Chapter 7
Teton Zone

System Geometry

The Teton Zone of the Salt Lake County water distribution system is located on the east side of the service area. It is in the east bench area where the ground slope is relatively steep. The Teton Zone is shown in Figure 7-1.

Piping

Table 7-1 indicates the size distribution and total length of the distribution pipe within the Teton Zone.

Table 7-1
Teton Zone
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	9,814
6"	61,601
8"	11,771
10"	7
12" or greater	7,632
Total Length	90,754

The Teton Zone is separated from the adjoining zones through a series of system values and PRVs. Table 7-2 indicates the SVs within the Teton Zone which are closed during the static simulation.

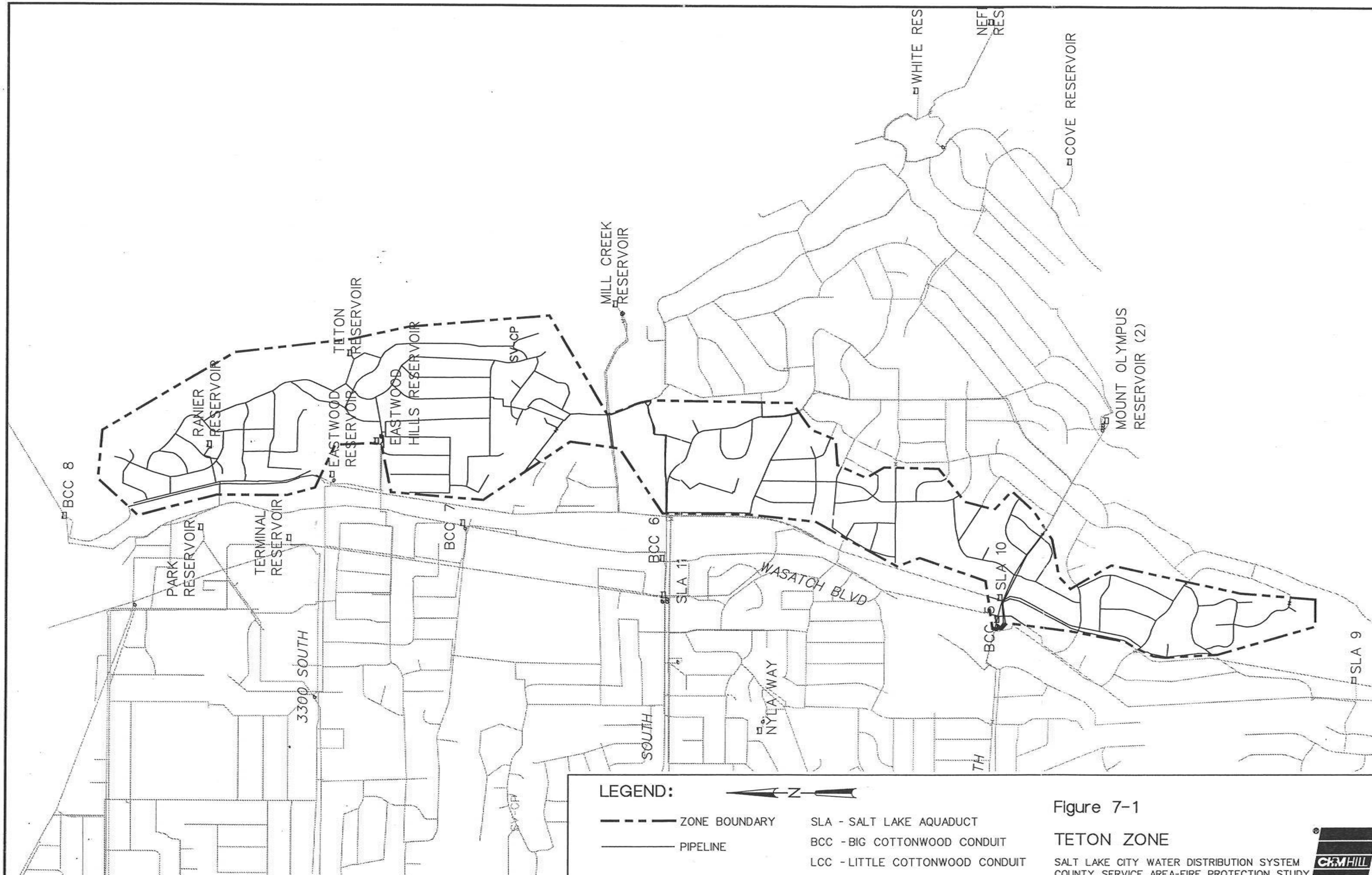


Figure 7-1

TETON ZONE

SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE8XX0LV

Table 7-2 Teton Zone Reservoir System Valves	
idsys	**Location**
3333	Wasatch Blvd, 3088 S.
5085	Eastwood, 3580 S.
7161	Hermes, 4135 S.
7182	Ceres, Achilles
7383	Mars, Diana
7747	Spruce, Diana
7977	East Cliff, Loren Von
8209	4435 S.,
8439	Roger, Parkhill
8674	Bernada, Idlewild
54489	Parkview Drive

The Teton Zone portion of the model includes six PRVs. Table 7-3 shows the location, pressure setting and HGL of the PRVs.

Table 7-3 Teton Zone PRVs				
Station No.	**idsys**	**Location**	**Pressure Setting**	**HGL**
CR-5	56662	Oakview	60	5217.93
CR-7	56664	Brockbank	60	5213.00
CR-33A	56702	Davinci	65	5146.00
CR-32A	57549	Upper Boundary Spring	48	5126.93
CR-9	56666	Quail Point Drive	70	5261.37
CR-10	56667	Quail Point Drive	75	5313.00

Reservoirs

Teton Tank controls the hydraulic grade line within the Teton Zone. The static hydraulic grade line of Teton Zone is 5326 feet.

Source Pumps

There are no source pumps serving the Teton Zone.

Booster Pumps

There are seven booster pumps serving the Teton Zone. Table 7-4 indicates the location of these booster pumps and the status of the pump during the simulation.

Table 7-4
Teton Zone
Reservoir Booster Pumps

Pump	Location	Status
4500 S. Pump #4	4430 S.	OFF
4500 S. Pump #5	4430 S.	ON
4500 S. Pump #7	4430 S.	ON
4500 S. Pump #8	4430 S.	ON
4500 S. Pump #10	4430 S.	ON
Eastwood Pump #1	Eastwood	ON
Mill Creek Pump #1	Upper Boundary Spring	ON
Mill Creek Pump #2	Upper Boundary Spring	ON
Eastwood Pump #2	Eastwood	ON

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the Teton Zone, two such tests were conducted.

Table 7-5 Teton Zone Calibration Test Results				
	Static Pressure		Dynamic Pressure	
Test No.	Measured	Calculated	Measured	Calculated
24	143	153	80	80.26
34	123	92	40	< 0

During the static calibration of the model, runs were made for an average demand condition and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations. The results of the static and dynamic calibration runs are shown in Table 7-5.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

This zone did not calibrate as well as some of the others. The steep terrain increases the possibility of errors associated with the elevation and the complexity of the supply system (booster pumps), and the interaction with the other zones creates many opportunities for opportunities for differences between what is in the field and what is on the system maps. Additional field work should be undertaken in this zone to further refine the model.

Fire Run Simulations

Fires were simulated at thirty-seven locations within this zone. The results of these simulations are shown on Figure 7-2 and given in Table 7-6. Because of the inaccuracies in the model, conditions besides pressures were considered. Pressure loss and velocity were also considered in determining where fire flows could not be met.

Table 7-6 Teton Zone Fire Flow Results					
Simulation No.	Fire Flow (gpm)	Calculated Pressure	Simulatio n No.	Fire Flow (gpm)	Calculated Pressure
1T	1005.12	39.66	20T	1006.24	150.25
2T	1004.92	43.34	21T	1005.22	150.46
3T	1011.78	23.54	22T	1003.90	140.28
4T	1004.54	47.26	23T	1002.00	< 0
5T	1004.64	25.28	24T	1008.08	114.24
6T	1007.68	< 0	25T	1009.80	133.16
7T	1009.62	100.42	26T	1005.08	142.35
8T	1007.60	103.10	27T	1004.56	141.83
9T	1009.94	57.56	28T	1004.28	133.56
10T	1006.68	174.06	29T	1006.32	140.72
11T	1011.66	165.45	30T	1014.67	186.30
12T	1008.24	174.62	31T	1007.26	170.92
13T	1005.78	166.94	32T	1005.56	223.07
14T	1006.56	98.10	33T	1006.28	199.14
15T	1010.12	63.13	34T	1005.56	225.83
16T	1003.96	127.74	35T	1005.98	167.90
17T	1003.04	92.54	36T	1007.88	188.76
18T	1002.88	147.45	37T	1006.82	107.56
19T	1007.08	147.64			

Problem Areas

Fire demands can be met over most of the Teton Zone. There are two long, small-diameter, dead end pipes that will not carry the needed flow. These locations are shown on Figure 7-2.

Areas in which fire flow and pressure were not achieved are also shown in Figure 7-2.

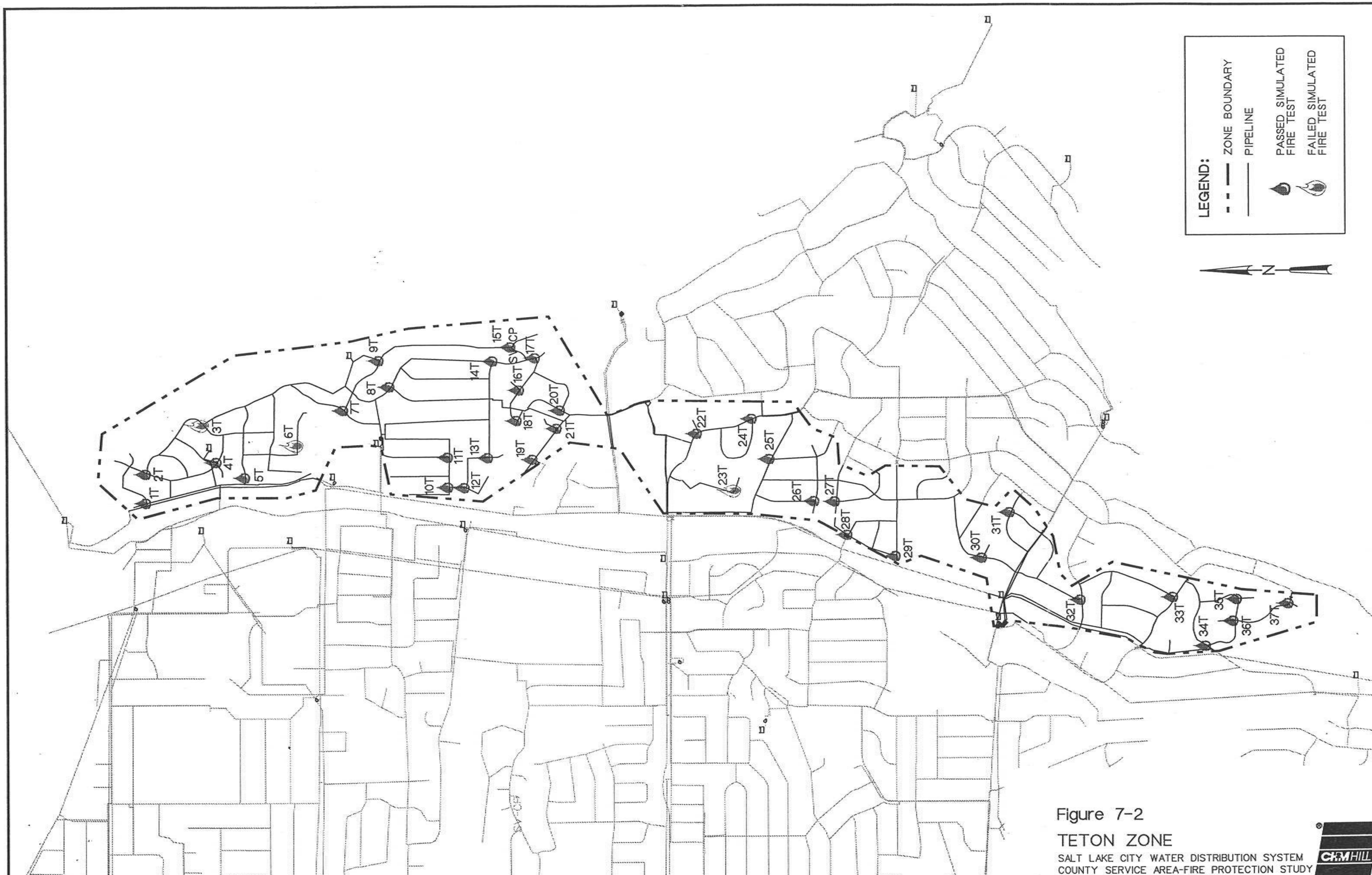


Figure 7-2
TETON ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE8-2.DLV

Recommended Solutions

For each of the areas in which fire flow and pressure was not achieved, an improvement was developed to overcome the problems associated with that location. Figure 7-3 shows the improvements for the Teton Zone. The same set of simulated fire run on the existing system were run again with the improvements shown in Figure 7-3. The calculated pressures were all in excess of the minimum criteria. A cost estimate was prepared for each of these improvements. Table 7-7 shows the cost estimates.

