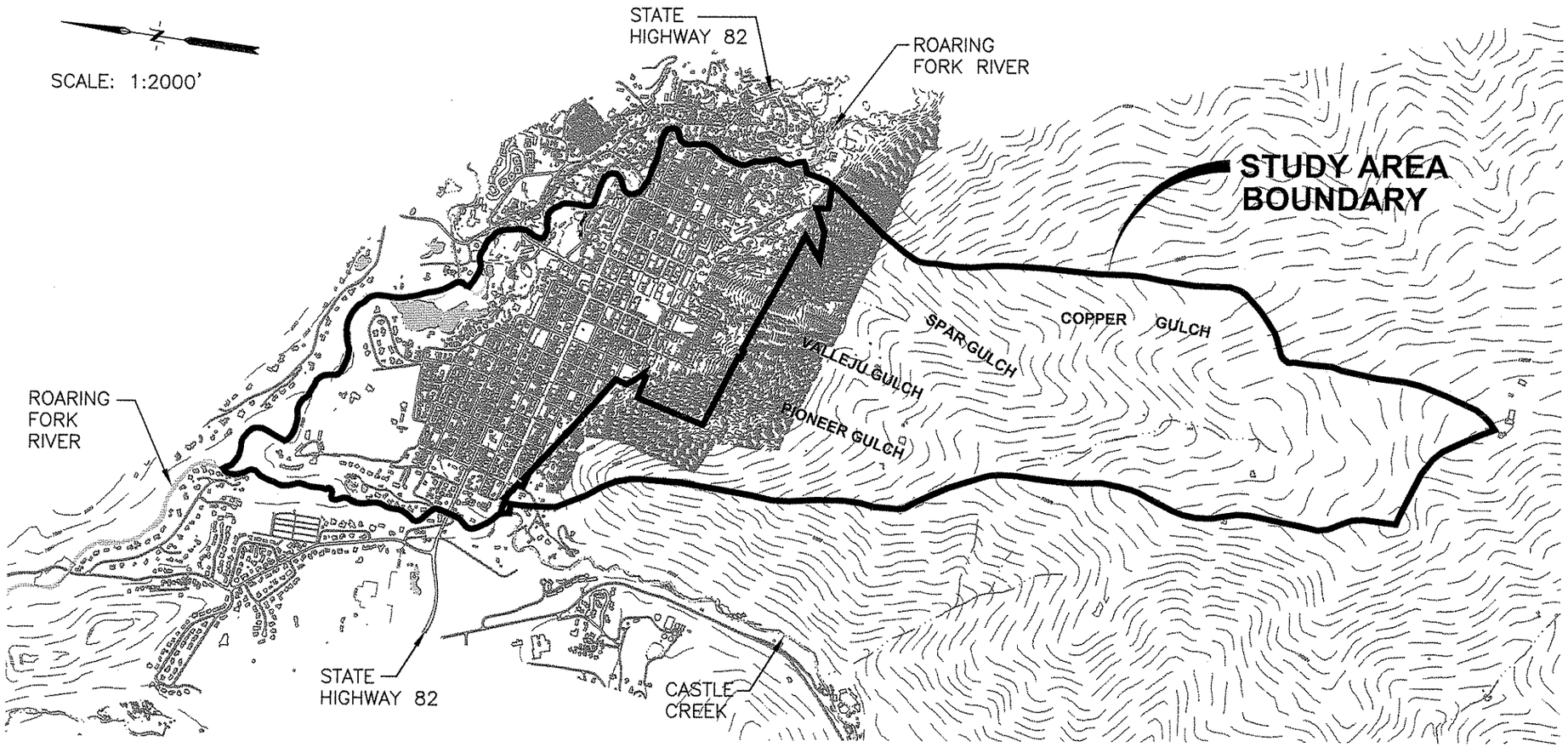
SURFACE DRAINAGE MASTER PLAN
FOR THE CITY OF ASPEN

SCALE: 1:2000'



PREPARED FOR:

CITY OF ASPEN
NOVEMBER 2001
UPDATED JANUARY 2006

WRC ENGINEERING, INC.
950 SOUTH CHERRY STREET, SUITE 404
DENVER, COLORADO 80246 (303)757-8513

STORM DRAINAGE MASTER PLAN
FOR
THE CITY OF ASPEN, COLORADO

PREPARED FOR
The City of Aspen, Colorado

PREPARED BY
WRC Engineering, Inc.
1963-20
November 2001

UPDATED
January 2006

A comparison of the various In-City alternatives, based upon current cost estimates, is provided by Table ES-1, and a comparison of the On-Mountain alternatives is supplied by Table ES-2.

CONCLUSIONS

The In-City design alternative selected by the City staff for a more detailed analysis is essentially Alternative 3 with some minor modifications.

Figure ES-19 graphically displays the recommended construction priority for the recommended In-City alternative. The highest priority reaches, or the reaches that should be constructed first, are the proposed storm sewer and water quality extended detention basin east of the intersection of Francis Street and Garmish Street, and the storm sewer and collection system on Ute Avenue. Storm sewers either do not exist at these locations or are under-sized. These high priority construction improvements would cost approximately $1,400,000 for the storm sewer and extended detention basin east of Garmisch Street, and $70,000 for the storm sewer system improvements on Ute Avenue.

The recommended On-Mountain alternative is Alternative 3. Alternative 1 and Alternative 2 are very expensive and financing is not currently available to spend on these alternatives. The recommended Alternative 3 will provide an interim solution until Alternative 1 and Alternative 2 can be tested and financing can be found to pay for these costly alternatives. The selected alternative will prevent the effect of a mudflow event from becoming worse due to new development.

