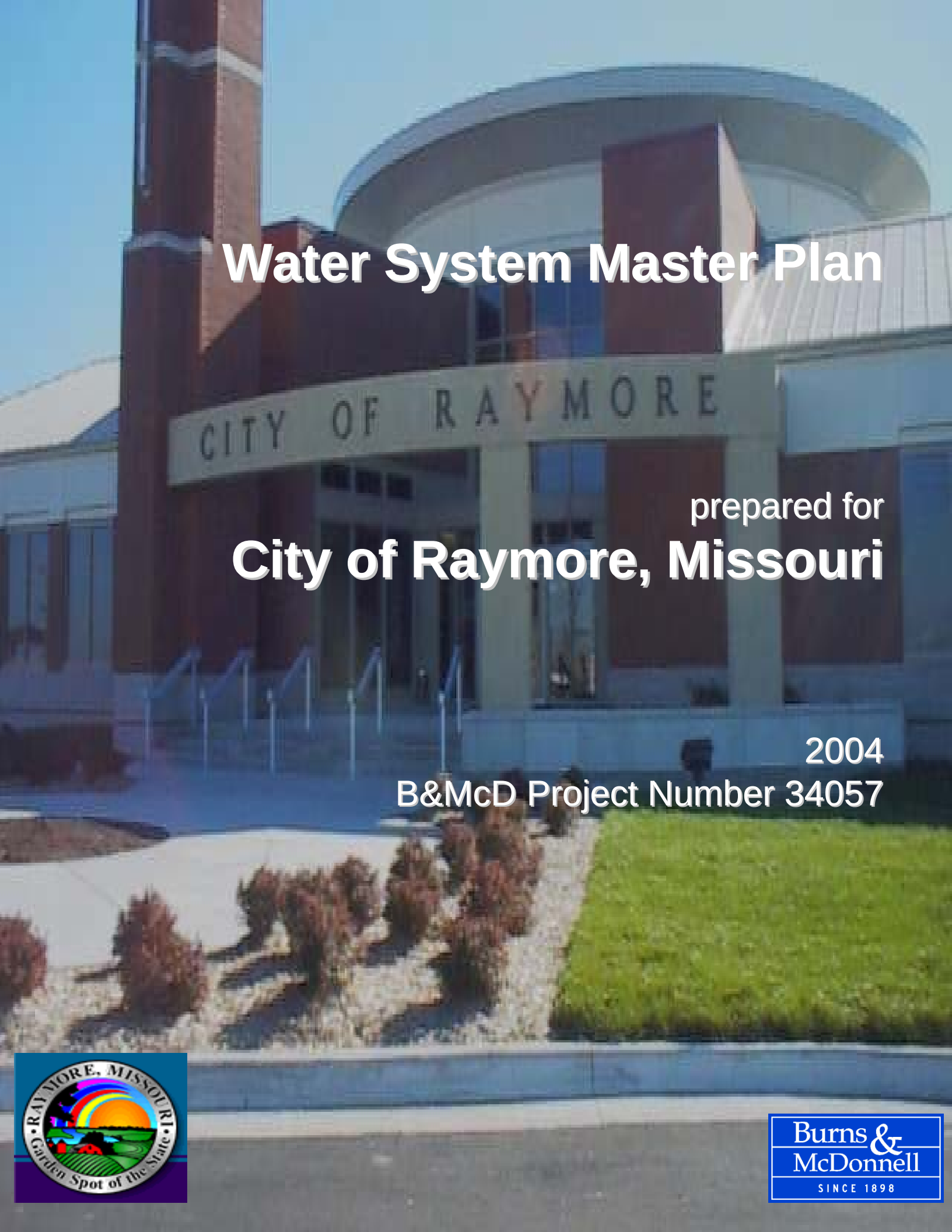

Water System Master Plan

prepared for

City of Raymore, Missouri

2004

B&McD Project Number 34057

Burns & McDonnell
SINCE 1898

September 17, 2004

Mr. Michael E. Krass, P.E.
Assistant Director of Public Works
City of Raymore
100 Municipal Circle
Raymore, Missouri 64083

RAYMORE
Water Distribution System Master Plan
Final Report
Project No. 34057

Dear Mr. Krass:

According to our contract dated June 11, 2003, please find the final *Water Distribution System Master Plan* and Appendix for your use. Raymore's water system has a number of growth related challenges in it's near, short-term and long-term future. These include negotiating additional supply from Kansas City Missouri Water Services, installation of additional storage, and installation of transmission mains designed to serve the City through full development of their water territory.

We appreciate to opportunity to serve the City of Raymore and the assistance of City staff. If you have any questions, please do not hesitate to contact us.

Sincerely,

L. Jeffrey Klein, P.E.
Project Manager

Enclosure

jk091704report

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[illegible], Missouri [illegible]
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City of Raymore, Missouri
Water Distribution System Master Plan
RAYMORE 34057

INDEX AND CERTIFICATION SHEET

ENGINEERING CERTIFICATION

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Introduction

INTRODUCTION

A. PURPOSE

The purpose of this project is to conduct an engineering study of the Raymore, Missouri water distribution system with the objective of developing a plan to meet projected year 2030 water demands.

B. SCOPE

This report includes the following tasks:

- Develop GIS linked water distribution map for computer model development.
- Describe the existing supply and distribution system.
- Review available historical population and water use data and any projections developed by the City.
- Evaluate unaccounted-for water and project average day demand to year 2030.
- Evaluate historical maximum day to average day ratios based on available data and project maximum day demand to year 2030.
- Determine the required water supply capacity through the year 2030. Compare to the existing supply capacity.
- Develop a computer model of the distribution system including pipes, elevations, demand (including large users), pump station, and storage facilities.
- Perform field tests to develop calibration and verification data. Use City recorded data for elevated tank level.
- Evaluate existing and required storage volumes for equalization and fire through the year 2030.
- Evaluate the distribution system and determine improvements to meet year 2008, 2013, and 2030 demands for maximum day, peak hour, minimum hour plus tank replenishment, and maximum day plus fire flow.
- Prepare opinions of probable cost for recommended improvements and an implementation schedule.
- Evaluate maintenance staffing requirements for existing activities and proposed water distribution system maintenance activities.

- Evaluate and recommend changes in fire hydrant flushing program and tank inspections.
- Develop GASB34 inventory of water system based on available GIS data.
- Prepare a report summarizing the findings.

*****

Part I – Existing Water System

PART I – EXISTING WATER SYSTEM

A. GENERAL

This section of the report discusses the existing service area, water supply, and distribution system for Raymore, Missouri. Raymore lies within Cass County and is bounded by Kansas City on the north and Belton on the west as shown in Figure I-1. Public Water Supply Districts (PWSD) Nos. 3 and 10 have service area within the City limits, but very few customers at this time. PWSD No. 6 has service area adjacent to the southeast portion of the City limits.

The system is owned and operated by the City of Raymore. Raymore's 2000 census was 11,146 people; virtually all of the current population lives within the City's water service area.

B. BACKGROUND

1. Supply

The City of Raymore purchases all their potable water from Kansas City, Missouri (KCMO). KCMO provides water through an 8-inch diameter pipeline to 155th and Kentucky on the northeast side of the City. A second connection at Lucy Webb and J Highway, on the east side of the City, was completed in June 2004.

The northeast connection takes water from KCMO through a pressure reducing valve at the meter, which limits the pressure to a maximum of about 45 psi and Raymore's supply to about 1300 gallons per minute (gpm). Water flows into a 0.75 million gallon (MG) ground storage tank, which supplies a booster pump station.

A new connection at Lucy Webb and J Highway was completed in June 2004. This connection includes a 24-inch diameter pipeline, two meters, and two pressure reducing valves. The pressure reducing valve is set a hydraulic grade line of 1240 feet, which limits the flow to about 1400 gpm.

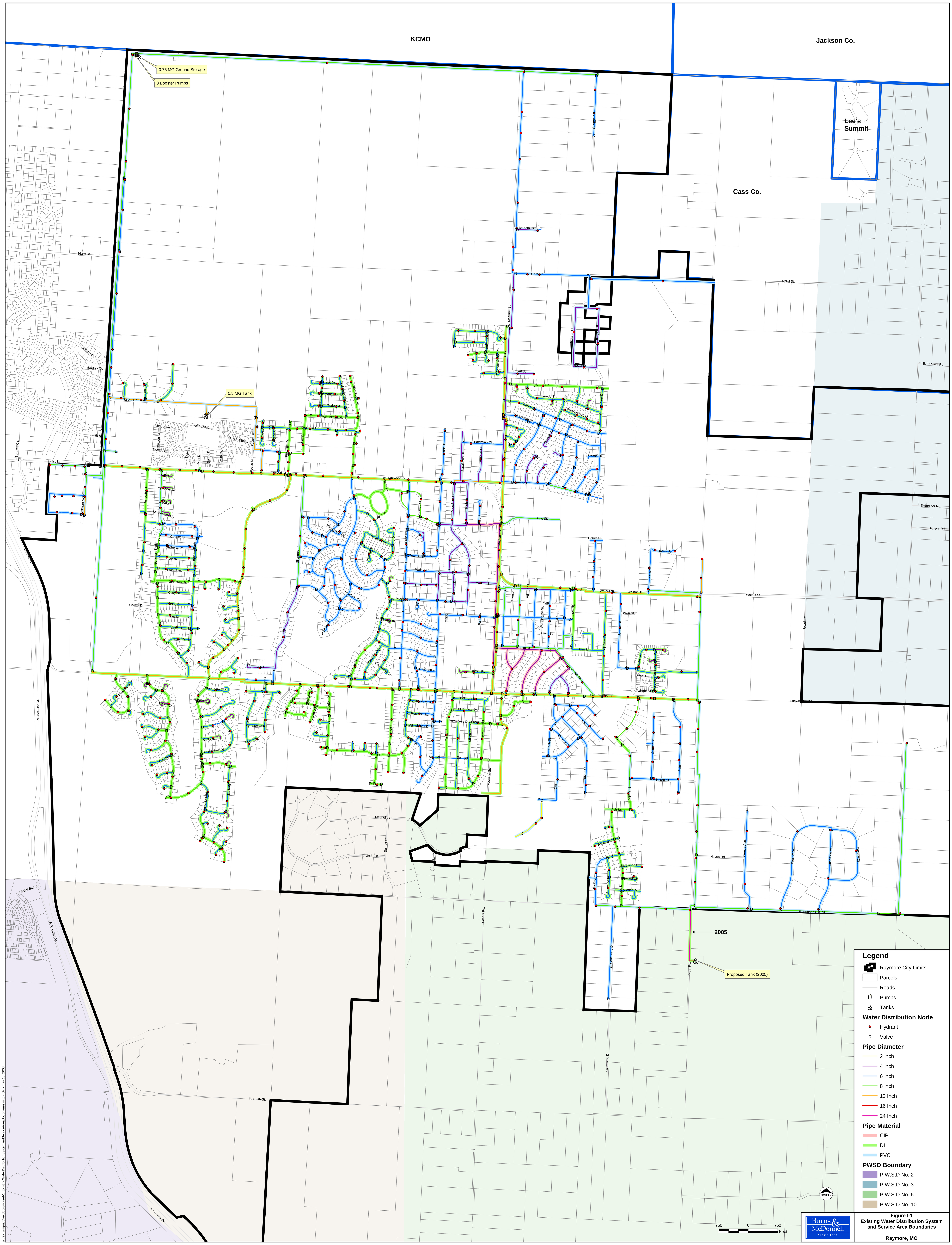


Figure I-1
Existing Water Distribution System and Service Area Boundaries

Raymore, MO

Copies of the booster pump curves and tank data are included in the Appendix.

2. Distribution

The location of the Raymore distribution system, associated facilities, and boundaries are shown in Figure I-1. The active system includes the following major facilities consisting of a 1,400 gpm high service pump station and 0.75 MG ground storage tank, a 0.5 MG elevated storage tank, and a 0.2 MG ground storage tank with a 400 gpm pump station (two pumps at 200 gpm each) for emergencies. The system also includes a 0.05 MG elevated storage tank, which is not used.

- The ground storage tank (T2) at 155th and Kentucky has a capacity of 0.75 MG, and an overflow elevation of 1078 feet. The tank supplies suction flow to the booster pumps.
- The high service pump station is located at 155th and Kentucky in the northern part of the City (P1, P2, and P3). One or two of the three pumps typically run to meet demands. Each of the 50 Hp pumps is designed to pump 680 gpm at 220 feet; these pumps were in service when field tests for model calibration were completed. Pump 3 is the only pump connected to the emergency generator. Pump impellers and motors were replaced in December 2003. Impeller size increased from 8.25 inches to 8.78 inches and motor size increased from 50 to 60 Hp. Two new pumps provide 1,400 gpm at 258 feet into the distribution system on a firm capacity basis.
- The Harold elevated tank has a capacity of 0.5 MG, an overflow elevation of 1231 feet, and a ground elevation of 1104 feet. The tank is located on Harold Drive in the northern part of the system (T1).
- The Washington and Elm ground storage tank and pump station were used during emergencies. Tank capacity is 0.2 MG with an overflow elevation of 1164 feet, and a ground elevation of 95 feet. This tank and pump station are not currently used and are not included in the model.
- The Washington and Elm elevated tank has a capacity of 0.05 MG, an overflow elevation of 1221 feet and is located in the southern part of the system. The tank's overflow elevation is about 10 feet below the 0.5 MG

tank on Harold Drive and is therefore submerged. The Washington and Elm tank is not currently used and is not included in the model.

- Distribution piping ranges in diameter from 2-inch to 12-inch. All new piping is AWWA Class 51 ductile iron pipe. Most of the older pipe north of Lucy Webb and south of 58 Highway is PVC.

3. Pumping Stations

Pump station data is listed in Table I-1 and includes the name, manufacturer, design flow and head, motor horsepower, and control tower for the replacement pumps at the high service pump station and the emergency pumps at Washington and Elm. Pump curves are included in the Appendix.

Table I-1

Pump Summary

Name	Manufacturer	Design Flow (gpm)	Design Head (feet)	Motor Hp	Control Tower
Booster (P1, P2, P3)	Layne Vertical Turbine	700	258	60	Harold
Washington & Elm	Aurora Centrifugal	200	230	20	Elm St.

4. Storage

Raymore's system includes one active ground storage tank, one active elevated tank, one inactive elevated tank, and one inactive emergency ground storage tank. Data is listed in Table I-2 for the active tanks including capacity, base elevation, overflow elevation, and head range.

Table I-2

Active Storage Tank Summary

Name	Capacity (MG)	Ground El. (feet)	Overflow El. (Feet)	Head Range (feet)
Harold Drive Ground (N6962)	0.76	1055	1078	22.0
Elevated (N5202)	0.5	1,104	1,231	30.0

5. Operation

Operational parameters for the booster pump station are listed in Table I-3. Actual operational parameters vary seasonally.

Table I-3

Booster Pump Station Operational Parameters

Pump Station	Control Tower	Start Level (feet)	Stop Level (feet)
High Service (155th & Kentucky)	Harold	Two pumps on at 23.0	Two pumps off at 25.0

*****

Part II – Water Demand

PART II – WATER DEMAND

A. GENERAL

This section of the report discusses the anticipated city limits and water service area; historical population, customer, and water use data; projected population, customer, and water use; and projected water need for Raymore, Missouri. The water service area, developed area, anticipated development and when development is projected to start, is detailed in Figure II-1.

B. POPULATION PROJECTION

Raymore has experienced extensive residential growth in recent years. This trend is anticipated to continue as shown in Figure II-2 and listed in Table II-1. Based on discussion with City staff and review of the concurrent Wastewater Master Plan, a projected growth rate of 500 customers per year to the year 2030 plus 150 homes per year in the Creekmoor Development from 2005 to 2014 are used for water and wastewater planning purposes. A net of 3 houses per acre and 2.76 people per household, based on Census data, are used to estimate development density throughout the study period. This increases the current population from about 13,814 people to about 51,400 people in 2030.

For the purpose of this Water Master Plan, all growth is anticipated to occur within Raymore's water service area. Based on this growth projection, the water service area will be completely developed by 2030; therefore, this report provides an ultimate water system master plan for Raymore. Realistically, growth will occur within Raymore's City limits but outside the water service area, but the extent of growth in these areas is unknown and depends on the developers' willingness to install large sewer force mains and make additional infrastructure improvements. If development within the existing water service area occurs slower than projected, the year 2030 plan will take longer to achieve. Likewise, if development occurs faster than projected, the recommended plan may be executed and completed before 2030.

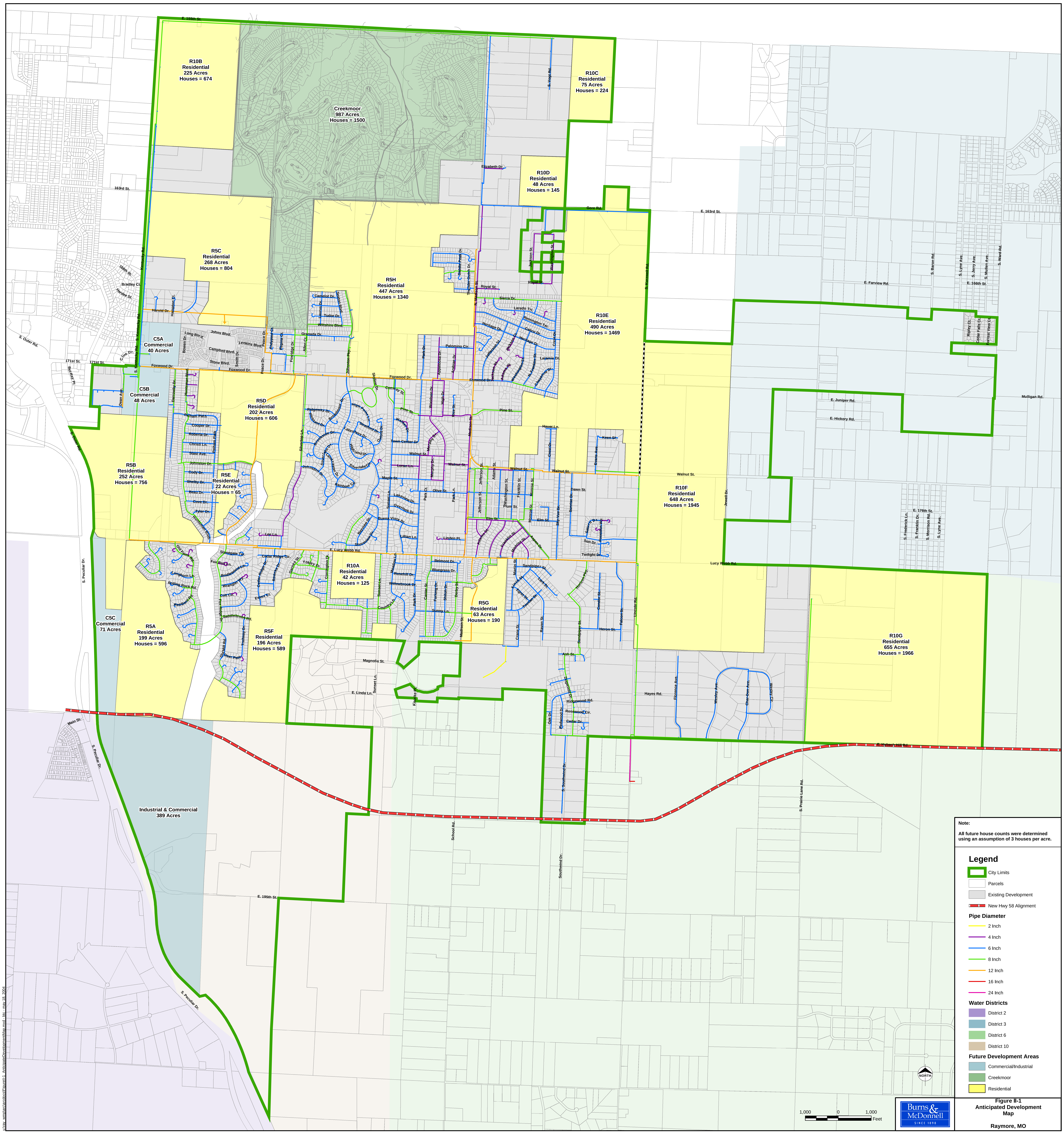
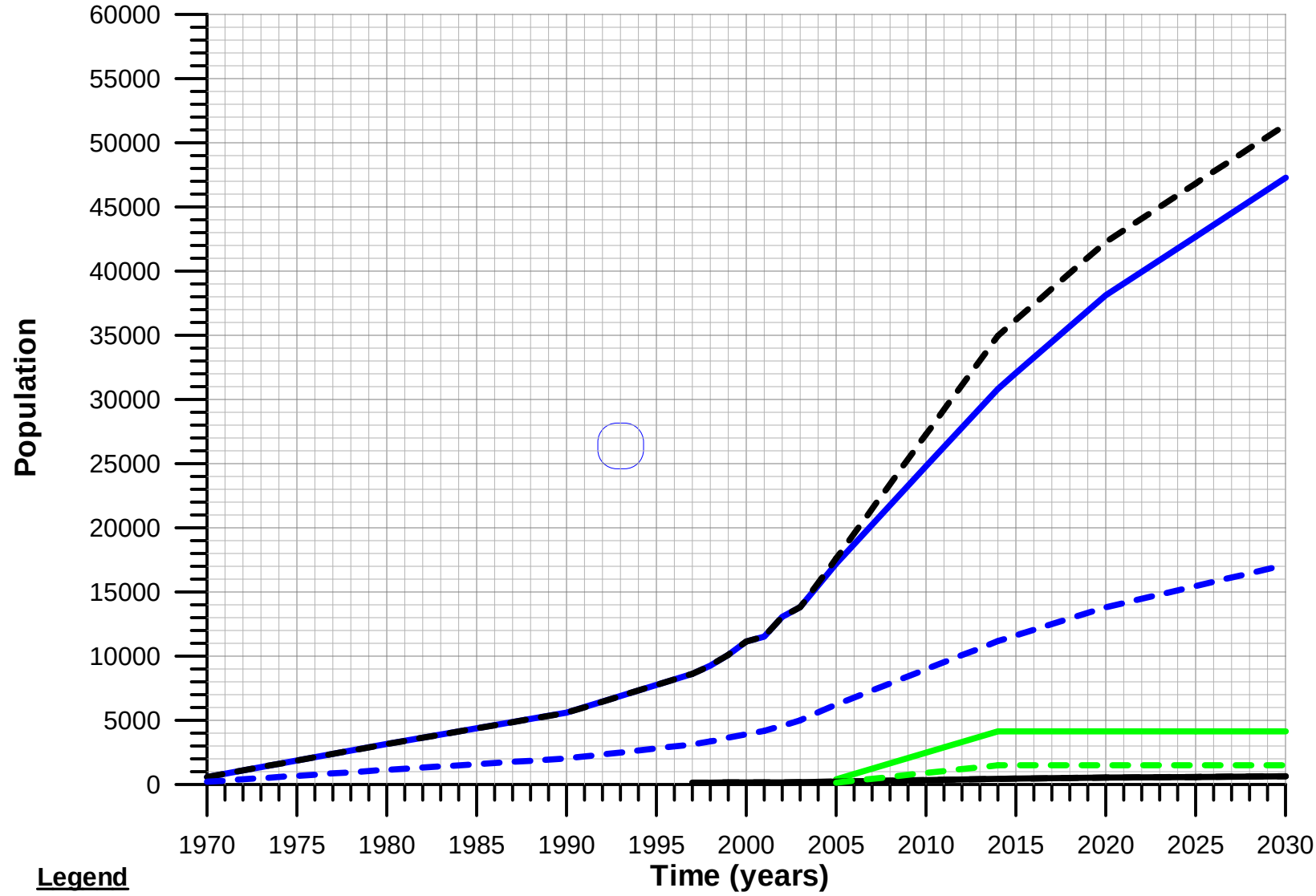


Figure II-1
Anticipated Development Map

Raymore, MO

population



Legend

- Total Population
- Residential Population
- Creekmoor Population
- Total Customers
- Residential Customers
- Creekmoor Customers

Burns & McDonnell

Figure II-2
Raymore, MO
Historic and Projected
Population

Table II-1

Population and Customer Projections
Water Service
Raymore, Missouri

Year	Population	Residential Customers	Creekmoor		Commercial	Total	
			Population	Customers		Population	Customers
1970	587	213				587	213
1980	3,154	1,143				3,154	1,143
1990	5,592	2,026				5,592	2,026
1997	8,625	3,125			146	8,625	3,271
1998	9,263	3,356			149	9,263	3,505
1999	10,096	3,658			155	10,096	3,813
2000	11,146	3,906			156	11,146	4,062
2001	11,523	4,175			160	11,523	4,335
2002	13,071	4,574			172	13,071	4,746
2003	13,814	5,005			181	13,814	5,186
2005	17,200	6,232	410	150	223	17,610	6,865
2010	24,801	8,986	2,480	900	345	27,281	11,811
2014	30,824	11,168	4,140	1,500	442	34,964	15,750
2015	32,063	11,617	4,140	1,500	458	36,203	16,215
2020	38,121	13,812	4,140	1,500	534	42,261	18,486
2025	42,689	15,467	4,140	1,500	592	46,829	20,199
2030	47,257	17,122	4,140	1,500	650	51,397	21,912

Notes:
1. Assumes development occurs within water service boundary of Raymore.

C. WATER DEMAND PROJECTION

A mix of customer, metered water use, water use by customer class, and purchased water data was provided from 1995 through 2003 as listed in Table II-2. Data review shows the information is incomplete and water use by customer class was substantially higher than the water purchased by the City due to an Incode programming issue. Water quantities sold by the City and purchased from Kansas City, Missouri adequately correlate given that the meters cannot be read simultaneously.

This data is used to develop unit water use projections in gallons per meter day (gpmd). The projected gpmd values are applied to the customer projections to determine average day demand as listed in Table II-3. Water use from 2000 through 2003 ranged from 196 to 242 gpmd. Review of the data shows the year 2003 average day historical gpmd was 242; during this period, the City had a limited water supply from Kansas City and Raymore was under voluntary conservation. The following growth related issues are ongoing and are anticipated to continue, which will cause gpmd usage to increase.

- Larger, more expensive homes are being built in Raymore. These typically use more water, especially for lawn watering.
- More lawn sprinkler systems are being installed with the homes. Sprinkler systems make it easier to irrigate and increase the quantity of water used for lawn watering.
- The KCMO eastern connection will be in service in spring 2004 and should alleviate the limited supply issue.
- The Raymore/KCMO elevated Tank will be in place by summer 2005 and will further help alleviate the supply issue.
- Commercial development will continue in the water service area.

Based on these factors, more water will be available, the number of commercial users continues to increase, and the ability of residential users to pay continues to increase. These factors combine to increase Raymore unit water use closer to other communities in the Kansas City metropolitan area. The following gpcd/gpmd values are used in the projections:

- Year 2005 – 110 gpcd or 304 gpmd.
- Year 2009 to 2030 – 130 gpcd or 360 gpmd.

Table II-2

Historical Customer and Water Use Data
City of Raymore, Missouri

			Number of Customers					Water Sold								Water Purchased			UAF	
Year	Month	Population	Resid	Comm	Lrg Comm	Govt	Total	Resid	Comm	Lrg Comm	Govt	Subtotal	Annual Avg	Total	Annual Avg	Total	Annual Avg	Difference	Monthly	Annual
1940		207																		
1960		268																		
1970		587																		
1980		3,154																		
1990		5,592																		
1994	Nov													15,467,637						
	Dec													16,410,328						
1995	Jan													16,410,328						
	Feb													13,340,248						
	Mar													17,702,294						
	Apr													12,883,748						
	May													17,810,513						
	June													19,549,350						
	Jul													15,212,901						
	Aug													22,472,268						
	Sep													16,101,632						
	Oct													18,437,766	560,553					
	Nov													14,459,994						
	Dec													15,635,221	555,601					
1996	Jan													17,065,682						
	Feb													17,065,628						
	Mar													14,797,848						
	Apr													19,461,778						
	May													29,876,877						
	June													18,768,950						
	Jul													18,299,043						
	Aug													19,527,054						
	Sep													15,954,548						
	Oct													18,535,483	609,578					
	Nov													15,007,164						
	Dec													13,024,917	603,847					
1997	Jan		643	17	1	1	662							22,673,941						
	Feb		2,804	128	1	3	2,936	43,526,085	1,013,203		10,390	44,549,678		14,311,602						
	Mar		2,832	130	1	3	2,966	50,583,258	624,359		12,260	51,219,877		15,630,428						
	Apr		2,855	132	1	4	2,992	40,357,604	843,140		14,030	41,214,774		19,194,941						
	May		2,879	133	1	4	3,017	21,355,380	932,510		29,940	22,317,830		19,156,890						
	June		2,897	134	2	4	3,037	21,552,006	987,346		23,050	22,562,402		22,946,469						
	Jul		2,909	134	2	4	3,049	26,246,289	2,030,216		42,390	28,318,895		26,486,288						
	Aug		2,925	134	2	4	3,065	25,440,575	968,884		60,990	26,470,449		20,266,695						
	Sep		2,958	138	2	4	3,102	41,591,571	1,814,136		23,730	43,429,437		19,400,365						
	Oct		2,984	139	2	4	3,129	76,025,110	4,716,864		29,520	80,771,494		20,252,864	634,313					
	Nov		3,119	146	2	4	3,271	57,301,379	2,495,121	995,000	19,060	60,810,560		16,162,631						
	Dec		3,125	146	2	4	3,277	64,855,409	1,936,960	865,000	11,620	67,668,989	1,482,831	16,913,580	648,324					
1998	Jan		3,266	144	1	4	3,415	15,133,352	2,053,030	958,000	10,020	18,154,402		18,027,082						
	Feb		3,266	144	1	4	3,415	25,108,530	2,105,070	922,000	12,290	28,147,890		16,182,803						
	Mar		3,270	144	1	4	3,419	42,988,475	1,852,340	811,000	12,280	45,664,095		14,773,360						
	Apr		3,270	144	1	4	3,419	35,128,906	2,073,060	856,000	23,820	38,081,786		20,942,729						
	May		3,271	145	1	4	3,421	45,733,319	2,224,880	1,004,000	29,050	48,991,249		24,959,788						
	June		3,275	145	2	4	3,426	71,271,138	2,270,640	1,137,010	49,080	74,727,868		20,592,740						
	Jul		3,283	146	2	4	3,435	37,157,250	2,376,140	981,470	43,740	40,558,600		24,510,892						
	Aug		3,285	146	2	4	3,437	77,565,672	2,093,810	1,182,500	50,110	80,892,092		25,541,737						
	Sep		3,290	147	2	4	3,443	62,733,242	2,151,980	1,528,510	73,060	66,486,792		30,705,016						
	Oct		3,317	149	2	4	3,472	27,899,144	2,091,960	1,325,720	76,080	31,392,904		20,149,882	692,951					
	Nov		3,332	149	2	4	3,487	56,660,322	1,433,210	1,947,270	37,990	60,078,792								

Table II-2

Historical Customer and Water Use Data
City of Raymore, Missouri

			Number of Customers					Water Sold								Water Purchased			UAF	
Year	Month	Population	Resid	Comm	Lrg Comm	Govt	Total	Resid	Comm	Lrg Comm	Govt	Subtotal	Annual Avg	Total	Annual Avg	Total	Annual Avg	Difference	Monthly	Annual
	Dec		3,356	149	2	4	3,511	34,100,004	1,285,093	1,651,690	20,710	37,057,497	1,583,983							
1999	Jan		3,545	149	2	4	3,700	57,804,620	1,535,757	2,054,730	23,520	61,418,627								
	Feb		3,549	151	2	4	3,706	55,399,891	1,392,560	1,888,430	23,560	58,704,441								
	Mar		3,553	151	2	4	3,710	75,754,375	1,464,330	1,983,470	21,290	79,223,465								
	Apr		3,559	152	2	4	3,717	35,540,085	1,423,270	1,809,170	35,960	38,808,485								
	May		3,562	152	2	4	3,720	38,603,965	1,595,787	1,834,510	29,890	42,064,152								
	June		3,572	153	2	4	3,731	39,283,484	1,479,513	1,805,820	55,040	42,623,857								
	Jul		3,581	154	2	4	3,741	80,471,399	2,031,860	2,059,880	44,950	84,608,089								
	Aug		3,590	155	2	4	3,751	54,030,345	101,832,757	1,884,170	51,280	157,798,552								
	Sep		3,608	155	2	4	3,769	33,843,625	2,026,413	2,152,050	81,120	38,103,208								
	Oct		3,622	155	2	4	3,783	90,031,190	1,697,780	1,840,420	17,810	93,587,200								
	Nov		3,638	155	2	4	3,799	58,090,560	1,553,950	1,747,250	15,120	61,406,880				28,974,528				
	Dec		3,658	155	2	4	3,819	48,728,050	1,487,870	1,919,450	16,160	52,151,530	2,251,385			25,325,784				
2000	Jan	11,146	3,795	156	2	4	3,957	28,428,601	1,487,940	2,240,940	42,950	32,200,431				21,875,260				
	Feb		3,802	156	2	4	3,964	47,093,179	2,166,890	1,410,350	10,800	50,681,219				17,049,912				
	Mar		3,804	156	2	4	3,966	16,913,570	1,841,000	1,058,860	13,920	19,827,350				23,696,640				
	Apr		3,816	156	2	4	3,978	99,204,280	2,149,020	1,271,980	51,550	102,676,830				26,026,660				
	May		3,824	156	2	4	3,986	43,016,460	2,402,550	1,358,600	40,220	46,817,830				31,180,380				
	June		3,831	156	2	4	3,993	34,057,734	2,313,810	1,399,260	33,410	37,804,214				25,066,228				
	Jul		3,849	157	2	4	4,012	82,003,999	2,612,620	1,257,490	33,750	85,907,859				31,796,732				
	Aug		3,853	157	2	4	4,016	61,727,257	2,371,444	1,262,110	33,180	65,393,991				36,663,968				
	Sep		3,879	158	2	4	4,043	62,703,750	3,252,516	1,914,210	64,190	67,934,666				31,882,752				
	Oct		3,893	158	2	4	4,057	21,475,430	2,831,470	1,346,480	22,450	25,675,830				25,921,940				
	Nov		3,905	158	2	4	4,069	68,848,300	2,533,220	1,188,570	32,960	72,603,050				23,210,440				
	Dec		3,906	156	2	4	4,068	30,307,564	1,908,892	1,489,180	24,512	33,730,148	1,781,259			27,874,220	895,125			
2001	Jan		4,084	157	2	4	4,247	60,918,554	2,926,295	1,024,440	26,139	64,895,428				24,085,600				
	Feb		4,087	157	2	4	4,250	59,773,292	2,268,222	1,198,710	17,940	63,258,164				22,926,200				
	Mar		4,088	157	2	4	4,251	24,706,374	2,031,660	1,278,460	8,800	28,025,294				25,248,740				
	Apr		4,089	157	2	4	4,252	18,881,384	2,431,421	1,505,020	18,220	22,836,045				25,929,420				
	May		4,099	158	2	4	4,263	47,696,610	2,216,740	1,117,630	19,320	51,050,300				26,800,840				
	June		4,106	159	2	4	4,271	43,602,920	2,675,420	1,923,350	43,270	48,244,960				29,871,380				
	Jul		4,111	160	2	4	4,277	126,677,560	2,386,020	1,735,440	25,860	130,824,880				33,199,980				
	Aug		4,117	160	2	4	4,283	69,440,905	2,591,730	2,017,780	36,940	74,087,355				36,438,820				
	Sep		4,134	160	2	4	4,300	43,478,240	2,446,890	1,780,810	35,220	47,741,160				26,755,960				
	Oct		4,148	160	2	4	4,314	31,496,435	2,457,770	1,674,150	21,630	35,649,985				23,749,000				
	Nov		4,165	160	2	4	4,331	30,865,355	1,951,050	1,440,560	24,260	34,281,225		22,024,970		20,199,740		(1,825,230)	(9.04)	
	Dec		4,175	160	2	4	4,341	22,315,120	1,865,970	1,523,580	24,970	25,729,640	1,740,623	22,376,932		19,836,960	875,118	(2,539,972)	(12.80)	
2002	Jan		4,224	154	2	4	4,384	71,507,962	1,755,560	1,584,420	9,720	74,857,662		23,316,089		20,693,420		(2,622,669)	(12.67)	
	Feb		4,227	154	2	4	4,387	72,117,036	2,059,880	1,638,710	12,300	75,827,926		19,760,430		15,655,640		(4,104,790)	(26.22)	
	Mar		4,241	154	2	4	4,401	28,989,410	1,723,330	1,351,210	13,000	32,076,950		23,603,730		18,258,680		(5,345,050)	(29.27)	
	Apr		4,254	154	2	4	4,414	61,547,650	1,934,250	1,608,840	24,020	65,114,760		22,337,360		21,418,980		(918,380)	(4.29)	
	May		4,263	155	2	4	4,424	30,318,730	1,911,830	1,315,640	24,470	33,570,670		22,932,317		20,383,000		(2,549,317)	(12.51)	
	June		4,293	162	2	4	4,461	23,514,510	1,909,290	1,472,860	28,930	26,925,590		35,975,628		20,132,420		(15,843,208)	(78.70)	
	Jul		4,327	164	2	4	4,497	31,563,188	2,163,090	1,838,940	42,140	35,607,358		38,028,979		44,707,960		6,678,981	14.94	
	Aug		4,444	169	2	4	4,619	32,832,579	2,808,980	2,018,080	43,330	37,702,969		61,015,746		34,516,460		(26,499,286)	(76.77)	
	Sep		4,490	169	2	4	4,665	28,042,432	3,573,335	1,944,450	39,220	33,599,437		12,175,200		38,033,556		25,858,356	67.99	
	Oct		4,507	170	2	5	4,684	45,460,024	2,876,775	1,678,150	72,140	50,087,089		23,246,964	907,762	30,431,632		7,184,668	23.61	
	Nov		4,531	170	2	5	4,708	29,392,015	2,287,060	1,410,400	28,100	33,117,575		23,395,794		26,942,960		3,547,166	13.17	
	Dec		4,574	172	2	5	4,753	22,281,925	2,352,390	2,105,390	60,390	26,800,095	1,459,134	27,271,935	925,167	30,064,364	892,331	2,792,429	9.29	(3.7)
2003	Jan		4,620	170	2	5	4,797	23,077,915	1,950,500	1,730,230	54,590	26,813,235		27,748,530		30,580,484		2,831,954	9.26	
	Feb		4,657	169	2	5	4,833	40,890,872	12,152,740	1,687,530	19,890	54,751,032		24,887,052		26,123,900		1,236,848	4.73	
	Mar		4,705	169	2	5	4,881	22,773,328	2,379,360	1,929,310	24,030	27,106,028		25,860,188		31,451,904		5,591,716	17.78	
	Apr		4,743	168	2	5	4,918	23,442,461	2,072,150	1,694,910	28,760	27,238,281		27,619,441		32,104,908		4,485,467	13.97	
	May		4,768	171	2	5	4,946	19,656,954	2,137,570	1,360,990	15,290	23,170,804		23,527,834		29,869,136		6,341,302	21.23	
	June		4,808	174	2	5	4,989	32,078,438	3,118,890	2,133,180	35,480	37,365,988		38,455,358		37,812,148		(643,210)	(1.70)	

Table II-2

Historical Customer and Water Use Data
City of Raymore, Missouri

			Number of Customers					Water Sold								Water Purchased			UAF	
Year	Month	Population	Resid	Comm	Lrg Comm	Govt	Total	Resid	Comm	Lrg Comm	Govt	Subtotal	Annual Avg	Total	Annual Avg	Total	Annual Avg	Difference	Monthly	Annual
	Jul		4,840	174	2	5	5,021	38,845,100	2,648,040	2,011,610	25,580	43,530,330		34,109,139		52,903,048		18,793,909	35.53	
	Aug		4,879	175	2	5	5,061	96,386,684	4,242,280	2,110,470	58,740	102,798,174		44,553,685		52,449,760		7,896,075	15.05	
	Sep		4,916	173	2	5	5,096	36,221,360	4,438,040	2,201,500	47,500	42,908,400		43,959,430		39,501,880		(4,457,550)	(11.28)	
	Oct		4,939	173	2	5	5,119	24,255,856	3,292,959	1,409,200	16,400	28,974,415		31,810,965	1,036,665	36,689,400	1,184,705	4,878,435	13.30	
	Nov		4,979	171	2	5	5,157	26,950,389	3,205,191	1,934,000	59,100	32,148,680		33,060,810		34,490,280		1,429,470	4.14	
	Dec		5,005	181	2	5	5,193	22,549,451	2,017,173	1,673,827	30,650	26,271,101	1,314,101	29,073,831	1,068,517	32,781,100	1,213,217	3,707,269	11.31	11.9

Table II-3

Water Demand Projections
Water Service
Raymore, Missouri

Year	Total		Water Use (gpmd)	Projected Demand (MGD)			Comments
	Population	Customers		Average Day	Maximum Day	MD/AD	
1970	587	213	NA	NA			
1980	3,154	1,143	NA	NA			
1990	5,592	2,026	NA	NA			
1995	NA	NA	NA	0.56			
1996	NA	NA	NA	0.60			
1997	8,625	3,271	NA	0.65			
1998	9,263	3,505	NA	0.69			
1999	10,096	3,813	NA	NA	2.00		
2000	11,146	4,062	223	0.91	1.81	2.00	
2001	11,523	4,335	204	0.89	2.19	2.47	
2002	13,071	4,746	196	0.93	1.97	2.12	Limited supply & voluntary conservation
2003	13,814	5,186	242	1.26	3.29	2.62	Limited supply & voluntary conservation
2005	17,614	6,382	304	1.9	5.8	3.0	
2009	25,436	9,216	360	3.3	10.0	3.0	
2010	27,285	9,886	360	3.6	10.7	3.0	
2014	34,964	12,668	360	4.6	13.7	3.0	
2015	36,203	13,117	360	4.7	14.2	3.0	
2020	42,261	15,312	360	5.5	16.5	3.0	
2025	46,829	16,967	360	6.1	18.3	3.0	
2030	51,397	18,622	360	6.7	20.1	3.0	

Notes:
1. Assumes development occurs within water service boundary of Raymore.
2. Based on water purchased from KCMO from year 2000 to 2003 and water sold through 1999.
3. City was on voluntary water restrictions in 2002 and 2003
4. Additional residential development is anticipated to be larger homes with additional lawn sprinkler systems. This will increase outdoor water use and the maximum day demand.
5. Water use projection is based on 130 gpcd and 2.76 people per household for years 2010 through 2030.
6. Water use projection for 2005 is based on 110 gpcd for 2.76 people per household.

These values increase the average day demand from 1.9 MGD in 2003 to 3.3 MGD in 2009 to 4.6 MGD in 2014 to 6.7 MGD in 2030.

Annual average day (AD) and maximum day (MD) water pumpage data from 2000 through 2003 is also listed in Table II-3. The ratios range from a low of 2.1 to a high of 2.62. The MD to AD ratio of 2.62 occurred in 2003 when water supply was limited. Based on these values and the potential water use growth factors discussed above, a MD to AD factor of 3.0 is used in the analysis. This results in a projected maximum day demand of 10.0 MGD in 2009, 13.7 MGD in 2014 and 20.1 in 2030 as shown in Figure II-3 and listed in Table II-3.

Since the gpmd values discussed above are based on purchased water, unaccounted-for (UAF) water is included in the analysis. Review of Table II-2 shows UAF was –4 percent in 2002 and 12 percent in 2003. A conservative UAF percentage of 12 percent is included in the gpmd values used above. UAF water of less than 10 percent is considered excellent, values around 15 percent are acceptable, and values in excess of 20 percent are excessive. Several programs can be completed over time to reduce and maintain low values of UAF including meter repair and replacement, universal metering, elimination/reduction of theft, and leak detection survey and repairs.

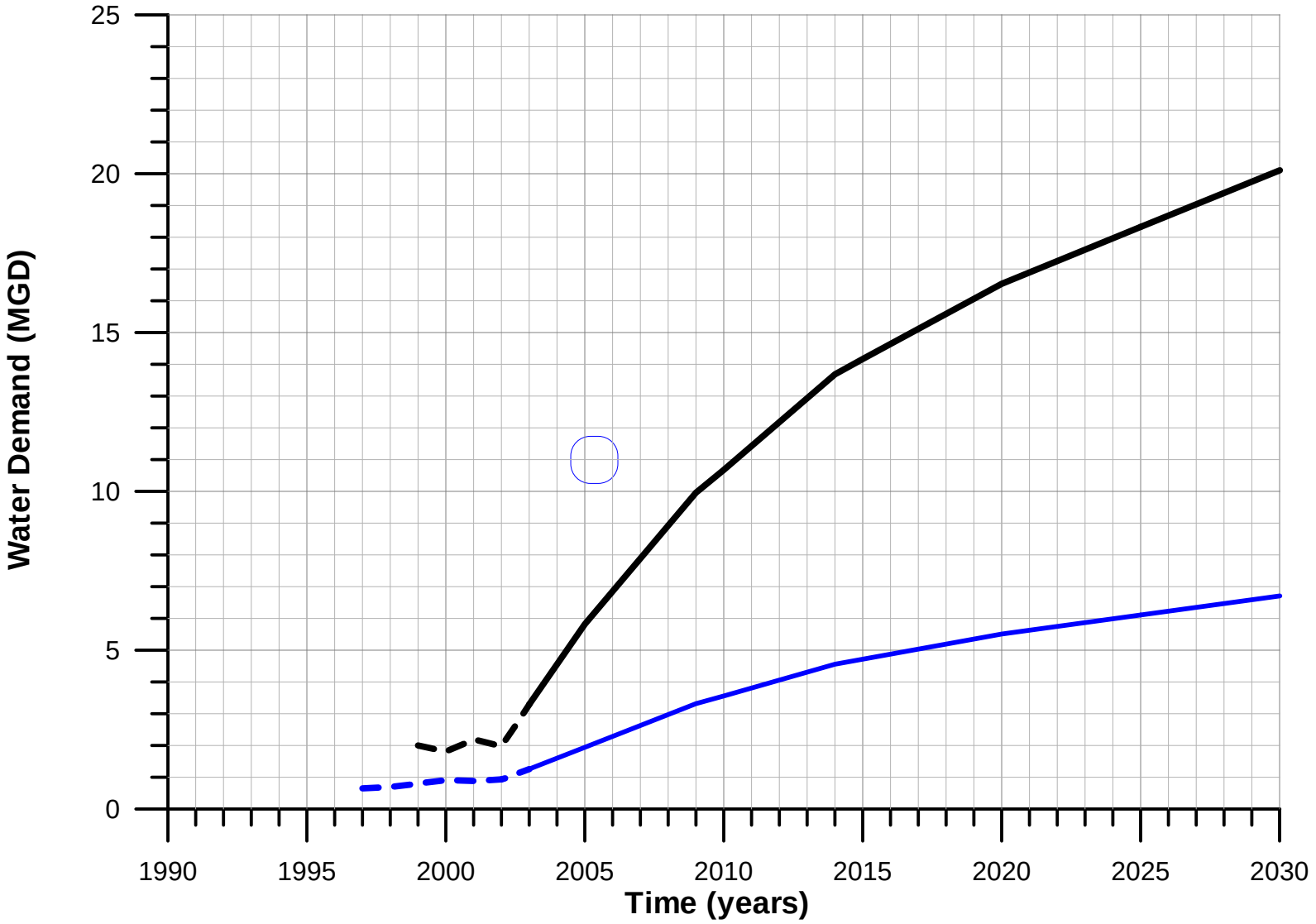
D. DEMAND MANAGEMENT

Demand management, or water conservation, can be used to reduce or control demand. Projections used in this study do not reflect any additional demand management activities beyond those currently in place.