Table 7-7

Salt Lake City Department of Public Utilities
Fire Flow Study
Cost Estimate - Teton

idsys	Existing Length	New Length	Existing Diameter	New Diameter	Number Required Valves	Number Required Hydrants	Number Required Service	Number Required Repair	Cost Pipe	Cost Valves	Cost Hydrants	Cost Service	Cost Repair	TOTAL
	LF	LF	inch	inch	ea	ea	ea	cy	$	$	$	$	$	$
56516	492	492	4	6	2	1	11	1,639	24,583	1,200	2,500	7,150	6,064	41,496
54272	661	661	4	6	3	2	15	2,204	33,059	1,800	5,000	9,750	8,155	57,764
54274	189	189	2	6	1	1	5	631	9,461	600	2,500	3,250	2,334	18,145
3374	328	328	4	6	1	1	8	1,094	16,417	600	2,500	5,200	4,049	28,766
3515	273	273	4	6	1	1	7	910	13,652	600	2,500	4,550	3,367	24,669
					8	6	46	6,478	97,172	4,800	15,000	29,900	23,969	170,841
									Eng, Legal & Admin				15%	25,626
									Subtotal				-	**196,467**
									Contigency				15%	29,470
									TOTAL				-	**225,937**

Edwards Drive Zone

Chapter 8
Edwards Drive Zone

System Geometry

The Edwards Drive Zone of the Salt Lake County water distribution system is located on the east side of the county service area, south of 3900 South. It is a relatively small area, containing less than 21,00 feet of pipe. Because of its eastside bench location there is significant elevation difference from the east side to the west. The Edwards Drive Zone is shown in Figure 8-1.

Piping

Table 8-1 indicates the size distribution and total length of the piping within the Edwards Drive Zone.

Table 8-1
Edwards Drive
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	21
6"	12,384
8"	3,487
10"	2,495
12" or greater	2,588
Total Length	20,894

Valves

This service zone is separated from the other zones by SVs and PRVs. Table 8-2 indicates the SVs within the Edwards Drive zone which were closed during the static simulation.

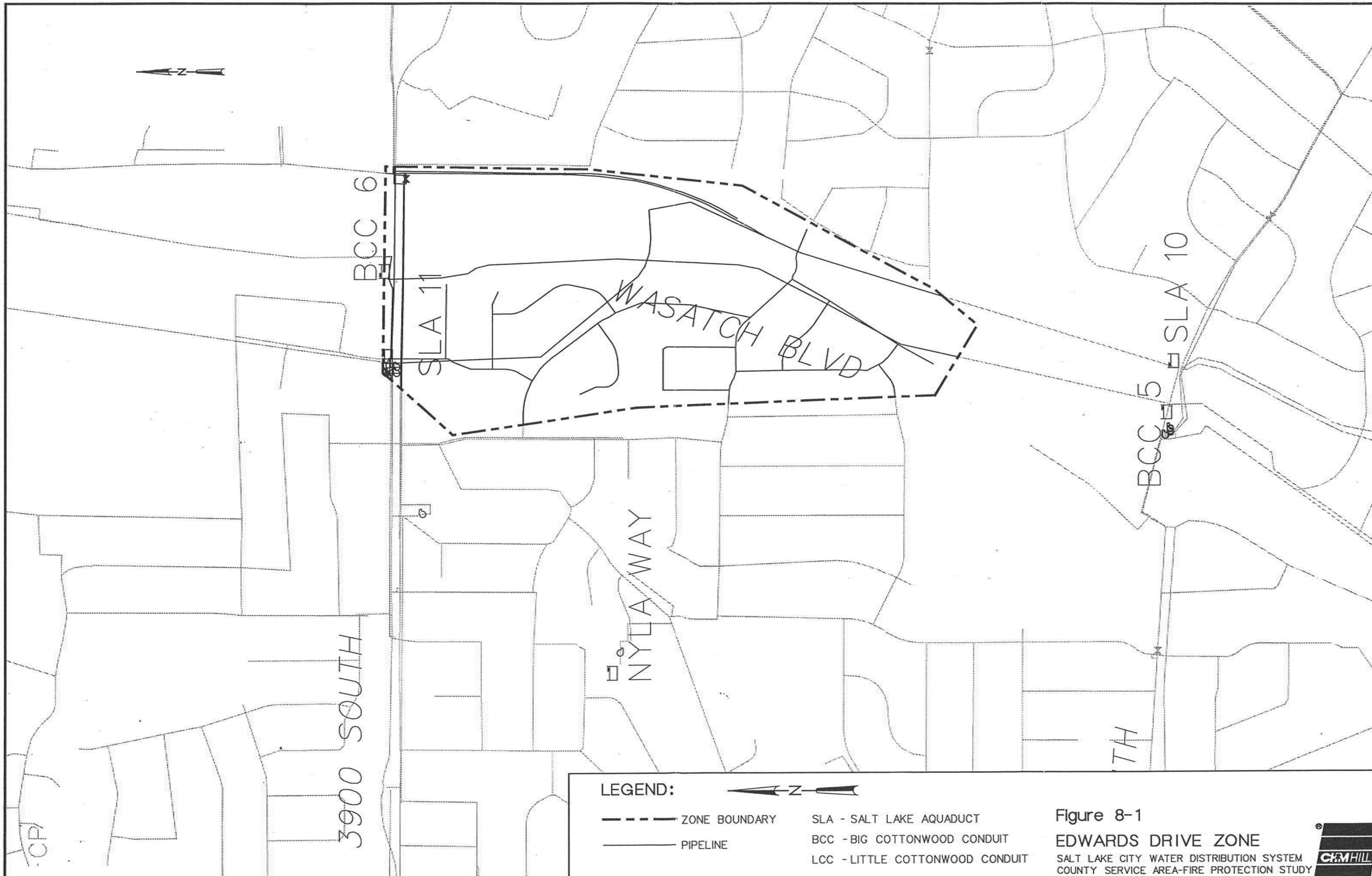


Figure 8-1
EDWARDS DRIVE ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE9-1.DLV

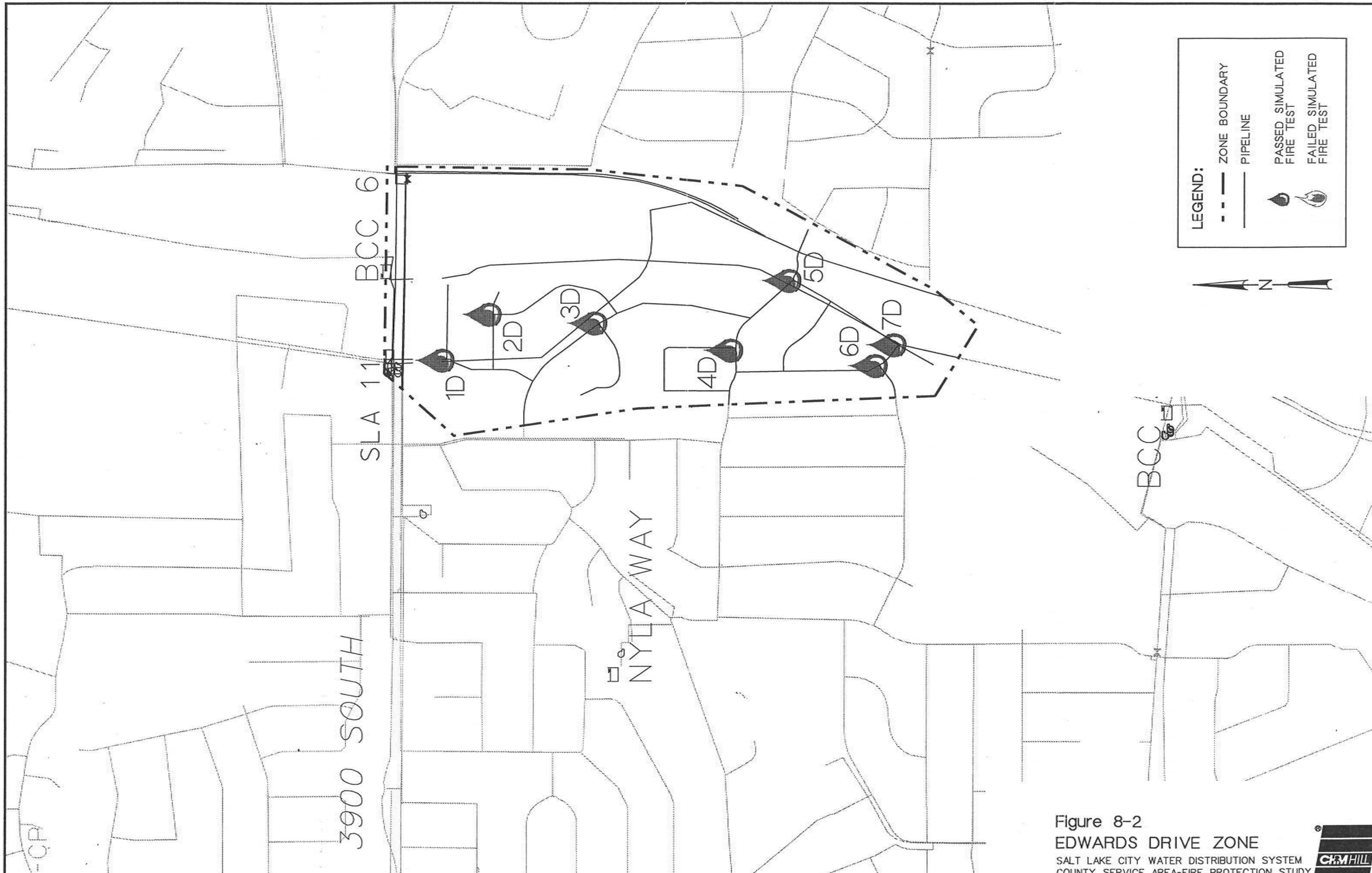


Figure 8-2
EDWARDS DRIVE ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

CH2M HILL

RMW37123\FIGURES\FIRES\ZONE9-2.DLV

Table 8-2 Edwards Drive Reservoir System Valves	
idsys	**Location**
54287	Wasatch, 3900 S.
54316	3900 S., Birch
54317	3900 S., Birch
55407	Wasatch, 3900 S.
55411	3900 S., Wasatch
55858	3900 S., Birch

The Edwards Drive portion of the model has one PRV. Table 8-3 shows the location, pressure setting and HGL of this PRV.

Table 8-3 Edwards Drive PRVs				
Station No.	**idsys**	**Location**	**Pressure Setting**	**HGL**
CR-3	56660	3900 S.	70	5120.00

Reservoirs

There are no reservoirs serving Edwards Drive Zone directly. Water is supplied directly from the Salt Lake Aqueduct and the Big Cottonwood Conduit.

Source Pumps

There are no source pumps serving the Edwards Drive Zone.

Booster Pumps

There are four booster pumps serving this zone. Table 8-4 indicates the location of these booster pumps and the status of the pump during the simulations.

Table 8-4 Edwards Drive Reservoir Booster Pumps		
Pump	**Location**	**Status**
Birch-Pump #1	3900 S., Birch	ON
Birch-Pump #2	3900 S., Birch	ON
Birch-Pump #3	3900 S., Birch	ON
Birch-Pump #4	3900 S., Birch	ON

Calibration

There were no field measurements taken in the Edwards Drive Zone. Without field measurement to calibrate against, it is not possible to calibrate this portion of the model.

Fire Run Simulations

Fire simulation locations in the Edwards Drive Zone are shown in Figure 8-2. Table 8-6 shows the low pressure in the zone for each of the fire runs.

Table 8-6 Edwards Drive Fire Flow Results		
Simulation No.	**Fire Flow (gpm)**	**Calculated Pressure (psi)**
1D	1005.50	224.21
2D	1004.62	213.33
3D	1005.82	209.16
4D	1002.00	172.72
5D	1004.58	156.27
6D	1002.00	161.30
7D	1003.30	156.97

Problem Areas

No problems occurred, as shown in Table 8-6 and Figure 8-2. The Edwards Drive Zone distribution system appears adequate to provide the required fire flows.

Mt. Olympus Zone

Chapter 9
Mt. Olympus Zone

System Geometry

The Mt. Olympus Zone of the Salt Lake County Distribution System is located on the east bench above Wasatch Boulevard. This zone is one of the smaller zones in the Salt Lake City County service area. Its east bench location means there is a significant amount of elevation change from the east side to the west. The Mt. Olympus Zone distribution system is shown in Figure 9-1.

Piping

Table 9-1 provides the size distribution and total length of the piping within the Mt. Olympus Zone.

Table 9-1
Mt. Olympus Zone
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	4,302
6"	30,962
8"	9,127
10"	0
12" or greater	5,283
Total Length	49,583

Valves

The Mt. Olympus Zone is isolated from adjoining service zones through a series of SVs and PRVs. Table 9-2 indicates the SVs within the Mt. Olympus Zone during the static simulation.