2006 UPDATE

This Master Plan has been updated to include storm sewer systems that have been constructed under the south end of Mill Street and under 2nd Street between Francis and Main Street. Two Water Quality pond sites, the Rio Grande and the Jenny Adair park sites, have been revised to include more detailed design which has occurred subsequent to the November 2001 report. The cost estimates have been revised to exclude storm sewer construction costs for Mill Street and 2nd Street and to include revised cost estimates for the two Water Quality ponds. Table 21 shows an updated total cost estimate. The preliminary construction drawings presented in this report have been revised to reflect these changes.

Costs associated with Drainage Systems 1, 2, and 3 are now estimated at $790,000, $289,000, and $2,532,000, respectively. Drainage System 1 now excludes costs for Mill Street and any costs related to the proposed water quality pond. Drainage System 3 now excludes costs for construction of a water quality pond. The costs of the water quality ponds are shown separately. An 11% inflation rate increase was added to each system to account for increases from 1999 to 2005. In addition, the construction for Rio Grande and Jenny Adair Water Quality ponds were estimated to be $1,524,000 and $1,270,000 respectively. These costs exclude Parks and Recreation aesthetic improvements to be determined by the City of Aspen at the time of construction. The total cost of the project would be about $6,405,000 in 2005 dollars.

TABLE ES-1: COMPARISON OF IN-CITY ALTERNATIVES

	CONCEPTUAL COST ESTIMATE	LEVEL OF PROTECTION	COMMENTS
ALTERNATIVE 1	$13,297,000		Flow conveyed by street and storm sewer
System 1	$5,870,000	100-Year	
System 2	$443,000	100-Year	
System 3	$6,984,000	100-Year	
ALTERNATIVE 2	$17,501,000		Flow conveyed by street and storm sewer
System 1	$7,170,000	100-Year	
System 2	$443,000	100-Year	
System 3	$9,888,000	100-Year	
ALTERNATIVE 3	$6,204,000		Flow conveyed by storm sewer only
System 1	$2,280,000	10-Year	
System 2	$455,000	10-Year	
System 3	$3,469,000	2- to 10-Year	

NOTES: In general, alternatives for each system are independent from other systems
The estimated costs are based in the 1999 currency value.

TABLE ES-2: COMPARISON OF ON-MOUNTAIN ALTERNATIVES

	CONCEPTUAL COST ESTIMATE	AVERAGE ANNUAL OPERATION AND MAINTENANCE EXPENSE	IMPACT ON MOUNTAIN AESTHETICS	RELATIVE RISK OF FAILURE	COMMENTS
ALTERNATIVE 1-CHANNEL/DRAIN	$10,969,000	Low	Low	Low	Stability analysis will need to be performed
ALTERNATIVE 2-CUTOFF WALL	$7,758,000	Medium	Low	Medium	Potential for erosion to expose walls
ALTERNATIVE 3-REGULATORY CONTROL	$0	High	None	High	Potential for 10's of millions of dollars of damage and loss of life. It will cost new development to implement regulations.

NOTES: In general, alternatives for each system are independent from other systems
The estimated costs are based in the 1999 currency value.

TABLE ES-3: CONCEPTUAL DESIGN COST ESTIMATE (2006 UPDATE)

IN-CITY SYSTEM 1	$790,000
IN-CITY SYSTEM 2	$289,000
IN-CITY SYSTEM 3	$2,532,000
JENNY ADAIR POND	$1,270,000
RIO GRANDE POND	$1,524,000
TOTAL ESTIMATED COST (2005 DOLLARS)	$6,405,000

0 150 300 600 900

ORIGINAL SCALE: 1"=300'

LEGEND

- OUTFALL POINT
- EXISTING OPEN DRAINAGE CHANNEL
- 36" EXISTING STORM SEWER (SIZE AS NOTED)
- COLLECTOR STORM SEWER

NOTE: ALL PIPES CMP UNLESS NOTED OTHERWISE

SYSTEM 1

SYSTEM 2

SYSTEM 3

ROARING FORK RIVER

CASTLE CREEK

1963P3D\MASTER PLAN UPDATES\1963-ES3.DWG, LAYOUT1 - 4/25/05 - MAS

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CHECKED	AJL
REVISED	
AS-BUILT	

