammoth Hospital improvements. This project proposes to follow suit with these improvements and extend them to the intersection of US Hwy 203. These improvements include the extension of the existing 42” storm drain line and the re-alignment of the easterly edge of Sierra Park Road adding new curb and gutter and a sidewalk.

The development site generally slopes from the southwest to the northeast. Site elevations range from approximately 7,813 feet at the southwest corner, to approximately 7,797 at the northeast corner of the site. The slope of the site varies, with an average of approximately 3.6% from the southwest corner to the northeast corner of the proposed development site.

Soils are granular, typical of SCS Type “B” based on Figure 1-7 in the Town of Mammoth Lakes Design Manual[2]. Native vegetation includes pine trees and brush. The pine trees existing on site range from 6” to 36” in diameter. Because the entire site is undeveloped, approximately half of the existing trees will need to be removed. See Appendix A, Figure 1 for site conditions.

5. Off-site/On-site Drainage

Runoff quantity calculations have been prepared using Excel Spreadsheets. Drainage facilities have been preliminary designed using StormCAD and Autodesk Hydrology Calculator. These calculations are included in Appendix B.

It is important to note that "on-site" refers to areas within the project area. "Off-site" refers to areas considered by the "on-site" areas. Property lines do not define the difference between the two terms. Off-Site Area A considers undisturbed historical runoff to be diverted around the project area. Off-Site Area B considers Sierra Park Road runoff as it is conveyed to a proposed storm drain to be shared by the project area.

Off-site drainage

This project considers two areas for off-site drainage. Off-Site Area A is south of the proposed development and Off-Site Area B is west of the proposed development as shown in Appendix A, Figure 1. Run-off from areas south or west of Areas A and B have been contained within their own respective retention or runoff facilities.

Area A is within the property boundary, sloping from southeast to northwest. The 20- and 100-year runoff quantities for this area are 0.22 and 0.41 cfs, respectively. The following includes recommendations for storm drainage collection in Off-site Area A:

- A 6" deep V-shaped earth swale located along the southerly boundary of the project area to convey runoff from Area A.
- A Level spreader at the southeast corner of the project area to allow storm water to exit the above mentioned swale in a sheet flow condition, as close to historic as practicable.

Area B is located along Sierra Park Road, its westerly boundary defined by the ridge along the centerline of Sierra Park Road and its easterly boundary defined by a ridge just inside the west property line of the project area. Area B includes the improvements to Sierra Park Road. The 20-year and 100-year runoff quantities for this area are 0.82 and 1.29 cfs, respectively. The Town of Mammoth Lakes Master Plan[1] was used to determine the runoff rate at the existing 48" CMP culverts located under US Hwy 203 (Appendix D). Required capacity for each culvert during a storm of 20-year intensity is 51 cfs, therefore 102 cfs is used to size the storm drain connection. The proposed improvements to Sierra Park Road will complete the replacement of the ditch that previously conveyed flow from Meridian Boulevard to US Hwy 203. Proposed improvements will be similar to those of the Hospital project located south of this project.

The following includes recommendations for storm drainage collection in Off-site Area B:

- Provide curb and gutter along the eastern side of Sierra Park Road to US Hwy 203.
- A proposed 42" storm drain pipe along the eastern side of Sierra Park Road will connect to the existing 42" storm drain pipe.
- A proposed 48" storm drain pipe will connect to the proposed 42" storm drain pipe 288' north from the connection to the existing 42" storm drain. This proposed increase in pipe size occurs at a grade break in Sierra Park Road.
- The proposed 48" storm drain pipe will connect to a proposed 10' x 20' storm vault. This vault will connect the proposed 48" storm drain pipe to the two 48" CMP culverts that cross US Hwy 203.
- New inlets along the eastern side of Sierra Park Road will be placed to collect and covey runoff from Area B.
- A new storm drain pipe from a proposed inlet in On-Site Area C will also connect to the proposed 48" storm drain pipe.
- Three existing storm drain pipes that presently discharge into the existing cobble swale along Sierra Park Road will be connected to the proposed 42" and 48" pipes.

Adjustments can be made to these proposed facilities and locations as long as these changes stay within the intent of this study.

On-Site Drainage

On-Site drainage is divided into three areas, A, B, and C. Runoff from On-Site Areas A and B will discharge via storm drain pipe and earth swales to two temporary infiltration ponds designed to also function as level spreaders (discussed in Retention/Infiltration Section). These infiltration ponds will be located east of the development site, but within the overall property.

Area A comprises the majority of the on-site drainage with 20-year and 100-year runoff quantities of 2.39 and 3.99 cfs, respectively. Curbs and valley gutters on either side of the crowned Tavern Road extension convey flow to two inlets. Runoff from these inlets is piped to a V-shaped earth swale located at the east end of Tavern Road. In addition, two curb cut outlets discharge flow from the turnaround at the end of Tavern Road to the proposed earth swale. This earth swale then conveys runoff to a 1.8′ deep infiltration pond / level spreader located to the north.

On-Site Area B includes the drive isle that ramps down to the sallyport along the western edge of the proposed building. Area B also includes the northerly drive entrance to the site as well as the ramp down to underground parking. Flows from these areas will be collected in slotted drains and one storm drain inlet. Due to the low elevation of these collection facilities, a 400′ pipe will transport runoff at a 0.3% slope to the proposed 1.8′ deep infiltration pond / level spreader. As details of the final site plan are finalized to include drains associated with the underground parking structure, it should be noted that future designs may require a pump to convey runoff to the infiltration pond / level spreader. 20-year and 100-year storm flows for this area are 0.34 and 0.57 cfs, respectively.

On-Site Area C is an existing natural area on the westerly portion of the proposed development site. This area will not be disturbed during construction. A proposed inlet in the northeastern portion of Area C will collect runoff and transport it to the proposed 48″ storm drain along Sierra Park Road via storm drain pipe. 20-year and 100-year storm flows for this area are 0.09 and 0.16 cfs, respectively.

For the 100-year storm, total on-site drainage has been calculated to be 4.72 cfs. It is anticipated that no on-site inlet will need to be larger than 2′x3′. In addition, on-site pipe sizes shall be sized upon final determination of Q’s during the final design process. Details of proposed drainage facilities will be included in this report once the site plan is finalized with greater detail.

6. Retention / Infiltration Facilities

To infiltrate on-site runoff into the ground, two infiltration pond systems have been designed, in conformance with the Water Quality Control Plan for the Lahontan Region[3], 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). Retention / infiltration facility sizing calculations are included in Appendix C. These infiltration ponds shall act as level spreaders during a large storm event. It should be noted that these ponds are temporary drainage solutions and final design of retention / infiltration facilities will be based on input from the Town of Mammoth Lakes.

Site Area, Runoff Coefficient, and Retention Volume For On-Site Areas A and B

On-Site Area A
Surface Area... 91,635 square feet
Runoff Coefficient after construction...................... 0.48
Retention Volume .... 3,700 cubic feet

A temporary 1.8' deep retention / infiltration pond servicing On-Site Area A is proposed east of the project area. It has a bottom dimension of 120' x 13' and has sidewalls sloped 3:1. This facility is adequate to contain the required 3,700 cubic feet of storm water as shown in Appendix C.