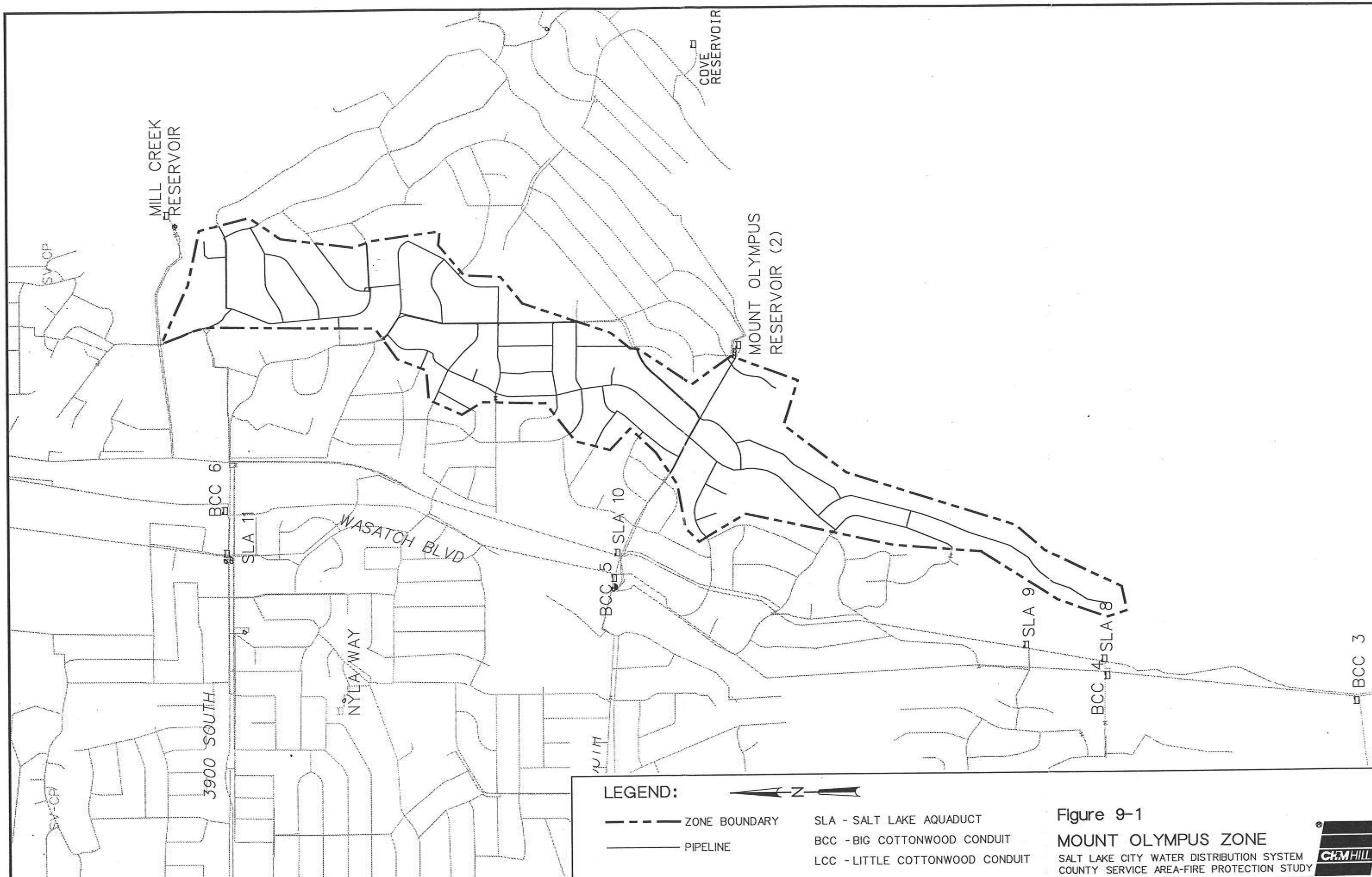


Figure 9-1
MOUNT OLYMPUS ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE10-1.dlv

Table 9-2 Mt. Olympus Zone Reservoir System Valves	
idsys	**Location**
6853	Ruth, Evelyn
7831	Parkview Drive, Foubert
7945	Jupiter, Eastcliff
54198	Lares, Neptune
54200	East Oaks, Park Hill
54246	Barbara Way, Mt. Olympus
54858	Crest Oak, Eastcliff
55227	Evelyn, Ruth
55229	Evelyn, Ruth

The Mt. Olympus Zone portion of the model includes one PRV. Table 9-3 shows the location, pressure setting and HGL of the PRV.

Table 9-3 Mt. Olympus Zone PRV				
Station No.	**idsys**	**Location**	**Pressure Setting**	**HGL**
CR-4	56661	Jupiter Drive	60	5234.00

Reservoirs

The Mt. Olympus Reservoir controls the hydraulic grade line within the Mt. Olympus Zone. The static hydraulic grade line used in the model of Mt. Olympus Reservoir is 5412 feet.

Source Pumps

There are no source pumps serving this zone.

Booster Pumps

There is one booster pump serving the Mt. Olympus Zone. Table 9-4 indicates the

Table 9-4 Mt. Olympus Zone Reservoir Booster Pumps		
Pump	**Location**	**Status**
Mt. Olympus Pump #3	Brockbank	ON

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the Mt. Olympus Zone, two such tests were conducted.

Table 9-5 Mt. Olympus Zone Calibration Test Results				
	Static Pressure		**Dynamic Pressure**	
Test No.	**Measured**	**Calculated**	**Measured**	**Calculated**
22	115	114	80	< 0
25	130	136	60	87.55

During the static calibration of the model, runs were made under an average demand condition and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

The static calibration for this zone is very close. However, the dynamic runs vary widely. There is not only a significant difference between the measured and calculated pressures, the difference is also in different directions (one high and the other low). This type of calibration problem usually indicates a difference in the way the system is described in the model and the way it is in the field. This type of differences cannot usually be explained by elevation differences, friction factor variations or other general system features. Additional field work will be required to further calibrate this portion of the model.

Fire Run Simulations

Sixteen fires were simulated in this zone. The fire simulation locations are shown in Figure 9-2. Table 9-6 shows the low pressure in the zone for each of the fire runs.

Table 9-6
Mt. Olympus Zone Fire Flow Results

Simulation No.	Fire Flow (gpm)	Calculated Pressure	Simulation No.	Fire Flow (gpm)	Calculated Pressure
1M	1007.60	< 0	9M	1005.98	81.61
2M	1007.72	51.11	10M	1006.62	95.86
3M	1002.00	66.89	11M	1004.66	82.70
4M	1002.00	113.32	12M	1005.56	87.71
5M	1009.82	67.30	13M	1011.58	72.90
6M	1004.94	117.50	14M	1017.38	60.84
7M	1009.70	69.22	15M	1006.76	58.59
8M	1006.28	100.66	16M	1012.60	33.71

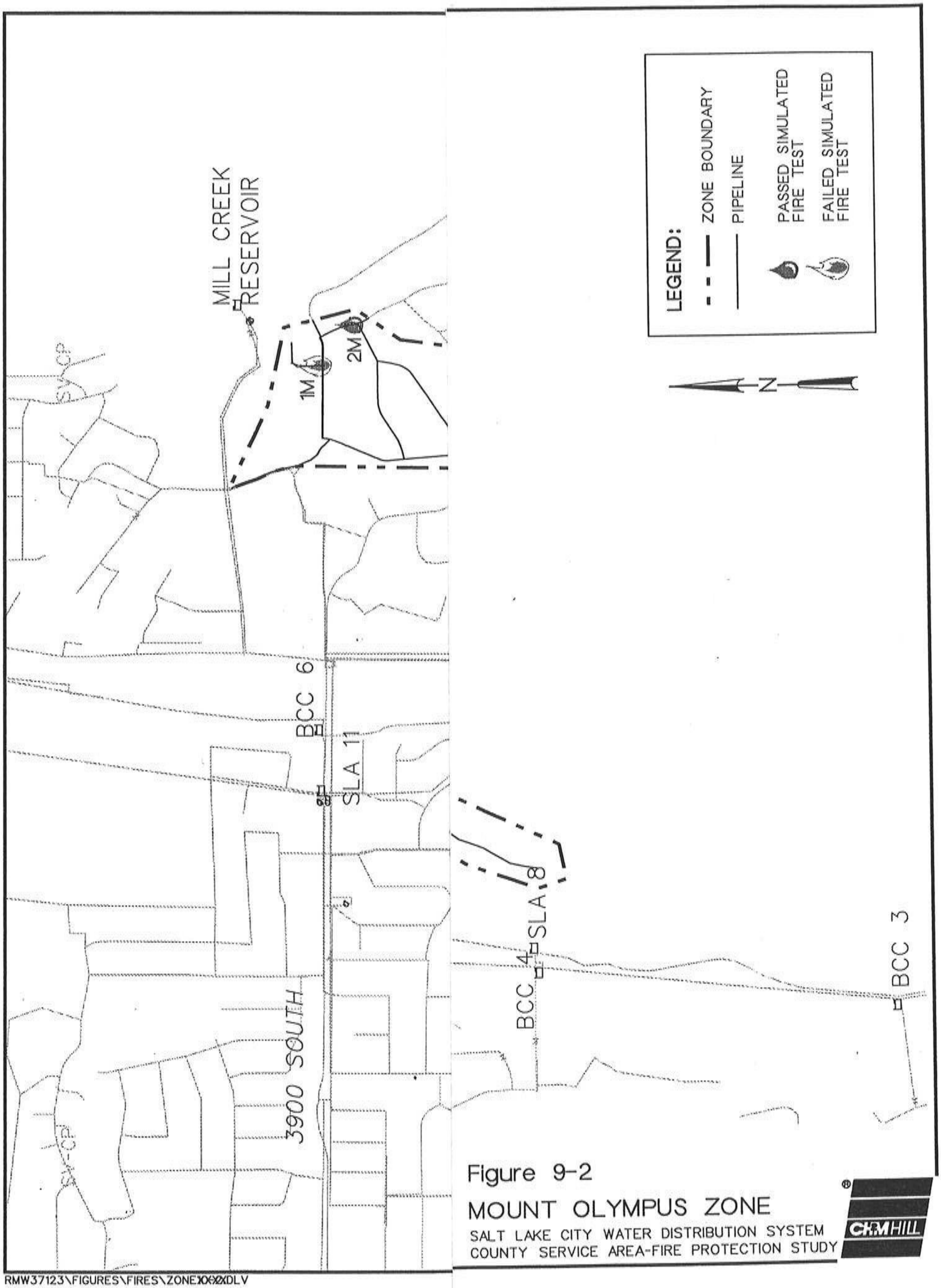


Figure 9-2

MOUNT OLYMPUS ZONE

SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONEXXXXDLV

Problem Areas

Areas in which fire flow and pressure were not achieved are also shown in Figure 9-2.

This zone can handle fires under most circumstances. It is well looped and has a relatively small amount of small diameter pipeline. Problems occur in one area, at the north end of the system. There is a dead end line and it is not possible to maintain adequate pressure over the distance.

Recommended Solution

The problem associated with a fire at the north end of this zone can be overcome by supplying water from the zone to the east. This can be done by opening the closed SV during a fire or installing a PRV to open under low pressure conditions. For the purposes of this study a PRV station was assumed at a cost of $50,000. Figure 9-3 shows the location of this PRV.

