AURORA, MISSOURI

STORMWATER MASTER PLAN

COUNCIL PACKET

February 2019

Prepared by
ALLGEIER, MARTIN and ASSOCIATES, INC.
Consulting Engineers
Joplin, Missouri

ALLGEIER, MARTIN and ASSOCIATES, INC.
Consulting Engineers

February 27, 2019

Mr. Jon Holmes, City Manager
City of Aurora
P. O. Box 30
Aurora, Missouri 65605

Re: Aurora Stormwater Master Plan – Council Packet

Dear Mr. Holmes:

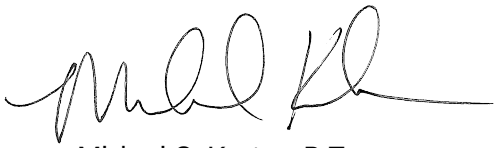
As authorized by our engineering services agreement dated November 1, 2017, we present herewith a pared down version of the Stormwater Master Plan for the Aurora City Councils use. The official signed and sealed report will be on file with City of Aurora.

The report analyzes the existing storm sewer system, and makes recommendations for a construction program to bring facilities into compliance with City standards.

We appreciate the opportunity to provide this service to the City of Aurora. We look forward to initiating design of the recommended improvements in the near future.

Sincerely,

ALLGEIER, MARTIN and ASSOCIATES, INC.



Michael C. Keaton, P.E.
Project Engineer

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I. EXECUTIVE SUMMARY

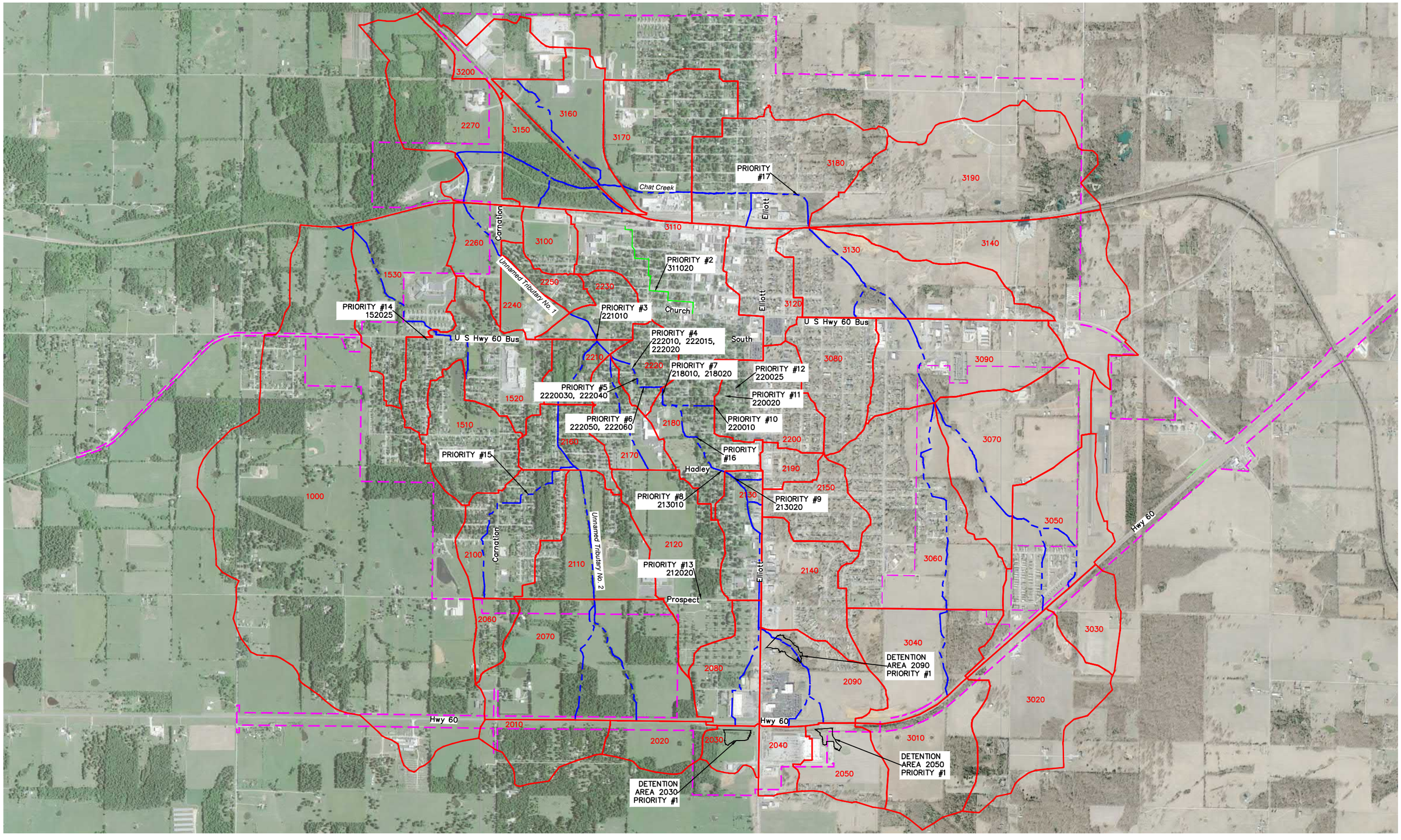
The City of Aurora has an aging storm sewer system that is in need of repair and upgrade. In recognizing this need, the City of Aurora contracted with Allgeier Martin and Associates to conduct a study of the City's system and provide recommendations for improvements over the next 10 to 20-year period.

Areas located within the primary flow path within each basin are the subject of this report. Small driveway culverts and minor systems were not collected at this time. The following report provides an analysis of 105 existing structures 30 of which (29%) are currently adequately sized, while 75 structures (71%) are currently undersized. Of those 75 undersized structures, 40 have a flowrate capacity of less than 50% of the City's current flowrate capacity requirements. Design criteria is defined in Aurora's General Design Requirements (AGDR), Section 545.100.A.1. In summary, structures with less than 1 square mile of drainage area are required to pass the 25 year storm event and structures with more than 1 square mile of drainage area are required to pass the 100 year event.

Based on site investigations, public meeting comments, city personnel experiences, and watershed impact Allgeier Martin and City staff generated recommend improvements. Each area has also been given a recommended priority level for improvement with number one being the most critical. The assigned priority was based on the opinion of the engineer who prepared this report and the City's staff after considering the factors mentioned above. There are 17 recommended improvement projects identified with a capital cost totaling close to $10,000,000. Locations are shown in Figure 1 below along with the various drainage areas, primary flow paths, and corporate limits at the time of the study. These projects are also listed in order of importance and summarized in Table 2. However, the responsibility for final establishment of project priorities rests with the Aurora City Council. In addition, the recommended improvement project descriptions and cost estimates should be considered planning grade. Each project will require a more detailed analysis and design prior to construction. Cost estimates are shown in Appendix H and include, construction cost, engineering, land acquisition as noted, and contingencies.

The City currently funds maintenance and improvement of the storm sewer system with a budget of approximately $150,000 per year. We estimate for minor system improvements and general maintenance tasks that an appropriate level of spending for a system of the size and age of the City of Aurora is approximately $180,000 per year. While the current funding mechanism generally covers maintenance tasks and minor improvements an increase in the current level of funding will be necessary to construct the recommended capital improvements.

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\FIGURE 1.DWG



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ALLGEIER, MARTIN and ASSOCIATES, INC.
CONSULTING ENGINEERS and SURVEYORS
7231 EAST 24th STREET JOPLIN, MISSOURI 64804 (417) 680 - 7200

CERTIFICATE OF AUTHORITY MISSOURI NO. 000427

DATE	REVISION

DWN. BY:	CCM
CKD. BY:	MCK
APPD. BY:	MCK
DATE :	NOV.,2018

DRAINAGE AREA AND CAPITAL IMPROVEMENT PRIORITY MAP
STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO.
FIG. 1

II. GENERAL INFORMATION

A. Authorization and Scope

Allgeier, Martin and Associates, Inc. (AMA) entered into an agreement with the City of Aurora on November 15, 2017 for the preparation of a Stormwater Master Plan. Specific services authorized include:

- Meet and coordinate with the City the project scope and schedule. Identify known problem areas and existing records for problems, projects and infrastructure.
- Hold a public meeting to solicit comments on drainage issues in the community.
- Identify design and analysis criteria for the project.
- Define key points of interest in each watershed.
- Develop base mapping. The current City GIS base map will be used as the base map for the SWMP.
- Locate and map the existing stormwater system elements including inlets, junctions, open channels, pipes, etc.
- Conduct site visits to verify mapping and collect hydrologic and hydraulic analysis parameters. Inspect system elements for structural integrity and/or other defects.
- Perform hydrologic analysis of each watershed to determine the design flowrates.
- Perform hydraulic analysis of existing conveyance system.
- Develop and analyze alternatives to provide the desired level of flood protection.
- Map proposed improvements.
- Develop a prioritized list of improvements.
- Prepare an estimate of probable cost for the recommended improvements.
- Review current City stormwater ordinances and make recommendations, if necessary, for revisions to these ordinances. Comments were provided as a separate document to the City and does not include actually making the revisions and updating the ordinances.
- Prepare a draft SWMP report. Review the report with City personnel and respond to comments.
- Finalize the SWMP report. Present report to City council.
- Present the report to the public in an open house format.

B. Area Information

The City of Aurora has a population of 7,481 and has a corporate limit of 6.17 square miles. The City is primarily comprised of roadway culverts and open channels. Very few inlets and closed systems exist throughout the City. Excluding minor driveway culverts and small systems, the City maintains over 100 major roadway culverts and over 11.5 miles of open channel. The City of Aurora also participates in FEMA's National Flood Insurance Program (NFIP) and therefore most of the major drainage ways are mapped within the City limits.

III. METHOD OF ANALYSIS

A. Data Collection

The first step in the analysis process was data collection. AMA conducted field investigations and collected survey data for existing roadway culverts, inlets, and piping within the City of Aurora. It should be noted that only those structures located in the primary flow path within each basin were collected. Small driveway culverts and minor systems were not collected at this time. Information was strategically collected so that it may be easily incorporated into the City's existing GIS mapping. Information generally included type, size, condition, approximate depth of cover, upstream elevation, downstream elevation, and four photos to document the existing conditions at the time of the survey. A GIS data dictionary is included in Appendix F that describes each attribute in greater detail.

To collect the GIS data a Leica Zeno 5 handheld unit and a Leica GG03 head unit were used on a survey range pole. The Leica Zeno 5 was running Zeno Office on ArcMap. The Leica GG03 head unit provided sub-centimeter accuracy and utilized the MoDOT (Missouri Department of Transportation) Network as a correction service. The handheld unit was preloaded with a base map and a menu containing the required attributes to simplify and provide uniformity to the data collection process.

In addition, a public meeting was held on July 12, 2018 at City Hall to gain public knowledge of known problem areas throughout the community. Approximately 27 residents were in attendance. Maps of the City's storm sewer system were displayed on easels and tables and City staff and Allgeier Martin employees were stationed at each map to take notes.

B. System Mapping

The project limits were established based on drainage patterns rather than political boundaries. Drainage basin boundaries were determined based on the combination of a LiDAR topography map of +/- 1 ft resolution superimposed upon an aerial photography map of Aurora, MO. Three major basins were determined which encompassed the area of interest. Minor basin areas were determined based on points of interest within each major basin such as key culvert and bridge locations where storm capacity information was desired. Maps for field use are located in Appendix I, however, system mapping will primarily reside in the City's existing GIS system.

C. Hydrology

The Army Corps of Engineering program, HEC-1, was used to model the system and hence compute peak discharges at specific locations corresponding to the array of local rainfall events. The Transfer Method was used to obtain peak discharges for structures inside the boundary of an upstream sub-basin. Point precipitation frequency estimates from NOAA Atlas 14, Volume 8, Version 2 were obtained for Aurora, MO to provide the precipitation amounts for the HEC-1 model. Rainfall data analyzed were for 2-, 5-, 10-, 25-, 50-, and 100-year return periods and 1-, 2-, 3-, 6-, 12-, and 24-hour storm durations. The storm duration that created the maximum discharge for each return period was used for subsequent computations. Huff's Distributions were used to temporally distribute the precipitation amounts in the model such that they approximated actual rainfall events. Huff's First Quartile Distribution was used for the rainfall events whose durations were six hours or less, while Huff's Second Quartile Distribution was used for the twelve-hour event, and Huff's Third Quartile Distribution was used for the twenty-four-hour event. Rainfall was assumed to have a uniform spatial distribution. The Area, the Runoff Curve Number and the Lag Time (based on the Time of Concentration) were computed for each minor basin and are tabulated in Appendix A. The procedures and assumptions associated with the computation of the latter two parameters are elaborated in Appendix B. The TR-55 Runoff Curve Number conversion table used for computations is shown in Appendix C. A sample of the HEC-1 output code used to model the system is shown in Appendix D. The hydrologic modeling presented is consistent with preliminary design. All future detailed engineering projects will require a more detailed investigation of the project site and drainage basin, and hence, the models shall be adjusted accordingly.