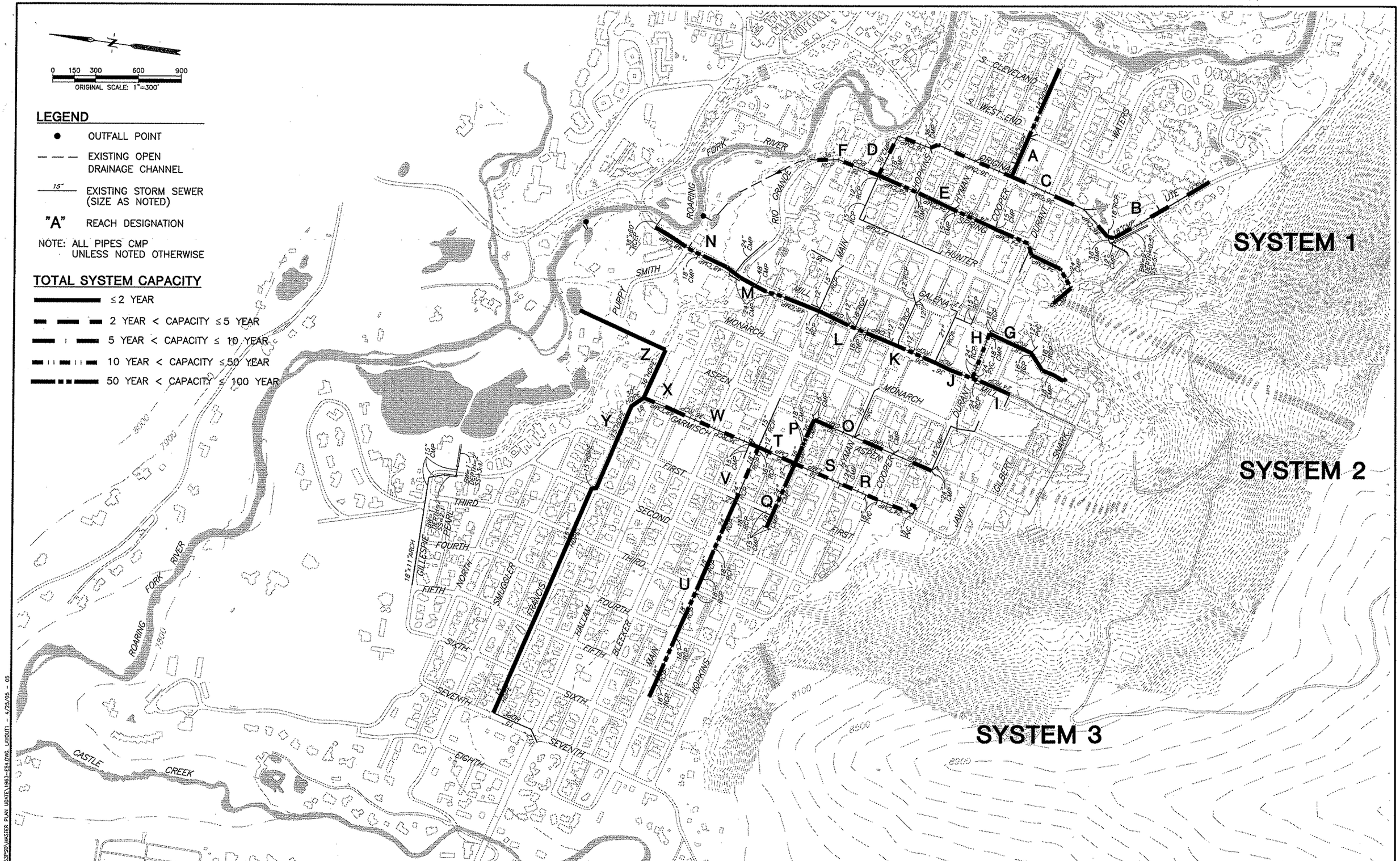
NO.	BY	DATE	REVISION DESCRIPTION

CITY OF ASPEN
MASTER DRAINAGE PLAN

EXISTING DRAINAGE FACILITIES

PROJECT NUMBER 1963

FIGURE ES-3



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CITY OF ASPEN
MASTER DRAINAGE PLAN

MAGNITUDE OF FLOODING PROBLEMS

PROJECT NUMBER 1963
FIGURE ES-4

I:\1963\39\MASTER PLAN UPDATE\1963-ES4.DWG, LAYOUT1 - 4/25/05 - 08

0 150 300 600 900
ORIGINAL SCALE: 1"=300'

LEGEND

- SYSTEM BOUNDARY
- SUBBASIN BOUNDARY
- OUTFALL POINT
- EXISTING OPEN DRAINAGE CHANNEL
- 15" EXISTING STORM SEWER (SIZE AS NOTED)
- 72"RCP PROPOSED STORM SEWER (SIZE AS NOTED)
- "A" REACH DESIGNATION

WATER QUALITY EXTENDED DETENTION BASIN A3B1
DESIGN STORAGE VOLUME = 3.40 ACRE-FEET

WATER QUALITY EXTENDED DETENTION BASIN A3B2
DESIGN STORAGE VOLUME = 3.94 ACRE-FEET

SYSTEM 1

SYSTEM 2

SYSTEM 3

ROARING FORK RIVER

CASTLE CREEK

MEADOWS

WRC ENGINEERING, INC. 950 SOUTH CHERRY STREET SUITE 404 DENVER, COLORADO 80246 PHONE NO: (303) 757-8513 FAX NO: (303) 758-3208	DESIGNED BAC DRAWN JLH CHECKED AJL REVISED AS-BUILT	NO. BY DATE REVISION DESCRIPTION	CITY OF ASPEN MASTER DRAINAGE PLAN	ALTERNATIVE NO. 3 - NORTH PREFERRED ALT. 10-YR CONVEYANCE	PROJECT NUMBER 1963PH2 FIGURE ES-18

1963PH2\DWG\1963ES18.DWG, ES-18 - 11/8/04 - MAS

0 150 300 600 900
ORIGINAL SCALE: 1"=300'

LEGEND

- HIGH CONSTRUCTION PRIORITY
- MEDIUM CONSTRUCTION PRIORITY
- LOW CONSTRUCTION PRIORITY
- OUTFALL POINT
- EXISTING OPEN DRAINAGE CHANNEL
- 15" EXISTING STORM SEWER (SIZE AS NOTED)
- COLLECTOR STORM SEWER
- "A" REACH DESIGNATION

