MEMORANDUM

DATE:	January 4, 2022
TO:	Gordon L. Miner, M.E.M, P.E. 12830 S Redwood Road Riverton, Utah 84065
FROM:	Greg Poole, P.E. Kayson Shurtz, P.E. Hansen, Allen & Luce, Inc. (HAL) 859 W. South Jordan Pkwy, Ste. 200 South Jordan, Utah 84095
SUBJECT:	Update to 2006 Riverton City Storm Drainage Master Plan (Study Area A)
PROJECT NO.:	065.12.100

PROFESSIONAL ENGINEER
1/4/2022
9437366-2202
KAYSON M.
SHURTZ
STATE OF UTAH

INTRODUCTION

Riverton City has asked Hansen, Allen, and Luce to perform an update to a previous master plan study completed in 2006 for a specific study area (Study Area A) that has experienced significant development over the past 15 years. Study Area A is generally bound on the west by the Utah and Salt Lake Canal, the east by the South Jordan Canal, the south by approximately 12200 S, and the north by approximately 11800 S. Study Area A is shown in Figure 1. The major purpose of this study update is to determine the size required for the planned regional detention facility considering how development has actually proceeded over the past 15 years. The location of the regional detention facility that was sized as part of this project is shown on Figure 1.

PREVIOUS STUDY

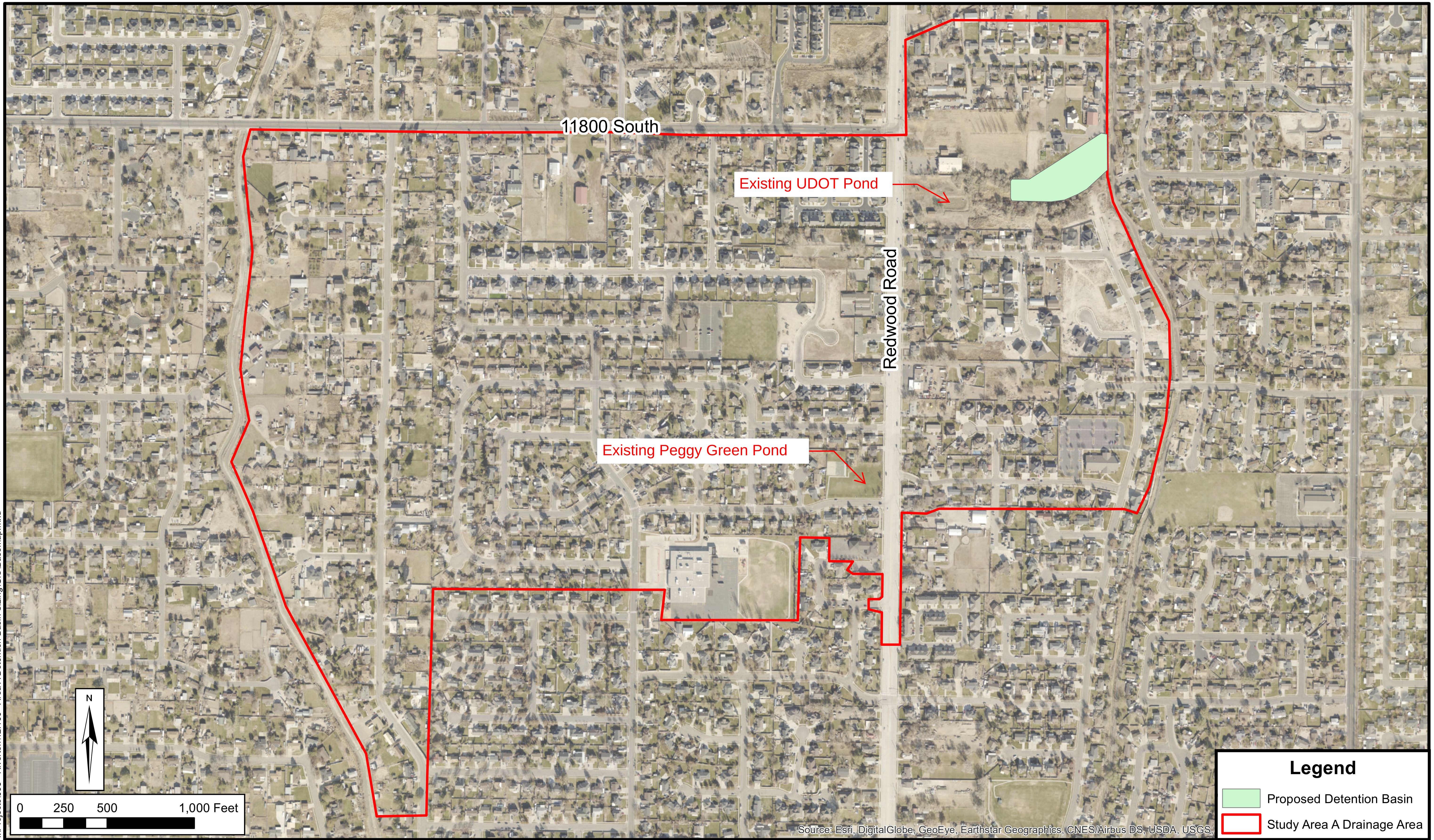
A study completed by Stantec Consulting titled “Riverton City Storm Drainage Master Plan 2006 Update” (dated September 2006) evaluated three specific study areas in the City of Riverton. The study areas were evaluated and master plan projects were recommended based on assumptions for how the study areas would develop. This study is an update to that study with the specific task of sizing the regional detention facility located within Study Area A.