D. Hydraulics

Once the peak discharges were generated for each structure of interest from the HEC-1 model, the maximum flowrate capacity of each structure was calculated using FHWA HDS-5 inlet control conditions and the submerged flow equation. The parameters of each structure needed for the computations, such as the inlet configuration, geometry, slope, and overtop elevation were obtained via survey points, photographs, aerial photography, topographic mapping, and GIS information. The flow elevation used for the computation of each structure's flowrate capacity was the crest elevation of the road or bridge which resided above the structure. The submerged flow condition was assumed in HDS-5 inlet control computations due to the fact that each structure's overtop elevation for its maximum flowrate capacity was greater than the elevation required to submerge the inlet. Appendix E tabulates the parameters associated with that computation for each structure. The maximum flowrate capacity for each existing structure was then compared to its peak flowrates corresponding to storm events from the HEC-1 model to determine its current storm capacity. The current storm capacities of each existing structure are tabulated in Table 1.

IV. Existing System Performance

A. Summary

Existing capacities were computed for 105 structures. For each structure, its existing capacity was compared against the current capacity requirements, as defined in Aurora's General Design Requirements (AGDR), Section 545.100.A.1 to evaluate whether the existing structure is adequately sized. Of the 105 existing structures evaluated, 30 of which (29%) are currently adequately sized, while 75 structures (71%) are currently undersized. Of those 75 undersized structures, 40 have a flowrate capacity of less than 50% of the City's current flowrate capacity requirements.

Table 1 summarizes the capacities of existing structures. In each row, the Structure ID identifies each structure and its corresponding drainage basin on the structure map. The Description identifies the inlet geometry and material. The Storm CAP identifies the capacity of each existing structure in terms of the maximum rainfall event for which it can handle the flowrate. The Flow CAP identifies the maximum inlet-controlled flowrate that the structure can handle

without water overtopping its associated road (or bridge, etc). Next, the peak flowrate associated with each rainfall event is shown. Grayed cells in each row indicate rainfall events which exceed the capacity of the structure. The AGDR Storm CAP column is the storm capacity that the Aurora General Design Requirements states is relevant for that structure location, based on the drainage area associated with the structure. Sister structures, whose individual flowrates combine to handle the total flowrate at a given location, have combined capacities denoted by merged rows. For example, Structures 152020 and 152030 are sister structures splitting the same peak runoff flowrate within the 1520 sub-basin, and combined, they currently have a 10-year capacity.

Table 1 - Inlet Control Capacities of Existing Structures

Current Structure & Capacity			Additional Details							
Structure ID	Description	Storm CAP	Flow CAP (cfs)	2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	AGDR* Storm CAP
152010	2 - 7' x 3' RCB	10-Yr	292	104	160	218	308	386	472	25-Yr
152020	4' x 2.5' RCB	10-Yr	277	104	160	218	308	386	472	25-Yr
152030	6' x 4' RCB									
152025	15" RCP	< 2-Yr	11	12	19	26	36	45	55	25-Yr
201010	3' RCP	100-Yr	118	12	17	20	26	31	35	25-Yr
202010	3' RCP	100-Yr	87	12	18	23	29	35	40	25-Yr
203010	3' RCP	100-Yr	118	12	19	27	39	49	61	25-Yr
204010	3' RCP	100-Yr	133	24	34	42	49	56	63	25-Yr
205010	5' x 6' RCB	100-Yr	486	21	36	51	75	97	121	25-Yr
206010	2 - 3' RCP	100-Yr	100	9	14	20	29	37	47	25-Yr
207010	2 - 64" x 43" CMPA	10-Yr	219	82	126	172	248	314	389	25-Yr
208010	8' x 4' RCB	10-Yr	257	119	185	249	351	437	533	25-Yr
208020	57" x 38" CMPA	5-Yr	80	43	69	94	134	169	208	25-Yr
208025	2.5' RCP	2-Yr	28	28	44	60	86	108	133	25-Yr
208030	18" RCP	100-Yr	17						12	25-Yr
209010	6' x 4' RCB	10-Yr	225	82	127	170	235	289	350	25-Yr
209020	4' RCP	100-Yr	212	24	36	46	63	77	92	25-Yr
209030	18" RCP	100-Yr	19						13	25-Yr
210010	2 - 57" x 38" CMPA	25-Yr	160	39	62	87	131	168	208	25-Yr
210020	2 - 42" x 29" CMPA	10-Yr	83	31	49	69	103	133	164	25-Yr
210030	21" x 15" CMPA	< 2-Yr	7	25	39	55	83	106	131	25-Yr
210040	21" x 15" CMPA	< 2-Yr	7	25	39	55	83	106	131	25-Yr
210050	21" x 15" CMPA	< 2-Yr	7	25	39	55	83	106	131	25-Yr
210060	57" x 38" CMPA	25-Yr	88	25	39	55	83	106	131	25-Yr
211010	3 - 4' CMP	10-Yr	270	109	168	232	338	433	540	25-Yr
212010	3 - 42" x 29" CMPA	10-Yr	125	46	72	98	141	178	219	25-Yr
212020	14" CMP	< 2-Yr	6	18	28	38	55	69	85	25-Yr
213010	2 - 64" x 43" CMPA	2-Yr	210	208	327	442	625	784	960	25-Yr
213020	2 - 64" x 43" CMPA	2-Yr	210	208	327	442	625	784	960	25-Yr
213030	8' x 4' RCB	5-Yr	232	119	185	249	351	437	533	25-Yr
213040	8' x 4' RCB	5-Yr	228	119	185	249	351	437	533	25-Yr
213050	8' x 4' RCB	10-Yr	257	119	185	249	351	437	533	25-Yr
213060	9.5' x 3.5' RCB	10-Yr	291	119	185	249	351	437	533	25-Yr
213070	8' x 4' RCB	5-Yr	204	119	185	249	351	437	533	25-Yr
213080	8' x 4' RCB	10-Yr	279	119	185	249	351	437	533	25-Yr

*ADGR - Aurora General Design Requirements [City of Aurora Storm Sewer and Drainage Design, Section 545.100.A.1]

Capacity Color Code	100% CAP	>75% CAP	50-75% CAP	<50% CAP

Table 1 - Inlet Control Capacities of Existing Structures (cont.)

Current Structure & Capacity			Additional Details							
Structure ID	Description	Storm CAP	Flow CAP (cfs)	2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	AGDR* Storm CAP
214005	8' x 4' RCB	100-Yr	265	39	60	81	114	142	174	25-Yr
214010	68" x 43" RCP	100-Yr	143	5	8	11	15	18	23	25-Yr
214015	68" x 43" RCP	50-Yr	143	34	52	70	98	122	150	25-Yr
214020	6' x 3' RCB	100-Yr	155	34	52	70	98	122	150	25-Yr
214025	64" x 43" CMPA	25-Yr	105	30	47	63	89	111	136	25-Yr
214030	64" x 43" CMPA	25-Yr	105	30	47	63	89	111	136	25-Yr
214035	64" x 43" CMPA	25-Yr	105	30	47	63	89	111	136	25-Yr
214040	2' RCP	5-Yr	23	14	21	28	40	50	61	25-Yr
214045	2' RCP	10-Yr	29	14	21	28	40	50	61	25-Yr
214055	2' RCP	5-Yr	23	12	19	25	35	44	54	25-Yr
214060	42" x 29" CMPA	25-Yr	42	12	19	25	35	44	54	25-Yr
214065	2' CMP	5-Yr	19	10	15	20	29	36	44	25-Yr
214070	2' CMP	5-Yr	19	10	15	20	29	36	44	25-Yr
214075	2' CMP	100-Yr	19	4	6	8	11	14	17	25-Yr
214080	18" CMP	10-Yr	10	4	6	8	11	14	17	25-Yr
215010	5' x 3.5' RCB	100-Yr	162	30	47	64	90	112	137	25-Yr
215020	42" x 29" CMPA	2-Yr	36	30	47	64	90	112	137	25-Yr
215030	35" x 24" CMPA	< 2-Yr	24	30	47	64	90	112	137	25-Yr
216010	3 - 64" x 43" CMPA	5-Yr	329	162	253	350	508	654	817	25-Yr
217010	2 - 49" x 33" CMPA	10-Yr	125	46	72	98	141	178	219	25-Yr
217020	64" x 43" CMPA	10-Yr	139	46	72	98	141	178	219	25-Yr
217030	35" x 24" CMPA									
217040	3' CMP	5-Yr	92	46	72	98	141	178	219	25-Yr
217050	3' CMP									
218010	64" x 43" CMPA	2-Yr	309	260	414	567	810	1020	1256	25-Yr
218020	8' x 4' RCB									
218030	77" x 52" CMPA	50-Yr	166	46	70	94	130	161	196	25-Yr
219010	2' RCP	5-Yr	29	19	28	37	50	61	73	25-Yr
220010	4' x 3' RCB	5-Yr	72	46	70	94	130	161	196	25-Yr
220020	3.5' x 3' RCB	2-Yr	52	46	70	94	130	161	196	25-Yr
220025	4' x 2.5' RCB	2-Yr	64	46	70	94	130	161	196	25-Yr
221010	2 - 7.5' x 5' RCB	2-Yr	565	481	766	1062	1542	1960	2427	100-Yr
222010	8' x 3' RCB	< 2-Yr	256	260	414	567	810	1020	1256	25-Yr
222020	64" x 43" CMPA									
222030	8' x 4' RCB	2-Yr	319	260	414	567	810	1020	1256	25-Yr
222040	64" x 43" CMPA									

*ADGR - Aurora General Design Requirements [City of Aurora Storm Sewer and Drainage Design, Section 545.100.A.1]

Capacity Color Code	100% CAP	>75% CAP	50-75% CAP	<50% CAP

Table 1 - Inlet Control Capacities of Existing Structures (cont.)

Current Structure & Capacity			Additional Details							
Structure ID	Description	Storm CAP	Flow CAP (cfs)	2-Yr (cfs)	5-Yr (cfs)	10-Yr (cfs)	25-Yr (cfs)	50-Yr (cfs)	100-Yr (cfs)	AGDR* Storm CAP
222050	9.5' x 3.5' RCB	< 2-Yr	252	260	414	567	810	1020	1256	25-Yr
222060	57" x 38" CMPA									
223010	2 - 12' x 5' RCB	25-Yr	1767	491	782	1081	1571	1999	2478	100-Yr
223020	10' x 7' RCB									
225010	2 - 10' x 7' RCB	5-Yr	1023	502	801	1104	1608	2049	2542	100-Yr
225020	25' x 5.5' Ped. Bridg	2-Yr	666	491	782	1081	1571	1999	2478	100-Yr
225030	2 - 9' x 5.2' Bridge	< 2-Yr	440	491	782	1081	1571	1999	2478	100-Yr
226010	12' x 8' RCB	10-Yr	1265	511	818	1125	1641	2094	2600	100-Yr
227010	2 - 3' CMP	< 2-Yr	118	511	818	1125	1641	2094	2600	100-Yr
301010	6' x 3' RCB	100-Yr	277	37	60	82	114	136	157	25-Yr
302010	5' x 3' RCB	100-Yr	225	45	71	93	121	141	158	25-Yr
303010	6' x 3' RCB	100-Yr	284	15	25	35	51	65	80	25-Yr
304010	4' x 1.5' RCB	< 2-Yr	33	82	130	177	249	302	360	25-Yr
305010	3.5' RCP	< 2-Yr	78	97	152	204	281	342	410	25-Yr
308010	6' x 4' RCB	100-Yr	193	39	61	83	119	150	184	25-Yr
308020	2 - 18" CMP	< 2-Yr	29	39	61	83	119	150	184	25-Yr
308030	35" x 24" CMPA	< 2-Yr	28	39	61	83	119	150	184	25-Yr
309010	2 - 12' x 6' RCB	25-Yr	1125	302	484	664	951	1201	1471	100-Yr
309020	4 - 64" x 43" CMPA	2-Yr	421	302	484	664	951	1201	1471	100-Yr
313010	35' x 10' RR Bridge	100-Yr	2848	409	642	889	1283	1637	2023	100-Yr
313020	2 - 20" Other	< 2-Yr	32	302	484	664	951	1201	1471	100-Yr
313030	12" RCP									
315010	2 - 12' x 7.5' RCB	10-Yr	1602	671	980	1373	2013	2596	3237	100-Yr
316010	20' x 59' RR Bridge	100-Yr	18764	592	875	1225	1796	2314	2883	100-Yr
316020	5 - 2' CMP	100-Yr	163	30	48	66	94	120	147	25-Yr
317010	45' x 6' RR Bridge	10-Yr	1365	557	827	1157	1694	2180	2713	100-Yr
318010	4 - 6' x 5' RCB	2-Yr	690	526	805	1122	1634	2097	2605	100-Yr
318020	3 - 57" x 38" CMPA	< 2-Yr	218	526	805	1122	1634	2097	2605	100-Yr
318030	64" x 43" CMPA	< 2-Yr	324	460	716	995	1445	1850	2294	100-Yr
318040	9' x 4' RCB									
318050	10' x 5' RCB	< 2-Yr	335	460	716	995	1445	1850	2294	100-Yr
318060	2 - 8' x 4' RR Bridge	2-Yr	624	409	642	889	1283	1637	2023	100-Yr
320010	5 - 2' CMP	50-Yr	132	30	48	66	94	120	147	25-Yr
320020	4 - 2' CMP	10-Yr	91	30	48	66	94	120	147	25-Yr