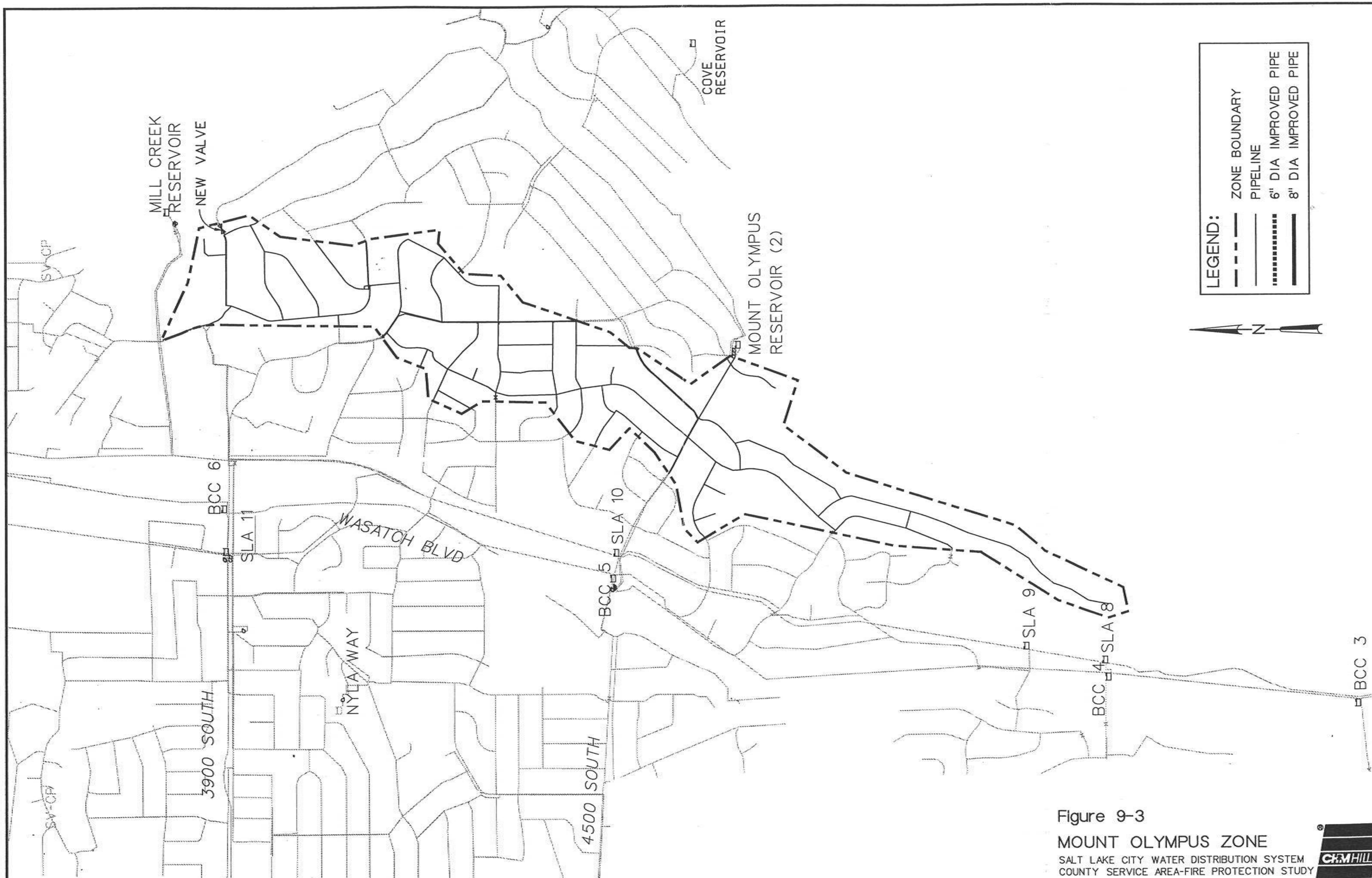


Figure 9-3

MOUNT OLYMPUS ZONE

SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

CH2M HILL

RMW37123\FIGURES\FIRES\ZONE10-3.DLV

White Reservoir Zone

Chapter 10

White Reservoir Zone

System Geometry

The White Reservoir Zone of the Salt Lake County water distribution system is located on the east bench, east of the Mt. Olympus Zone. Like other east bench zones, it is relatively small and has a significant amount of elevation difference from the east side to the west. The White Reservoir distribution system is shown in Figure 10-1.

Piping

Table 10-1 indicates the size distribution and total length of the piping within the White Reservoir Zone.

Table 10-1
White Reservoir
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	5,418
6"	15,905
8"	9,467
10"	0
12" or greater	2,183
Total Length	32,872

Valves

The White Reservoir Zone is separated from the adjoining zone by SVs. There are no PRVs serving this zone. Table 10-2 indicates the SVs within the White Reservoir which were closed during the static simulations.

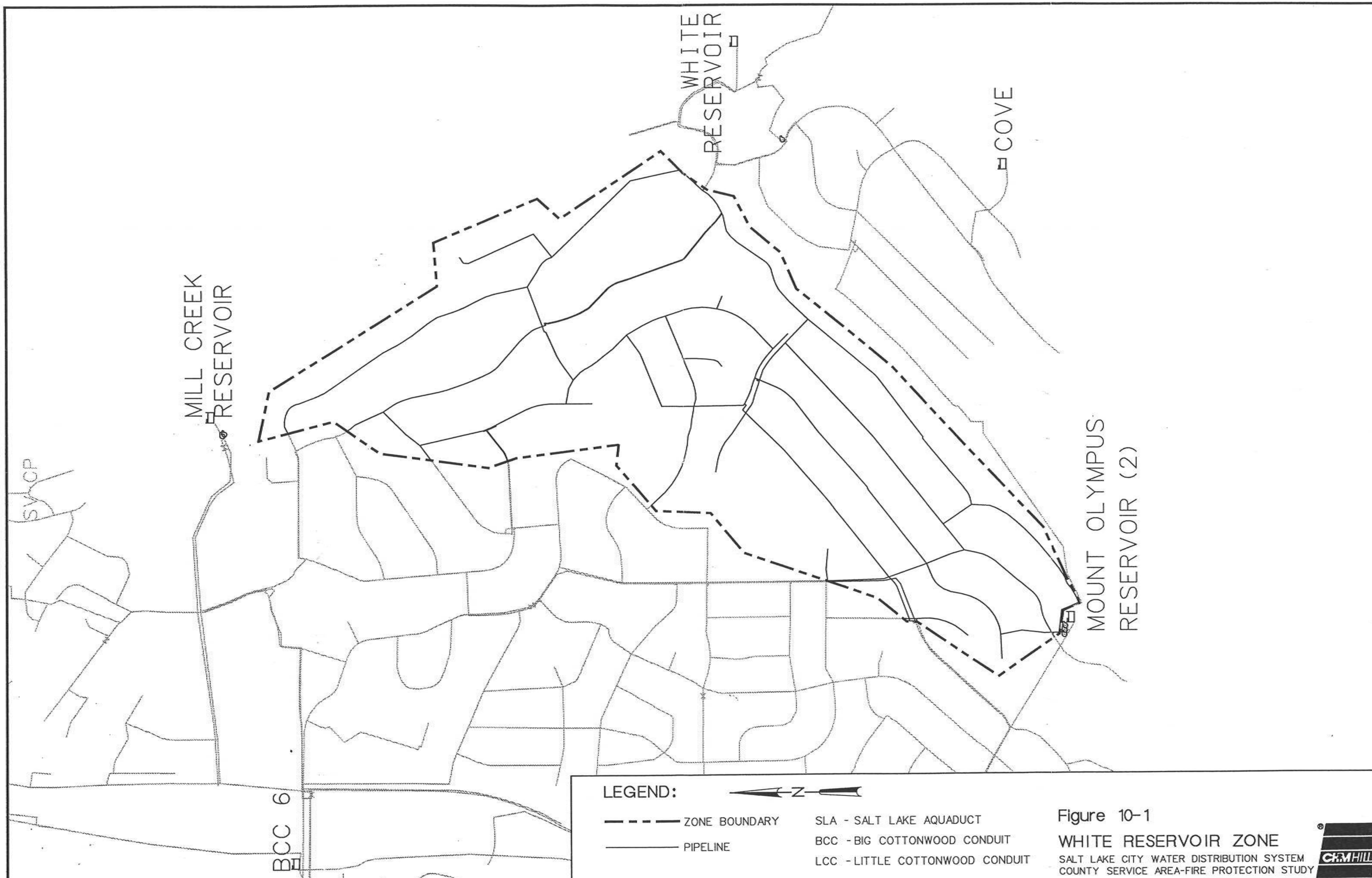


Figure 10-1
WHITE RESERVOIR ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE11-1.DLV

Table 10-2 White Reservoir Reservoir System Valves	
idsys	**Location**
8650	Brockbank, Crest Oak
54863	Crest Oak, Brockbank

Reservoirs

The White Reservoir controls the hydraulic grade line within this zone. The static hydraulic grade line of White Reservoir used in the modeling is 5612 feet.

Source Pumps

There are no source pumps serving the White Reservoir Zone.

Booster Pumps

There are two booster pumps providing water to this zone.

Table 10-3 White Reservoir Reservoir Booster Pumps		
Pump	**Location**	**Status**
Mt. Olympus Pump #3	Brockbank	ON
Mt. Olympus Pump #2	Brockbank	OFF

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the White Reservoir, two such tests were conducted.

During the static calibration of the model, runs were made at an average demand scenario and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

The results of the calibration runs are presented in Table 10-4.

Table 10-4
White Reservoir Calibration Test Results

	Static Pressure		Dynamic Pressure	
Test No.	Measured	Calculated	Measured	Calculated
40	134	138	110	41.09
41	146	153	140	103.07

Fire Run Simulations

Twenty-five simulations were made in the White Reservoir Zone. The locations are shown in Figure 10-2. Table 10-5 shows the low pressure in the zone for each of the fire runs.

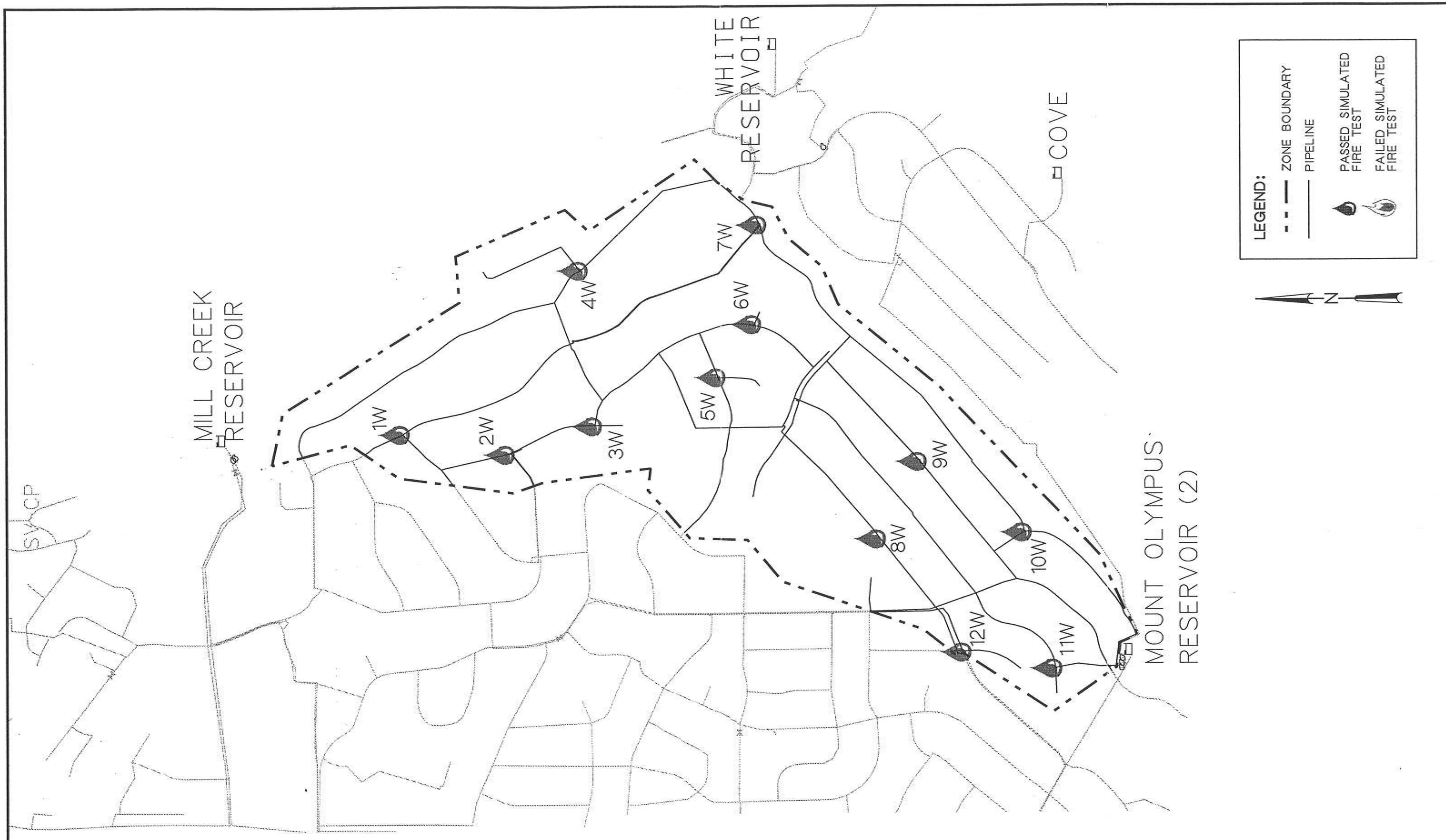


Figure 10-2
WHITE RESERVOIR ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY
CH2M HILL

RMW37123\FIGURES\FIRES\ZONE11-2.DLV

Table 10-5 White Reservoir Fire Flow Results		
Simulation No.	**Fire Flow (gpm)**	**Calculated Pressure**
1W	1012.14	171.43
2W	1002.00	93.36
3W	1007.76	150.69
4W	1021.52	107.01
5W	1006.60	121.72
6W	1005.18	100.64
7W	1009.44	82.37
8W	1013.60	141.66
9W	1016.30	102.08
10W	1011.50	98.76
11W	1010.42	134.99
12W	1005.24	144.21

Problem Areas

There were no fire flow and pressure problems, as shown in Figure 10-2.

Cove Zone

Chapter 11
Cove Zone

System Geometry

The Cove Zone of the Salt Lake County water distribution system is located high on the east bench. It is a very small zone and has a considerable amount of elevation difference from the east side to the west. The Cove Zone distribution system is shown in Figure 11-1.

