APPENDIX C
Preliminary Drainage Study

HOLIDAY HAUS
Mammoth Lakes, California

Preliminary Drainage Study

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Date of Amended Report: February 2008

Job No. 01.1371.1

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HOLIDAY HAUS
Preliminary Drainage Study

INDEX

APPENDIX

- Town of Mammoth Lakes 2005 Storm Drain Master Update, May 2005, Boyle Engineering Corporation
- 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

PRELIMINARY DRAINAGE STUDY – Holiday Haus

1. Project

The Holiday Haus project site is located along Main Street (California Department of Transportation Highway 203) in Mammoth Lakes, Mono County, California. The site is accessed directly from Main Street. The existing west entrance is approximately 450 feet east of Minaret Road. For the project vicinity and location, refer to Appendix A, Figures 1 and 2.

The site is approximately 1.55 +/- acres, or 67,345 square feet (sf) in size. The Holiday Haus Hotel is currently on the site. It has a large amount of paving and numerous buildings, hot tub and surface features. The project site is zoned Commercial Lodging. To the east and west of the site are Commercial Lodging properties. To the south is Resort property, presently known as Sierra Star Golf Course.

The proposed development is to consist of one building with an underground parking structure, which is to be three levels. The building over the parking structure is to have five levels and is for the purpose of providing nightly rental units. The project is to include - in addition to the main building – an entrance drive, walks, utilities, terrace/recreation area, drainage improvements and associated grading. The recreation and amenities of the project are to consist of a swimming pool, fire pit, hot tub and sledding hill for guests.

A drive is proposed to enter and exit the project from Main Street. The drive allows access to the drop-off/entrance as well as the underground parking garage. It incorporates a hammerhead in the design to allow access to emergency vehicles. There are three parking spaces (one being handicapped accessible) at the drop-off; there is no other onsite parking aside from these and the underground parking structure.

At build-out, the proposed project will include approximately 44,100 square feet of impervious surfaces consisting of roofs, drives, and walks/terrace areas; this area includes portions of the garage that is covered by landscaping. The majority of the roof and first level are within the parking structure footprint. See Appendix A, Figure 4 for the plan view of the proposed improvements.

Construction activities for this project include excavation for the underground parking structure, construction of the building over the structure, and construction / installation of associated utilities, drainage facilities, paving, grading and landscaping. The project is to be developed by Holiday Haus, LLC.

2. Objective

The objective of this preliminary drainage study is to determine the expected hydrologic runoff quantities and preliminarily design facilities for the proposed Holiday Haus project.

3. Assumptions

The hydrology calculations for this drainage report have been prepared based on the Town of Mammoth Lakes 2005 Master Plan Update[1] (Master Plan), Procedure A. On-site drainage facilities including inlets, storm drain pipes, slotted drains, and/or swales shall be designed for 20-year storm intensity. Hydrology calculations are included in Appendix B.

Retention facilities have been preliminarily designed to retain onsite runoff produced from a one-hour 20-year storm event, which is assumed to be 1 inch (0.083 feet) * Area (square feet) * C (infiltration coefficient). Because the retention facilities are 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 are conservatively sized.

4. Project Background and Observations

a. Watershed and Offsite Storm Water Runoff

The Town of Mammoth Lakes Storm Sewer System (TMLSSS) is made up of underground and surface storm drainage facilities. Tributary sub-areas within the Town - and existing and proposed drainage facilities within each sub-area - are identified in the Master Plan[1].

The developed areas of the Mammoth Lakes community are within Watersheds 2 and 3. The Master Plan Update[1] shows the tributary area upstream of the project, and the project area, as part of a watershed boundary within Tributary Sub-area 3.6 (Figure 2.4 in the Master Plan[1]). The project site is located in the sub-area 3.6.1 (Exhibit 8.3 in the Master

Plan[1]). Drainage from this sub-area is located on the north side (Murphy Gulch side) of an easterly trending ridge that separates the Murphy Gulch and the Mammoth Creek drainage systems. Runoff from the site eventually enters the TMLSSS that crosses under Highway 203 and ends up in Murphy Gulch. Murphy Gulch is eventually tributary to Mammoth Creek (after crossing Highway 203 again in culverts). Mammoth Creek is listed for mercury and metals in the Proposed 2006 CWA Section 303(d) State Water Resources Control Board list, which notes the metals needs monitoring to determine the need for TMDL (Total Maximum Daily Limit).

The site generally slopes from the northwest to the southeast. The elevations range from approximately 7,984 feet at the northwest corner to approximately 7,965 feet at the southeast corner of the site. The average slope of the lot is 5%. Along the west property line, the buildings and a shallow ridge send runoff to the west. Runoff is conveyed in a shallow swale on the adjacent property. Along Main Street to the north, runoff flows toward this property. Along the south and east sides of the property, runoff generally exits the site in sheet flow, but is somewhat accelerated as it exits the paved areas between the buildings.

There is little vegetation on the site as it is improved with several buildings and pavement. There are some trees scattered throughout the site, which includes mainly indigenous pines and firs. This project is not located on a receiving water and will not disturb any wetlands or blue-line streams. Soils are granular, typical of SCS Type “B”, based on Figure 1-7 in the Town of Mammoth Lakes 2005 Storm Drain Master Update[1], Appendix D. See Appendix A, Figure 3 for the existing site conditions.

The offsite tributary area was determined by the use of the town aerial map and field investigation. The total offsite tributary area depicted in Figure 3 is approximately 0.65 acres (28,400+/- square feet) in size. Runoff for this offsite area is approximately 0.80 cfs for Q_{20} and 1.26 cfs for Q_{100}. For existing conditions, the offsite tributary area enters the project along the entire north side of the lots. The runoff may historically concentrate, depending upon snow conditions at the driveways.

The project area was accounted for in the total design runoff for Sub-area 3.6, and its planned facilities downstream were sized to convey the runoff. Based on the Master Plan[2] Appendix B, the 20-year runoff rate developed in sub-area 3.6.1 is 100 cfs; 166 cfs for the 100-year. The total runoff developed, including runoff from other areas, at the collection point of sub-area 3.6 is 230 cfs for Q_{20}, and 416 cfs for Q_{100}.

b. Drainage from Onsite Sources

Runoff flows across the existing paved surfaces in generally sheet flow conditions. Runoff falls directly to the ground from the sloped building roofs. The site runoff in the existing conditions is partially concentrated at the paved areas at the openings between buildings.

Refer to Appendix A, Figure 3 for existing site conditions and drainage patterns. Refer to Appendix B for a summary of onsite design intensities and flow rates for pre- and post-development conditions for 20-year and 100-year storms, respectively.

5. Post Development Hydrologic Conditions

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

a. Offsite Drainage

Under the post developed condition, the runoff along Main Street will be conveyed in swales and piping to the east side of the property where it will be allowed to overflow out of an energy dissipater/level spreader located close to a historic runoff location.

The following includes recommendations for storm drainage collection and conveyance for the offsite area:

- A proposed 6-inch deep, 3-foot wide "V-shaped" earth swale located along the northerly border of the project site to convey runoff from the offsite tributary areas to the east.
- Proposed storm drain piping, preliminarily sized at 12-inches, to convey the offsite tributary flow east.

- A proposed level spreader/energy dissipater at the northeast corner of the site to allow the tributary runoff to exit the above-mentioned swale and piping in a sheet flow condition, as close to historic flow as possible.

Refer to Appendix B for a summary of hydrology calculations. Adjustments can be made to these proposed facilities and locations as long as these changes stay within the intent of this study.

b. Onsite Drainage

The onsite drainage facilities have been preliminarily designed to collect and transport the additional runoff generated by the added impervious areas on the site to retention facilities for this Preliminary Drainage Study. A more in-depth analysis of the areas and facilities will be done in the Drainage Study that will accompany the grading plans.

At this preliminary stage in the design, runoff flow for the post-developed site was divided into four separate general areas – A, B, C and D. The post-development onsite storm water from the project improvements will be collected in swales, gutters and inlets, and conveyed in swales, gutters and pipes to underground retention / infiltration systems throughout the site. Runoff in excess of the capacity of the retention systems is proposed to overflow at one of two locations south of the proposed building, and will go through appropriate permanent BMP's. Excess runoff will exit the site in sheet flow via level-spreaders or equivalent devices. Refer to Figure 4 included in Appendix A, for the proposed facilities.

The onsite runoff for each area was determined to be: Area A (northeast area of site) – 0.55 cfs Q_{20} (0.87 cfs Q_{100}); Area B (northwest area of site) – 0.45 cfs Q_{20} (0.71 cfs Q_{100}); Area C (southwest area of site) – 0.53 cfs Q_{20} (0.84 cfs Q_{100}); and Area D (southeast area of site) – 0.35 cfs Q_{20} (0.56 cfs Q_{100}).

- The inlets proposed at this preliminary design stage are designed with depressions to show that the inlet can accommodate the Q_{20} capacity for that entire area. Although, during the final design - the grading/improvement plans – the general areas will be further divided into sub areas, as each inlet will not receive the flow for the entire area. This will allow the depressions to be lessened in most cases. For example, Area A's 18-inch round inlets can accommodate the runoff for the entire area with a depression of 0.12-feet. The amount of runoff at any inlet in Area A will not be the entire Q_{20} of 0.55 cfs, so a depression of 0.12 is sufficient for this area. Calculations provided in Appendix C on the inlet sizing sheet show that the proposed inlets can accommodate the capacities for each specific area.

- The onsite graded earth swales have been preliminarily sized to accommodate the capacity for each area, with a minimum slope of 2% (the minimum slope for any swale onsite). With a swale sized at 3-feet wide, and 6-inches deep throughout the site - the swale can sufficiently carry Area A's Q_{20} of 0.55 cfs (as well as the Q_{100} of 0.87 cfs). Area A has the greatest Q of all the areas.

  At this stage of conceptual design, the swales are shown to be able to convey the flow for each entire area. No one swale in each area will convey the flow for that entire area. Therefore, the swales are sufficiently sized at this preliminary stage, and the sizes are quite conservative.

- Proposed storm drain piping, preliminarily sized as 12-inch PVC is proposed to have a minimum slope of 1.0%. The 12-inch pipe can carry 3.5 cfs at 100% full. This is more than any of the Q_{20} and Q_{100} for the proposed onsite and tributary areas.