*ADGR - Aurora General Design Requirements [City of Aurora Storm Sewer and Drainage Design, Section 545.100.A.1]

Capacity Color Code	100% CAP	>75% CAP	50-75% CAP	<50% CAP

V. Recommended System Improvements

A. Capital Improvements

Allgeier Martin and City staff generated recommend improvements based on site investigations, public meeting comments, city personnel experiences, and watershed impact. Each area has also been given a recommended priority level for improvement with number one being the most critical. The assigned priority was based on the opinion of the engineer who prepared this report and the City's staff after considering the factors mentioned above. The areas of interest are located in various watersheds throughout the City of Aurora as shown in Figure 1. Each area has been summarized in Appendix G with an existing problem description, recommended improvements, and potential alternatives (if applicable) to the recommended improvements. A detailed construction cost estimate was also generated for most of the recommended improvements and is located in Appendix H. Table 2 below, summarizes the 17 projects identified in this report with present worth cost estimates for each. A future worth cost estimate for the year 2023 and 2028 is also shown for reference, with the understanding that some of these projects may not be built for quite some time.

It is important to note that the willingness of potentially benefited property owners to dedicate easements for the construction of improvements has not been considered. Another factor not considered is the potential influence of other improvement programs within the vicinity of the storm drainage improvement projects. It is also important to note that the 17 projects listed are considered high priority over the 10 to 20-year period. That is not to say that other improvements to the system will not be needed as there are many other deficiencies that will eventually need to be addressed. For those reasons, the priorities should not be considered as absolute. In addition, the recommended improvement project descriptions and cost estimates should be considered planning grade. Each project will require a more detailed analysis and design prior to construction.

TABLE 2 - CAPITAL IMPROVEMENT PROJECT RECOMMENDATION							
Priority Number	Structure Number	Location	2018 Cost Estimate	2023 Cost Estimate	2028 Cost Estimate	Existing Capacity (yr.)	Proposed Design Capacity (yr.)
1	N/A	Regional Detention in Subbasins 2030, 2050, and 2090	$2,401,000	$2,784,000	$3,228,000	N/A	N/A
2	311020	Box Culvert/Sidewalk Network Between W. Locust St. and E. South St.	$3,001,000	$3,479,000	$4,034,000	<2	5
3	221010	E. South St. at White Park	$284,000	$330,000	$383,000	2	100
4	222010,222015, 222020	S. Lincoln Ave.	$543,000	$630,000	$731,000	2	25
5	222030, 222040	W. St. Louis St.	$247,000	$287,000	$333,000	2	25
6	222050, 222060	S. Harrison Ave	$336,000	$390,000	$453,000	2	25
7	218010, 218020	E. Springfield St.	$503,000	$584,000	$678,000	2	25
8	213010	E. Hadley St.	$821,000	$952,000	$1,104,000	2	25
9	213020	S. Jefferson Ave.	$257,000	$298,000	$346,000	2	25
10	220010	S. Madison Ave. Between Springfield and Pearl	$138,000	$160,000	$186,000	5	25
11	220020	E. Springfield St. Between Madison and Jefferson	$159,000	$185,000	$215,000	2	25
12	220025	S. Jefferson Ave. Between E. Springfield St. and E. St Louis St.	$134,000	$156,000	$181,000	2	25
13	212020	E. Prospect, Between High School and Cemetery	$133,000	$155,000	$180,000	<2	25
14	152025	Terrace Dr. and Business 60	$399,000	$463,000	$537,000	<2	25
15	N/A	Channel Improvements Btwn W. Hadley St. and S. Tyler Ave. in the 2100 Subbasin	$149,000	$173,000	$201,000	<2	25
16	N/A	Channel Improvements Between E. Springfield St. and E. Hadley St.	$50,000	$58,000	$68,000	N/A	N/A
17	N/A	Chat Creek Flood Plain Remap	$150,000	$174,000	$202,000	N/A	N/A
		TOTAL	$9,705,000	$11,258,000	$13,060,000		

1) Detention

Since a large percentage of the total structures evaluated were undersized, possible upstream detention areas were considered as top priority to help reduce peak flowrates to many structures. The use of detention to reduce peak flowrates along a stream path can effectively increase the storm capacities of structures along the stream, and it can reduce structure re-size requirements (and hence lower the cost) needed to replace any structures along the stream to bring them to current capacity requirements. Major basins 2000 and 3000 were examined for possible detention areas due to the fact that the vast majority of undersized structures reside in those two major basins.

a. 2000 Major Basin

Incidental storage areas reside upstream of the Highway 60 embankment in sub-basins 2010, 2020, 2030, and 2040. Those areas were accounted for in modeling the system for existing structure capacities. The system model showed that the incidental detention areas in 2010, 2020, and 2040 are currently utilized. However, the model also showed that the incidental detention area in 2030 is currently under-utilized and a potential detention area exists in 2050. Also, a possible detention area in 2090 was noticed via the aerial photography and topos. Detention in these three areas was modeled because they were located upstream of several existing undersized structures in 2130 as well as flood-prone residential areas near E. Hadley St. The model showed that detention in these areas, as described in detail below, would increase the storm capacity of 8 of 12 existing undersized structures immediately downstream of the detention to meet or exceed the City's capacity requirements. Figure 2, below, illustrates the locations and sizes of the three detention areas

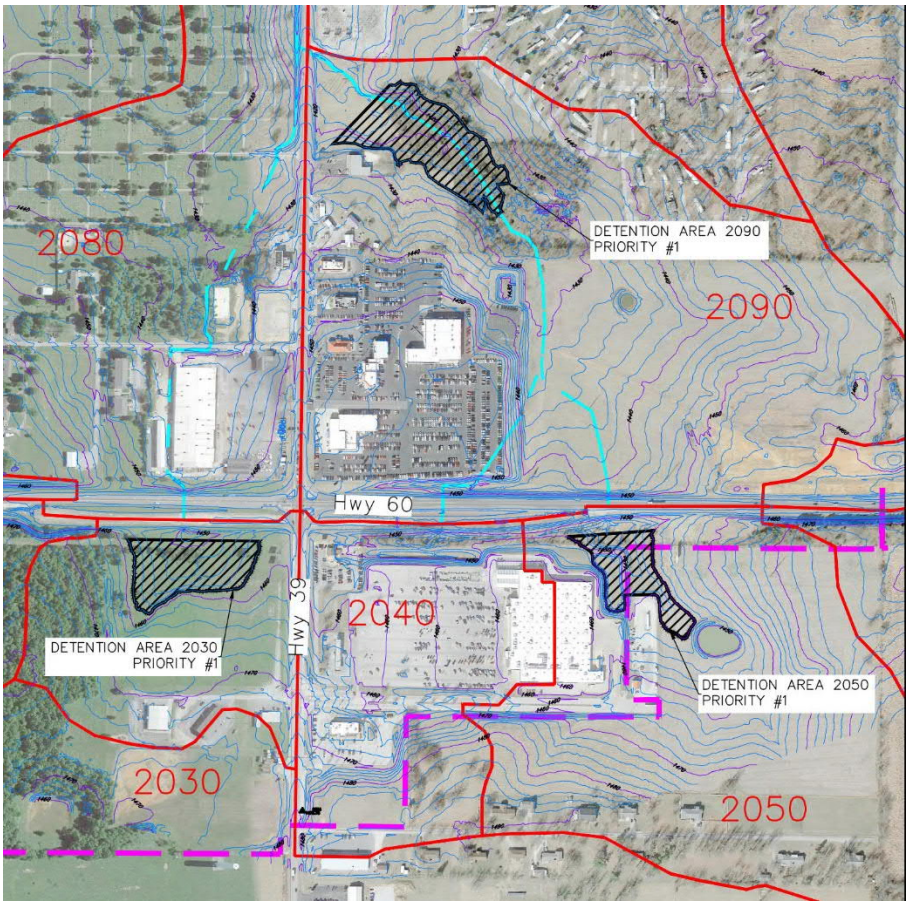


Figure 2 – Detention Basin Locations

The modeled detention area in 2030 would have a footprint of approximately 2.7 acres, and have a dam length of approximately 560' to an elevation of 1458' with a 3.5:1 embankment slope. The exit structure was modeled as an 80' length pipe with a 6" circular concrete inlet, designed to be inlet-controlled, with an inlet flowline elevation of 1448' and an exit elevation of 1446'. This system allows for approximately 1.2' of freeboard for a 100-year event and reduces the peak 100-year flowrate exiting sub-basin 2030 by about 95%, from 61 cfs to 3 cfs.

The modeled detention area in 2050 would have a footprint of approximately 2.1 acres, and have a dam length of approximately 370' to an elevation of 1450' with a 3.5:1 embankment slope. The exit structure was modeled as a 65' length pipe with a 30" circular concrete inlet, designed to be

inlet-controlled, with an inlet flowline elevation of 1442' and an exit elevation of 1441'. This system allows for approximately 1.2' of freeboard for a 100-year event and reduces the peak 100-year flowrate exiting sub-basin 2050 by nearly 2/3, from 121 cfs to 46 cfs. This detention area would require an agreement between the City and Wal-Mart to merge Wal-Mart's existing detention basin in 2050 into this detention area. The berm on the north and east side of Wal-Mart's detention basin would need to be removed and its soil used towards constructing the detention dam and building a berm to elevate the north side of Wal-mart's gas tanks to 1450'.

The modeled detention area in 2090 would have a footprint of approximately 4.0 acres, and have a dam length of approximately 360' to an elevation of 1458' with a 3.5:1 embankment slope. The exit structure was modeled as a 60' length pipe with a 60" circular concrete inlet, designed to be inlet-controlled, with an inlet flowline elevation of 1417' and an exit elevation of 1416'. This system allows for approximately 1.1' of freeboard for a 100-year event and reduces the peak 100-year flowrate exiting sub-basin 2090 by about 25% from 267 cfs to 197 cfs.

Table 3, below, compares the effects of modeled detention in 2030, 2050, and 2090 on the storm capacities of structures immediately downstream of the detention areas. It should also be noted that the modeled detention areas not only affect these 12 structures, but also reduce 100-year peak flowrates for all sixteen additional structures downstream of 213010 by approximately 250 cfs, which would also reduce resizing requirements and costs for each of those structures.

Table 3 - Comparison of Existing Structure Capacity with and without Regional Detention		
Structure ID	Storm CAP, Existing Conditions	Storm CAP, Regional Detention
208010	10-Yr	50-Yr
208020	5-Yr	10-Yr
208025	2-Yr	2-Yr
209010	10-Yr	100-Yr
213010	2-Yr	2-Yr
213020	2-Yr	2-Yr
213030	5-Yr	25-Yr
213040	5-Yr	25-Yr
213050	10-Yr	50-Yr
213060	10-Yr	100-Yr
213070	5-Yr	25-Yr
213080	10-Yr	100-Yr

A detention area of roughly 18 acres in sub-basin 2070, just upstream of Structure 207010 and Prospect St. was also considered and modeled, and it was determined that, although it would help increase the capacities of Structures 207010 and 211010 downstream, the detention elevation of 1412' required would present site difficulties that would likely more than offset the benefits gained by prohibitive costs. A 16-acre area in sub-basin 2110 was considered for detention as well, but was not modeled, as it was determined that detention in 2110 would be less-effective for structures downstream than a larger detention area upstream of 2110 would be--such as the modeled detention basin in 2070.

One possible area of detention that could be worth analyzing for potential benefits is an area of approximately 4.5 acres in sub-basin 2100, west of S. Carnation Dr. and south of Chickory Ln. Possible detention in this area was not modeled due to the fact that several of the undersized structures immediately downstream of the location were small private driveway culverts. Furthermore, detention in 2100 could potentially cause higher peak flowrates to structures further downstream in the 1+ sq-mi drainage area zone of the 2000 major basin. This is possible due to the fact that delaying the lag time to peak flowrate from sub-basin 2100 could potentially cause its peak flowrate to arrive further downstream at the same time as the peak flowrate from the other tributaries, which would be detrimental.

b. 3000 Major Basin

Incidental storage areas reside upstream of the Highway 60 embankment in sub-basins 3010, 3020, and 3030, and hence, those areas were accounted for in modeling the system for existing structure capacities. However, the model shows that the existing storage capacity in those basins is already maximized in 100-year events, leaving little room for further improvements.