Piping

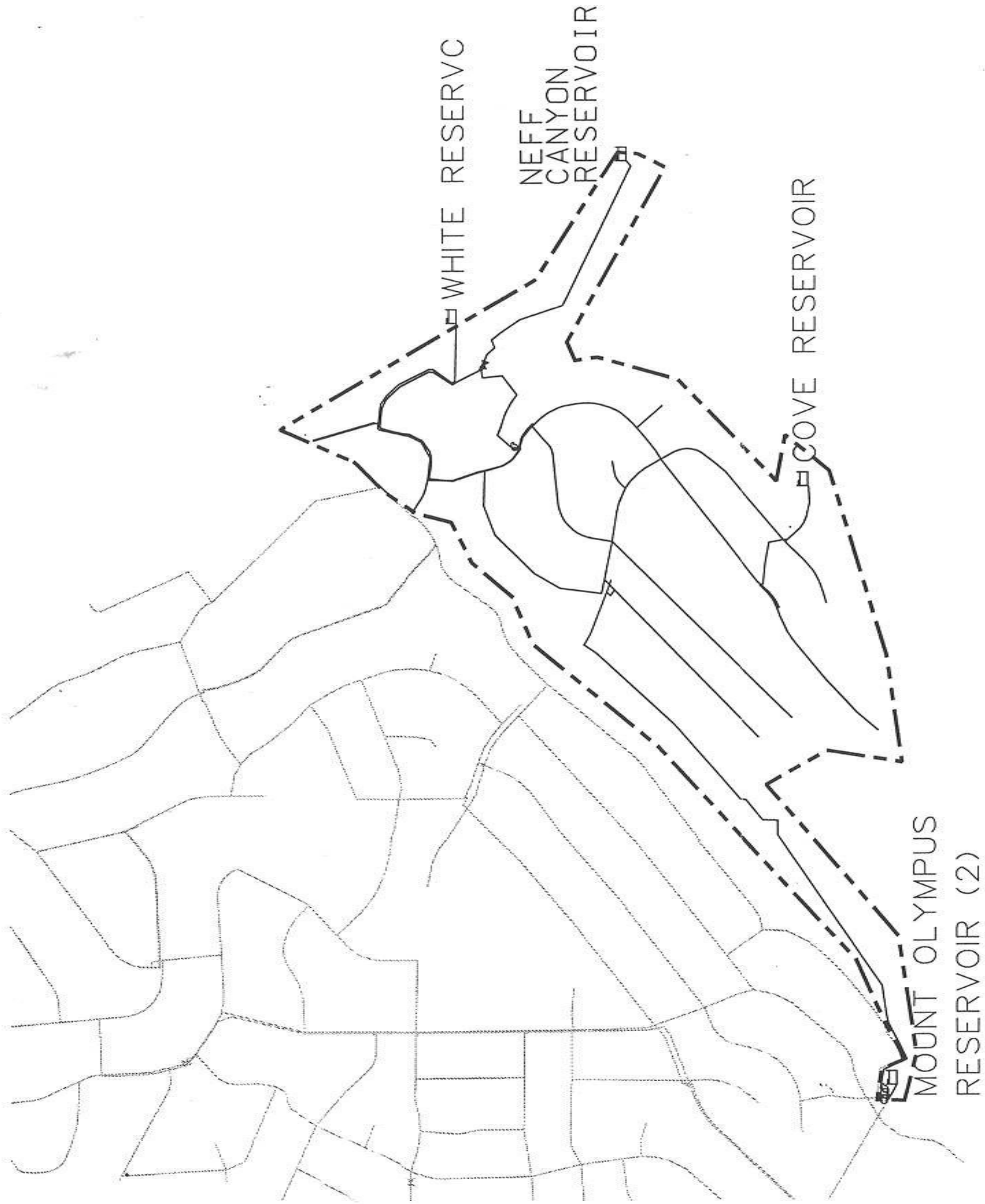
Table 11-1 indicates the size distribution and total length of the piping within the Cove.

Table 11-1
Cove
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	395
6"	10,485
8"	90
10"	0
12" or greater	8,359
Total Length	19,218

Valves

The Cove Zone is isolated from the adjoining zones by SVs and PRVs. Table 11-2 indicates the SVs within the Cove Zone which were closed during the static simulation.



LEGEND: ←Z—

- - - ZONE BOUNDARY
—— PIPELINE

SLA - SALT LAKE AQUADUCT
BCC - BIG COTTONWOOD CONDUIT
LCC - LITTLE COTTONWOOD CONDUIT

Figure 11-1
COVE TANK
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

CH2M HILL

RMW37123\FIGURES\FIRES\ZONE12-1.DLV

Table 11-2 Cove Reservoir System Valves	
idsys	**Location**
54118	Zarahemla Drive
54138	Zarahemla Drive

The Cove portion of the model includes one PRV. Table 11-3 shows the location, pressure setting and HGL of the PRVs.

Table 11-3 Cove PRVs				
Station No.	**idsys**	**Location**	**Pressure Setting**	**HGL**
CR-35A	56703	Zarahemla	190	6035.39

Reservoirs

The Cove Reservoir controls the hydraulic grade line within the Cove Zone. The static hydraulic grade line for the Cove Reservoir used in the model is 5766 feet.

Source Pumps

There are no source pumps serving the Cove.

Booster Pumps

There are two booster pumps serving this zone. Table 11-4 indicates the location of these booster pumps and the status of the pump during the simulation.

Table 11-4 Cove Reservoir Booster Pumps		
Pump	**Location**	**Status**
Zarahemla Pump Station	Zarahemla	OFF
Mt. Olympus Pump #4	Brockbank	ON

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the Cove, one such test was conducted. The results of the test in the Cove are summarized in Table 11-5.

Table 11-5
Cove Calibration Test Results

Test No.	Static Pressure		Dynamic Pressure	
	Measured	Calculated	Measured	Calculated
42	130	129	110	107.36

During the static calibration of the model, runs were made under an average demand condition and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

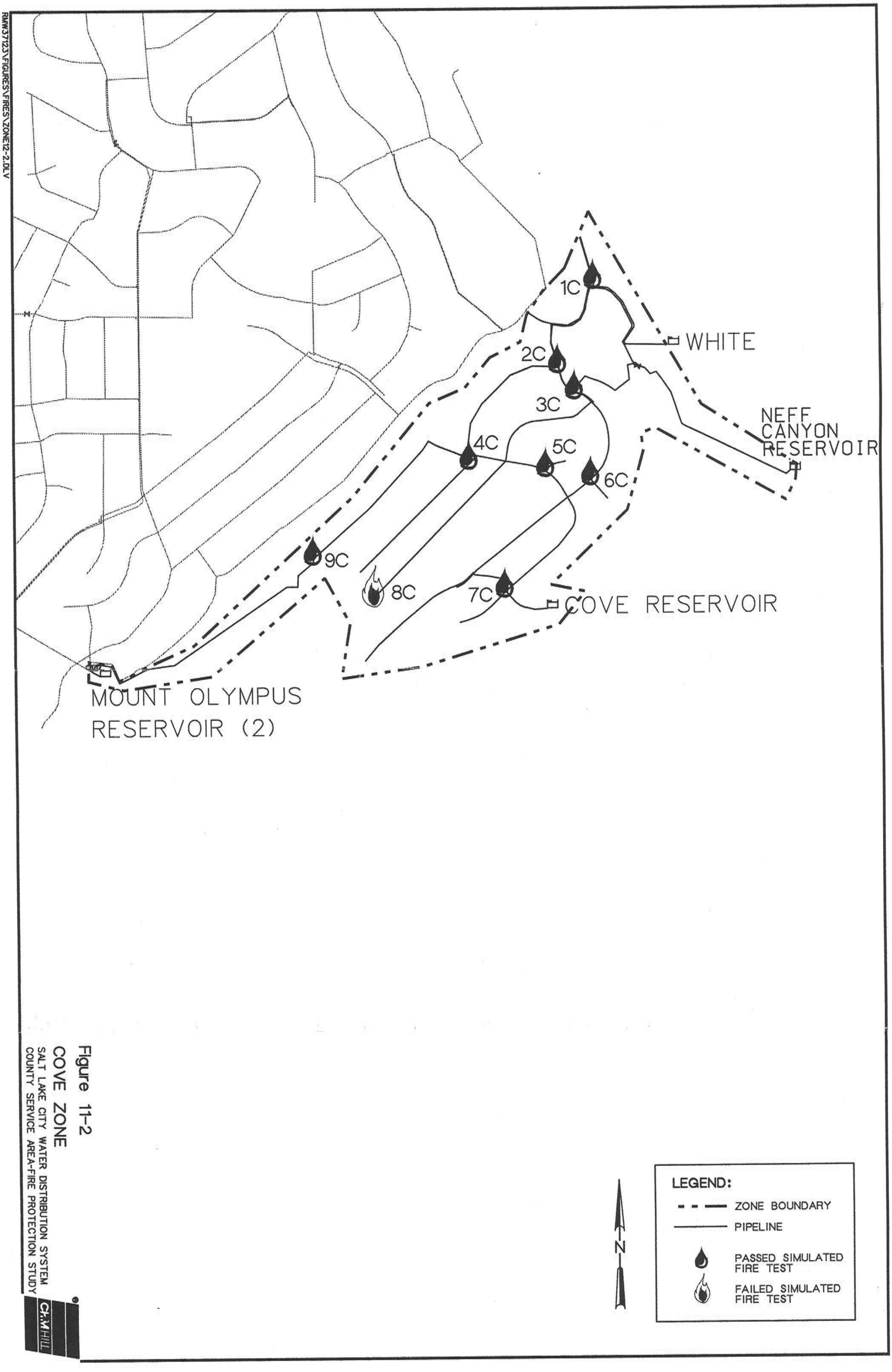


Figure 11-2
COVE ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY
CH2M HILL

Fire Run Simulations

Nine fire simulations were run in the Cove Zone. The locations are shown in Figure 11-2. Table 11-6 shows the low pressure in the zone for each of the fire runs.

Table 11-6
Cove Fire Flow Results

Simulation No.	Fire Flow (gpm)	Calculated Pressure
1C	1002.00	104.14
2C	1006.66	116.74
3C	1002.00	107.81
4C	1002.00	162.17
5C	1005.28	110.40
6C	1005.62	87.62
7C	1007.82	57.16
8C	1009.16	19.06
9C	1012.42	196.74

Problem Areas

The Cove Zone has some very long unlooped pipelines. The length of these unlooped runs makes it difficult to meet flow and pressure requirements. Areas in which fire flow and pressure were not achieved are shown in Figure 11-2.

Recommended Solutions

For each of the areas in which fire flow and pressure was not achieved, an improvement scenario was developed to deliver the required quantity of water to the location at an adequate pressure. Figure 11-3 shows the required improvements for the Cove Zone. A cost estimate was prepared for each of these improvements. Table 11-7 shows these cost estimates.

It should be noted that the solutions presented in Figure 11-3 may not be the optimum. It may be possible to reduce the amount of pipe replaced (and thus the cost) by looping the system and putting in a smaller amount of larger diameter pipe than shown.

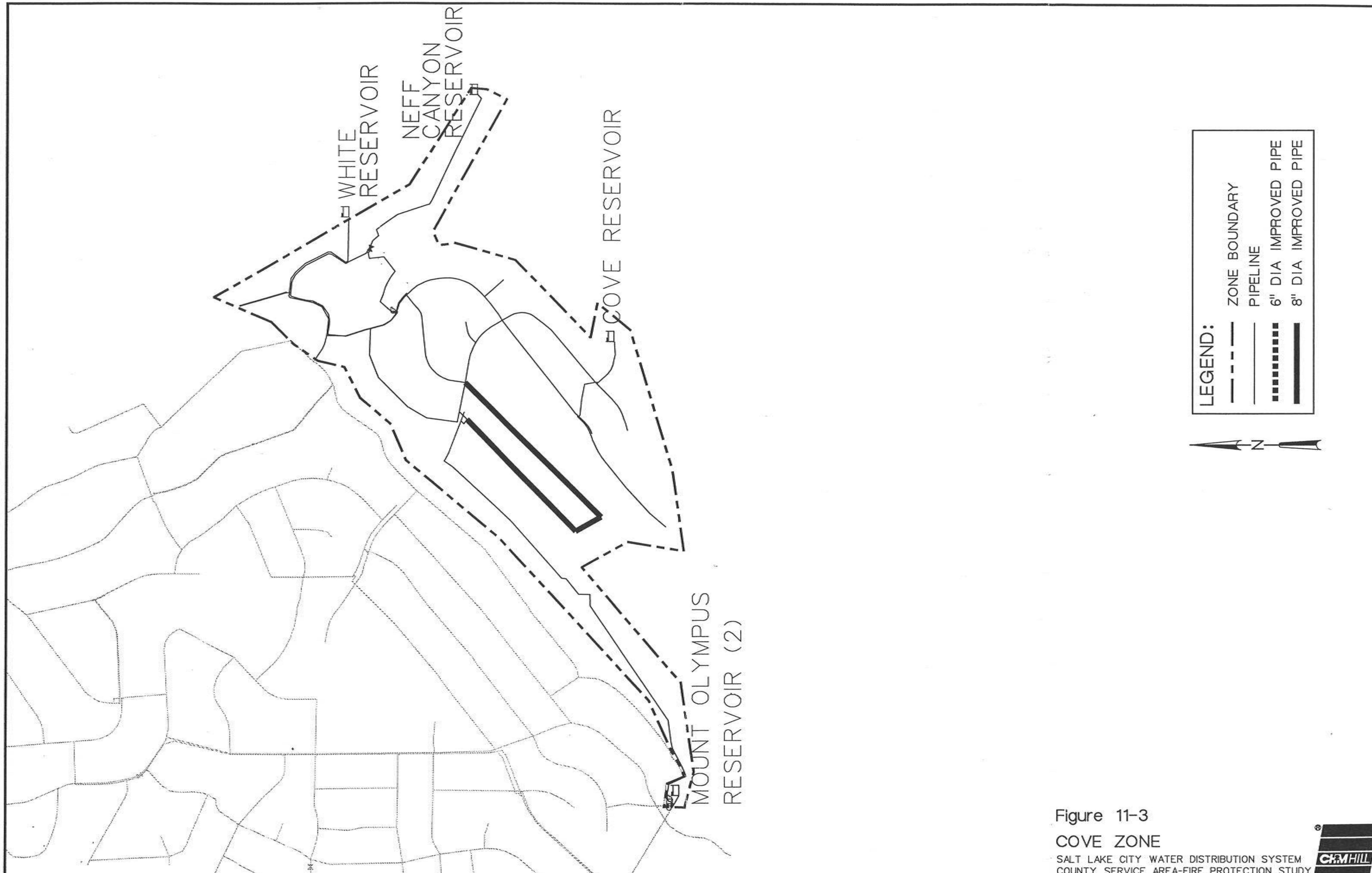


Figure 11-3
COVE ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE12-3.DLV

Table 11-7

Salt Lake City Department of Public Utilities
Fire Flow Study
Cost Estimate - Cove Tank Zone