Typical recommended demand management activities for systems serving more than 10,000 people include the following (per EPA Guidelines for Conservation Planning):

- Universal metering - meter all water users to provide a complete accounting of use.
- Control water loses – leak detection surveys and associated repairs.
- Costing – institute an inverted water rate to encourage the wise use of water. An inverted rate is a higher volume charge, usually 200 to 500 percent of the current volume charge for water use in excess of 110 to 125 percent of average winter use or average system winter use (whichever is higher).

demand



Legend

Maximum Day

Average Day

Burns & McDonnell

Figure II-3
Raymore, MO
Historic and Projected Demand

- Distribute information and education material on water conservation with water bills, at schools, special city functions, etc.
- Water-use audits – help customers realize how much water they are really using and where.
- Retrofits – provide plumbing retrofits kits to decrease water use from showers, toilet flushing, and faucets.
- Pressure management – lowering system pressure decreases the amount of water people can use in comparable time periods and reduces leakage.
- Xeriscape – plant water efficient trees, shrubs, flowers, and most importantly grass. Tall fescue, zoysia, bermuda, and buffalo grasses use much less water and chemicals than rye and blue grass varieties.

The greatest seasonal waste of water is usually lawn watering. Many people water at the wrong time of day and too often. Most grasses only need about 1 inch of water per week and need only be watered once or twice a week. This promotes a deeper root system and ultimately a stronger turf. Turf and lawn watering should be covered in the public education component of the City's demand management program.

Implementation of the first four conservation guidelines detailed above could reduce average day and maximum day water demands 10 to 30 percent. Implementation of the remaining conservation guidelines could save an additional 5 to 20 percent. The impacts of additional demand management are not included in the demand analysis. Additional data on residential and commercial water use should be evaluated before selecting demand management measures.

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Part III – Model Development

PART III – MODEL DEVELOPMENT

A. GENERAL

This section of the report discusses the field test program, model development, existing fire demands, storage analysis, and the criteria for hydraulic analyses.

B. FIELD TESTING

Daily continuous water system operating data was collected by automatic and manual means with City staff from October 7 through October 10, 2003 (pressure recorders and hydrant tests). This data is used to calibrate and verify the hydraulic model of the distribution system. City staff provided a 7-day chart for the 0.5 MG elevated tank levels.

Eleven pressure recorders were installed across the distribution system to record changes in pressure over a 24-hour period as listed in Table III-1. Hazen Williams C-value tests were not conducted to determine the pipe roughness factor or internal condition of the water mains since the older City main are PVC and the ductile iron pipe is generally new, installed within the last 5 years.

An extensive number of fire hydrant tests were conducted to develop model calibration and verification data. Copies of completed field test forms for the hydrant tests are included in the Appendix. Locations for the hydrant tests are as follows:

- Char-Don and Wesley.
- Dogwood – Birch and Oak.
- Toucan – Raven and Egret.
- Secretariat – Furlong to Canter.
- Country Lane – Coventry to Sunset.
- Roanke – south of Cedar Ridge.
- Trailway – south of Saddlebrook.
- Red Barn – south of Goose Creek.
- Poseidon – Saturn to Sun.
- Adams – north of Lucy Webb.
- Olive and Maple.
- Calico – Washington to Crest.
- Palomino and Appaloosa.
- Washington and Gore.
- Madison near Elizabeth.

Table III-1

RAYMORE, MISSOURI WATER DISTRIBUTION SYSTEM
SUMMARY OF FIELD DATA

		Pressure (psi)														
		Pump Station				0.5 MG Tank										
Date	Time	Clearwell N (psi)	Suction N (psi)	Discharge N (psi)	Flow N (gpm)	Level N (feet)	Pressure N (psi)	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)
10/7/2003	0:00					29.5										
	1:00					29.7										
	2:00					29.5										
	3:00					30.0										
	4:00					29.4										
	5:00					30.5										
	6:00					30.0										
	7:00					29.5										
	8:00					29.0										
	9:00					30.8										
	10:00					30.8										
	11:00					30.8										
	12:00		*9.0*	*75*	*1880.0*	30.2										
	13:00		*9.0*	*75*	*1880.0*	29.5										
	14:00		9.0	75	1880.0	29.0			93	82						
	15:00		9.0	75	1880.0	29.5			95	81			78	63	70	60
	16:00		9.0	90	1650.0	29.5		70	94	80	83	63	77	62	69	61
	17:00		8.5	89	1660.0	29.5		70	93	80	82	63	74	61	68	59
	18:00		9.0	89	1670.0	30.3		70	93	80	81	63	76	60	68	59
	19:00		9.0	88	1680.0	29.8		68	92	80	80	61	75	59	66	58
	20:00		9.0	88	1680.0	30.4		68	92	75	80	62	75	60	67	58
	21:00		9.0	89	1670.0	30.0		69	93	75	81	62	77	61	67	57
	22:00		9.0	89	1670.0	29.8		70	95	75	83	63	78	63	69	59
	23:00		9.0	75	1880.0	28.3		70	97	77	83	64	80	61	68	60
10/8/2003	0:00		9.0	75	1880.0	29.0		69	95	75	84	59	79	62	68	61
	1:00		9.0	76	1870.0	29.8		70	95	75	83	59	77	63	69	62
	2:00		9.0	90	1650.0	30.6		70	98	74	83	64	76	63	70	61
	3:00		9.0	76	1870.0	28.7		71	94	74	82	59	77	63	69	61
	4:00		9.0	77	1850.0	29.2		71	95	74	81	58	75	63	69	61
	5:00		9.0	76	1870.0	29.5		70	94	74	81	58	74	62	69	62
	6:00		9.0	89	1670.0	30.6		69	93	74	80	61	75	61	68	60
	7:00		9.0	89	1670.0	29.5		68	92	74	76	61	76	57	67	58
	8:00		9.0	75	1880.0	28.5		70	94	74	80	57		59	67	59
	9:00		9.0	75	1880.0	28.5		69	94	72	81	59	80	59	68	60
	10:00		9.0	86	1870.0	28.5		69	94	84	80	59	80	59	68	60
	11:00		9.0	76	1870.0	29.8		71	96	79	81	57	77	60	68	61
	12:00		9.0	90	1650.0	30.0		70	97	75	83	63	82	58	70	63
	13:00		9.0	76	1870.0	30.5		70	96	76	84	63	81	60	69	63
	14:00		8.5	90	1630.0	30.6		71	96	77	83	62	80	58	69	64
	15:00		9.0	90	1650.0	30.5		71	98	76	84	63	80	58	70	63

Table III-1

RAYMORE, MISSOURI WATER DISTRIBUTION SYSTEM
SUMMARY OF FIELD DATA

		Pressure (psi)														
		Pump Station				0.5 MG Tank										
Date	Time	Clearwell N (psi)	Suction N (psi)	Discharge N (psi)	Flow N (gpm)	Level N (feet)	Pressure N (psi)	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)
	16:00		9.0	90	1650.0	29.4		70	96	77	84	63	81	58	70	63
	17:00		9.0	90	1650.0	30.6		69	96	77	84	63	80	57	70	63
	18:00		9.0	89	1670.0	30.5		69	95	76	84	63	79	55	68	61
	19:00		8.0	89	1670.0	30.4		70	95	76	83	63	78	58	68	61
	20:00		8.0	87	1680.0	28.0		64	87	70	75	58	71	51	60	53
	21:00		8.0	86	1690.0	25.5		63	86	70	74	57	70	48	60	53
	22:00		8.0	88	1670.0	25.5		67	94	70	75	61	78	57	67	53
	23:00		9.0	89	1670.0	28.0		69	95	69	83	63	80	59	68	61
10/9/2003	0:00		9.0	76	1870.0	29.0		71	96	69	83	58	79	59	69	63
	1:00		8.0	90	1620.0	30.0		70	98	73	84	64	81	59	70	62
	2:00		10.0	76	1880.0	28.7		73	96	73	82	58	79	59	68	63
	3:00		10.0	76	1880.0	29.6		71	96	72	81	58	77	59	69	63
	4:00		10.0	76	1880.0	29.5		70	95	71	80	58	77	61	69	62
	5:00		10.0	76	1880.0	29.0		69	93	71	80	57	76	57	69	62
	6:00		9.0	75	1880.0	29.5			91	71	78	61	75	58	67	62
	7:00		9.0	89	1670.0	30.5			92	71	79	61	76		66	60
	8:00		9.0	75	1880.0	29.5		68	95	71	80	57	77		68	61
	9:00		9.0	75	1880.0	28.7		70	94	90	80	58	81	60	71	62
	10:00		9.0	75	1880.0	28.5		70	94	90	81	57	78	57	69	61
	11:00		9.0	75	1880.0	28.5		69	95	90	81	57	79	57	69	61
	12:00		9.0	75	1880.0	28.5		69	95	95	80	57	78	57	70	62
	13:00		9.0	75	1880.0	28.5		70	96	96	82	57	77	58	70	62
	14:00		9.0	75	1880.0	28.5		71	95	96	81	57	77	59	70	62
	15:00		9.0	75	1880.0	28.5		70	96	95	81	57	79	59	70	62
	16:00		10.0	86	1680.0	29.5		70	98	95	80	62	81	59	70	63
	17:00		10.0	89	1680.0	29.5		68	97	96	81	62	80	58	69	63
	18:00		9.0	89	1670.0	29.5		70	96	91	80	61	79	57	68	
	19:00		9.0	75	1880.0	29.0		70	93	97	82	55	76	54	68	
	20:00		8.0	89	1650.0	30.5		69	95	98	81	62	78	56	68	
	21:00		9.0	89	1670.0	30.5		70	95	98	81	62	79	57	67	
	22:00		9.0	89	1670.0	29.5		71	96	98	83	63	80	56	68	
	23:00		9.0	75	1880.0	29.5		69	96		83	58	80	57	68	
10/10/2003	0:00		9.0	90	1650.0	30.0		70	100		84	63	80	59	69	
	1:00		10.0	76	1880.0	28.5		70	95		83	58	79	58	70	
	2:00		10.0	76	1880.0	29.0		70	95		82	58	79	57	69	
	3:00		10.0	90	1670.0	30.0		70	98		82	64	77	57	69	
	4:00		10.0	76	1880.0	28.5		69	94		80	57	78	57	70	
	5:00		10.0	76	1880.0	28.5		71	94		80	57	77	57	69	
	6:00		9.0	75	1880.0	29.0		69	91		80	56	74	53	67	
	7:00		9.0	89	1670.0	30.2		69	92		78	61	76	55	66	

Table III-1

RAYMORE, MISSOURI WATER DISTRIBUTION SYSTEM
SUMMARY OF FIELD DATA

		Pressure (psi)														
		Pump Station				0.5 MG Tank										
Date	Time	Clearwell N (psi)	Suction N (psi)	Discharge N (psi)	Flow N (gpm)	Level N (feet)	Pressure N (psi)	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)
	8:00		9.0	89	1670.0	30.0		70	93		80	61	77	56	67	
	9:00		9.0	89	1670.0	30.5		69	92	79	86	62	83	60	71	
	10:00		9.0	90	1650.0	30.5		69	93	77	85	62	82	57	71	63
	11:00		10.0	90	1670.0	30.5		71	95	75	86	63	82	57	71	64
	12:00		9.0	75	1880.0	29.5		72	93	74	85	58	80	57	70	63
	13:00		9.0	89	1670.0	30.5		73	94	76	87	63	83	57	71	65
	14:00		9.0	75	1880.0	29.5					86	57	82	57	70	63
	15:00		9.0	75	1880.0	29.0										
	16:00															
	17:00															
	18:00															
	19:00															
	20:00															
	21:00															
	22:00															
	23:00															

- Madison Creek – west of Madison.
- Sunset – north of Overlook.
- Skyline and Municipal Circle.
- Camelot – west of Seaton.
- Silvertop – south of Johnston.
- South Fox Ridge – Johnston to Verona.
- Christi – Pelham to Huntsman.
- Deer Path – Old Mill to Trailway.
- Woodson – Pine to Walnut.
- Harold – east of Kentucky.
- Dean – south of 58 Highway.

This data, combined with factory curves for the high service pumps, is required to build the model to confirm that the model predicts, within a relative accuracy of about 5 psi, actual field conditions. The more quality data provided, such as field pump curves and hydrant tests in addition to the above listed data, the more accurate a model that can be developed.

C. MODEL DEVELOPMENT

Geographic Information System (GIS) is used to build the model as well as develop data in a format that will be useful to the City as they expand their GIS capabilities. Utilizing GIS as the foundation for the water distribution system study not only allows for efficient completion of the study but also creates a valuable piece of the city's GIS data. As a result of the modeling process a cleaned and topologically correct set of GIS files were developed that represent the City's water distribution system. These files include the actual pipes in the distribution system, the valves, the hydrants, the pumps, the reservoirs, and the tanks. Each of these files was created in the ESRI software ArcView and are in the shapefile format. These files are readily usable by the city and also allow the city to be able to simply port the information from a shapefile into a geodatabase in ESRI's newest software ArcGIS. The result is a readily updateable and completely open set of files that can be edited and adapted to the City's changing system and future needs.

H2ONet by MWH Soft is used as the modeling software for this project. Changes in the H2ONet and GIS are seamless; changes in the software are made immediately in the model.

Model inputs include the following:

- GIS file of the water pipe, valves, and fire hydrants.
- Distribution of water users based on physical address.
- Distribution of year 2003 average day demands across the system is based on the City's electronic customer usage data sorted by address. This data is based on metered use; therefore, 19 percent is added to the metered water use to match the total water purchased from KCMO.
- Distribution of future water demand within the water service area boundary based on projections for the nine growth areas in accordance with City staff comments.
- For future modeling purposes, residential and commercial demands were separated because the commercial demand is much less than the residential demand. As previously stated in Part II-C, the total demand from 2010 to 2030 is 360 gpmd, with the commercial demand absorbing 30 gpmd and residential absorbing 330 gpmd.
- Elevation at each junction (denoted by "N" and represents the intersection of two or more pipes). Elevations are based on USGS electronic contour maps available from the USGS.

Hazen Williams C-values represent the relative roughness of the pipes. A C-value of 140 is used for all PVC pipe. C-values of 130 are used for new 24-inch ductile iron pipe, 125 for 16-inch, 120 for 12-inch, 110 for 8-inch, and 100 for 6-inch. All other C-values are developed in the model calibration and verification.

Model calibration data and results for the existing water distribution system are respectively listed in Table III-2. Review of the tables shows a good working model. Calibration of the model is based on the existing piping system. Elevations are adjusted to calibrate and verify the model since only 10 foot contours are available. C-values are adjusted to achieve test results within about 5 psi at each node. Consistently high or low pressures found in the system can be attributed to general construction and or partially closed valves. This conclusion is consistent with the status of the system at the time and location the pressures were recorded. A copy of the calibrated input file is included in the Appendix. The existing system is evaluated in the base model to confirm model performance to the collected system pressures.

Table III - 2

RAYMORE, MO WATER DISTRIBUTION SYSTEM
SUMMARY OF CALIBRATION/VERIFICATION

Item	Date	Time	Pressure (psi)													Junction	Static		Flowing		GDF Ratio	Demand (gpm)	Comments
			Pump Station			0.5 MG Tower T_ N	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)		Field	Modeled	Field	Modeled			
			Suction Pressure N	Discharge Pressure N	Discharge Flow (gpm)																		
Harold	10/10/2003	11:00 AM																					
Field			10	76	900	1.0	72	90	85	80	57	78	57	70	58	G-6669	58	56			1.75	1190	
Model			9	81	866		68	86	83	82	59	78	56	65	60	F-5403			58	54			
HGL																							
T. Level																							
Dean Ave.	10/10/2003	1:30 PM																					
Field			10	76	900	1.0	72	93	80	85	60	83	58	71	64	G-4572	62	67			1.94	1061	
Model			9	81	890		68	85	82	81	59	78	55	64	59	F-3660			50	51			
HGL																							
T. Level																							
Christie Lane	10/10/2003	11:00 AM																					
Field			9	86	1560	1.0	72	95	75	85	63	86	58	71	64	G-J18	68	72			1.33	1187	*Partially closed valve in the vicinity.
Model			8	90	1616		70	88	85	85	66	81	59	68	63	F-J16			50	61*			
HGL																							
T. Level																							
S. Fox Ridge	10/10/2003	11:00 AM	9	86	1560	1.0	72	95	80	85	63	86	58	71	64	G-6168	9?	90			1.33	750	
Field			8	86	1560		70	88	85	85	66	81	59	68	63	F-6166			92	86			
Model																							
HGL																							
T. Level																							
Red Barn	10/8/2003	11:45 AM	9	86	1560	1.0	72	98	78	82	63	80	60	72	63	G-4444	93-97	95			0.96	1222	
Field			8	90	1573		70	89	86	86	67	82	60	69	65	F-4441			77	82			
Model																							
HGL																							
T. Level																							
Trailway	10/8/2003	11:30 AM																					
Field			9	86	1560	1.0	72	90	75	79	63	80	60	69	64	G-6127	101	95			1.19	1244	
Model			8	90	1576		70	88	86	85	66	82	60	69	64	F-6646			67	72			
HGL																							
T. Level																							
Deer Path	10/10/2003	11:30 AM																					
Field			10	75	870	1.5	70	93	75	86	63	82	58	71	64	G-6646	104	94			2.28	1210	
Model			9	81	869		66	84	79	79	58	76	53	62	57	F-6126			55	55			
HGL																							
T. Level																							
Roanoke	10/8/2003	11:15 AM																					
Field			9	86	1560	1.0	70	90	76	80	64	80	60	70	63	G-5194	101	97			1.19	990	*5 psi deducted from model result to account for the actual distance between the flowing junction and the gauged junction. Assume closed valve in vicinity.
Model			8	90	1576		70	88	86	85	66	82	59	69	64	F-4404			58	71*			
HGL																							
T. Level																							
Silvertop	10/10/2003	10:45 AM																					
Field			9	86	1560	1.5	70	93	75	85	63	82	58	71	64	G-4672	84	85					
Model			9	90	1572		70	87	84	83	66	80	58	67	62	F-J10			76	73	0.96	430	
HGL																							
T. Level																							
Skyline	10/10/2003	10:00 AM																					
Field			9	76	865	1.5	69	92	72	85	62	81	58	71	63	G-6675	55	51			2.48	840	*Partially closed valve in the vicinity.
Model			9	80	870		66	82	78	78	57	74	51	60	55	F-6674			26	41*			
HGL																							
T. Level																							
Camelot	10/10/2003	10:15 AM																					
Field			9	75	870	1.5	70	92	74	86	58	80	56	71	62	G-5844	68	64			2.49	710	*Changed roughness (HWC) in subdivision - from 110 to 130. And added pipe P15 to connect neighboring subdivision.
Model			9	81	870		66	83	78	78	57	74	51	60	55	F-5850			55	53			
HGL																							
T. Level																							
Madison	10/8/2003	2:30 PM																					
Field			10	86	1560	1.0	71	97	79	82	63	80	60	70	62	G-5358	106-112	110			0.96	610	
Model			8	91	1611		71	89	86	86	67	82	60	69	64	F-5360			81	74			

Table III - 2

RAYMORE, MO WATER DISTRIBUTION SYSTEM
SUMMARY OF CALIBRATION/VERIFICATION

Item	Date	Time	Pressure (psi)													Junction	Static		Flowing		GDF Ratio	Demand (gpm)	Comments
			Pump Station			0.5 MG Tower T_ N	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)		Field	Modeled	Field	Modeled			
			Suction Pressure N	Discharge Pressure N	Discharge Flow (gpm)																		
HGL																							
T. Level																							
Madison Creek	10/8/2003	3:00 PM																					
Field			9	75	870	1.0	71	95	76	82	63	80	58	70	63	G-5620	85	79			2.0	1034	Added new pipe, P17 (connectivity)
Model			9	82	889		68	85	82	81	59	78	55	64	59	F-6904			60	58			
HGL																							
T. Level																							
Sunset	10/10/2003	9:45 AM																					
Field			10	86	1560	1.5	69	93	72	85	62	81	57	69	61	G-6814	70	71			1.12	890	*Partially closed valve in the vicinity.
Model			8	91	1616		70	88	86	85	67	82	60	69	64	F-6924			46	63*			
HGL																							
T. Level																							
Country Lane	10/8/2003	11:00 AM	10	86	1560	1.0	72	95	75	80	63	78	60	70	61	G-5444	88	87			1.52	970	
Field			8	90	1620		70	88	85	84	66	81	59	68	63	F-5724			70	71			
Model																							
HGL																							
T. Level																							
Palomino	10/8/2003	2:15 PM	9	75	870	1.0	72	95	70	83	63	80	59	70	64	G-5332	57	55			1.44	380	*Partially closed valve in the vicinity or
Field			9	81	893		70	88	85	84	66	81	59	68	63	F-5331			9	49*			construction activity.
Model																							
HGL																							
T. Level																							
Woodson	10/10/2003	1:00 PM																					
Field			72	94	76	1.0	72	94	76	87	63	82	58	71	64	G-5307	58	57			1.19	670	Roughness coefficients were changed.
Model			8	91	1606		71	89	87	86	68	83	61	70	65	F-5304			40	47			Some pipe diameters were changed to 6"
HGL																							and 12" based off field map -database
T. Level																							was incorrect.
Calico	10/8/2003	2:00 PM	8	86	1560	1.0	70	96	76	84	63	80	58	70	64	G-5349	61	59			1.52	1034	
Field			8	90	1620		70	88	85	84	66	81	59	68	63	F-3889			46	43			
Model																							
HGL																							
T. Level																							
Secretariat	10/8/2003	10:50 AM	9	86	1560	1.0	71	95	75	83	63	78	60	68	63	G-5485	89	84			2.27	1267	
Field			8	89	1650		67	84	80	80	58	75	53	62	57	F-5483			69	62			
Model																							
HGL																							
T. Level																							
Adams	10/8/2003	1:20 PM																					
Field			9	75	870	1.0	72	95	75	83	57	78	58	68	63	G-6689	62	72			2.05	430	Changed roughness (HWC) from 110 to
Model			9	82	889		67	85	81	81	59	77	55	64	59	F-5182			16	67			130. Construction activity.
HGL																							
T. Level																							
Toucan	10/8/2003	10:30 AM	8	86	1560	1.5	71	95	75	80	62	80	60	70	62	G-5284	61	60			1.24	870	Changed roughness (HWC) from 140 to
Field			NR*	NR	NR		70	NR	88	85	66	81	59	68	64	F-5176			33	35			120. *NR = not recorded
Model																							
HGL																							
T. Level																							
Olive	10/8/2003	1:45 AM	10	86	1560	1.5	73	96	77	82	63	80	60	70	63	G-J14	61	63			1.12	750	Changed roughness (HWC) to 120 and
Field			8	91	1616		70	88	86	85	67	82	60	69	64	F-5278			47	51			inserted new junction (J14) for elevation
Model																							purposes.
HGL																							
T. Level																							
Gore	10/8/2003	2:30 PM	10	86	1560	0.5	71	97	79	82	63	80	60	70	62	G-3977	72	83			1.33	530	
Field			8	91	1613		70	88	85	85	66	81	59	68	63	F-3974			28	32			
Model																							
HGL																							
T. Level																							
Poseidon	10/8/2003	1:15 PM	9	75	870	1.0	70	95	77	82	63	80	58	70	63	G-3282	78	77			2.27	970	Changed roughness (HWC).

Table III - 2

RAYMORE, MO WATER DISTRIBUTION SYSTEM
SUMMARY OF CALIBRATION/VERIFICATION

Item	Date	Time	Pressure (psi)													Junction	Static		Flowing		GDF Ratio	Demand (gpm)	Comments
			Pump Station			0.5 MG Tower T_ N	Darrowby N (psi)	Meadowlark N (psi)	Country Lane N (psi)	Maple & Lakeshore N (psi)	Royal N (psi)	Foxwood & Crest N (psi)	Elm & Washington N (psi)	Horizon & Lucy Webb N (psi)	Char-Don N (psi)		Field	Modeled	Field	Modeled			
			Suction Pressure N	Discharge Pressure N	Discharge Flow (gpm)																		
Field			9	81	890		70	88	85	85	61	81	59	68	64	F-3217			42	37			
Model																							
HGL																							
T. Level																							
Dogwood	10/8/2003	10:15 AM	8	86	1560	1.5	70	94	75	80	62	80	59	69	60	G-5610	95	88			1.24	950*	*Did not open FH completely. **Assume partially closed valve in the vicinity.
Field			8	90	1618		70	88	85	85	66	81	59	68	64	F-5257			58	68**			
Model																							
HGL																							
T. Level																							
Chardon	10/8/2003	9:45 AM	8	75	870	1.5	71	95	70	83	62	78	57	68	60	G-J30	76 (low 70)	71			1.12	790	Added junction (J12) as a new gauged location for elevation purposes and roughness (HWC) were changed in subdivision.
Field			9	81	895		70	88	86	85	67	81	60	69	64	F-2490			28	36			
Model																							
HGL																							
T. Level																							

D. FIRE DEMAND

The Insurance Services Office (ISO) defines fire demand and duration for City's. Insurance companies use these studies to set insurance rates for City residents. How the water distribution system complies with their goals is a major component of the ISO report; however, Raymore's ISO report is over 10 years old and the City has experienced extensive growth. Therefore, discussions were conducted with the South Metro Fire Protection District (SMFPD) to collect specific fire demand and duration data for specific locations and general categories as listed in Table III-3. The maximum ISO fire demand is 3,500 gpm for 3 hours while typical residential fire demand is 1,500 gpm for 2 hours; however, SMFPD prefers 2,000 gpm for 2 hours for areas with homes over 3000 square feet in size and areas where the homes are close together.

Table III-3

Fire Demand Summary

Location	Demand (gpm)	Duration (hours)
Raymore Health Care	4,250	4
Fox Wood Apartments	8,000	4
Fox Wood Comm. Building	4,250	4
Fox Wood RCC	4,250	4
Walmart	6,000 to 8,000	4
Schools	3,250	3
Raymore Elementary	3,750	3
Strip Mall	3,250	3

E. STORAGE ANALYSIS

Total storage required in the water distribution system is the summation of equalization and fire storage as listed in Table III-4. Equalization refers to water stored in tanks for use during peak periods or other periods where demand exceeds supply. Emergency storage refers to water for fires and system failures. Emergency storage of 630,000 gallons is required based on the maximum ISO fire demand of 3,500 gpm for 3 hours.

Table III-4

RAYMORE, MISSOURI - WATER DISTRIBUTION SYSTEM
STORAGE ANALYSIS

Year	Max Day Demand (MGD)	Equalization Storage Factor (%)	Equalization Storage (MG)	Fire Storage (MG)	Required Storage (MG)	Existing Storage (MG)	Surplus/ Deficit (MG)
2003	3.3	25	0.83	0.63	1.46	1.25	**-0.2**
2005	5.8	25	1.45	0.63	2.08	3.25	**1.2**
2009	10.0	25	2.50	0.63	3.13	3.25	**0.1**
2010	10.7	25	2.68	0.63	3.31	3.25	**-0.1**
2014	13.7	25	3.43	0.63	4.06	3.25	**-0.8**
2015	14.2	25	3.55	0.63	4.18	3.25	**-0.9**
2020	16.5	25	4.13	0.63	4.76	3.25	**-1.5**
2025	18.3	25	4.58	0.63	5.21	3.25	**-2.0**
2030	20.1	25	5.03	0.63	5.66	3.25	**-2.4**

Note:
1. A surplus is shown as a positive number and a deficit is shown as a negative number.

Equalization storage requirements are based on the maximum day demand. Calculations for equalization storage require the development of a diurnal curve, which requires continual source flow and tank level data over one or multiple 24-hour periods. Based on the diurnal operations data provided by City staff, equalization storage ranged from 15 to 19 percent of the daily demand. Since that information was provided for October, a more conservative value of 25 percent will be used to represent high water use conditions.

Raymore was under water restrictions in 2002 and 2003 due to supply issues. The new KCMO connection at J Highway and Lucy Webb should negate the need for restrictions, provided the contracted volumes of water can be supplied by KCMO during dry perioeds. Evaluation of data from the new SCADA system should allow the City to reevaluate their equalization storage need based on year 2004 maximum day demands.

With the completion of the improvements at the booster pump station, new pumps and generator, Raymore's available storage is 1.25 MG. The addition of the generator allows the City to include the 0.75 MG ground storage tank capacity and the two pumps at 155th and Kentucky booster pump station. The proposed elevated storage tank at Hubach Hill is recommended to be 2.5 MG in capacity, 2.0 MG for Raymore and 0.5 MG for KCMO. This increases storage capacity to 3.25 MG after the proposed elevated tank is constructed (2005).

Review of Table III-4 shows the City has a slight storage deficit in 2004. The completion of the proposed tank will provide a short-term storage surplus. This surplus will be short-lived and the system will have a storage deficit of 0.1 MG by 2010 and a deficit of 2.4 MG by 2030.

F. HYDRAULIC ANALYSIS CRITERIA

Hydraulic analyses include the use of the computer model of the distribution system and engineering judgement to evaluate improvements and meet specific criteria for year 2030 demand conditions. The following demand conditions are evaluated for the base, year 2009, year 2014, and year 2030 model:

- Maximum day.
- Peak hour of the maximum day.

- Minimum hour plus tank replenishment.
- Maximum day plus fire flow.

Maximum day model runs show whether the water supply is of sufficient capacity and can be distributed throughout the system to maintain adequate pressures. Maximum day demand is 3.0 times the average day demand based on review of historical data. Peak hour runs test the adequacy of the storage facilities and the distribution system to supply temporary high rates of flow. Minimum hour runs show the ability of the system to replenish tank storage overnight. Maximum day plus fire flow runs test the ability of the system to protect property while maintaining adequate system pressures.

Diurnal curves are developed for October 7, 8 and 9, 2003 as listed in Table III-5, and shown in Figures III-1 through III-3. Review of the diurnal data shows the system experienced a peak hour demand factor of about 2.1 times the maximum day and a minimum hour factor of 0.1 times the maximum day.

As Raymore's residential and commercial development continues to grow, peak hour factors could increase. Review of the tank level data for August 2003 shows Raymore did not experience the large morning irrigation peak seen in many residential communities; this may have been the result of the voluntary water restrictions. A large peak was also experienced between 6:00 p.m. and 10:00 p.m. As Raymore adds larger homes, the peak hour factor may increase and switch towards the morning. Based on the possible impact of continued residential and commercial development and an increase in irrigation demand, a peak hour to maximum day factor of 2.5 and a minimum hour to maximum day factor of 0.3 are used in the analyses.

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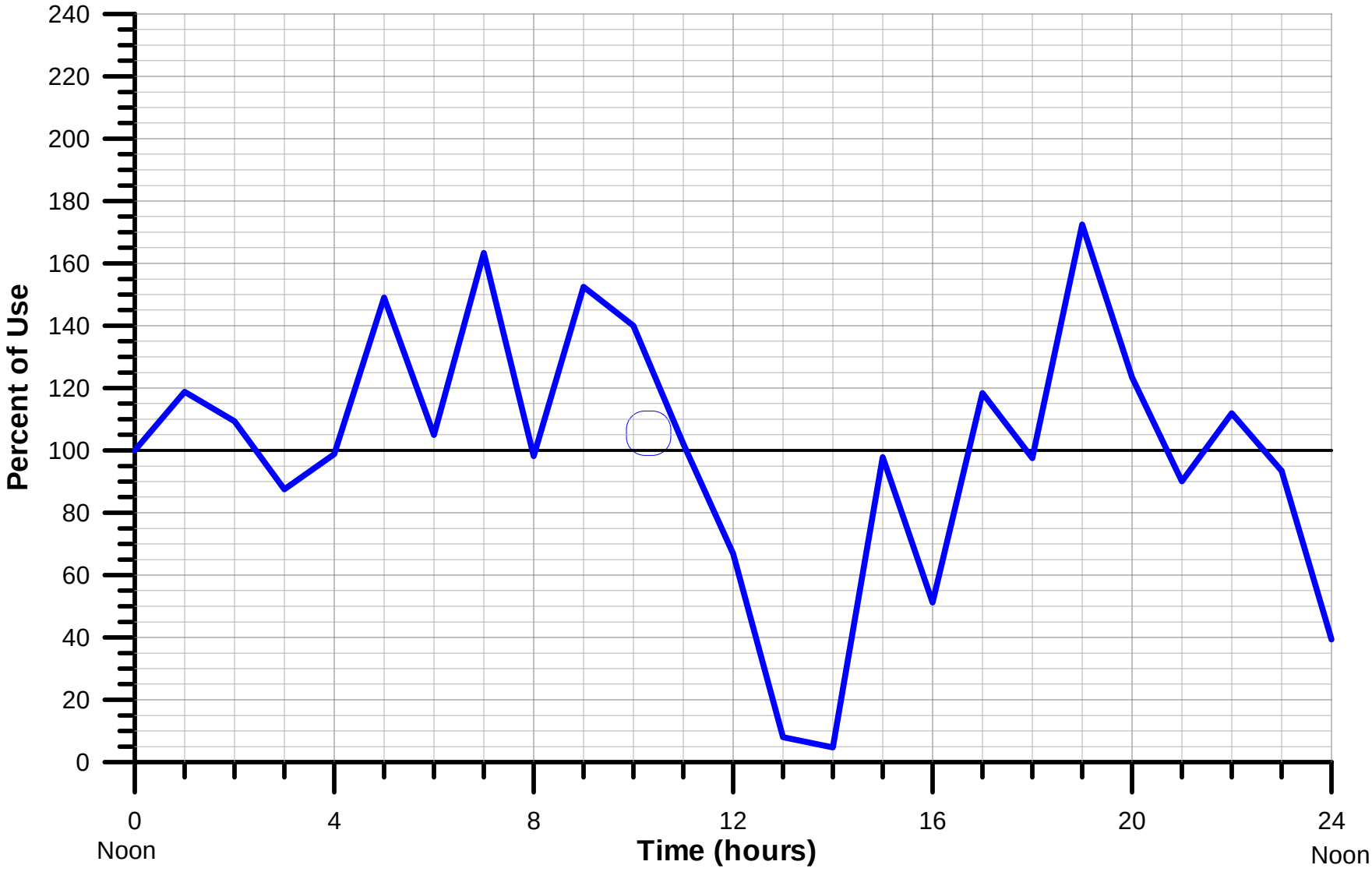
Table III-5

RAYMORE, MISSOURI -- WATER DISTRIBUTION SYSTEM
DIURNAL DATA

		Pump Station		0.5 MG Tank		Entire System				
						Tot Demand	Equalization Storage		Equalization	
Date	Time	Rate (gpm)	Volume (gallons)	Elevation (feet)	Volume (gallons)	Rate (gph)	Fill (gallons)	Draft (gallons)	Factor (%)	Diurnal (%)
10/7/2003	12:00	1880	73,320	30.2						100
	13:00	1880	67,680	29.5	11,690	79,370		(12,551)		119
	14:00	1880	56,400	28.5	16,700	73,100		(6,281)		109
	15:00	1880	75,200	29.5	(16,700)	58,500	8,319			88
	16:00	1650	66,000	29.5	-	66,000	819			99
	17:00	1660	99,600	29.5	-	99,600		(32,781)		149
	18:00	1670	83,500	30.3	(13,360)	70,140		(3,321)		105
	19:00	1680	100,800	29.8	8,350	109,150		(42,331)		163
	20:00	1680	75,600	30.4	(10,020)	65,580	1,239			98
	21:00	1670	95,190	30.0	6,680	101,870		(35,051)		152
	22:00	1670	90,180	29.8	3,340	93,520		(26,701)		140
	23:00	1880	43,240	28.3	25,050	68,290		(1,471)		102
10/8/2003	0:00	1880	56,400	29.0	(11,690)	44,710	22,109			67
	1:00	1870	18,700	29.8	(13,360)	5,340	61,479			8
	2:00	1650	16,500	30.6	(13,360)	3,140	63,679			5
	3:00	1870	33,660	28.7	31,730	65,390	1,429			98
	4:00	1850	42,550	29.2	(8,350)	34,200	32,619			51
	5:00	1870	84,150	29.5	(5,010)	79,140		(12,321)		118
	6:00	1670	83,500	30.6	(18,370)	65,130	1,689			97
	7:00	1670	96,860	29.5	18,370	115,230		(48,411)		172
	8:00	1880	65,800	28.5	16,700	82,500		(15,681)		123
	9:00	1880	60,160	28.5	-	60,160	6,659			90
	10:00	1870	74,800	28.5	-	74,800		(7,981)		112
	11:00	1870	84,150	29.8	(21,710)	62,440	4,379			93
	12:00	1650	29,700	30.0	(3,340)	26,360	40,459		15	39
	13:00	1870	56,100	30.5	(8,350)	47,750	13,254			78
	14:00	1630	52,160	30.6	(1,670)	50,490	10,514			83
	15:00	1650	57,750	30.5	1,670	59,420	1,584			97
	16:00	1650	54,450	29.4	18,370	72,820		(11,816)		119
	17:00	1650	61,050	30.6	(20,040)	41,010	19,994			67
	18:00	1670	66,800	30.5	1,670	68,470		(7,466)		112
	19:00	1670	75,150	30.4	1,670	76,820		(15,816)		126
	20:00	1680	100,800	28.0	40,080	140,880		(79,876)		231
	21:00	1690	101,400	25.5	41,750	143,150		(82,146)		235
	22:00	1670	100,200	25.5	-	100,200		(39,196)		164
	23:00	1670	100,200	28.0	(41,750)	58,450	2,554			96
10/9/2003	0:00	1870	59,840	29.0	(16,700)	43,140	17,864			71
	1:00	1620	24,300	30.0	(16,700)	7,600	53,404			12
	2:00	1880	-	28.7	21,710	21,710	39,294			36
	3:00	1880	37,600	29.6	(15,030)	22,570	38,434			37
	4:00	1880	-	29.5	1,670	1,670	59,334			3
	5:00	1880	43,240	29.0	8,350	51,590	9,414			85
	6:00	1880	65,800	29.5	(8,350)	57,450	3,554			94
	7:00	1670	100,200	30.5	(16,700)	83,500		(22,496)		137
	8:00	1880	65,800	29.5	16,700	82,500		(21,496)		135
	9:00	1880	47,000	28.7	13,360	60,360	644			99
	10:00	1880	56,400	28.5	3,340	59,740	1,264			98
	11:00	1880	56,400	28.5	-	56,400	4,604			92
	12:00	1880	56,400	28.5	-	56,400	4,604		19	92
	13:00	1880	56,400	28.5	-	56,400		(1,790)		103
	14:00	1880	50,760	28.5	-	50,760	3,850			93
	15:00	1880	62,040	28.5	-	62,040		(7,430)		114
	16:00	1680	55,440	29.5	(16,700)	38,740	15,870			71
	17:00	1680	52,080	29.5	-	52,080	2,530			95
	18:00	1670	75,150	29.5	-	75,150		(20,540)		138
	19:00	1880	103,400	29.0	8,350	111,750		(57,140)		205
	20:00	1650	82,500	30.5	(25,050)	57,450		(2,840)		105
	21:00	1670	66,800	30.5	-	66,800		(12,190)		122
	22:00	1670	66,800	29.5	16,700	83,500		(28,890)		153
	23:00	1880	56,400	29.5	-	56,400		(1,790)		103
10/10/2003	0:00	1650	13,200	30.0	(8,350)	4,850	49,760			9
	1:00	1880	28,200	28.5	25,050	53,250	1,360			98
	2:00	1880	37,600	29.0	(8,350)	29,250	25,360			54
	3:00	1670	16,700	30.0	(16,700)	-	54,610			-
	4:00	1880	15,040	28.5	25,050	40,090	14,520			73
	5:00	1880	43,240	28.5	-	43,240	11,370			79
	6:00	1880	65,800	29.0	(8,350)	57,450		(2,840)		105
	7:00	1670	86,840	30.2	(20,040)	66,800		(12,190)		122
	8:00	1670	75,150	30.0	3,340	78,490		(23,880)		144
	9:00	1670	58,450	30.5	(8,350)	50,100	4,510			92
	10:00	1650	49,500	30.5	-	49,500	5,110			91
	11:00	1670	53,440	30.5	-	53,440	1,170			98
	12:00	1880	56,400	29.5	16,700	73,100		(18,490)	14	134

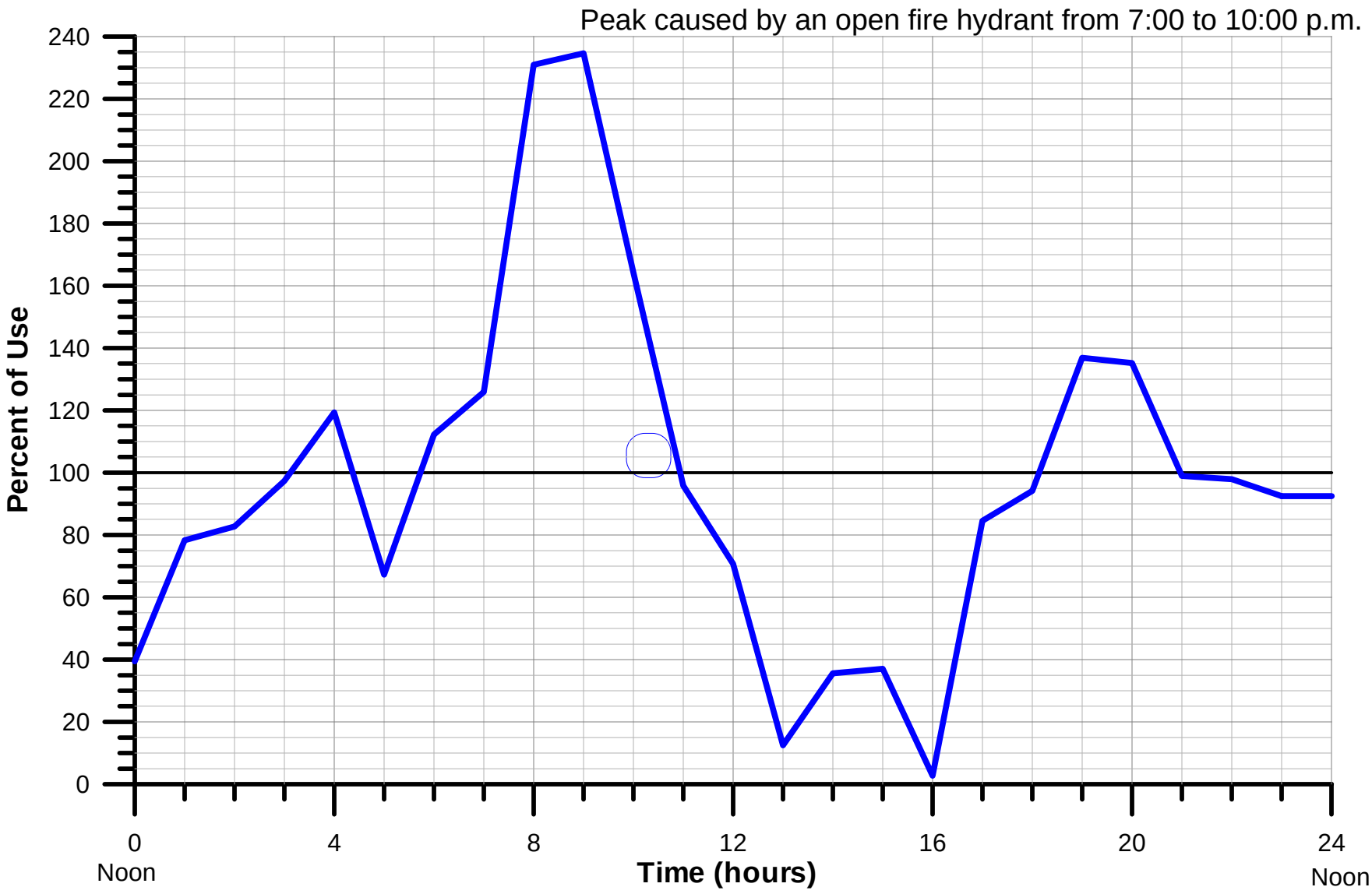
diurnalraymore 10-7-03



Burns & McDonnell

Figure III-1
Raymore, Missouri
Diurnal Curve
October 7 & 8, 2003

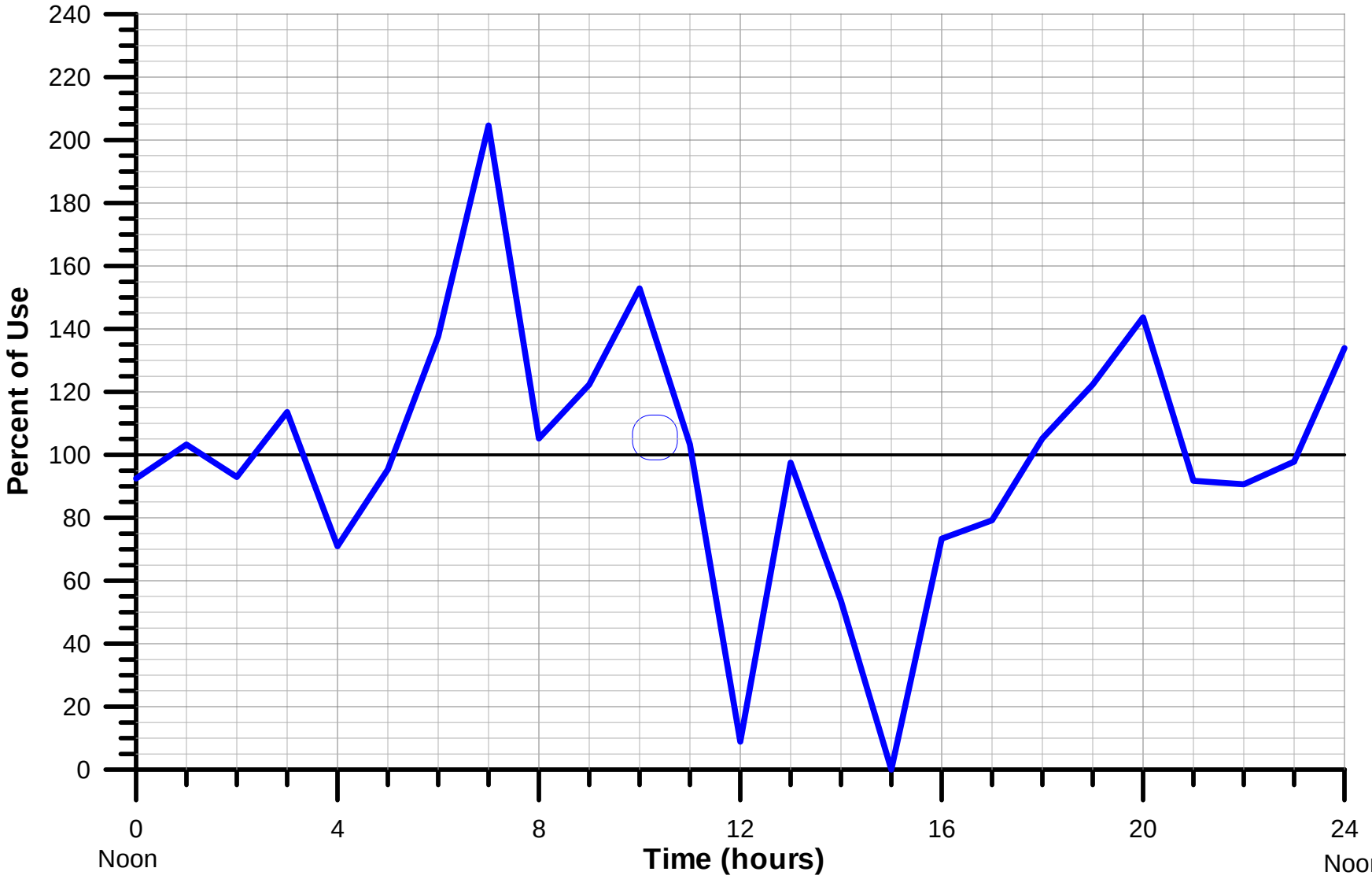
diurnalraymore 10-8-03



Burns & McDonnell

Figure III-2
Raymore, Missouri
Diurnal Curve
October 8 & 9, 2003

diurnalraymore 10-9-03



Burns & McDonnell

Figure III-3
Raymore, Missouri
Diurnal Curve
October 9 & 10, 2003

Part IV – Hydraulic Analyses and System Improvements

PART IV – HYDRAULIC ANALYSES AND SYSTEM IMPROVEMENTS

A. GENERAL

This section of the report describes the results of the hydraulic analyses for the Raymore water distribution system. Analyses of water facilities are conducted to determine their capabilities to meet projected demand as well as their deficiencies with respect to supply, piping, storage, pumping, pressure, and fire flow. The following guidelines are used to determine deficiencies:

- Distribution system pressure should be greater than 40 psi and less than 100 psi during all conditions.
- Distribution system pressure should be greater than 20 psi during a fire flow analysis.
- Pump stations should have firm capacity capable of pumping the average demand on the maximum day at adequate pressure with the largest pump out of service.
- Storage should be replenished completely over a 24-hour period and active storage replenished over an 8-hour period at night.
- Transmission pipeline velocities should be less than 5 feet per second and head loss less than 6 feet per 1,000 feet. Additional deficiencies such as insufficient fire flow or low pressure or additional growth are typically required in addition to this guideline to justify pipe replacement.
- Evaluate of total head loss compared to the length of pipe.