An area with an 18-acre footprint in sub-basin 3040 just south of Prospect St. was analyzed as a potential detention area. Though it would cause reductions in peak flowrates downstream, its flowrate attenuation would not be sufficient to increase the storm capacity of any structures in the problematic 3180 sub-basin. Reduced downstream benefits where needed, paired with the site difficulties that would be required to construct the detention area, point towards a poor cost-to-benefit ratio.

In general, detention does not seem to be a practical option for the City in the 3000 major basin due to several reasons. Almost half of the most-severely undersized structures in the major basin reside in sub-basin 3180, which is also the most-populated area of the 3000 basin, where several buildings along Crescent St. currently reside in the flood plain. Sub-basin 3180 is located toward the downstream end of the major basin, and hence, it experiences flow from an upstream drainage area of nearly 3 sq-mi. The large drainage area, combined with severely undersized structures, would require impractically large detention volumes and/or major size increases to structures in 3180 in order to comply. Therefore, purchasing the properties in the flood plain along Crescent St. may be a viable option for the City to consider to safely resolve flooding issues in sub-basin 3180.

2) Structure Replacement

The majority of the recommended improvements include the replacement of existing structures. Most structures throughout the City are in good to fair condition, however, as mentioned previously, there are several that are woefully undersized. Primarily the recommended structure replacements reside in the 2000 major basin due to

the low existing capacity and public comments. Detailed descriptions of the recommended structure replacements are located in Appendix G. These recommendations may need to evolve over time as residents continue to point out stormwater problems throughout the City.

B. Minor System Improvements

The capital improvements recommended in this report are intended to correct deficiencies within the system that are known to be a nuisance by city staff, or have been reported by the citizens of the community. As these problems are corrected, other smaller components of the City's overall storm drainage system will start appearing to be deficient because the public will begin to notice them after the more prevalent problems are corrected. It is also common to experience after one problem is corrected the problem will relocate further downstream to an area that did not experience problems before. As such, a regular program of improvement to the minor system is an integral element in any comprehensive plan of improvement to the storm drainage system. For a minor system of the scale and age of that in the City of Aurora, an appropriate level of spending would average roughly $75,000 per year.

The intersection of W. Hadley St. and Mary Lane is a good example of the need for minor system improvements. During the public meeting, residents reported that the intersection floods regularly. An on-site investigation revealed that the intersection has a sizable drainage area and is very flat. It is also surrounded by curb and gutter on all sides and the nearest inlets are 160 feet east of the intersection. Deposited sediment and pavement failure are evident, due to water ponding in the intersection. Simply adding a few inlets and/or flumes in key locations to drain water away from the intersection to the nearby ditches would drastically improve this situation.

C. System Maintenance

Regular system maintenance can go a long way in improving the function and public perception of the storm sewer infrastructure. It is recommended that the City develop an ongoing maintenance and inspection program for roadway culverts, ditches, detention ponds, catch basins, and closed systems. The use of the City's GIS system should be considered for tracking inspections and maintenance history on the various system components.

1) Roadway Culvert, Ditch, and Detention Pond

The City has many miles of improved and unimproved ditches that must be maintained for several reasons. In order for the system to function properly, obstructions must be removed on a regular basis to prevent clogging of the system, which can cause severe flooding. If the city does not provide proper maintenance of the City system, then they could be liable for flooding caused by the lack of maintenance. Obstructions that periodically require removal include vegetation, yard debris, silt, illegal dumping, etc.

There are a few regional and private detention basins within the City limits. These numbers will continue to grow as the City continues to take a proactive approach to reduce the number of areas that flood during heavy rains. The majority of detention basins are within private developments that are required to be maintained by the owners. Without proper maintenance the basins become overgrown with vegetation and harbor unwanted wildlife and mosquitoes. Silt will accumulate over time and thereby reduce the storage available for stormwater making the detention basins less affective.

Based on the miles of ditches and number of detention basins, a suggested level of spending would average $75,000 per year.

2) Catch Basin and Closed System

Currently the City has a very limited number of catch basins and piping networks, however as areas are improved and curb and gutter is installed, this will become a more prevalent maintenance item. Using an estimated fee of $3 per lineal foot and $100 each to clean the pipes and inlets, an annual spending of $30,000 per year for 10 years would be needed to clean the entire system.

D. Removal of Improvements

Purchasing and removing, relocating or elevating existing structures that are subject to flooding on a regular basis should be considered whenever the cost to protect the structure or eliminate flooding would be disproportionately large. While beyond the scope of this report, based upon current FEMA Flood Plain mapping and City staff experience, there are likely several locations throughout the City that could benefit from the removal of existing structures, particularly in the 3000 major basin, as mentioned previously. There are also several in the 2000 major basin that appear to be subject to flooding.

Appendix G
Capital Improvement Project Recommendation Descriptions

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Regional Detention, Sub-basins 2030, 2050, and 2090

Priority No.: 1

Date Summary

Watershed:	2000 Basin (Unnamed Tributary No. 1)
Estimated Cost:	(2018) $2,400,888 – (2028) $3,228,000
Structure ID No.:	N/A
Level of Service:	N/A

Existing Problem Description

Roadway flooding, property flooding downstream, and excessive peak discharges at undersized downstream structures are experienced in the 2130, 2180, 2220, 2230, and 2250 sub-basins.

Recommended Improvements

Construct a 2.7-acre detention basin in the 2030 sub-basin and a 2.1-acre detention basin in the 2050 sub-basin just upstream of Highway 60. Construct a 4.0-acre detention basin in the 2090 sub-basin just upstream of S. Elliot Ave. To construct regional detention in these locations would increase the storm capacity of 8 of 12 existing undersized structures immediately downstream to the point that they would meet or exceed the City's current capacity requirements and therefore would not require modification or replacement. In addition, it is anticipated that 100-year peak flowrates for all sixteen additional structures downstream of 213010 would be reduced by approximately 250 cubic feet per second (cfs), which would also reduce resizing requirements and costs for each of those structures.

Potential Alternatives

Replace or modify all structures in the 2130 sub-basin in addition to downstream culvert replacements in sub-basins 2180, 2220, 2230, and 2250 including the associated channel improvements. 100-year peak flowrates would not be reduced. Capital costs would exceed that required to build detention.

Additional Notes

The cost for this project includes an assumed amount for land acquisition and will be significantly impacted by the City's ability to purchase property in these three locations. Most of the land in question would likely have limited use because of topography and therefore it may be possible for the City to obtain drainage easements from the property owner while still allowing them to use the property in the same manner that they do currently, such as farming.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Box Culvert/Sidewalk Network Between W. Locust St. and E. South St.

Priority No.: 2

Date Summary

Watershed:	3110 Sub-basin
Estimated Cost:	(2018) $3,000,360 – (2028) $4,034,000
Structure ID No.:	311020
Level of Service:	Existing <2 yr., Proposed 5 yr.

Existing Problem Description

The existing box culvert network in the 3110 sub-basin has been experiencing issues with structural integrity and clogging for several years now. Multiple collapses have occurred and it is consistently requiring repair. In addition, roadway and property flooding have been reported at the intersection of Madison and South St., among other various locations throughout the reach.

Recommended Improvements

Reconstruct the entire box culvert network from W. Locust St. and extend up to and potentially along E. South St. Construct a 6'x3' reinforced concrete box culvert and separate it from the sidewalk, including the necessary inlets and piping.

Additional Notes

The proposed level of service does not meet the current City guidelines which would require a 25-year capacity. The limiting factor is the downstream culverts under Olive St. and the grain silos which are not recommended for replacement at this time.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: E. South St. at White Park

Priority No.: 3

Date Summary

Watershed:	2210 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $283,041– (2028) $382,000
Structure ID No.:	221010
Level of Service:	Existing 2 yr. - Proposed 100 yr.

Existing Problem Description

The existing structure is undersized and aging. Downstream erosion is evident.

Recommended Improvements

Remove and replace the existing structure with a double 12'x5' reinforced concrete box culvert. Transition upstream and downstream channel to new box culvert (approximately 150' on either side of culvert) and install paved ditch on downstream channel to prevent erosion.

Additional Notes

Structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. A double 13'x5' would be required without upstream detention. At a minimum the proposed culvert replacement will require a FEMA No-Rise Certificate. However, once upstream detention basins are constructed and this culvert replaced, it may make sense to look at remapping the flood plain on Unnamed Tributaries 1 through 4.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: S. Lincoln Ave.

Priority No.: 4

Date Summary

Watershed:	2220 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $542,424– (2028) $730,000
Structure ID No.:	222010, 222015, 222020
Level of Service:	Existing <2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and S. Lincoln Ave. is considered a major collector street. Erosion downstream is occurring due to high velocities and existing channel geometry. The existing channel takes two back to back 90-degree turns immediately after water exits the culvert.

Recommended Improvements

Remove and replace the existing structure with a quadruple 8'x2.5' reinforced concrete box culvert, or equivalent. Transition upstream and downstream channel to new box culvert (approximately 150' on either side of culvert) and install erosion control measures on the downstream channel. Acquire easements and straighten out downstream channel to eliminate back to back 90-degree bends.

Additional Notes

The cost for this project includes an assumed amount for land acquisition and will be significantly impacted by the City's ability to purchase property just upstream of the culvert. The upstream channel cannot be transitioned into the new structure without acquiring the house immediately upstream and removing the existing pedestrian bridge. Currently the home is located within the floodway. Structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 38'x2.5' opening would be required without upstream detention. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: W. St. Louis St.

Priority No.: 5

Date Summary

Watershed:	2220 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $246,748– (2028) $333,000
Structure ID No.:	222030, 222040
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and is showing signs of erosion on the upstream and downstream ends. Also, it is in fair condition. The floodway is wider than the existing structure.

Recommended Improvements

Remove and replace the existing structure with a triple 7'x3.5' reinforced concrete box culvert, or equivalent. Transition upstream and downstream channel to new box culvert (approximately 100' on either side of culvert) and install erosion control measures on the downstream channel as needed.

Potential Alternatives

Close W. St. Louis St. between S. Lincoln and S. Harrison Ave. and remove the existing culvert and construct a trapezoidal ditch in its place.

Additional Notes

Structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 27'x3.5' opening would be required without upstream detention to pass the 25-year event. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: S. Harrison Ave.

Priority No.: 6

Date Summary

Watershed:	2220 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $335,792– (2028) $453,000
Structure ID No.:	222050, 222060
Level of Service:	Existing <2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and flooding has been reported at a home just upstream of the culvert. The floodway is wider than the existing structure and the structure is in fair condition.

Recommended Improvements

Remove and replace the existing structure with a quadruple 8'x2.5' reinforced concrete box culvert, or equivalent. Transition upstream and downstream channel to new box culvert (approximately 150' on either side of culvert) and install erosion control measures on the downstream channel as needed. Reworking the 90-degree bend at the downstream end to provide a smoother transition should be considered.

Additional Notes

Structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 38'x2.5' opening would be required without upstream detention to pass the 25-year event. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum and will also require relocation of a few electrical poles.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: E. Springfield St.

Priority No.: 7

Date Summary

Watershed:	2180 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $502,582– (2028) $676,000
Structure ID No.:	218010, 218020
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and E. Springfield St. is considered a major collector street. The floodway is much wider than the current structure and it is in fair condition.

Recommended Improvements

Remove and replace the existing structure with a triple 8'x3.5' reinforced concrete box culvert, or equivalent. Transition upstream and downstream channel to new box culvert (approximately 100' upstream and 200' downstream) and install erosion control measures on the downstream channel as needed. Reworking the 90-degree bend to provide a smoother transition should be considered. This will potentially impact 2 existing homes.

Additional Notes

The cost for this project includes an assumed amount for land acquisition and will be significantly impacted by the City's ability to purchase property just upstream and downstream of the culvert. The upstream channel cannot be transitioned into the new structure without acquiring the house immediately upstream. Reworking the channel on the downstream end will also likely have an effect on an existing home. Currently both homes are located within the floodway. Structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 29'x3.5' opening would be required without upstream detention. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: E. Hadley St.

Priority No.: 8

Date Summary

Watershed:	2130 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $820,796– (2028) $1,104,000
Structure ID No.:	213010
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and nearby houses have reported flooding. The E. Hadley and Madison intersection has also had reported flooding on a regular basis. E. Hadley is considered a minor arterial street.