At the southwest area of the site (Area C) runoff may be required to be pumped, due to the elevation of some features (terrace and sled hill). This runoff will be pumped to the proposed retention facility for Area C, with any overflow being pumped to a dissipator. Refer to Appendix A Figure 4 for the onsite drainage facilities. Supporting hydraulic calculations are presented in Appendix B.

c. Retention / Infiltration Facilities

To infiltrate onsite runoff into the ground, a retention / infiltration basin system will be designed, in conformance with the Water Quality Control Plan for the Lahontan Region[3], to contain a 20-year intensity storm for 1-hour, generated from the project paving, roofs, landscaping and hardscape. The 20-year intensity storm for 1-hour is assumed to be 1-inch (0.083 feet) * Area (square feet) * C (infiltration coefficient). Retention / infiltration facility sizing calculations are included in Appendix C. No onsite runoff from improved areas is to be allowed offsite without going through the retention facilities.

The site is divided into the four general areas, each of which contains a preliminarily designed retention system. All areas are proposed to have a Hancor retention system at this time. Each of the individual retention systems has been preliminarily sized to accommodate the runoff for that entire area. Runoff that exceeds the capacity of the retention basins will go through appropriate permanent BMP's. A level spreader, or an equivalent device, will be used to ensure the excess runoff exits the site in sheet flow fashion.

Site Area, Runoff Coefficient, and Retention Volume For Onsite Areas

Area A
Surface Area .... 19,690 square feet
Runoff Coefficient after construction 0.81
Retention Volume .... 1,328 cubic feet

Area A contains two proposed Hancor systems, providing a total of 1,578 cf of storage for both units.

Area B
Surface Area .... 16,030 square feet
Runoff Coefficient after construction 0.73
Retention Volume .... 980 cubic feet

Area B contains a proposed Hancor basin which provides 1,000 cf of retention.

Area C
Surface Area .... 19,045 square feet
Runoff Coefficient after construction 0.77
Retention Volume .... 1,203 cubic feet

Area C contains a proposed Hancor basin which has a 1,264 cf capacity.

Area D
Surface Area .... 12,585 square feet
Runoff Coefficient after construction 0.73
Retention Volume .... 766 cubic feet

Area C contains a proposed Hancor basin which has a 789 cf capacity.

Adjustments can be made to these proposed facilities and locations as long as these changes stay within the intent of this study. Calculations are shown in Appendix C.

6. 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 the offsite tributary area is recommended to be intercepted and conveyed to the east of the site. It will be conveyed to a level spreader / energy dissipater to allow it to sheet flow southeast in its historic flow.

As the site is already developed, the onsite runoff quantities for the overall site do not appear to increase or decrease due to the proposed development. Due to the changes, the runoff may increase in some areas, this increase will be limited in short duration and small storms by the proposed infiltration systems, and will outflow in sheet conditions.

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.

The 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 retention basins, 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

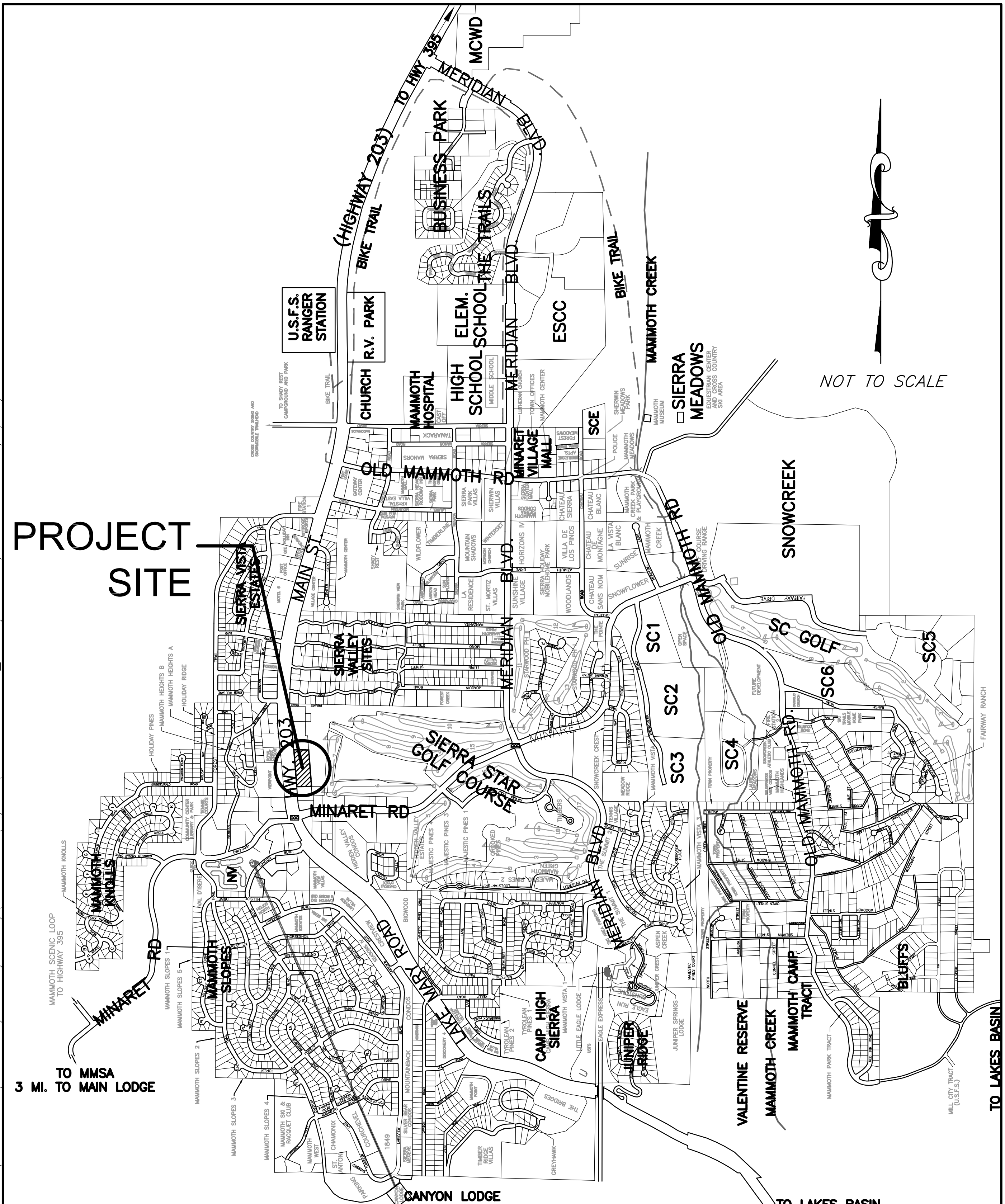
[2] Design Manual, Mammoth Lakes Storm Drainage and Erosion Control, Prepared for Mono County Public Works Department, July 1984, Brown and Caldwell and Triad Engineering

[3] Water Quality Control Plan for the Lahontan Region Basin Plan, prepared by the State of California, Regional Water Quality Control Board, Lahontan Region

Preliminary Drainage Study
Holiday Haus

APPENDIX A

FIGURES



triad/holmes associates

HOLIDAY HAUS
MAMMOTH LAKES, CALIFORNIA

OVERALL
VICINITY MAP

Figure 1

PROJECT NO.
01.1371.1

DATE
FEBRUARY 2008

DRAWING NAME:
1371–1drn01–02_R2.dwg

SCALE:
N. T. S.

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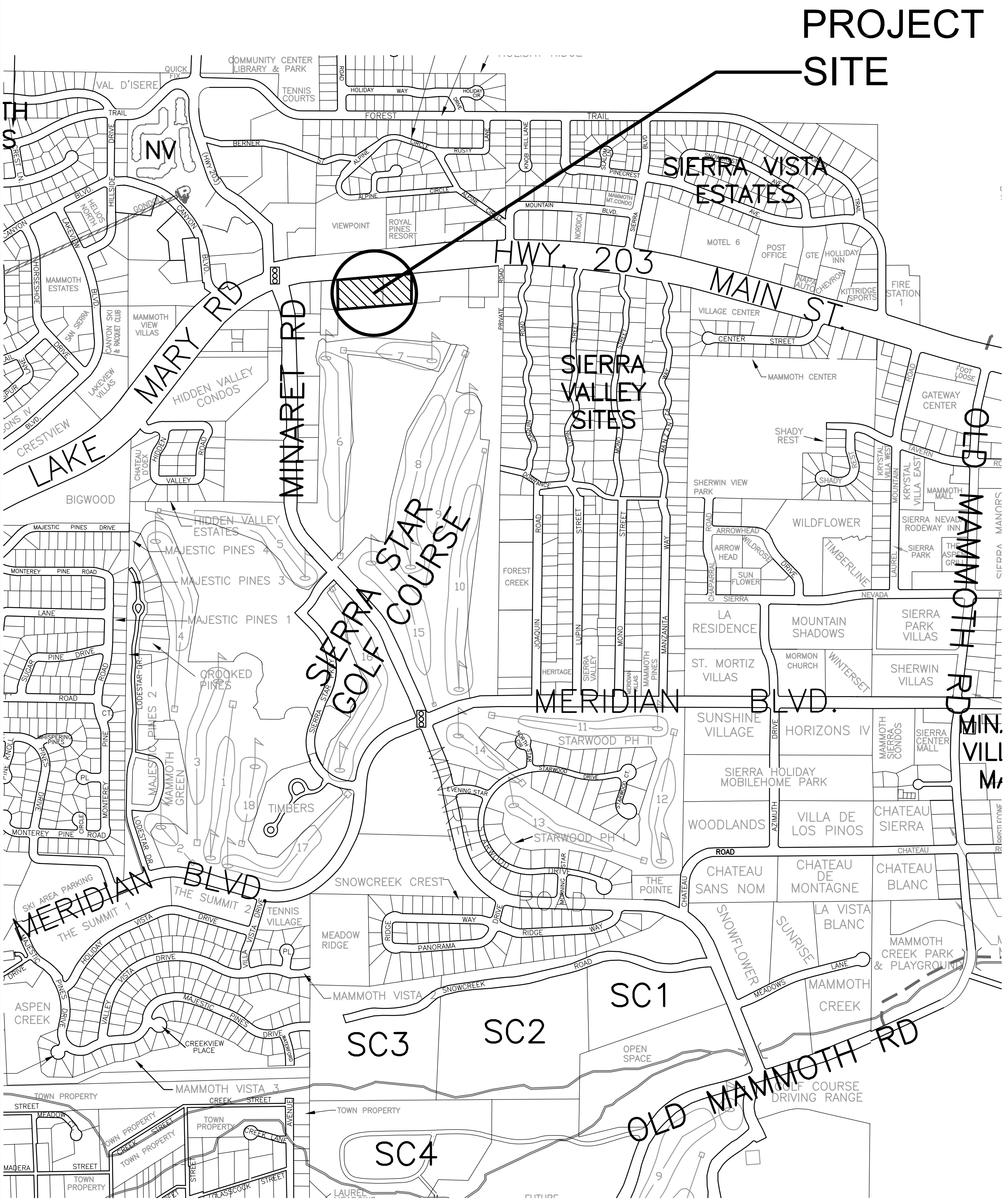