System improvements for years 2009, 2014 and 2030 are coordinated with known and anticipated development activities and the need to enhance system pressures and fire protection. These improvements are evaluated with the computer model and proposed improvements are recommended.

Raymore's water distribution system has approximately 90 miles of pipe. The City has 4-, 6-, 8-, 10- and 12-inch diameter PVC, DI, and CIP mains. Future supply and transmission improvements should alleviate City's low pressure and low fire flow issues in original Raymore and other areas with higher ground and small diameter pipe.

B. HYDRAULIC MODEL ANALYSIS

Four model scenarios including Calibration, Year 2009, Year 2014, and Year 2030, are evaluated for the following steady-state demand conditions to determine existing system capabilities, need, and location for additional supply, piping, storage, and pump stations:

- Maximum day.
- Peak hour of the maximum day.
- Minimum hour plus tank replenishment.
- Maximum day plus fire flow.

Distribution system improvement projects are verified with the computer simulations of the water system hydraulics and evaluation of the resulting flows, hydraulic grade lines, and pressures. Various combinations of improvements are analyzed to determine a means of meeting projected system growth and operating goals.

1. Calibration Model

The Calibration model, or existing system, was developed from hydrant testing and pressure recordings to accurately reflect distribution system hydraulics. Roughness coefficients, or C values, were also used to calibrate distribution system hydraulics based on the type and age of pipe in areas found with pressures beyond ±5 psi. The main function of the Calibration model was to review pipe network connectivity, identify any orphan nodes or pipes imported from the GIS interface, and produce a "green light" simulation.

The Calibration model consists of the following:

- 4-inch – 9 miles
- 6-inch – 43 miles
- 8-inch – 24 miles
- 10-inch – 120 feet (booster station discharge line)
- 12-inch – 13 miles
- 0.75 MG ground storage tank and booster pump station at 155th and Kentucky
- 0.5 MG elevated storage tank on Harold Drive

Additional water lines are in the planning, design, or installation process in 2004, primarily for new developments. City staff is in the process of planning or installing new waterlines at the following locations to enhance pressures and fire flows:

- 12-inch on Madison from Elizabeth Drive south about 0.5 miles.
- 12-inch main from 12-inch on Madison east on Royal to 4-inch dead end loop.
- Increased the size of the pump impellers and motors on the three pumps at the booster station.

2. Year 2009 Model

Proposed improvements in the Year 2009 model allow the City to provide a projected maximum day demand of 10.0 MGD (6944 gpm) while improving pressures in low pressure areas, and increasing available fire flows in portions of the system near major improvements. Significant Year 2009 model improvements include the following:

- 2.0 MG elevated storage tank just south of the Hubach Hill subdivision (the tank is actually 2.5 MG but Raymore will have 2.0 MG of capacity).
- 2.5 MG tank and associated main on the west side.
- 24-inch main on Kentucky between tank and 58 Highway.
- 16-, 12-, 8-, and 6-inch new service lines to Creekmoor, R5E, R5G, C5C, C5B, and C5A totaling 22 miles.
- 24-inch main on 163rd.
- 16-inch main on 58 Highway from J Highway west to Woodson.
- Two meter stations.
- Replacement of small mains in original Raymore.
- 8- and 6-inch replacement and new service lines in the existing system totaling 4 miles.

The Year 2009 model has 58 nodes with available fire flows less than 1,000 gpm, 69 nodes with available fire flow between 1,000 and 1,500 gpm, and 102 nodes with fire flows between 1,500 and 2,000 gpm. This compares well to the Calibrated system which has 87 nodes with available fire flows less than 1,000

gpm, 109 nodes with available fire flow between 1,000 and 1,500 gpm, and 132 nodes with fire flows between 1,500 and 2,000 gpm. The low fire flows primarily occur on small diameter and dead-end mains.

The following Year 2009 additional water mains improved fire flow to the three areas of interest as follows:

- 770 feet of 12-inch pipe increased available fire flow from 1,620 gpm to 7,300 gpm for Raymore Health Care.
- 450 feet of 12-inch pipe increased available fire flow from 2,380 gpm to 8,100 gpm for Walmart.
- 760 feet of 8-inch pipe increased available fire flow from 2,140 gpm to 3,600 gpm for Stonegate Elementary School.

3. Year 2014 Model

Proposed improvements in the Year 2014 model allow the City to provide a projected maximum day demand of 13.7 MGD (9,514 gpm) while improving pressures in low pressure areas, and increasing available fire flows in portions of the system near major improvements. Significant Year 2014 model improvements include the following:

- 24-inch on J Highway from 155th to 163rd.
- 16-inch along 155th.
- 16-inch and 24-inch mains on Kentucky between 155th and the 2.5 MG west tank.
- 24-inch and 16-inch main on Kentucky between 58 Highway and Lucy Webb.
- One meter station.

The Year 2014 model has 53 nodes with available fire flows less than 1,000 gpm, 50 nodes with available fire flow between 1,000 and 1,500 gpm, and 83 nodes with fire flows between 1,500 and 2,000 gpm. This compares well to the Calibrated system which has 87 nodes with available fire flows less than 1,000 gpm, 109 nodes with available fire flow between 1,000 and 1,500 gpm, and 132 nodes with fire flows between 1,500 and 2,000 gpm. It also improves the

available fire flow from the Year 2009 system. The low fire flows primarily occur on small diameter and dead-end mains.

4. Year 2030 Model

Proposed improvements in the Year 2030 model allow the City to provide a projected maximum day demand of 20.1 MGD (13,950 gpm) while improving pressures and available fire flows throughout the system. Significant Year 2030 model improvements include the following:

- 24-inch main on J Highway from 163rd to Lucy Webb.
- One meter station.

The Year 2030 model has 45 nodes with available fire flows less than 1,000 gpm, 38 nodes with available fire flow between 1,000 and 1,500 gpm, and 77 nodes with fire flows between 1,500 and 2,000 gpm. This compares well to the Calibrated system which has 87 nodes with available fire flows less than 1,000 gpm, 109 nodes with available fire flow between 1,000 and 1,500 gpm, and 132 nodes with fire flows between 1,500 and 2,000 gpm. This continues the trend of increased fire flow with the addition of supply capacity, storage and transmission mains. The low fire flows primarily occur on small diameter and dead-end mains.

5. Fire Flow Results

The South Metropolitan Fire Protection District provided fire demands in 2003 for residential and larger Raymore facilities as listed in Table III-3. These demands range from 3,000 gpm for 3 hours to 8,000 gpm for 4 hours. Demands for the larger facilities exceed the Insurance Services Office maximum criteria of 3,500 gpm for 3 hour duration. Fire flows that exceed these criteria are typically the responsibility of the facility.

Existing and modeled fire flows are compared to desired fire demands for the Calibrated, Year 2009, 2014 and 2030 models as listed in Table IV- 1. Review of the data shows most of the fire demands are met at most locations. Raymore Health Care, Walmart, and Stonegate Elementary School will need additional

Table IV-1

Fire Demands and Locations
Raymore, Missouri

Location	Fire Demand (gpm)	Duration (hours)	Node	Intersection	Available Fire Flow (gpm)			
					Calibration	Year 2009	Year 2014	Year 2030
Raymore Health Care	4,250	4	6997	Sunrise	1,500	1,620	1,640	2,430
Foxwood	4,250 to 8,000	4	6582	58 Highway and Mott	4,130	8,160	8,450	8,460
Walmart	8,000	4	4572	58 Highway and Dean	2,190	2,380	2,380	2,380
Timber Creek School	3,250	3	3880	Calico	2,590	3,250	3,250	5,400
Raymore Elementary	3,750	3	6312	Madison and Elm	3,130	9,150	9,940	10,300
Stonegate Elementary School	3,250	3	6126	S. Foxridge and Old Mill	1,890	2,140	1,010	3,990
Strip Mall	3,250	3	6605	58 Highway and Peace	4,870	10,900	11,400	11,430
Apple Market	3,000	3	6612	58 Highway and Foxridge	4,060	9,700	10,430	10,480
Eagle Glen Middle School	3,250	3	6168	S. Foxridge and Johnson	5,040	9,090	11,600	11,530

Preferential Fire Flow Range				Available Fire Flow Range (gpm)	Number of Nodes in Fire Demand Range			
					Calibration	Year 2009	Year 2014	Year 2030
Residential:								
Minimum	1,000	3		Less than 1000	87	58	53	45
Better	1,500	3		1001 to 1500	109	69	50	38
Preferred	2,000	3		1501 to 2000	132	102	83	77
				Greater than 2000	452	679	775	871

Fire demands listed were provided by South Metropolitan Fire Protection District.

pipeline improvements to meet desired fire flows. These improvements are discussed above.

C. SYSTEM IMPROVEMENTS

1. Supply

Kansas City supplies Raymore with potable water. Discussions are ongoing to renegotiate their contract for water to meet future projected maximum day demands. Proposed improvements do not address KCMO's supply of water between the KCMO Water Plant and the north connection at the intersection of 155th and J Highway.

2. Piping

The existing system performs adequately to meet most of the systems pressures and fire flows. However, the system is undersized to meet the extensive growth and projected demands for the service area.

Primary improvements include transmission, pumping, and storage and should be installed by year 2009, 2014 or 2030 as shown in Figure IV-1. Significant improvements are summarized above and discussed in more detail in Part V of this report. Transmission improvements are summarized below and are included in one of the four following categories:

- Primary improvements include new transmission mains and transmission mains parallel to existing pipes.
- Secondary improvements include miscellaneous pipelines to improve fire flow.
- Other secondary improvements include replacement of small mains, 4-inch and smaller.
- Development improvements to provide potable water and fire protection to new areas.

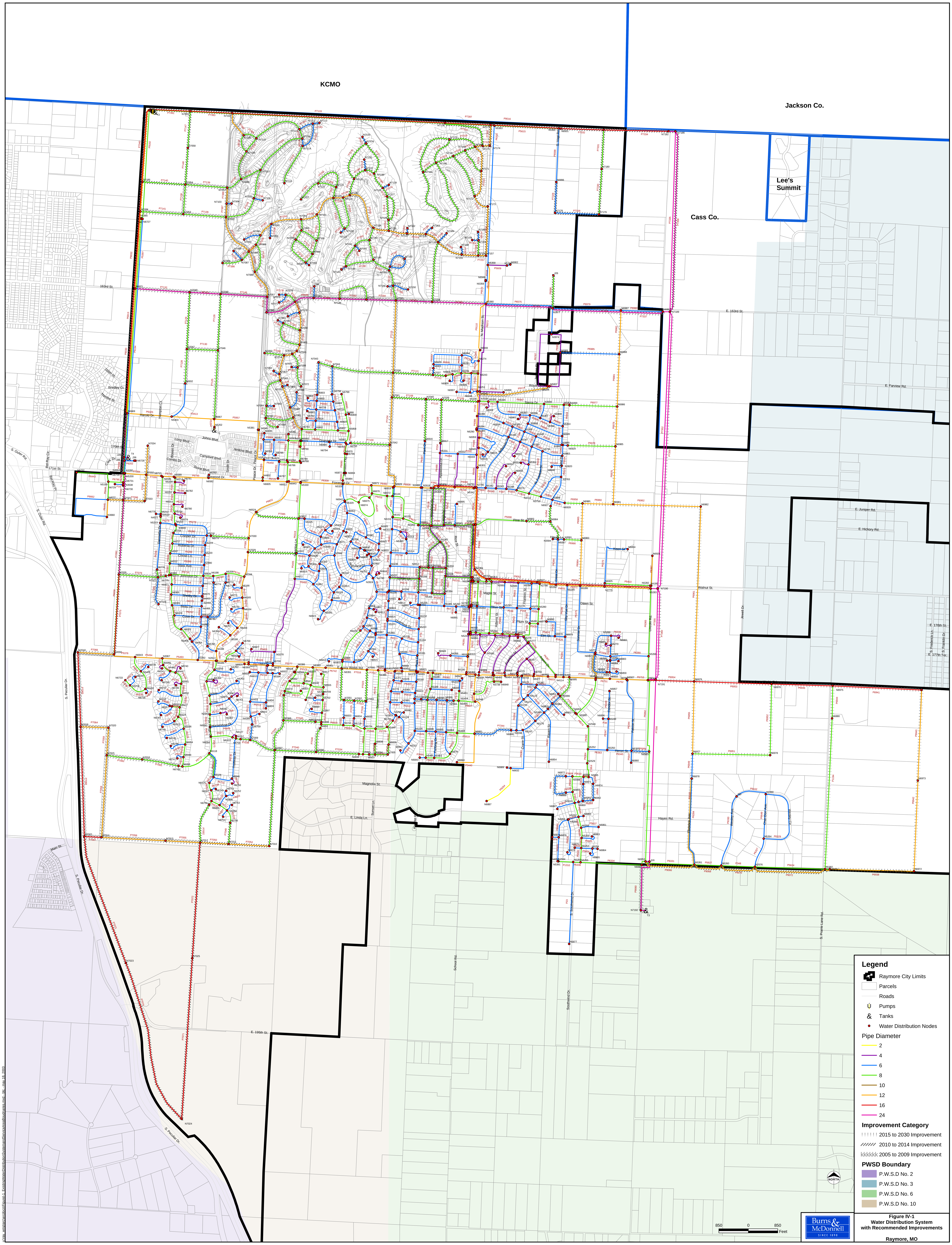


Figure IV-1
Water Distribution System
with Recommended Improvements

Raymore, MO

3. Storage

Currently, Raymore only has the 0.5 MG elevated storage tank and 0.76 MG of ground storage with booster pumps and back-up generators. Raymore and KCMO are cooperating in the installation of a 1.5 MG tank, of which Raymore will own 1.0 MG of its capacity. We recommend the tank capacity be increased to 2.5 MG with Raymore purchasing 2.0 MG of capacity. The tank is scheduled for completion in 2005. These discussions have been initiated with Kansas City.

In 2003, Raymore's storage requirement was 1.5 MG, a deficit of 0.25 MG. With the construction of a new 2.5 MG tank at Hubach Hill, the storage deficit decreases to 0.1 MG by 2010, then increases to 0.8 MG in 2014 and 2.4 MG in 2030 as listed in Table III- 4. Equalization storage is based on a storage factor of 25 percent of the maximum day demand developed from the diurnal curve plus fire flow storage of 0.63 MG (3,500 gpm for 3 hour).

Construction of the proposed tanks should be a priority. Storage improvements are as follows:

- Installation of a new 2.5 MG elevated tank at Hubach Hill in 2005, of which Raymore would own 2.0 MG of capacity, is recommended. The tank should have an overflow elevation of about 1,240 feet, be about 131 feet tall, and have a head range of 40 to 45 feet. This tank is required to help meet the peak hour equalization flows of about 9,000 gpm modeled in year 2030 and improve fire flow reliability.
- Installation of a new 2.5 MG elevated tank by 2009 built just north of the intersection of Highway 58 and Kentucky is recommended. Although the capacity is not required until year 2010, the tank is required by year 2009 to maintain peak hour pressures along 58 Highway above 35 psi; three nodes had pressure less than 40 psi. Without the proposed tank, pressures dropped to a low of 30 psi and about 200 nodes had pressures below 40 psi. The tank would have an overflow elevation of about 1231 feet to match the existing 0.5 MG tank. This tank will be about 131 feet tall with a head range of 40 to 45 feet. This tank is required to help meet the peak hour equalization flows of about 10,000 gpm modeled in year 2030, stabilize system pressures in the

area and maintains peak hour pressure over 35 psi with the tank half full, and improve fire flow reliability.

4. Pumping

Raymore's water system includes one pump station. Three new pumps were installed in 2004. Based on these pump curves and other system improvements, no additional pump improvements are required in the Raymore system.

5. Water Quality

Raymore's water distribution system has a number of dead-ends. Connection of these dead-ends improves system pressure, fire flow and water quality. Many dead-end mains are connected with the improvements discussed above, but not all of them. Periodic flushing of these dead-end mains may help maintain water quality.

*****

Part V – Conclusions and Recommendations

PART V – CONCLUSIONS AND RECOMMENDATIONS

A. GENERAL

This section of the report discusses conclusions, opinions of probable cost, and schedule for recommended improvements to the Raymore water distribution system. Improvements are itemized for installation by year 2009, 2014 or 2030.

B. CONCLUSIONS

1. Supply

Raymore should negotiate a new contract with Kansas City for a maximum day supply. Ultimately, year 2030, Raymore will need 20.1 MGD.

2. Pump Stations

No additional pump stations or changes to the existing pump station are required at this time. The report assumes Kansas City can supply the necessary gradient or pressure to meet Raymore's needs. Pump station capacity could be increased if Kansas City is capable of supplying more water to this connection.

3. Storage

Installation of a 2.5 MG tank at Hubach Hill is recommended with Raymore using 2.0 MG and Kansas City using the remaining 0.5 MG. The design of this tank has been contracted and installation is anticipated to be complete in 2005. This is an increase in storage capacity from 1.5 MG of 2.5 MG. Installation of a 2.5 MG tank provides Raymore with enough storage capacity through year 2010. If a 1.5 MG tank is installed, Raymore would need to start a 1.0 MG tank project near Hubach Hill about year 2006. Installation of the 2.5 MG tank in 2005 will save about $0.5 million over the 1.5 MG and 1.0 MG tank approach.

A 2.5 MG elevated storage tank is required by 2009 to meet future demands. This tank could be located just off Kentucky north of Highway 58. The proposed 2.5 MG tank should have the same overflow elevation as the existing 0.5 MG tank, 1231 feet.

4. Piping

Raymore's pipe system is relatively small in size; the largest pipeline is 12-inch diameter. Due to the projected 50 MGD peak hour demand, additional transmission mains are required to convey water through the system. This requires installation of parallel or replacement 12-inch, 16-inch and 24-inch waterlines in strategic areas as well as installation of four additional meter locations off the Kansas City Jackson Cass waterline. Pipeline and tank projects are prioritized by category in Table IV-1 as follows:

- Priority A – are required to supply water at reasonable pressure.
- Priority B – are required to improve fire flow. Small main replacement projects are also in this category.
- Priority D – are developer driven improvement. City will pay the additional material cost for pipe greater than 8-inch in diameter.

These projects will improve system flow, available fire flow, and reduce leakage. Pipelines could be installed in conjunction with road improvement projects.

C. OPINIONS OF PROBABLE COST

Opinions of project cost are based on construction and other cost allowances including contingency, engineering, surveying, legal and other related costs are summarized in Table V-1. A detailed list is included in the Appendix. Unit cost data and component cost information for the proposed improvements are based on historical projects and vendor's cost information. Unit costs are based on an Engineering News Record Construction Cost Index of 7111.60 for Kansas City for April 2004.

Project costs include construction costs, contingencies, land, right-of-way, and other costs. Unit cost for pipeline projects are based on review of historical data and are listed in Table V-2. A contingency of 20 percent plus other costs at 20 percent are added to the opinions of probable cost. Contingency covers items that are not anticipated, changes in condition, or other factors that may increase the cost.

Table V-1

Improvement Summary
Opinion of Probable Cost

Raymore, Missouri

Year	Item	Street	Development Area	Quantity	Unit	Unit Cost	Subtotal Cost	Developer Cost	City Cost	Priority	Designation
By 2009											
	2.5 MG Tank (2.0 MG for Raymore)	Hubach Hill	na	1	LS	$2,810,000	$2,810,000	$0	$2,810,000	A1	South Tank
	24" Discharge Pipe	unknown	na	147	LF	$96	$14,000	$0	$14,000	A1	P13
	Meter Station 3	Walnut	R10F	1	LS	$50,000	$50,000	$0	$50,000	A2	V3
	16" Parallel Line	Walnut St. Meter to Foxwood	na	8924	LF	$80	$714,000	$0	$714,000	A2	P9054, P9052, P9090, P9088, P9076, P9080
	Meter Station 2	Gore Rd.	R10E	1	LS	$50,000	$50,000	$0	$50,000	A3	V2
	24" Line	on 163 St. (from S. Kurzwell to Kentucky)	multiple	15,907	LF	$120	$1,909,000	$0	$1,909,000	A3	P7132, P7131, P7146, P7145, P7365, P9048, P7383, P7382, P7294, P7301, P7300, P7339, P7338, P7337
	2.5 MG Tank	Kentucky	C5A	1	LS	3,340,000	$3,340,000	$0	$3,340,000	A4	West Tank
	24" Discharge Line	Kentucky	C5A	128	LS	$96	$12,000	$0	$12,000	A4	P9100
	24" Parallel Line	on Kentucky (from Harold to Foxwood)	C5A	1746	LF	$120	$210,000	$0	$210,000	A4	P9028, P9098
	24" Parallel Line	on Foxwood	C5B	35	LF	$120	$4,000	$0	$4,000	A4	P9000
	8" Fire Flow Improvement	Old Mill Rd. (between Deer Path & Foxridge Dr.)	existing	758	LF	$32	$24,000	$0	$24,000	B1	P9210
	12" Fire Flow Improvement	Dogleg between Sunrise & Poseidon	existing	769	LF	$48	$37,000	$0	$37,000	B2	P9218
	12" Fire Flow Improvement	South of 171 St. (between Dean & S. Kentucky)	C5B	445	LF	$48	$21,000	$0	$21,000	B3	P9212
	12" Fire Flow Improvement	North of Sierra Dr. and North Madison	existing	2124	LF	$48	$102,000	$0	$102,000	B4	P9114
	12" Proposed Line	area next to Foxwood & Madison	existing	48	LF	$48	$2,000	$0	$2,000	B5	P9094
	8" Lines (size increase, 4")	area next to Foxwood & Madison	existing	13,392	LF	$40	$536,000	$0	$536,000	B6	P236, P2883, P2900, P373, P5113, P5273, P5544, P5597, P5816, P5829, P6303, P6408, P6502, P6504, P6519, P6522, P6532, P6540, P6542, P6817, P6818, P6819, P6918
	6" Proposed Line	on Heron between Falcon & Lincoln	existing	511	LF	$24	$12,000	$0	$12,000	B7	P6994
	6" Proposed Line	dogleg between Sun Dr. & Poseidon	existing	856	LF	$30	$26,000	$0	$26,000	B8	P7007
	6" Proposed Line	South of Bluegrass Dr.	existing	939	LF	$30	$28,000	$0	$28,000	B9	P7012, P7013, P7014, P7011
	4" Proposed Line	Just south of Original Raymore	existing	59	LF	$16	$1,000	$0	$1,000	B10	P9224
	8" Proposed Line	Just south of Original Raymore	existing	22	LF	$32	$1,000	$0	$1,000	B11	P9228
	8" Proposed Line	Just south of Original Raymore	existing	27	LF	$32	$1,000	$0	$1,000	B12	P9240
	6" Proposed Line	not available	R5E	3,209	LF	$24	$77,000	$77,000	$0	D	P7082, P7083, P7084
	12" Line	unknown	Creekmoor	4183	LF	$60	$251,000	$217,000	$34,000	D	P9046, P7182, P7184, P7183, P7169, P7170, P7162, P7373, P7375, P7374, P7163, P7159
	6" Proposed Line	on Sunny Ln. (between Finch & Derby)	R5G	1,097	LF	$24	$26,000	$26,000	$0	D	P7344
	16" Proposed Line	along outer road (next to S. Peculiar Dr.)	C5C	5,808	LF	$64	$372,000	$266,000	$106,000	D	P7065, P7068, P7067
	12" Proposed Line	along outer road (next to S. Peculiar Dr.)	C5C	5,014	LF	$48	$241,000	$201,000	$40,000	D	P7059, P7058, P7066, P7064

Table V-1

Improvement Summary
Opinion of Probable Cost

Raymore, Missouri

Year	Item	Street	Development Area	Quantity	Unit	Unit Cost	Subtotal Cost	Developer Cost	City Cost	Priority	Designation
	12" Proposed Line	outer road (next to S. Peculiar Dr.)	R5A	2,847	LF	$48	$137,000	$114,000	$23,000	D	P7056, P7055
	8" Proposed Line	outer road (next to S. Peculiar Dr.)	R5A	2,096	LF	$32	$67,000	$67,000	$0	D	P7062, P7061
	8" Proposed Line	not available	R5B	1,135	LF	$32	$36,000	$36,000	$0	D	P7079
	12" Proposed Line	1 line off Foxwood & 1 line off Kentucky	C5B	1,375	LF	$48	$66,000	$55,000	$11,000	D	P7096, P7097
	12" Proposed Line	off Foxwood	C5A	840	LF	$48	$40,000	$33,000	$7,000	D	P7098
	8" Proposed Line	1 line on Toucan and 1 line on Sandpiper	existing	1,299	LF	$32	$42,000	$42,000	$0	D	P7002, P7004
	8" Proposed Line	on south end of Darroby	existing	457	LF	$40	$18,000	$18,000	$0	D	P7080, 7078
	6" Proposed Line	on Toucan between Raven & Sandpiper	existing	509	LF	$30	$15,000	$15,000	$0	D	P6997, P7001
	6" Proposed Line	Ash Street connections	existing	2,493	LF	$30	$75,000	$75,000	$0	D	P6991, P6988, P6990, P6989, P6987
	6" Proposed Line	on south end of Darroby	existing	801	LF	$30	$24,000	$24,000	$0	D	P7081
	6" Proposed Line	not available	R5F	451	LF	$24	$11,000	$11,000	$0	D	P7039
	8" Proposed Line	not available	R5F	7,936	LF	$32	$254,000	$254,000	$0	D	P7038, P7041, P7044, P7043, P7045, P7040, P7036, P7034, P7029, P7030, P7032, P7031
	6" Proposed Line	not available	R5H	1,744	LF	$24	$42,000	$42,000	$0	D	P7122, P7121
	12" Proposed Line	not available	R5H	6,535	LF	$48	$314,000	$261,000	$53,000	D	P7099, P7104, P7114, P7115, P7055
	8" Proposed Line	not available	R5H	3,308	LF	$32	$106,000	$106,000	$0	D	P7100, P7118, P7120
	8" Proposed Line	not available	R5C	3,865	LF	$32	$124,000	$124,000	$0	D	P7128, P7125, P7130
	8" Proposed Line	not available	R10B	4,541	LF	$32	$145,000	$145,000	$0	D	P7139, P7136, P7141, P7138
	6" Proposed Line	not available	Creekmoor	8,287	LF	$24	$199,000	$199,000	$0	D	P7241, P7245, P7284, P7157, P7236, P7165, P7376, P7166, P7381, P7293, P7208, P9208, P7240, P7242, P7186, P7188, P7289, P7178, P7189, P7246, P7207, P7288, P7287, P7286, P7285, P7196
	8" Proposed Line	not available	Creekmoor	32,963	LF	$32	$1,055,000	$1,055,000	$0	D	P7168, P7379, P7380, P7291, P7158, P7283, P7370, P7180, P7280, P7279, P7264, P7262, P7281, P7385, P7386, P7296, P7213, P7265, P7261, P7260, P7259, P7222, P7221, P7220, P7219, P7217, P7215, P7214, P7239, P7185, P7187, P7371, P7368, P7231, P7290, P7243, P7282, P7258, P7206, P7200, P7229, P7292, P7367, P7230, P7228, P7238, P7237, P7155, P7233, P7232, P7193

Table V-1

Improvement Summary
Opinion of Probable Cost

Raymore, Missouri

Year	Item	Street	Development Area	Quantity	Unit	Unit Cost	Subtotal Cost	Developer Cost	City Cost	Priority	Designation
	12" Proposed Line	not available	Creekmoor	8,986	LF	$48	$431,000	$359,000	$72,000	D	P7362, P7388, P7387, P7363, P7250, P7369, P7202, P7204, P7205, P7248, P7247, P7198, P7249
	6" - Abandon in Place	163 St. to Foxwood & Clint Dr.	R5C, existing	7657	LF	$0	$0	$0	$0	-	P9126, P9202, P9194
	8" - Abandon in Place	163 St. to Foxwood	R5C, R10B, existing	8810	LF	$0	$0	$0	$0	-	P5397, P210, P9190, P9192
	8" Proposed Line	all off Pelham Path or Silver Lane	R5D	1,093	LF	$32	$35,000	$35,000	$0	D	P7090
	Subtotal						$14,107,000	$3,857,000	$10,250,000		
	Contingency @ 20%						$2,821,000	$771,000	$2,050,000		
	Subtotal						$16,928,000	$4,628,000	$12,300,000		
	Engineering and Other Costs @ 20%						$3,386,000	$926,000	$2,460,000		
	By 2009 Total						**$20,314,000**	**$5,554,000**	**$14,760,000**		
2010 to 2014											
	Meter Station 1	155 St.	na	1	LS	$50,000	$50,000	$0	$50,000	A1	V1
	16" Line	on 155 St. (from S. Kurzwell to Kentucky)	multiple	14,956	LF	$80	$1,196,000	$0	$1,196,000	A1	P7334,P7332, P9016, P7396, P7397, P7395, P7393, P7391, P9014
	16" Parallel Line	on Kentucky (from 155 St. to Harold)	multiple	8867	LF	$80	$709,000	$0	$709,000	A2	P9032, P9030
	24" Parallel Line	155 St. to 163 St.	R10F	5,236	LF	$96	$503,000	$0	$503,000	A3	P7358
	16" Parallel Line	on Kentucky (from Johnson Dr. to Lucy Webb)	multiple	2305	LF	$80	$184,000	$0	$184,000	A4	P9006
	24" Parallel Line	on Kentucky (from Foxwood to Johnson Dr.)	R5B	2924	LF	$96	$281,000	$0	$281,000	A4	P9004
	8" Proposed Line	within Lucy Webb, Sunset Ln, & Country Lane	R10A	2,544	LF	$32	$81,000	$81,000	$0	D	P7018, P7020, P7022, P7023
	12" Proposed Line	not available	R5F	1,991	LF	$48	$96,000	$80,000	$16,000	D	P7050, P7054
	8" Proposed Line	not available	R5F	4,540	LF	$32	$145,000	$145,000	$0	D	P7052, P7049, P7053
	16" Proposed Line	not available	Industrial & Commercial	16,666	LF	$64	$1,067,000	$763,000	$304,000	D	P7073, P7074, P7071, P7072
	8" Proposed Line	all off Pelham Path or Silver Lane	R5D	2,686	LF	$32	$86,000	$86,000	$0	D	P7091, P7085
	8" Proposed Line	not available	R5C	3,264	LF	$32	$104,000	$104,000	$0	D	P7129, P7126
	8" Proposed Line	not available	R5H	6,459	LF	$32	$207,000	$207,000	$0	D	P7112, P7113, P7108, P7105, P7110, P7106, P7109
	6" Proposed Line	not available	R5H	190	LF	$24	$5,000	$5,000	$0	D	P7111

Table V-1

Improvement Summary
Opinion of Probable Cost

Raymore, Missouri

Year	Item	Street	Development Area	Quantity	Unit	Unit Cost	Subtotal Cost	Developer Cost	City Cost	Priority	Designation
	8" Proposed Line	not available	R10D	973	LF	$32	$31,000	$31,000	$0	D	P9096
	8" Proposed Line	not available	R10C	2,441	LF	$32	$78,000	$78,000	$0	D	P7331, P7330
	6" Proposed Line	not available	R10C	2,151	LF	$24	$52,000	$52,000	$0	D	P7329, P7328
	8" Proposed Line	not available	R10B	3,354	LF	$32	$107,000	$107,000	$0	D	P7148, P7147, P7140
	12" Proposed Line	not available	Creekmoor	7,036	LF	$48	$338,000	$281,000	$57,000	D	P7316, P7307, P7312, P7314, P7318, P7257, P7256, P7255, P7309, P7317, P7315
	8" Proposed Line	not available	Creekmoor	20,157	LF	$32	$645,000	$645,000	$0	D	P7269, P7270, P7327, P7326, P7324, P7323, P7322, P7320, P7302, P7275, P7306, P7313, P7319, P7277, P7321, P7267, P7266, P9116, P7325, P7273, P7271, P7316
	6" Proposed Line	not available	Creekmoor	1,890	LF	$24	$45,000	$45,000	$0	D	P7304, P7297, P7274, P7276, P7278, P7299, P7303, P7305
	Subtotal						$6,010,000	$2,710,000	$3,300,000		
	Contingency @ 20%						$1,202,000	$542,000	$660,000		
	Subtotal						$7,212,000	$3,252,000	$3,960,000		
	Engineering and Other Costs @ 20%						$1,442,000	$650,000	$792,000		
	2010 to 2014 Total						**$8,654,000**	**$3,902,000**	**$4,752,000**		
2015 to 2030											
	Meter Station 5	Hubach Hill	na	1	LS	$50,000	$50,000	$0	$50,000	A1	V8000
	24" Parallel Line	163 St. to Lucy Webb	R10F	10,674	LF	$96	$1,025,000	$0	$1,025,000	A2	P7359, P7360
	16" Parallel Line	Lincoln Rd to Florence Ave.	na	1507	LF	$60	$90,000	$0	$90,000	A3	P9066
	12" Parallel Line	Florence Ave. to S. Prairie Lane Rd	na	4073	LF	$60	$244,000	$0	$244,000	A4	P9068, P9070, P9072
	12" Proposed Line	South end of Florence Ave.	existing	2,528	LF	$48	$121,000	$0	$121,000	A5	P6284
	12" Line	on Florence Ave.	na	2528	LF	$48	$121,000	$0	$121,000	A6	P6284
	16" Proposed Line	Lucy Webb (SE corner of Raymore), existing	existing	1,762	LF	$64	$113,000	$0	$113,000	A7	P6946
	16" Proposed Line	on Lucy Webb - east end	R10G	2,565	LF	$64	$164,000	$117,000	$47,000	D	P6941

Table V-1

Improvement Summary
Opinion of Probable Cost

Raymore, Missouri

Year	Item	Street	Development Area	Quantity	Unit	Unit Cost	Subtotal Cost	Developer Cost	City Cost	Priority	Designation
	12" Proposed Line	between Lucy Webb E. Hubach Hill Rd.	R10G	7,827	LF	$48	$376,000	$313,000	$63,000	D	P6943, P6942, P6938, P9074
	8" Proposed Line	between Lucy Webb E. Hubach Hill Rd.	R10G	937	LF	$32	$30,000	$30,000	$0	D	P6944
	6" Proposed Line	within Lucy Webb, Sunset Ln, & Country Lane	R10A	1,531		$24	$37,000	$37,000	$0	D	P7024, P7025, P7026
	16" Proposed Line	not available	R10F	3,564	LF	$64	$228,000	$163,000	$65,000	D	P6954, P6953
	12" Proposed Line	not available	R10F	10,366	LF	$48	$498,000	$415,000	$83,000	D	P6955, P6961, P6949, P6942
	8" Proposed Line	not available	R10F	4,289	LF	$32	$137,000	$137,000	$0	D	P6951, P6952
	12" Proposed Line	not available	R10E	8,845	LF	$48	$425,000	$354,000	$71,000	D	P6964, P6965, P6960, P6975, P6976, P6981, P6982
	8" Proposed Line	not available	R10E	5,492	LF	$32	$176,000	$176,000	$0	D	P6966, P6958, P6977, P6970, P6971, P6978
	6" Proposed Line	not available	R10E	1,698	LF	$24	$41,000	$41,000	$0	D	P6985
	6" Proposed Line	within Lucy Webb, Sunset Ln, & Country Lane	R10A	1,531	LF	$24	$37,000	$37,000	$0	D	P7024, P7025, P7026
	Subtotal						$3,913,000	$1,820,000	$2,093,000		
	Contingency @ 20%						$783,000	$364,000	$419,000		
	Subtotal						$4,696,000	$2,184,000	$2,512,000		
	Engineering and Other Costs @ 20%						$939,000	$437,000	$502,000		
	2015 to 2030 Total						**$5,635,000**	**$2,621,000**	**$3,014,000**		
	2009 to 2030 Total						**$34,603,000**	**$12,077,000**	**$22,526,000**		

Table V-2

Water Master Plan
Unit Costs
Raymore, Missouri

Item	Size	Unit	Unit Cost
Pipeline (new development):	6	inch	24
	8	inch	32
	12	inch	48
	16	inch	64
	24	inch	96
Pipeline (parallel or replacement):	6	inch	30
	8	inch	40
	12	inch	60
	16	inch	80
	24	inch	120
Elevated Storage:	1.0	MG	1,750,000
	1.5	MG	2,280,000
	2.0	MG	2,810,000
	2.5	MG	3,340,000
Meter Station:	1	each	50,000
Pipe Material Upsize (8-inch to):	12	LF	8
	16	LF	18
	24	LF	40

Other costs accounts for technical, professional, and special services are required to execute the project. These include environmental, technical, and geotechnical studies; land and right-of-way appraisals and negotiations, design and resident engineering fees, construction material testing, legal fees, project insurance, land surveying and legal descriptions, project design surveying, operation and maintenance manuals, and personnel training. Land and right-of-way costs for each improvement are not included in the cost opinions.

These order-of-magnitude cost opinions are based on experience and judgement as a professional consultant combined with information from past experience, vendors, and published sources, such as Means. Since Burns & McDonnell has no control over weather, cost and availability of labor, material and equipment, labor productivity, construction contractor's procedures and methods, unavoidable delays, construction contractor's method of pricing, economic conditions, government regulations and laws, competitive bidding or market conditions and other factors affecting such opinions or projection, Burns & McDonnell does not guarantee the actual rates, costs, etc. will not vary from the opinions and projections developed herein.

D. RECOMMENDATIONS

Recommended improvements are detailed in Part IV of this report and are discussed above. Review of Table V-1 shows the improvements and schedule of the year by which improvements should be installed. Actual installation year can vary based on the developer, rate of growth, water use, weather conditions, and other factors. Types of projects are as follows:

By Year 2009:

- 2.0 MG tank at Hubach Hill (actual capacity is 2.5 MG but Raymore will utilize 2.0 MG of capacity).
- 2.5 MG elevated tank on the west side.
- 24-inch main on 163rd.
- 24-inch main on Kentucky between the proposed tank and 58 Highway.
- 16-inch main on 58 Highway from J Highway west to Woodson.
- Two meter stations.
- Small main replacement in original Raymore.

- Various developer projects.

By Year 2014:

- 24-inch on J Highway from 155th to 163rd.
- 16-inch along 155th.
- 16-inch and 24-inch mains on Kentucky between 155th and the proposed tank.
- 24-inch and 16-inch main on Kentucky between 58 Highway and Lucy Webb.
- One meter station.
- Various developer projects.

By Year 2030:

- 24-inch main on J Highway from 163rd to Lucy Webb.
- One meter station.
- Various developer projects.