Recommended Improvements

Remove and replace the existing structure with a double 9'x3' reinforced concrete box culvert. Transition upstream and downstream channel to new box culvert (approximately 100' upstream and 200' downstream) and install erosion control measures on the downstream channel as needed.

Additional Notes

Proposed structure will need to be at least 290 feet long and will require extensive pavement replacement due to skewed alignment across E. Hadley St. Proposed structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 24'x3' opening would be required without upstream detention. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum and will also require easements.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: S. Jefferson Ave.

Priority No.: 9

Date Summary

Watershed:	2130 Sub-basin (Unnamed Trib. No. 1)
Estimated Cost:	(2018) $256,128– (2028) $345,000
Structure ID No.:	213020
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized. The area has also had reported flooding on a regular basis. S. Jefferson Ave. is considered a major collector street.

Recommended Improvements

Remove and replace the existing structure with a double 9'x3' reinforced concrete box culvert. Transition upstream and downstream channel to new box culvert (approximately 100' upstream and 100' downstream).

Additional Notes

Proposed structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins. An equivalent to a 24'x3' opening would be required without upstream detention. Proposed culvert replacement will require a FEMA No-Rise Certificate at a minimum and will also require easements.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: S. Madison Ave. Between Springfield and Pearl

Priority No.: 10

Date Summary

Watershed:	2200 Sub-basin
Estimated Cost:	(2018) $137,309– (2028) $186,000
Structure ID No.:	220010
Level of Service:	Existing 5 yr. - Proposed 25 yr.

Existing Problem Description
The existing structure is undersized and in fair to poor condition.

Recommended Improvements
Remove and replace the existing structure with a single 6'x2.5' reinforced concrete box culvert. Transition upstream and downstream ditches to new box culvert (approximately 100' on either side of culvert). Remove existing pedestrian crossing and extend new box culvert to allow room for future sidewalk.

Additional Notes
Project will require easement acquisition.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: E. Springfield St. Between Madison and Jefferson

Priority No.: 11

Date Summary

Watershed:	2200 Sub-basin
Estimated Cost:	(2018) $158,827– (2028) $215,000
Structure ID No.:	220020
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description

The existing structure is undersized and in poor condition. E. Springfield St. is a major collector.

Recommended Improvements

Remove and replace the existing structure with a single 8'x2' reinforced concrete box culvert with a 45-degree bend to line up with existing channel and eliminate the 90-degree bend. Transition upstream and downstream ditches to new box culvert (approximately 100' on either side of culvert). Connect 18" RCP to new box culvert and extend across alley to drain ditch lines on the north and south sides of E. Springfield St.

Additional Notes

Project will likely require easement acquisition on the downstream side along the alley.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: S. Jefferson Ave. Between E. Springfield St. and E. St. Louis St.

Priority No.: 12

Date Summary

Watershed:	2200 Sub-basin
Estimated Cost:	(2018) $133,206– (2028) $180,000
Structure ID No.:	220025
Level of Service:	Existing 2 yr. - Proposed 25 yr.

Existing Problem Description
The existing structure is undersized and in poor condition. S. Jefferson Ave. is a major collector.

Recommended Improvements
Remove and replace the existing structure with a single 8'x2' reinforced concrete box culvert. Transition upstream and downstream ditches to new box culvert (approximately 100' on either side of culvert). Install paved ditch on the downstream end to direct water to existing ditch line and prevent erosion. Connect 18" RCP to new box culvert and extend across driveway to drain ditch line on the west side of S. Jefferson.

Additional Notes
Project will likely require easement acquisition.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: E. Prospect Between High School and Cemetery

Priority No.: 13

Date Summary

Watershed:	2120 Sub-basin
Estimated Cost:	(2018) $132,645– (2028) $179,000
Structure ID No.:	212020
Level of Service:	Existing <2 yr. - Proposed 25 yr.

Existing Problem Description

The existing 15" corrugated metal pipe is undersized. E. Prospect St. is a minor arterial and likely experiences flooding on a regular basis in this location.

Recommended Improvements

Remove and replace the existing structure with a battery of 10-15" diameter RCPs or equivalent. Clear trees on the downstream end and lower the flowline to gain more cover over the pipes on E. Prospect St. Install a concrete apron around pipes on the upstream and downstream end to prevent erosion.

Additional Notes

Project will likely require easement acquisition.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Terrace Dr. and Business 60

Priority No.: 14

Date Summary

Watershed:	1520 Sub-basin
Estimated Cost:	(2018) $398,395– (2028) $536,000
Structure ID No.:	152025
Level of Service:	Existing <2 yr. - Proposed 25 yr.

Existing Problem Description

House flooding has been reported at 601 and 603 Terrace Dr. Stormwater from Sunshine Dr. is directed to the alley between Sunshine Dr. and Terrace Dr. Existing topography directs runoff directly into the back yards along Sunshine Dr. and towards the houses at 601 and 603 Terrace Dr.

Recommended Improvements

Reduce flooding frequency by installing a 30-inch reinforced concrete pipe (RCP) in the alley from the south ditch along Business 60 to a point approximately 730 feet south where runoff from Sunshine Dr. enters the alley. Install 4-Type S inlets in low spots in the adjacent back yards and connect to the 30-inch RCP. Replace structure 152025 (under Sunshine Dr.) with a 3'x2' reinforced concrete box culvert and regrade roadway ditch down to structure 152020. Install paved ditch between 30-inch RCP and structure 152025 in the Business 60 ditch line.

Additional Notes

Included in this cost estimate is the lowering or relocation of the existing sanitary sewer line in the alley, however, it may be possible to complete the project without lowering the sanitary sewer. The project will require easement acquisition to install Type S inlets on private property. A MODOT permit for work within the right-of-way will also be required.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Channel Improvements Between W. Hadley St. and S. Tyler Ave.

Priority No.: 15

Date Summary

Watershed:	2100 Sub-basin
Estimated Cost:	(2018) $148,224– (2028) $200,000
Structure ID No.:	N/A
Level of Service:	Existing <2 yr. - Proposed 25 yr.

Existing Problem Description

The existing grass lined channel is very flat and the house at 1400 S. Tyler Ave. gets water in their garage. The existing channel is also very overgrown downstream and needs to be cleaned out.

Recommended Improvements

To reduce frequency of flooding at 1400 S. Tyler Ave. it is recommended that a concrete paved ditch be constructed. Construct a 10-foot-wide trapezoidal ditch with 3:1 side slopes from the downstream end of 210020 to a point 300' downstream, with a running slope of 0.6%. The radius of the channel should be a minimum of 50 feet where the channel turns and goes into the woods. Provide a 20-foot-long riprap pad at the end of the paved ditch to dissipate energy and prevent downstream erosion. Remove accumulated sediment and debris from structure 210020. Also, regrade the south ditch line along Kirby Lane to the east from the intersection and remove debris from existing culvert pipes in the intersection and driveways.

Additional Notes

Project will require a FEMA No-Rise Certificate at a minimum and will likely require easement acquisition and a permit from the Army Corps of Engineers.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Channel Improvements Between E. Springfield St. and E. Hadley St.

Priority No.: 16

Date Summary

Watershed:	2180 Sub-basin
Estimated Cost:	(2018) $50,000– (2028) $68,000
Structure ID No.:	N/A
Level of Service:	N/A

Existing Problem Description

Flooding occurs around the intersection of Madison and Hadley. The City has noted having to rescue people from a home along Madison. The existing grass and rock lined channel is very flat and appears to be overgrown.

Recommended Improvements

As a first step it is recommended that heavy brush, debris, and sediment buildup in the main flowline of the channel be removed for the entire 2,100 feet.

Potential Alternatives

Construct a 20' wide by 2.5' tall concrete channel with vertical walls to pass the 25-year peak flowrate. Flooding of the surrounding area for larger storm events will still occur. Proposed structure size is dependent upon upstream detention basins being constructed in the 2030, 2050, and 2090 sub-basins.

Additional Notes

Construction of the detention basins in the 2030, 2050, and 2090 sub-basins will greatly help the channel in this location. In addition, the City should consider purchasing, elevating, or relocating homes within the flood plain in this location in the future. Easements and a permit from the Army Corps of Engineers will likely be required to complete this work.

Aurora, Missouri
Stormwater Management Master Plan
Capital Improvements Project Recommendation

Project Name: Chat Creek Flood Plain Remap

Priority No.: 17

Date Summary

Watershed:	3000 (Chat Creek)
Estimated Cost:	(2018) $150,000-(2028) $202,000
Structure ID No.:	N/A
Level of Service:	N/A

Existing Problem Description

The downstream end of the Chat Creek Drainage Basin, within the City limits, experiences flooding issues. Current flood plain mapping does not reflect channel improvements that have occurred over the years including the rerouted channel east of N. Elliott Ave. and downstream of the railroad.

Recommended Improvements

A remap of the flood plain and floodway between Carnation Dr. and Highland Street (location of existing detailed modeling, approximately 2.0 miles) is needed to determine the impacts of the rerouted channel in the 3180 sub-basin. This would include submission to FEMA and sizing of any potential channel improvements. In addition, it is recommended that a detailed study be done to determine the extent of flood prone houses in the 3180 basins so that the City can plan for a program to either elevate, buy, or relocate homes in the future to remove them from the flood plain and floodway.

Appendix H
Opinion of Probable Cost Estimates

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 1
Structure: N/A
Subbasin: 2030
Location: Southwest Corner of Hwy 60 and 39

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	AC	3.5	$8,000.00	$28,000.00
2	Excavation and Embankment	CY	3850	$20.00	$77,000.00
3	Shaping Slopes	AC	3.5	$10,000.00	$35,000.00
4	Seed and Mulch	AC	3.5	$4,000.00	$14,000.00
5	Outlet Structure	LS	1	$20,000.00	$20,000.00
6	Mobilization	LS	1	$13,920.00	$13,920.00
				Construction Subtotal	**$187,920.00**
MISCELLANEOUS					
1	Land Acquisition	AC	5	$75,000.00	$375,000.00
				Miscellaneous Subtotal	**$375,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	20%		$37,584.00
2	Construction Admin. Engineering	Percent	12%		$22,550.40
				Professional Services Subtotal	**$60,134.40**
				Subtotal	$623,054.40
				Contingency (20%)	$124,610.88
				Total Opinion of Probable Cost	**$747,665.28**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 1
Structure: N/A
Subbasin: 2050
Location: South of Hwy 60, East of Walmart

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	AC	3.5	$8,000.00	$28,000.00
2	Excavation and Embankment	CY	1550	$20.00	$31,000.00
3	Shaping Slopes	AC	3.5	$10,000.00	$35,000.00
4	Seed and Mulch	AC	3.5	$4,000.00	$14,000.00
5	Outlet Structure	LS	1	$20,000.00	$20,000.00
6	Mobilization	LS	1	$10,240.00	$10,240.00
				Construction Subtotal	**$138,240.00**
MISCELLANEOUS					
1	Land Acquisition	AC	5	$75,000.00	$375,000.00
				Miscellaneous Subtotal	**$375,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	22%		$30,412.80
2	Construction Admin. Engineering	Percent	12%		$16,588.80
				Professional Services Subtotal	**$47,001.60**
				Subtotal	$560,241.60
				Contingency (20%)	$112,048.32
				Total Opinion of Probable Cost	**$672,289.92**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 1
Structure: N/A
Subbasin: 2090
Location: Between Empire Substation and Mayse Automotive on Hwy 39