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HOLIDAY HAUS
MAMMOTH LAKES, CALIFORNIA

PROJECT
LOCATION MAP

Figure 2

PROJECT NO. 01.1371.1

DATE FEBRUARY 2008

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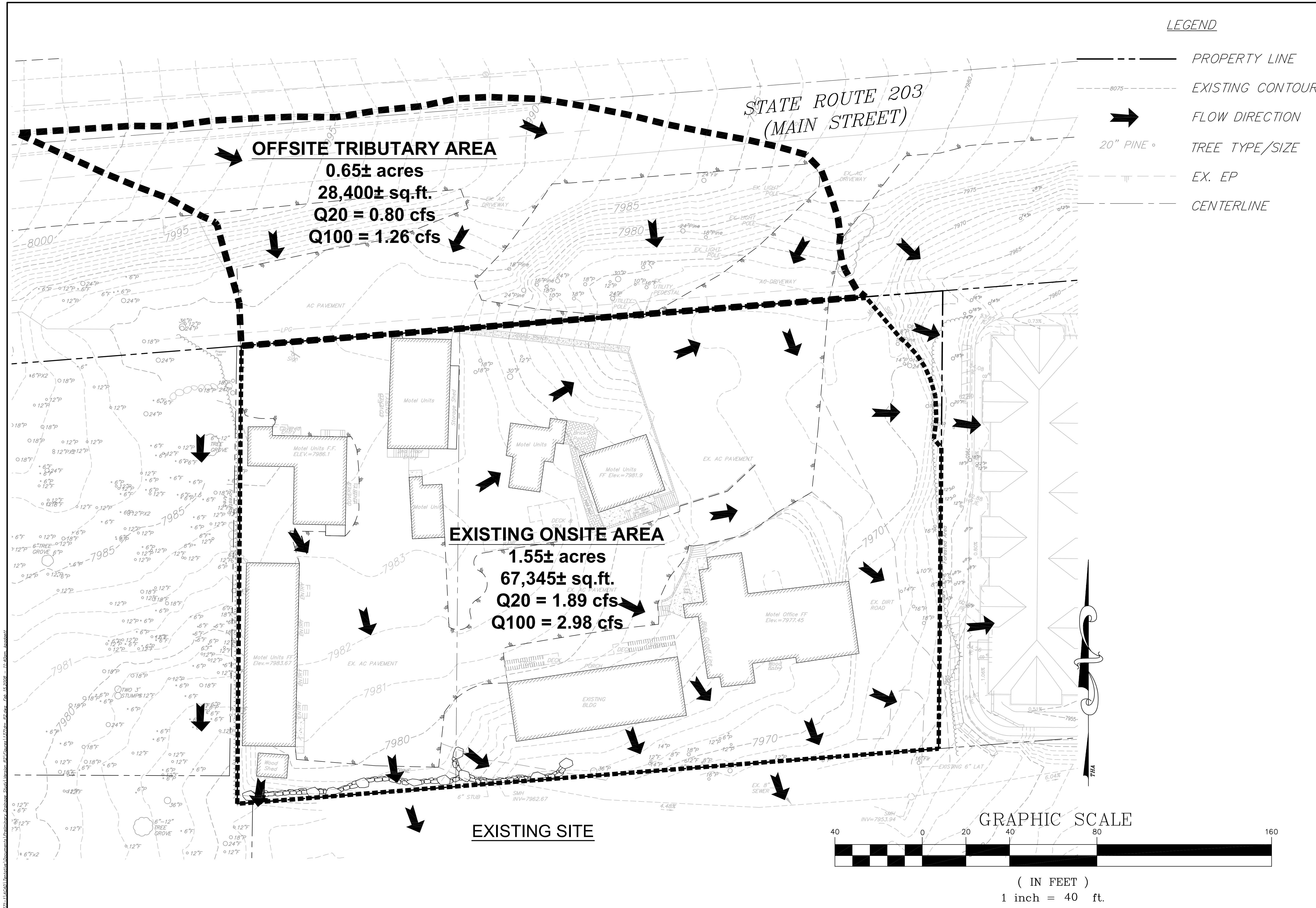
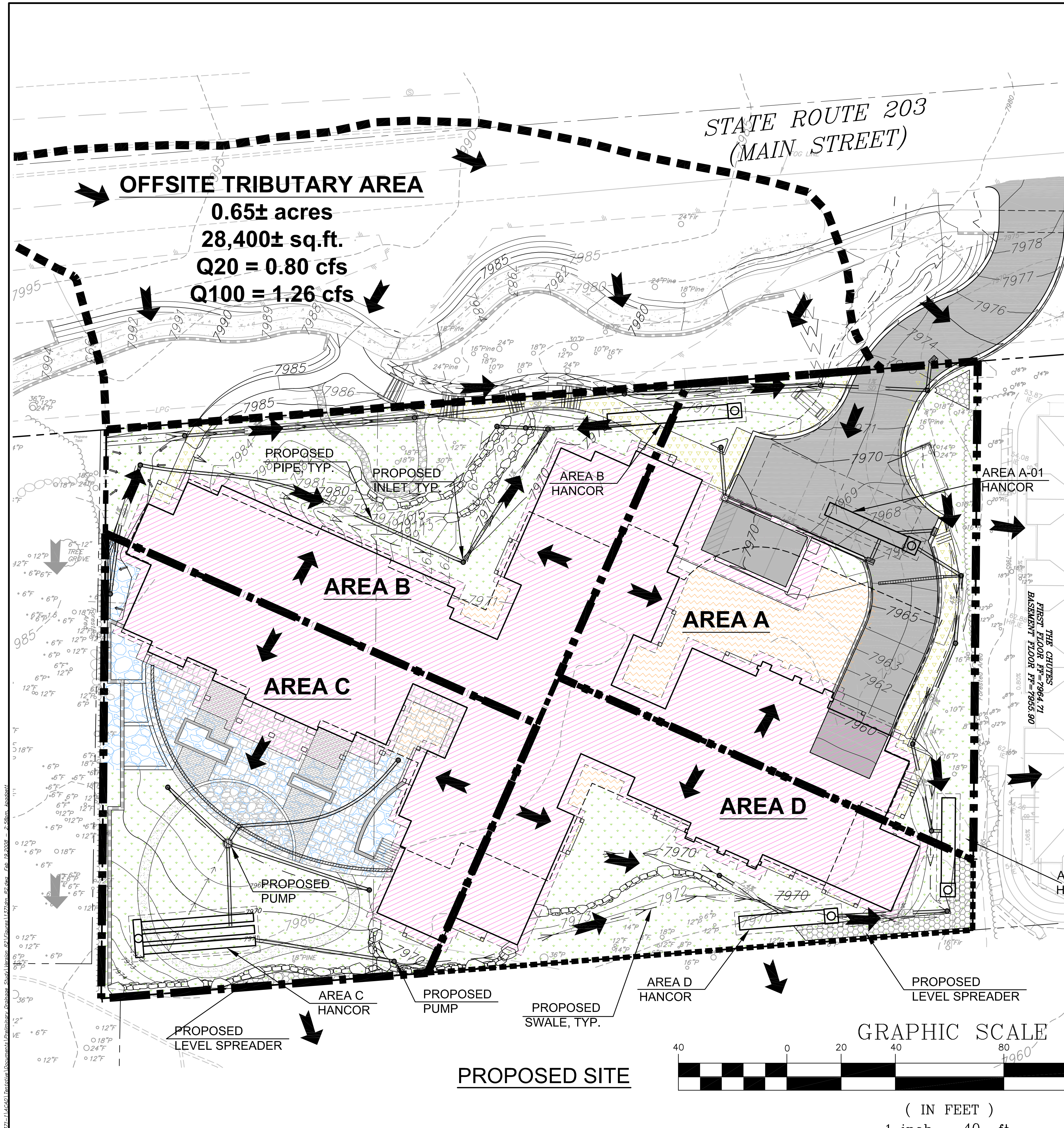


PRE-DEVELOPMENT DRAINAGE
HOLIDAY HAUS

triad/holmes assoc.
civil engineering
land surveying

REVISIONS: OCTOBER 2007; FEBRUARY 2008

DATE: SEPTEMBER 2005
SCALE: 1"=40'
DRAWN: KP
JOB NO.: 1371.1
DWG: 1371drn_R2.dwg
SHEET: FIG 3



LEGEND

- PROPERTY LINE
- EXISTING CONTOUR
- FLOW DIRECTION
- ROOF AREA
- PAVEMENT AREA
- TERRACE/PATIO
- LANDSCAPE/NAT.
- LANDSCAPE OVER GARAGE DECK
- CONCRETE

ONSITE AREA NOTES:

AREA A
AREA=0.45 acres
Q_{20}=0.55 CFS
Q_{100}=0.87 CFS

AREA B
AREA=0.37 acres
Q_{20}=0.45 CFS
Q_{100}=0.71 CFS

AREA C
AREA=0.44 acres
Q_{20}=0.53 CFS
Q_{100}=0.84 CFS

AREA D
AREA=0.29 acres
Q_{20}=0.35 CFS
Q_{100}=0.56 CFS

RETENTION BASIN NOTES:

AREA A
RETENT. REQ. = 1,328 CFS

PROPOSED HANCOR 01:
ONE 60" ø PIPE, 30' LENGTH
CAPACITY = 789 CF

PROPOSED HANCOR 02:
ONE 60" ø PIPE, 30' LENGTH
CAPACITY = 789 CF

AREA B
RETENT. REQ. = 980 CFS

PROPOSED HANCOR:
ONE 60" ø PIPE, 20' LENGTH
CAPACITY = 1,000 CF

AREA C
RETENT. REQ. = 1,203 CFS

PROPOSED HANCOR:
THREE 36" ø PIPE,
40' LENGTH EACH,
CAPACITY = 1,264 CF

AREA D
RETENT. REQ. = 766 CFS

ONE 60" ø PIPE, 30' LENGTH
CAPACITY = 789 CF

STORM DRAIN PIPE NOTES:

PROPOSED 12" PVC
MINIMUM SLOPE 1%
Capacity=3.5 CFS
V_{full}=4.5 CFS

Q_{20}=0.55 cfs
AREA A (max. onsite)