On-Site Area B
Surface Area... 12,936 square feet
Runoff Coefficient after construction...................... 0.90
Retention Volume .... 970 cubic feet

A temporary 1.8' deep retention / infiltration pond servicing On-Site Area B is proposed to the northeast On-Site Area A infiltration pond. It has a bottom dimension of 30' x 9' and has sidewalls sloped 3:1. This facility is adequate to contain the required 970 cubic feet of storm water as shown in Appendix C.

7. Conclusion

The designs and calculations included in this preliminary report are for planning purposes. The final location and details of drainage facilities will be determined during the design process in preparation of the improvement plans and will be in accordance with Town of Mammoth Lakes requirements in place at that time. The criteria followed during the design process should address issues such as safety, erosion protection and water quality, as well as conforming to the requirements of the Clean Water Act and the Lahontan Regional Water Quality Control Board.

Storm drainage from Sierra Park Road and South and West (Off-Site Areas A and B) of the site will be intercepted and conveyed past the site without affecting the site. Storm drainage from the off-site areas directly south of the site will be intercepted by a new swale and conveyed to an infiltration basin / level spreader to minimize change in the runoff conditions.

As a result of the proposed development, this study suggests on-site runoff quantities will increase from approximately 1.2 to 4.7 cfs. This increase will be limited in short duration and small storms by the proposed infiltration systems and will outflow in sheet flow condition. Since runoff quantities are small, impacts to downstream facilities should be insignificant. In addition, it is emphasized that these infiltration / level spreader facilities are temporary and permanent drainage facilities will be designed in coordination with the Town of Mammoth Lakes as the property is further developed in the future.

In the event of a large storm in which runoff exceeds design capacity, storm flow will exit the site similarly to its historic fashion. A low area exists in the vicinity of the northeasterly proposed infiltration pond / level spreader. In the event that drainage exits the infiltration facility, storm water will pond in this low area along a small berm at the edge of the RV Resort pavement. If the storm is large enough, storm water will either exit this low area over the berm and onto pavement to the east, or continue ponding north along the berm until it reaches an earth swale past the northern edge of RV Resort pavement. This earth swale conveys flow to the east, running south of the bike path and north of the RV Resort pavement area. Flow in the swale is directed under the US Hwy 203 RV Resort drive entrance via a culvert and continues east in the earth swale where another culvert conveys flow under the bike path and yet another culvert discharges flow under US Hwy 203 and into Murphy Gulch. Two infiltration basins are located in Murphy Gulch which ultimately discharges to Mammoth Creek.

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 permit 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. Additionally, snow removal must be performed in a way so as not to restrict drainage collection in gutters, inlets, and flow paths.

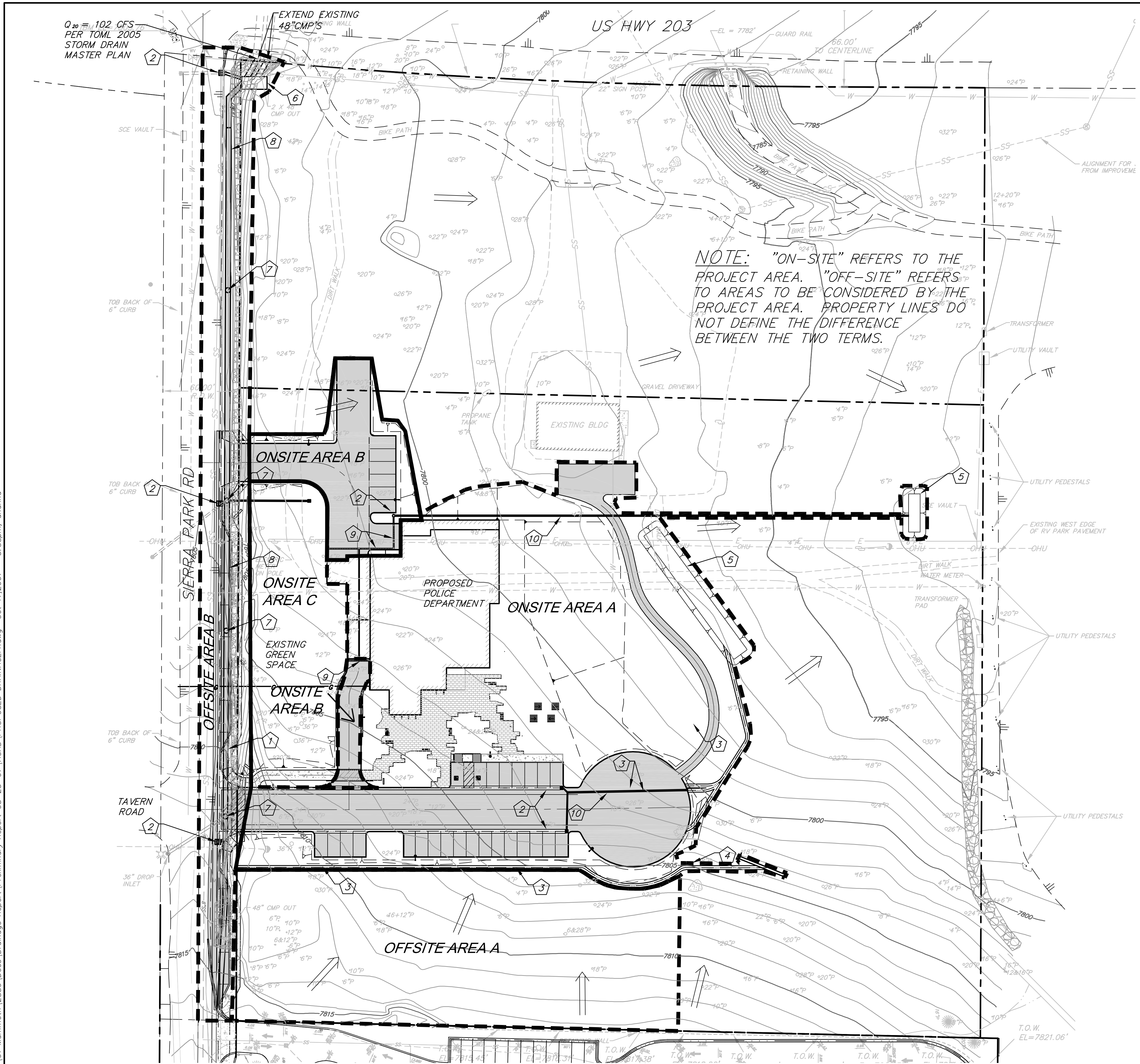
[1]The Town of Mammoth Lakes 2005 Storm Drain Master Update, May 2005, Boyle Engineering Corporation.

[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.