NOTE: ALL PIPES CMP UNLESS NOTED OTHERWISE

WATER QUALITY EXTENDED DETENTION BASIN A3B1
DESIGN STORAGE VOLUME = 3.40 ACRE-FEET

WATER QUALITY EXTENDED DETENTION BASIN A3B2
DESIGN STORAGE VOLUME = 3.94 ACRE-FEET

SYSTEM 1

SYSTEM 2

SYSTEM 3

A3S1-1 30" RCP
A3S1-2 24" RCP
A3S1-3 27" RCP
A3S2-1 27"RCP
A3S2-2 48"RCP
A3S3-1 15"RCP
A3S3-2 18"RCP
A3S3-3 24"RCP
A3S3-4 24"RCP
A3S3-5 36"RCP
A3S3-6 48"RCP
A3S3-7 54"RCP
A3S3-8 27"RCP
A3S3-9 27"RCP
A3S3-10 54"RCP

ROARING FORK RIVER
CASTLE CREEK

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NO.	BY	DATE	REVISION DESCRIPTION
1	MS	3/2005	ADDED CONSTRUCTED MILL ST & 2nd ST STORM SEWERS

CITY OF ASPEN
MASTER DRAINAGE PLAN

CONSTRUCTION PRIORITY OF RECOMMENDED IN-CITY ALTERNATIVE

PROJECT NUMBER 1963
FIGURE ES-19

1963\PH2\1963D372.DWG, PLAN - 1/18/06 - WS

Alternative 2 will cost approximately $7,800,000. Since this alternative does not prevent the minor mudflows that may occur or the annual erosion that occurs, the operation and maintenance costs will be relatively high. Since the cutoff walls will be buried, they should have no effect on the aesthetic appeal of the mountain. Mudflows on alluvial fans frequently change course during the event (typically this is on shallower fans), and thus they may flow around the edge of the proposed cutoff walls. The risk of failure is probably higher than with Alternative 1.

Alternative 3 does not have a capital construction cost, but new developments or re-developments that are located in the designated mudplain would have increased costs. These structures would have to be designed to have no effect on the depth of the mudflow and designed to withstand the force of the mudflow. The operation and maintenance costs could be extremely high with this alternative. If a major mudflow event were to occur, the damages could easily be in the 10's of millions of dollars and cleanup costs for a mudflow event are typically more than the damage that they cause. The probability that a mudflow event will occur on Aspen Mountain is relatively high. Mudflows have historically occurred on the Mountain. Geologic maps published by the U.S. Geological Survey show large areas on Aspen Mountain directly above the City that are defined as potentially unstable.

The actual risk of a mudflow event occurring on Aspen mountain is not precisely known. Further study and analysis may yield better data and tools that can define the location and hazard of mudflow events on Aspen Mountain. Alternatives 1 and 2 are conceptual solutions which need additional investigation and analysis prior to selection of a recommended alternative. The construction of these alternatives on the extremely steep slopes of Aspen Mountain would be very difficult and may be infeasible. Before Alternatives 1 or 2 are implemented, it is strongly recommended that a test site be constructed to test the effectiveness and feasibility of these alternatives. Alternatives 1 and 2 are also very costly, and the City does not currently have the financing available to construct either of these alternatives. Based on this analysis, it is recommended that regulatory controls be initiated until financing becomes available to construct alternatives that can control or prevent mudflow events and until the designs used in Alternatives 1 and 2 can be refined and tested. The proposed mudflow hazard area is delineated on Figure 11.

VI. CONCEPTUAL DESIGN

The stormwater design alternative selected by the City for a more detailed analysis of the needed drainage facilities for the City is essentially Alternative 3 with some minor modifications. Plan and profiles of this conceptual design are provided in Drawings 20 through 35.

The modifications to Alternative 3 include a grass-lined open channel along Ute Avenue to collect the runoff from Spar Gulch. Also, the design and shape of the detention basins was changed slightly. Since the design was described in the previous section, it will not be described again.

2006 UPDATE -This Master Plan includes updates to Alternative 3. Mill Street and 2nd Street storm sewer systems have been constructed and cost estimates for Drainage Systems 1 and 2 have been revised to exclude these construction costs. In addition, cost estimates for the Jenny Adair and Rio Grande Water Quality ponds have now been included as a separate cost estimate.

A more detailed cost estimate was produced based on this conceptual design (see Table 21). The total cost of the project would be about $6,405,000. Costs associated with Drainage Systems 1, 2, and 3 would be $790,000, $289,000, and $2,532,000, respectively. The water quality pond construction cost estimates would be $1,270,000 for the Jenny Adair Pond and $1,524,000 for the Rio Grande Pond.

This design will provide the City of Aspen with a financially feasible solution to convey relatively frequent runoff events to the Roaring Fork River. The water quality basins incorporated into the design also treat the runoff before it enters the Roaring Fork River to assist in protecting this valuable resource for the City and the region.