	Existing	New	Existing	New	Number Required				Cost					
idsys	Length	Length	Diameter	Diameter	Valves	Hydrants	Service	Repair	Pipe	Valves	Hydrants	Service	Repair	TOTAL
	LF	LF	inch	inch	ea	ea	ea	cy	$	$	$	$	$	$
53994	1,487	1,487	6	8	5	3	34	4,957	96,653	3,900	7,500	22,100	23,841	153,995
53993	1,213	1,213	6	8	4	3	27	4,044	78,849	3,120	7,500	17,550	19,449	126,468
58089	NEW	228	0	8	1	1	6	760	14,820	780	2,500	3,900	3,656	25,656
					10	7	67	9,760	190,322	7,800	17,500	43,550	46,946	306,118
									Eng, Legal & Admin				15%	45,918
									Subtotal				-	**352,036**
									Contigency				15%	52,805
									TOTAL				-	**404,841**

4500 South Low Zone

Chapter 12
4500 South Low Zone

System Geometry

The 4500 South Low Zone of the Salt Lake County water distribution system is located in the area around 4500 South and Wasatch Boulevard. The 4500 South Low distribution system is shown in Figure 12-1.

Piping

Table 12-1 indicates the size distribution and total length of the piping within the 4500 South Low system.

Table 12-1
4500 South Low
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	388
6"	13,090
8"	3,352
10"	0
12" or greater	2,298
Total Length	23,628

Valves

This zone is separated from adjoining zones by SVs and PRVs. Table 12-2 gives the SVs within the 4500 South Low which were closed during the simulations.

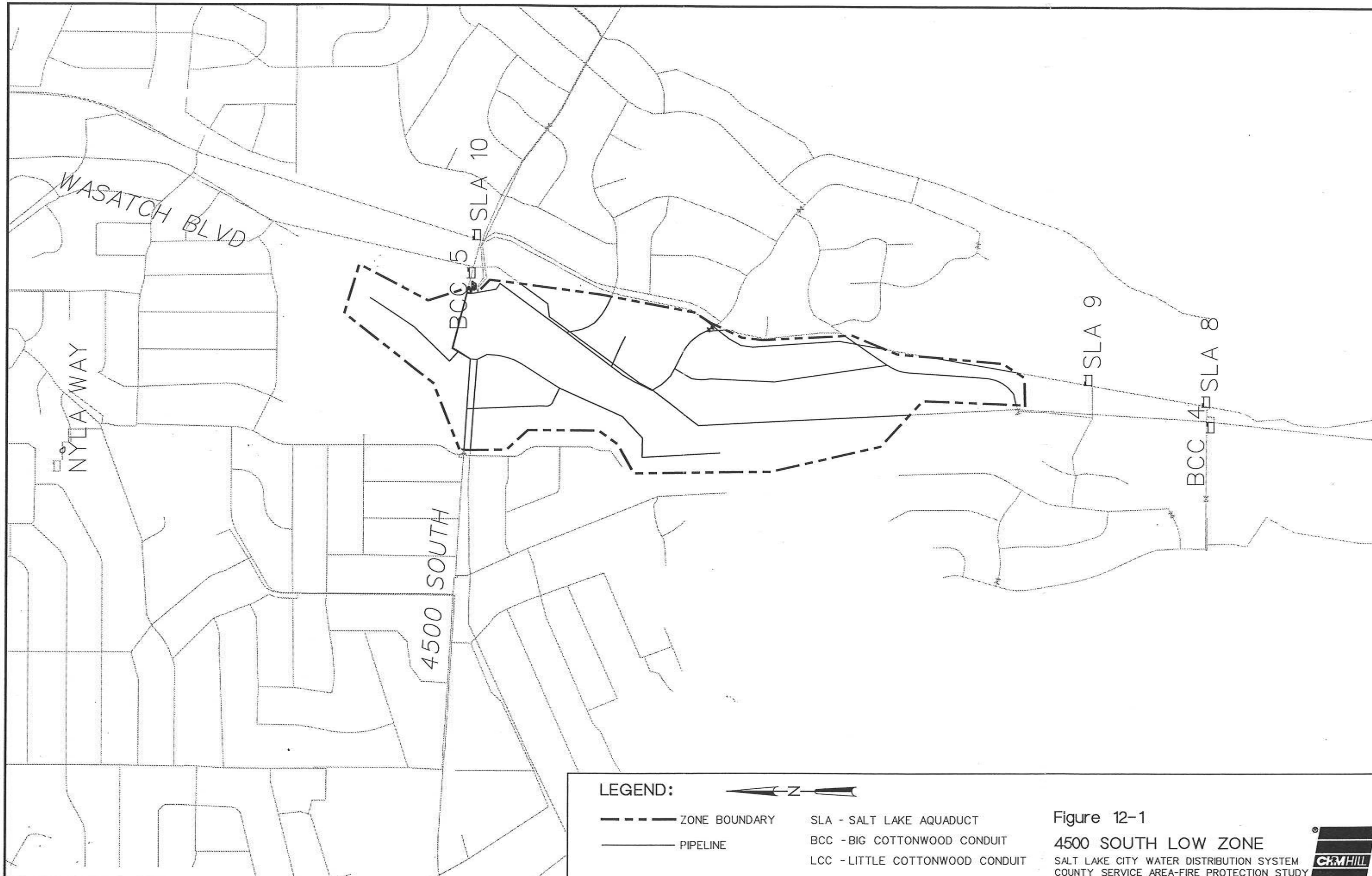


Figure 12-1
4500 SOUTH LOW ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE13-1.DLV

Table 12-2 4500 South Low Reservoir System Valves	
idsys	**Location**
8664	Bernada, Wasatch
9144	Fortuna, Westview

The 4500 South Low portion of the model includes two PRVs. Table 12-3 shows the location, pressure setting and HGL of the PRVs.

Table 12-3
4500 South Low PRVs

Station No.	idsys	Location	Pressure Setting	HGL
CR-8	56665	Oak Cliff	60	5083.27
CR-11	56668	Fortuna	65	4999.00

Reservoirs

There are no reservoirs serving the 4500 South Low Zone. Water is supplied directly from the Salt Lake Aqueduct.

Source Pumps

There are no source pumps serving the 4500 South Low Zone.

Booster Pumps

There are two booster pumps providing water to the 4500 South Low Zone. Table 12-5 indicates the location of these booster pumps and the status of the pump during the simulations.

Table 12-5 4500 South Low Reservoir Booster Pumps		
Pump	**Location**	**Status**
4500 S. Pump #1	4430 So.	OFF
4500 S. Pump #2	4430 So.	ON

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the 4500 South Low, no such tests were conducted.

Fire Run Simulations

Five fire conditions were simulated in this zone. The locations of the fire simulations are shown in Figure 12-2. Table 12-6 shows the low pressure in the zone for each of the fire runs.

Table 12-6 4500 South Low Fire Flow Results		
Simulation No.	**Fire Flow (gpm)**	**Calculated Pressure**
1F	1002.00	83.18
2F	1002.00	54.46
3F	1007.80	270.88
4F	1022.08	180.09
5F	1008.34	257.29

Problem Areas

All simulated fires met the flow and pressure criteria.

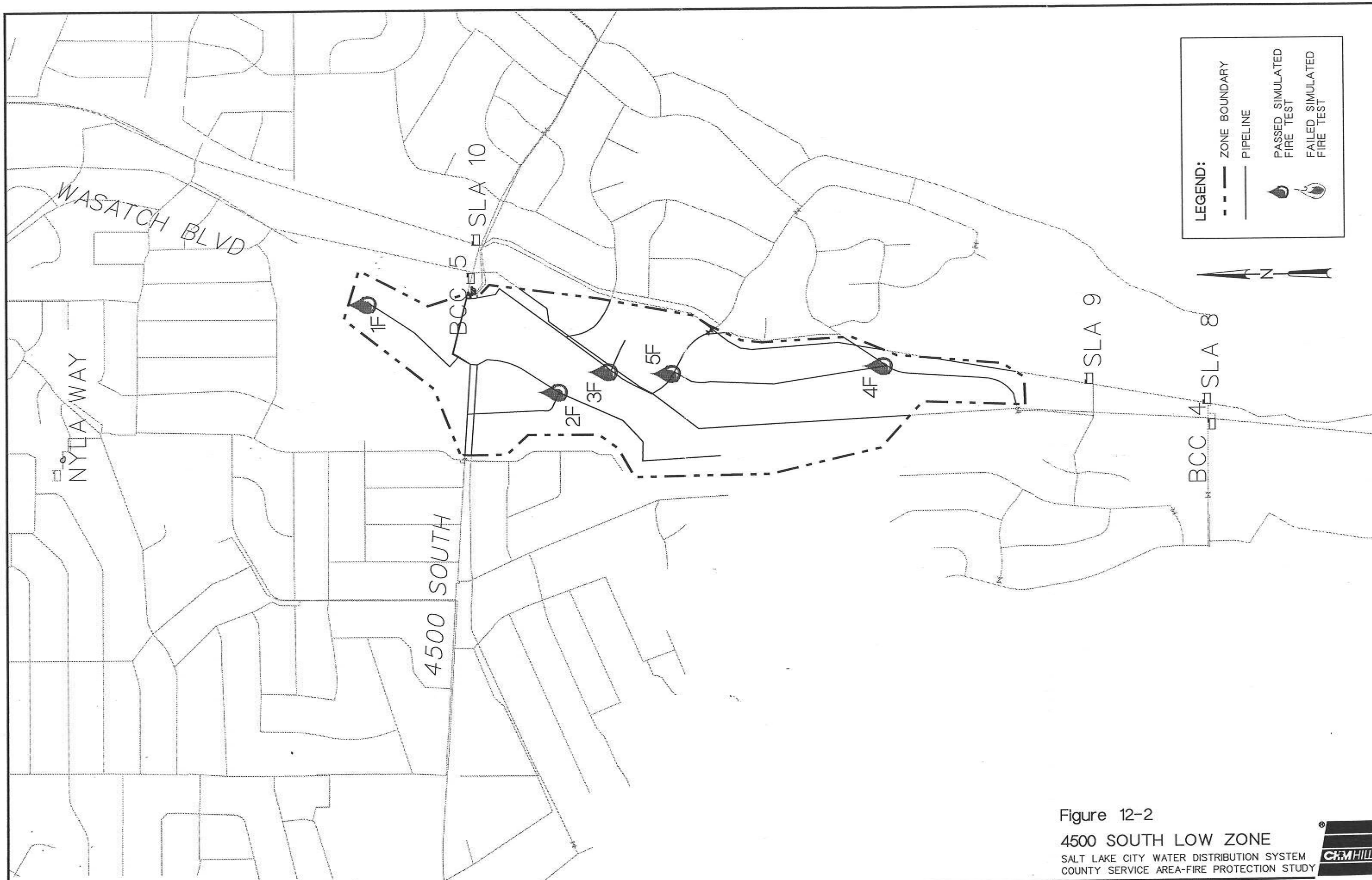


Figure 12-2
4500 SOUTH LOW ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

RMW37123\FIGURES\FIRES\ZONE13-2.DLV

Cottonwood Hills Zone (Gravity 1)

Chapter 13
Cottonwood Hills Zone (Gravity 1)

System Geometry

The Cottonwood Hills Zone of the Salt Lake County water distribution system (sometimes referred to as Gravity Zone 1) is located in the vicinity of 2300 East between approximately 6800 South and Creek Road. The Cottonwood Hills distribution system is shown in Figure 13-1.