Preliminary Drainage Study
Mammoth Lakes Police Department

APPENDIX A
FIGURES



LEGEND

- PROPERTY BOUNDARY
- DRAINAGE BOUNDARY
- EX. EDGE OF PAVEMENT
- EX. CONTOUR
- FLOW DIRECTION
- EXISTING TREE

CONTOUR INTERVAL: 1'

SCALE:
1" = 40' (24"X36" PLOT SIZE)
1" = 80' (11"X17" PLOT SIZE)

PROPOSED RUNOFF:

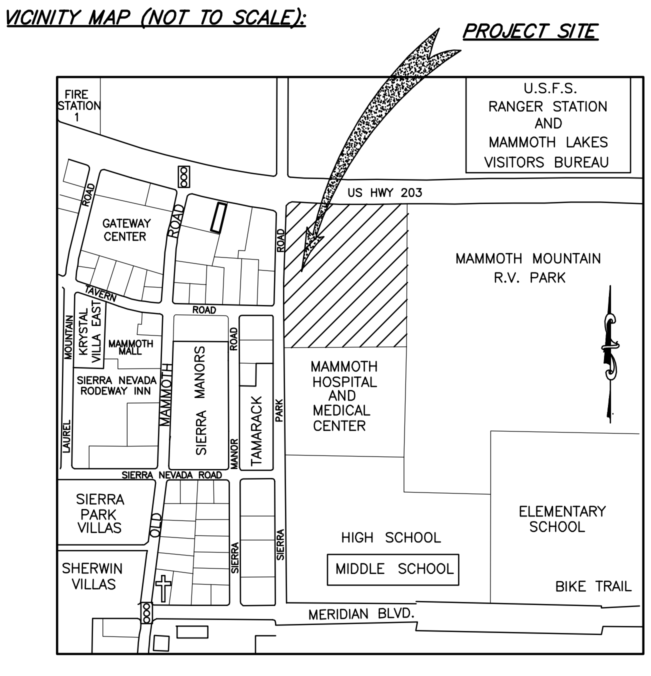
AREA (AC)		Q20 (CFS)	Q100 (CFS)
ONSITE A	2.10	2.39	3.99
ONSITE B	0.30	0.34	0.57
ONSITE C	0.37	0.09	0.16
OFFSITE A	0.96	0.22	0.41
OFFSITE B	**	102.00	**

**Q VALUE PER TOML 2005 STORM DRAIN MASTER PLAN

PROPOSED DRAINAGE FACILITIES:

1. 42" STORM DRAIN CPP
2. DRAIN INLET
3. 3' EARTH SWALE
4. LEVEL SPREADER
5. 1.8' DEEP WITH SIDEWALLS SLOPED 3:1 INFILTRATION POND.
6. 10' X 20' STORM VAULT
7. STORMDRAIN MANHOLE
8. 48" STORM DRAIN CPP
9. SLOTTED DRAIN
10. 12" STORM DRAIN PIPE

VICINITY MAP (NOT TO SCALE):



triad/holmes assoc.
civil engineering
land surveying
MAMMOTH LAKES
BISHOP
NAPA
PLEASANTON
REDWOOD CITY
SAN LUIS OBISPO

PREPARED & SUBMITTED BY:
REGISTERED PROFESSIONAL ENGINEER
PAUL EDWARD ROTEN
NO. C 56891
EXP. 6/30/07
CIVIL
STATE OF CALIFORNIA
DATE:

PREPARED FOR:
THE TOWN OF MAMMOTH LAKES

ON-SITE AND OFF-SITE TRIBUTARY AREAS
MAMMOTH POLICE DEPARTMENT
MAMMOTH LAKES, MONO COUNTY, CA

DATE	10/17/07
SCALE	AS NOTED
DRAWN	PR/DH
JOB NO.	2880
DWG	D1
SHEET	1 OF 1

Preliminary Drainage Study

Mammoth Lakes Police Department

APPENDIX B

HYDROLOGIC CALCULATIONS

MAMMOTH POLICE DEPARTMENT FACILITY

20- and 100-Year Intensity Storm

Procedure A

Area	Exceedence Interval for Design (years)	Acres	Land Use Type	Inensity (cfs/acre)	Design Q (cfs)
On-Site Existing	Q20	2.77	N	0.23	**0.64**
	Q100			0.43	**1.19**
Proposed On-Site A	Q20	2.10	H	1.14	**2.39**
	Q100			1.90	**3.99**
Proposed On-Site B	Q20	0.30	H	1.14	**0.34**
	Q100			1.90	**0.57**
Proposed On-Site C	Q20	0.37	N	0.23	**0.09**
	Q100			0.43	**0.16**
Off-Site A	Q20	0.96	N	0.23	**0.22**
	Q100			0.43	**0.41**
Off-Site B	Q20	0.67	C	1.22	**0.82**
	Q100			1.93	**1.29**

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

EARTH SWALE SIZE CALC

Channel Calculator Off-Site Area A

Given Input Data:

Shape	Trapezoidal
Solving for	Depth of Flow
Flowrate	0.4100 cfs
Slope	0.0194 ft/ft
Manning's n	0.0350
Height	6.0000 in
Bottom width	0.0000 in
Left slope	0.3333 ft/ft (V/H)
Right slope	0.3333 ft/ft (V/H)

Computed Results:

Depth	3.5202 in
Velocity	1.5880 fps
Full Flowrate	1.6995 cfs
Flow area	0.2582 ft2
Flow perimeter	22.2658 in
Hydraulic radius	1.6698 in
Top width	21.1235 in
Area	0.7501 ft2
Perimeter	37.9507 in
Percent full	58.6704 %

Critical Information

Critical depth	3.1055 in
Critical slope	0.0379 ft/ft
Critical velocity	2.0404 fps
Critical area	0.2009 ft2
Critical perimeter	19.6428 in
Critical hydraulic radius	1.4731 in
Critical top width	18.6350 in
Specific energy	0.3325 ft
Minimum energy	0.3882 ft
Froude number	0.7310
Flow condition	Subcritical