HYDROLOGIC/HYDRAULIC MODEL DEVELOPMENT

The model selected for this study was Autodesk’s Storm and Sanitary Analysis (SSA). This model was selected because of its capability to easily combine hydrologic and hydraulic calculations into a single model. The runoff was calculated based on HEC-1 methodology and the hydraulics were calculated based on the EPA SWMM engine to determine pipe capacity and flows.

Watershed Delineation

The watershed boundaries used for this study were delineated using the prior study as a guide coupled with Lidar contours for additional subbasin splits. The subbasin boundaries used for this study are shown in Figure 2.



HANSEN ALLEN & LUCE inc ENGINEERS

Riverton City

Study Area A Extents with Regional Detention Basin Location

FIGURE 1

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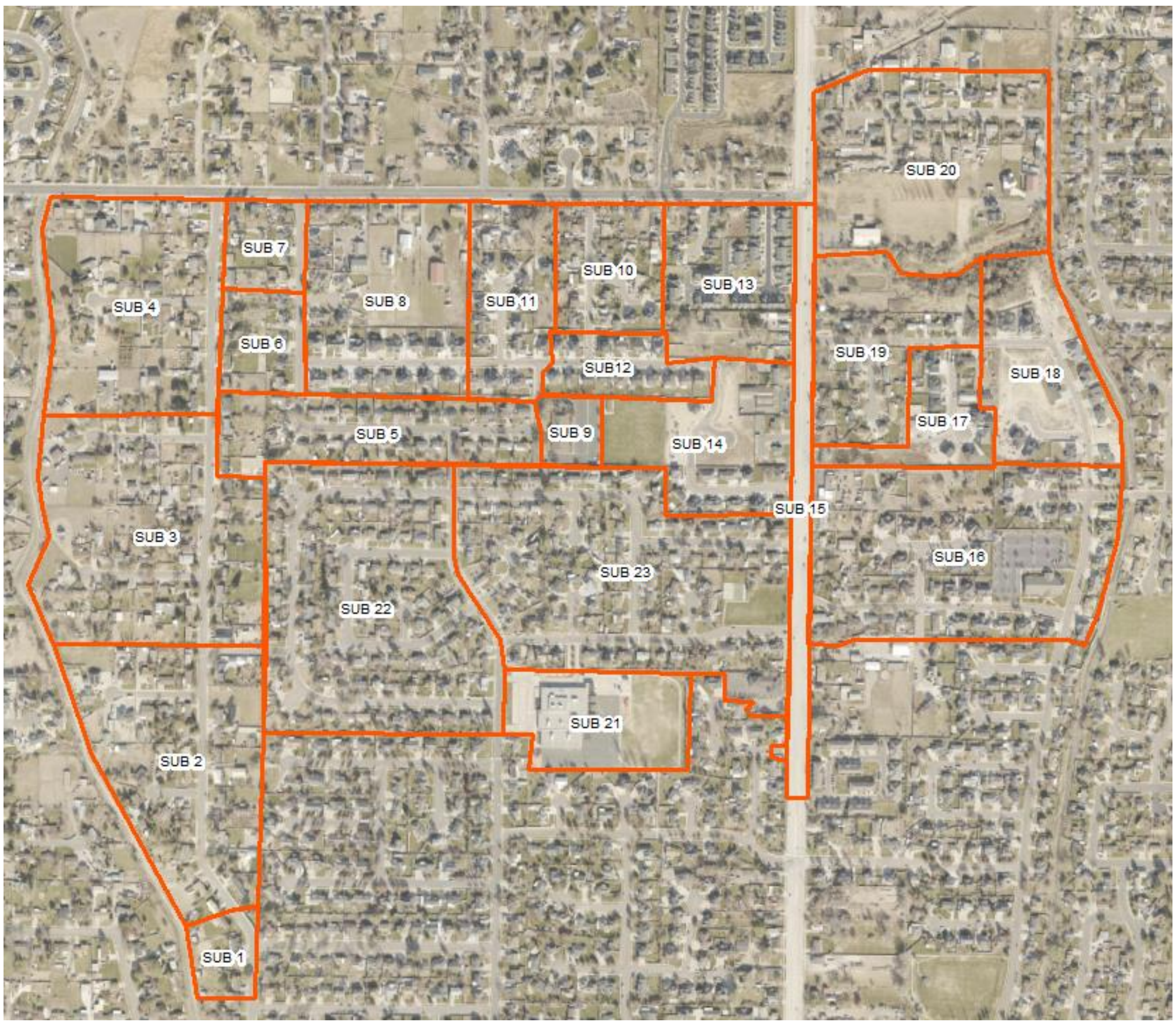

FIGURE 2. SUBBASIN BOUNDARIES FOR STUDY AREA A UPDATE

Model Parameter Estimation

The rainfall runoff method chosen for this analysis was the SCS curve number. Much of the methodology for model parameter estimation is documented in Technical Release 55: Urban Hydrology for Small Watersheds (NRCS 1986), hereafter referred to as TR-55. Soil data from the NRCS was downloaded to establish the hydrologic soil group within the area tributary to Study Area A (100% of the soil in Study Area A is classified as hydrologic soil group D).

A curve number of 80 was assumed based on Table 2-2a from TR-55 for all open space areas with good cover. In the case of Study Area A, this represents all areas that are not defined as impervious area as the majority of this basin is residential with the vast majority of the lots having grassed yards.

Impervious areas were estimated based on the National Agriculture Imagery Program (NAIP) imagery. This particular dataset includes infrared images which can be combined with the typical RGB images to identify healthy vegetation. This process is known as the Normalized Difference Vegetation Index (NDVI) approach. While this data is often used to identify healthy vegetation, the same process can be used to isolate areas that are impervious by using parts of the spectrum that are opposite the growing vegetation areas. An example of the impervious area that was produced using this approach is shown in Figure 3.