*****

Appendix

Water Use/Demand Data

Table A3

Raymore, Missouri Growth Distribution

Year	R5A Acres	R5A HH	R5B Acres	R5B HH	R5C Acres	R5C HH	R5D Acres	R5D HH	R5E Acres	R5E HH	R5F Acres	R5F HH	R5G Acres	R5G HH	R5H Acres	R5H HH	R5 Total HH	Sum R5 Total HH	Year
	Build-out	199	Build-out	252	Build-out	268	Build-out	202	Build-out	22	Build-out	196	Build-out	63	Build-out	447			
	HH/year	597	HH/year	756	HH/year	804	HH/year	606	HH/year	66	HH/year	588	HH/year	189	HH/year	1,341			
		10		10		10		10		5		10		5		10			
		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH			
2004	60	60	76	76			61	61			59	59					256	256	2004
2005	60	120	76	152	80	80	61	122	13	13	59	118	38	38	134	134	521	777	2005
2006	60	180	76	228	80	160	61	183	13	26	59	177	38	76	134	268	521	1,298	2006
2007	60	240	76	304	80	240	61	244	13	39	59	236	38	114	134	402	521	1,819	2007
2008	60	300	76	380	80	320	61	305	13	52	59	295	38	152	134	536	521	2,340	2008
2009	60	360	76	456	80	400	61	366	13	65	59	354	38	190	134	670	521	2,861	2009
2010	60	420	76	532	80	480	61	427			59	413			134	804	470	3,331	2010
2011	60	480	76	608	80	560	61	488			59	472			134	938	470	3,801	2011
2012	60	540	76	684	80	640	61	549			59	531			134	1,072	470	4,271	2012
2013	60	600	76	760	80	720	61	610			59	590			134	1,206	470	4,741	2013
2014					80	800									134	1,340	214	4,955	2014

Year	R10A Acres	R10A HH	R10B Acres	R10B HH	R10C Acres	R10C HH	R10D Acres	R10D HH	R10E Acres	R10E HH	R10F Acres	R10F HH	R10G Acres	R10G HH	R10 Total HH	R5 + R10 Total HH	Sum R5 + R10 Total HH	Cooper Dev. Acres	Cooper Dev. HH	Platted but not Occupied pre-2004 HH	Total HH	Sum Total HH	Year
	Build-out	42	Build-out	225	Build-out	75	Build-out	48	Build-out	490	Build-out	648	Build-out	655				Build-out	987				
	HH/year	126	HH/year	675	HH/year	225	HH/year	144	HH/year	1,470	HH/year	1,944	HH/year	1,965				HH/year	1500				
		10		10		10		10		17		16		16					10				
		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH		Sum HH					Sum HH				
2003																					5,005		2003
2004															-	256	256			300	556	5,561	2004
2005															-	521	777	150	150	150	821	6,382	2005
2006															-	521	1,298	150	300	150	821	7,203	2006
2007															-	521	1,819	150	450		671	7,874	2007
2008															-	521	2,340	150	600		671	8,545	2008
2009															-	521	2,861	150	750		671	9,216	2009
2010	13	13			23	23	14	14							50	520	3,381	150	900		670	9,886	2010
2011	13	26	68	68	23	46	14	28							118	588	3,969	150	1,050		738	10,624	2011
2012	13	39	68	136	23	69	14	42							118	588	4,557	150	1,200		738	11,362	2012
2013	13	52	68	204	23	92	14	56							118	588	5,145	150	1,350		738	12,100	2013
2014	13	65	68	272	23	115	14	70	86	86					204	418	5,563	150	1,500		568	12,668	2014
2015	13	78	68	340	23	138	14	84	86	172	122	122	123	123	449	449	6,012				449	13,117	2015
2016	13	91	68	408	23	161	14	98	86	258	122	244	123	246	449	449	6,461				449	13,566	2016
2017	13	104	68	476	23	184	14	112	86	344	122	366	123	369	449	449	6,910				449	14,015	2017
2018	13	117	68	544	23	207	14	126	86	430	122	488	123	492	449	449	7,359				449	14,464	2018
2019	13	130	68	612	23	230	14	140	86	516	122	610	123	615	449	449	7,808				449	14,913	2019
2020			68	680					86	602	122	732	123	738	399	399	8,207				399	15,312	2020
2021									86	688	122	854	123	861	331	331	8,538				331	15,643	2021
2022									86	774	122	976	123	984	331	331	8,869				331	15,974	2022
2023									86	860	122	1,098	123	1,107	331	331	9,200				331	16,305	2023
2024									86	946	122	1,220	123	1,230	331	331	9,531				331	16,636	2024
2025									86	1,032	122	1,342	123	1,353	331	331	9,862				331	16,967	2025
2026									86	1,118	122	1,464	123	1,476	331	331	10,193				331	17,298	2026
2027									86	1,204	122	1,586	123	1,599	331	331	10,524				331	17,629	2027
2028									86	1,290	122	1,708	123	1,722	331	331	10,855				331	17,960	2028
2029									86	1,376	122	1,830	123	1,845	331	331	11,186				331	18,291	2029
2030									86	1,462	122	1,952	123	1,968	331	331	11,517				331	18,622	2030
															6,562	11,517		1,500		600	18,622		

Existing Water System

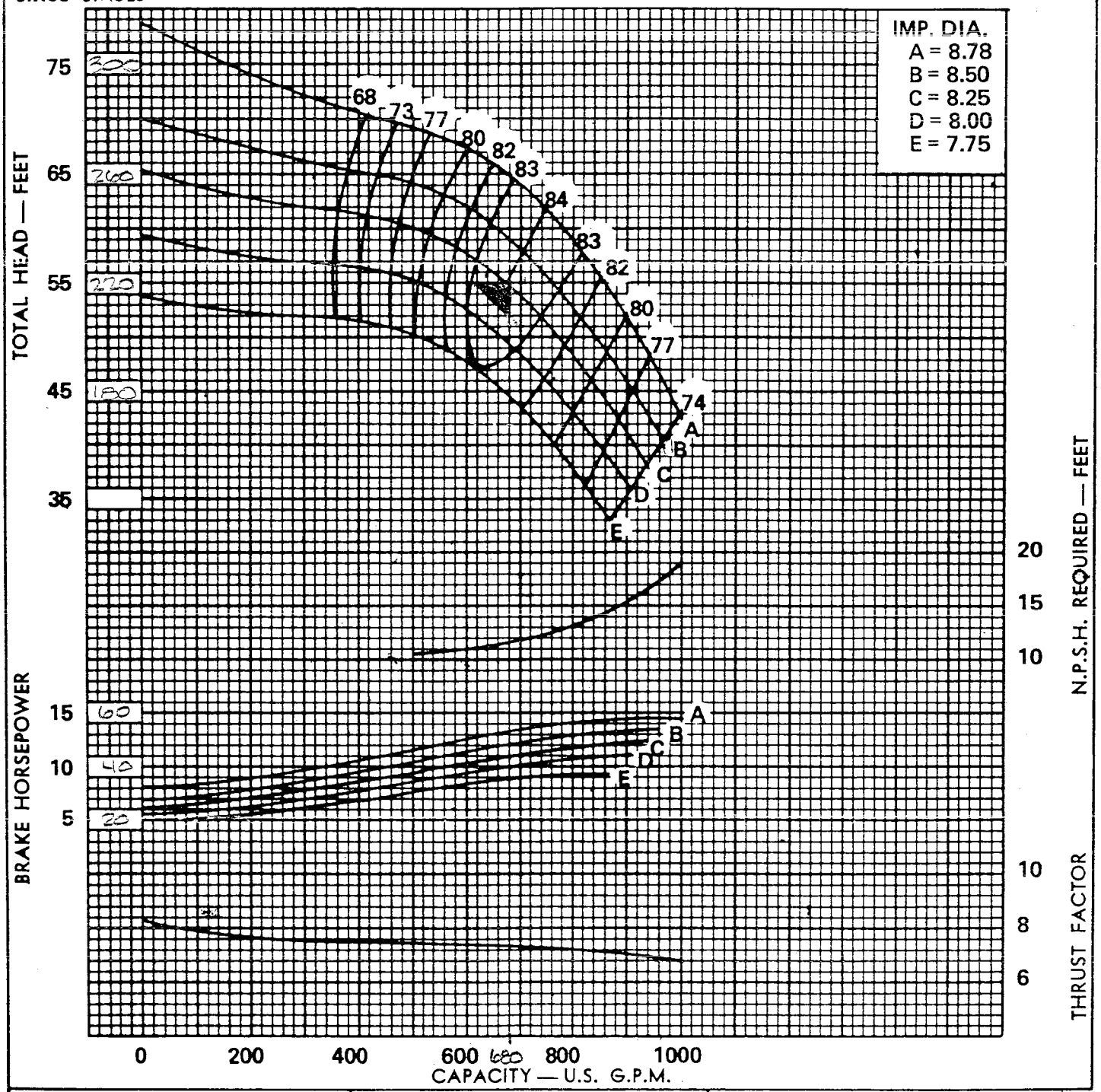
CURVE NO.
18-083
5-1-79

No. Stages	Eff. Change	MATERIAL	Eff. Change
1	– 4	IMP.—C.I.	– 2
2	– 2	IMP.—NI-RI	– 1
3	– 1	BOWL—BRZ.	– 1
4	0	BOWL—NI-R.	– 1

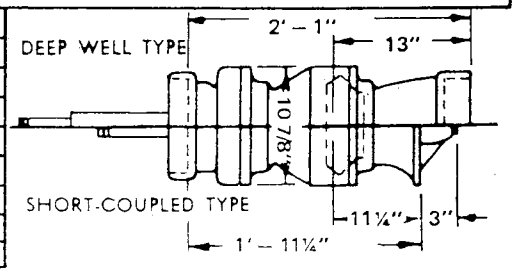
11 BHC 1770 R.P.M.

SINGLE STAGE LAB PERFORMANCE WITH STANDARD MATERIALS. EFFICIENCY SHOWN FOR 4 OR MORE STAGES. HORSE POWER SHOWN FOR ONE STAGE BASED ON 4 STAGE EFFICIENCY. CORRECTIONS SHOULD BE MADE FOR STAGES AND MATERIAL.

680 GPM @ 220' TDH



EYE AREA — SQ. IN.	=	14.71	IMPELLER WT.-LBS.	=	12.7
WR^2 PER IMPELLER	=	0.74 LB.-FT.^{2}	ONE STAGE WT.-LBS.	=	186
MAX. SPHERE SIZE	=	0.62 in.	ADD'L STAGE WT.-LBS.	=	74
MAX. NO. STD. STAGES	=	13	IMPELLER NUMBER	=	55B17
MAX. OPERATING P.S.I.	=	430	DISCH. SIZES	=	8 , 6
STD. LATERAL	=	0.62 in.	SUCTION SIZES	=	8
STD. SHAFT DIA.	=	1.500 in.	MAX. LATERAL	=	––– in.
MAX. SHAFT DIA.	=	1.687 in.	BOWL CONN.		FLANGED–COLLET
MIN. SUBMERGENCE	=	22 in.	ADD 9¾		" PER ADDITIONAL STAGE.



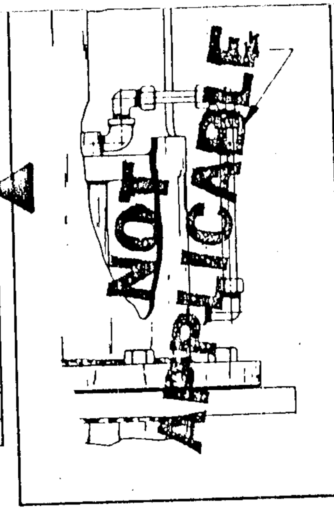
Layne
A Marley Company
LAYNE & BOWLER, INC.
MEMPHIS, TN 38108 USA

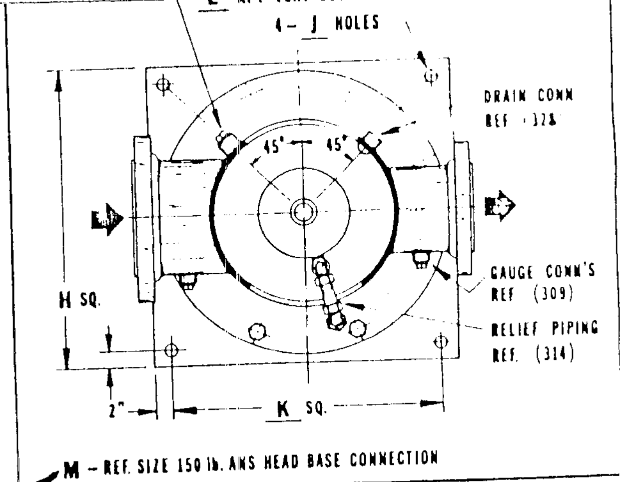
INSTALLATION PLAN & SECTIONAL DRAWING- VERTICAL CAN PUMP
DL INLINE HEAD - DIRECT CONNECTED
FOR VHS DRIVER OR VSS DRIVER W/NON - SPACER COUPLING
11B, 12RKB, 13C, 14T & 15C BOWLS

USE DIMENSIONS SHOWN ONLY WHEN CERTIFIED BY FACTORY

23DL12	2	2	3	3	12	6	23
34DL12	3	3	4	4	12	7	24
34DL17	3	3	4	4	17	7	24
46DL12	4	4	6	6	12	9	27
~~46DL17~~	~~4~~	~~4~~	~~6~~	~~6~~	~~17~~	~~9~~	~~29~~
68DL12	6	~~6~~	8	~~8~~	12	10	32
~~68DL17~~	~~6~~	~~6~~	~~8~~	~~8~~	~~17~~	~~10~~	~~32~~
68DL20	6	6	8	8	20	10	32
810DL12	8	8	10	10	12	11	35
810DL17	8	8	10	10	17	11	35
810DL20	8	8	10	10	20	11	40
810DL25	8	8	10	10	25	11	40
1012DL17	10	10	12	12	17	13	38
1012DL20	10	10	12	12	20	13	43
1012DL25	10	10	12	12	25	13	43
1014DL17	10	10	14	14	17	14	40
1014DL20	10	10	14	14	20	14	45
1014DL25	10	10	14	14	25	14	45

8 5/8	12	10B	10	5/8	1 1/8	17	7/8	13	1½	10
	17	14B	11	3/4	1 1/4	20	7/8	16	1½	12
10 3/4	12	10B	10	5/8	1 1/8	17	7/8	13	1½	10
	17	14B	11	3/4	1 1/4	20	7/8	16	1½	12
~~12 3/4~~	~~12,17~~	~~14B~~	~~11~~	~~3/4~~	~~1 1/4~~	~~20~~	~~7/8~~	~~16~~	~~1½~~	~~12~~
	~~20~~	~~18B~~	~~14~~	~~1~~	~~1 3/8~~	~~24~~	~~1~~	~~20~~	~~2~~	~~16~~
14	12, ~~17~~	16B.	13	~~3/4~~	~~1 1/4~~	~~20~~	~~7/8~~	~~16~~	1½	14
	~~20~~	~~18B~~	~~14~~	~~1~~	~~1 3/8~~	~~24~~	~~1~~	~~20~~	~~2~~	~~16~~
~~16~~	~~12,17~~	~~16B~~	~~13~~	~~7/8~~	~~1 3/8~~	~~22~~	~~7/8~~	~~18~~	~~2~~	~~14~~
	~~20~~	~~18B~~	~~14~~	~~1~~	~~1 3/8~~	~~24~~	~~1~~	~~20~~	~~2~~	~~16~~
	~~25~~	~~20B~~	~~15~~	~~1 1/8~~	~~1 5/8~~	~~28~~	~~1~~	~~24~~	~~2½~~	~~20~~
18	12,17,20	18B	14	1	1 3/8	24	1	20	2	16
	25	20B	15	1 1/8	1 5/8	28	1	24	2½	20
20	12,17,20	20B	15	1	1 1/2	26	1	22	2	18
	25	20B	16	1 1/8	1 5/8	28	1	24	2½	20
24	17,20,25	24B	18	1 1/4	1 7/8	33	1 1/8	29	2½	24





CUSTOMER: City of Raymore
JOB NAME:
LOCATION: Raymore, Missouri
APPLICATION: Booster Pumps
CONSULTING ENGR.:
FOR APPROVAL: James W. Dunn DATE: 7-1-85
CERTIFIED: James W. Dunn DATE: 7-25-85

HEAD NO. 68DL12 - 16B W/ 150# DISCH, 150# SUCT & STD. BASE

BOWL SIZE MODEL: 11BHC STG: 4		COLUMN SIZE: – x –
NPSH AVAIL AT SUCT ℄		CUST ORDER NO: A-119-D
LIQUID: Water	SP.GR: 1.0	REF JOB NO:
TEMP:	SUCT PSTG:	REF QUOTE NO:
DIFF P.SIG: 95.2	DISCH PSIG:	SALES ORDER NO: 85H-3354
GPM: 680	RPM: 1800	PUMP SERIAL NO: 103603-5
TDH: 220'	BHP:	DRAWING NO: 85H-3354

SECTION:
DRWG NO: A120-P22D
DATE: March 1973
SUPERSEDES: Dec. 1977

CURVE NO.	No. Stages	Eff. Change	MATERIAL	Eff. Change
18-083	1	−4	IMP.—C.I.	−2
5-1-79	2	−2	IMP.—NI-RI	−1
	3	−1	BOWL—BRZ.	−1
	4	0	BOWL—NI-R.	−1

11 BHC — **1770** R.P.M.

SINGLE STAGE LAB PERFORMANCE WITH STANDARD MATERIALS. EFFICIENCY SHOWN FOR 4 OR MORE STAGES. HORSE POWER SHOWN FOR ONE STAGE BASED ON 4 STAGE EFFICIENCY. CORRECTIONS SHOULD BE MADE FOR STAGES AND MATERIAL.

IMPELLERS: B - 55817
E - 55827

ONE STAGE (4) STAGES

DESIGN 700 GPM @ 258' TDH

IMP. DIA.
A = 8.78
B = 8.50
C = 8.25
D = 8.00
E = 7.75

TOTAL HEAD — FEET: 300, 260, 220, 180, 140

BRAKE HORSEPOWER: 60, 40, 20

N.P.S.H. REQUIRED — FEET: 20, 15, 10

THRUST FACTOR: 10, 8, 6

CAPACITY — U.S. G.P.M.: 0, 200, 400, 600, 800, 1000

EYE AREA — SQ. IN.	=	14.71	IMPELLER WT.-LBS.	=	12.7
WR^2 PER IMPELLER	=	0.74 LB.-FT.^{2}	ONE STAGE WT.-LBS.	=	186
MAX. SPHERE SIZE	=	0.82 in.	ADD'L STAGE WT.-LBS.	=	74
MAX. NO. STD. STAGES	=	13	IMPELLER NUMBER	=	55817
MAX. OPERATING P.S.I.	=	430	DISCH. SIZES	=	8, 6
STD. LATERAL	=	0.82 in.	SUCTION SIZES	=	8
STD. SHAFT DIA.	=	1.500 in.	MAX. LATERAL	=	——— in.
MAX. SHAFT DIA.	=	1.687 in.	BOWL CONN.	FLANGED—COLLET	
MIN. SUBMERGENCE	=	22 in.	ADD 9¾ " PER ADDITIONAL STAGE.		

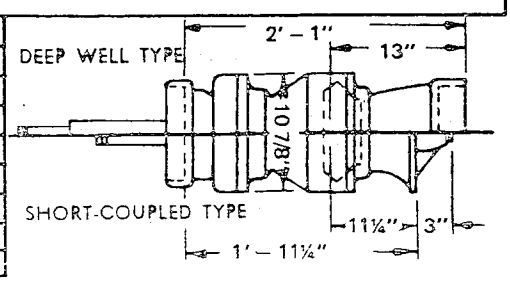


Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
155TH STREET	8	UNK	1990	9,961	278,918	4,732	197,138
58 TRUNK	6	DI	1990	103	2,158	4,732	1,525
58 TRUNK	6	DI	1998	63	1,332	5,920	1,178
58 TRUNK	6	DI	2002	48	1,012	6,538	988
58 TRUNK	6	UNK	1990	29	617	4,732	436
58 TRUNK	8	DI	1998	3	97	5,920	86
58 TRUNK	8	DI	2002	9	258	6,538	252
58 TRUNK	8	PVC	2000	32	909	6,221	845
58 TRUNK	12	DI	1990	4,701	197,434	4,732	139,546
58 TRUNK	12	DI	1992	5,068	212,863	4,985	158,495
58 TRUNK	12	DI	1998	1,991	83,604	5,920	73,926
58 TRUNK	12	DI	2002	2,716	114,073	6,538	111,398
58 TRUNK	12	PVC	1990	56	2,340	4,732	1,654
58 TRUNK	12	PVC	1992	375	15,745	4,985	11,723
58 TRUNK	12	UNK	1990	732	30,748	4,732	21,733
BRIDLECROFT	4	PVC	1990	1,665	23,305	4,732	16,472
BRIDLECROFT	4	UNK	1985	2,224	31,135	4,195	19,509
BRIDLECROFT	6	PVC	1985	1,069	22,456	4,195	14,071
BRIDLECROFT	6	PVC	1990	15	308	4,732	218
BRIDLECROFT	6	UNK	1985	29	617	4,195	386
BROOKSIDE	6	DI	2000	30	623	6,221	579
BROOKSIDE	6	DI	2001	758	15,909	6,343	15,072
BROOKSIDE	6	DI	2002	953	20,020	6,538	19,550
BROOKSIDE	8	DI	1993	4,671	130,775	5,210	101,768
BROOKSIDE	8	DI	2001	1,296	36,278	6,343	34,370
BROOKSIDE	8	DI	2002	2,275	63,706	6,538	62,212
BUSH INDUSTRIAL PARK	6	DI	1992	15	314	4,985	234
BUSH INDUSTRIAL PARK	6	UNK	1990	15	309	4,732	218
BUSH INDUSTRIAL PARK	8	PVC	1990	1,948	54,558	4,732	38,561
CANTER RIDGE	6	UNK	1999	758	15,908	6,059	14,397
CANTER RIDGE	6	DI	1993	915	19,217	5,210	14,955
CANTER RIDGE	6	DI	1996	89	1,877	5,620	1,575
CANTER RIDGE	6	DI	1999	688	14,443	6,059	13,071
CANTER RIDGE	6	DI	2000	1,636	34,361	6,221	31,928
CANTER RIDGE	6	UNK	1994	1,140	23,944	5,408	19,341
CANTER RIDGE	6	UNK	1996	1,165	24,467	5,620	20,538
CANTER RIDGE	8	DI	1993	1,068	29,892	5,210	23,261
CANTER RIDGE	8	DI	1996	643	17,999	5,620	15,109
CANTER RIDGE	8	DI	1999	1,970	55,173	6,059	49,931

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
CANTER RIDGE	8	DI	2000	2,058	57,616	6,221	53,537
CANTER RIDGE	8	DI	2002	373	10,442	6,538	10,197
CEDAR RIDGE	6	DI	1997	4,576	96,088	5,826	83,616
CEDAR RIDGE	8	DI	2002	34	960	6,538	938
COUNTRY SIDE VIEW	6	UNK	1985	1,577	33,110	4,195	20,746
COUNTRY SIDE VIEW	8	UNK	1990	1,927	53,948	4,732	38,130
COVENTRY MEADOWS	6	DI	1992	639	13,418	4,985	9,991
COVENTRY MEADOWS	6	UNK	1990	30	624	4,732	441
COVENTRY MEADOWS	8	UNK	1990	1,505	42,138	4,732	29,783
CUMBERLAND HILLS	4	DI	1993	232	3,244	5,210	2,524
CUMBERLAND HILLS	4	UNK	1993	435	6,083	5,210	4,734
CUMBERLAND HILLS	6	DI	1993	1,347	28,278	5,210	22,005
CUMBERLAND HILLS	6	DI	2002	4	79	6,538	77
CUMBERLAND HILLS	6	PVC	1993	3,238	68,006	5,210	52,922
CUMBERLAND HILLS	6	UNK	1993	5,005	105,108	5,210	81,794
CUMBERLAND HILLS	8	DI	1993	722	20,206	5,210	15,724
CUMBERLAND HILLS	8	UNK	1993	1,880	52,638	5,210	40,962
CUMBERLAND HILLS SOUTH	6	PVC	1990	906	19,023	4,732	13,446
CUMBERLAND HILLS SOUTH	6	PVC	1993	3,220	67,625	5,210	52,625
CUMBERLAND HILLS SOUTH	8	PVC	1990	297	8,327	4,732	5,886
CUMBERLAND PLAZA	8	PVC	1992	178	4,991	4,985	3,716
DEAN SUBDIVISION	6	PVC	1993	1,356	28,480	5,210	22,163
DEAN SUBDIVISION	6	UNK	1993	35	728	5,210	567
DEAN SUBDIVISION	8	PVC	1993	382	10,707	5,210	8,332
DEAN SUBDIVISION	8	PVC	2000	13	363	6,221	337
DEAN SUBDIVISION	8	UNK	1993	317	8,887	5,210	6,916
DEAN'S INDUSTRIAL PARK	8	PVC	2000	1,859	52,047	6,221	48,362
EAGLE GLEN	6	DI	2000	557	11,692	6,221	10,864
EAGLE GLEN	6	DI	2002	2,937	61,679	6,538	60,232
EAGLE GLEN	6	DI	2003	33	688	6,695	688
EAGLE GLEN	8	DI	2000	471	13,196	6,221	12,262
EAGLE GLEN	8	DI	2002	1,063	29,752	6,538	29,055
EAGLE GLEN	8	DI	2003	84	2,361	6,695	2,361
EAGLE GLEN	12	DI	2002	2,994	125,735	6,538	122,786
EAGLE GLEN	12	DI	2003	3,107	130,497	6,695	130,497
EVAN-BROOK	6	DI	1999	2,440	51,236	6,059	46,369
EVAN-BROOK	6	PVC	1992	1,846	38,764	4,985	28,863
EVAN-BROOK	6	UNK	1990	59	1,234	4,732	872
EVAN-BROOK	6	UNK	1992	3,528	74,086	4,985	55,163

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
EVAN-BROOK	8	DI	1990	1,368	38,313	4,732	27,079
EVAN-BROOK	8	DI	1999	1,858	52,016	6,059	47,075
EVAN-BROOK	8	DI	2001	273	7,632	6,343	7,231
EVAN-BROOK	8	DI	2002	112	3,142	6,538	3,069
EVAN-BROOK	8	PVC	1992	60	1,677	4,985	1,249
EVAN-BROOK	8	UNK	1992	5	153	4,985	114
FAIRFIELD ESTATES	6	UNK	1985	3,141	65,966	4,195	41,334
FALCON CREST	6	PVC	1996	1,604	33,692	5,620	28,282
FOXHAVEN	4	DI	1994	1,317	18,435	5,408	14,891
FOXHAVEN	6	CIP	1994	116	2,445	5,408	1,975
FOXHAVEN	6	DI	1994	6,986	146,702	5,408	118,501
FOXHAVEN	6	DI	1997	3,745	78,648	5,826	68,440
FOXHAVEN	6	DI	1998	50	1,058	5,920	935
FOXHAVEN	6	PVC	1994	3,556	74,675	5,408	60,320
FOXHAVEN	6	UNK	1994	1,226	25,741	5,408	20,793
FOXHAVEN	8	DI	1994	2,252	63,069	5,408	50,945
FOXHAVEN	8	DI	1997	3,404	95,300	5,826	82,930
FOXHAVEN	8	DI	1998	52	1,443	5,920	1,276
FOXHAVEN	8	PVC	1994	1,969	55,124	5,408	44,528
FOXRIDGE CENTER	6	DI	1998	555	11,657	5,920	10,307
FOXRIDGE CENTER	6	UNK	1998	13	278	5,920	246
FOXRIDGE CENTER	8	DI	1985	96	2,701	4,195	1,693
FOXRIDGE CENTER	8	DI	1998	1,091	30,553	5,920	27,016
FOXWOOD SPRINGS	6	DI	1998	90	1,894	5,920	1,675
GORE ESTATES	4	PVC	1985	553	7,747	4,195	4,854
GORE ESTATES	6	UNK	1985	44	929	4,195	582
GORE ESTATES	6	UNK	1990	15	308	4,732	218
HAROLD ESTATES	6	DI	1998	2,139	44,927	5,920	39,727
HAROLD ESTATES	6	PVC	1993	1,175	24,670	5,210	19,198
HAROLD ESTATES	8	PVC	1993	1,351	37,821	5,210	29,432
HAROLD ESTATES	8	UNK	1993	5,615	157,228	5,210	122,354
HAROLD ESTATES	12	PVC	1998	2,517	105,702	5,920	93,467
HERITAGE HILLS	4	PVC	1990	20	280	4,732	198
HERITAGE HILLS	4	PVC	1993	2,221	31,098	5,210	24,200
HERITAGE HILLS	6	PVC	1990	1,230	25,824	4,732	18,253
HERITAGE HILLS	6	PVC	1993	6,656	139,778	5,210	108,774
HERITAGE HILLS	8	PVC	1990	429	12,013	4,732	8,491
HERITAGE PLAZA	8	PVC	1992	1,503	42,097	4,985	31,345
HIBNER ACRES	4	CIP	1992	1,453	20,339	4,985	15,144

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
HIBNER ACRES	6	CIP	1992	15	309	4,985	230
HIDDEN MEADOWS	6	DI	1985	1,514	31,798	4,195	19,924
HUBACH HILL	6	PVC	1990	30	635	4,732	449
HUBACH HILL	6	PVC	1994	2,497	52,445	5,408	42,363
HUBACH HILL	6	UNK	1990	44	926	4,732	655
HUBACH HILL	6	UNK	1994	29	618	5,408	499
HUBACH HILL	8	PVC	1990	1,276	35,732	4,732	25,255
HUBACH HILL	8	UNK	1990	1,410	39,471	4,732	27,898
HUNTERS GLEN	6	DI	1992	1,171	24,592	4,985	18,311
HUNTERS GLEN	6	PVC	1992	1,530	32,125	4,985	23,920
JOHNSTON INDUSTRIAL PARK	6	DI	1985	294	6,169	4,195	3,866
JOHNSTON INDUSTRIAL PARK	6	DI	2002	25	515	6,538	503
JOHNSTON INDUSTRIAL PARK	6	PVC	1985	2,162	45,410	4,195	28,453
JOHNSTON INDUSTRIAL PARK	6	PVC	1992	15	313	4,985	233
JOHNSTON INDUSTRIAL PARK	6	UNK	1985	2,719	57,093	4,195	35,774
JONES ADDITION	4	UNK	1992	434	6,072	4,985	4,521
JONES ADDITION	6	DI	2002	488	10,254	6,538	10,013
JONES ADDITION	6	UNK	1992	30	631	4,985	470
JONNSTON INDUSTRIAL PARK	8	PVC	1990	719	20,135	4,732	14,231
JWEDEA	6	UNK	1990	118	2,473	4,732	1,748
JWEDEA	6	UNK	1994	7,527	158,066	5,408	127,681
JWEDEA	8	UNK	1990	3,225	90,308	4,732	63,829
KEENLAND COMMERCIAL CENTER	4	CIP	1992	601	8,410	4,985	6,262
KEENLAND COMMERCIAL CENTER	6	CIP	1992	15	308	4,985	230
KEENLAND ESTATES	4	CIP	1992	313	4,382	4,985	3,262
KEENLAND ESTATES	4	PVC	1992	4,315	60,415	4,985	44,984
KEENLAND ESTATES	4	UNK	1992	2,909	40,732	4,985	30,328
KEENLAND ESTATES	6	PVC	1992	59	1,233	4,985	918
KEENLAND ESTATES	6	UNK	1992	59	1,235	4,985	919
KENTUCKY RD	6	PVC	1993	3,018	63,371	5,210	49,315
KENTUCKY RD	6	UNK	1993	44	925	5,210	720
KENTUCKY RD	8	UNK	1993	3,191	89,345	5,210	69,528
LAKESHORE MEADOWS	6	DI	1993	1,890	39,689	5,210	30,886
LAKESHORE MEADOWS	6	DI	1997	2,247	47,181	5,826	41,057
LAKESHORE MEADOWS	6	PVC	1993	1,606	33,723	5,210	26,243
LAKESHORE MEADOWS	6	UNK	1985	104	2,179	4,195	1,365
LAKESHORE MEADOWS	6	UNK	1992	10	218	4,985	162
LAKESHORE MEADOWS	6	UNK	1993	760	15,956	5,210	12,417
LAKESHORE PLACE	4	UNK	1992	376	5,266	4,985	3,921

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
LAKESHORE PLACE	6	DI	1992	756	15,877	4,985	11,822
LAKESHORE PLACE	6	DI	1993	1,029	21,606	5,210	16,814
LAKESHORE PLACE	6	DI	1996	575	12,085	5,620	10,144
LAKESHORE PLACE	6	DI	1998	2,229	46,809	5,920	41,390
LAKESHORE PLACE	6	UNK	1992	2,498	52,456	4,985	39,058
LAKESHORE PLACE	8	DI	1998	1,038	29,052	5,920	25,689
LAKESHORE PLACE	8	DI	2002	196	5,488	6,538	5,360
LAKESHORE PLAZA	8	DI	2002	2,413	67,559	6,538	65,975
LAKESHORE PLAZA	8	OTHER	2003	60	1,687	6,695	1,687
LAKEVIEW	4	CIP	1985	716	10,030	4,195	6,284
LAKEVIEW	4	PVC	1992	14	195	4,985	145
LAKEVIEW	6	CIP	1992	15	306	4,985	228
LAKEVIEW	6	DI	2002	112	2,358	6,538	2,303
LAKEVIEW	6	PVC	1990	1,160	24,356	4,732	17,215
LAKEVIEW	6	PVC	1992	4,106	86,229	4,985	64,205
LAKEVIEW	6	UNK	1985	15	310	4,195	194
LAKEVIEW	6	UNK	1990	1,038	21,801	4,732	15,409
LAKEVIEW	6	UNK	1992	5,195	109,086	4,985	81,224
LAKEVIEW	8	DI	2002	31	871	6,538	850
LUCY WEBB TRUNK	6	DI	2002	57	1,197	6,538	1,169
LUCY WEBB TRUNK	6	UNK	1990	15	308	4,732	218
LUCY WEBB TRUNK	8	DI	2002	34	961	6,538	939
LUCY WEBB TRUNK	12	DI	1990	3,938	165,409	4,732	116,910
LUCY WEBB TRUNK	12	DI	2002	11,582	486,456	6,538	475,048
LUCY WEBB TRUNK	12	PVC	1990	56	2,331	4,732	1,648
MADISON CREEK	6	DI	2000	3,027	63,565	6,221	59,064
MADISON CREEK	6	DI	2002	2,132	44,766	6,538	43,716
MADISON CREEK	8	DI	2000	610	17,068	6,221	15,859
MADISON CREEK	8	DI	2002	362	10,142	6,538	9,905
MADISON CREEK	12	DI	2000	10	426	6,221	396
MADISON TRUNK	4	PVC	1990	1,102	15,426	4,732	10,903
MADISON TRUNK	4	UNK	1990	2,580	36,121	4,732	25,530
MADISON TRUNK	6	DI	2002	21	449	6,538	438
MADISON TRUNK	6	UNK	1985	4,560	95,758	4,195	60,001
MADISON TRUNK	6	UNK	1990	723	15,187	4,732	10,734
MADISON TRUNK	8	DI	2002	5	130	6,538	127
MADISON TRUNK	12	DI	1990	2,161	90,769	4,732	64,155
MADISON TRUNK	12	DI	1998	1,567	65,807	5,920	58,190
MADISON TRUNK	12	DI	2000	1,358	57,019	6,221	52,982

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
MADISON TRUNK	12	DI	2002	4,259	178,861	6,538	174,667
MAPLEWOOD	4	CIP	1985	7,129	99,804	4,195	62,536
MAPLEWOOD	4	PVC	1985	1,004	14,060	4,195	8,810
MAPLEWOOD	6	CIP	1985	59	1,233	4,195	772
MAPLEWOOD	6	DI	2002	394	8,277	6,538	8,083
MAPLEWOOD	6	PVC	1985	29	617	4,195	387
MAPLEWOOD	6	UNK	1985	15	314	4,195	197
MAPLEWOOD	8	DI	2002	51	1,421	6,538	1,387
MAPLEWOOD	8	PVC	1985	1,527	42,769	4,195	26,799
MATLOCK JOHNSON SUBDIVISION	6	PVC	2000	324	6,807	6,221	6,325
MATLOCK JOHNSON SUBDIVISION	6	UNK	2000	2,526	53,038	6,221	49,283
MATLOCK JOHNSON SUBDIVISION	8	PVC	2000	2,418	67,717	6,221	62,923
MATLOCK JOHNSON SUBDIVISION	12	UNK	2000	503	21,115	6,221	19,620
MESSICKS ADDITION	4	CIP	1985	456	6,382	4,195	3,999
MOON VALLEY	6	DI	1998	1,608	33,778	5,920	29,868
MOON VALLEY	8	DI	1992	143	4,014	4,985	2,988
MOON VALLEY	8	DI	1998	1,933	54,118	5,920	47,854
MORNINGVIEW	4	UNK	1985	577	8,078	4,195	5,062
MORNINGVIEW	6	DI	1985	1,353	28,409	4,195	17,800
MORNINGVIEW	6	UNK	1985	3,334	70,018	4,195	43,872
MORNINGVIEW	6	UNK	1990	28	588	4,732	416
ORIGINAL RAYMORE	4	CIP	1985	576	8,058	4,195	5,049
ORIGINAL RAYMORE	4	PVC	1992	770	10,781	4,985	8,028
ORIGINAL RAYMORE	6	CIP	1985	15	308	4,195	193
ORIGINAL RAYMORE	6	DI	1985	54	1,140	4,195	714
ORIGINAL RAYMORE	6	DI	2002	379	7,960	6,538	7,774
ORIGINAL RAYMORE	6	PVC	1985	6,750	141,752	4,195	88,820
ORIGINAL RAYMORE	6	PVC	1992	658	13,815	4,985	10,286
ORIGINAL RAYMORE	8	DI	2002	71	1,981	6,538	1,935
ORIGINAL RAYMORE	8	PVC	1985	4,568	127,911	4,195	80,147
ORIGINAL RAYMORE	8	PVC	1992	625	17,507	4,985	13,036
ORIGINAL RAYMORE	8	UNK	1985	1,271	35,597	4,195	22,305
ORIGINAL RAYMORE	8	UNK	1992	70	1,950	4,985	1,452
PARK ESTATES	4	CIP	1985	261	3,649	4,195	2,286
PARK ESTATES	6	UNK	1992	548	11,507	4,985	8,568
PARK PLACE	6	DI	1992	1,835	38,528	4,985	28,688
PARK PLACE	8	DI	1992	1,373	38,447	4,985	28,627
PEACEFUL MEADOWS	4	PVC	1997	759	10,625	5,826	9,246
PEACEFUL MEADOWS	6	DI	2002	59	1,244	6,538	1,215

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
PEACEFUL MEADOWS	6	PVC	1990	1,039	21,818	4,732	15,421
PEACEFUL MEADOWS	6	UNK	1990	41	856	4,732	605
PRAIRIE LANE	6	UNK	1990	29	617	4,732	436
PRAIRIE LANE	8	UNK	1990	4,995	139,852	4,732	98,847
RAYMORE COMMERCIAL CENTER	6	PVC	1992	698	14,662	4,985	10,917
RAYMORE DEVELOPMENT PARK	4	UNK	1992	114	1,599	4,985	1,191
RAYMORE DEVELOPMENT PARK	6	PVC	1990	1,852	38,884	4,732	27,483
RAYMORE DEVELOPMENT PARK	6	UNK	1992	29	615	4,985	458
RAYMORE DEVELOPMENT PARK	8	PVC	1990	1,307	36,591	4,732	25,862
RAYMORE DEVELOPMENT PARK	12	PVC	1992	863	36,249	4,985	26,990
RECREATION PARK	6	UNK	1985	1,809	37,983	4,195	23,800
REMINGTON	6	DI	1997	6,354	133,427	5,826	116,108
REMINGTON	8	DI	1997	4,067	113,871	5,826	99,091
REMINGTON	12	DI	1985	100	4,180	4,195	2,619
REMINGTON VILLAGE	6	DI	1997	146	3,068	5,826	2,670
REMINGTON VILLAGE	6	DI	1998	2,028	42,588	5,920	37,658
REMINGTON VILLAGE	6	UNK	1998	15	308	5,920	273
REMINGTON VILLAGE	8	DI	1997	531	14,876	5,826	12,945
REMINGTON VILLAGE	8	DI	1998	1,720	48,163	5,920	42,588
REMINGTON VILLAGE	12	PVC	1998	229	9,634	5,920	8,519
REMINGTON VILLAGE	12	UNK	1998	1,120	47,044	5,920	41,598
ROLLING GLENNS ESTATES	4	UNK	1990	687	9,613	4,732	6,794
ROLLING GLENNS ESTATES	6	UNK	1990	28	587	4,732	415
ROLLING HILLS	4	PVC	1992	2,775	38,844	4,985	28,923
ROLLING HILLS	6	PVC	1990	1,124	23,610	4,732	16,687
ROLLING HILLS	6	PVC	1992	1,340	28,150	4,985	20,960
ROLLING HILLS	6	UNK	1992	356	7,485	4,985	5,573
SCHMIDT HIGHLANDS	12	PVC	1998	1,531	64,307	5,920	56,863
SCHMIDT HIGHLANDS	12	UNK	1998	115	4,850	5,920	4,289
SCHMIDT HIGHLANDS WEST	6	PVC	1993	1,914	40,188	5,210	31,274
SHADOWOOD	6	DI	2002	23	487	6,538	476
SHADOWOOD	6	DI	2003	18	378	6,695	378
SHADOWOOD	8	DI	2002	1,635	45,775	6,538	44,702
SHADOWOOD	12	DI	2002	2,370	99,530	6,538	97,196
SHADOWOOD	12	DI	2003	788	33,076	6,695	33,076
SHILOH HILLS	6	DI	1998	1,464	30,736	5,920	27,178
SHILOH HILLS	12	DI	1998	25	1,057	5,920	935
SILVER LAKE	4	PVC	1982	2,277	31,874	3,825	18,210
SILVER LAKE	4	UNK	1985	23	318	4,195	199

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
SILVER LAKE	6	DI	1997	291	6,107	5,826	5,314
SILVER LAKE	6	PVC	1982	112	2,362	3,825	1,350
SILVER LAKE	6	PVC	1985	4,830	101,428	4,195	63,553
SILVER LAKE	6	UNK	1982	7,163	150,418	3,825	85,937
SILVER LAKE	6	UNK	1985	4,696	98,611	4,195	61,788
SILVER LAKE	8	DI	2002	440	12,306	6,538	12,018
SILVER LAKE	8	PVC	1982	734	20,558	3,825	11,745
SILVER LAKE	8	PVC	1985	2,035	56,976	4,195	35,701
SKY VUE ESTATES	6	DI	2002	48	1,008	6,538	985
SKY VUE ESTATES	6	PVC	1985	7,418	155,776	4,195	97,607
SKY VUE ESTATES	6	PVC	1990	15	309	4,732	218
SKY VUE ESTATES	6	PVC	1994	3,816	80,126	5,408	64,723
SKY VUE ESTATES	6	UNK	1985	2,580	54,178	4,195	33,947
SKY VUE ESTATES	6	UNK	1990	59	1,234	4,732	872
SKY VUE ESTATES	6	UNK	1994	1,913	40,169	5,408	32,447
SKY VUE ESTATES	8	DI	1994	13	375	5,408	303
SKY VUE ESTATES	8	DI	1998	526	14,738	5,920	13,032
SKY VUE ESTATES	8	DI	2002	59	1,642	6,538	1,604
SKY VUE ESTATES	8	OTHER	1998	1,188	33,253	5,920	29,403
SKY VUE ESTATES	8	PVC	1990	4,099	114,781	4,732	81,127
SKY VUE ESTATES	8	PVC	1994	1,069	29,922	5,408	24,170
SOUTHWIND ESTATES	6	UNK	1985	2,363	49,622	4,195	31,092
SOUTHWIND ESTATES	6	UNK	1990	49	1,036	4,732	732
SOUTHWIND ESTATES	8	UNK	1990	1,125	31,492	4,732	22,258
SOUTHWIND ESTATES	8	UNK	1992	5	141	4,985	105
STONEGATE OF THE GOOD RANCH	4	DI	1994	505	7,072	5,408	5,712
STONEGATE OF THE GOOD RANCH	4	DI	1996	577	8,079	5,620	6,782
STONEGATE OF THE GOOD RANCH	4	DI	1997	368	5,147	5,826	4,479
STONEGATE OF THE GOOD RANCH	6	DI	1994	1,862	39,108	5,408	31,590
STONEGATE OF THE GOOD RANCH	6	DI	1996	1,770	37,176	5,620	31,207
STONEGATE OF THE GOOD RANCH	6	DI	1997	3,524	73,999	5,826	64,394
STONEGATE OF THE GOOD RANCH	6	DI	2002	1,480	31,080	6,538	30,351
STONEGATE OF THE GOOD RANCH	8	DI	1995	1,836	51,419	5,471	42,018
STONEGATE OF THE GOOD RANCH	8	DI	1997	2,017	56,471	5,826	49,141
STONEGATE OF THE GOOD RANCH	8	DI	2001	239	6,681	6,343	6,329
STONEGATE OF THE GOOD RANCH	8	DI	2002	1,613	45,154	6,538	44,095
THE MEADOWS OF THE GOOD RANCH	6	DI	1997	385	8,078	5,826	7,030
THE MEADOWS OF THE GOOD RANCH	6	DI	1999	178	3,747	6,059	3,391
THE MEADOWS OF THE GOOD RANCH	6	DI	2002	428	8,978	6,538	8,768

Table A4

GASB34 WATER SYSTEM SUMMARY
RAYMORE, MISSOURI

Subdivision	Diameter (in)	Material	Year Installed	Linear Feet	Present Worth ($)	ENR	Adj. Value ($)
THE MEADOWS OF THE GOOD RANCH	8	DI	1997	690	19,316	5,826	16,809
THE MEADOWS OF THE GOOD RANCH	8	DI	1999	746	20,890	6,059	18,906
THE MEADOWS OF THE GOOD RANCH	8	DI	2002	340	9,512	6,538	9,289
TIMBER TRAILS	6	UNK	2000	15	308	6,221	286
TIMBER TRAILS	8	PVC	2000	3,350	93,797	6,221	87,156
TOWN CENTER	4	PVC	1992	351	4,919	4,985	3,663
TOWN CENTER	6	DI	2003	15	320	6,695	320
TOWN CENTER	6	PVC	1990	2,223	46,680	4,732	32,993
TOWN CENTER	6	PVC	1992	3,604	75,678	4,985	56,349
TOWN CENTER	8	OTHER	2003	2,724	76,286	6,695	76,286
WALNUT HEIGHTS COMMERCIAL PARK	4	CIP	1992	149	2,083	4,985	1,551
WALNUT HEIGHTS COMMERCIAL PARK	4	PVC	1992	412	5,766	4,985	4,293
WALNUT HEIGHTS COMMERCIAL PARK	6	DI	1992	55	1,146	4,985	854
WALNUT HEIGHTS COMMERCIAL PARK	6	PVC	1992	15	308	4,985	230
WEDGEWOOD PLACE	6	UNK	1985	1,395	29,300	4,195	18,359
WILLOW HILLS	4	PVC	1985	4,134	57,877	4,195	36,265
WILLOW HILLS	6	PVC	1985	1,912	40,160	4,195	25,164
WILLOW HILLS	6	UNK	1985	1,040	21,848	4,195	13,689
WILLOWIND SQUARE	6	PVC	1998	497	10,437	5,920	9,229
WILLOWIND SQUARE	8	DI	2002	85	2,372	6,538	2,317
WILLOWIND SQUARE	12	PVC	1998	519	21,812	5,920	19,287
WILLOWIND SQUARE	12	UNK	1998	29	1,239	5,920	1,095
WOOD CREEK OF THE GOOD RANCH	4	DI	1996	823	11,516	5,620	9,667
WOOD CREEK OF THE GOOD RANCH	6	DI	1996	546	11,460	5,620	9,620
WOOD CREEK OF THE GOOD RANCH	6	DI	1997	801	16,824	5,826	14,640
WOOD CREEK OF THE GOOD RANCH	6	DI	1998	1,791	37,601	5,920	33,248
WOOD CREEK OF THE GOOD RANCH	6	DI	2001	1,325	27,823	6,343	26,360
WOOD CREEK OF THE GOOD RANCH	8	DI	1996	1,259	35,262	5,620	29,600
WOOD CREEK OF THE GOOD RANCH	8	DI	1997	1,870	52,362	5,826	45,565
WOOD CREEK OF THE GOOD RANCH	8	DI	2001	1,517	42,469	6,343	40,236
			Totals	**471,475**	**11,685,029**		**9,317,011**