**CAPACITY OF CHANNEL IS ADEQUATE TO COLLECT AND CONVEY 0.41 CFS.

OFF-SITE AREA B PIPE REPORT

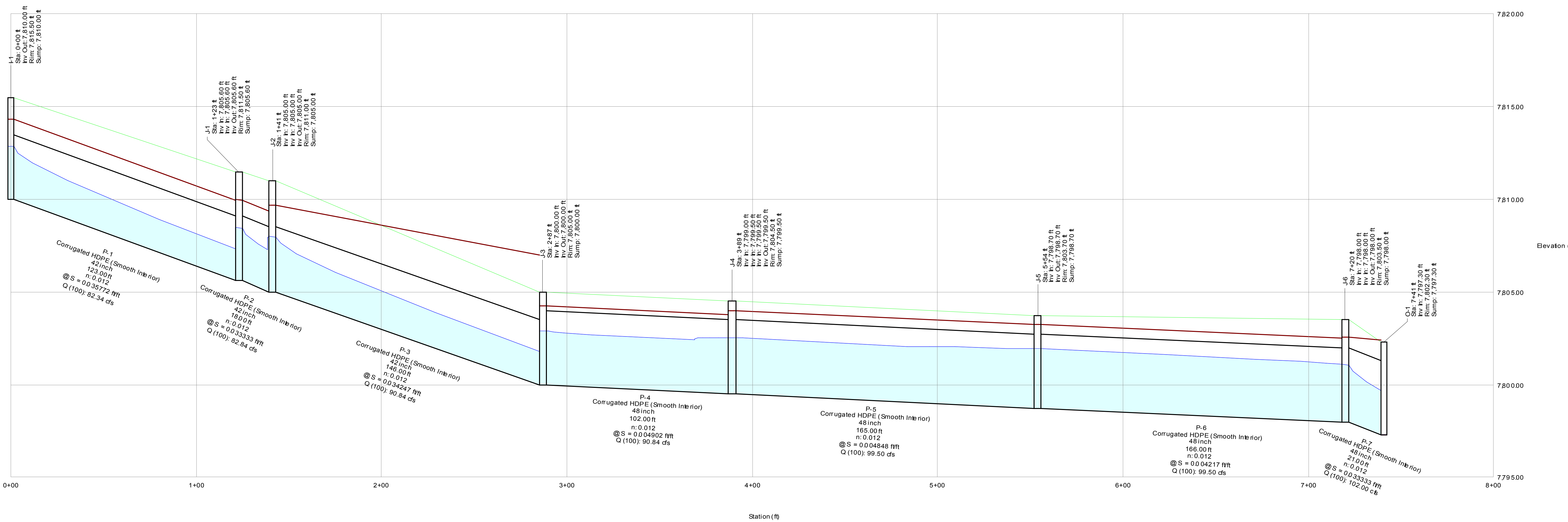
Label	Upstream Node	Downstream Node	Total System Flow (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Mannings n	Full Capacity (cfs)	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Average Velocity (ft/s)	Velocity In (ft/s)
P-8	I-4	J-6	2.5	18	0.066667	18 inch	0.012	29.38	7,799.20	7,798.00	7,802.70	7,803.50	2	4	7,801.07	7,801.06	1.41	1.41
P-9	I-5	I-4	2	32	0.01875	24 inch	0.012	33.56	7,799.80	7,799.20	7,802.80	7,802.70	1	1.5	7,801.07	7,801.07	5.86	0.95
P-7	J-6	O-1	102	21	0.033333	48 inch	0.012	284.09	7,798.00	7,797.30	7,803.50	7,802.30	1.5	1	7,801.06	7,799.64	20.75	9.89
P-5	J-4	J-5	99.5	165	0.004848	48 inch	0.012	108.35	7,799.50	7,798.70	7,804.50	7,803.70	1	1	7,802.52	7,801.92	9.78	9.77
P-6	J-5	J-6	99.5	166	0.004217	48 inch	0.012	101.05	7,798.70	7,798.00	7,803.70	7,803.50	1	1.5	7,801.91	7,801.09	9.17	9.2
P-10	I-6	I-3	8	66	0.012121	18 inch	0.012	12.53	7,802.00	7,801.20	7,805.50	7,804.70	2	2	7,803.10	7,802.70	7.52	5.78
P-11	I-3	J-4	8.5	6	0.283333	42 inch	0.012	580.13	7,801.20	7,799.50	7,804.70	7,804.50	0	1.5	7,802.65	7,802.64	0.88	0.88
P-1	I-1	J-1	82.34	123	0.035772	42 inch	0.012	206.14	7,810.00	7,805.60	7,815.50	7,811.50	2	2.4	7,812.83	7,808.45	20.22	9.87
P-13	I-2	J-1	0.5	6	0.566667	18 inch	0.012	85.66	7,809.00	7,805.60	7,812.50	7,811.50	2	4.4	7,809.26	7,808.46	13.22	2.42
P-2	J-1	J-2	82.84	18	0.033333	42 inch	0.012	198.98	7,805.60	7,805.00	7,811.50	7,811.00	2.4	2.5	7,808.44	7,807.97	19.74	9.91
P-12	I-7	J-2	8	52	0.071154	24 inch	0.012	65.37	7,808.70	7,805.00	7,812.20	7,811.00	1.5	4	7,809.71	7,808.01	14.11	5.05
P-3	J-2	J-3	90.84	146	0.034247	42 inch	0.012	201.69	7,805.00	7,800.00	7,811.00	7,805.00	2.5	1.5	7,807.96	7,801.79	20.42	10.48
P-4	J-3	J-4	90.84	102	0.004902	48 inch	0.012	108.95	7,800.00	7,799.50	7,805.00	7,804.50	1	1	7,802.89	7,802.53	9.7	9.34
P-14	I-8	J-4	0.16	65	0.005385	12 inch	0.012	2.83	7,799.35	7,799.00	7,801.60	7,804.50	1.25	4.5	7,802.52	7,802.52	0.2	0.2

**StormCAD v5.5 [5.5003]
Triad Holmes Associates
Preliminary Drainage Study
7-Sep

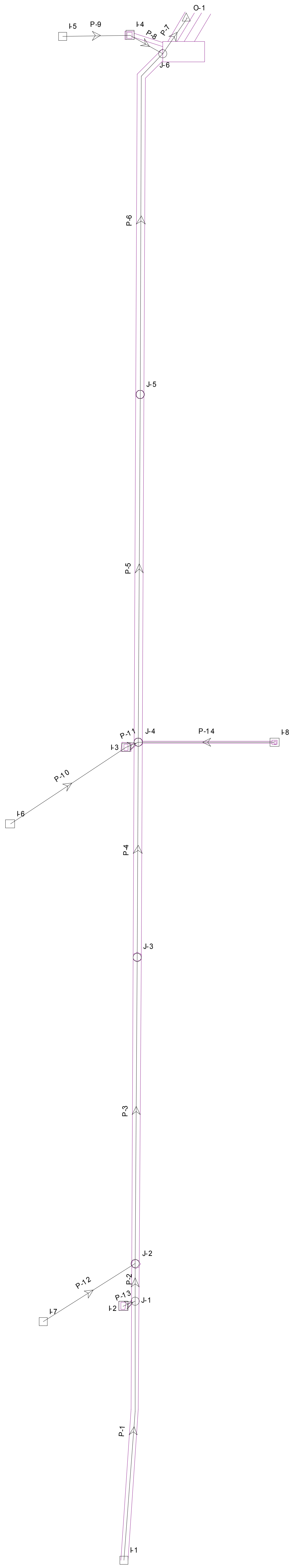
Profile
Scenario: Base

Profile: Profile - 2

Scenario: Base



Scenario: Base



Preliminary Drainage Study
Mammoth Lakes Police Department

APPENDIX C

RETENTION/INFILTRATION BASIN

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

Calc'd By:	**DH**
Job No.:	**2880**
Date:	**10/17/2007**

On-Site Storage Volume Area A

based on Lahontan RWQCB Design Parameters

Mammoth Police Department Facility

Input:

Rainfall Intensity

1 in/hr = 0.083 ft/hr

Percolation Rate (Though there is adequate percolation, none will be assumed for storage volume)

0 in/hr = 0.00 ft/hr

Tributary Area:				Runoff Coefficient	
Roof Area	13,989	SF	15%	0.95	Roof Area
Pavement Area	25,952	SF	28%	0.90	Pavement Area
Natural Area	51,694	SF	56%	0.15	Landscaping Area
Total Area	**91,635**	**SF**		**0.48**	**Average Runoff Coefficient**

Storage Volume = Total Area * Average Runoff Coefficient * Rainfall Intensity * 1 Hour

Storage Volume = 3700 CF

On-Site Storage Basin

Bottom Length	Top Length	Bottom Width	Top Width	Height	**Volume Provided**	Volume Required
120 ft	131 ft	13 ft	24 ft	1.8 ft	**4206 cf**	3700 cf

Calc'd By: **DH**
Job No.: **2880**
Date: **10/17/2007**

On-Site Storage Volume Area B

based on Lahontan RWQCB Design Parameters

Mammoth Police Department Facility

Input:

Rainfall Intensity

1 in/hr = 0.083 ft/hr

Percolation Rate (Though there is adequate percolation, none will be assumed for storage volume)

0 in/hr = 0.00 ft/hr

Tributary Area:				Runoff Coefficient	
Roof Area	0,000	SF	0%	0.95	Roof Area
Pavement Area	12,936	SF	100%	0.90	Pavement Area
Natural Area	0,000	SF	0%	0.15	Landscaping Area
Total Area	**12,936**	**SF**		**0.90**	**Average Runoff Coefficient**

Storage Volume = Total Area * Average Runoff Coefficient * Rainfall Intensity * 1 Hour

Storage Volume = 970 CF

On-Site Storage Basin

Bottom Length	Top Length	Bottom Width	Top Width	Height	**Volume Provided**	Volume Required
30 ft	41 ft	9 ft	20 ft	1.8 ft	**970 cf**	970 cf

Preliminary Drainage Study
Mammoth Lakes Police Department

APPENDIX D

REFERENCES

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

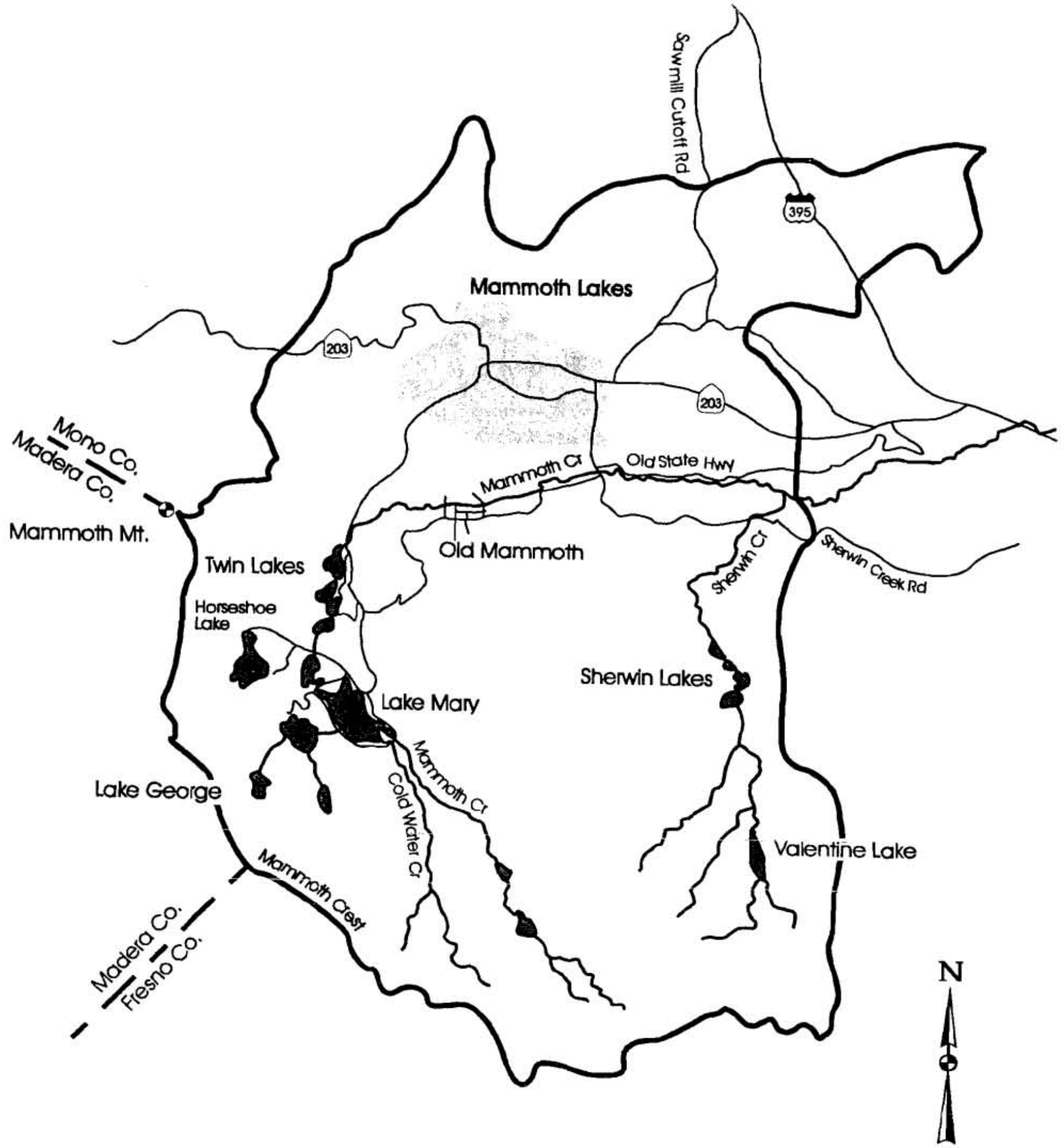
- reduction of direct discharges (e.g., through culverts)
- reduction of runoff velocity
- infiltration, detention and retention practices
- management of deicing compounds, fertilizer, and herbicide use
- spill cleanup measures
- treatment of toxic stormwater pollutants

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
OWENS HYDROLOGIC UNIT



Approximate Erosion Control Policy Area

THE TOWN OF MAMMOTH LAKES CALIFORNIA

2005 STORM DRAIN Master Plan Update

May 26, 2005
(Revision 0D)

VT-M01-100-01

BOYLE ENGINEERING CORPORATION

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

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[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