FIGURE 3. IMPERVIOUS AREA ESTIMATE EXAMPLE USING NDVI APPROACH

The impervious area was separated into directly connected impervious area (DCIA) and unconnected impervious areas for modeling purposes. Based on a sampling within Study Area A the typical directly connected impervious area was generally about 50% of the total impervious area. This percentage was applied to almost all the basins within Study Area A. SUB 9 and SUB 21 were treated differently than the others because the impervious area runoff is directed to large grassy areas before reaching the storm drain system and are therefore largely unconnected. SUB 15 was considered 100% directly connected because it only includes Redwood Road. The timing and shape of the runoff hydrographs were calculated using a two-plane approach where one plane calculates runoff for the directly connected areas and the other plane calculates runoff for the rest of the subbasin. The overall runoff hydrograph is the sum of the runoff from both planes. Impervious areas were assigned a curve number of 98. The unconnected impervious area was area weighted with the other curve number assumption for each subbasin in the study area to produce a composite curve number. Table 1 summarizes the composite curve numbers and impervious area details for each of the subbasins in Study Area A.

TABLE 1. SUMMARY OF COMPOSITE CN AND IMPERVIOUS AREAS FOR STUDY AREA A

Name	Composite CN	Acres	Percent DCIA	Total Percent Impervious
SUB 1	82.8	3.09	13.4%	26.7%
SUB 10	84.8	7.73	21.2%	42.4%
SUB 11	83.4	9.24	16.0%	31.9%
SUB 13	85.0	11.37	21.7%	43.5%
SUB 14	83.7	12.24	17.0%	33.9%
SUB 15	98.0	6.61	100.0%	100.0%
SUB 16	85.5	29.26	23.3%	46.5%
SUB 17	84.5	6.45	19.8%	39.7%
SUB 18	84.3	12.42	19.4%	38.8%
SUB 19	83.5	13.05	16.1%	32.2%
SUB 2	83.2	22.83	15.3%	30.5%
SUB 20	84.5	24.64	20.0%	39.9%
SUB 21	90.0	9.64	0.0%	55.5%
SUB 22	84.3	32.13	19.3%	38.6%
SUB 23	84.4	34.88	19.8%	39.6%
SUB 3	82.4	26.99	11.9%	23.9%
SUB 4	82.4	20.98	11.7%	23.5%
SUB 5	83.3	12.44	15.6%	31.2%
SUB 6	83.1	4.79	14.8%	29.7%
SUB 7	83.6	4.07	16.6%	33.2%
SUB 8	83.0	17.87	14.2%	28.4%
SUB 9	92.8	2.44	4.2%	72.6%
SUB 12	87.3	5.32	28.9%	57.8%

Design Storm

To compute runoff from a given storm, the distribution of the rainfall through time must be known. Critical runoff events from urban areas along the Wasatch Front are caused by cloudburst type storms which are characterized by short periods of high intensity rainfall. The Farmer–Fletcher design storm distributions were developed using local Utah recording gauge networks for summer thunderstorm type rainfall events. The Farmer–Fletcher design storm distributions were developed with methodology that preserved the measured individual storm burst rainfall intensities. Farmer and Fletcher (1971) examined rainfall gauge records and classified storms based on whether the heaviest rainfall of the storm fell in the first, second, third, or fourth quarter of the storm period. Farmer and Fletcher found that “first and second quartile storms together comprise 76% of those storms containing a burst of 5-minute duration with a 5-year recurrence interval and 92% of storms containing a burst of 10-minute duration, with a 10-year recurrence interval.” Farmer and Fletcher developed model storms for the first and second quartile storms. It was determined in consultation with the City that a 3-hour duration design storm that incorporates a Farmer Fletcher 1-hour first quartile storm event as the middle hour of the three-hour design storm would be used for this analysis. The selected 3-hour design storm distribution is shown in Figure 2.