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	AC	5	$12,000.00	$60,000.00
2	Excavation and Embankment	CY	2305	$20.00	$46,100.00
3	Shaping Slopes	AC	5	$10,000.00	$50,000.00
4	Seed and Mulch	AC	5	$4,000.00	$20,000.00
5	Outlet Structure	LS	1	$50,000.00	$50,000.00
6	Mobilization	LS	1	$18,088.00	$18,088.00
				Construction Subtotal	**$244,188.00**
MISCELLANEOUS					
1	Land Acquisition	AC	10	$50,000.00	$500,000.00
				Miscellaneous Subtotal	**$500,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	18%		$43,953.84
2	Construction Admin. Engineering	Percent	12%		$29,302.56
				Professional Services Subtotal	**$73,256.40**
				Subtotal	$817,444.40
				Contingency (20%)	$163,488.88
				Total Opinion of Probable Cost	**$980,933.28**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 2
Structure: 311020
Subbasin: 3110
Location: Box Culvert/Sidewalk Network Between W. Locust St. and E. South St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Remove and Replace Sidewalk Box	LS	1	$2,080,000.00	$2,080,000.00
				Construction Subtotal	**$2,080,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	10%		$208,000.00
2	Construction Admin. Engineering	Percent	6%		$124,800.00
3	ROW Acquisition	EA	25	$3,500.00	$87,500.00
				Professional Services Subtotal	**$420,300.00**
				Subtotal	$2,500,300.00
				Contingency (20%)	$500,060.00
				Total Opinion of Probable Cost	**$3,000,360.00**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 3
Structure: 221010
Subbasin: 2210
Location: E. South St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$10,000.00	$10,000.00
3	Excavation	CY	260	$20.00	$5,200.00
4	Linear Grading (Channel Improvements)	STA.	3	$1,000.00	$3,000.00
5	Pavement Replacement	SY	175	$80.00	$14,000.00
6	Traffic Control	LS	1	$6,000.00	$6,000.00
7	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
8	Rock Blanket	LS	1	$3,500.00	$3,500.00
9	Mobilization	LS	1	$12,756.00	$12,756.00
10	Paved Ditch	SY	650	$60.00	$39,000.00
11	Double 12'x5'	LS	1	$75,000.00	$75,000.00
				Construction Subtotal	**$172,206.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	18%		$30,997.08
2	Construction Admin. Engineering	Percent	12%		$20,664.72
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$63,661.80**
				Subtotal	$235,867.80
				Contingency (20%)	$47,173.56
				Total Opinion of Probable Cost	**$283,041.36**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 4
Structure: 222010, 222015, 222020
Subbasin: 2220
Location: S. Lincoln Ave.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$20,000.00	$20,000.00
3	Excavation	CY	900	$20.00	$18,000.00
4	Linear Grading (Channel Improvements)	STA.	3	$1,000.00	$3,000.00
5	Pavement Replacement	SY	500	$80.00	$40,000.00
6	Curb and Gutter	LF	130	$25.00	$3,250.00
7	Traffic Control	LS	1	$6,000.00	$6,000.00
8	Seed and Mulch	AC	0.5	$5,000.00	$2,500.00
9	Rock Blanket	LS	1	$5,000.00	$5,000.00
10	Mobilization	LS	1	$19,832.00	$19,832.00
11	Quadruple 8'x2.5'	LS	1	$131,250.00	$131,250.00
12	Curb Inlets	EA	4	$3,500.00	$14,000.00
13	18" RCP	LF	40	$60.00	$2,400.00
				Construction Subtotal	**$267,732.00**
MISCELLANEOUS					
1	Land Acquisition	LS	1	$100,000.00	$100,000.00
				Miscellaneous Subtotal	**$100,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	15%		$40,159.80
2	Construction Admin. Engineering	Percent	12%		$32,127.84
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$84,287.64**
				Subtotal	$452,019.64
				Contingency (20%)	$90,403.93
				Total Opinion of Probable Cost	**$542,423.57**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 5
Structure: 222030, 222040
Subbasin: 2220
Location: W. St. Louis St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$3,500.00	$3,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	450	$25.00	$11,250.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,000.00	$2,000.00
5	Pavement Replacement	SY	180	$80.00	$14,400.00
6	Traffic Control	LS	1	$6,000.00	$6,000.00
7	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
8	Rock Blanket	LS	1	$10,000.00	$10,000.00
9	Construction Staking	LS	1	$2,000.00	$2,000.00
10	Mobilization	LS	1	$10,432.00	$10,432.00
11	Triple 7'x3.5'	LS	1	$75,000.00	$75,000.00
				Construction Subtotal	**$140,832.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	20%		$28,166.40
2	Construction Admin. Engineering	Percent	15%		$21,124.80
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	3	$3,500.00	$10,500.00
				Professional Services Subtotal	**$64,791.20**
				Subtotal	$205,623.20
				Contingency (20%)	$41,124.64
				Total Opinion of Probable Cost	**$246,747.84**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 6
Structure: 222050, 222060
Subbasin: 2220
Location: S. Harrison Ave.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	750	$25.00	$18,750.00
4	Linear Grading (Channel Improvements)	STA.	3	$1,000.00	$3,000.00
5	Pavement Replacement	SY	170	$80.00	$13,600.00
6	Traffic Control	LS	1	$6,000.00	$6,000.00
7	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
8	Rock Blanket	LS	1	$5,000.00	$5,000.00
9	Construction Staking	LS	1	$2,000.00	$2,000.00
10	Mobilization	LS	1	$11,568.00	$11,568.00
11	Quadruple 8'x2.5'	LS	1	$87,500.00	$87,500.00
				Construction Subtotal	**$156,168.00**
MISCELLANEOUS					
1	Utility Relocation	LS	1	$50,000.00	$50,000.00
				Miscellaneous Subtotal	**$50,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	20%		$31,233.60
2	Construction Admin. Engineering	Percent	15%		$23,425.20
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	4	$3,500.00	$14,000.00
				Professional Services Subtotal	**$73,658.80**
				Subtotal	$279,826.80
				Contingency (20%)	$55,965.36
				Total Opinion of Probable Cost	**$335,792.16**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 7
Structure: 218010, 218020
Subbasin: 2180
Location: E. Springfield St. and S. Adams Ave.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$3,500.00	$3,500.00
2	Removal of Existing Improvements	LS	1	$6,000.00	$6,000.00
3	Excavation	CY	900	$25.00	$22,500.00
4	Linear Grading (Channel Improvements)	STA.	3	$1,000.00	$3,000.00
5	Pavement Replacement	SY	140	$80.00	$11,200.00
6	Traffic Control	LS	1	$5,000.00	$5,000.00
7	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
8	Rock Blanket	LS	1	$10,000.00	$10,000.00
9	Construction Staking	LS	1	$2,000.00	$2,000.00
10	Mobilization	LS	1	$11,156.00	$11,156.00
11	Triple 8'x3.5'	LS	1	$75,000.00	$75,000.00
				Construction Subtotal	**$150,606.00**
MISCELLANEOUS					
1	Land Acquisition	LS	1	$200,000.00	$200,000.00
				Miscellaneous Subtotal	**$200,000.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	20%		$30,121.20
2	Construction Admin. Engineering	Percent	15%		$22,590.90
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	3	$3,500.00	$10,500.00
				Professional Services Subtotal	**$68,212.10**
				Subtotal	$418,818.10
				Contingency (20%)	$83,763.62
				Total Opinion of Probable Cost	**$502,581.72**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 8
Structure: 213010
Location: S. Madison and W. Hadley St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$20,000.00	$20,000.00
3	Excavation	CY	900	$25.00	$22,500.00
4	Linear Grading (Channel Improvements)	STA.	3	$1,200.00	$3,600.00
5	Pavement Replacement	SY	700	$80.00	$56,000.00
6	Curb and Gutter	LF	300	$25.00	$7,500.00
7	Traffic Control	LS	1	$6,000.00	$6,000.00
8	Seed and Mulch	AC	1	$3,500.00	$3,500.00
9	Construction Staking	LS	1	$5,000.00	$5,000.00
10	Mobilization	LS	1	$40,048.00	$40,048.00
11	Double 9' x 3' RCB	LS	1	$348,000.00	$348,000.00
12	Curb Inlets	EA	4	$3,500.00	$14,000.00
13	18" RCP	LF	200	$60.00	$12,000.00
				Construction Subtotal	**$540,648.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	15%		$81,097.20
2	Construction Admin. Engineering	Percent	8%		$43,251.84
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	4	$3,500.00	$14,000.00
				Professional Services Subtotal	**$143,349.04**
				Subtotal	$683,997.04
				Contingency (20%)	$136,799.41
				Total Opinion of Probable Cost	**$820,796.45**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost - WITH DETENTION

Priority No.: 9
Structure: 213020
Location: Jefferson South of W. Hadley St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	500	$25.00	$12,500.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,000.00	$2,000.00
5	Pavement Replacement	SY	180	$80.00	$14,400.00
6	Traffic Control	LS	1	$6,000.00	$6,000.00
7	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
8	Construction Staking	LS	1	$2,000.00	$2,000.00
9	Mobilization	LS	1	$13,565.00	$13,565.00
10	Double 9'x3'	LS	1	$90,000.00	$90,000.00
				Construction Subtotal	**$149,215.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	20%		$29,843.00
2	Construction Admin. Engineering	Percent	15%		$22,382.25
3	FEMA No Rise Certificate	LS	1	$5,000.00	$5,000.00
4	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$64,225.25**
				Subtotal	$213,440.25
				Contingency (20%)	$42,688.05
				Total Opinion of Probable Cost	**$256,128.30**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 10
Structure: 220010
Location: S. Madison Ave. Btwn Springfield and Pearl

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$3,500.00	$3,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	200	$25.00	$5,000.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,200.00	$2,400.00
5	Pavement Replacement	SY	100	$80.00	$8,000.00
6	Traffic Control	LS	1	$5,000.00	$5,000.00
7	Rock Blanket	LS	1	$2,000.00	$2,000.00
8	Seed and Mulch	AC	0.2	$5,000.00	$1,000.00
9	Mobilization	LS	1	$5,890.00	$5,890.00
10	Construction Staking	LS	1	$2,000.00	$2,000.00
11	6' x 2.5' RCB	LS	1	$25,000.00	$25,000.00
				Construction Subtotal	**$64,790.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	35%		$22,676.50
2	Construction Admin. Engineering	Percent	20%		$12,958.00
3	ROW Acquisition	EA	4	$3,500.00	$14,000.00
				Professional Services Subtotal	**$49,634.50**
				Subtotal	$114,424.50
				Contingency (20%)	$22,884.90
				Total Opinion of Probable Cost	**$137,309.40**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 11
Structure: 220020
Location: E. Springfield St. Btwn Madison and Jefferson

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	300	$25.00	$7,500.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,200.00	$2,400.00
5	Pavement Replacement	SY	225	$80.00	$18,000.00
6	Traffic Control	LS	1	$5,000.00	$5,000.00
7	Rock Blanket	LS	1	$2,000.00	$2,000.00
8	Seed and Mulch	AC	0.2	$5,000.00	$1,000.00
9	Mobilization	LS	1	$8,140.00	$8,140.00
10	Construction Staking	LS	1	$2,000.00	$2,000.00
11	8' x 2' RCB	LS	1	$30,000.00	$30,000.00
12	18" RCP	LF	60	$60.00	$3,600.00
13	18" RCP Flared End Section	EA	2	$1,200.00	$2,400.00
				Construction Subtotal	**$89,540.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	25%		$22,385.00
2	Construction Admin. Engineering	Percent	15%		$13,431.00
3	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$42,816.00**
				Subtotal	$132,356.00
				Contingency (20%)	$26,471.20
				Total Opinion of Probable Cost	**$158,827.20**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 12
Structure: 220025
Location: E. Springfield St. Btwn Madison and Jefferson

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	200	$25.00	$5,000.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,200.00	$2,400.00
5	Pavement Replacement	SY	100	$80.00	$8,000.00
6	Traffic Control	LS	1	$5,000.00	$5,000.00
7	Paved Ditch	SY	30	$80.00	$2,400.00
8	Seed and Mulch	AC	0.2	$5,000.00	$1,000.00
9	Mobilization	LS	1	$6,100.00	$6,100.00
10	Construction Staking	LS	1	$2,000.00	$2,000.00
11	8' x 2' RCB	LS	1	$25,000.00	$25,000.00
12	18" RCP	LF	25	$60.00	$1,500.00
13	18" RCP Flared End Section	EA	1	$1,200.00	$1,200.00
				Construction Subtotal	**$67,100.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	35%		$23,485.00
2	Construction Admin. Engineering	Percent	20%		$13,420.00
3	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$43,905.00**
				Subtotal	$111,005.00
				Contingency (20%)	$22,201.00
				Total Opinion of Probable Cost	**$133,206.00**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 13
Structure: 212020
Location: E. Springfield St. Btwn Madison and Jefferson

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$4,000.00	$4,000.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	200	$25.00	$5,000.00
4	Linear Grading (Channel Improvements)	STA.	2	$1,200.00	$2,400.00
5	Pavement Replacement	SY	100	$80.00	$8,000.00
6	Traffic Control	LS	1	$6,000.00	$6,000.00
7	Paved Ditch	SY	120	$80.00	$9,600.00
8	Seed and Mulch	AC	0.25	$5,000.00	$1,250.00
9	Mobilization	LS	1	$6,275.00	$6,275.00
10	Construction Staking	LS	1	$1,500.00	$1,500.00
11	15" RCP	LF	400	$50.00	$20,000.00
				Construction Subtotal	**$69,025.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	32%		$22,088.00
2	Construction Admin. Engineering	Percent	18%		$12,424.50
3	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$41,512.50**
				Subtotal	$110,537.50
				Contingency (20%)	$22,107.50
				Total Opinion of Probable Cost	**$132,645.00**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 14
Structure: 152025
Subbasin: 1520
Location: Terrace Dr. and Business 60

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$2,500.00	$2,500.00
2	Removal of Existing Improvements	LS	1	$5,000.00	$5,000.00
3	Excavation	CY	250	$20.00	$5,000.00
4	Linear Grading (Channel Improvements)	STA.	8.5	$1,000.00	$8,500.00
5	Pavement Replacement	SY	100	$80.00	$8,000.00
6	Curb and Gutter	LF	50	$25.00	$1,250.00
7	Traffic Control	LS	1	$6,000.00	$6,000.00
8	Seed and Mulch	AC	0.6	$7,000.00	$4,200.00
9	Mobilization	LS	1	$17,920.00	$17,920.00
10	Paved Ditch	SY	400	$50.00	$20,000.00
11	3' x 2' RCB	LS	1	$24,000.00	$24,000.00
12	30" RCP	LF	730	$85.00	$62,050.00
13	18" RCP	LF	100	$60.00	$6,000.00
14	Type S Inlet	EA	4	$2,750.00	$11,000.00
15	5'x5' Junction Box	EA	4	$2,500.00	$10,000.00
16	4' Dia. Manholes	EA	2	$3,500.00	$7,000.00
17	8" Gravity Sewer	LF	760	$50.00	$38,000.00
18	Lateral Line Connection	EA	11	$500.00	$5,500.00
				Construction Subtotal	**$241,920.00**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	18%		$43,545.60
2	Construction Admin. Engineering	Percent	12%		$29,030.40
3	ROW Acquisition	EA	5	$3,500.00	$17,500.00
				Professional Services Subtotal	**$90,076.00**
				Subtotal	$331,996.00
				Contingency (20%)	$66,399.20
				Total Opinion of Probable Cost	**$398,395.20**

Aurora, MO Stormwater Management Master Plan
Opinion of Probable Cost

Priority No.: 15
Structure: N/A
Subbasin: 2100
Location: Channel between S. Tyler and W. Hadley St.