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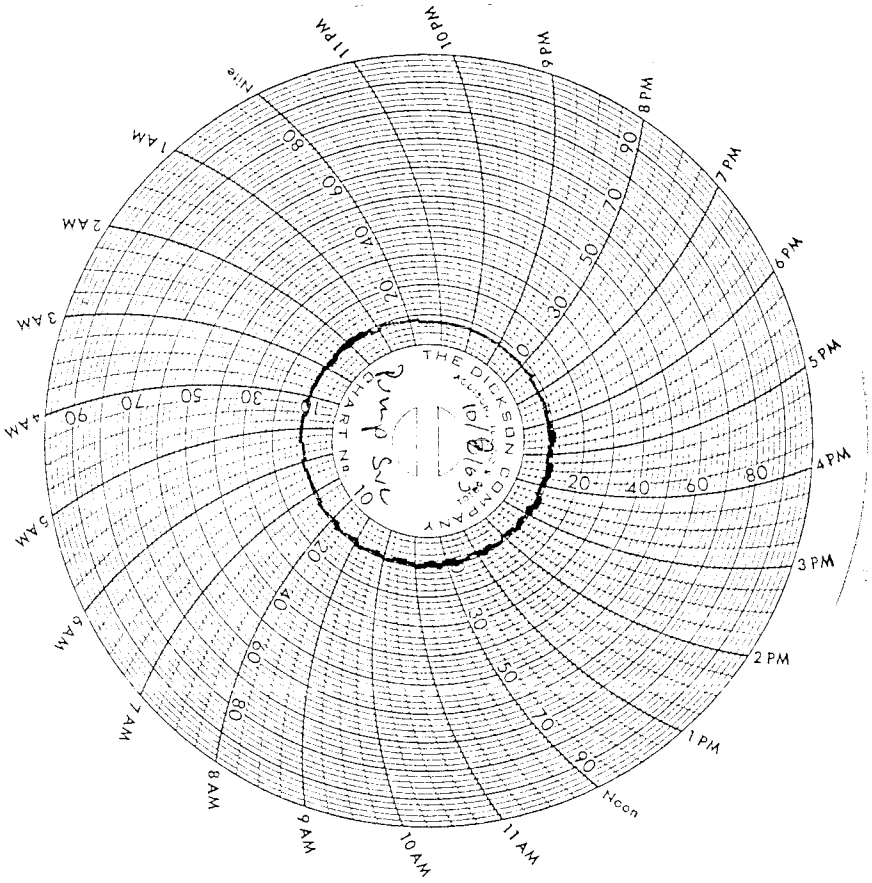
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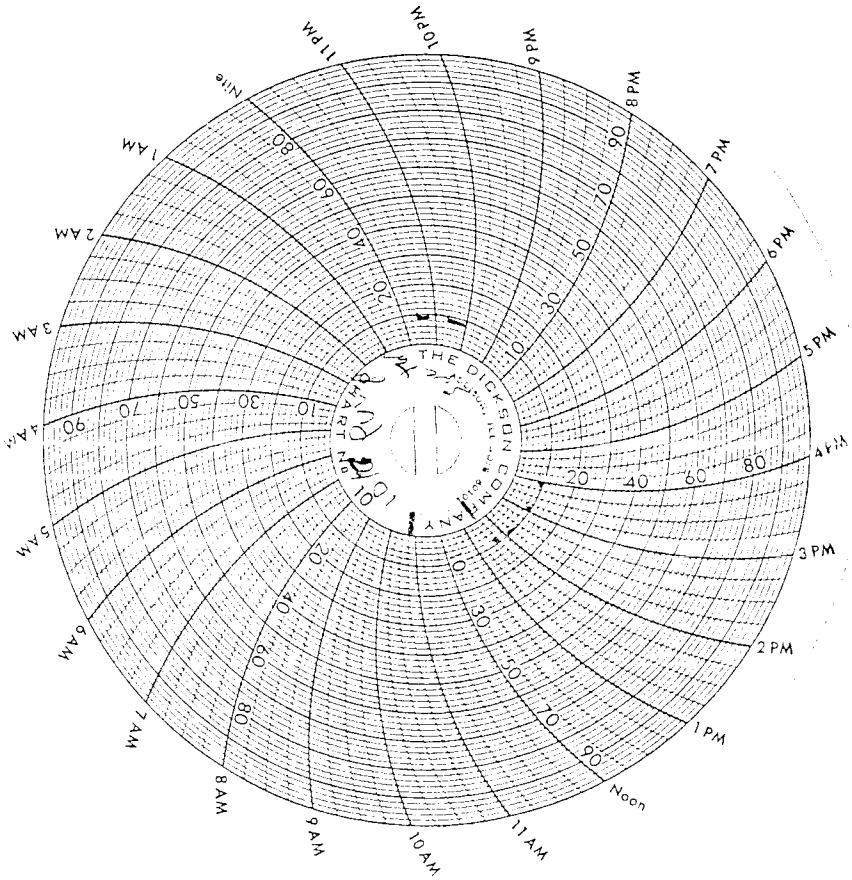
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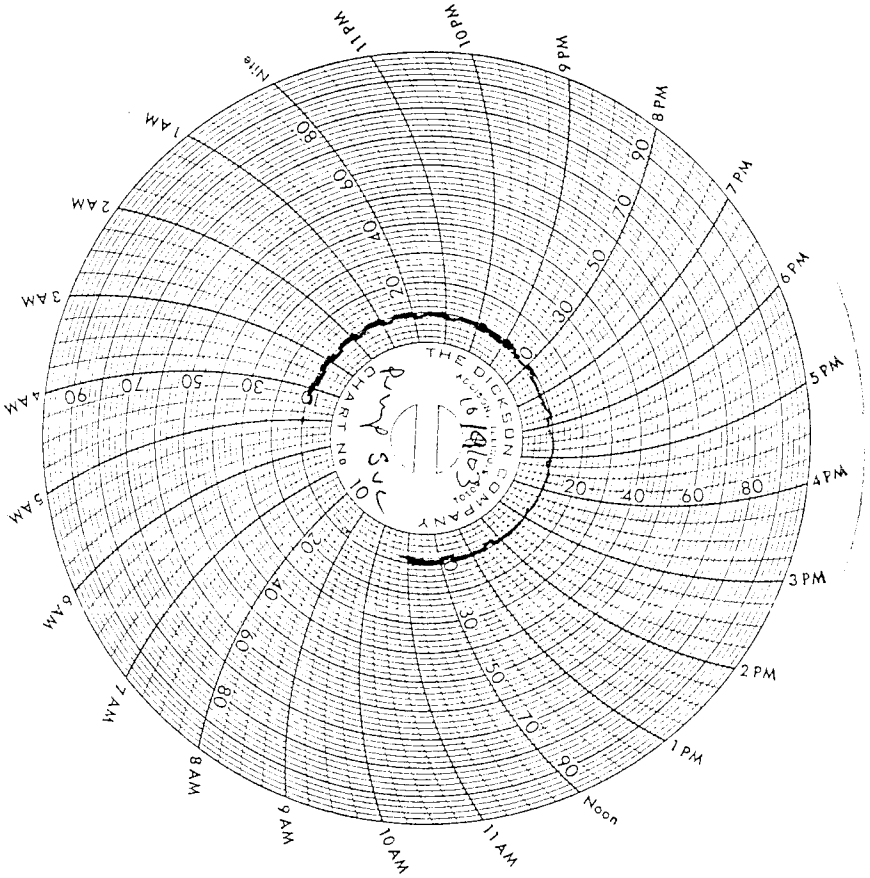
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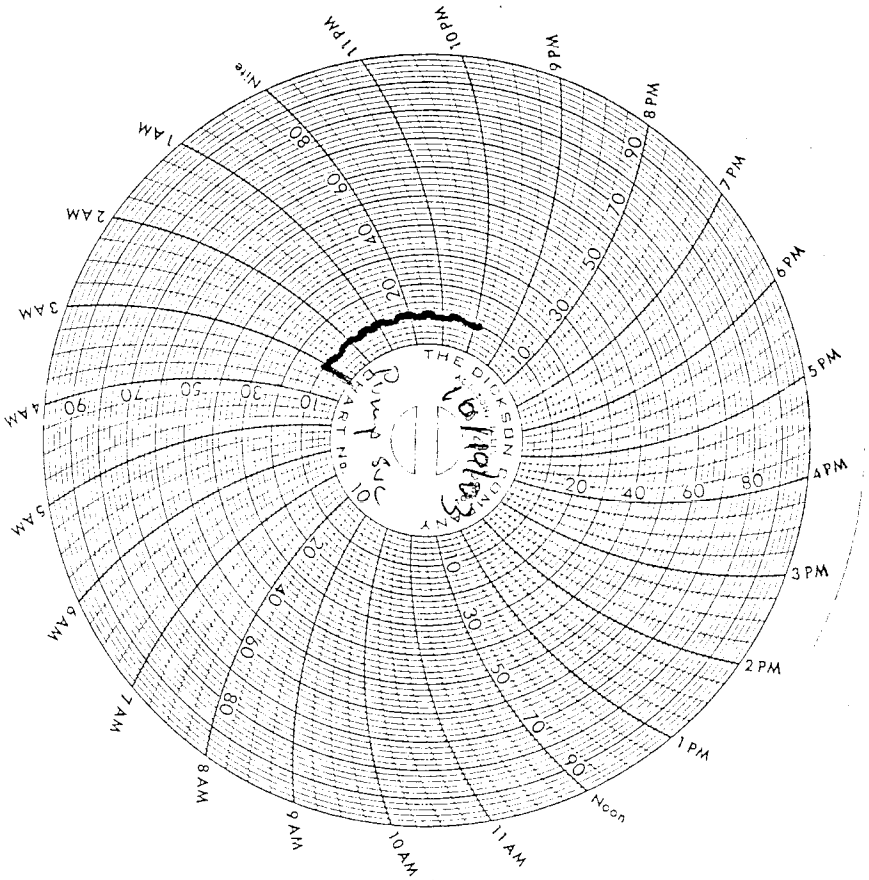
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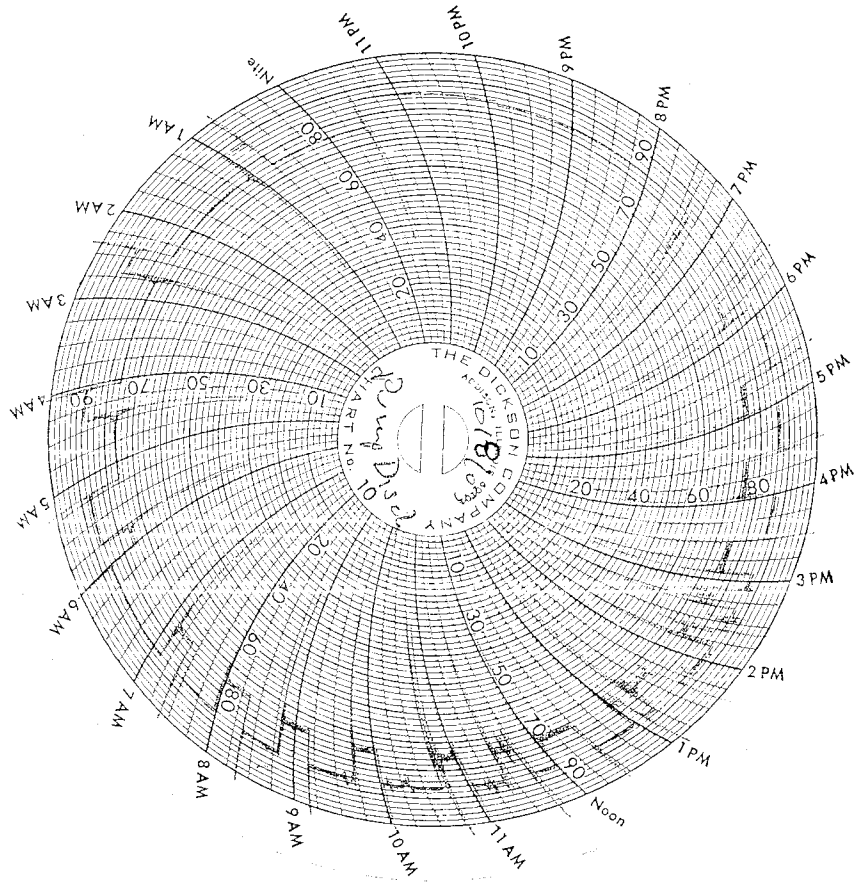
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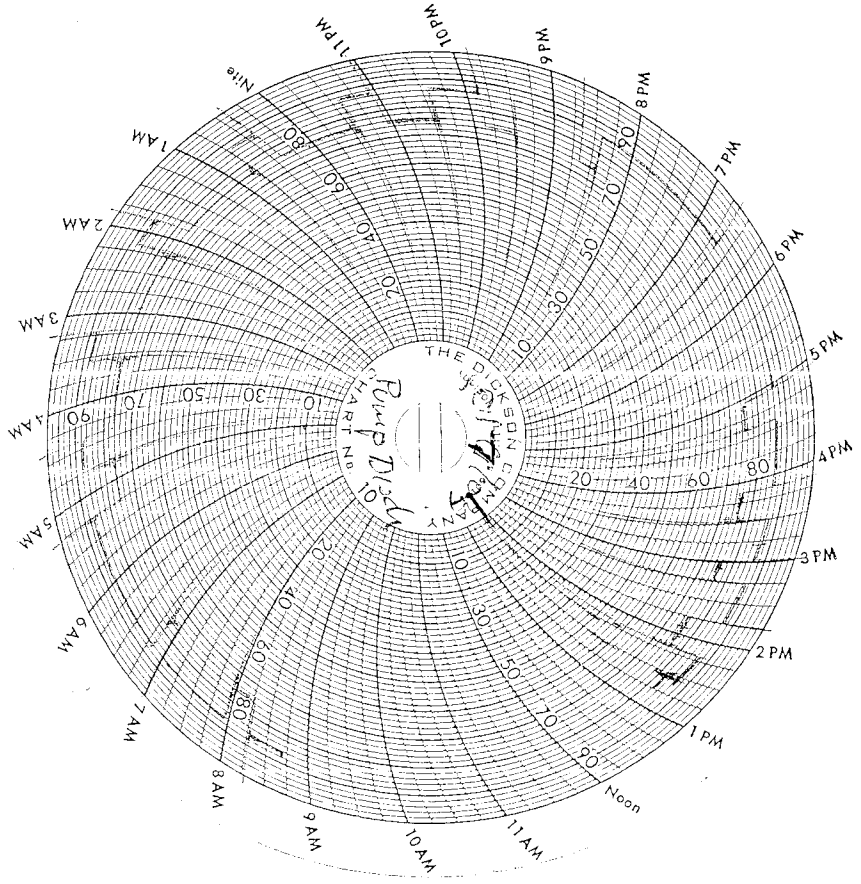
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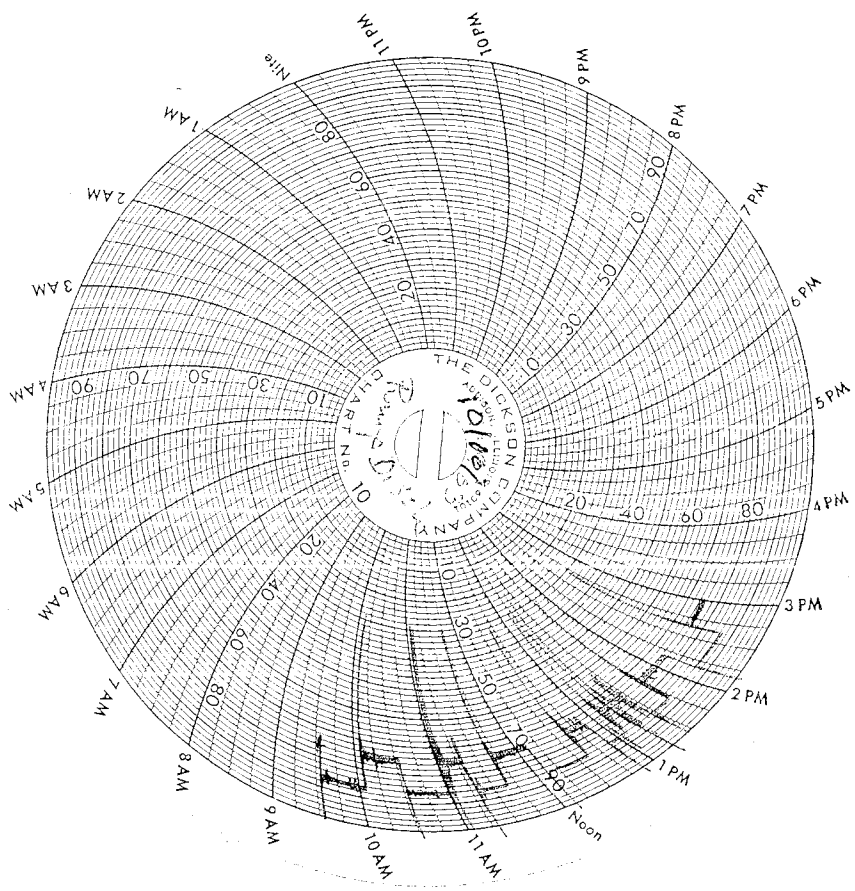
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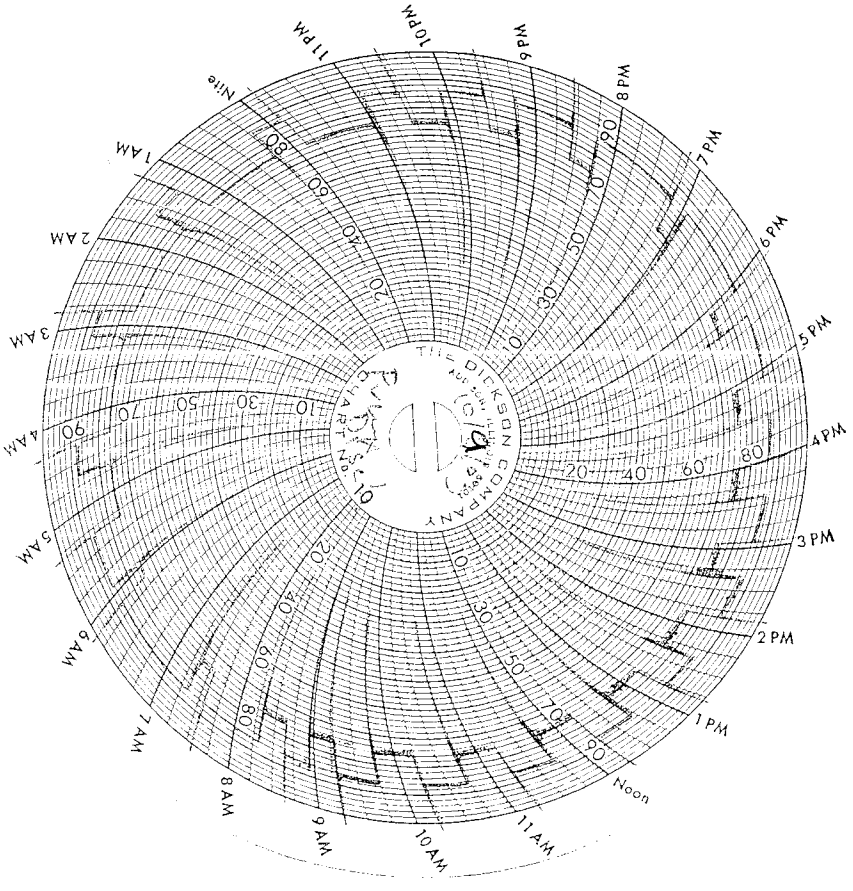
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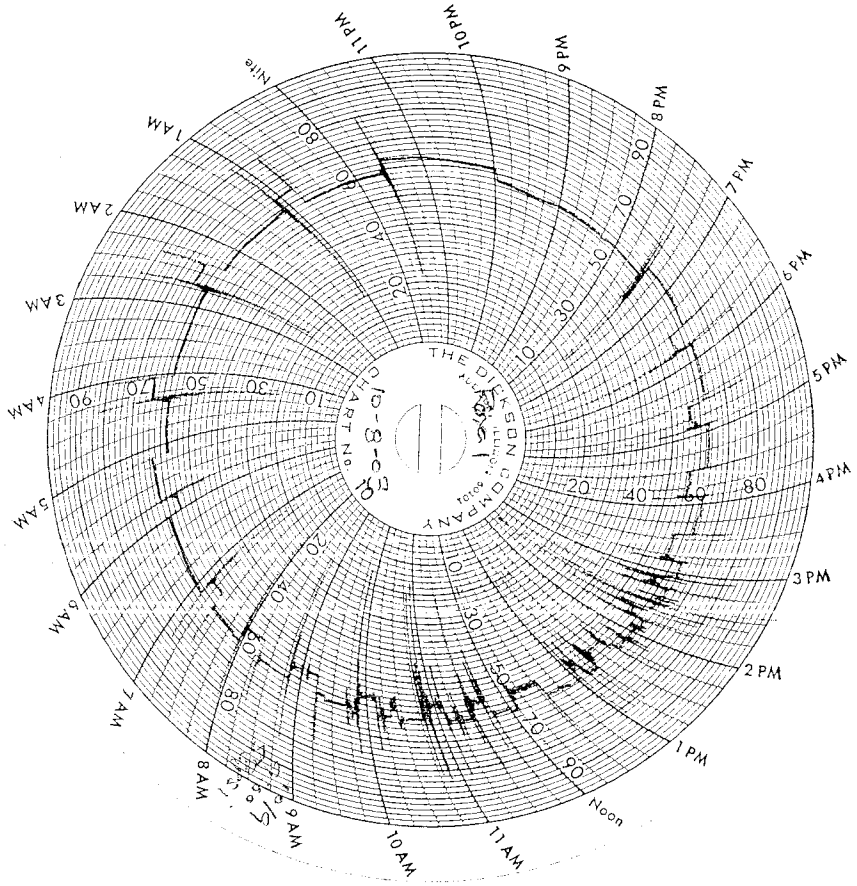
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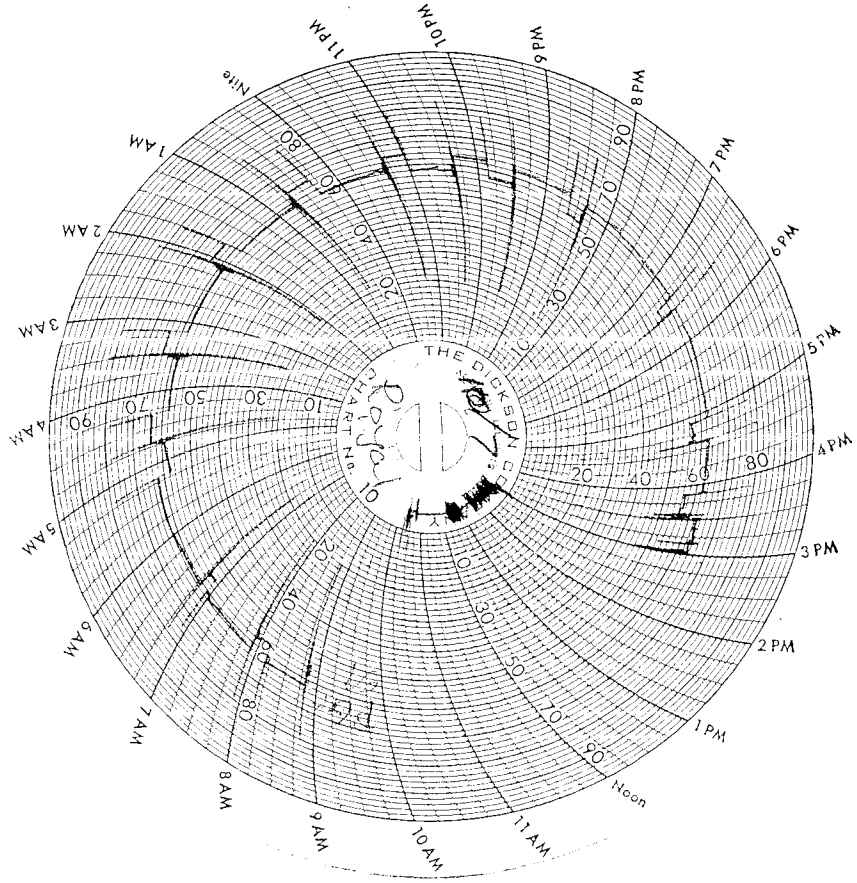
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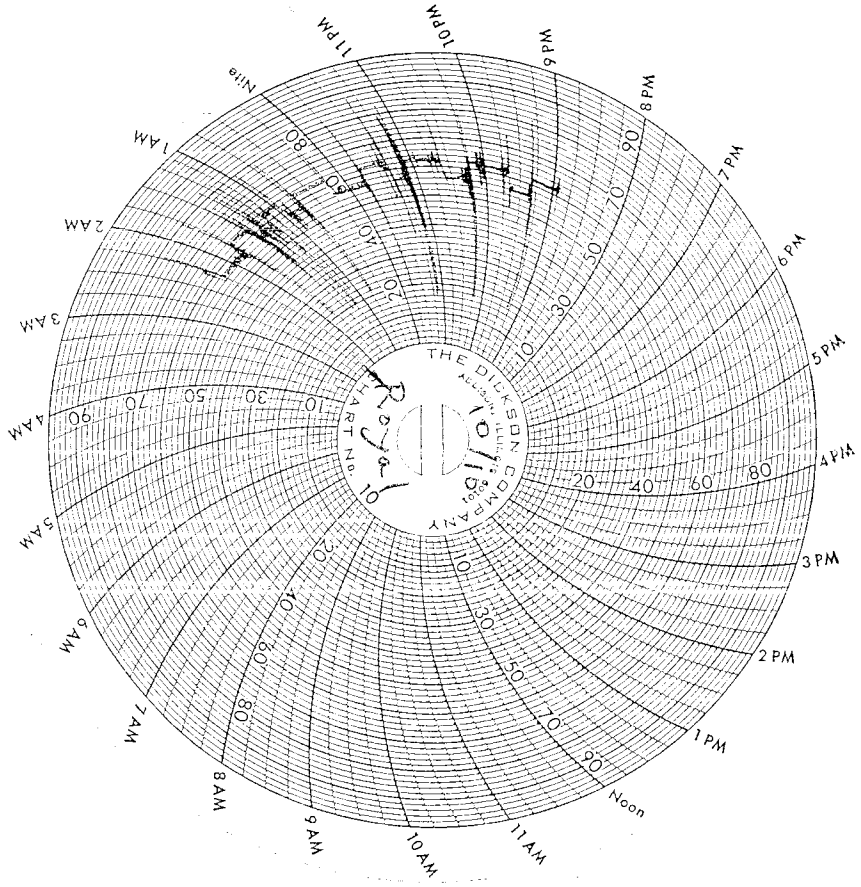
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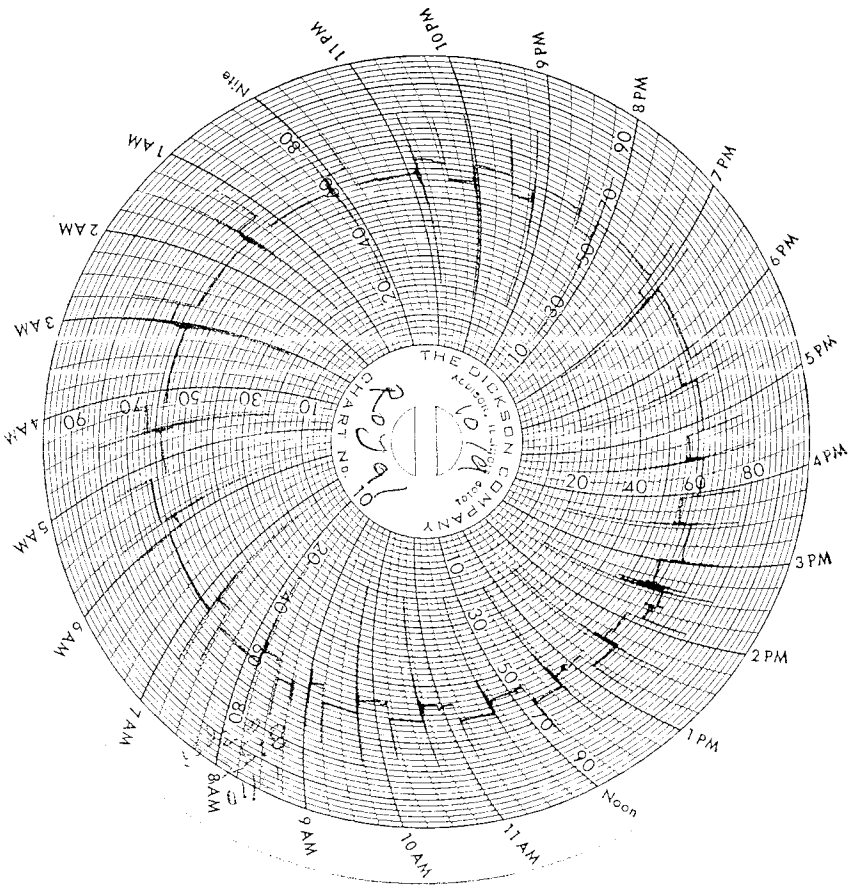
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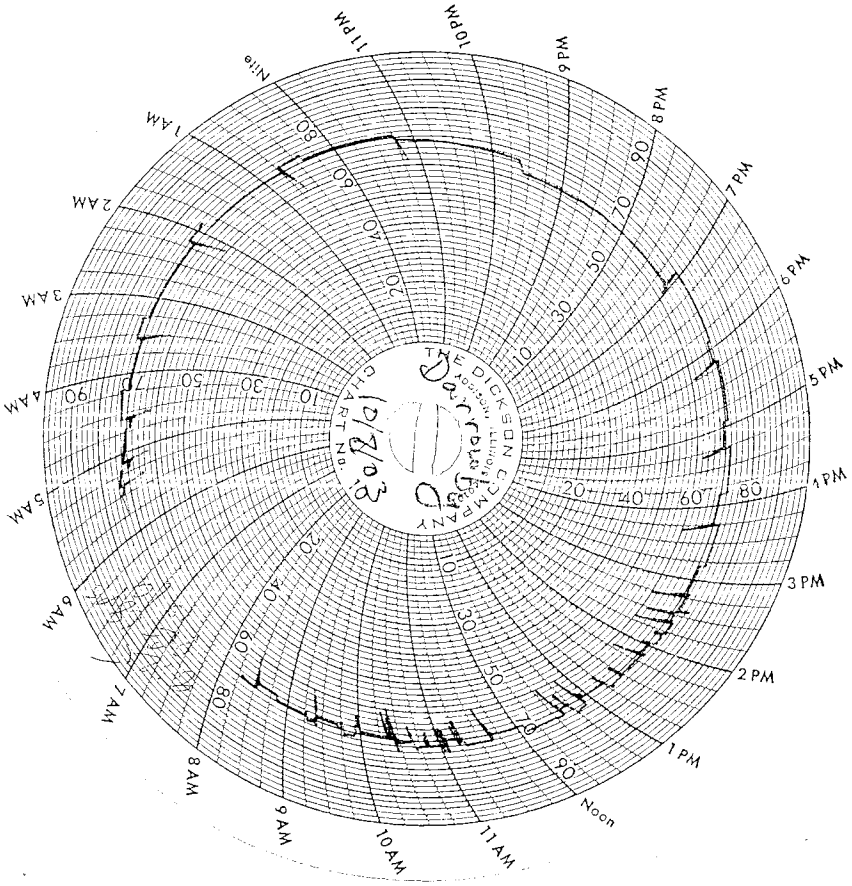
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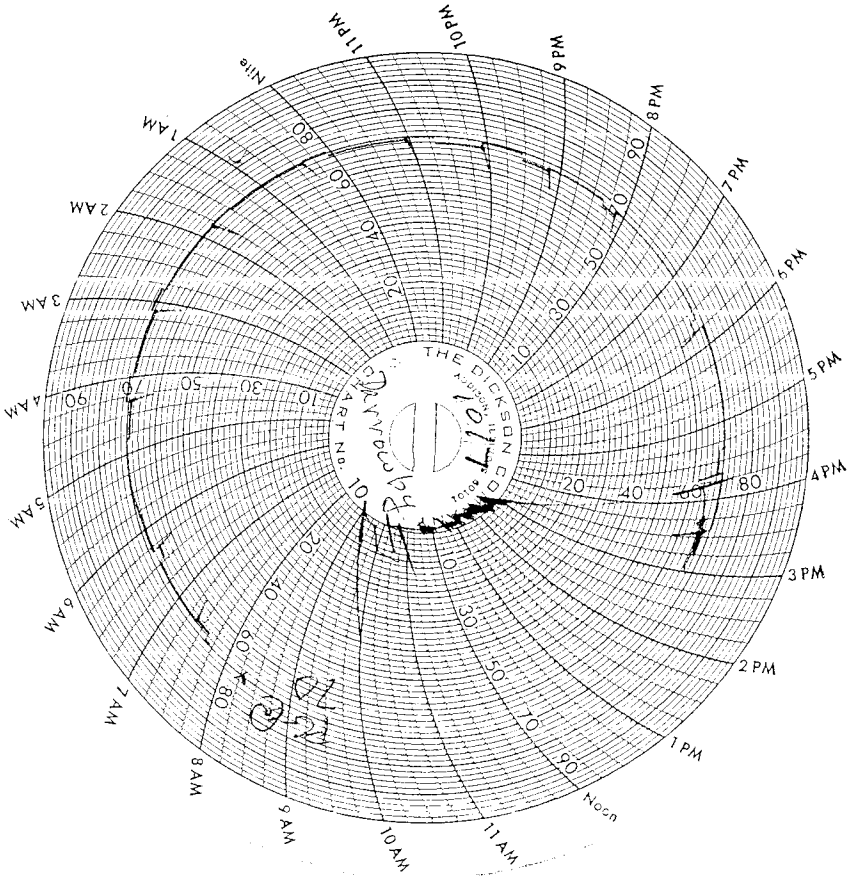
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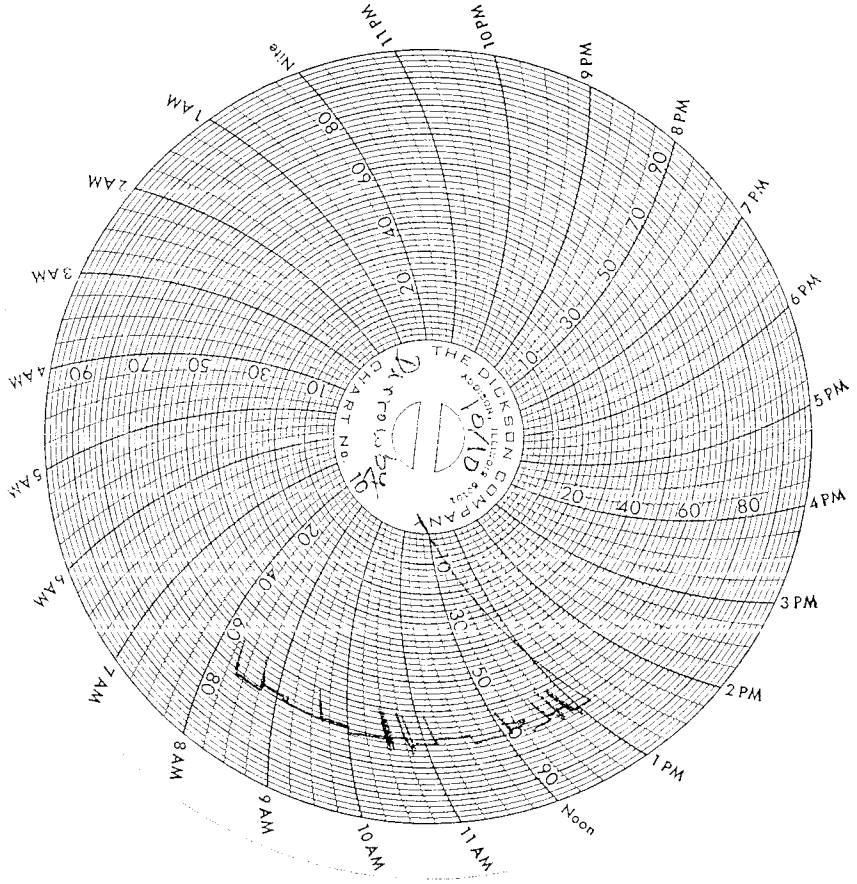
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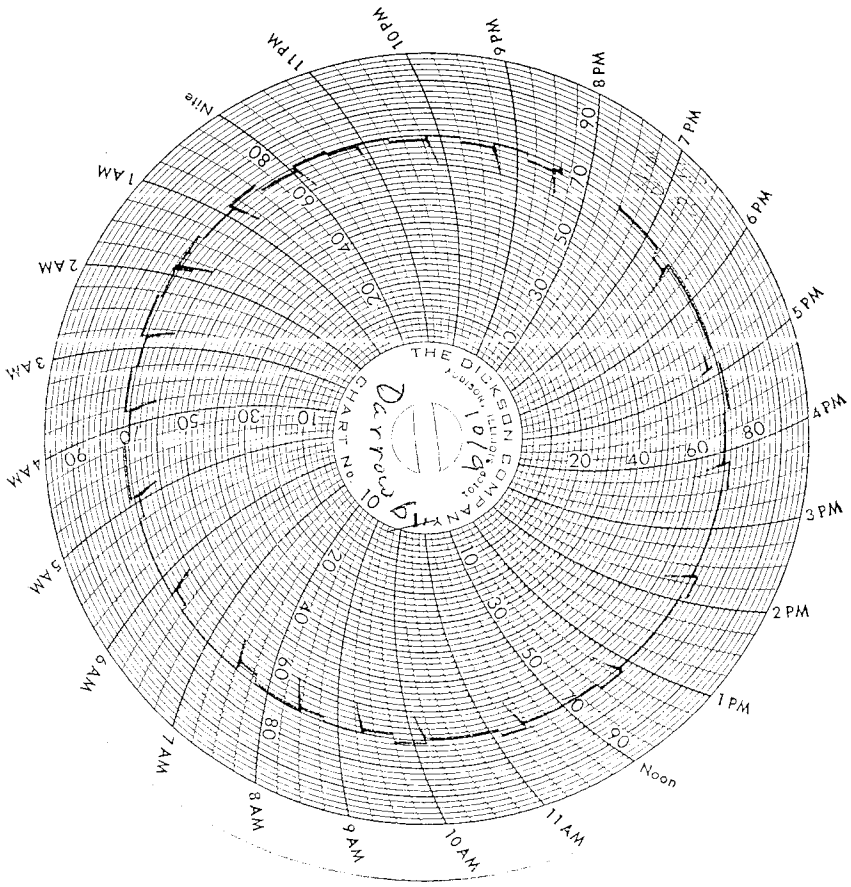
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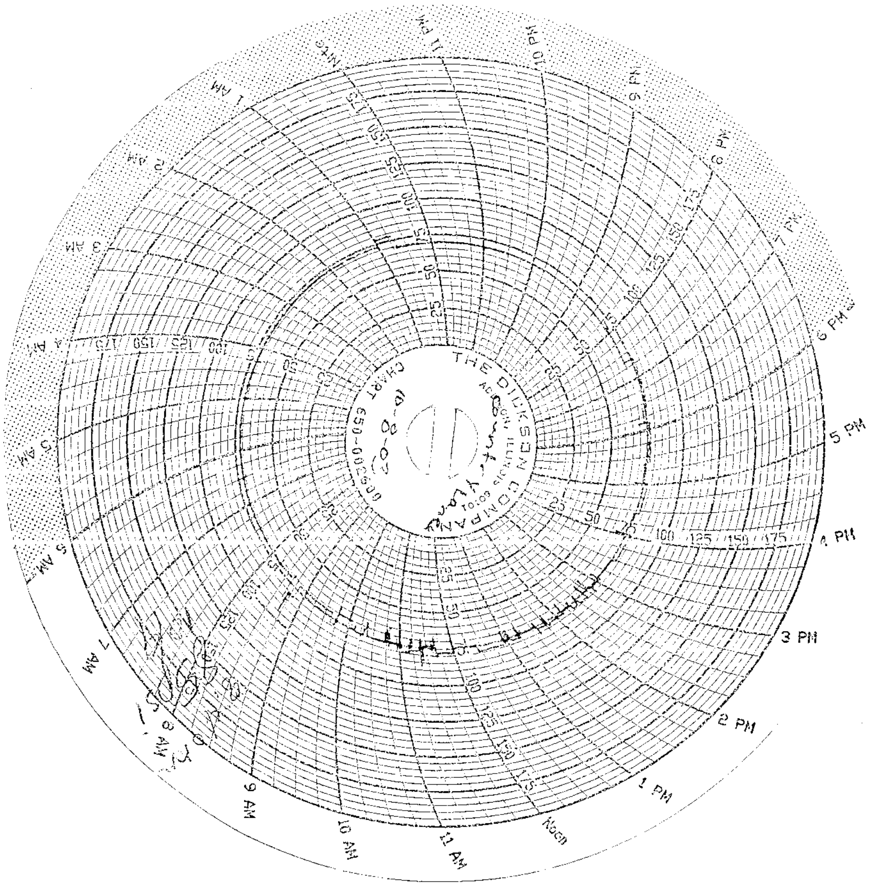