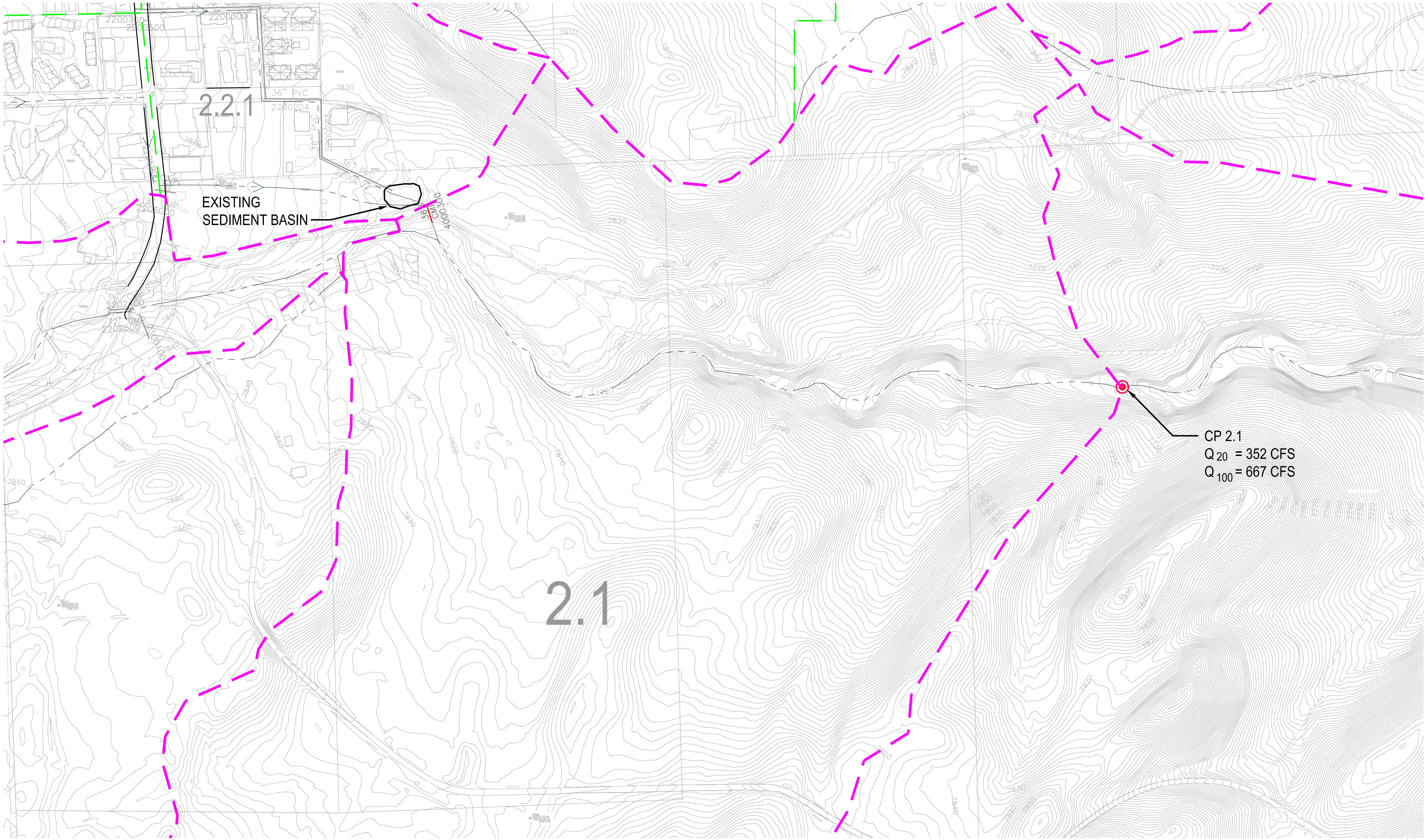
Land Use Type	20-Year	100-Year
Natural	0.23	0.43
Single Family Residence	0.65	1.30
High Density Residence	1.14	1.90
Commercial	1.22	1.93

Basin	Pipe ID	Length (ft)	Section Size (in)	Calculated Capacity 94% full	Total Basin Q	% of Basin	Basin Q at Pipe	Contibuting Basins				Contributing Q	Required Capacity	Pipe Meets Required Capacity
2.3.3	2306800	124	30	146	24	65%	16					0	16	Yes
2.3.3	2307100	77	30	123	24	35%	9					0	9	Yes
2.3.3	2307200	14	30	83	24	35%	9					0	9	Yes
2.3.3	2307300	100	24	50	24	35%	9					0	9	Yes
2.3.3	2307500	436	24	51	24	35%	9					0	9	Yes
2.3.3	2307800	8	24	122	24	10%	2					0	2	Yes
2.3.3	2308000	57	24	32	24	10%	2					0	2	Yes
2.3.3	2308200	121	24	307	24	10%	2					0	2	Yes
2.3.3	2308400	69	24	29	24	10%	2					0	2	Yes
2.3.3	2308700	56	24	103	24	1%	0					0	0	Yes
2.3.3	2308900	27	24	148	24	1%	0					0	0	Yes
2.3.3	2309100	38	24	28	24	1%	0					0	0	Yes
2.3.3	2309302	41	18	39	24	1%	0					0	0	Yes
2.5.3	2309303	632	36	178	24	1%	0					0	0	Yes
2.5.3	2309305	71	18	9	24	5%	1					0	1	Yes
2.5.3	2309307	55	18	11	24	2%	0					0	0	Yes
2.5.3	2309309	19	18	18	24	5%	1					0	1	Yes
2.5.3	2309402	83	18	58	24	10%	2					0	2	Yes
2.5.3	2309404	99	18	16	24	10%	2					0	2	Yes
2.5.3	2309406	474	36	57	24	10%	2					0	2	Yes
2.5.3	2309408	17	18	47	24	10%	2					0	2	Yes
2.5.3	2309410	16	18	49	24	10%	2					0	2	Yes
2.5.3	2309502	23	18	41	24	3%	1					0	1	Yes
3.1	3200201	221	36	68	26	45%	12					0	6	Yes
3.1	3200202	221	36	68	26	45%	12					0	6	Yes
3.3.1	3200401	142	36	52	42	100%	42	3.3.3	3.3.2			86	64	No
3.3.1	3200402	143	36	52	42	100%	42	3.3.3	3.3.2			86	64	No
3.3.1	3200600	82	24	92	42	99%	41					0	41	Yes
3.3.1	3200800	261	36	148	42	98%	41	3.3.2				74	115	Yes
3.3.1	3201000	384	36	162	42	98%	41	3.3.2				74	115	Yes
3.3.1	3201200	546	30	80	42	98%	41	3.3.2				74	115	No
3.3.1	3201250	108	30	95	42	40%	17					0	17	Yes
3.3.2	3201400	43	18	12	33	15%	5					0	5	Yes
3.3.2	3201600	384	30	53	33	70%	23	3.3.4				41	64	No
3.3.2	3201800	335	30	66	33	60%	20	3.3.4				41	61	Yes
3.3.2	3202000	602	30	58	33	30%	10	3.3.4				41	51	Yes
3.3.2	3202200	259	30	129	33	20%	7	3.3.4				41	47	Yes
3.3.2	3202400	128	30	82	33	15%	5					0	5	Yes
3.3.1	3202700	43	24	59	42	20%	8					0	8	Yes
3.3.4	3203001	119	30	36	41	100%	41					0	20	Yes
3.3.4	3203002	119	30	36	41	100%	41					0	20	Yes
3.3.4	3203201	91	24	18	41	95%	39					0	19	No
3.3.4	3203202	94	24	21	41	95%	39					0	19	Yes
3.3.4	3203501	51	24	26	41	90%	37					0	18	Yes
3.3.4	3203502	51	24	26	41	90%	37					0	18	Yes
3.3.4	3203700	20	24	54	41	40%	16					0	16	Yes
3.3.3	3203900	86	24	49	12	80%	9					0	9	Yes
3.3.3	3204100	106	24	24	12	80%	9					0	9	Yes
3.3.3	3204400	70	18	53	12	80%	9					0	9	Yes
3.3.4	3204600	62	18	11	41	90%	37					0	37	No
3.3.4	3204800	46	18	13	41	90%	37					0	37	No
3.3.4	3205200	37	24	27	41	30%	12					0	12	Yes
3.3.1	3205400	48	24	35	42	60%	25	3.3.3				12	37	No
3.3.1	3205600	81	24	54	42	40%	17	3.3.3				12	28	Yes
3.3.1	3206100	44	30	141	42	15%	6					0	6	Yes
3.3.1	3206200	107	24	24	42	35%	15	3.3.3				12	26	No
3.3.1	3206600	83	24	19	42	25%	10	3.3.3				12	22	No
3.3.1	3206900	62	24	41	42	15%	6	3.3.3				12	18	Yes
3.3.1	3207200	12	18	45	42	15%	6	3.3.3				12	18	Yes
3.3.3	3207500	90	12	4	12	10%	1					0	1	Yes
3.3.3	3207700	36	12	4	12	10%	1					0	1	Yes
3.4	3300100	115	18	11	31	1%	0					0	0	Yes
3.4	3300300	145	24	67	31	15%	5					0	5	Yes
3.4	3300400	87	24	74	31	15%	5					0	5	Yes
3.4	3300600	39	24	39	31	15%	5					0	5	Yes
3.4	3300800	28	18	48	31	5%	2					0	2	Yes
3.4	3301000	121	48	183	31	15%	5	3.5.1				97	51	Yes