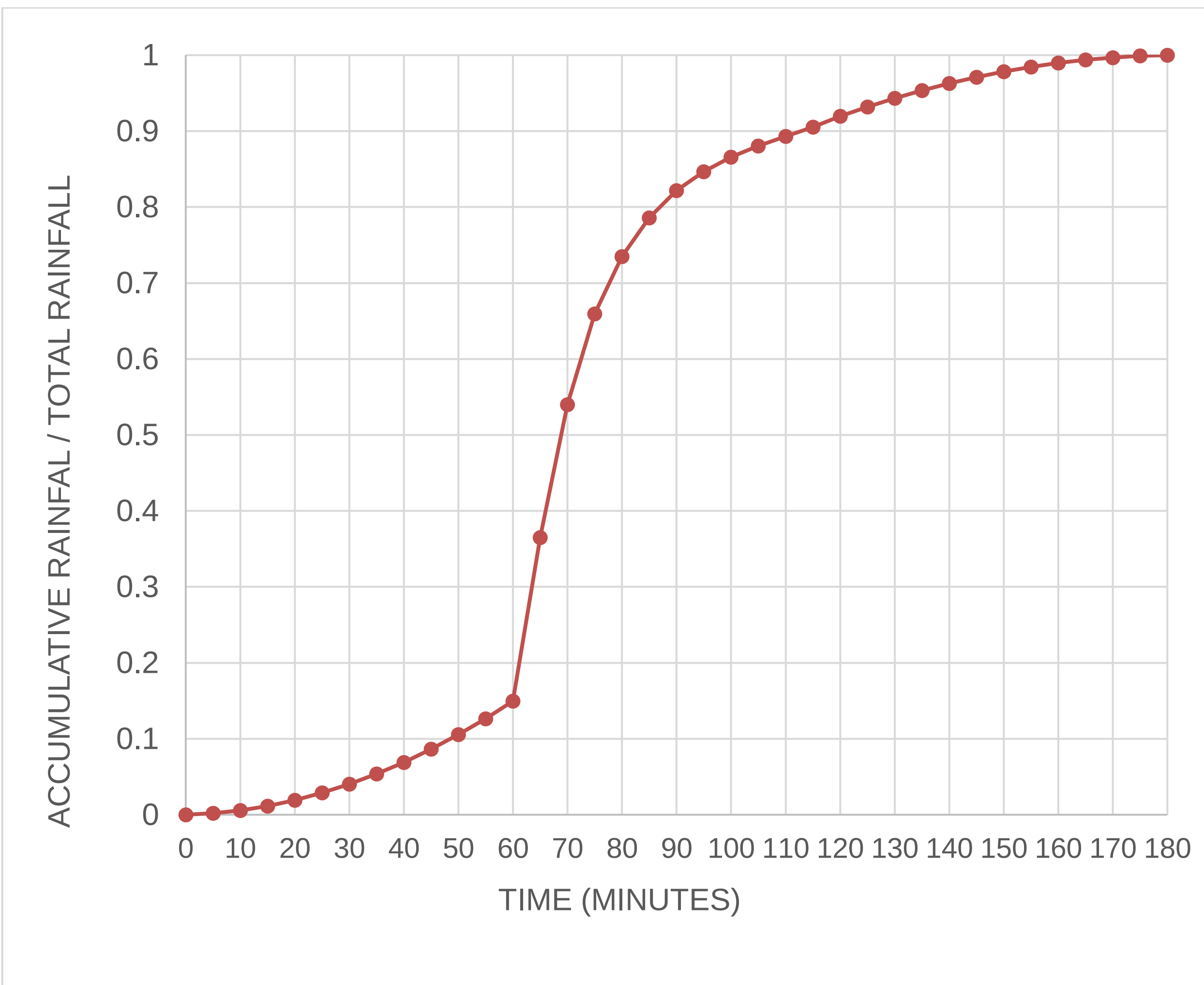

FIGURE 1. SELECTED DESIGN STORM DISTRIBUTION

Precipitation Depth

Precipitation depth for a 100-year return interval for the 3-hour storm were obtained from NOAA Atlas 14: Precipitation-Frequency Atlas of the United States (Bonnin et al. 2004; NOAA 2013). The total drainage area of Study Area A is approximately 0.5 square miles. Thunderstorms in Utah typically have a high intensity core that covers a relatively small area with reduced rainfall depths and intensities as distance from the center of the storm increases. Depth Area Reduction Factors (DARF) are a mechanism that is used to account for this phenomenon. The DARF factor is simply the ratio of a point rainfall and aerial average rainfall that represent the same return period. A cloudburst study was performed in the Salt Lake County by the U.S. Corps of Engineers from 1970-1975. According to this study the appropriate DARF factor for an area of 0.5 square miles and a storm duration of 3 hours is 0.97. The 100-year point rainfall depth, DARF factor, and resulting design rainfall depth are presented in Table 2. The modeling was performed based on the design precipitation depth of 1.80 inches.

TABLE 2. 100-YR STORM DEPTH FOR 3-HOUR DURATION

Storm Duration	Point Precipitation Depth (in.)	DARF Factor 0.5 square miles	Design Precipitation Depth (in.)
3-Hour	1.86	0.97	1.80

Storm Drain Network Data

The main pipe network that drains Study Area A was defined using a combination of City GIS data, “as-built” construction drawings, and field survey data collected by HAL. The major pipes considered critical to this particular analysis were included in the model. The purpose of the modeling was to define the regional detention basin size for a 100-year runoff event. The pipes were not sized for this large of an event and therefore flooding in the streets was expected. Water was allowed to pond at the nodes when pipe capacity was insufficient. In some cases, the water is expected to pond in the streets and slowly drain into the pipes based on capacity. In other cases, water is expected to runoff to other areas of the City if pipe capacity is limited based on elevations. For example, the areas near Peggy Green detention pond along Redwood Road are sloped away from the regional detention facility and therefore if pipe capacity is insufficient, excess runoff is not expected to reach the regional detention facility. Figure 3 shows the SSA model schematic of the Area A storm drainage system.