ITEM NO.	DESCRIPTION	UNITS	QUANTITY	UNIT PRICE	EXTENDED TOTAL
CONSTRUCTION					
1	Clearing and Grubbing	LS	1	$15,000.00	$15,000.00
2	Excavation	CY	300	$25.00	$7,500.00
3	Linear Grading	Sta.	3.5	$1,200.00	$4,200.00
4	Paved Ditch	SY	525	$75.00	$39,375.00
5	Rock Lining	SY	50	$60.00	$3,000.00
6	Seed and Mulch	LS	1	$5,000.00	$5,000.00
7	Mobilization	LS	1	$7,407.50	$7,407.50
				Construction Subtotal	**$81,482.50**
PROFESSIONAL SERVICES					
1	Surveying, Design Engineering, Utility Relocation, Bidding	Percent	28%		$22,815.10
2	Construction Admin. Engineering	Percent	15%		$12,222.38
3	ROW Acquisition	EA	2	$3,500.00	$7,000.00
				Professional Services Subtotal	**$42,037.48**
				Subtotal	$123,519.98
				Contingency (20%)	$24,704.00
				Total Opinion of Probable Cost	**$148,223.97**

Appendix I
System Maps

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\OVERALL.DWG

DWG. #2

DWG. #3

DWG. #4

DWG. #5

DWG. #6

DWG. #7

3200 3160 3170 3180 3190 3110 3100 3140 3120 3080 3090 3070 3060 3050 3030 3020 3010 3040 2270 2260 2250 2240 2230 2220 2210 2200 2190 2180 2170 2150 2140 2120 2110 2100 2090 2080 2070 2060 2050 2040 2030 2020 2010 1530 1520 1510 1000 SCALE: 1"=800' N

ALLGEIER, MARTIN and ASSOCIATES, INC.
CONSULTING ENGINEERS and SURVEYORS
7231 EAST 24th STREET JOPLIN, MISSOURI 64804 (417) 680 - 7200

CERTIFICATE OF AUTHORITY MISSOURI NO. 000427

DATE	REVISION

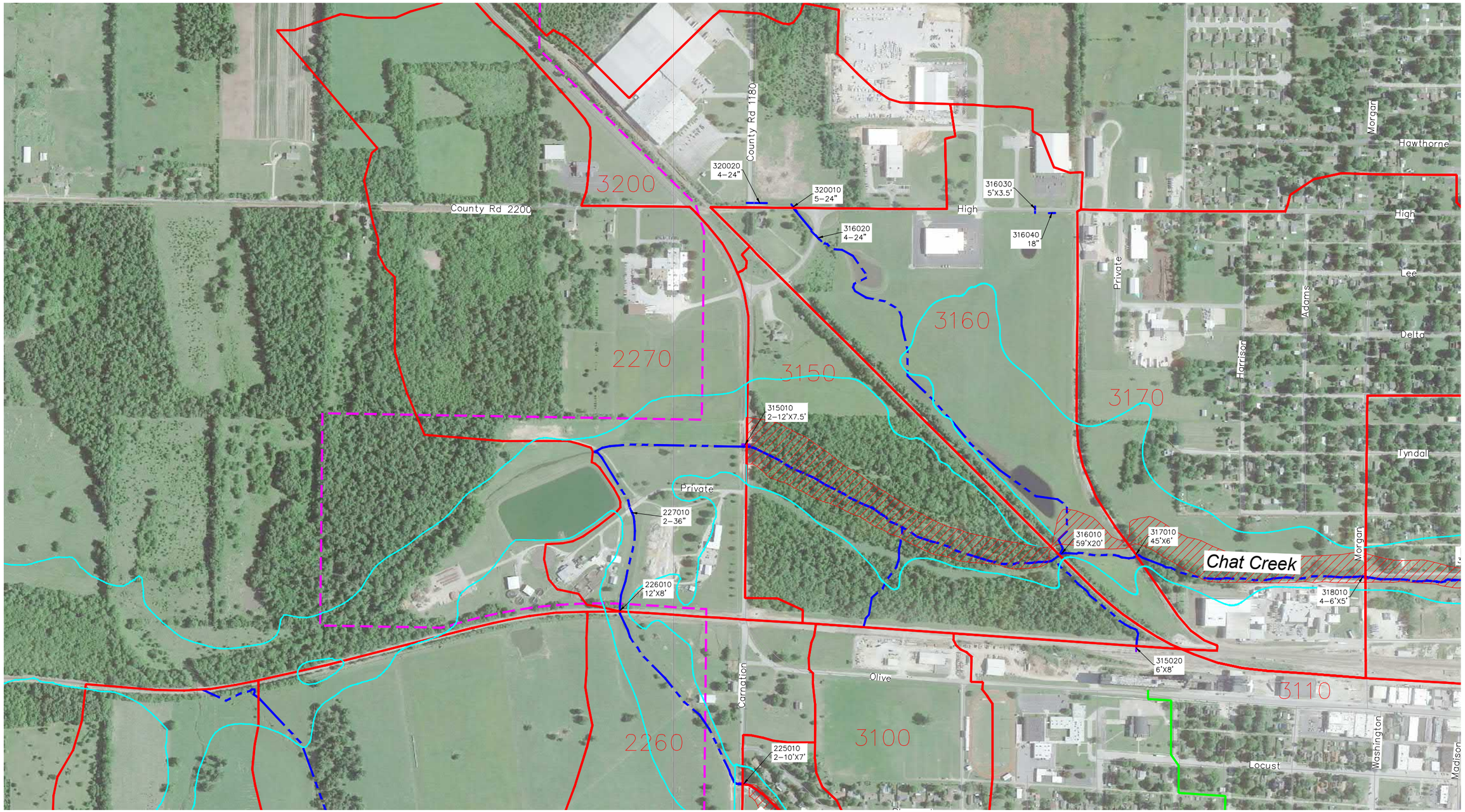
DWN. BY:	CCM
CKD. BY:	MCK
APPD. BY:	MCK
DATE :	NOV.,2018

EXISTING SYSTEM MAPS (APPENDIX I)
STORM WATER MASTER PLAN

AURORA, MISSOURI

DWG. NO. 1

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\MAPS 1-6.DWG



BRIDGE
CMP
CMPA
OTHER
RCB

RCP
RCP (ELLIPTICAL)
INLET
BASINS

STREAMS
BOX CULVERT NETWORK
CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

ALLGEIER, MARTIN and ASSOCIATES, INC.
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7231 EAST 24th STREET JOPLIN, MISSOURI 64804 (417) 680 - 7200

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STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO. 2

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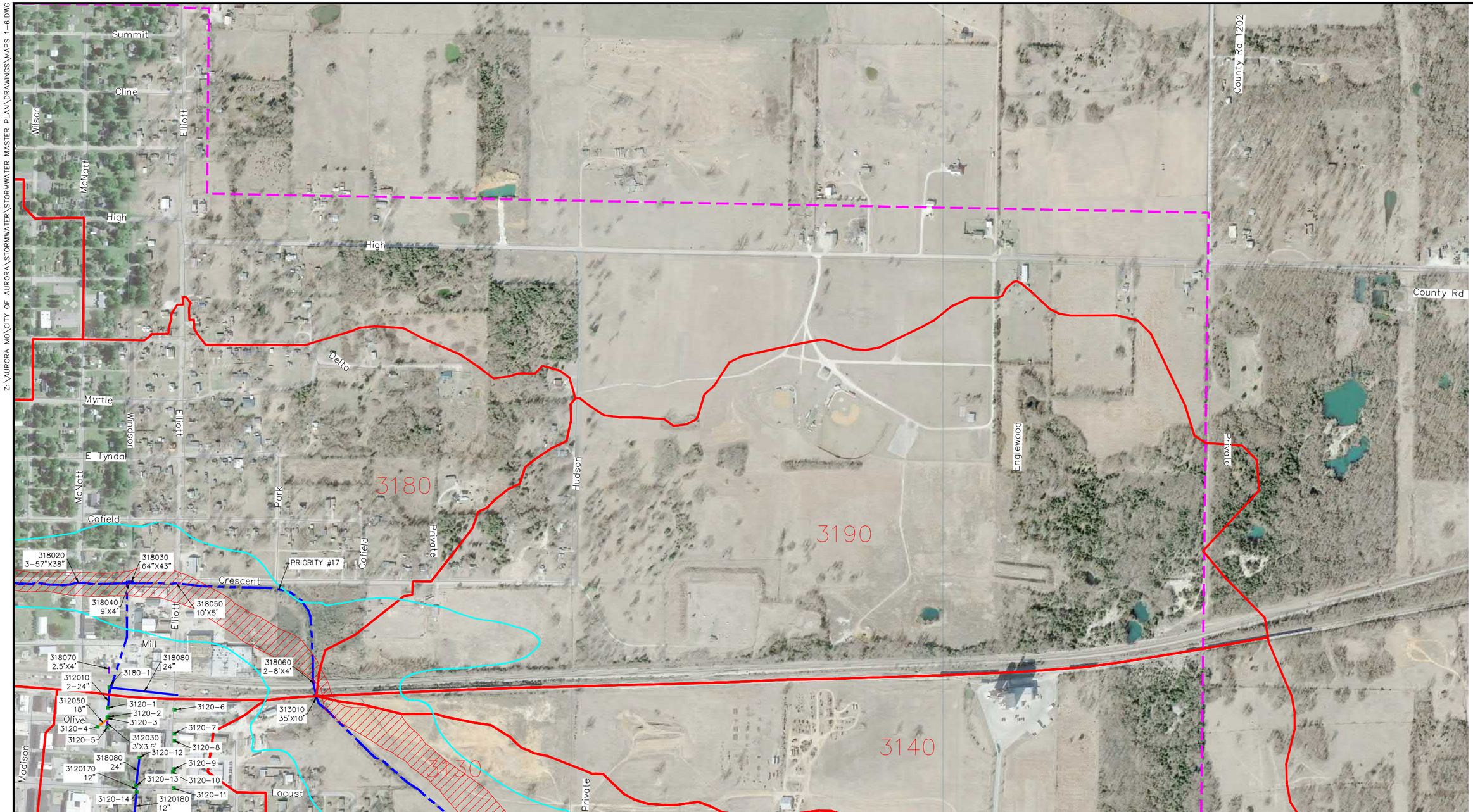

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RCP (ELLIPTICAL)
INLET
BASINS

STREAMS
BOX CULVERT NETWORK
CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

ALLGEIER, MARTIN and ASSOCIATES, INC.
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7231 EAST 24th STREET JOPLIN, MISSOURI 64804 (417) 680 - 7200

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EXISTING SYSTEM MAPS (APPENDIX I)
STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO. 3