Q_{20}=0.80 cfs
OFFSITE TRIBUTARY

ONSITE SWALE NOTES:

PROP. 3' WIDE, 6" DEEP
Capacity=1.7 CFS
V_{full}=2.3 CFS

Q_{20}=0.55 cfs
AREA A (max. onsite)
Q_{20}=0.8 cfs
OFFSITE TRIBUTARY

POST-DEVELOPMENT DRAINAGE
HOLIDAY HAUS

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REVISIONS	BY
OCTOBER 2007	
FEBRUARY 2008	

DATE SEPTEMBER 2005
SCALE 1"=40'
DRAWN KP
JOB NO. 1371.1
DWG 1371drn_R2.dwg
SHEET FIG 4

Preliminary Drainage Study
Holiday Haus

APPENDIX B

HYDROLOGIC CALCULATIONS

Holiday Haus
20 -Year and 100-Year Intensity Storm

Procedure A					
Area	Exceedence Interval for Design (years)	Acres	Land Use Type	Inensity (cfs/acre)	Design Q (cfs)
Offsite Tributary	Q20	0.65	C	1.22	**0.80**
	Q100			1.93	**1.26**
Onsite Existing	Q20	1.55	C	1.22	**1.89**
	Q100			1.93	**2.98**
Post - Area A (NE)	Q20	0.45	C	1.22	**0.55**
	Q100			1.93	**0.87**
Post - Area B (NW)	Q20	0.37	C	1.22	**0.45**
	Q100			1.93	**0.71**
Post - Area C (SW)	Q20	0.44	C	1.22	**0.53**
	Q100			1.93	**0.84**
Post - Area D (SE)	Q20	0.29	C	1.22	**0.35**
	Q100			1.93	**0.56**

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

Holiday Haus
JN 01.1371.1
October 2007

SWALE OFFSITE TRIB AREA – full-flow flow rate
Graded Earth Swale – 3-feet wide, 6-inches deep
MINIMUM SLOPE – 2%

Channel Calculator

Given Input Data:
Shape .... Trapezoidal
Solving for .... Flowrate
Slope .... 0.0200 ft/ft
Manning's n 0.0350
Depth .... 6.0000 in
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:
Flowrate .... 1.7256 cfs > 0.80 cfs Q20 offsite trib runoff
Velocity .... 2.3006 fps
Full Flowrate .... 1.7256 cfs
Flow area 0.7501 ft2
Flow perimeter .... 37.9507 in
Hydraulic radius .... 2.8461 in
Top width .... 36.0036 in
Area 0.7501 ft2
Perimeter .... 37.9507 in
Percent full .... 100.0000 %

Critical Information
Critical depth .... 5.5182 in
Critical slope .... 0.0313 ft/ft
Critical velocity .... 2.7199 fps
Critical area 0.6345 ft2
Critical perimeter .... 34.9035 in
Critical hydraulic radius .... 2.6175 in
Critical top width .... 33.1127 in
Specific energy .... 0.5823 ft
Minimum energy .... 0.6898 ft
Froude number 0.8112
Flow condition .... Subcritical

Holiday Haus
JN 01.1371.1
October 2007

<u>SWALE OFFSITE AREAS A, B, C, D – full-flow flow rate</u>
Graded Earth Swale – 3-feet wide, 6-inches deep
MINIMUM SLOPE – 2%

Channel Calculator

Given Input Data:
Shape .... Trapezoidal
Solving for .... Flowrate
Slope .... 0.0200 ft/ft
Manning's n 0.0350
Depth .... 6.0000 in
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:
Flowrate .... 1.7256 cfs > 0.55 cfs Q20 Area A (greatest Q of areas)
Velocity .... 2.3006 fps
Full Flowrate .... 1.7256 cfs
Flow area 0.7501 ft2
Flow perimeter .... 37.9507 in
Hydraulic radius .... 2.8461 in
Top width .... 36.0036 in
Area 0.7501 ft2
Perimeter .... 37.9507 in
Percent full .... 100.0000 %

Critical Information
Critical depth .... 5.5182 in
Critical slope .... 0.0313 ft/ft
Critical velocity .... 2.7199 fps
Critical area 0.6345 ft2
Critical perimeter .... 34.9035 in
Critical hydraulic radius .... 2.6175 in
Critical top width .... 33.1127 in
Specific energy .... 0.5823 ft
Minimum energy .... 0.6898 ft
Froude number 0.8112
Flow condition .... Subcritical

Holiday Haus
JN 01.1371.1
October 2007

SWALE OFFSITE AREAS A, B, C, D – depth of flow
Graded Earth Swale – 3-feet wide, 6-inches deep
MINIMUM SLOPE – 2%

Channel Calculator

Given Input Data:
Shape .... Trapezoidal
Solving for .... Depth of Flow
Flowrate .... 0.5500 cfs Q20 for Area A (greatest area Q of all areas)
Slope .... 0.0200 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 .... 3.9078 in
Velocity .... 1.7286 fps
Full Flowrate .... 1.7256 cfs
Flow area 0.3182 ft2
Flow perimeter .... 24.7173 in
Hydraulic radius .... 1.8536 in
Top width .... 23.4491 in
Area 0.7501 ft2
Perimeter .... 37.9507 in
Percent full .... 65.1299 %

Critical Information
Critical depth .... 3.4927 in
Critical slope .... 0.0364 ft/ft
Critical velocity .... 2.1639 fps
Critical area 0.2542 ft2
Critical perimeter .... 22.0920 in
Critical hydraulic radius .... 1.6568 in
Critical top width .... 20.9585 in
Specific energy .... 0.3721 ft
Minimum energy .... 0.4366 ft
Froude number 0.7552
Flow condition .... Subcritical

Catch Basin Inlet Capacity
Q20

Inlet	Q_{20}(cfs)		Size: Width	Size: Length	SIDES	clogging factor	Inlet Capacity (y<0.4 feet), $Q=3Py^{3/2}$	y=depth of flow at inlet, ft	Capacity Greater than Q
Area A inlets, square	0.55	Square	16	16	4	0.5	0.56	0.17	**yes**
Area A inlets, round	0.55	Round	18		4	0.5	0.59	0.12	**yes**
Area A curb inlet	0.55	Square	24	36	4	0.5	0.62	0.12	**yes**
Area B inlets	0.45	Round	18		4	0.5	0.52	0.11	**yes**
Area C inlets	0.53	Round	18		4	0.5	0.59	0.12	**yes**
Area D inlets	0.35	Round	18		4	0.5	0.45	0.10	**yes**

Generally, under 0.4 feet of depth it is assumed that a catch basin operates under weir conditions. At depths over 1.4 feet catch basins operate under orifice conditions. In between, the typical assumption is to calculate both considerations and use the more conservative. Under sump conditions, the perimeter is the entire perimeter of the catch basin. Under non sump conditions, the perimeter is the leading edge, and the sides reduced by a side flow efficiency factor.

Basins shown as 4 sided are located in sumps.

Inlets for the area have been designed to take all of the runoff from their area, even though there are other basins in that area also designed for full runoff.

These inlets will be depressed approximately 0.15 foot (and 0.25 feet for round 36" inlet). Since basins are all located in sumps, sideflow efficiency was not calculated. Round basins in non sump conditions are only considered to accept runoff on the leading edge.

Holiday Haus
JN 01.1371.1
October 2007

<u>DRAIN PIPE – AREAS A, B, C, D AND OFFSITE TRIBUTARY</u>
12" PVC – FULL FLOW FLOWRATE
MINIMUM SLOPE – 1.0%

Manning Pipe Calculator

Given Input Data:
Shape .... Circular
Solving for .... Flowrate
Diameter .... 12.0000 in
Depth .... 12.0000 in
Slope .... 0.0100 ft/ft
Manning's n 0.0130

Computed Results:
Flowrate .... 3.5628 cfs
Area 0.7854 ft2
Wetted Area 0.7854 ft2
Wetted Perimeter .... 37.6991 in
Perimeter .... 37.6991 in
Velocity .... 4.5363 fps
Hydraulic Radius .... 3.0000 in
Percent Full .... 100.0000 %
Full flow Flowrate .... 3.5628 cfs > Q_{20} for Areas A, B, C, D and offsite
Full flow velocity .... 4.5363 fps

Holiday Haus
JN 01.1371.1
October 2007

<u>DRAIN PIPE – OFFSITE TRIBUTARY</u>
12” PVC – PERCENT FULL
MINIMUM SLOPE – 1.0%

Manning Pipe Calculator

Given Input Data:

Shape .... Circular
Solving for .... Depth of Flow
Diameter .... 12.0000 in
Flowrate .... 0.8000 cfs = Q_{20} of offsite tributary area
Slope .... 0.0100 ft/ft
Manning's n 0.0130

Computed Results:

Depth .... 3.8651 in
Area 0.7854 ft2
Wetted Area 0.2186 ft2
Wetted Perimeter .... 14.4842 in
Perimeter .... 37.6991 in
Velocity .... 3.6593 fps
Hydraulic Radius .... 2.1735 in
Percent Full .... 32.2094 %
Full flow Flowrate .... 3.5628 cfs
Full flow velocity .... 4.5363 fps

Holiday Haus
JN 01.1371.1
October 2007

<u>DRAIN PIPE – AREAS A, B, C and D</u>
12" PVC – PERCENT FULL
MINIMUM SLOPE – 1.0%

Manning Pipe Calculator

Given Input Data:
- Shape .... Circular
- Solving for .... Depth of Flow
- Diameter .... 12.0000 in
- **Flowrate .... 0.5500 cfs = Q_{20} Area A (max area Q)**
- Slope .... 0.0100 ft/ft
- Manning's n 0.0130

Computed Results:
- Depth .... 3.1871 in
- Area 0.7854 ft2
- Wetted Area 0.1672 ft2
- Wetted Perimeter .... 12.9942 in
- Perimeter .... 37.6991 in
- Velocity .... 3.2898 fps
- Hydraulic Radius .... 1.8527 in
- **Percent Full .... 26.5592 %**
- Full flow Flowrate .... 3.5628 cfs
- Full flow velocity .... 4.5363 fps

Preliminary Drainage Study
Holiday Haus

APPENDIX C

RETENTION / INFILTRATION CALCULATIONS

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

Calc'd By:	**kp**
Job No.:	**01.1371.1**
Date:	**February 2008**

Runoff Volume and Drywell Sizing Calulation

based on Lahontan RWQCB Design Parameters

Holiday Haus

Area A - NE

Input:

Rainfall Intensity				
	1	in/hr =	0.083	ft/hr
Percolation Rate				
	0	in/hr =	0.00	ft/hr