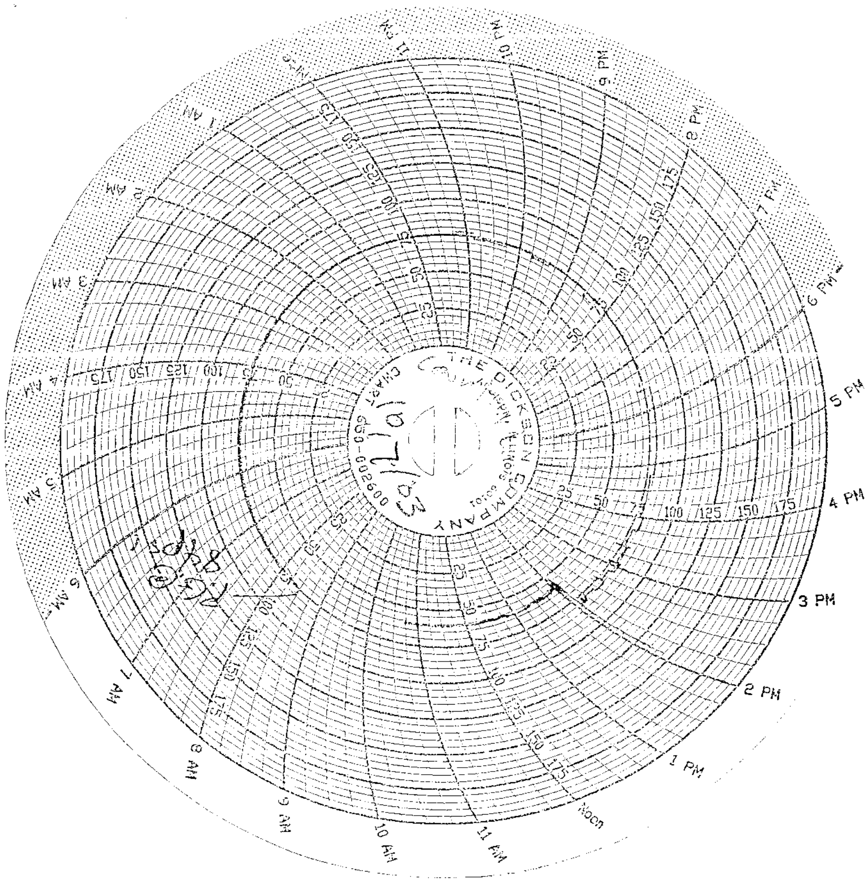

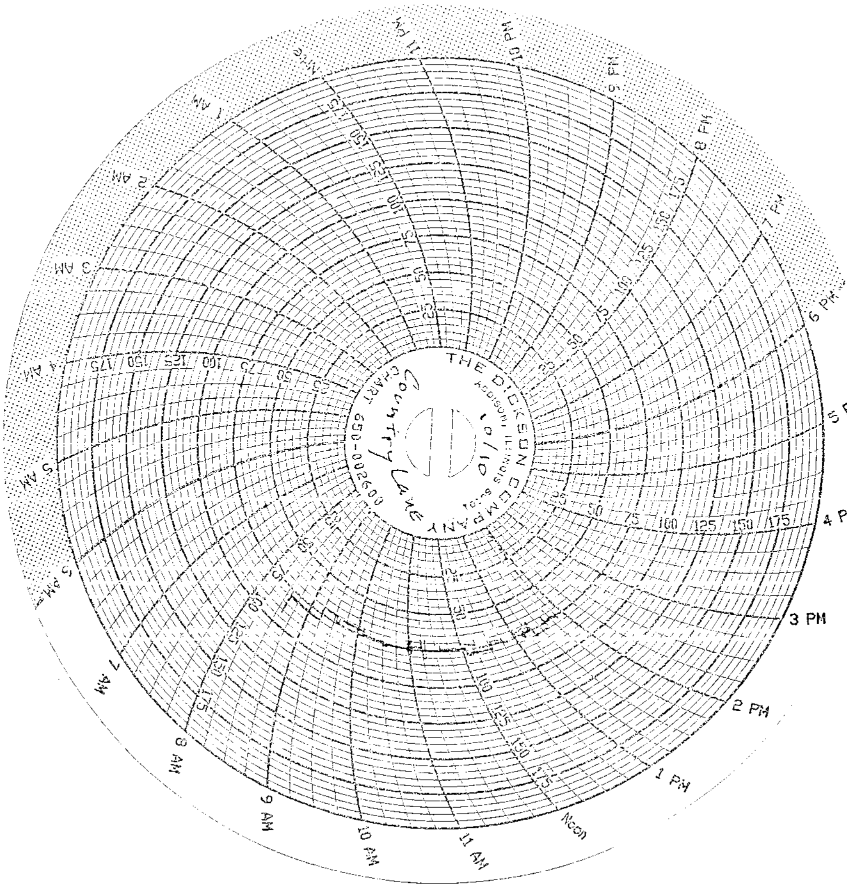
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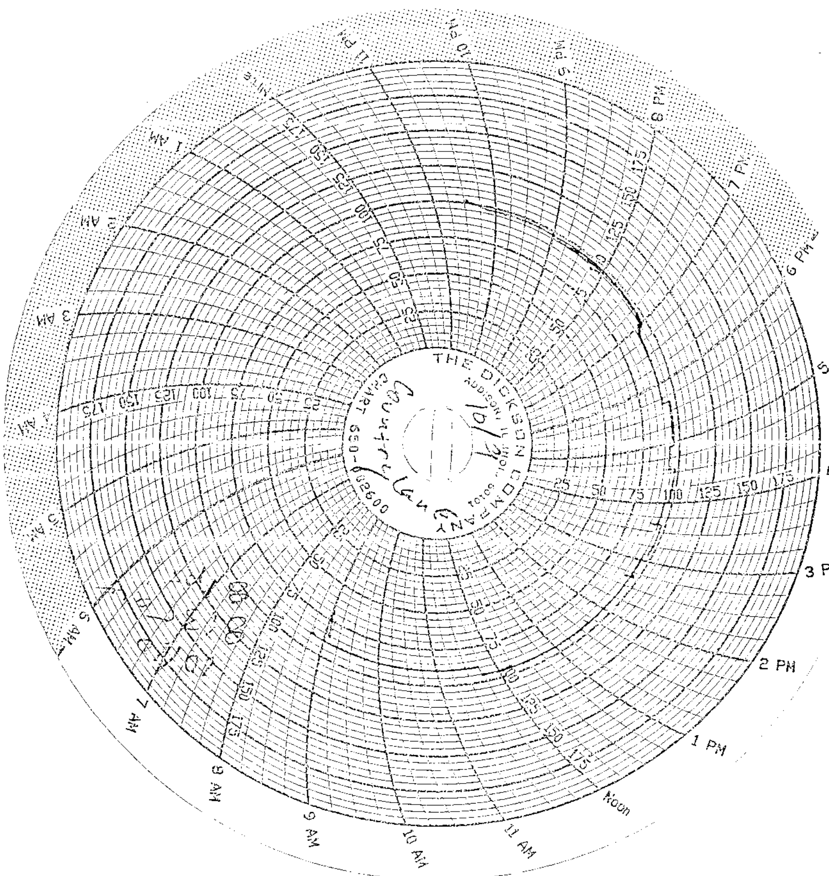
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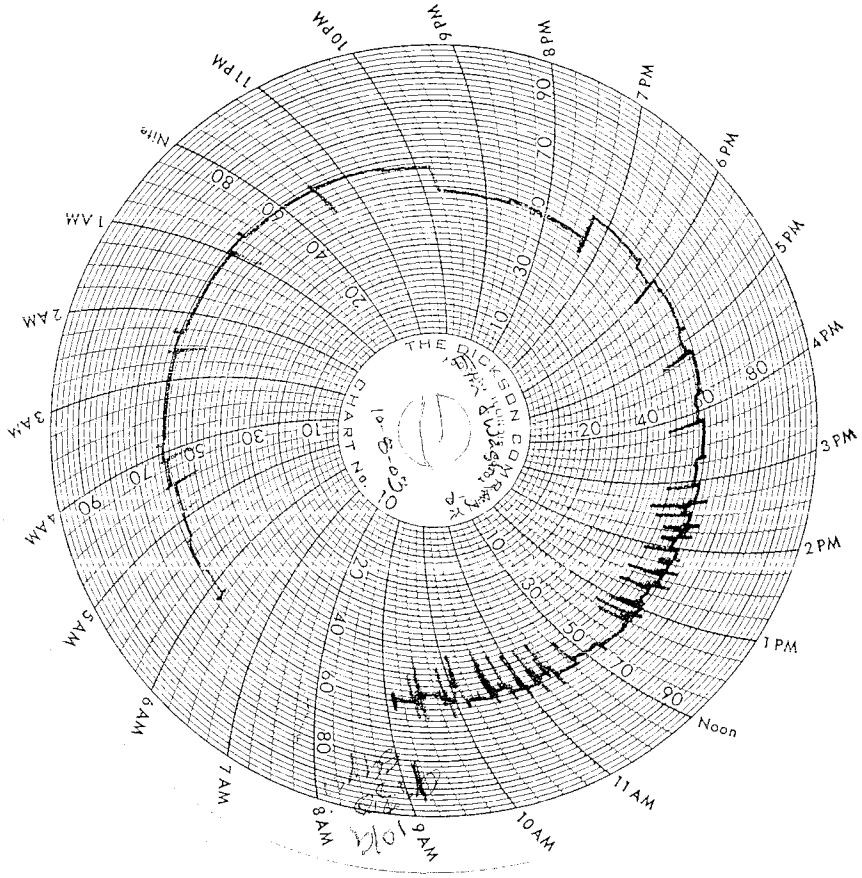
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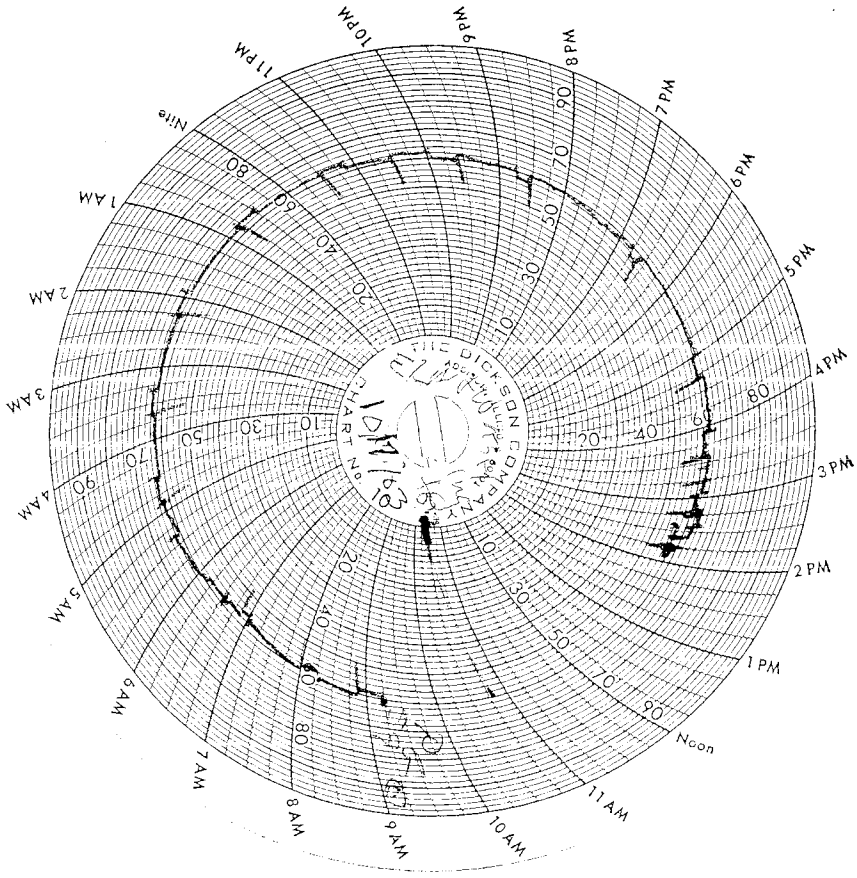
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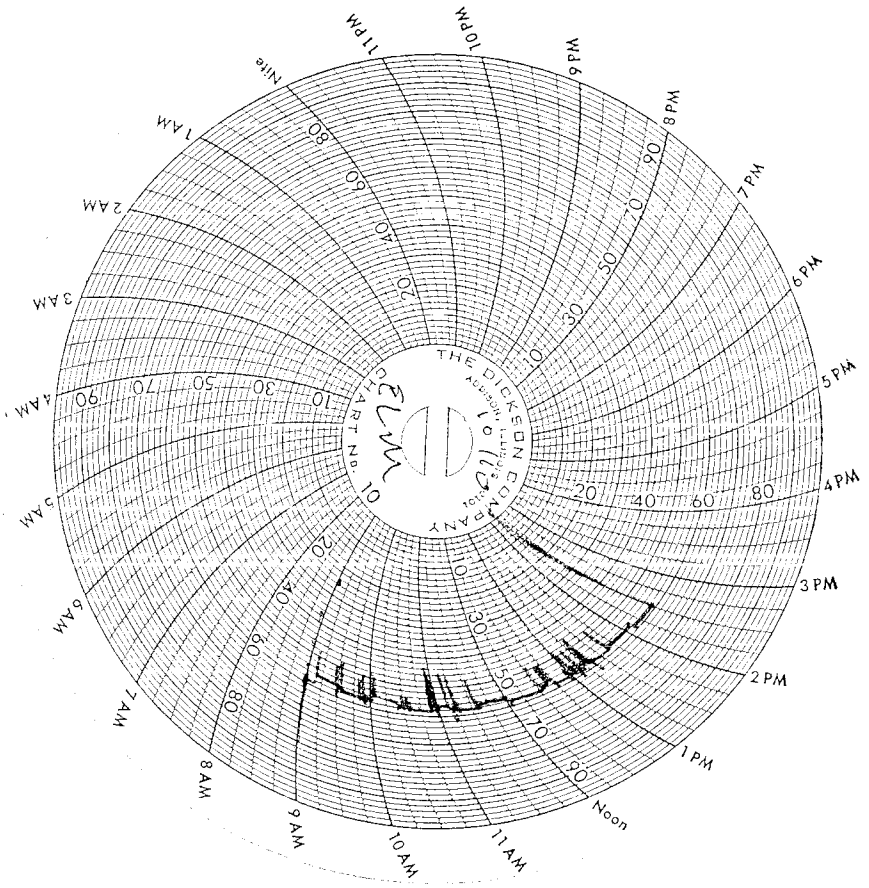
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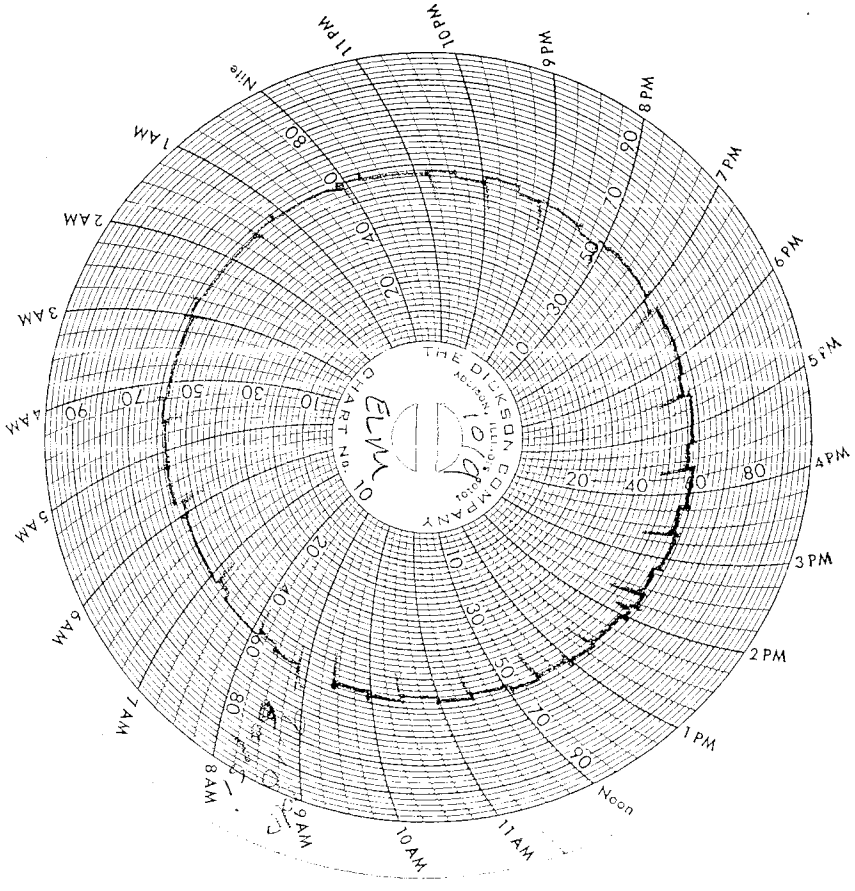
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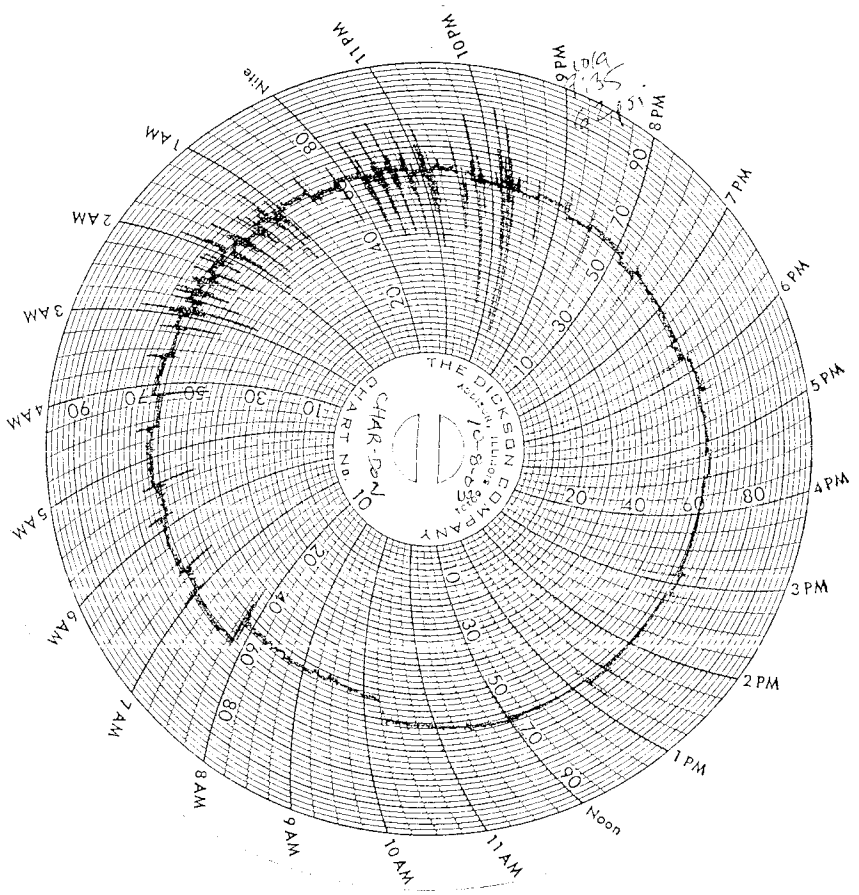
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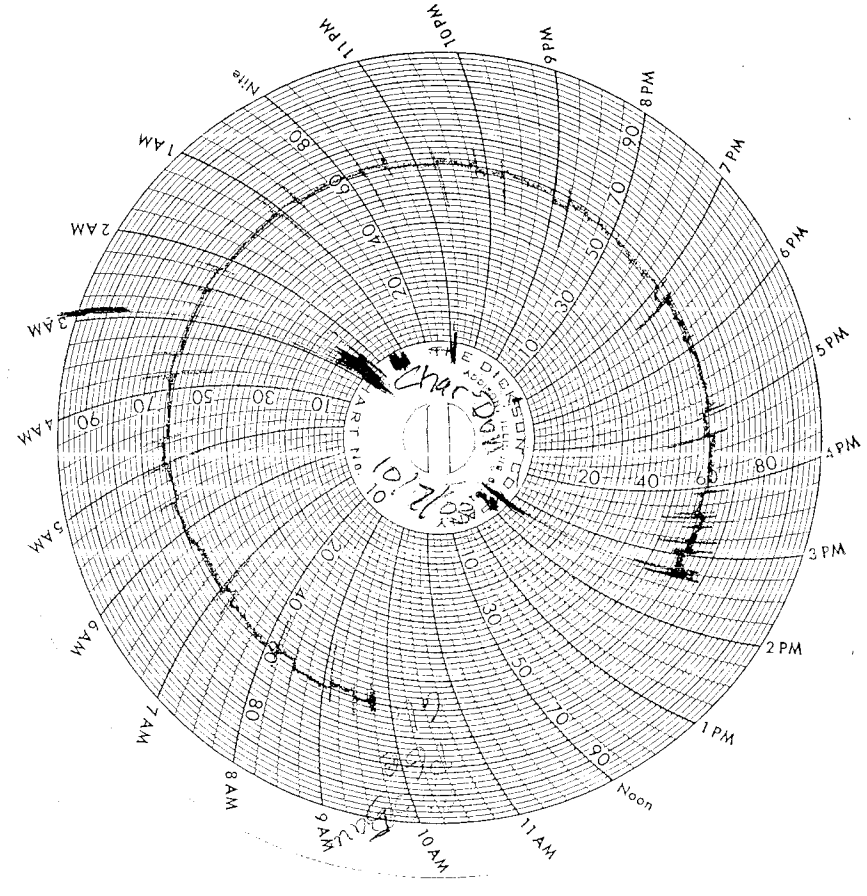
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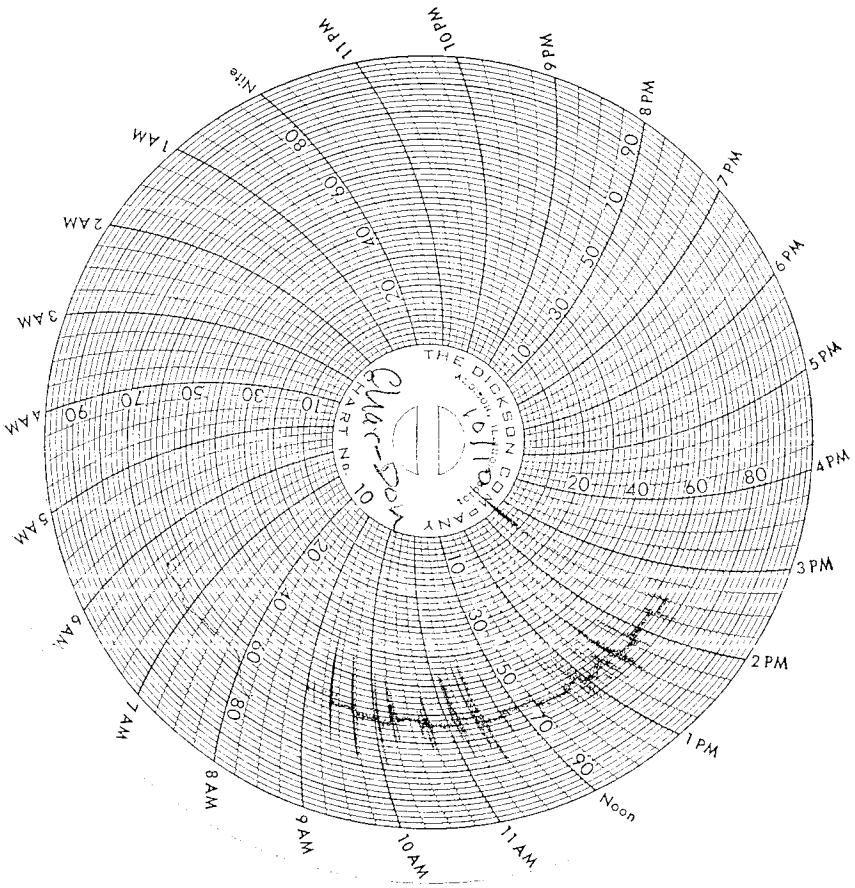
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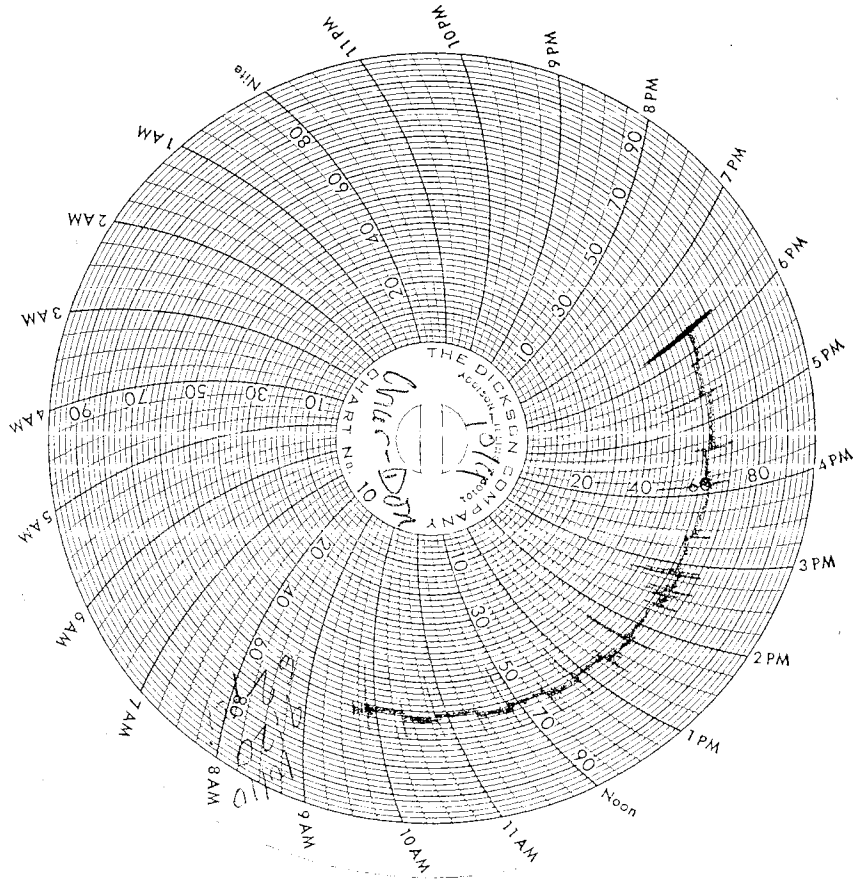
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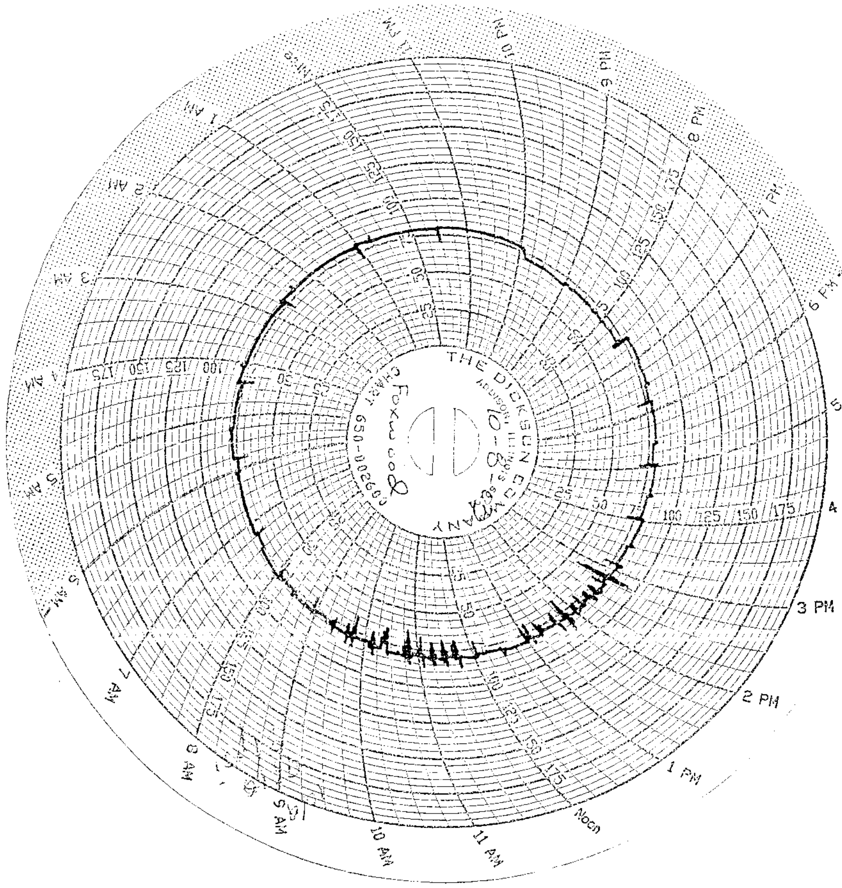
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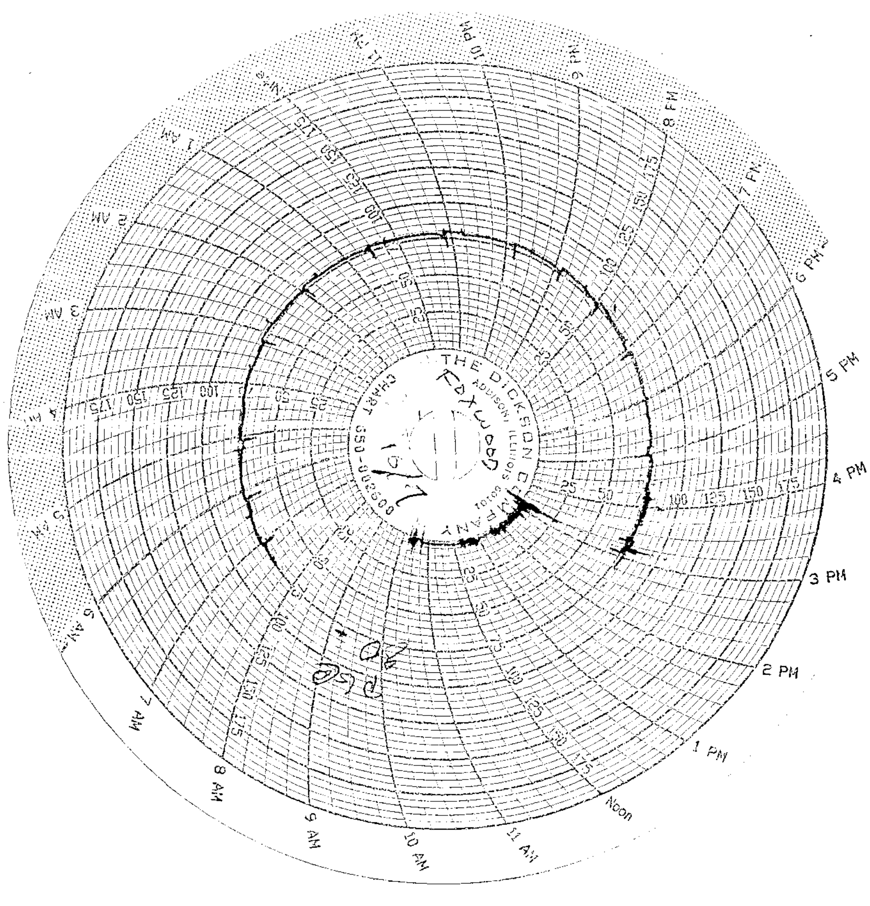
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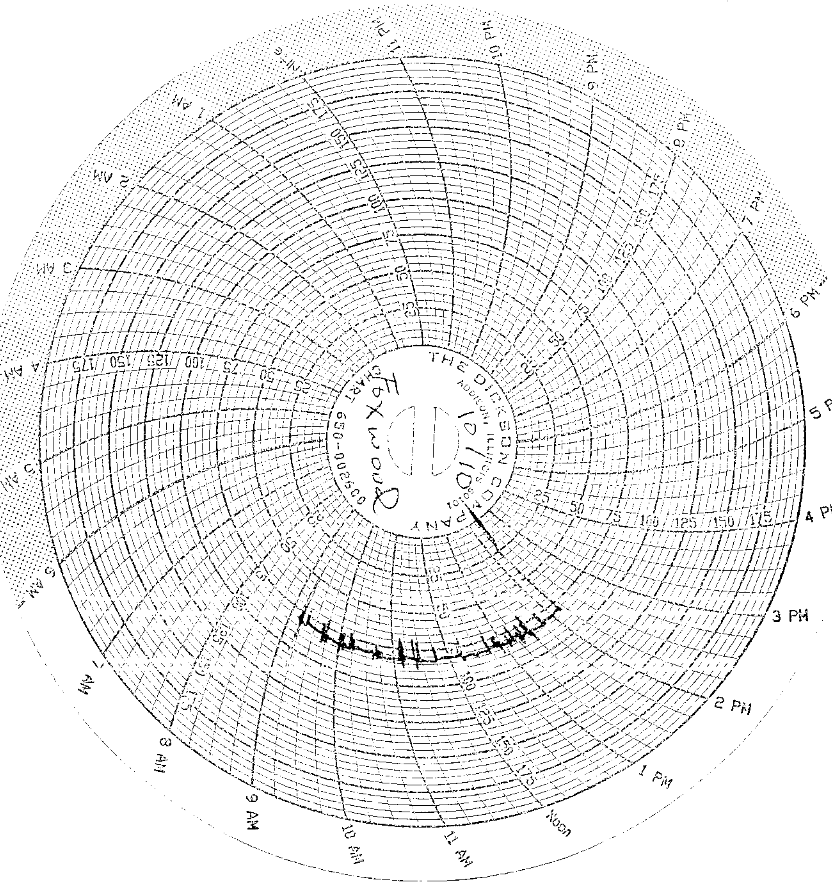
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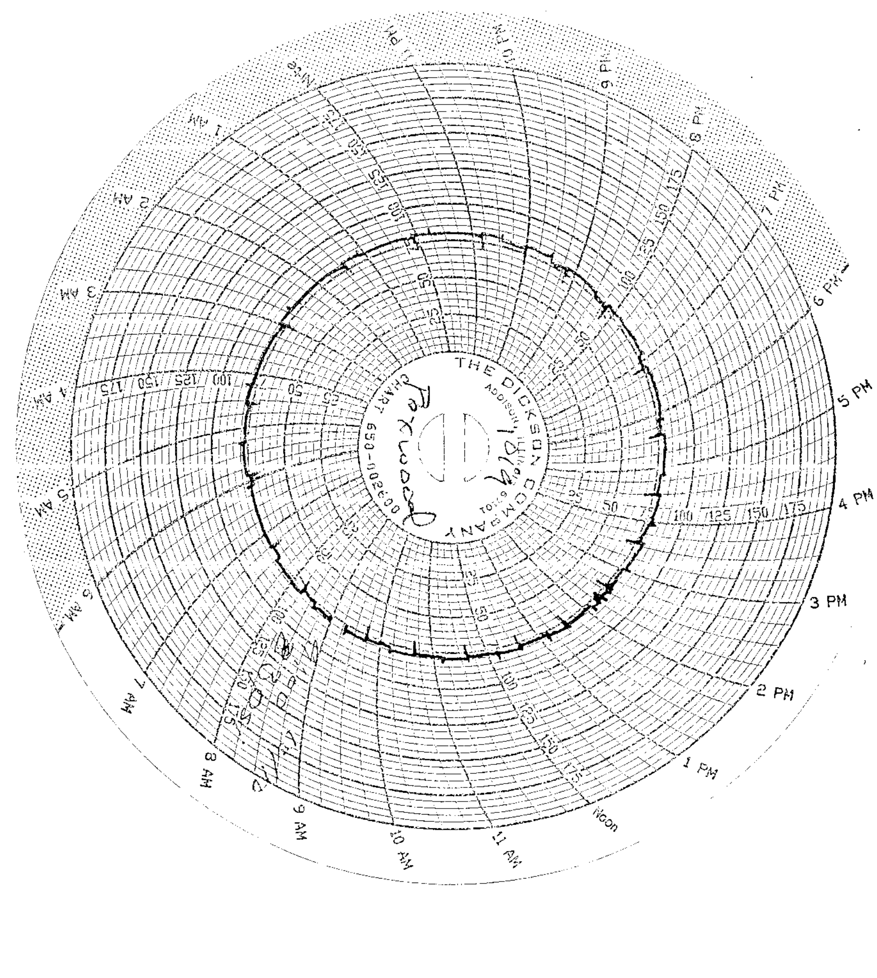
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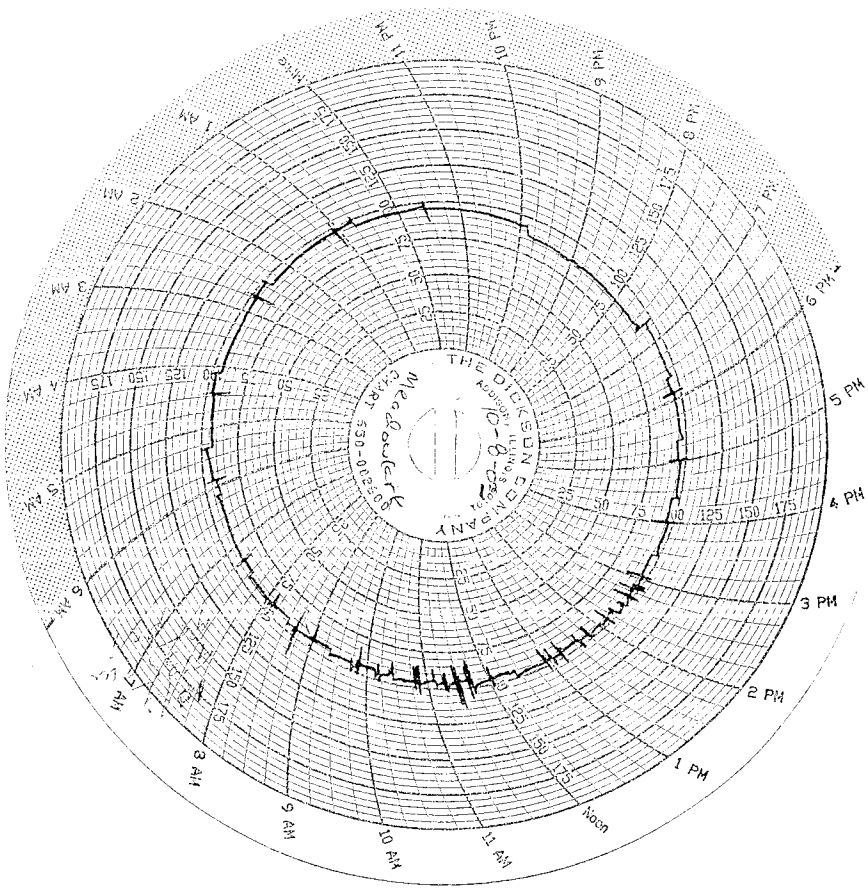
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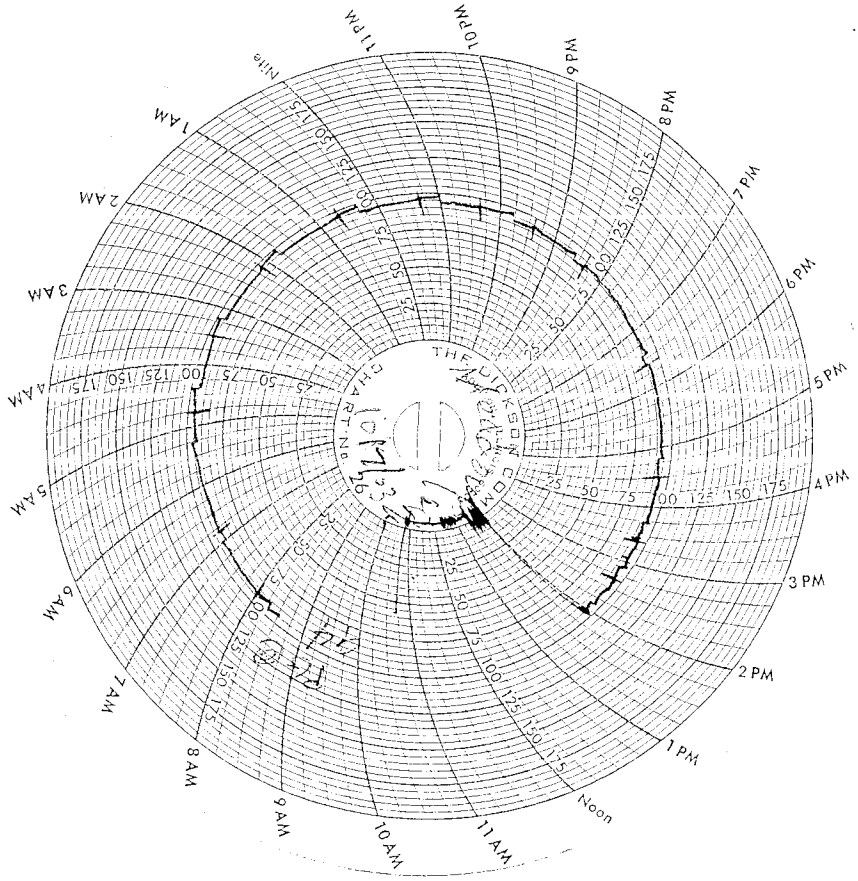
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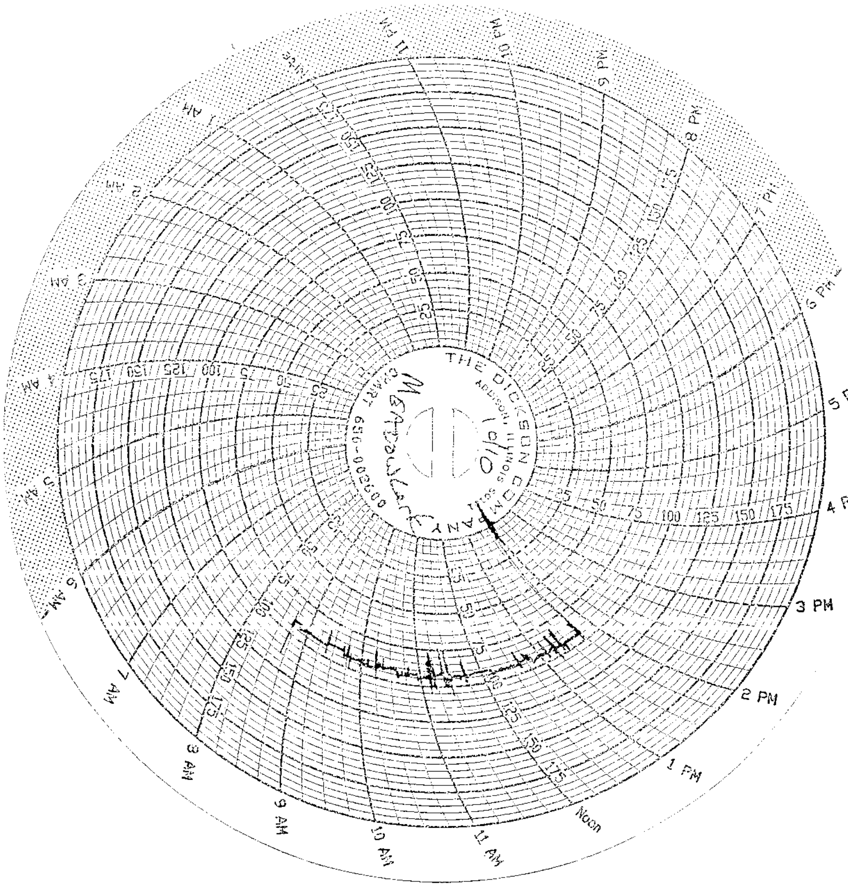
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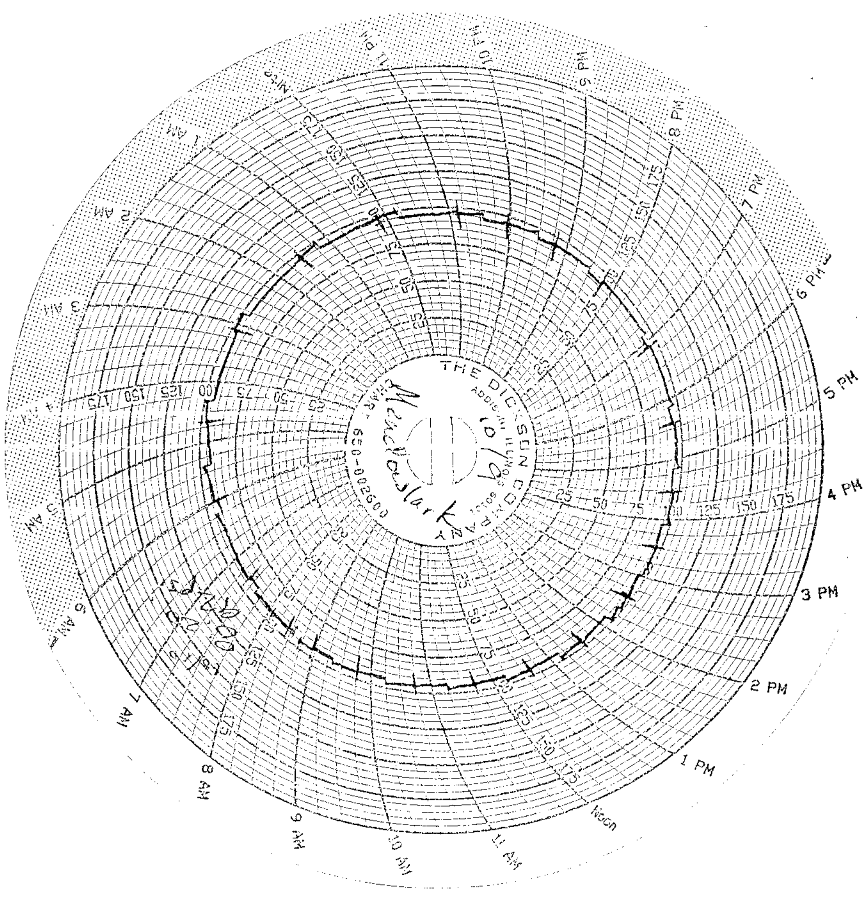
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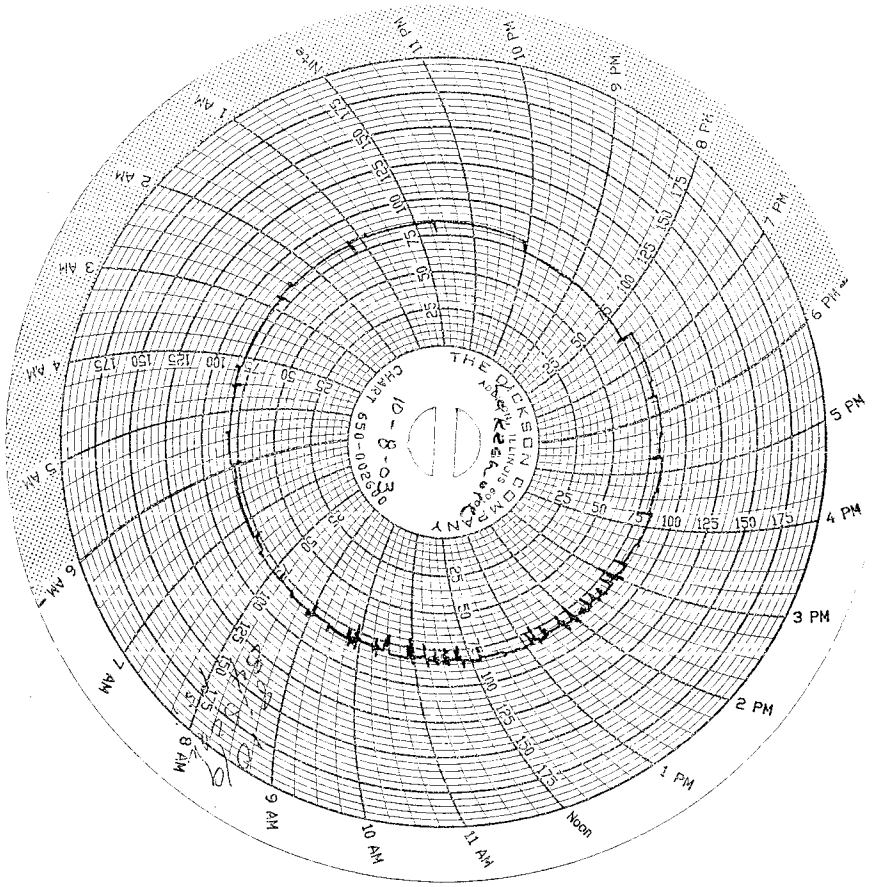