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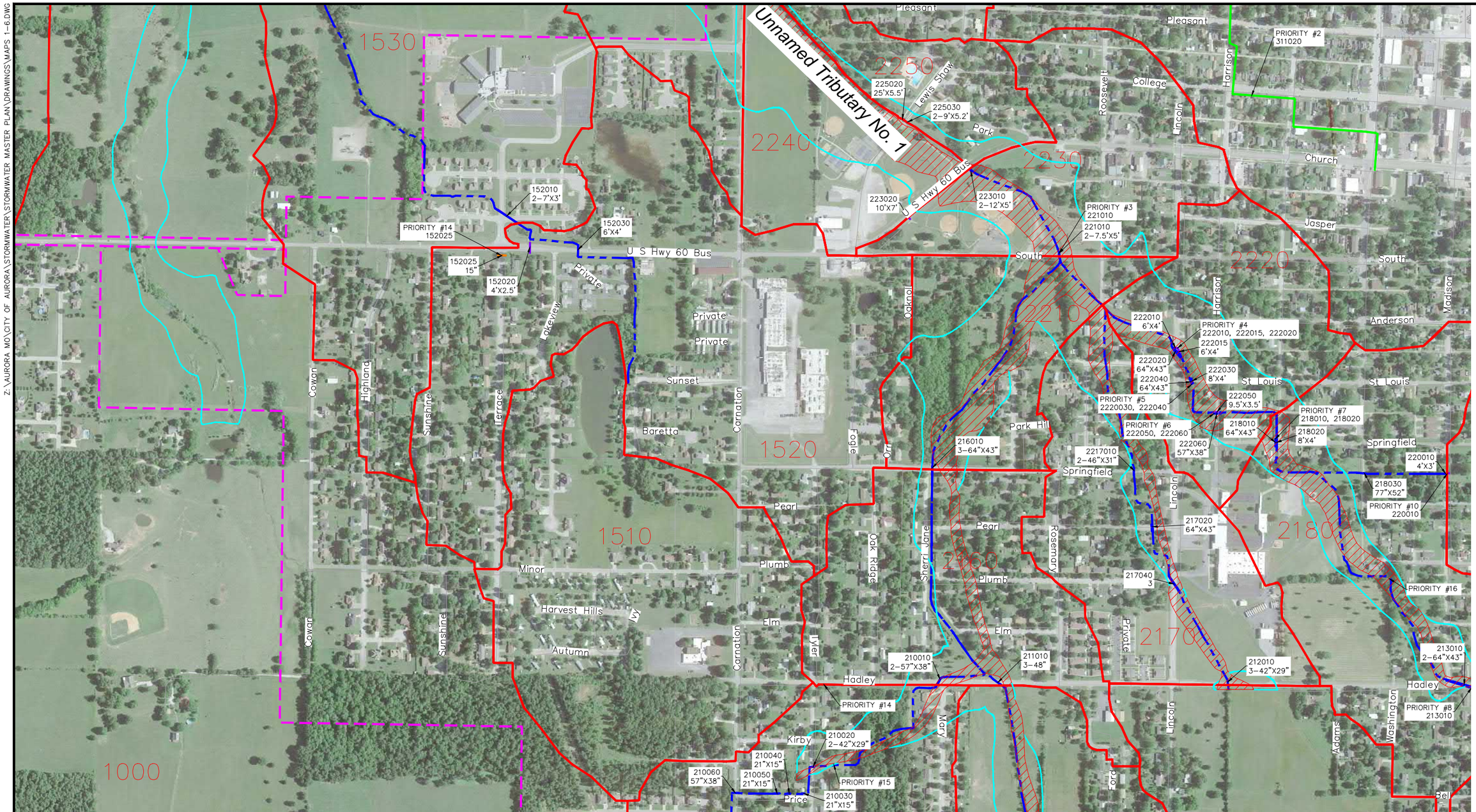

BRIDGE
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OTHER
RCB

RCP
RCP (ELLIPTICAL)
INLET
BASINS

STREAMS
BOX CULVERT NETWORK
CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

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CONSULTING ENGINEERS and SURVEYORS
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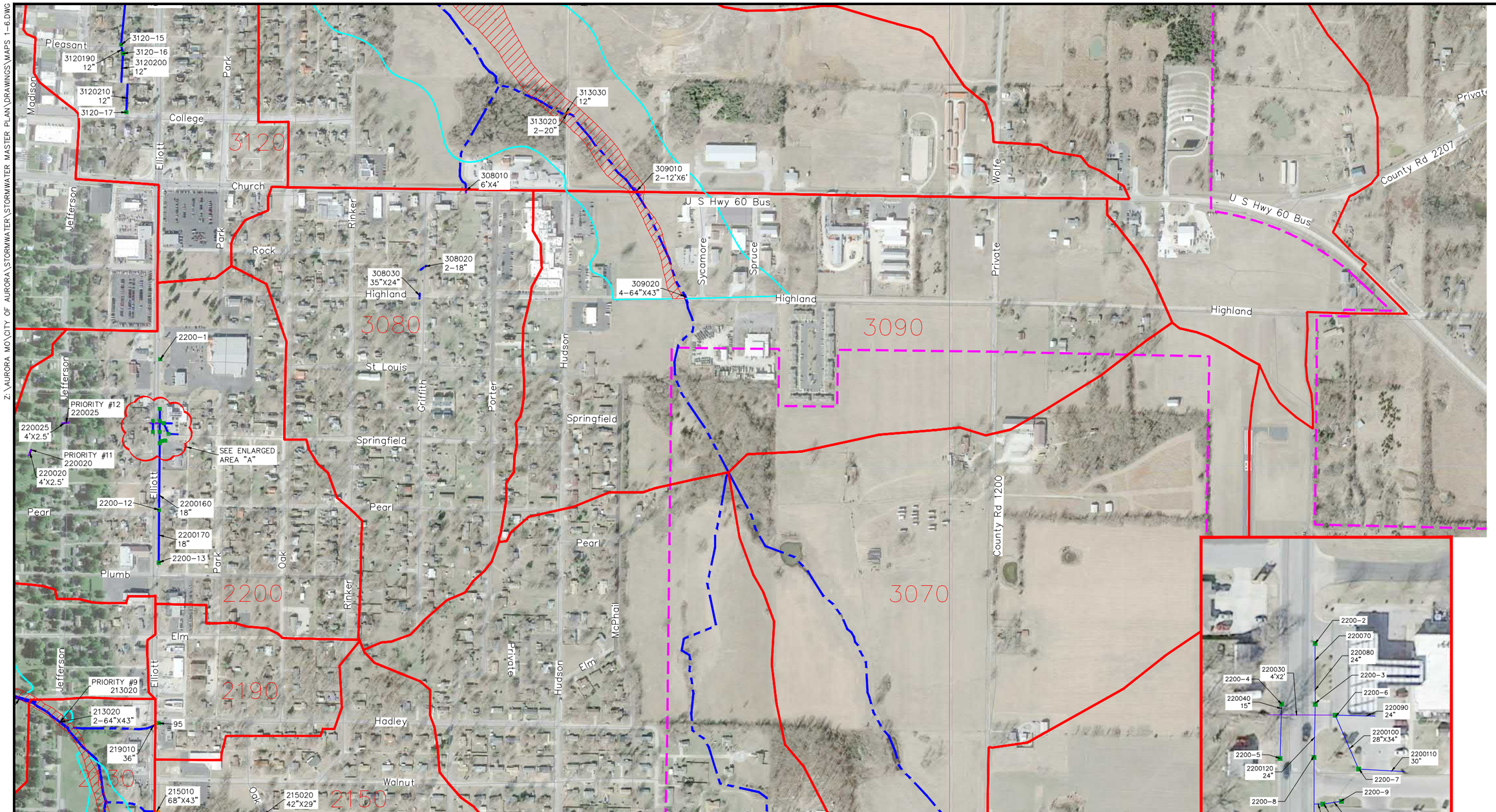
EXISTING SYSTEM MAPS (APPENDIX I)
STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO. 4

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\MAPS 1-6.DWG



ENLARGED AREA "A"
N.T.S.

BRIDGE
CMP
CMPA
OTHER
RCB

RCP
RCP (ELLIPTICAL)
INLET
BASINS

STREAMS
BOX CULVERT NETWORK
CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

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EXISTING SYSTEM MAPS (APPENDIX I)
STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO. 5

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\MAPS 1-6.DWG

21"X15"

Daniels

Carnation

Unnamed Tributary No. 2

2100

2110

2120

206010
2-36"

207010
2-64"X43"

PRIORITY #13
212020

212020
14"

County Rd 2220

Prospect

Private

2060

2070

County Rd 1180

2080

Chestnut

Private

Madison

201010
36"

202010
36"

Hwy 60

2010

2020

2030

BRIDGE
CMP
CMPA
OTHER
RCB

RCP
RCP (ELLIPTICAL)
INLET
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CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

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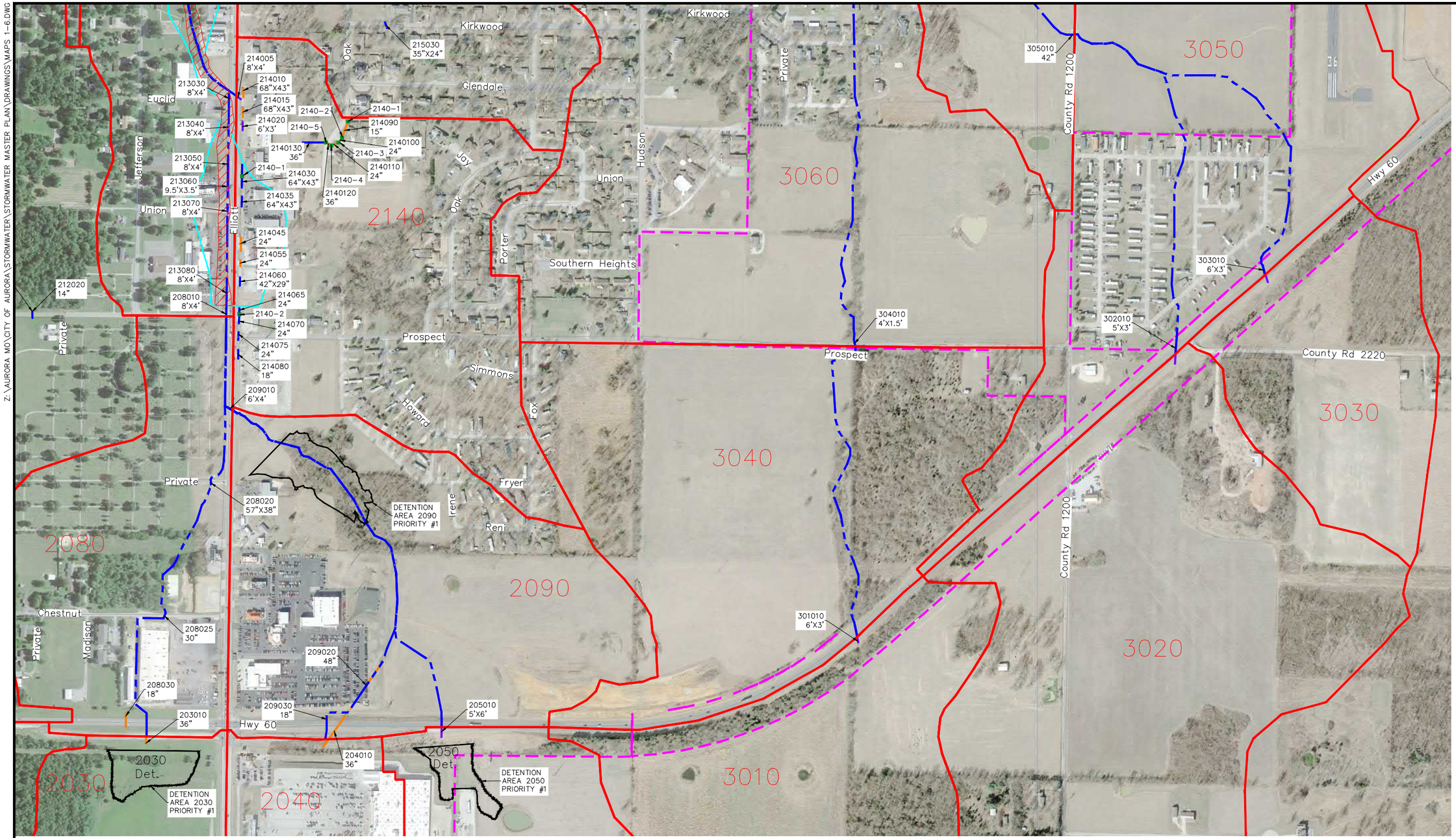
STORM WATER MASTER PLAN

AURORA, MISSOURI

DWG. NO. 6

Z:\AURORA MO\CITY OF AURORA\STORMWATER\STORMWATER MASTER PLAN\DRAWINGS\MAPS 1-6.DWG



BRIDGE
CMP
CMPA
OTHER
RCB
RCP
RCP (ELLIPTICAL)
INLET
BASINS
STREAMS
BOX CULVERT NETWORK
CITY BOUNDARY
REGULATORY FLOODWAY
1% ANNUAL CHANCE FLOOD HAZARD

SCALE
300' 0 150' 300'
N

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EXISTING SYSTEM MAPS (APPENDIX I)
STORM WATER MASTER PLAN
AURORA, MISSOURI

DWG. NO. 7