Analysis of Pipe Capacities: Existing Conditions, 20-Year Event

Basin	Pipe ID	Length (ft)	Section Size (in)	Calculated Capacity 94% full	Total Basin Q	% of Basin	Basin Q at Pipe	Contibuting Basins				Contributing Q	Required Capacity	Pipe Meets Required Capacity
3.4	3301100	121	48	183	31	15%	5	3.5.1				97	51	Yes
3.4	3301200	53	18	16	31	5%	2					0	2	Yes
3.5.1	3301400	44	18	17	53	15%	8					0	8	Yes
3.5.1	3301650	50	54	299	53	85%	45	3.5.2				46	92	Yes
3.5.1	3301652	276	48	294	53	80%	43	3.5.2				46	89	Yes
3.5.1	3301654	148	48	254	53	80%	43	3.5.2				46	89	Yes
3.5.1	3301656	203	48	217	53	80%	43	3.5.2				46	89	Yes
3.5.1	3301658	70	48	320	53	70%	37	3.5.2				46	84	Yes
3.5.1	3301660	21	36	248	53	40%	21					0	21	Yes
3.5.1	3301663	234	24	30	53	40%	21					0	21	Yes
3.5.1	3303000	334	24	48	53	40%	21					0	21	Yes
3.5.1	3303400	331	36	74	53	15%	8	3.5.2				46	54	Yes
3.5.1	3303600	319	36	57	53	10%	5	3.5.2				46	52	Yes
3.5.1	3303750	747	42	119	53	40%	21					0	21	Yes
3.5.2	3303800	104	36	70	46	98%	45	3.5.2				46	92	No
3.5.1	3303850	80	18	18	53	4%	2					0	2	Yes
3.4	3400100	68	42	125	31	100%	31					0	31	Yes
3.4	3400500	56	42	176	31	5%	2					0	2	Yes
3.4	3400701	43	30	67	31	5%	2					0	1	Yes
3.4	3400702	42	30	68	31	5%	2					0	1	Yes
3.4	3400703	41	30	69	31	5%	2					0	1	Yes
3.4	3400900	373	72	626	31	98%	30	3.5.1	3.6.1			327	358	Yes
3.4	3401100	615	72	586	31	98%	30	3.5.1	3.6.1			327	358	Yes
3.4	3401300	558	72	603	31	90%	28	3.5.1	3.6.1			327	355	Yes
3.4	3401500	435	72	464	31	90%	28	3.5.1	3.6.1			327	355	Yes
3.4	3401700	441	72	732	31	80%	25	3.6.1				230	255	Yes
3.4	3401900	478	66	517	31	80%	25	3.6.1				230	255	Yes
3.4	3402100	6	24	310	31	80%	25					0	25	Yes
3.4	3402300	82	66	498	31	85%	26					0	26	Yes
3.4	3402500	93	18	41	31	5%	2					0	2	Yes
3.4	3402700	153	18	9	31	5%	2					0	2	Yes
3.4	3402800	59	18	15	31	5%	2					0	2	Yes
3.4	3402900	594	66	549	31	85%	26					0	26	Yes
3.7.1	3403100	681	60	527	31	10%	3	3.9	3.7.2			185	188	Yes
3.7.1	3403300	712	60	509	31	10%	3	3.9	3.7.2			185	188	Yes
3.7.1	3403500	701	54	469	31	8%	2	3.9	3.7.2			185	187	Yes
3.7.1	3403700	330	60	723	31	10%	3	3.9	3.7.2			185	188	Yes
3.4	3403901	42	24	38	31	10%	3					0	2	Yes
3.4	3403902	42	18	14	31	2%	1					0	0	Yes
3.6.1	3500100	60	72	625	97	97%	94	3.6.2	3.6.3	3.6.4	3.6.5	188	282	Yes
3.6.1	3500300	55	72	456	97	90%	87	3.6.2	3.6.3	3.6.4	3.6.5	188	275	Yes
3.6.1	3500500	46	72	435	97	97%	94	3.6.2	3.6.3	3.6.4	3.6.5	188	282	Yes
3.6.1	3500800	157	72	536	97	60%	58	3.6.3	3.6.4	3.6.5		85	143	Yes
3.6.1	3501000	158	72	1025	97	20%	19	3.6.3	3.6.4	3.6.5		85	104	Yes
3.6.1	3501200	190	18	12	97	3%	3					0	3	Yes
3.6.1	3501300	15	24	140	97	3%	3	3.6.2	3.6.3	3.6.4	3.6.5	188	191	No
3.6.2	3501400	248	48	121	48	95%	45	3.6.6				76	122	No
3.6.1	3501600	105	12	4	97	20%	1					0	1	Yes
3.6.2	3501800	274	48	129	48	50%	24	3.6.6				76	50	Yes
3.6.2	3502000	276	48	208	48	50%	24	3.6.6				76	50	Yes
3.6.2	3502200	61	48	156	48	50%	24	3.6.6				76	50	Yes
3.6.2	3502400	3	18	92	48	45%	21	3.6.6				76	49	Yes
3.6.2	3502600	285	42	190	48	45%	21	3.6.6				76	49	Yes
3.6.2	3502800	3	24	140	48	45%	21	3.6.6				76	49	Yes
3.6.2	3503000	88	24	37	48	30%	14	3.6.6				76	45	No
3.6.2	3503100	230	42	50	48	20%	10	3.6.6				76	43	Yes
3.6.2	3503300	276	42	164	48	25%	12	3.6.6				76	44	Yes
3.6.2	3503500	59	36	127	48	30%	14	3.6.6				76	91	Yes
3.6.6	3503700	19	36	222	13	100%	13	3.6.8				21	33	Yes
3.6.6	3503900	62	24	51	13	90%	11	3.6.8				21	32	Yes
3.6.6	3504000	47	24	58	13	90%	11	3.6.8				21	32	Yes
3.6.6	3504200	104	24	48	13	90%	11	3.6.8				21	32	Yes
3.6.6	3504400	37	24	61	13	90%	11	3.6.8				21	32	Yes
3.6.6	3504600	102	24	49	13	90%	11	3.6.8				21	32	Yes
3.6.6	3504800	26	24	45	13	80%	10	3.6.8				21	31	Yes
3.6.6	3505000	73	24	35	13	80%	10	3.6.8				21	31	Yes
3.6.6	3505200	32	24	51	13	80%	10	3.6.8				21	31	Yes