0 150 300 600 900
ORIGINAL SCALE: 1"=300'

LEGEND

- OUTFALL POINT
- EXISTING OPEN DRAINAGE CHANNEL
- 15" EXISTING STORM SEWER (SIZE AS NOTED)
- COLLECTOR STORM SEWER
- "A" REACH DESIGNATION

NOTE: ALL PIPES CMP UNLESS NOTED OTHERWISE

SYSTEM 1

SYSTEM 2

SYSTEM 3

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1	MAS	3/2005	ADDED CONSTRUCTED MILL ST & 2nd ST STORM SEWERS

CITY OF ASPEN
MASTER DRAINAGE PLAN

EXISTING DRAINAGE FACILITIES

PROJECT NUMBER 1963PH2

FIGURE 7

1963\DWG\ASPEN_MP UPDATE\1963-F7.DWG, LAYOUT1 - 4/25/05 - MAS

0 150 300 600 900
ORIGINAL SCALE: 1"=300'

LEGEND

- OUTFALL POINT
- EXISTING OPEN DRAINAGE CHANNEL
- 15" EXISTING STORM SEWER (SIZE AS NOTED)
- COLLECTOR STORM SEWER
- "A" REACH DESIGNATION

NOTE: ALL PIPES CMP UNLESS NOTED OTHERWISE

WATER QUALITY EXTENDED DETENTION BASIN A3B1
DESIGN STORAGE VOLUME = 3.4 ACRE-FEET

WATER QUALITY EXTENDED DETENTION BASIN A3B2
DESIGN STORAGE VOLUME = 3.94 ACRE-FEET

SYSTEM 1

SYSTEM 2

SYSTEM 3

M:\1963POT\DWG\MASTER PLAN UPDATES\1963-019.DWG, LAYOUT1 - 1/18/08 - MS

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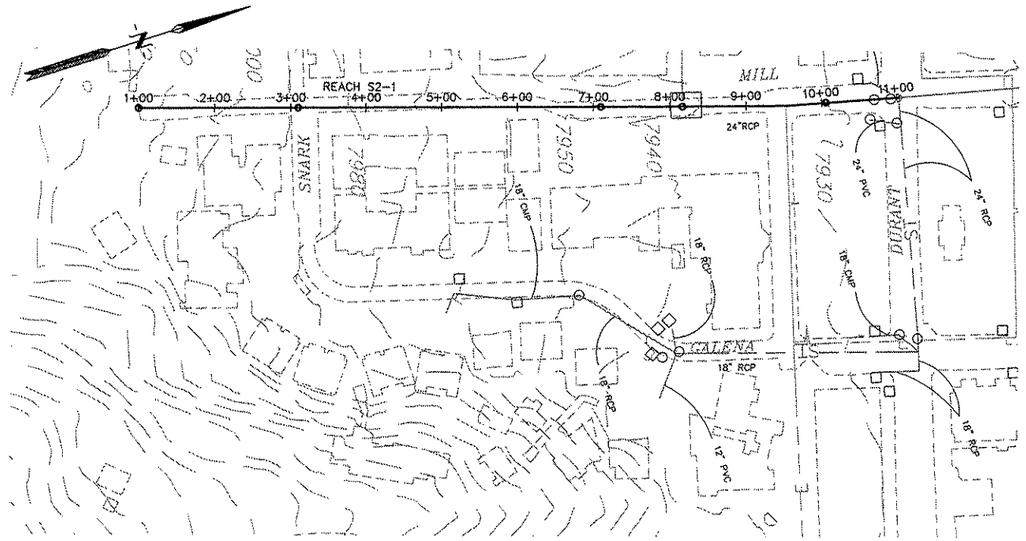
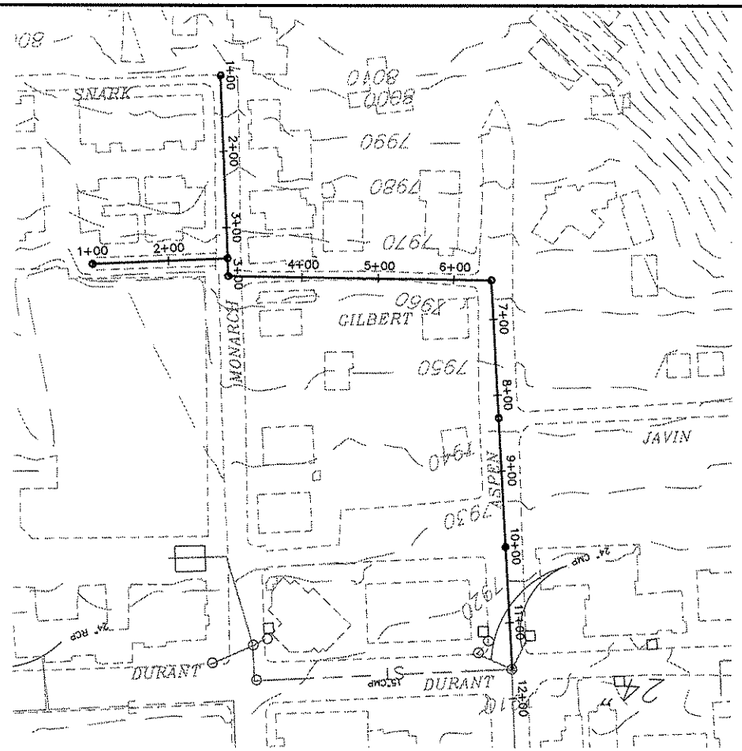
CITY OF ASPEN
MASTER DRAINAGE PLAN