Tributary Area:				Runoff Coefficient	
Roof Area	7070	SF	36%	0.95	Roof Area
Pavement Area	4600	SF	23%	0.90	Pavement Area
Landscape over Decking	2380	SF	12%	0.80	Gravel/Aggregate Area
Patio/Walk/Curb/Gutter	1410	SF	7%	0.90	Concrete
Landscaping/Natural	4229	SF	21%	0.45	Landscaping Area
Total Area	**19689**	**SF**		**0.81**	**Average Runoff Coefficient**

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

Average Runoff Volume = 1328 CF

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san luis obispo • lompoc • pleasanton

Calc'd By:	**kp**
Job No.:	**01.1371.1**
Date:	**February 2008**

Runoff Volume and Drywell Sizing Calulation

based on Lahontan RWQCB Design Parameters

Holiday Haus

Area B - NW

Input:

Rainfall Intensity

	1	in/hr =	0.083	ft/hr

Percolation Rate

	0	in/hr =	0.00	ft/hr

Tributary Area: Runoff Coefficient

Roof Area	8105	SF	51%	0.95	Roof Area
Pavement Area	0	SF	0%	0.90	Pavement Area
Landscape over Decking	180	SF	1%	0.80	Gravel/Aggregate Area
Patio/Walk/Curb/Gutter	960	SF	6%	0.90	Concrete
Landscaping/Natural	6783	SF	42%	0.45	Landscaping Area
Total Area	**16028**	**SF**		**0.73**	**Average Runoff Coefficient**

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

Average Runoff Volume = 980 CF

triad/holmes associates
civil engineering
land surveying
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san luis obispo • lompoc • pleasanton

Calc'd By:	**kp**
Job No.:	**01.1371.1**
Date:	**February 2008**

Runoff Volume and Drywell Sizing Calulation

based on Lahontan RWQCB Design Parameters

Holiday Haus

Area C - SW

Input:

Rainfall Intensity				
	1	in/hr =	0.083	ft/hr
Percolation Rate				
	0	in/hr =	0.00	ft/hr

Tributary Area:

				Runoff Coefficient	
Roof Area	7570	SF	40%	0.95	Roof Area
Pavement Area	0	SF	0%	0.90	Pavement Area
Landscape over Decking	0	SF	0%	0.80	Gravel/Aggregate Area
Patio/Walk/Curb/Gutter	4620	SF	24%	0.90	Concrete
Landscaping/Natural	6855	SF	36%	0.45	Landscaping Area
Total Area	**19045**	**SF**		**0.76**	**Average Runoff Coefficient**

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

Average Runoff Volume = **1203** **CF**

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san luis obispo • lompoc • pleasanton

Calc'd By:	**kp**
Job No.:	**01.1371.1**
Date:	**February 2008**

Runoff Volume and Drywell Sizing Calulation

based on Lahontan RWQCB Design Parameters

Holiday Haus

Area D - SE

Input:

Rainfall Intensity

1 in/hr = 0.083 ft/hr

Percolation Rate

0 in/hr = 0.00 ft/hr

Tributary Area:				Runoff Coefficient	
Roof Area	6930	SF	55%	0.95	Roof Area
Pavement Area	0	SF	0%	0.90	Pavement Area
Landscape over Decking	200	SF	2%	0.80	Gravel/Aggregate Area
Patio/Walk/Curb/Gutter	0	SF	0%	0.90	Concrete
Landscaping/Natural	5454	SF	43%	0.45	Landscaping Area
Total Area	**12584**	**SF**		**0.73**	**Average Runoff Coefficient**

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

Average Runoff Volume = 766 CF

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STORMWATER RETENTION / DETENTION PIPE SYSTEM SIZING WORKSHEET

Version 6.5

Project Name:	Holiday Haus - Area A - Basins 01 and 02 (calc for each basin)
Location (City, State):	Main Street, Mammoth Lakes, CA
Prepared For:	Holiday Haus, LLC
Date Prepared:	Feb-08
Engineer:	KP
Contractor:	
Regional Engineer:	
Area Sales Representative:	
Surface Application:	

Enter or Select values in the Yellow fields ONLY

SYSTEM

Joint Type	Plain End ST	
Spacing	Standard	
Design Storage Volume	700	CF
Average Cover Height[4]	2.00	FT

HEADER

Header Diameter	60
Number of Headers	1
Perforate Headers?	No
Include Header(s) in Storage Volume?	No

LATERALS

	Lateral Diameter	Lateral Length	Number of Laterals	# of Sticks / Lateral	Approx. Length of End Stick
Group 1	60	30	1	2	11.5-ft
Group 2	30			0	0-ft
Group 3	30			0	0-ft

Perforate Laterals? Yes

BACKFILL

Stone Porosity? 33 %

*Enter "0" to not include the backfill in the storage volume

Additional Stone Layer Allowing Storage (ASV)? 0 in.

STORAGE VOLUME / APPROXIMATE SYSTEM SIZE / EXCAVATION

	Storage Volume Component: Product Volume (CF)	Stone (CF)	ASV (CF)	Total System (CF)	Approximate System Size: Width (FT)	Length (FT)	Excavation: Pipe Diameter (IN)	Width (FT)	Length (FT)	Disturbed Surface Area (SYD)	Excavation[2] (CYD)	Estimated Backfill[3] (CYD)	ASV (CYD)
Group 1	579	210	0	789	5.5	36.5	60	8.5	39.5	38	100	79	0
Group 2	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
Group 3	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
TOTALS	**579**	**210**	**0**	**789**						38	100	79	0

112.8% of the required storage

View Generic Layout Drawings

NOTES

1 - Full Stick: Assumed a standard lay length of 19'-8".
2 - Excavation: Based on manufacturer's recommended trench width and bedding depth. Estimated volumes assume a flat system based on the user-entered Average Cover Height.
3 - Backfill: Does not account for pipe corrugations - calculated for conservative quanitites. Not for use with take-offs or ordering purposes.
4 - Cover Height: For traffic installations, 1-ft of minimum cover is required for diameters 12-36", 2-ft for 42-60". Maximum cover shall not exceed 8-ft.
5 - Bill of Materials: Does not differentiate between ST and WT fittings or between A and H profile connections. Determined on a project-specific basis.
6 - Quantities: Assumes all Groups are same diameter. Run separate calculations to determine quantities and costs for different Group diameters.

BILL OF MATERIALS[5]

Part Description	Unit	Quantity[6]: Group 1	Group 2	Group 3	Cost/Unit	Total
60" IB Pipe, Perf ST	LF	30	0	0	$0.00	$ -
60" 90 Bend Manifold	EACH	0	0	0		
60" Triple Manifold	EACH	0	0	0		
60" Double Manifold	EACH	0	0	0		
60" Single Manifold	EACH	0	0	0		
60" Couplers ST	EACH	1	0	0	$0.00	$ -
60" End Caps	EACH	1	0	0	$0.00	$ -
Filter Fabric	SY	140	0	0	$0.00	$ -
24" Riser (2403AN)	EACH	4			$0.00	$ -
8" Cleanout (0802AN)	EACH	4			$0.00	$ -
					Total Material Cost	**$ -**

This Excel spreadsheet is provided for rough estimating purposes only. This tool is intended to assist the design engineer in sizing stormwater management systems using Hancor pipe and manifold components. As with any calculation aid this tool should be used for estimating only; the engineer must verify the assumptions and methods to ensure they satisfy the project and local design criteria.

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STORMWATER RETENTION / DETENTION PIPE SYSTEM SIZING WORKSHEET

Version 6.5

Project Name:	Holiday Haus - Area B
Location (City, State):	Main Street, Mammoth Lakes, CA
Prepared For:	Holiday Haus, LLC
Date Prepared:	Feb-08
Engineer:	KP
Contractor:	
Regional Engineer:	
Area Sales Representative:	
Surface Application:	

Enter or Select values in the Yellow fields ONLY

SYSTEM		
Joint Type	Plain End ST	
Spacing	Standard	
Design Storage Volume	980	CF
Average Cover Height[4]	2.00	FT

HEADER

Header Diameter	60
Number of Headers	1
Perforate Headers?	No
Include Header(s) in Storage Volume?	No

LATERALS

	Lateral Diameter	Lateral Length	Number of Laterals	# of Sticks / Lateral	Approx. Length of End Stick
Group 1	60	38	1	2	19.5-ft
Group 2	30			0	0-ft
Group 3	30			0	0-ft

Perforate Laterals? Yes

BACKFILL

Stone Porosity? 33 %

*Enter "0" to not include the backfill in the storage volume

Additional Stone Layer Allowing Storage (ASV)? 0 in.

	STORAGE VOLUME				APPROXIMATE SYSTEM SIZE		EXCAVATION						
	COMPONENT			Total System									
	Product Volume (CF)	Stone (CF)	ASV (CF)	(CF)	Width (FT)	Length (FT)	Pipe Diameter (IN)	Width (FT)	Length (FT)	Disturbed Surface Area (SYD)	Excav-ation[2] (CYD)	Estimated Backfill[3] (CYD)	ASV (CYD)
Group 1	734	266	0	1,000	5.5	44.5	60	8.5	47.5	45	120	93	0
Group 2	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
Group 3	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
TOTALS	734	266	0	1,000						45	120	93	0

102% of the required storage

View Generic Layout Drawings

NOTES

1 - Full Stick: Assumed a standard lay length of 19'-8".
2 - Excavation: Based on manufacturer's recommended trench width and bedding depth. Estimated volumes assume a flat system based on the user-entered Average Cover Height.
3 - Backfill: Does not account for pipe corrugations - calculated for conservative quanitites. Not for use with take-offs or ordering purposes.
4 - Cover Height: For traffic installations, 1-ft of minimum cover is required for diameters 12-36", 2-ft for 42-60". Maximum cover shall not exceed 8-ft.
5 - Bill of Materials: Does not differentiate between ST and WT fittings or between A and H profile connections. Determined on a project-specific basis.
6 - Quantities: Assumes all Groups are same diameter. Run separate calculations to determine quantities and costs for different Group diameters.