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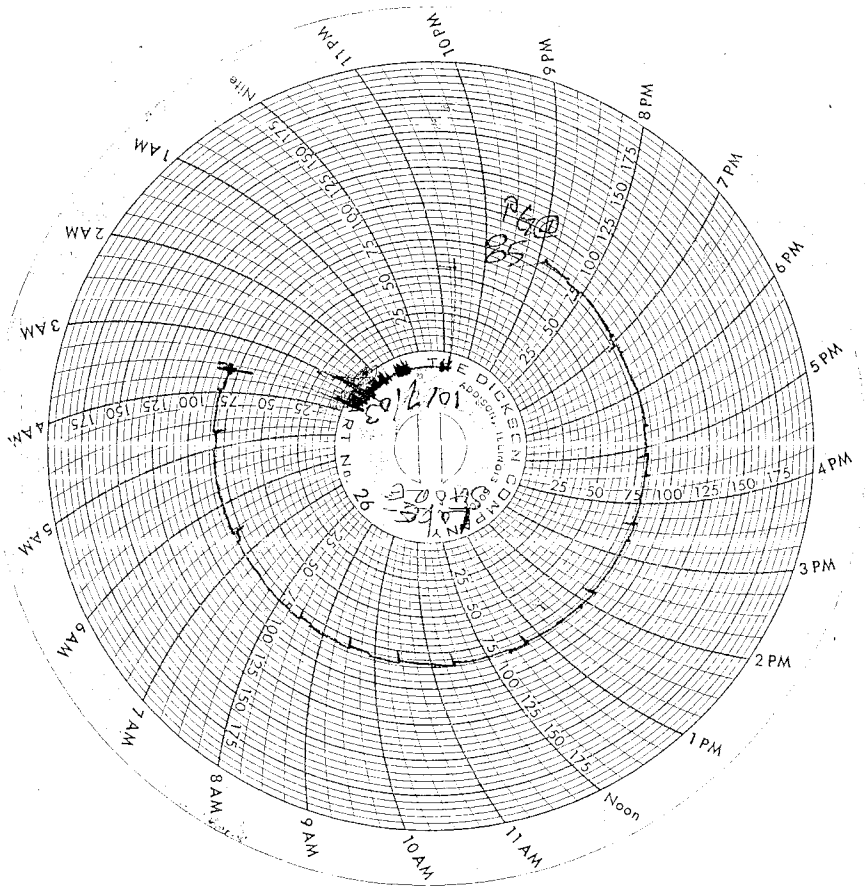
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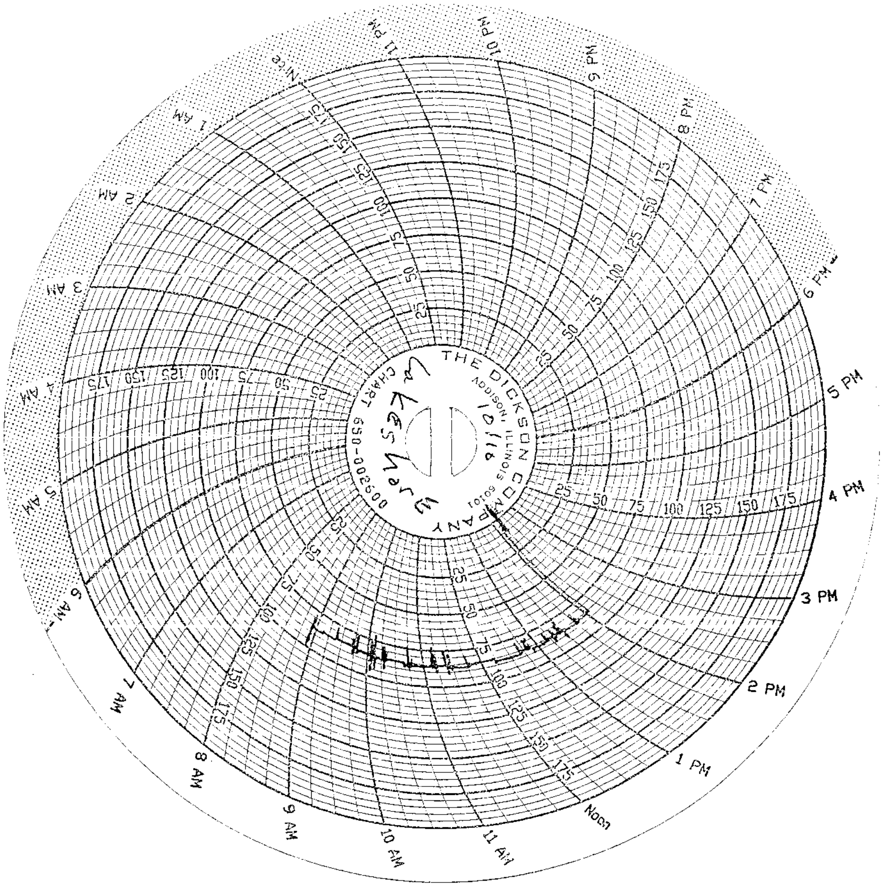
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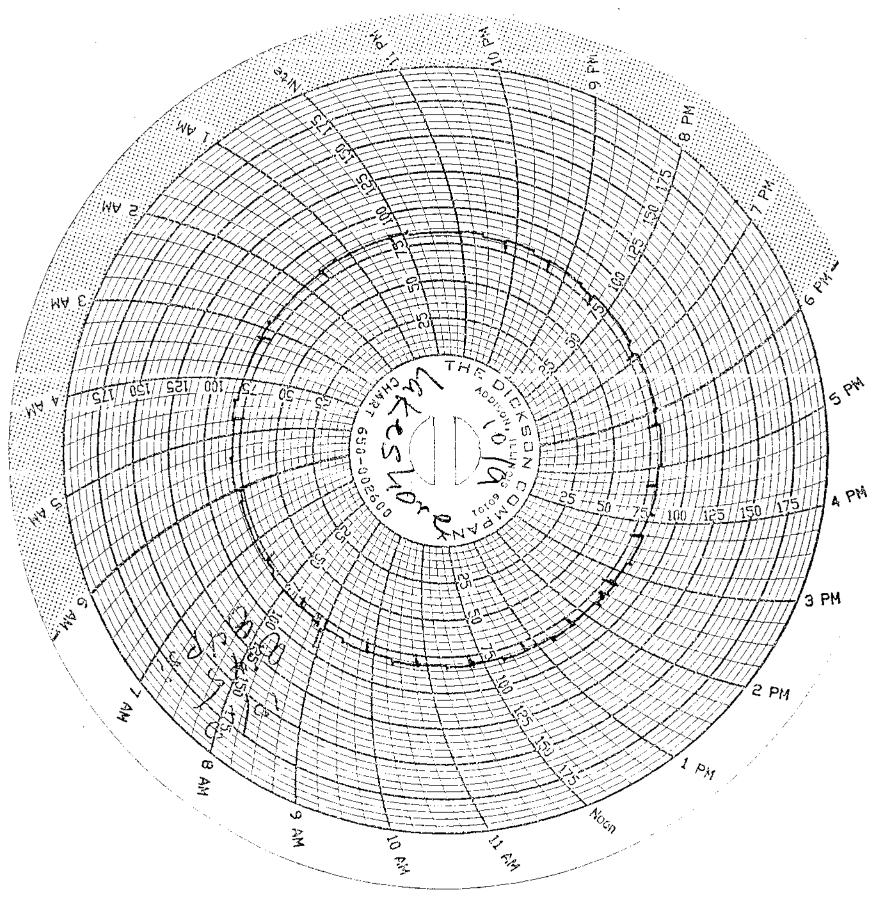
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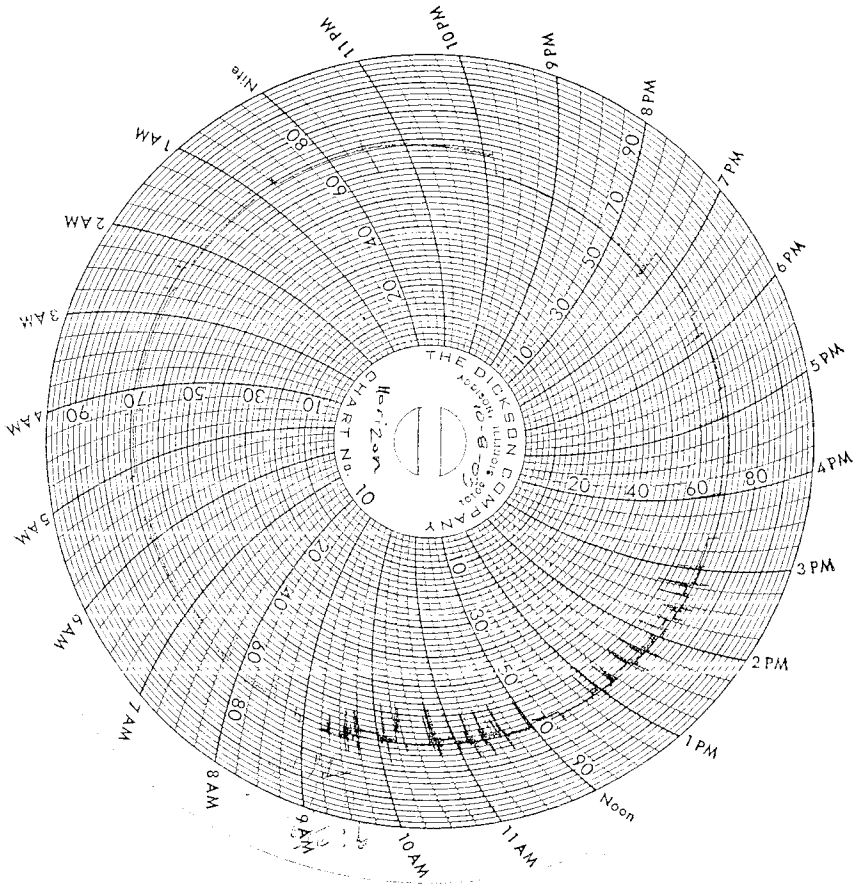
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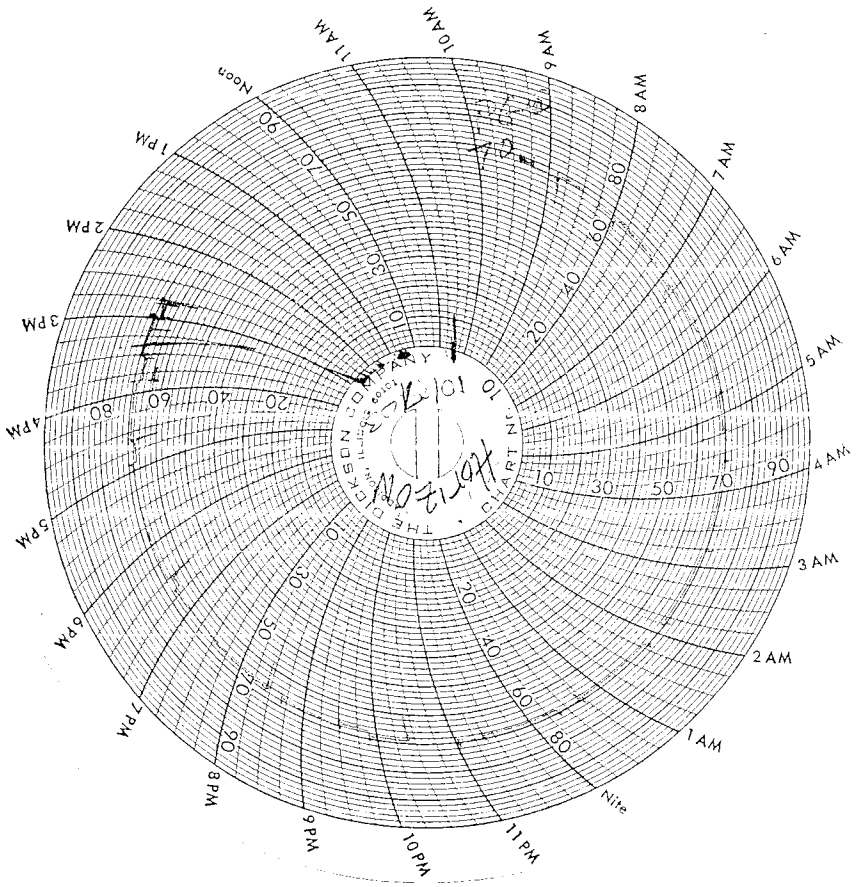
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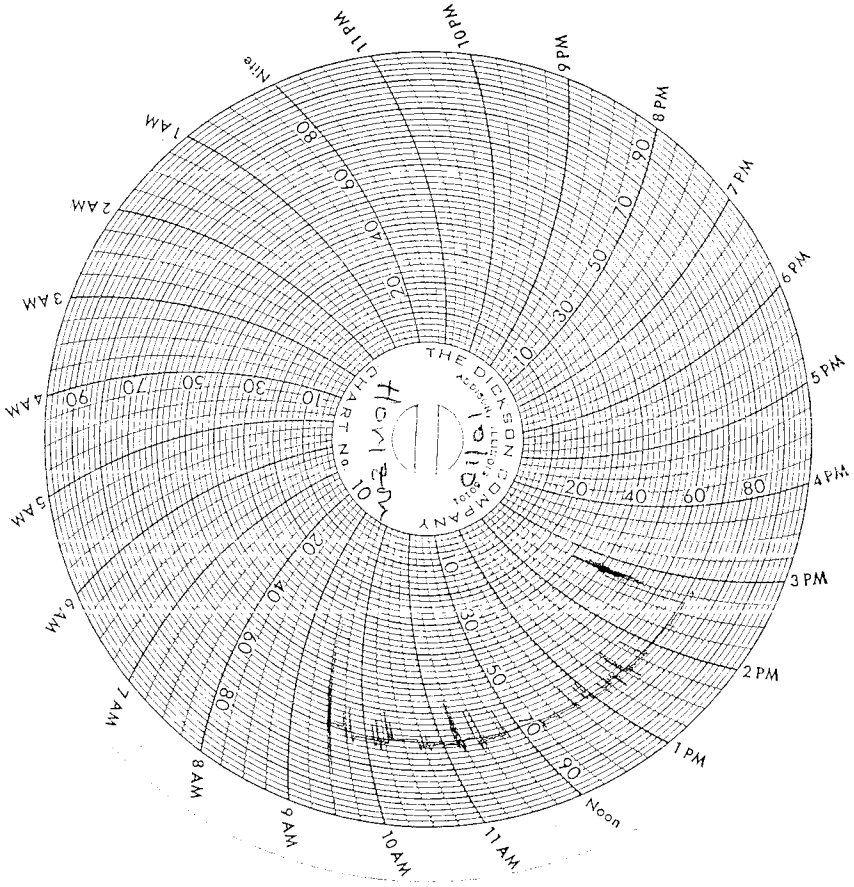
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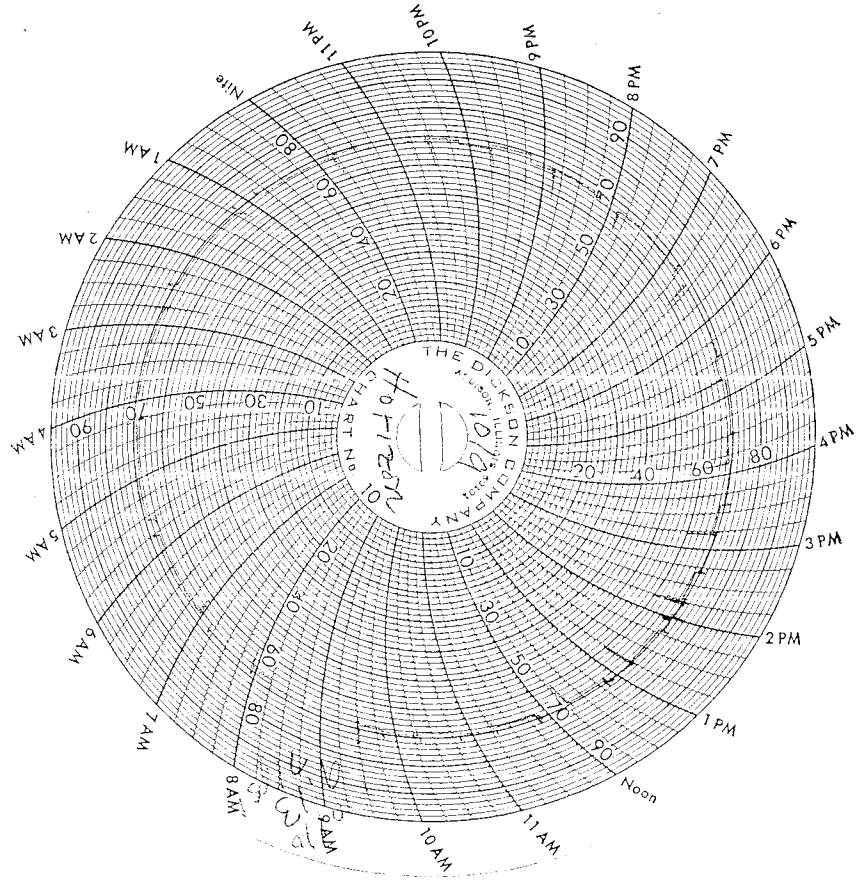
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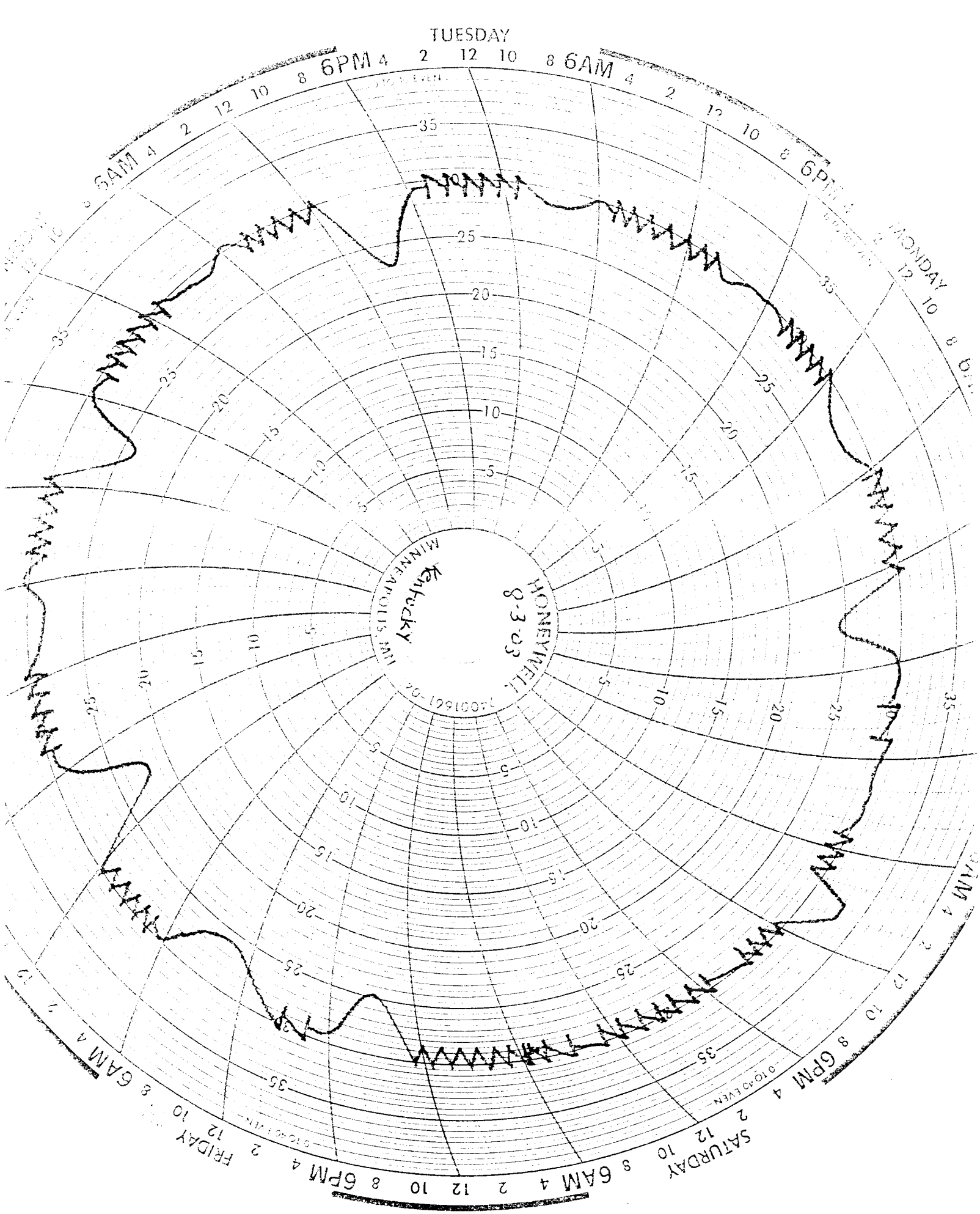
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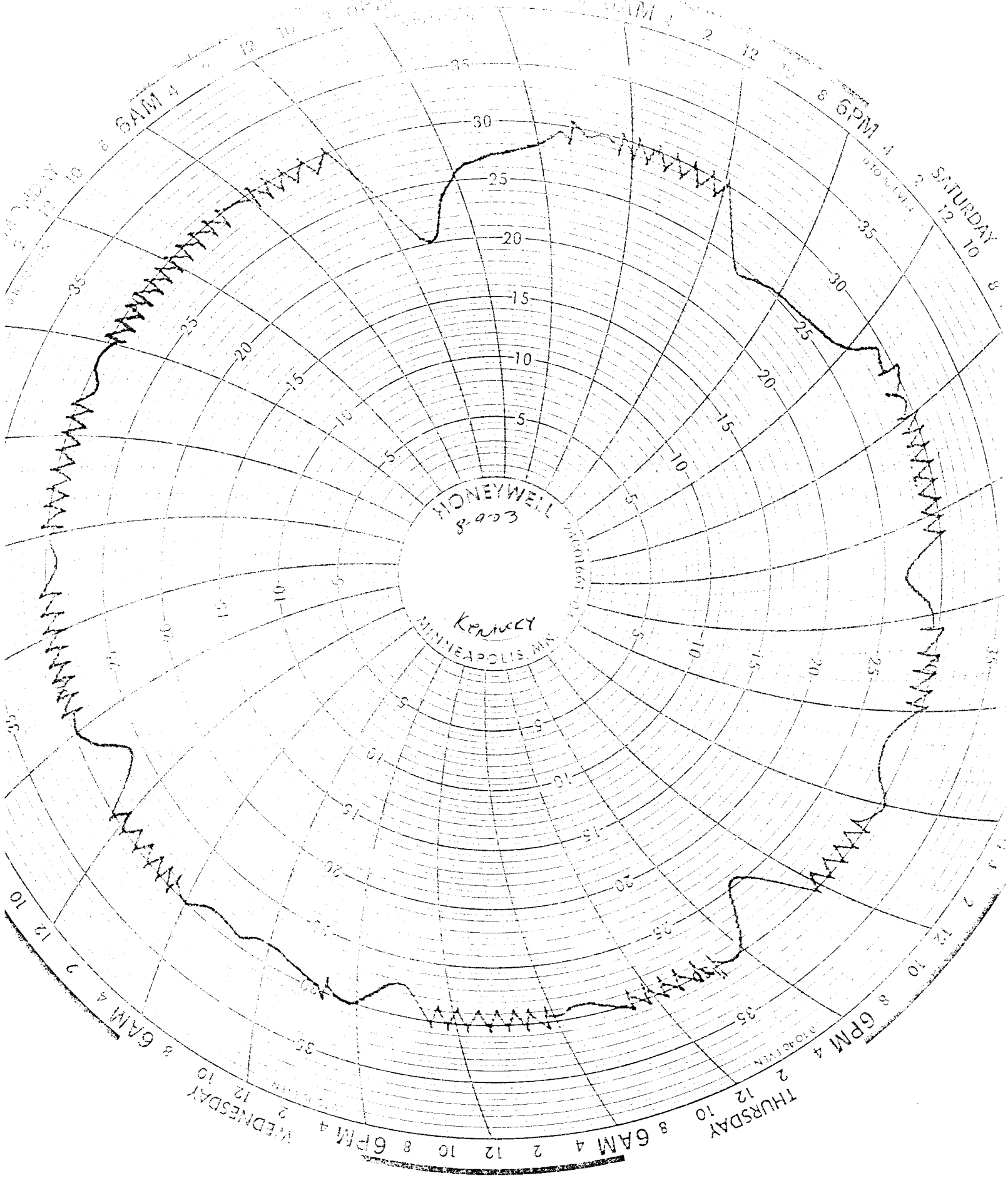
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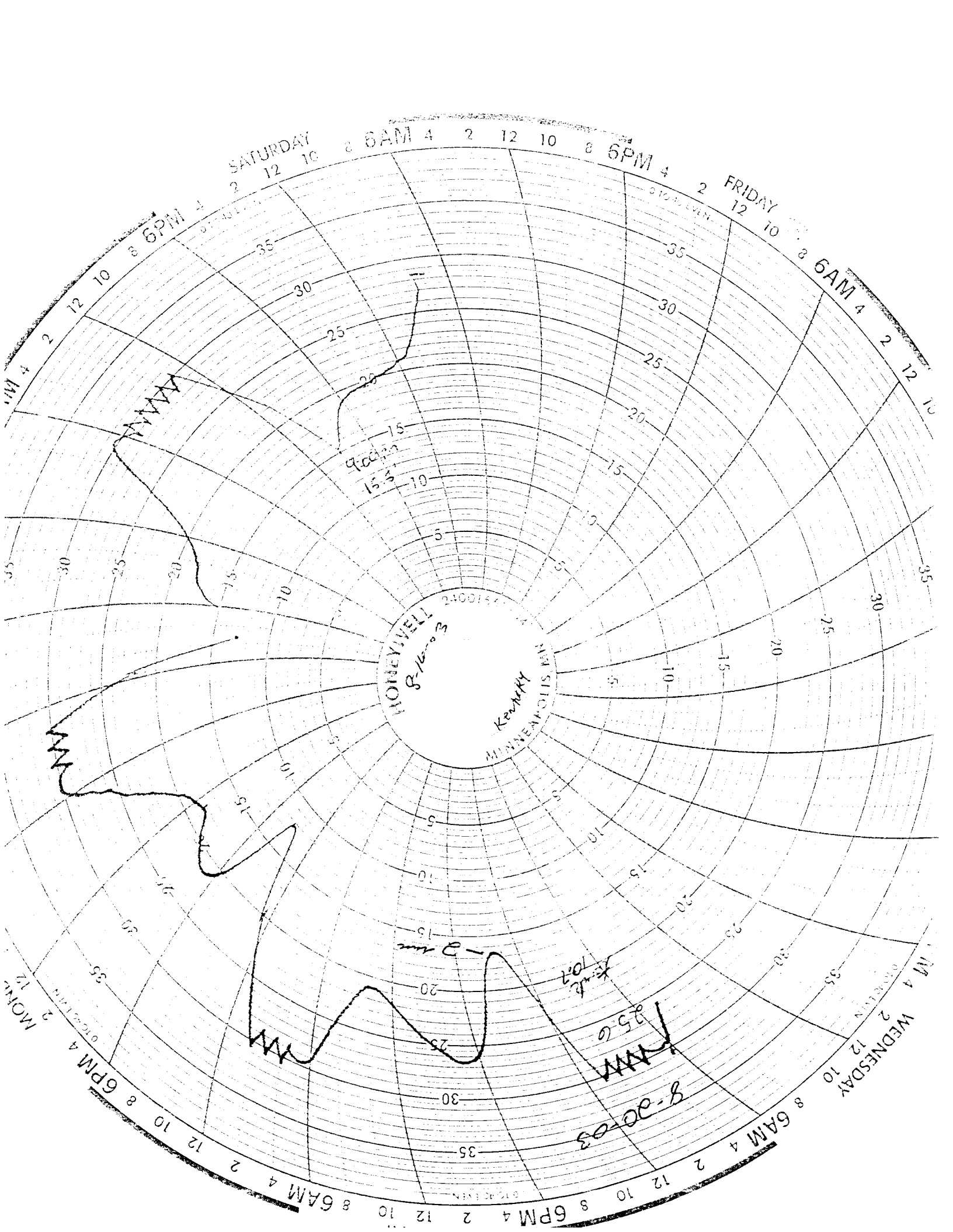
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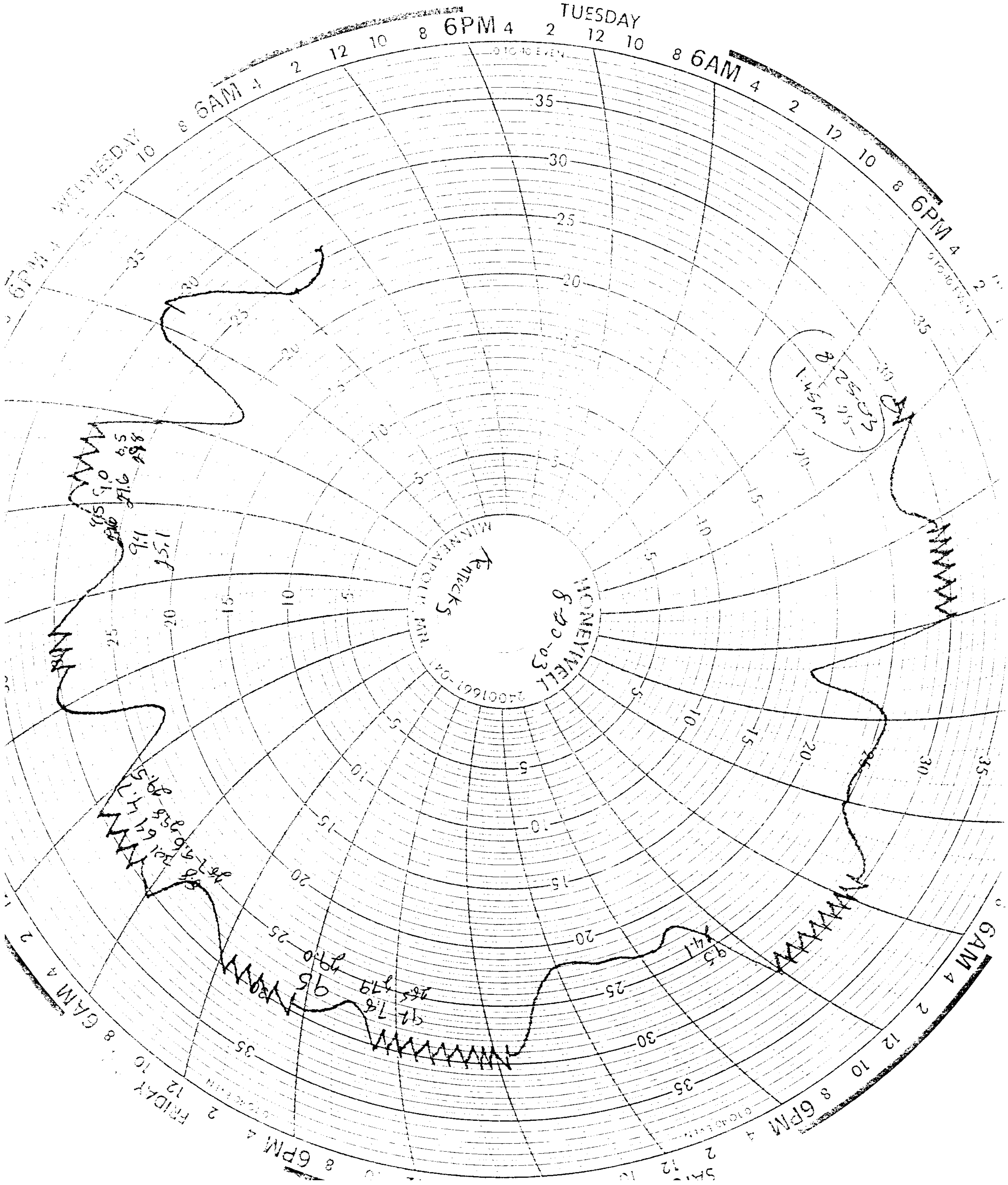
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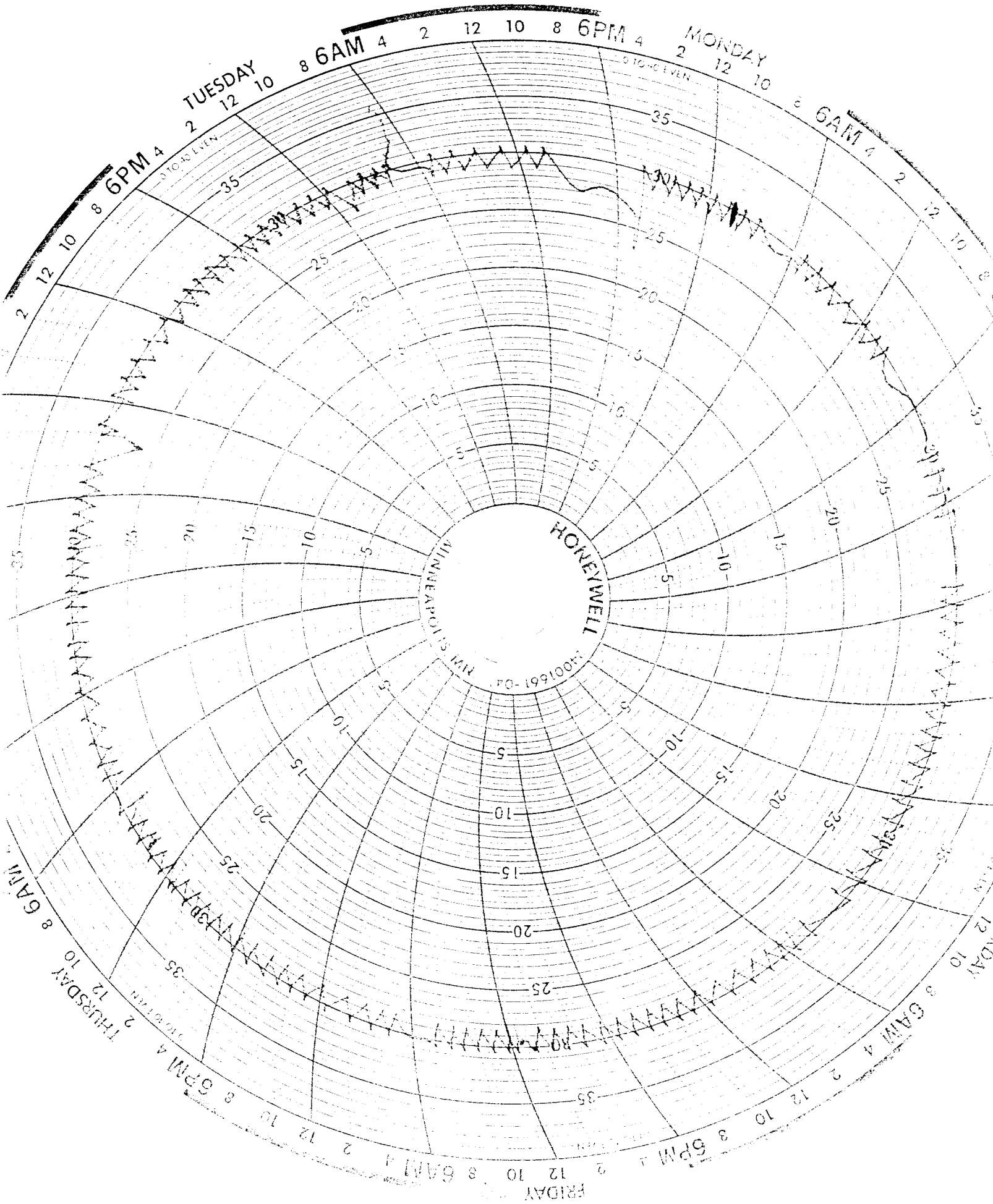
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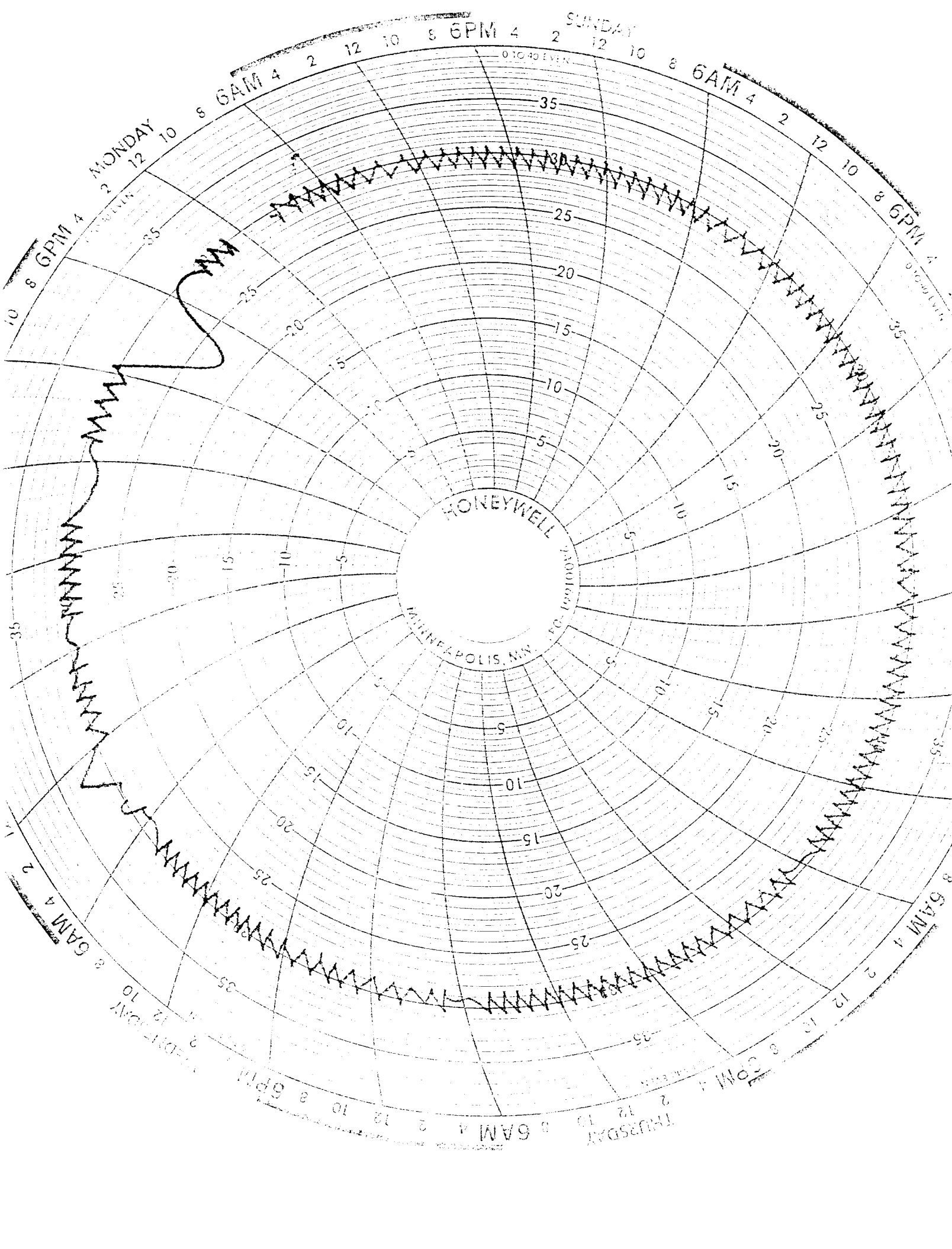
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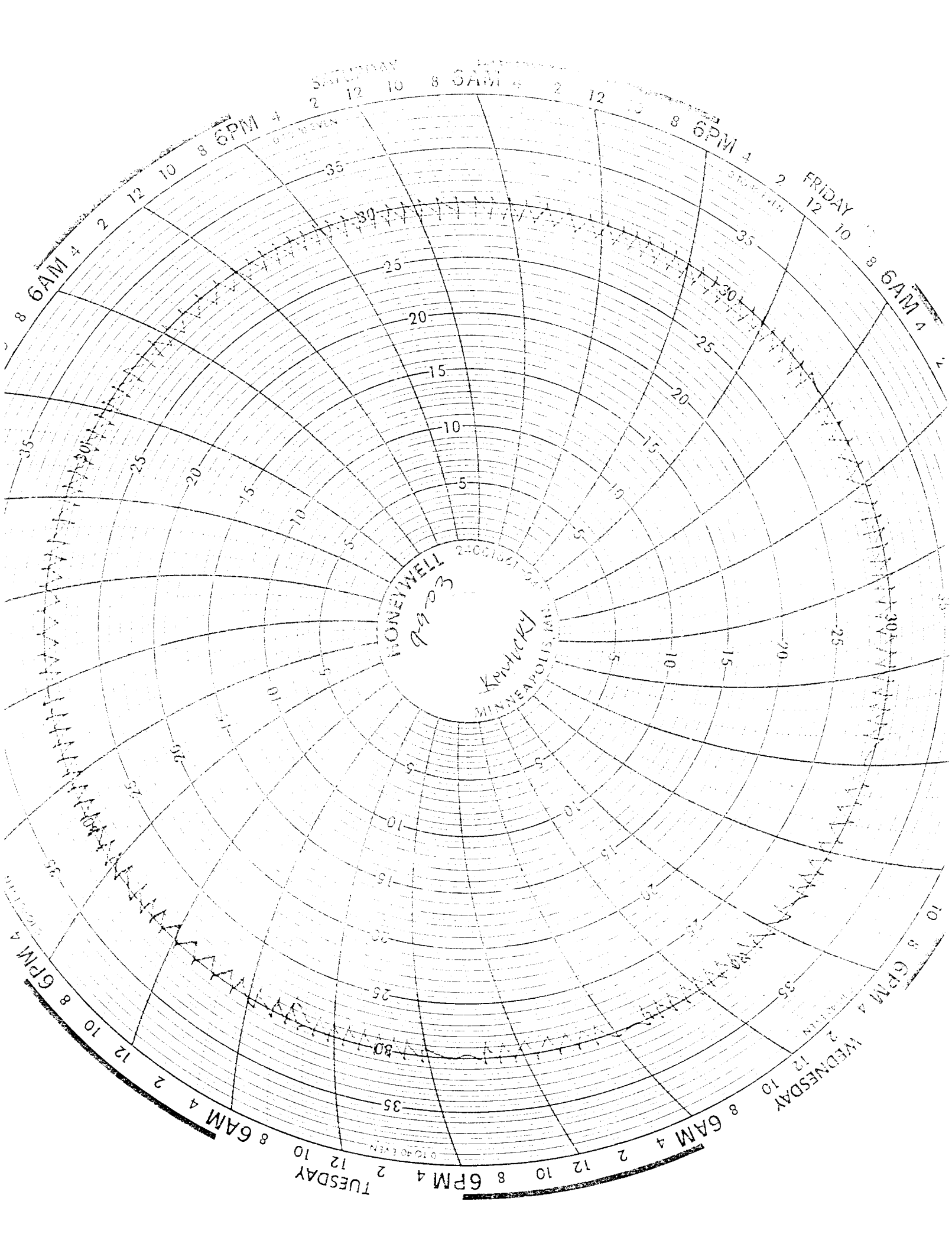
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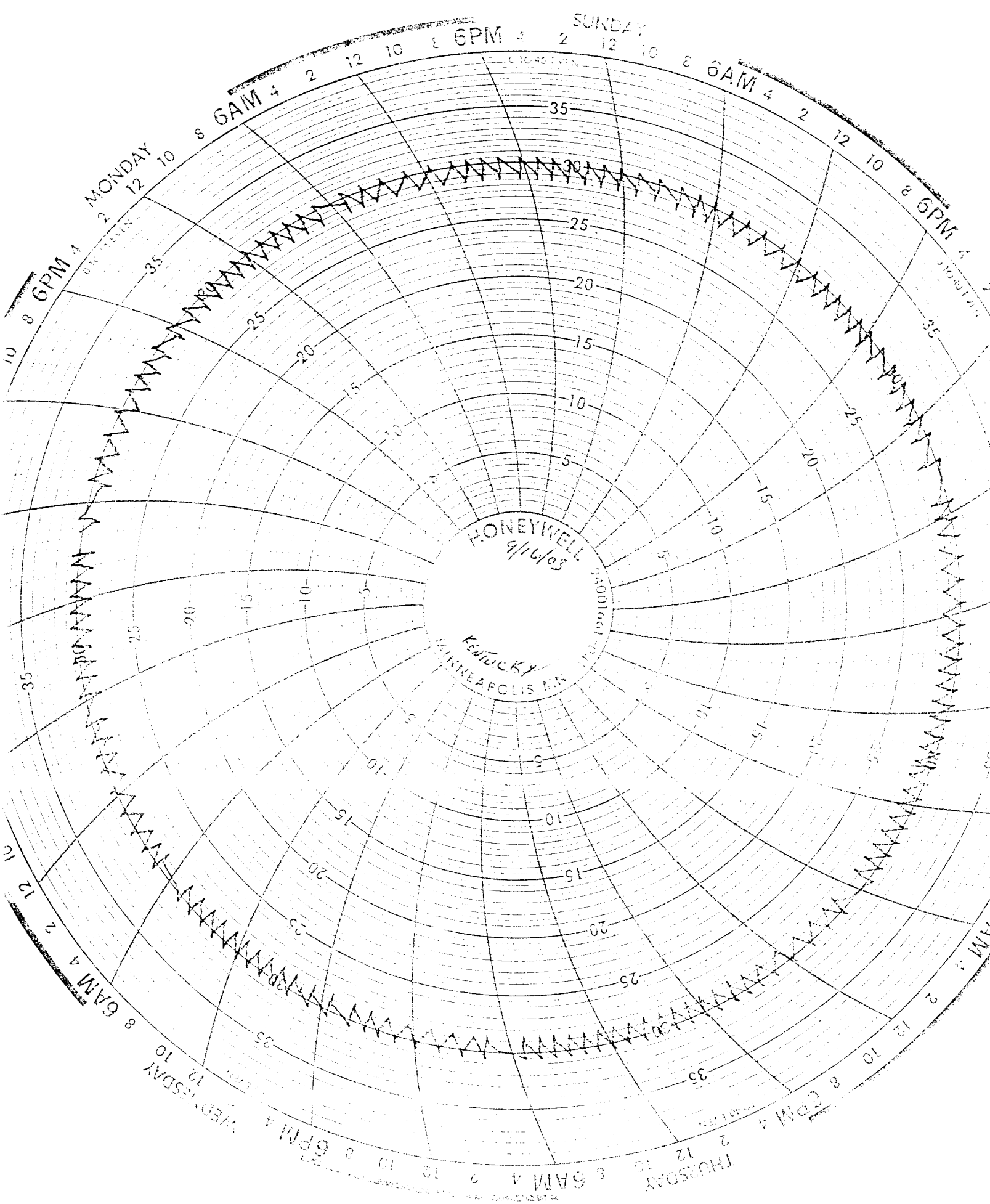
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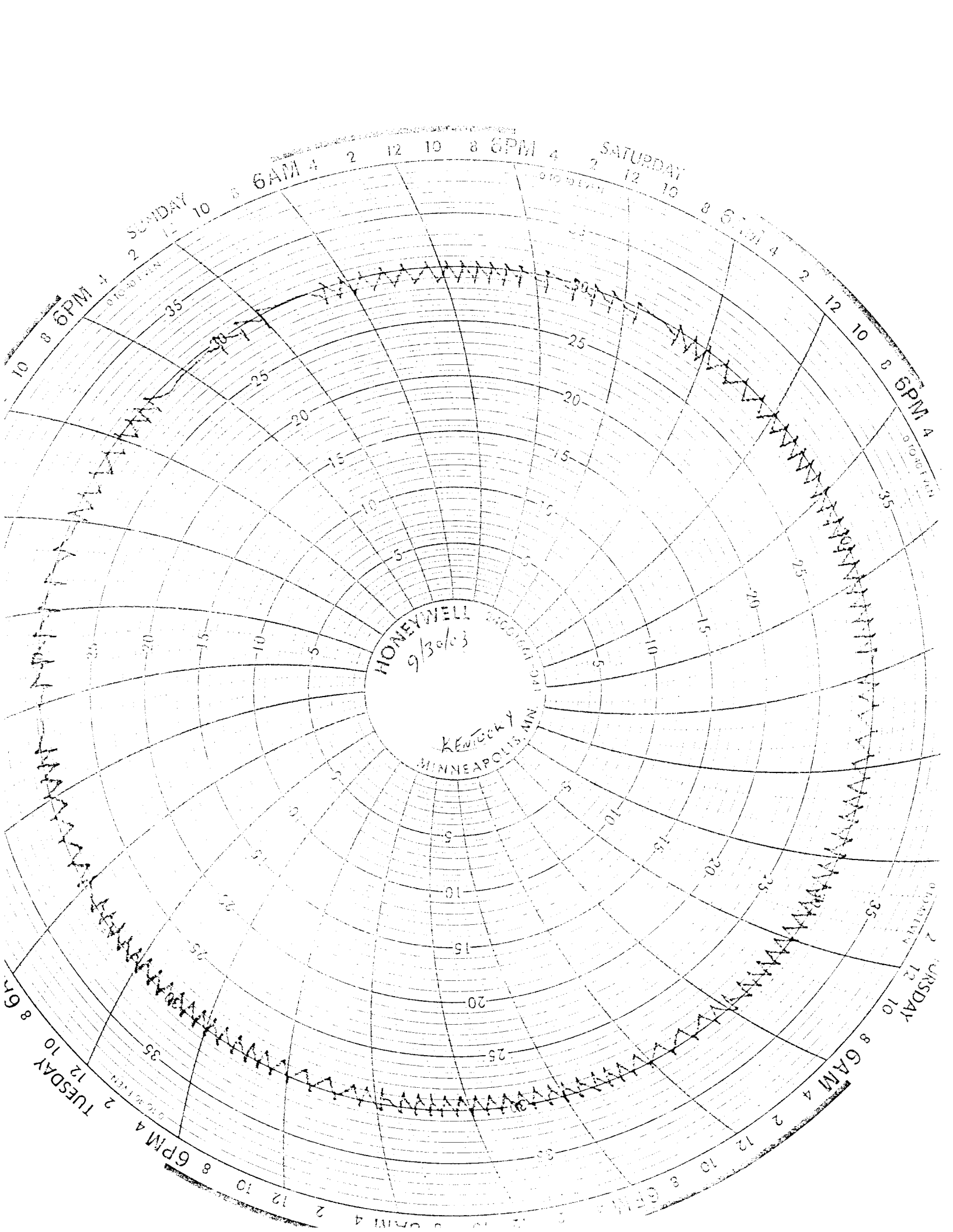
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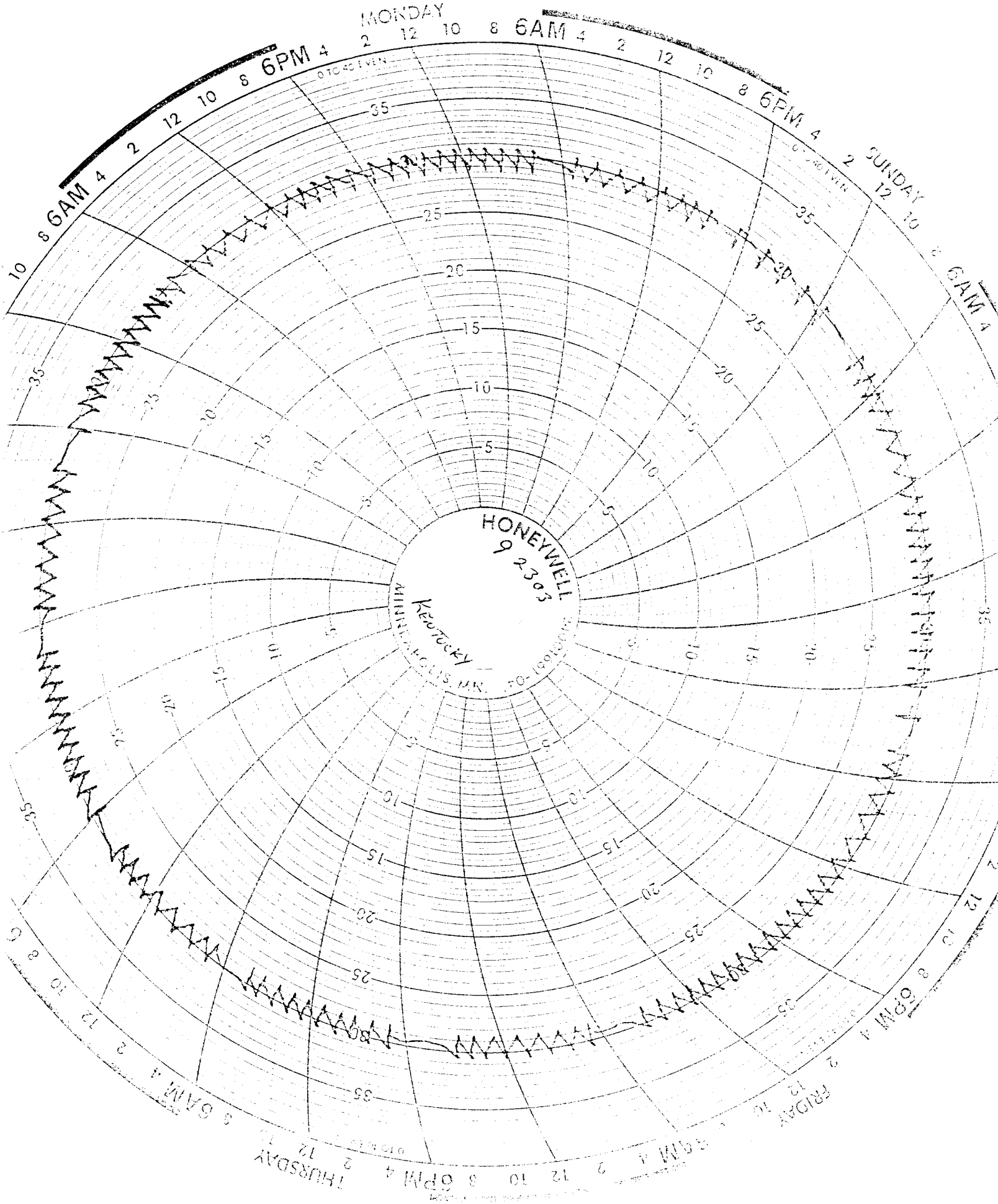
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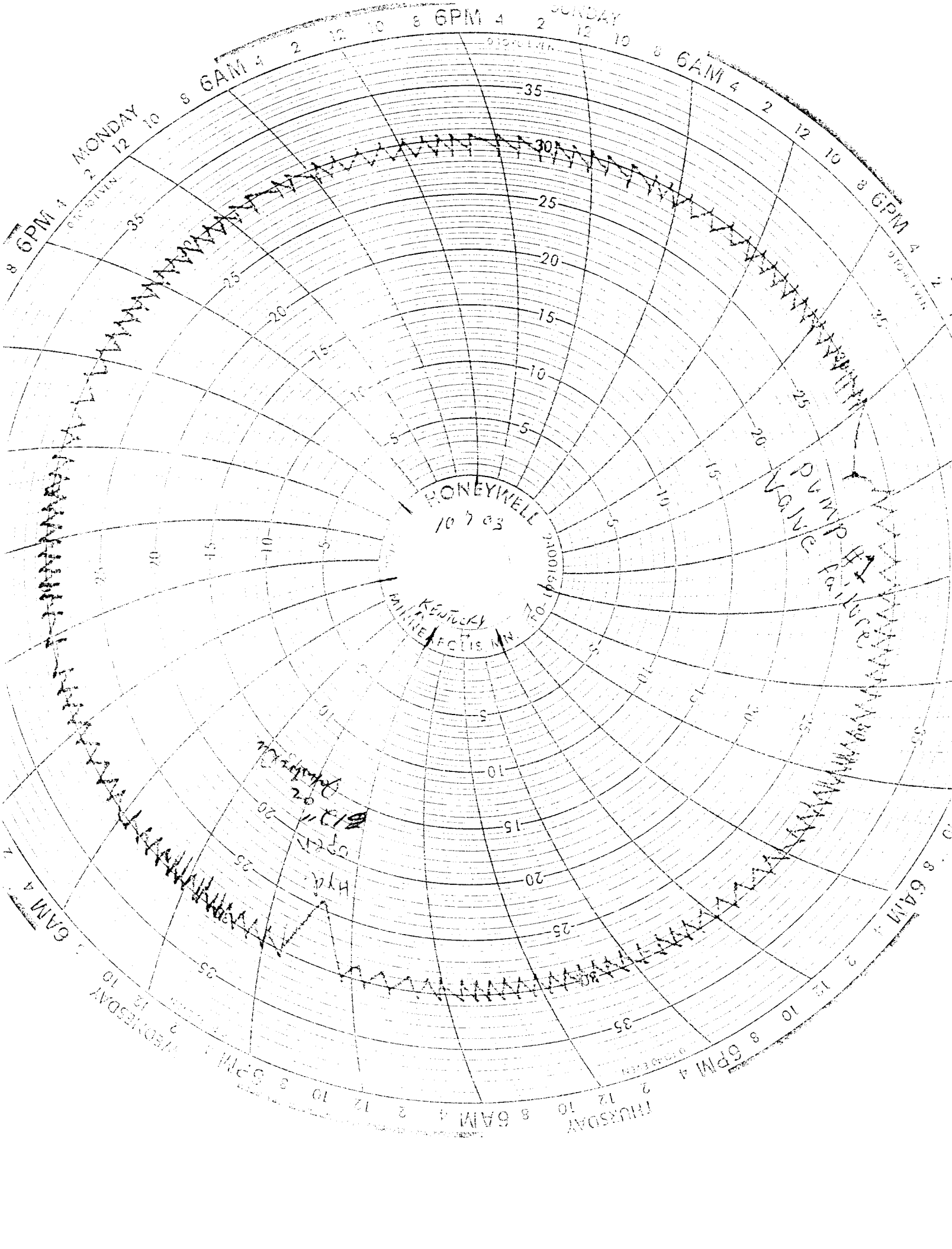
6PM
6AM
MONDAY
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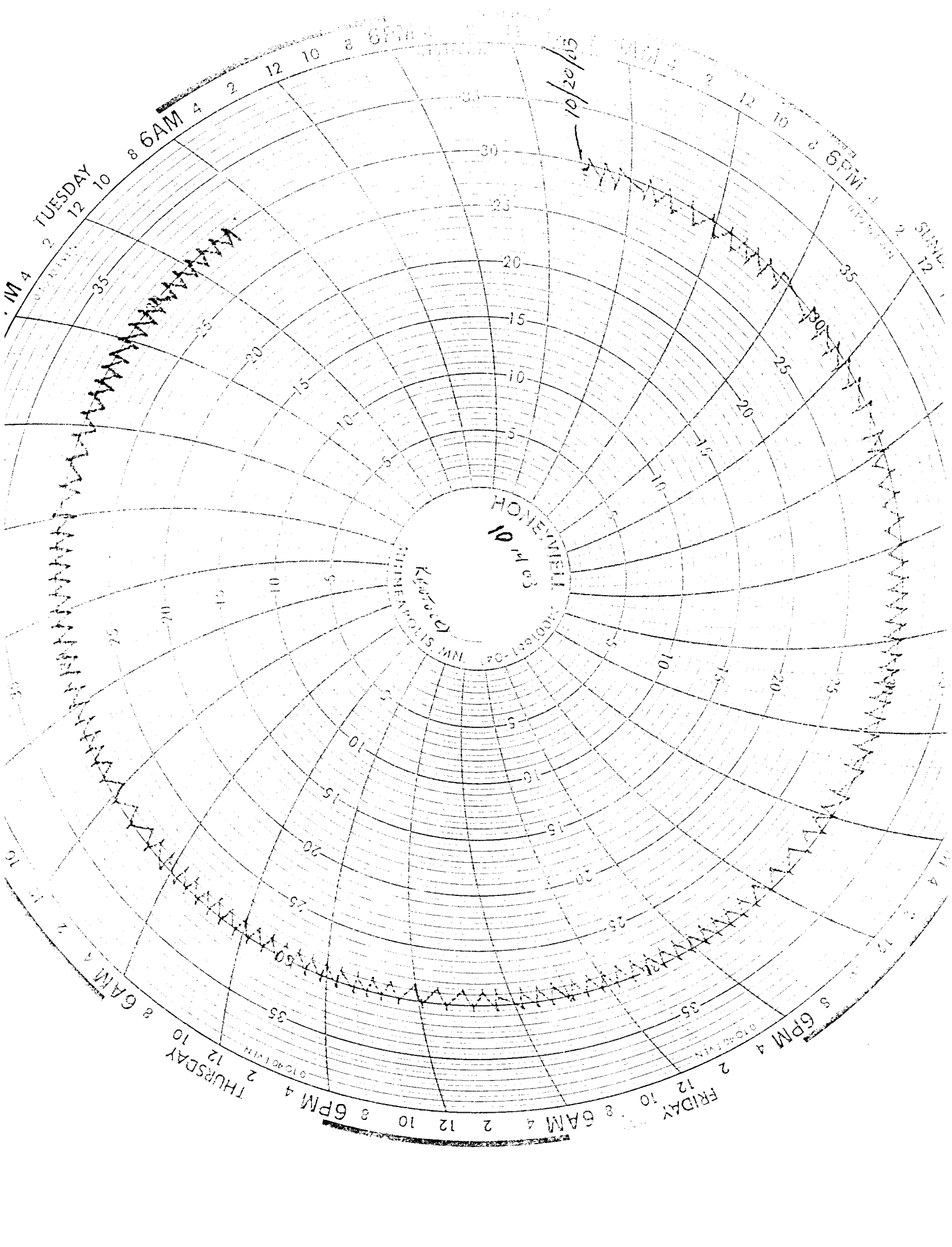
HONEYWELL
KENTUCKY
PUMP #1
VALVE
FAILURE