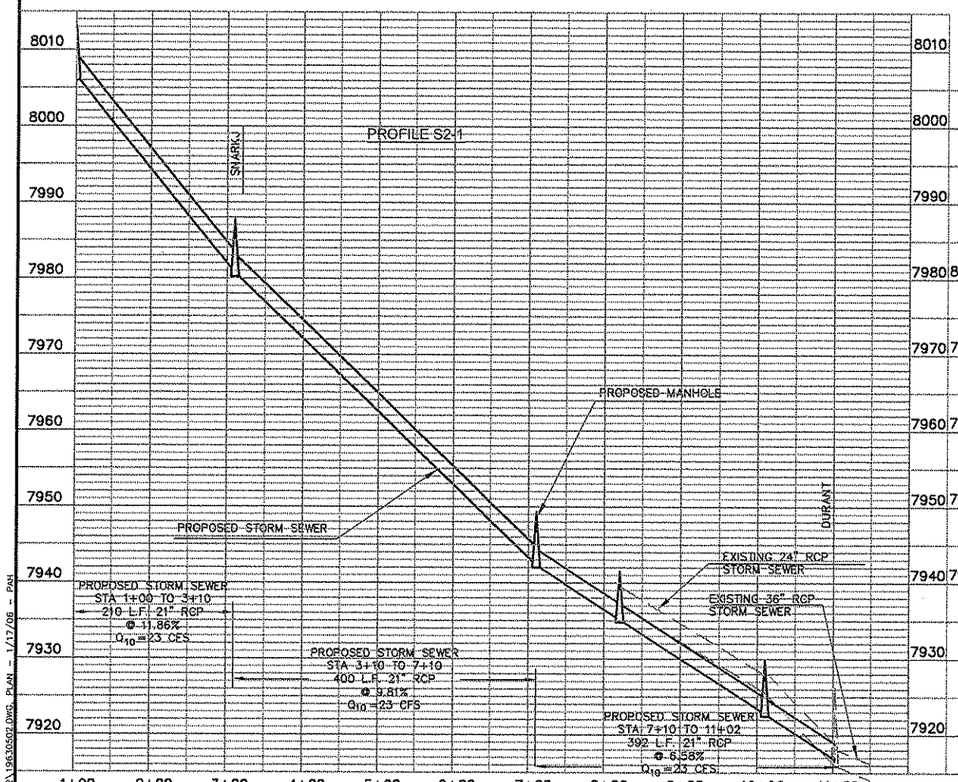
ALTERNATIVE NO. 3 - NORTH

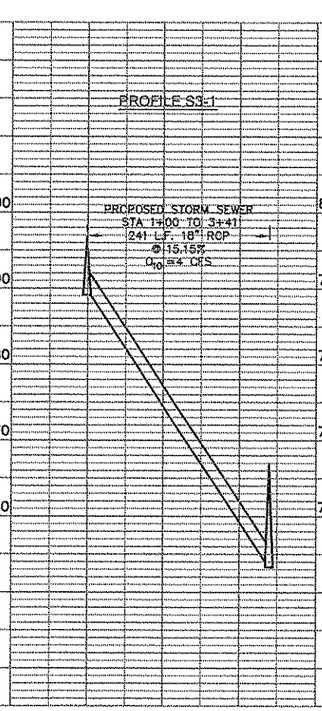
PROJECT NUMBER 1963PH2

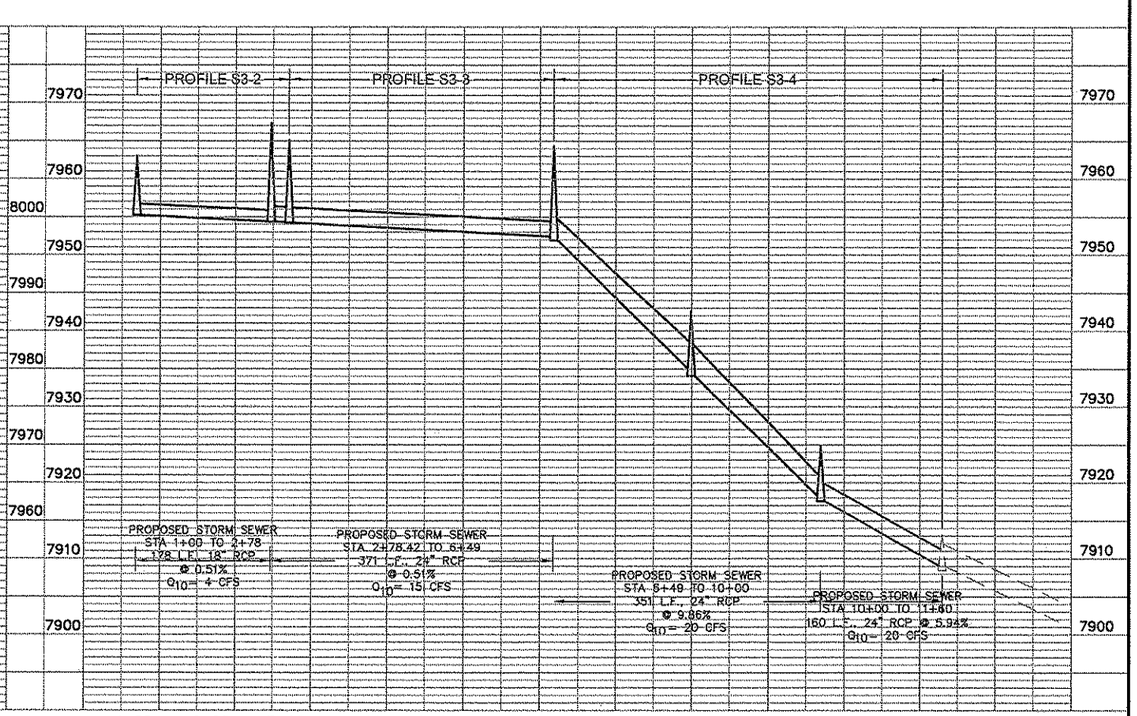
DRAWING NUMBER 19











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AS-BUILT		DATE	

CITY OF ASPEN

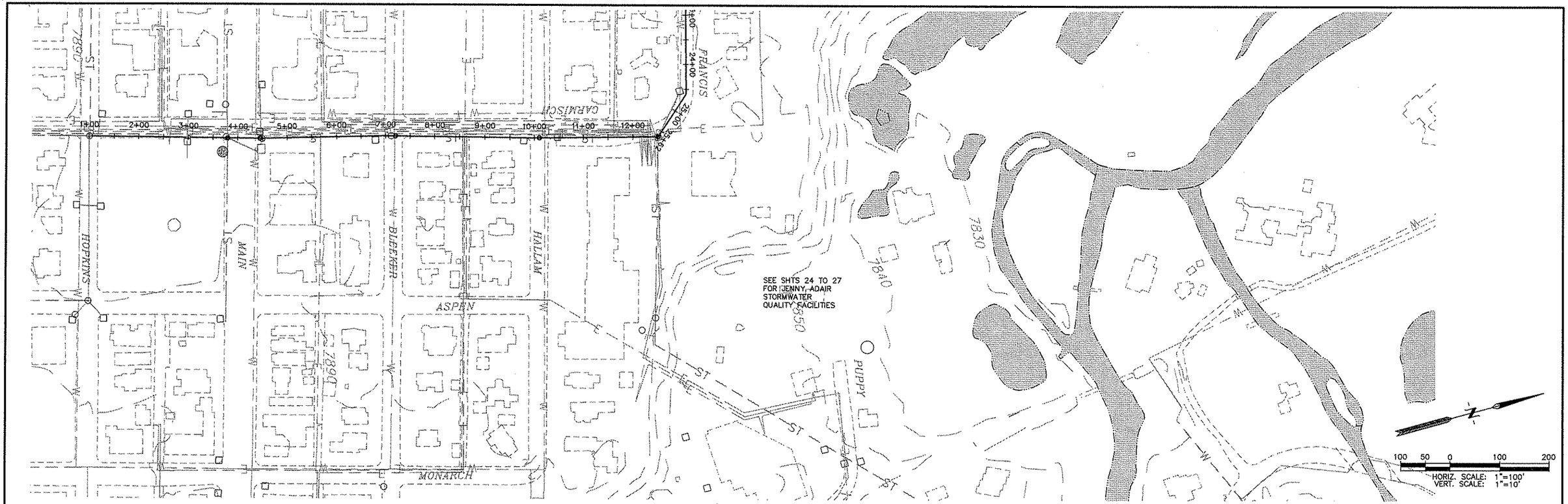
STORM DRAINAGE MASTER PLAN
CONCEPTUAL DESIGN

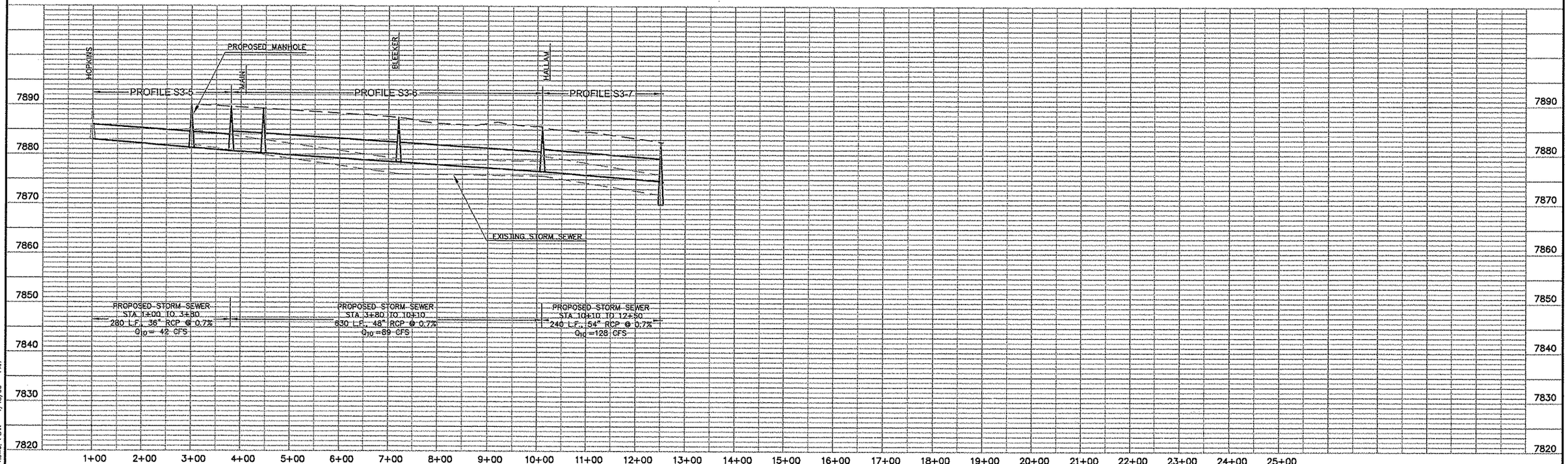