Piping

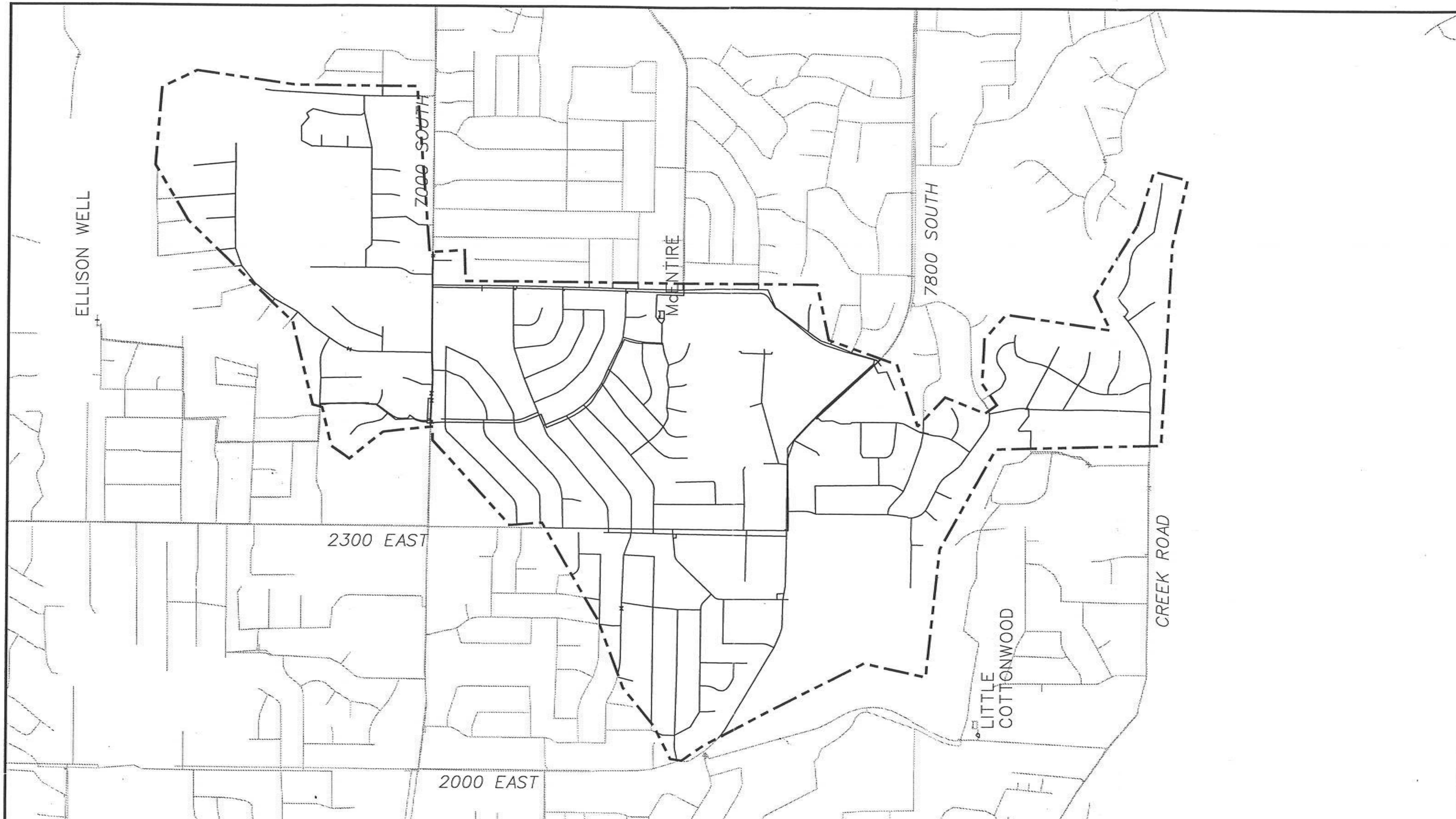
Table 13-1 indicates the size distribution and total length of the piping within the Cottonwood Hills.

Table 13-1
Cottonwood Hills
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	10,491
6"	69,386
8"	20,512
10"	2,276
12" or greater	28,939
Total Length	131,473

Valves

The Cottonwood Hills Zone is separated from the adjoining zones by a series of SVs and PRVs. Table 13-2 shows the SVs within the Cottonwood Hills Zone which were closed during the simulations.



LEGEND:

ZONE BOUNDARY

PIPELINE

SLA - SALT LAKE AQUADUCT

BCC - BIG COTTONWOOD CONDUIT

LCC - LITTLE COTTONWOOD CONDUIT

Figure 13-1

COTTONWOOD HILLS ZONE (GRAVITY 1)

SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

CH2M HILL

RMW37123\FIGURES\FIRES\ZONE14-1.DLV

Table 13-2 Cottonwood Hills Reservoir System Valves	
idsys	**Location**
11763	Sundown, 2485 E.
12106	Ellison Well, Promenade
12278	Cinnabar, 2300 E.
12563	Catalina, 2300 E.
13170	Lonsdale, Viscayne
13265	Viscayne, Cashe Hill
13281	Castle Hill, 7600 S.
13530	Highland, 7495 S.
52842	Promenade, 2700 E.
53275	7000 S., Hollowmill
53340	Promenade, 2700 S.
53345	7000 S., Promenade
53355	Promenade, Sundown
53360	Sundown, Promenade

The Cottonwood Hills portion of the model includes two PRVs. Table 13-3 shows the location, pressure setting and HGL of the PRVs.

Table 13-3 Cottonwood Hills PRVs				
Station No.	**idsys**	**Location**	**Pressure Setting**	**HGL**
CR-34A	56680	Hollow Mill	93	4863.46
CR-19	56676	7000 S.	50	4774.08

Reservoirs

There are no reservoirs directly serving the Cottonwood Hills Zone. Water is supplied through PRVs from adjoining zones.

Source Pumps

There are no source pumps in the Cottonwood Hills Zone.

Booster Pumps

There are no booster pumps serving the Cottonwood Hills Zone.

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the Cottonwood Hills, three such tests were conducted. The results of the tests in the Cottonwood Hills are summarized in Table 13-4.

Table 13-4
Cottonwood Hills Calibration Test Results

	Static Pressure		Dynamic Pressure	
Test No.	Measured	Calculated	Measured	Calculated
11	85	77	60	40.16
12	85	89	66	71.03
13	81	95	54	79.85

During the static calibration of the model, runs were made at an average demand scenario and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

Fire Run Simulations

Twenty-three fires were simulated. The locations of the simulated fires are shown in Figure 13-2. Table 13-5 shows the low pressure in the zone for each of the fire runs.

Table 13-5
Cottonwood Hills Fire Flow Results

Simulation No.	Fire Flow (gpm)	Calculated Pressure	Simulation No.	Fire Flow (gpm)	Calculated Pressure
1G1	1006.82	67.70	13G1	1005.32	133.18
2G1	1011.76	82.44	14G1	1006.42	118.06
3G1	1007.66	102.86	15G1	1006.20	125.67
4G1	1007.26	94.58	16G1	1005.90	104.03
5G1	1004.74	177.88	17G1	1003.82	< 0
6G1	1015.32	171.87	18G1	1006.82	94.74
7G1	1010.94	136.08	19G1	1006.16	48.62
8G1	1009.34	139.13	20G1	1006.30	< 0
9G1	1007.74	123.06	21G1	1004.96	< 0
10G1	1004.78	107.35	22G1	1006.58	< 0
11G1	1005.76	131.40	23G1	1005.46	< 0
12G1	1007.28	132.88			

Problem Areas

Areas in which fire flow and pressure were not achieved are also shown in Figure 13-2.

Recommended Solutions

For each of the areas in which fire flow and pressure was not achieved, an improvement scenario was developed to deliver the required quantity of water to the location at an adequate pressure. Figure 13-3 shows the required improvements for the Cottonwood Hills Zone. A cost estimate was prepared for each of these improvements. Table 13-6 shows these cost estimates.

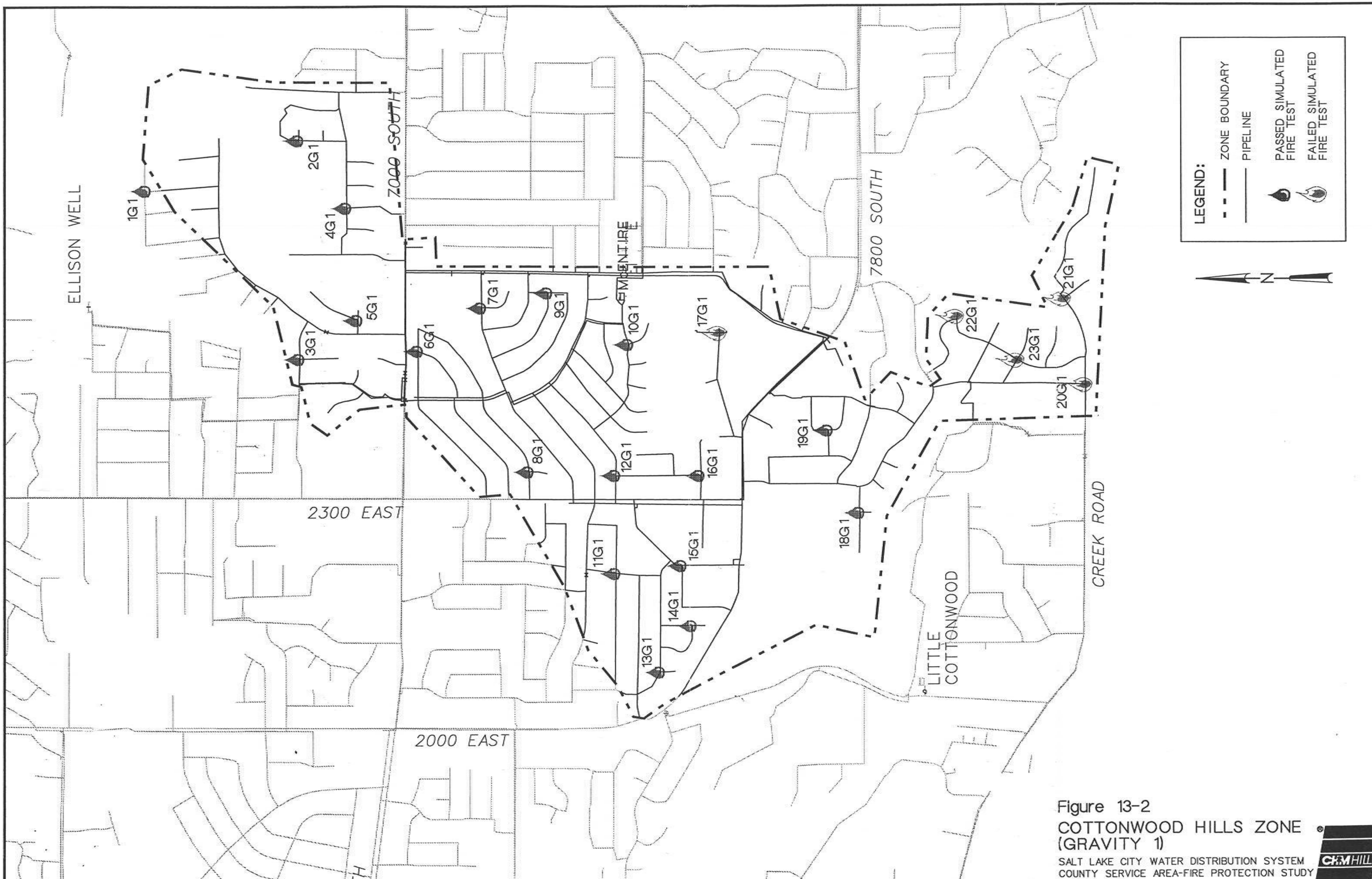


Figure 13-2
COTTONWOOD HILLS ZONE
(GRAVITY 1)
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