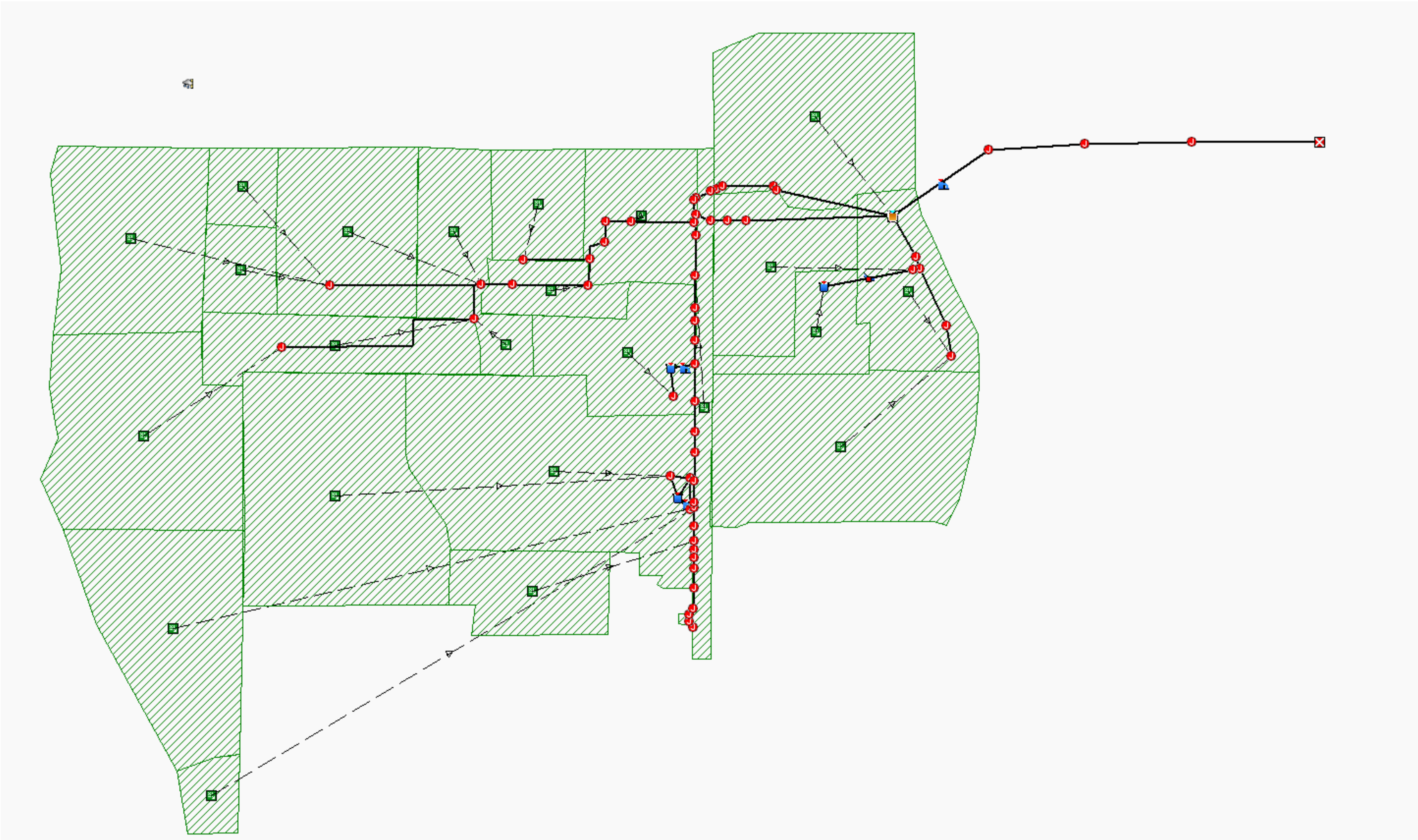

FIGURE 2. SSA MODEL SCHEMATIC FOR STUDY AREA A

ANALYSIS RESULTS

ALTERNATIVES ANALYZED

The following three alternatives were analyzed.

- Expansion of the existing UDOT pond just east of Redwood Road.
- Expansion of existing detention pond at Peggy Green Park.
- Creating a detention pond in the natural low spot of the system just west of the South Jordan Canal (Proposed Regional Detention Facility location on Figure 1).

After review of the property surrounding the UDOT pond it was found that the existing ground owned by UDOT was not large enough to create a pond with sufficient volume to handle the runoff generated by the selected design storm.

Our analysis indicated the expansion of the Peggy Green Detention Pond would not be an effective location for additional storage. A majority of the area tributary to the proposed regional pond is not tributary to Peggy Green and would therefore require additional storage near the UDOT pond or the natural low ground. Additionally, the anticipated release from Peggy Green plus the additional tributary area is greater than the restrictive release under the South Jordan Canal. This means the downstream pond ends up storing most of the volume of the upstream pond making the storage upstream largely ineffective in reducing the overall storage volume required at the downstream end of the system.

Sycamore Glen is a planned development that includes the proposed regional detention facility shown on Figure 1. This location is ideal because it is the low point of the entire system. This study evaluated the total required storage volume at this location. Based on the Sycamore Glen preliminary plans and modeling results this location appears to be feasible for the regional detention facility, and is the recommended alternative.

RECOMMENDED DETENTION BASIN SIZE

Model results indicate the anticipated peak flow into the proposed detention facility is approximately 109 cfs. An important factor in sizing the proposed regional detention facility is the design release rate. In consultation with the City, it was determined that the release rate would be based on the capacity of a 12-inch pipeline. Our modeling indicated that a release rate of 7 cfs would be appropriate for the proposed detention basin. Based on the assumed release rate of 7 cfs the total required storage volume for the proposed detention basin is approximately 14.5 acre-ft. A graph of these results in shown in Figure 3.