BILL OF MATERIALS[5]

Part Description	Unit	Quantity[6] Group 1	Group 2	Group 3	Cost/Unit	Total
60" IB Pipe, Perf ST	LF	38	0	0	$0.00	$ -
60" 90 Bend Manifold	EACH	0	0	0		
60" Triple Manifold	EACH	0	0	0		
60" Double Manifold	EACH	0	0	0		
60" Single Manifold	EACH	0	0	0		
60" Couplers ST	EACH	1	0	0	$0.00	$ -
60" End Caps	EACH	1	0	0	$0.00	$ -
Filter Fabric	SY	170	0	0	$0.00	$ -
24" Riser (2403AN)	EACH	4			$0.00	$ -
8" Cleanout (0802AN)	EACH	4			$0.00	$ -
					Total Material Cost	**$ -**

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STORMWATER RETENTION / DETENTION PIPE SYSTEM SIZING WORKSHEET

Version 6.5

Project Name:	Holiday Haus - Area C
Location (City, State):	Main Street, Mammoth Lakes, CA
Prepared For:	Holiday Haus, LLC
Date Prepared:	Feb-08
Engineer:	KP
Contractor:	
Regional Engineer:	
Area Sales Representative:	
Surface Application:	

Enter or Select values in the Yellow fields ONLY

SYSTEM

Joint Type	Plain End ST	
Spacing	Standard	
Design Storage Volume	1203	CF
Average Cover Height[4]	2.00	FT

HEADER

Header Diameter	60
Number of Headers	1
Perforate Headers?	No
Include Header(s) in Storage Volume?	No

LATERALS

	Lateral Diameter	Lateral Length	Number of Laterals	# of Sticks / Lateral	Approx. Length of End Stick
Group 1	36	40	3	3	1.5-ft
Group 2	30			0	0-ft
Group 3	30			0	0-ft

Perforate Laterals? Yes

BACKFILL

Stone Porosity? 33 %

*Enter "0" to not include the backfill in the storage volume

Additional Stone Layer Allowing Storage (ASV)? 0 in.

	STORAGE VOLUME COMPONENT				APPROXIMATE SYSTEM SIZE		EXCAVATION						
	Product Volume (CF)	Stone (CF)	ASV (CF)	Total System (CF)	Width (FT)	Length (FT)	Pipe Diameter (IN)	Width (FT)	Length (FT)	Disturbed Surface Area (SYD)	Excav-ation[2] (CYD)	Estimated Backfill[3] (CYD)	ASV (CYD)
Group 1	848	416	0	1,264	14.0	44.4	36	17.0	47.4	89	239	208	0
Group 2	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
Group 3	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
TOTALS	**848**	**416**	**0**	**1,264**						89	239	208	0

105.1% of the required storage

View Generic Layout Drawings

NOTES

1 - Full Stick: Assumed a standard lay length of 19'-8".

2 - Excavation: Based on manufacturer's recommended trench width and bedding depth. Estimated volumes assume a flat system based on the user-entered Average Cover Height.

3 - Backfill: Does not account for pipe corrugations - calculated for conservative quanitites. Not for use with take-offs or ordering purposes.

4 - Cover Height: For traffic installations, 1-ft of minimum cover is required for diameters 12-36", 2-ft for 42-60". Maximum cover shall not exceed 8-ft.

5 - Bill of Materials: Does not differentiate between ST and WT fittings or between A and H profile connections. Determined on a project-specific basis.

6 - Quantities: Assumes all Groups are same diameter. Run separate calculations to determine quantities and costs for different Group diameters.

BILL OF MATERIALS[5]

Part Description	Unit	Quantity[6] Group 1	Group 2	Group 3	Cost/Unit	Total
36" IB Pipe, Perf ST	LF	120	0	0	$0.00	$ -
60" 90 Bend Manifold	EACH	2	0	0	$0.00	$ -
60" Triple Manifold	EACH	0	0	0		
60" Double Manifold	EACH	0	0	0		
60" Single Manifold	EACH	1	0	0	$0.00	$ -
60" Couplers ST	EACH	8	0	0	$0.00	$ -
60" End Caps	EACH	3	0	0	$0.00	$ -
Filter Fabric	SY	235	0	0	$0.00	$ -
24" Riser (2403AN)	EACH	4			$0.00	$ -
8" Cleanout (0802AN)	EACH	4			$0.00	$ -
					Total Material Cost	**$ -**

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STORMWATER RETENTION / DETENTION PIPE SYSTEM SIZING WORKSHEET

Version 6.5

Project Name:	Holiday Haus - Area D
Location (City, State):	Main Street, Mammoth Lakes, CA
Prepared For:	Holiday Haus, LLC
Date Prepared:	Feb-08
Engineer:	KP
Contractor:	
Regional Engineer:	
Area Sales Representative:	
Surface Application:	

Enter or Select values in the Yellow fields ONLY

SYSTEM

Joint Type	Plain End ST	
Spacing	Standard	
Design Storage Volume	766	CF
Average Cover Height[4]	2.00	FT

HEADER

Header Diameter	60
Number of Headers	1
Perforate Headers?	No
Include Header(s) in Storage Volume?	No

LATERALS

	Lateral Diameter	Lateral Length	Number of Laterals	# of Sticks / Lateral	Approx. Length of End Stick
Group 1	60	30	1	2	11.5-ft
Group 2	30			0	0-ft
Group 3	30			0	0-ft

Perforate Laterals? Yes

BACKFILL

Stone Porosity? 33 %

*Enter "0" to not include the backfill in the storage volume

Additional Stone Layer Allowing Storage (ASV)? 0 in.

	STORAGE VOLUME				APPROXIMATE SYSTEM SIZE		EXCAVATION						
	COMPONENT			Total System									
	Product Volume (CF)	Stone (CF)	ASV (CF)	(CF)	Width (FT)	Length (FT)	Pipe Diameter (IN)	Width (FT)	Length (FT)	Disturbed Surface Area (SYD)	Excavation[2] (CYD)	Estimated Backfill[3] (CYD)	ASV (CYD)
Group 1	579	210	0	789	5.5	36.5	60	8.5	39.5	38	100	79	0
Group 2	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
Group 3	0	0	0	0	0.0	0.0	30	0.0	0.0	0	0	0	0
TOTALS	**579**	**210**	**0**	**789**						38	100	79	0

103% of the required storage

View Generic Layout Drawings

NOTES

1 - Full Stick: Assumed a standard lay length of 19'-8".

2 - Excavation: Based on manufacturer's recommended trench width and bedding depth. Estimated volumes assume a flat system based on the user-entered Average Cover Height.

3 - Backfill: Does not account for pipe corrugations - calculated for conservative quanitites. Not for use with take-offs or ordering purposes.

4 - Cover Height: For traffic installations, 1-ft of minimum cover is required for diameters 12-36", 2-ft for 42-60". Maximum cover shall not exceed 8-ft.

5 - Bill of Materials: Does not differentiate between ST and WT fittings or between A and H profile connections. Determined on a project-specific basis.

6 - Quantities: Assumes all Groups are same diameter. Run separate calculations to determine quantities and costs for different Group diameters.

BILL OF MATERIALS[5]

Part Description	Unit	Quantity[6] Group 1	Group 2	Group 3	Cost/Unit	Total
60" IB Pipe, Perf ST	LF	30	0	0	$0.00	$ -
60" 90 Bend Manifold	EACH	0	0	0		
60" Triple Manifold	EACH	0	0	0		
60" Double Manifold	EACH	0	0	0		
60" Single Manifold	EACH	0	0	0		
60" Couplers ST	EACH	1	0	0	$0.00	$ -
60" End Caps	EACH	1	0	0	$0.00	$ -
Filter Fabric	SY	140	0	0	$0.00	$ -
24" Riser (2403AN)	EACH	4			$0.00	$ -
8" Cleanout (0802AN)	EACH	4			$0.00	$ -
					Total Material Cost	**$ -**

Preliminary Drainage Study
Holiday Haus

APPENDIX D

REFERENCE MATERIAL

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

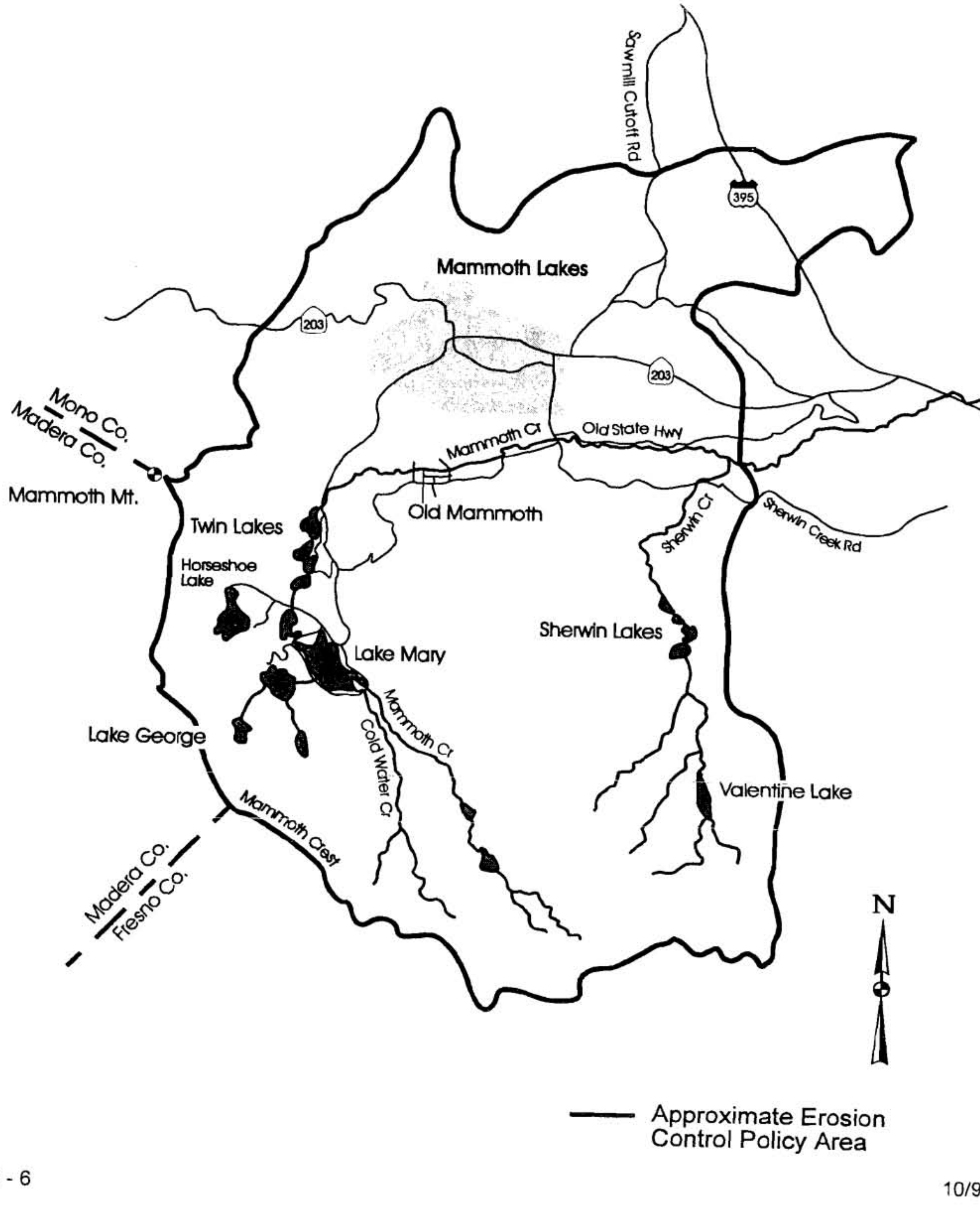
- reduction of direct discharges (e.g., through culverts)
- reduction of runoff velocity
- infiltration, detention and retention practices
- management of deicing compounds, fertilizer, and herbicide use
- spill cleanup measures
- treatment of toxic stormwater pollutants

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



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.