DWG: F:\ellison\M0110001 - Mammoth Storm\CAD\Exhibits\Area 2.1.dwg USER: rherbst
DATE: Jun 10, 2005 4:54pm XREFS: basemap 2162p3 BLDG ONLY 2162p3 TOPO ONLY Xref System pipe ID Basins-Hatch (Sub Areas) Mammoth C&G New Construction



NOTES:

1. FLOWS SHOWN ARE TOTALS FOR FUTURE BUILD OUT CONDITIONS.

LEGEND

- MAJOR WATERSHED BOUNDARY
- DETAILED DRAINAGE WATERSHED BOUNDARIES
- FLOWLINE
- STORM DRAIN, EXISTING
- STORM DRAIN, RECOMMENDED
- CURB AND GUTTER, EXISTING
- CURB AND GUTTER, RECOMMENDED
- WATERSHED COLLECTION POINT, CP
- 30" RECOMMENDED PIPE REPLACEMENT OR NEW PIPE. (RED SHADING = PRIORITY 1, YELLOW SHADING = PRIORITY 2)
- 10 NEW PIPE ID

BOYLE

REV	DATE	DESCRIPTION	APPR
6			
5			
4			
3			
2			
1	–		

TOWN OF MAMMOTH LAKES

AREA 2.1 PLAN

VT-M01-100-01 MAY 2005 EXHIBIT 8.1

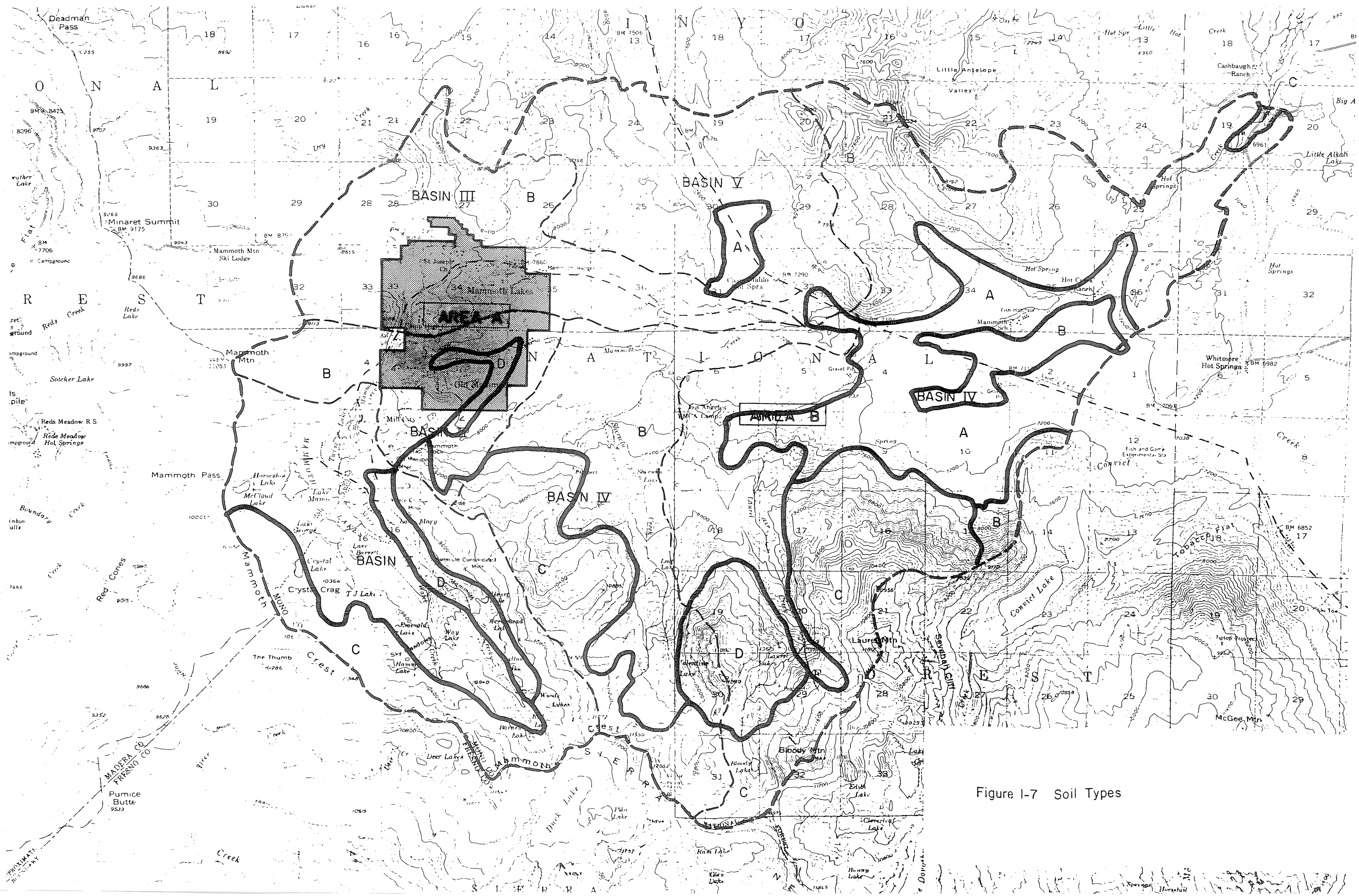


Figure I-7 Soil Types