PLAN & PROFILE
S2-1 & S2-2

PROJECT NUMBER
1963

DRAWING NUMBER
21

1963PH2\1963S02.DWG, PLAN - 1/17/06 - PAH





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CHECKED	AJL	DATE
REVISED	MAS	DATE 3/2005
AS-BUILT		DATE

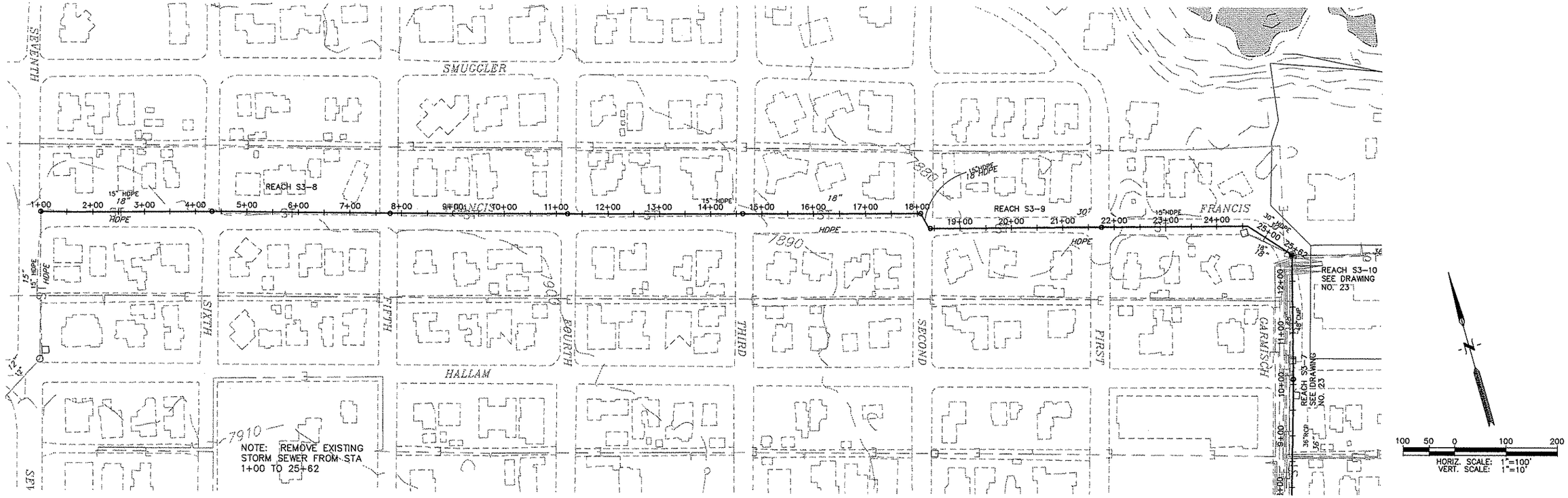
CITY OF ASPEN

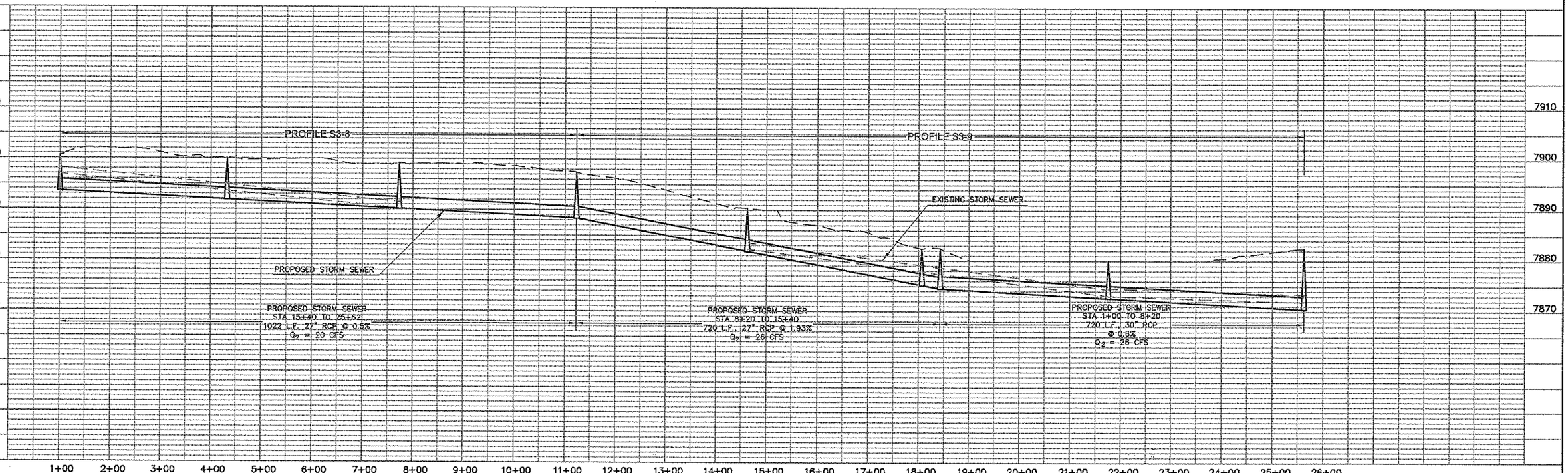
STORM DRAINAGE MASTER PLAN
CONCEPTUAL DESIGN

PLAN & PROFILE
S3-5, S3-6, S3-7, S3-10

PROJECT NUMBER 1963
DRAWING NUMBER 22

1963Ph2\19630504.DWG, PLAN - 1/18/06 - PAH





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REVISED		DATE
AS-BUILT		DATE

CITY OF ASPEN

STORM DRAINAGE MASTER PLAN
CONCEPTUAL DESIGN

PLAN & PROFILE
S3-8 & S3-9

PROJECT NUMBER 1963

DRAWING NUMBER 23

1963 1963050S.DWG XREF 1963050S.DWG LS SH-24 RICOH-IMAGE.PC2 1/18/06 PAH