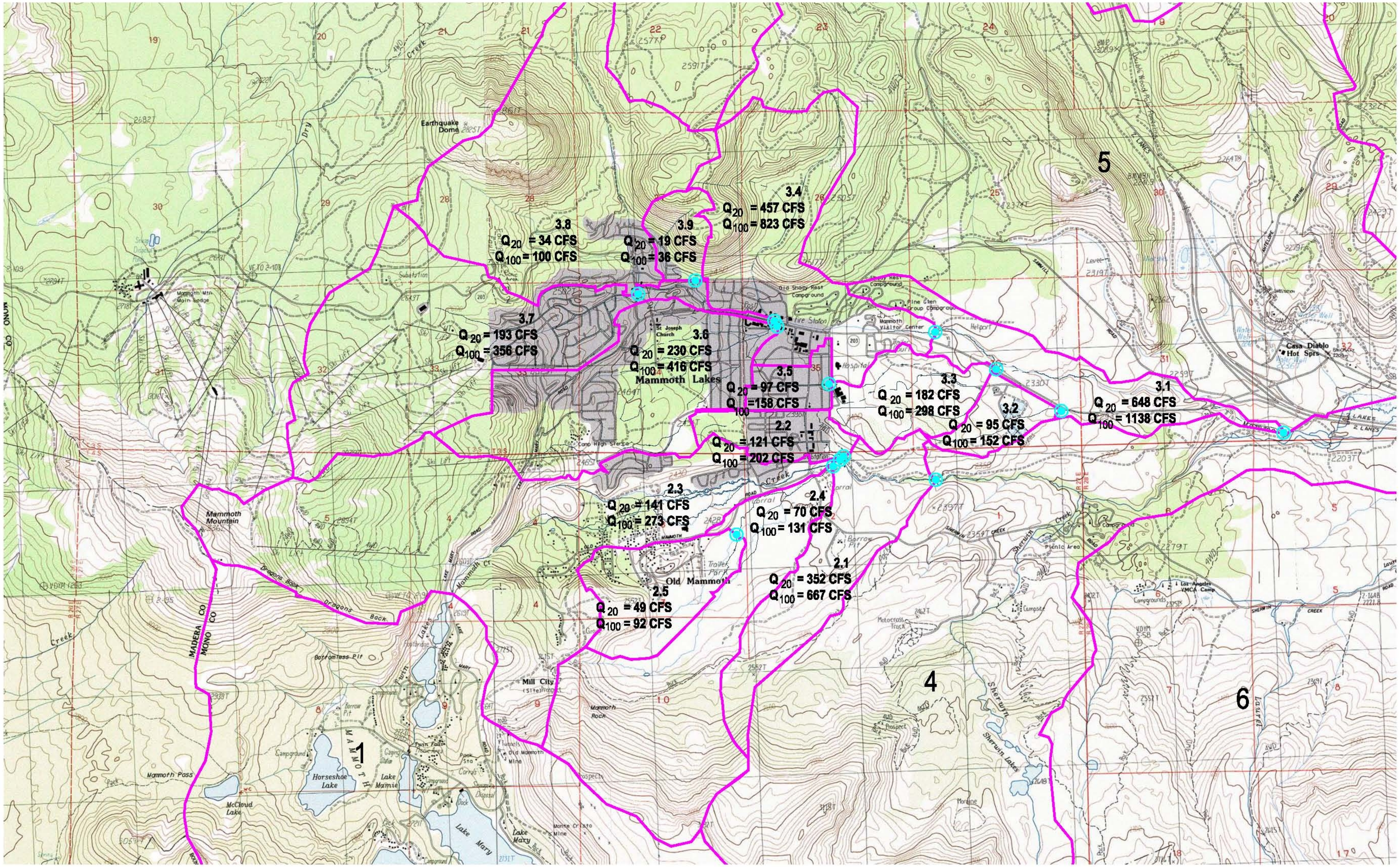
[4] A 10-year storm is defined as a storm event that is equaled or exceeded every 10 years on average. Another way to define a 10-year storm is to say that the probability of an event of having a 10-year magnitude or more has a 1/10 chance in a given year. Likewise, a 100-year storm is defined as a storm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



NOTES:

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

LEGEND

WATERSHED BOUNDARY

WATERSHED CONCENTRATION POINT

1600' 800' 0 1600' 3200'

SCALE IN FEET

REV	DATE	DESCRIPTION	APPR

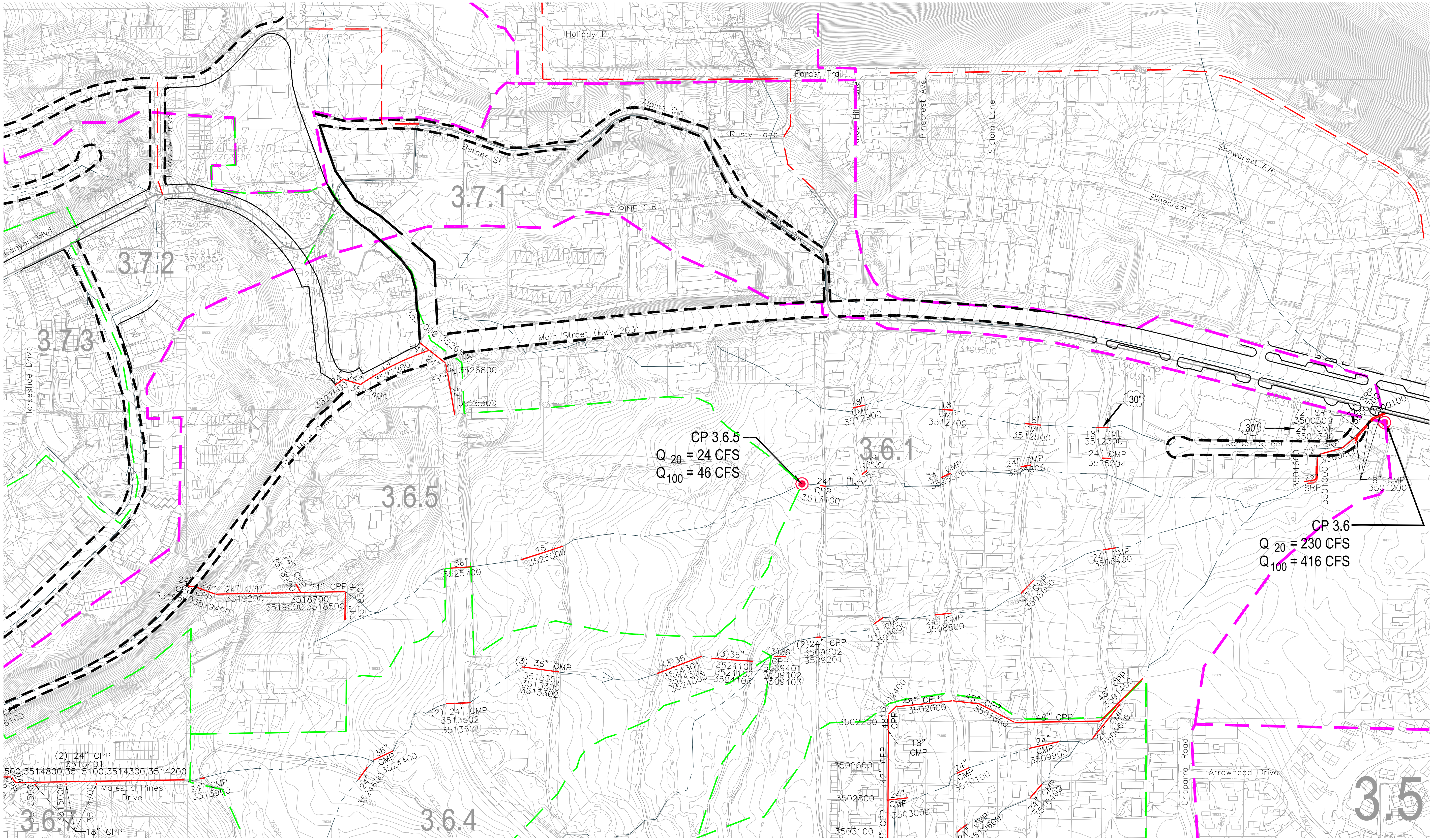
BOYLE

TOWN OF MAMMOTH LAKES

DETAILED DRAINAGE SUBAREAS

VT-M01-100-01 MAY 2005 FIGURE 2-4

DWG: F:\ellison\M0110001 - Mammoth Storm\CAD\Exhibits\Area 3.6.1 and .5.dwg USER: kmarin
DATE: Jun 10, 2005 4:57pm 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