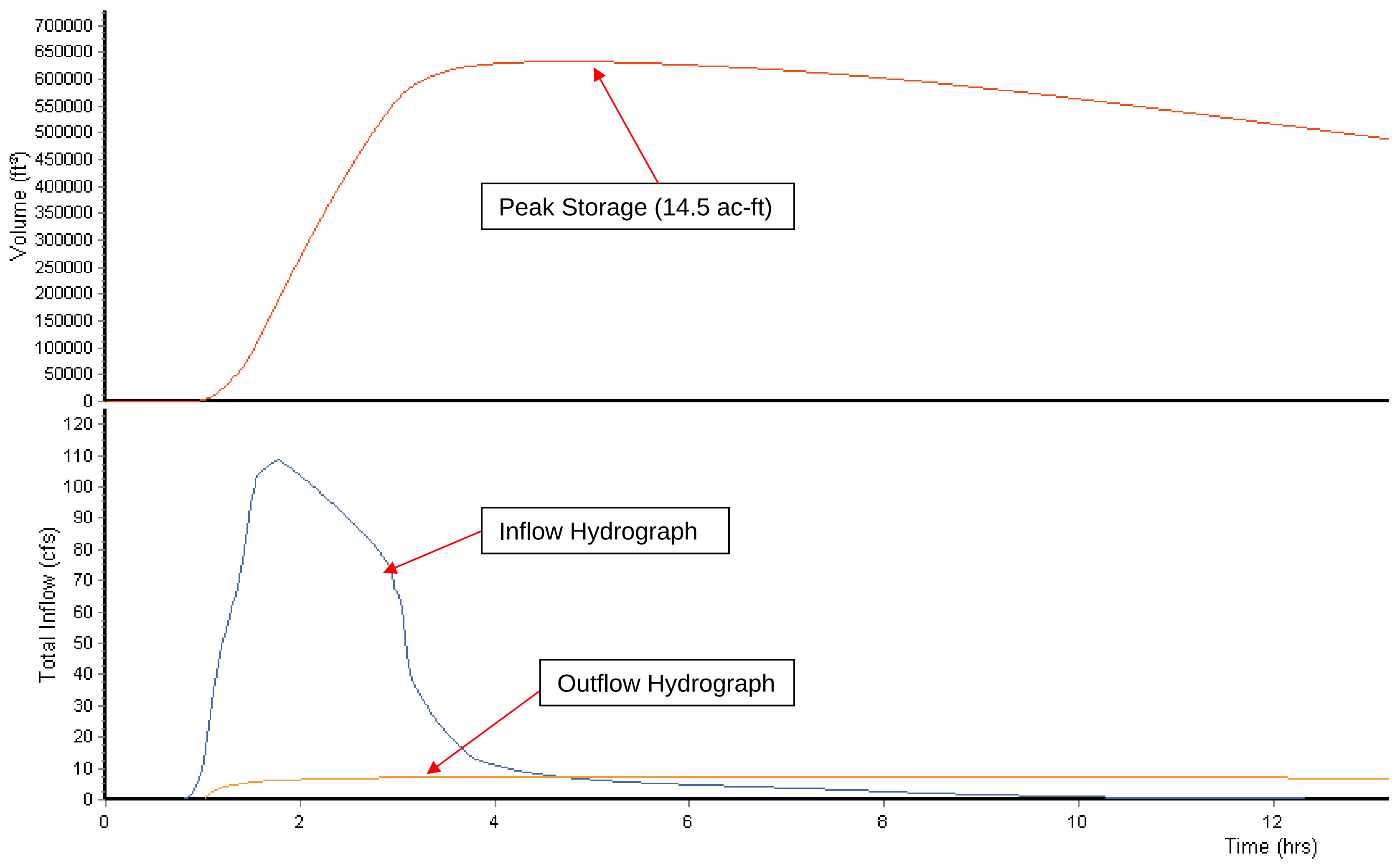

FIGURE 3. MODEL RESULTS FOR 100-YR 3-HR DESIGN STORM AT PROPOSED DETENTION FACILITY

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