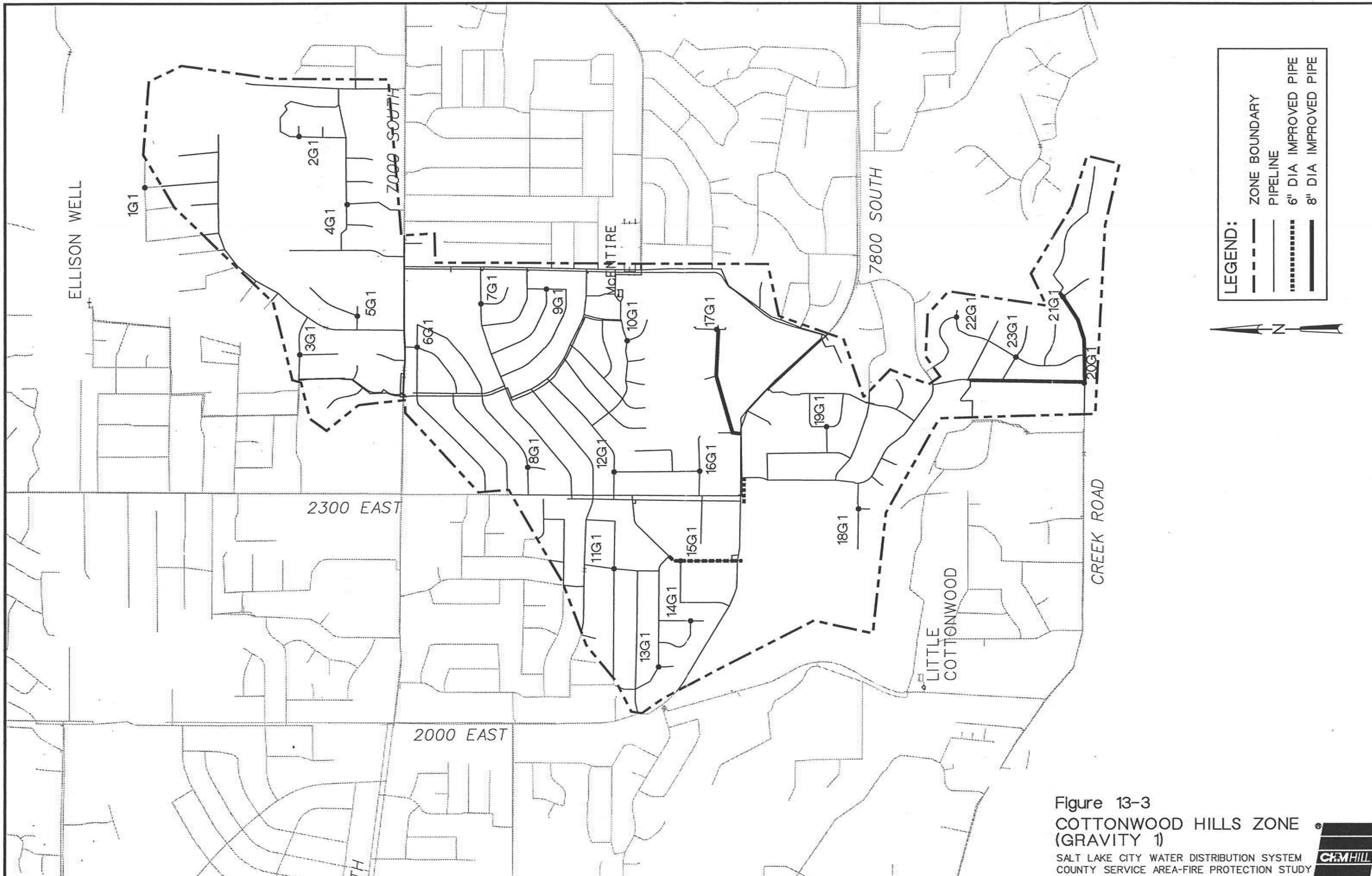


Figure 13-3
COTTONWOOD HILLS ZONE
(GRAVITY 1)
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY
CH2M HILL

RMW37123\FIGURES\FIRES\ZONE14-3.DLV

Salt Lake City Department of Public Utilities
Fire Flow Study
Cost Estimate - Gravity 1 Zone

Table 13-6

idsys	Existing Length	New Length	Existing Diameter	New Diameter	Number Required				Cost					
					Valves	Hydrants	Service	Repair	Pipe	Valves	Hydrants	Service	Repair	TOTAL
	LF	LF	inch	inch	ea	ea	ea	cy	$	$	$	$	$	$
14682	1,357	1,357	4	8	5	3	31	4,523	88,207	3,900	7,500	20,150	21,758	141,514
13644	93	93	6	8	1	1	3	309	6,028	780	2,500	1,950	1,487	12,745
13613	687	687	6	8	3	2	16	2,291	44,667	2,340	5,000	10,400	11,018	73,425
13577	542	542	6	8	2	2	13	1,805	35,198	1,560	5,000	8,450	8,682	58,890
52793	118	118	4	6	1	1	3	394	5,905	600	2,500	1,950	1,456	12,411
13621	599	599	4	6	2	2	14	1,996	29,940	1,200	5,000	9,100	7,385	52,625
13460	155	155	4	6	1	1	4	515	7,727	600	2,500	2,600	1,906	15,333
53105	7	7	4	8	1	1	1	23	450	780	2,500	650	111	4,490
14615	58	58	6	8	1	1	2	194	3,786	780	2,500	1,300	934	9,300
14691	745	745	6	8	3	2	17	2,484	48,430	2,340	5,000	11,050	11,946	78,766
14689	316	316	6	8	1	1	8	1,052	20,515	780	2,500	5,200	5,060	34,056
13744	0	266	0	6	1	1	6	886	13,290	600	2,500	3,900	3,278	23,568
					22	18	118	16,472	304,142	16,260	45,000	76,700	75,022	517,123
									Eng, Legal & Admin				15%	77,568
									Subtotal				-	**594,692**
									Contigency				15%	89,204
									TOTAL				-	**683,895**

Indian Rock Regulated Zone

Chapter 14
Indian Rock Regulated Zone

System Geometry

The Indian Rock Regulated Zone of the Salt Lake County water distribution system is a small zone served directly from the Big Cottonwood Conduit. The Indian Rock Regulated Zone distribution system is shown in Figure 14-1.

Piping

Table 14-1 indicates the size distribution and total length of the piping within the Indian Rock Regulated Zone.

Table 14-1
Indian Rock Regulated
Reservoir Piping Distribution

Diameter	Length in Zone
4" or less	734
6"	6,807
8"	122
10"	0
12" or greater	211
Total Length	7,733

Valves

There are no system valves within the Indian Rock Regulated Zone.

The Indian Rock Regulated portion of the model does include one PRV. Table 14-2 shows the location, pressure setting and HGL of the PRV.

Table 14-2
Indian Rock Regulated PRVs

Station No.	Capitals	Location	Pressure Setting	HGL
CR-15A	58090	5520 S.	65	4743

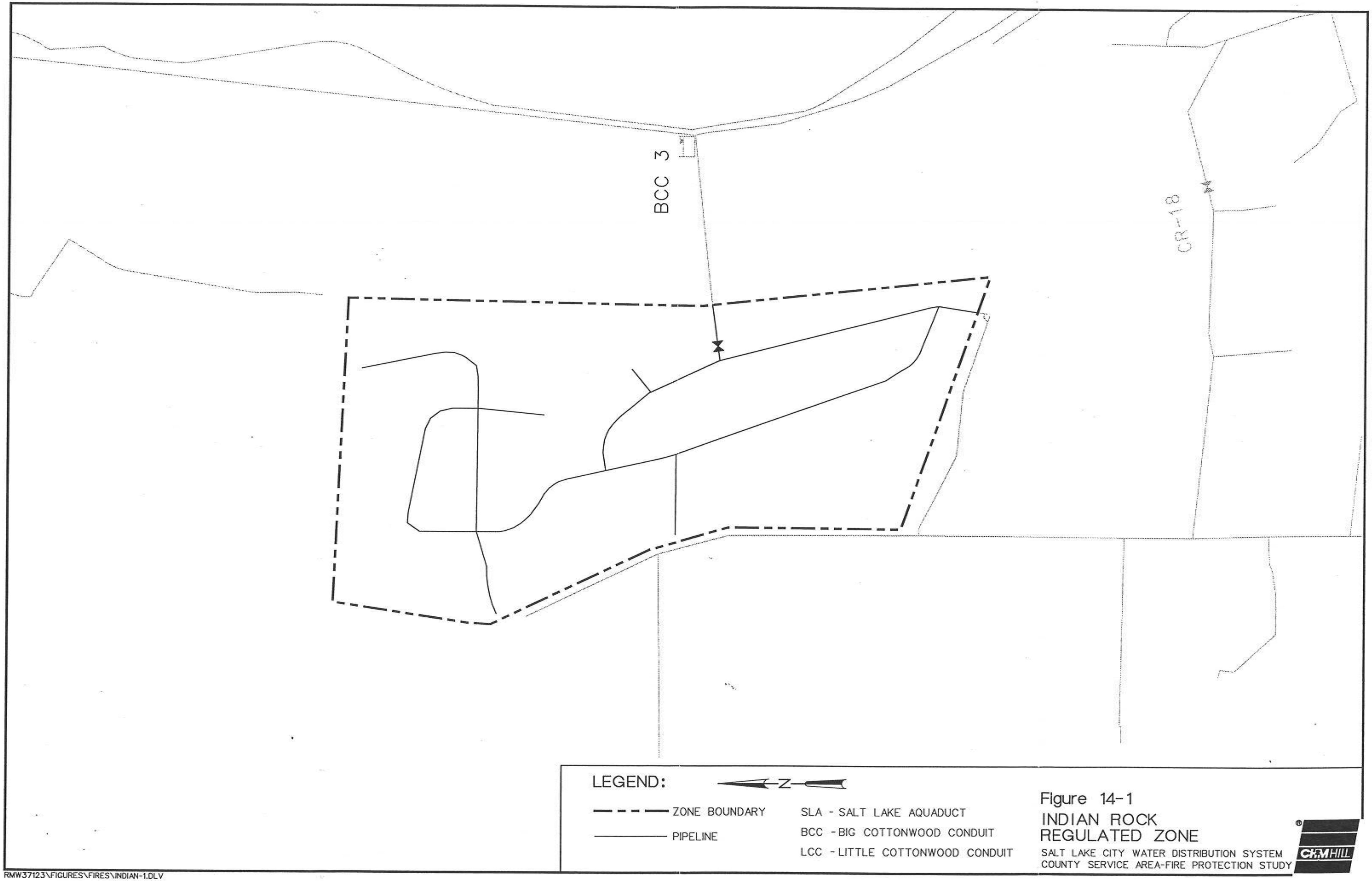


Figure 14-1
INDIAN ROCK
REGULATED ZONE
SALT LAKE CITY WATER DISTRIBUTION SYSTEM
COUNTY SERVICE AREA-FIRE PROTECTION STUDY

Reservoirs

The hydraulic grade line within the Indian Rock is regulated by the one PRV.

Booster Pumps

There are no booster pumps serving the Indian Rock Regulated Zone.

Calibration

Prior to the modelling effort, a series of fire hydrant flow tests were conducted within the Salt Lake County Distribution System to assist in the calibration of the model. Within the Indian Rock Regulated, one such test was conducted. The results of the tests in the Indian Rock Regulated are summarized in Table 14-3.

Table 14-3
Indian Rock Regulated Calibration Test Results

	Static Pressure		Dynamic Pressure	
Test No.	Measured	Calculated	Measured	Calculated
19	95	93	42	57.85

During the static calibration of the model, runs were made at an average demand scenario and adjustments made until the measured pressure equalled the modelled pressure as near as possible. Typical adjustments included the opening and closing of system valves, the adjustment of PRV pressure settings, and the verification of node elevations.

After completion of the static calibration, the model was calibrated against the fire flow tests. This is called the dynamic calibration. The intent of the dynamic calibration is to test the system under some stress (high flows) and check the model's performance against that condition. The measured flows from the fire hydrants were modeled and the calculated pressures compared against those measured in the field. Adjustments in the model were made to bring the calculated results in line with the field measured results.

Dynamic calibration often requires an iterative process. Initial field measurements and system maps are used to set up the model, but the situation in the field is frequently not exactly as described in the maps and other system documentation. Inaccurate mapping (with inexact elevations), valves not in the position recorded (either open or closed), or pipes a different size than shown on maps, are all conditions that exist in most water distribution systems. To get an accurate dynamic model it is often necessary to go back into the field and check valve position, elevation, etc. This additional field work to verify model conditions was not done as a part of this study. It is recommended that as time and manpower permit, field verification be undertaken. For example, elevations of reservoirs, pump stations and PRVs are known. However, the elevations for the remainder of the system were obtained from USGS mapping and are likely not completely accurate for a given location. An elevation difference (between actual and the model) of 5 feet would result in a pressure difference of 2.2 psi. The elevation contours on the USGS mapping are 40 feet. Errors in elevations of up to 20 feet could be expected using this type of mapping. A 20-foot elevation difference would result in a pressure difference of almost 9 psi. Static and dynamic calibration results must be viewed with this potential for errors based on erroneous information in mind.

Fire Run Simulations

Five fire conditions were simulated in this zone. The locations of the simulated fires are shown in Figure 14-2. Table 14-4 shows the low pressure in the zone for each of the fire runs.

Table 14-4
Indian Rock Regulated Fire Flow Results

Simulation No.	Fire Flow (gpm)	Calculated Pressure
1R	1009.22	< 0
2R	1002.00	18.21
3R	1003.72	73.86
4R	1007.82	70.60
5R	1215.54	37.98

Problem Areas

The simulated fire conditions all met the flow and pressure criteria with the exception of a long dead end line. The area in which fire flow and pressure were not achieved are also shown in Figure 14-2.

Recommended Solutions

For the location at which flow and pressure were not achieved, an improvement was developed. The same simulated fires were then run again and the minimum conditions were met. Figure 14-3 shows the required improvements for the Indian Rock Regulated Zone. A cost estimate was prepared for each of these improvements. Table 14-5 shows these cost estimates.