REV	DATE	DESCRIPTION	APPR

BOYLE

TOWN OF MAMMOTH LAKES

AREAS 3.6.1 AND 3.6.5 PLAN

VT-M01-100-01 MAY 2005 EXHIBIT 8.13

Hydrologic Table - Existing Conditions

Sub Area Number	Total Area (Acres)	Total Area (mi2)	% Natural	% HD Res	% LD Res	% Commercial	20-yr (cfs/acre)	100-yr (cfs/acre)	Area Runoff 20-yr (cfs)	Total Runoff 20-yr (cfs)	Area Runoff 100-yr (cfs)	Total Runoff 100-yr (cfs)	Total Contributing Area (acres)	Sub-area Area Adjustment	Cumlative Area Adjustment	Adjusted Area Runoff 20-yr (cfs)	Adjusted Total Runoff 20-yr (cfs)	Adjusted Area Runoff 100-yr (cfs)	Adjusted Total Runoff 100-yr (cfs)
2.1	443	0.69	100	0	0	0	0.08	0.15	36	492	68	912	3473	0.77	0.55	28	352	52	667
2.2.1	33	0.05	15	0	0	85	1.07	1.71	35	121	56	202	117	1.00	0.88	35	106	56	178
2.2.2	42	0.07	0	40	45	15	0.93	1.63	39	39	69	69	42	1.00	1.00	39	39	69	69
2.2.3	42	0.07	0	75	10	15	1.10	1.84	46	46	77	77	42	1.00	1.00	46	46	77	77
2.2	117								121	121	202	202	117	0.88	0.88	106	106	178	178
2.3.1	393	0.61	65	10	22	3	0.09	0.16	35	224	65	434	1751	0.77	0.63	27	222	50	439
2.3.2	622	0.97	95	0	5	0	0.07	0.12	41	158	77	310	1042	0.69	0.63	29	180	53	361
2.3.3	316	0.49	100	0	0	0	0.10	0.19	32	32	59	59	316	0.77	0.77	24	24	46	46
2.3.4	420	0.66	100	0	0	0	0.08	0.16	35	35	66	66	420	0.77	0.77	27	27	51	51
2.3	1751								143	224	268	434	1751	0.63	0.63	90	141	169	273
2.4	871	1.36	97	3	0	0	0.05	0.10	47	111	88	208	1162	0.69	0.63	33	70	61	131
2.5.1	171	0.27	75	0	25	0	0.15	0.27	25	63	46	120	291	0.88	0.77	22	49	41	92
2.5.2	22	0.03	10	0	90	0	0.61	1.21	13	39	27	73	120	1.00	0.88	13	34	27	64
2.5.3	98	0.15	97	3	0	0	0.26	0.47	25	25	46	46	98	0.97	0.97	24	24	45	45
2.5	291								63	63	120	120	291	0.77	0.77	49	49	92	92
3.1	359	0.56	100	0	0	0	0.09	0.17	33	1055	62	1878	4531	0.77	0.55	26	580	48	1033
3.2	111	0.17	65	0	0	35	0.58	0.96	64	64	106	106	111	0.88	0.88	56	56	93	93
3.3.1	58	0.09	45	0	10	45	0.72	1.19	42	128	69	213	177	1.00	0.88	42	112	69	187
3.3.2	28	0.04	0	0	5	95	1.19	1.90	33	74	53	122	68	1.00	1.00	33	74	53	122
3.3.3	51	0.08	100	0	0	0	0.23	0.43	12	12	22	22	51	1.00	1.00	12	12	22	22
3.3.4	40	0.06	0	0	35	65	1.02	1.71	41	41	68	68	40	1.00	1.00	41	41	68	68
3.3	177								128	128	213	213	177	0.88	0.88	112	112	187	187
3.4	770	1.20	75	0	10	15	0.06	0.11	45	830	84	1497	3884	0.69	0.55	31	457	58	823
3.5.1	45	0.07	0	40	0	60	1.19	1.92	53	100	86	163	85	1.00	0.97	53	97	86	158
3.5.2	40	0.06	0	75	0	25	1.16	1.91	46	46	76	76	40	1.00	1.00	46	46	76	76
3.5	85								100	100	163	163	85	0.97	0.97	97	97	158	158
3.6.1	99	0.15	15	80	0	5	1.01	1.68	100	334	166	603	713	0.97	0.69	97	230	161	416
3.6.2	55	0.09	30	70	0	0	0.87	1.46	48	134	80	251	244	1.00	0.77	48	103	80	193
3.6.3	47	0.07	100	0	0	0	0.23	0.43	11	11	20	20	47	1.00	1.00	11	11	20	20
3.6.4	45	0.07	100	0	0	0	0.23	0.43	10	65	19	119	247	1.00	0.77	10	50	19	92
3.6.5	76	0.12	80	0	20	0	0.31	0.60	24	24	46	46	76	1.00	1.00	24	24	46	46
3.6.6	55	0.09	100	0	0	0	0.23	0.43	13	87	24	171	189	1.00	0.88	13	76	24	150
3.6.7	40	0.06	20	40	40	0	0.76	1.37	30	55	55	100	202	1.00	0.77	30	42	55	77
3.6.8	52	0.08	60	0	40	0	0.40	0.78	21	21	40	40	52	1.00	1.00	21	21	40	40
3.6.9	82	0.13	0	0	100	0	0.65	1.30	53	53	107	107	82	0.97	0.97	52	52	103	103
3.6.10	162	0.25	80	10	10	0	0.15	0.28	24	24	45	45	162	0.88	0.88	21	21	40	40
3.6	713								310	334	557	603	713	0.69	0.69	214	230	385	416
3.7.1	40	0.06	0	0	80	20	0.76	1.43	31	351	57	647	2316	1.00	0.55	31	193	57	356
3.7.2	79	0.12	0	50	50	0	0.90	1.60	71	301	126	552	2176	1.00	0.55	71	165	126	304
3.7.3	29	0.05	0	35	65	0	0.82	1.51	24	177	44	326	922	1.00	0.69	24	122	44	225
3.7.4	81	0.13	2	38	60	0	0.83	1.51	67	153	122	282	893	0.97	0.69	65	105	119	195
3.7.5	176	0.28	100	0	0	0	0.14	0.27	25	25	47	47	176	0.88	0.88	22	22	41	41
3.7.6	505	0.79	98	0	2	0	0.08	0.14	38	38	71	71	505	0.69	0.69	26	26	49	49
3.7.7	131	0.20	85	0	15	0	0.17	0.32	22	61	42	113	636	0.88	0.69	20	42	37	78
3.7	1041								278	351	510	647	2316	0.63	0.55	175	193	321	356
3.8	1175	1.84	95	0	3	2	0.05	0.08	53	53	100	100	1175	0.63	0.63	34	34	63	63
3.9	100	0.16	90	0	10	0	0.20	0.38	20	20	38	38	100	0.97	0.97	19	19	36	36
L.M.									81	81	166	166							

Runoff Potential

A	Very low runoff potential
B	Low runoff potential
C	Moderate runoff potential
D	High runoff potential

Soil Depth

1	0 to 20 inches
2	20 to 36 inches
3	More than 36 inches
4	Variable conditions

Inherent Erosion Hazard

1	Low hazard
2	Moderate hazard
3	High hazard

Vegetative Productivity

1	Low potential
2	Medium potential
3	High potential

Soil types within the Basin are mapped on Figure 3-7 and summarized by watersheds and subareas in Table 3-5. The mapping symbols represent the above described characteristics in accordance with the following code:

Soil Symbol (Example B322)

B	3	2	2
Runoff potential--low	Soil depth--over 36 inches	Erosion hazard--moderate	Vegetative productivity--medium

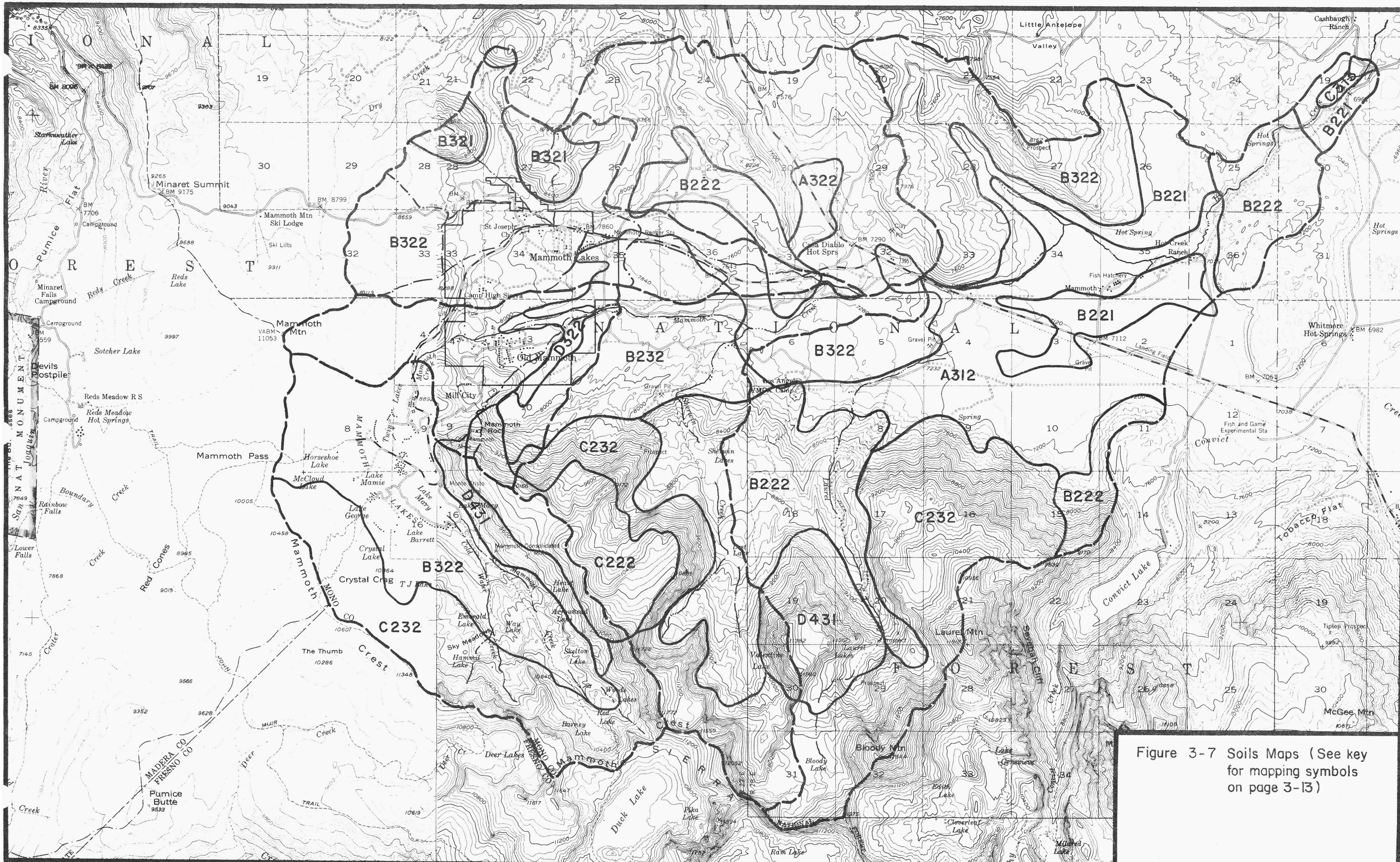


Figure 3-7 Soils Maps (See key for mapping symbols on page 3-13)