10/20/93
HONEYWELL
MODEL 194
6AM
6PM
TUESDAY
WEDNESDAY
THURSDAY
FRIDAY
SATURDAY
SUNDAY
MONDAY

Fire Demand Data

South Metropolitan Fire Protection District
611 W. Foxwood Dr. • P.O. Box 467 • Raymore, MO 64083

Fax Transmittal

816-822-3414

Date: November 19, 2003

To: Jeff Klein

From: Fire Marshal Powers

Subject: Estimated Fire Flows

Here is a list of the buildings we consider to be target hazards. The first number is the square feet and the second number is the fire flow.

1.	Raymore Health Care		30,000sf	4250gpm for 4 hours
2.	Fox Wood	Apartments	122,100sf	8000gpm for 4 hours
		Community building	25,850sf	4250gpm for 4 hours
		RCC	121,825sf	4250gpm for 4 hours
3.	Walmart		196,190sf	6-8000gpm for 4 hrs
4.	Schools		54,000sf	3250-3 hours
		Raymore Elem.	69,000sf	3750gpm for 3 hours
5.	Strip Mall		49,140sf	3250gpm for 3 hours
6.	Apple Market		44,576sf	3000gpm for 3 hours

KCMO Contract

CONTRACT = 22009
ORDINANCE = 011127
EFFECTIVE DATE: 5-25-01

5/22/01

WATER PURCHASE AGREEMENT

THIS AGREEMENT, made and entered into this 11th day of June 2001 by and between the CITY of RAYMORE, MISSOURI, a municipal corporation of the State of Missouri, hereinafter referred to as "BUYER", and KANSAS CITY, MISSOURI, a municipal corporation of the State of Missouri, hereinafter referred to as "CITY".

WITNESSETH:

WHEREAS, BUYER currently purchases water from the CITY authorized by a Water Purchase Agreement, dated November 13, 1995; and

WHEREAS, BUYER desires to enter into a new Water Purchase Agreement and purchase water at a second metering location, Lucy Webb Road and Missouri Route J; and

WHEREAS, BUYER desires to purchase water and CITY is willing to deliver and sell water to BUYER in accordance with the terms and conditions set forth herein; and

WHEREAS, BUYER desires to contract for a maximum rate consumption of 3.0 million gallons per day (MGD); and

WHEREAS, CITY presently does not have sufficient water facilities at or near Lucy Webb Road and Missouri Route J to deliver and sell water to BUYER; and

WHEREAS, CITY and BUYER are willing to share in the expenses for construction of a transmission main, elevated tank, and pump station to provide the necessary facilities; and

WHEREAS, BUYER is willing to construct, at BUYER's expense, a metering/regulating facility to purchase water from CITY at said second location; and

WHEREAS, BUYER and CITY agree to have facilities in place by June 1, 2003; and

WHEREAS, BUYER agrees that CITY will have the right to repurchase water from BUYER;

NOW THEREFORE:

For and in consideration of the mutual covenants, agreements, and conditions contained herein, it is agreed by and between BUYER and CITY as follows:

ARTICLE I
GENERAL CONDITIONS

1. Applicable Law: This is a cooperative Agreement authorized by Missouri Revised Statutes Section 70.200 et seq (1994). In accordance with Missouri Revised Statutes 70.300 (1994), a copy of this Agreement will be filed in the Office of the Secretary of State and in the Office of the Recorder of Deeds of Jackson County. This Agreement shall be governed by and construed according to the laws of the State of Missouri.

2. Facilities: BUYER recognizes and understands that, in order to receive water at the second location, facilities need to be constructed. The facilities will consist of the "Cass County Transmission Main – Phase 1" (hereinafter 'Main'), the "Hubach Hill Elevated Tank" (hereinafter 'Tank'), and the "South Terminal Pump Station" (hereinafter 'Pump Station'). BUYER will share in the total cost of the engineering and construction of the facilities as described in Article VI.

a. Ownership and Maintenance – Main and Pump Station: BUYER understands and agrees that, upon completion and acceptance of the Main and Pump Station by CITY, said Main and Pump Station, whether located within the corporate limits of CITY or within the corporate limits of BUYER or any other corporate entity, shall be the property of CITY, and the control, ownership, operation, maintenance, and right of use of said Main and Pump Station so constructed shall be vested wholly and exclusively in CITY, and that BUYER shall have no interest in the Main and Pump Station or any other part of the CITY's water system.

b. Ownership and Maintenance – Tank: BUYER understands and agrees that, upon completion and acceptance of the Tank by CITY, said Tank, whether located within the corporate limits of CITY or within the corporate limits of BUYER or any other corporate entity, shall be the property of CITY, and the control, ownership, operation, maintenance, and right of use of said Tank so constructed shall be vested wholly and exclusively in CITY, and that BUYER shall have no interest in the Tank, except as noted below, or any other part of the CITY's water system.

1. BUYER shall be entitled to 1.0 million gallon capacity in the tank and can operate tank accordingly.

2. BUYER will own and maintain grounds including fencing, drives, etc., while providing 24 hour access to CITY.

3. CITY will, within reason, paint and sign tank as appropriate to serve as a BUYER landmark.

4. BUYER will grant CITY a no-cost lease on property on which Tank is situated or until such time that Tank is not needed by CITY or BUYER.

3. Contract Variable: Reserved

4. Contract Void: Reserved

5. Construction Records: BUYER and CITY each agree to furnish the other party with information consisting of reports and engineering plans and studies that could impact the operation of the other's system. BUYER agrees to furnish to CITY for informational purposes, within thirty (30) days following the effective date of this Agreement, one (1) set of the BUYER's maps of its existing distribution system and to furnish an updated set of maps of BUYER's distribution system annually thereafter.

6. Term of Contract: This Water Purchase Agreement shall continue in force and effect, except as otherwise provided herein, for a period of twenty (20) years from and after its effective date.

7. Contract Binding: This Agreement shall be binding upon the parties hereto, their successors and assigns, whether the result of legal process, assignment, or otherwise, when finally executed and fully approved.

8. Director Defined: References herein to CITY's Director of Water Services ("Director") and to CITY's Water Services Department ("WSD") shall be construed to mean that person and department and/or any successor city title holder and city department name.

9. Assignment: Neither CITY nor BUYER shall sell, assign, transfer or otherwise convey any of their rights under this Agreement without the prior and express written consent of the other party. Each party may, in its sole discretion, refuse to consent to any proposed sale, assignment, transfer or other conveyance. Any attempted sale, assignment, transfer, or conveyance in violation of this paragraph shall be void and shall relieve the non-consenting party of any further liability under the Agreement but shall not relieve the violating party of any liability. If a party consents in writing to a sale, assignment, transfer, or conveyance, unless specifically stated to the contrary in the consent, it shall not release or discharge the party receiving consent from any duty or responsibility set for in the Agreement.

10. Annual Meeting: CITY and BUYER agree to hold a joint annual meeting on or before March 1 each year. Agenda items for the annual meeting shall include, but not limited to, the following:

a. Proposed Rate Changes: CITY shall report to BUYER any proposed rate changes for the next fiscal year.

b. Reporting of Water Consumption: BUYER shall present in writing to CITY the amount of water purchased during the preceding calendar year from other water purveyors by March 1 of each year.

c. System Maps: BUYER shall present an updated set of maps of BUYER's distribution system showing mains and storage and pumping facilities.

ARTICLE II
POINTS OF SERVICE

1. Location: BUYER will purchase water from CITY, in accordance with the provisions of this agreement, at the following metering facilities:

a. Kentucky Road: At Kentucky Road and 175th Street.

b. Lucy Webb Road: At Lucy Webb Road and Missouri Route J.

c. Other locations: As may be mutually agreed upon by BUYER and Director.

2. Repurchase Locations: CITY and BUYER agree that CITY may repurchase water from BUYER at locations as may be mutually agreed upon by BUYER and CITY.

ARTICLE III
SERVICE CONDITIONS

1. Water Delivery: From and after the time that the necessary facilities are accepted by CITY and placed into service, CITY agrees, subject to the following conditions, to deliver water to BUYER in such quantities as necessary to satisfy the provisions of this contract:

a. Water Quantity Purchased: BUYER and CITY understand and agree that the amount of water delivery and purchase referred to herein shall be based on the combined total of water delivered through each of the metering facilities at the locations defined in Article II herein.

1. Kentucky Road: CITY agrees to deliver water at a maximum instantaneous rate of 1.75 million gallons per day (MGD) at a minimum pressure of 50 p.s.i. and maximum quantity on any day of 1.75 million gallons at the present Kentucky Road Metering Facility, as referenced in Article II, paragraph 1.a., and subject to the conditions outlined in Article V. At such time that the proposed Lucy Webb Road Metering Facility is placed in operation, but not later than June 1, 2003, the maximum instantaneous rate of delivery at the Kentucky Road Metering Facility shall be reduced to 1.33 MGD and a maximum quantity on any day reduced to 1.0 million gallons.

2. Lucy Webb Road: CITY agrees to deliver a maximum quantity of water on any day of 2.0 million gallons, plus an additional amount up to 1.0 million gallons during emergencies only, for a total of 3.0

million gallons, at the proposed Lucy Webb Road Metering Facility, as referenced in Article II, paragraph 1.b., and subject to the conditions outlined in Article V. The total maximum daily quantity of water available to BUYER through both metering facilities will be 3.0 million gallons, plus the additional 1.0 million gallons during emergencies. The maximum instantaneous rate of delivery at the Lucy Webb Road Metering Facility is not expected to exceed 5.0 mgd.

b. Delivery Obligation: The extent of CITY's obligation to deliver water to BUYER shall not exceed the capacity of the facilities of CITY at any point of purchase nor shall such obligation exceed the provisions of this Agreement. The total quantity of water delivered to BUYER, during periods of normal operating conditions within CITY's distribution system, shall be limited to the above rates by the regulatory devices at or near the points of delivery to BUYER, and the settings of said regulatory devices shall be determined by the Director.

c. Curtailment: During any shortage of water, CITY may proportion the distribution of water among its customers to maintain efficient operation of the system. However, the percentage of decrease from normal usage shall not be greater for BUYER than for other water customers of CITY, it being the intention of the parties hereto, that in the event of rationing or limitation on amounts of water used, that the degree or percentage of rationing or limitation imposed upon BUYER shall be no greater than the degree or percentage of rationing imposed upon those other customers of CITY. In the event of a localized water shortage resulting from failures of either equipment or structures, the degree or percentage of rationing or limitation imposed upon BUYER shall be no greater than the degree or percentage of rationing or limitation imposed upon similarly situated customers of the CITY.

d. Control and Monitoring System:

1. Kentucky Road: BUYER agrees to operate a control system which varies the flow rate in incremental steps and to minimize large changes in flow rate which are detrimental to the efficient operation of the CITY Water System and may adversely affect other customers as well as the customers of BUYER. The control system must be able to reduce the flow rate to zero during specific hours of the day coincident with the peak demand on the CITY system. The CITY has the discretion to require that the flow be reduced or discontinued during the period from 5:00 PM to 11:00 PM during peak demand periods. If, at the discretion of CITY, the flow rate is reduced to zero (0), the maximum rate of delivery shall be increased during the period from 11:00 PM to 5:00 PM to allow for delivery of the maximum quantity per day.

e. Operating Records: BUYER agrees to provide, upon written request from CITY, any operations records needed to establish that said system is being operated to minimize flow rate fluctuations.

2. Quantity Exceedance: BUYER and CITY agree that, in the event the water supply requirement from CITY exceeds the maximum amount of water as provided herein, and therefore BUYER desires to increase the amount of water purchased from CITY, the parties will negotiate with the intent of entering into a new Water Purchase Agreement.

3. Meter Readings: The reading of the meters and the billing periods for each of the metering facilities, situated at the locations described in Article II herein, shall be monthly and the dates for such meter readings and billings shall be determined by CITY. CITY shall submit a separate monthly bill to BUYER for water purchased through each of the aforesaid metering facilities.

4. Payment Delinquency: BUYER agrees to be bound by all the Ordinances of CITY pertaining to the purchase and use of water and, in particular, authorizes CITY to shut off the supply of water to BUYER for any delinquency of more than sixty (60) days in the payment of any bill for water furnished to BUYER, or for any other bill submitted by CITY under the terms of this Agreement, subject to law.

5. Sole Source: BUYER and CITY agree that CITY shall be the sole source of water for the BUYER's system. BUYER may use other sources of supply during an emergency or any planned outage of the CITY source.

a. Annexation: BUYER and CITY agree that, in the event BUYER acquires a supplemental water supply by virtue of expanding its corporate boundaries through annexation, CITY shall continue to deliver water to BUYER and BUYER shall continue to purchase water from CITY. It is understood and agreed by both BUYER and CITY that annexation of areas served by other water suppliers does not constitute a supplemental water supply, unless and until that supply is connected to BUYER's distribution system. It is understood and agreed by both BUYER and CITY that BUYER agrees to provide CITY a one (1) year prior written notice before connecting its distribution system to any source other than CITY. It is understood and agreed by BUYER and CITY that the terms of this contract shall change from "sole source" to "dual source", at which time "water rates" (paragraph 7 below) will change to the Suburban Meter Rate / Wholesale Customer / Unrestricted, and minimums will be established equal to an average day's consumption based on the previous 12 months.

6. Storage: BUYER agrees that during normal and peak operating periods storage and pumping facilities shall be available and implemented to the fullest extent for the purpose of offsetting peak demands. BUYER currently has a 0.75 million gallon ground reservoir and a 0.5 million gallon elevated tank. BUYER's capacity in Tank is 1.0 million gallons which will bring BUYER's total storage to 2.25 million gallons.

a. Emergency Storage: BUYER understands and agrees that BUYER is responsible for constructing and maintaining emergency storage equal to an average day's consumption, during the term of this contract. Such emergency storage shall be in addition to equalizing storage required to minimize the changes in flow rates.

b. Equalizing Storage: The amount of storage required for equalizing storage is a minimum of one-quarter (1/4) of the maximum day's consumption. Equalizing storage is required for Sole Source customers on the Suburban Meter Rate / Wholesale Customer / Restricted. BUYER understands that if such storage is not maintained, the terms of this agreement will change to the Suburban Meter Rate / Wholesale Customer / Unrestricted.

7. Water Rate: BUYER agrees to pay for the amount of water received under this Agreement at the Suburban Meter Rate / Wholesale Customer / Restricted for commodity charge, plus service charge and repumping charge. It is understood that the Suburban Meter Rate is established by Chapter 78 of the Code of Ordinances of the CITY and may be amended from time to time by the Council of CITY. CITY shall provide BUYER no less than sixty (60) days prior written notice of such increase or decrease, along with CITY's cost of service study. The cost of service methodology shall be in accordance with an American Water Works Association (AWWA) approved water rate model. Should BUYER violate any of the service conditions stated in paragraphs 1, 5, and 6 above, then BUYER's rate category will change to the Suburban Meter Rate / Wholesale Customer / Unrestricted at the discretion of the Director. BUYER agrees to recognize the validity of these changes and agrees to pay the amended rate.

8. Water Usage: BUYER agrees that the water purchased under the terms of this Agreement shall be used solely within the boundaries now served by BUYER, or as they may be extended in the future, or as provided in paragraph 9 for resale.

9. Water Usage Resale:

a. Current Resale: BUYER currently has no resale customers.

b. Future Resale: Any other resale of water purchased from CITY for any use outside BUYER's service area, including water sold by the BUYER's resale customers to other water purveyors, shall require the prior written notification to Director of intent to sell. BUYER shall notify Director in writing 30 days prior to commencing sale of water and within 30 days after terminating any such customers.

10. Water Contract Termination - CITY: BUYER understands that in the event CITY believes BUYER has violated any of the conditions stated in Paragraphs 1 through 9 above, CITY shall notify BUYER in writing and BUYER shall have 30 days from the date of written notification to correct, or submit a plan, satisfactory to the Director, which will outline the plan and schedule for correction of said violation. In the event the

violation is not corrected or a mutually satisfactory plan submitted within 30 days, the CITY may notify BUYER of its intention to terminate the agreement thirty (30) days thereafter in absence of any corrective action by BUYER. BUYER agrees that any of BUYER's remaining obligation for the engineering and construction costs of the Facilities described in Article IV, if any, shall continue to be paid monthly to CITY as originally agreed between the BUYER and CITY.

11. Contract Termination - BUYER: BUYER and CITY agree that BUYER may cease its purchase of water through any, but not all, of the metering facilities provided for in Article III herein after one (1) year written notification to Director, without contract termination. BUYER may terminate this agreement after five (5) years written notification to the Director. BUYER agrees that any of the BUYER's remaining obligation for the engineering and construction costs of the improvements described in Article IV shall be paid to CITY within 180 days of termination.

a. CITY understands that if CITY violates the terms of this agreement, BUYER shall have a right to terminate this Agreement after giving notices as set out in Paragraph 10 above.

12. Water Quality Requirements - CITY: CITY agrees that the water delivered to BUYER at the aforesaid metering facilities shall be of the same quality as that which is furnished to CITY's individual customers. BUYER agrees to hold CITY harmless to the extent permitted by the laws of the State of Missouri from any and all claims which may arise due to the physical, chemical, or biological quality of water in BUYER's system and further agrees to hold CITY harmless for damages or injuries sustained arising out of any operation connected with its water system unless it can be proved that such is due to the negligence or fault of CITY.

13. Access To Water Quality Analysis: CITY agrees to provide BUYER with the results of any water quality analyses required by applicable Federal or Missouri State statutes or regulations.

14. Water Quality Requirements - BUYER: BUYER agrees and understands that BUYER is solely responsible for performing all water quality testing and related testing within BUYER's system as presently required by regulatory authority or as required anytime in the future. BUYER understands that CITY will have no obligation whatsoever regarding the above said testing and agrees to hold CITY harmless, to the extent permitted by the laws of the State of Missouri, from any and all claims which may arise due to said testing unless it can be proved that such is due to the negligence or fault of CITY.

15. Water Repurchase: CITY shall have the right during the term of this Agreement to purchase water from BUYER at locations as set forth in Article II herein. CITY agrees to pay commercial or wholesale rates for water purchased under this Agreement in accordance with that part of BUYER's rules and regulations governing the sale of water. It is understood that the cost of water and related charges may be amended from time to time by BUYER and that CITY recognizes the validity of these changes and

agrees to pay any pumping charge and any service charge included in said rules and regulations.

16. Water Repurchase - Water Quality: BUYER agrees that water delivered to CITY at the aforesaid metering facilities shall be of the same quality as that which is furnished to BUYER's individual customers. CITY agrees to hold BUYER harmless, to the extent permitted by the laws of the State of Missouri, from any and all claims which may arise due to the physical, chemical, or biological quality of water in CITY's system and further agrees to hold BUYER harmless for damages or injuries sustained arising out of any operation connected with its water system unless it can be proved that such is due to the negligence or fault of BUYER.

17. Water Repurchase - Access to Water Quality Analysis: If BUYER sells water to CITY, BUYER agrees to provide CITY with the results of any water quality analyses required by applicable Federal or Missouri State statutes or regulations.

18. Water Quality Testing: CITY agrees and understands that CITY is solely responsible for performing all water quality testing and related testing within CITY's system as presently required by regulatory authority or as required anytime in the future. CITY understands that BUYER will have no obligation whatsoever regarding the above said testing and agrees to hold BUYER harmless to the extent permitted by the laws of the State of Missouri from any and all claims which may arise due to said testing.

19. Antenna Placement: CITY agrees to allow placement of BUYER's antennas on the Tank to be used solely for the purpose of facilitating normal municipal functions. All requests for antenna placement shall be submitted to the Director in writing for approval. No antennas for commercial applications will be allowed.

ARTICLE IV
TRANSMISSION MAIN, ELEVATED TANK, AND PUMP STATION DESIGN AND CONSTRUCTION

1. Engineering Services: BUYER and CITY agree that a Main, Tank, and Pump Station will be necessary to transport water from the CITY's existing system to BUYER's Lucy Webb Road Metering Facility. CITY will reserve capacity in the Main, Tank, and Pump Station to serve other customers. BUYER will share in the cost of engineering of the Main, Tank, and Pump Station in direct proportion to the capacity reserved for BUYER versus the capacity reserved for CITY's other customers.

2. Main, Tank, and Pump Station Construction: BUYER and CITY agree that the CITY will construct, or have constructed at CITY's cost, the Main, Tank, and Pump Station and that an outlet will be provided with a valve, for the BUYER's connection to the Lucy Webb Road Metering Facility. However, BUYER and CITY understand and agree that all such costs will be included in the water delivery facilities fixed costs (Article VI, paragraph 3). The hydraulic characteristics of the Pump Station and Tank will be such that the hydraulic gradient on the BUYER's side of the Metering Facility at

the maximum instantaneous delivery rate will complement the overflow gradient of BUYER's existing elevated tank.

3. Construction Costs Exclusions: The cost of construction specifically excludes the cost of any connections to metering facilities, the cost of any metering facility or appurtenance thereto, or the cost of obtaining property or easements for any such connection or metering facility.

4. Easements / Property:

a. CITY: CITY agrees to obtain all necessary easements for the construction of the Main and Pump Station. The cost of easement acquisition will be included in the construction costs to be shared by the parties. BUYER understands and agrees that these easements are necessary for the construction and maintenance of the facilities, and as such, will remain the property of CITY, and that CITY will have all rights, title, and interest granted therein, and that BUYER shall have no interest therein.

b. BUYER: BUYER agrees to be solely responsible for the acquisition of all easements, permits or land necessary to accommodate construction of all mains to be owned by the BUYER. BUYER and CITY agree that the cost of easement or land on which the Tank is constructed will be part of the total construction cost and will be shared by the BUYER and CITY in direct proportion to the capacity reserved in the Tank versus the capacity reserved for CITY's other customers.

ARTICLE V
METERING & REGULATING FACILITIES

1. Specifications: BUYER agrees to have Metering Facilities at the point of service identified in Article II designed and constructed in complete accordance with CITY's Water Department's "Specifications for Water Main Extensions and Relocations" dated January 1, 1983 and "Regulations of the Water Services Department" dated March, 2000, including any supplements to or revisions thereof, and any other requirements of the WSD. The drawings and specifications for these Metering Facilities shall be submitted by BUYER to CITY for review and approval in writing by the Director prior to the start of any construction.

2. Easements, Rights-of-Way or Leases: BUYER agrees to be solely responsible for the acquisition of the easements or land necessary to accommodate these Metering Facilities, including provisions for CITY's permanent access to them.

3. Construction Records: BUYER agrees that, following CITY's approval of the drawings and specifications for construction of the Metering Facility, BUYER will provide to CITY reproducible Mylar drawings and either Microstation or DXF files, on 3 1/2" magnetic disk media, which have been verified to contain all of the elements of the

original drawings. BUYER further agrees that the aforesaid materials shall become and remain the property of CITY.

4. Construction: BUYER agrees that, upon issuance of a Water Service Permit by the WSD, BUYER shall proceed to construct these Metering Facility complete with valves, fittings, meters, pressure regulators, power supply and all other appurtenant items including access to the site, and understands that BUYER will pay all costs related to said construction including, but not limited to, land and all rights-of-way, engineering, procurement and processing of permits required by any governmental body, actual construction costs, and all inspection costs. BUYER recognizes that CITY shall have no financial obligation therefore, except issuance of the aforesaid Water Service Permit, which shall be issued to BUYER without payment of any permit fee.

5. Ownership, Repair, Adjustments: BUYER agrees that any meters and regulators to be installed in any Metering Facility shall be of a size and type to be determined by Director. BUYER understands and agrees that, upon acceptance by CITY, the meters and regulators in these Metering Facilities shall become, and shall remain the property of CITY, and CITY shall have the right to remove, inspect, test, repair, or replace any meter or regulator at any time. When such inspection indicates that any meter or regulator is measuring inaccurately and when this discrepancy can be corrected by repair, then CITY shall repair the defective meter or regulator and shall bear the cost thereof. In the event that accuracy cannot be restored by repair, then CITY shall replace the meter or regulator at its expense. BUYER shall also have the right to request removal and testing of any meter or regulator by an independent expert, at the expense of BUYER, in order to determine the accuracy of the meter or regulator. If a meter test shows that the meter is measuring with an accuracy of ±1.5%, no billing adjustment shall be made. If the meter accuracy is determined to be less accurate than ±1.5%, any credits or debits to previous bills shall be estimated based upon the facts of the situation. In no case shall such billing adjustments be made to bills prior to six months before the inaccuracy was discovered.

6. Inspection: BUYER agrees that all work in constructing each of these Metering Facilities shall be open to inspection by CITY.

7. Facility Maintenance: BUYER understands and agrees that, upon completion and upon CITY's acceptance of the Metering Facility, BUYER shall be solely responsible for the maintenance of said facility, including the site, access to the site, power supply and all other appurtenances thereto, with the exception that CITY shall be solely responsible for the maintenance of the aforesaid meters, regulators, and any associated equipment which CITY may later install pursuant to Paragraph 9 below.

8. Facility Access: BUYER agrees to provide CITY access at all times, to the metering facilities described herein, for the maintenance of CITY's meters, regulators, and associated equipment.

9. Telemetry / Regulating Systems: BUYER and CITY grant to each other the right to utilize any of the metering/regulating facilities provided for herein for the

installation of telemetry control and monitoring systems, pressure and flow regulating devices, and unauthorized-intrusion alarms. It is understood that CITY shall be solely responsible for the installation costs and maintenance of such equipment installed by CITY, and that BUYER shall be solely responsible for the installation costs and maintenance of such equipment installed by BUYER, except that BUYER agrees to provide electric power for CITY's equipment, at BUYER's cost.

ARTICLE VI
FINANCIAL CONSIDERATIONS

1. Capital Cost:

   a. Main: The design capacity of the 24" Main is 9.0 MGD and BUYER reserves a right to 2.0 MGD of that capacity for the term of this agreement. BUYER and CITY will share in the cost of the engineering and construction (including the cost of any necessary easements) of the Main to the point of outlet, in proportion to the Main's capacity reserved for each. BUYER's pro-rata share of the engineering and construction cost (Article IV, paragraph 2) is therefore 22.22% of the total construction, engineering and easement costs of the Main.

   b. Tank: The capacity of the Tank is 1.5 million gallons, and BUYER reserves a right to 1.0 million gallons of that capacity for the term of this Agreement. BUYER and CITY will share in the cost of engineering and construction (including the cost of any necessary easements or land) in proportion to the Tank's capacity reserved for each. BUYER's pro-rata share of the engineering and construction costs (Article IV, paragraph 2) is therefore 66.67% of the total construction, engineering, and land and easement costs.

   c. Pump Station: The design capacity of the Pump Station is 20.0 million gallons per day and BUYER reserves a right to 2.0 million gallons of that capacity for the term of this Agreement. BUYER and CITY will share in the cost of engineering and construction (including the cost of any necessary easements or land) in proportion to the Pump Station's capacity reserved for each. BUYER's pro-rata share of the engineering and construction costs (Article IV, paragraph 2) is therefore 10.0% of the total construction, engineering, and easement costs.

2. Actual Costs: Actual cost shall be determined after design is completed, easements obtained and construction has been completed. BUYER's percentage contribution shall remain the same regardless of the final cost.

3. Water Delivery Facilities Fixed Costs: The reimbursement by BUYER of its pro-rata share of the costs to construct the water delivery facilities in accordance with the terms of this Agreement shall be made in equal monthly installments, beginning with the first payment 30 days after notification to BUYER that the Main is complete and water is available for usage. In addition to the amount set forth with respect to BUYER's pro-

rata share of the costs of such water delivery facilities, BUYER shall pay CITY for the costs to finance such amounts. Such actual costs shall be determined at the time of initial water service and shall be based upon the most recent sale of water revenue bonds. The payments for such costs shall be amortized over a twenty (20) year term commencing on the delivery start date and shall be over such period.

4. Financial Assistance: CITY agrees to seek and make application for any financial assistance which may be available for the development of a regional water supply plan. Any assistance obtained will be applied to proportionately reduce the capital costs. If assistance is obtained for a specific community (s) and not the entire project, the assistance will go to the community (s) that qualified for assistance.

ARTICLE VII
EXECUTION

This Agreement shall become effective only after it has been authorized by the governing body of the City of BUYER, and signed by BUYER's Mayor, and authorized by an Ordinance of CITY, and signed by Director; certified copies of said Ordinances being attached hereto and thereby made a part of this Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their respective representatives, thereunto duly authorized, as of the day and year first above written.

(SEAL)

CITY OF RAYMORE, MISSOURI

BY: _____
Mayor

ATTEST:

_____
Clerk

Approved as to form and legality:

_____
City Attorney

(SEAL)

CITY OF KANSAS CITY, MISSOURI

BY: _____
Director of Water Services

Approved as to form and legality:

_____
City Attorney

#02009

ORDINANCE NO. 011127

Authorizing a Cooperative Agreement for Water Purchase between Kansas City, Missouri and the City of Raymore, Missouri for a term of twenty (20) years; and directing the City Clerk to record same.

BE IT ORDAINED BY THE COUNCIL OF KANSAS CITY:

Section 1. That the Director of Water Services is hereby authorized to execute, on behalf of Kansas City, a Cooperative Agreement for Water Purchase between Kansas City, Missouri and the City of Raymore, Missouri for a 20-year term. A copy of the Agreement is on file in the office of the Director of Water Services.

Section 2. That upon the effective date of said Agreement, the City Clerk is directed to cause a copy of this ordinance and of the Agreement to be recorded in the office of the Recorder of Deeds for Cass County, Missouri, and with the Secretary of State of Missouri, in accordance with Section 70.300, R.S.Mo. (1994).

Approved as to form and legality:

Assistant City Attorney

Authenticated as Passed

KAY BARNES, Mayor

Catherine T. Rocha, City Clerk

DATE PASSED AUG 16 2001

Cost Data

Table A1

Tank Opinion of Probable Cost

Item	Total Cost
1.0 MG Tank - 140 feet Tall:	
Standard Tank	1,200,000
Foundation	180,000
Piping/Altitude Valve	20,000
Site Work/Access Road/Fence/Security	100,000
Grounding/Controls/Lighting	20,000
Subtotal	1,520,000
Contingency @ 25%	380,000
Subtotal	1,520,000
Other Costs @ 15%	230,000
Project Cost (1.0 MG Tank)	**1,750,000**
1.5 MG Tank - 140 feet Tall:	
Standard Tank	1,600,000
Foundation	240,000
Piping/Altitude Valve	20,000
Site Work/Access Road/Fence/Security	100,000
Grounding/Controls/Lighting	20,000
Subtotal	1,980,000
Contingency @ 25%	500,000
Subtotal	1,980,000
Other Costs @ 15%	300,000
Project Cost (1.5 MG Tank)	**2,280,000**
2.0 MG Tank - 140 feet Tall:	
Standard Tank	2,000,000
Foundation	300,000
Piping/Altitude Valve	20,000
Site Work/Access Road/Fence/Security	100,000
Grounding/Controls/Lighting	20,000
Subtotal	2,440,000
Contingency @ 25%	610,000

Table A1

Tank Opinion of Probable Cost

Item	Total Cost
Subtotal	2,440,000
Other Costs @ 15%	370,000
Project Cost (2.0 MG Tank)	**2,810,000**
2.5 MG Tank - 140 feet Tall:	
Standard Tank	2,400,000
Foundation	360,000
Piping/Altitude Valve	20,000
Site Work/Access Road/Fence/Security	100,000
Grounding/Controls/Lighting	20,000
Subtotal	2,900,000
Contingency @ 25%	730,000
Subtotal	2,900,000
Other Costs @ 15%	440,000
Project Cost (2.5 MG Tank)	**3,340,000**

Table A2

Tank Opinion of Probable Cost Comparison

Item	Cost	Raymore Portion
Two Tanks (2.0 MG Capacity):		
1.0 MG of 1.5 MG Capacity	2,280,000	1,530,000
1.0 MG	1,750,000	1,750,000
Total		**3,280,000**
One Tank:		
2.0 MG		**2,810,000**
Savings		**470,000**

Improvement Figures

U:\Ray_WMP\ARC\ArcDocs\FigureX_MeterStation3Improvements.mxd cgb 06/21/04

N4180
P1535
N5282
S. Kurzweil Rd.
P22
Walnut St.
N5283
V3
P7350
P7351
N7190
Lincoln Rd.

NORTH

100 0 100 Feet

Legend

- Water Distribution Valve
- *Water Distribution Node*

Pipe Diameter

- 8
- 12
- 16
- 24

Improvement Category

- 2030 Improvement
- 2009 Improvement
- Parcels
- Roads

Burns & McDonnell SINCE 1898

Priority A2
Meter Station 3 and
16" Parallel Line
Recommended Improvement

Raymore, MO

Hardee St.
Spring Valley Rd.
Harold Dr.
Ashley Ct.
Hampton Ct.
P9030
N6669
170th St.
Clint Dr.
171st St.
171st St.
P9028
P9100
T4
P9204
P9098
N3280
N4553
N6716
N5200
P9000
Foxwood Dr.
N4572
P9212
N7031
Dean Ave.
NORTH
200 0 200
Feet

Legend

- Tanks
- *Water Distribution Node*

Pipe Diameter

- 6
- 8
- 12
- 16
- 24

Improvement Category

- 2014 Improvement
- 2009 Improvement
- Raymore City Limits
- Parcels
- Roads

Burns & McDonnell SINCE 1898

Priorities A4, B3
Kentucky and Foxwood
Recommended Improvements

Raymore, MO

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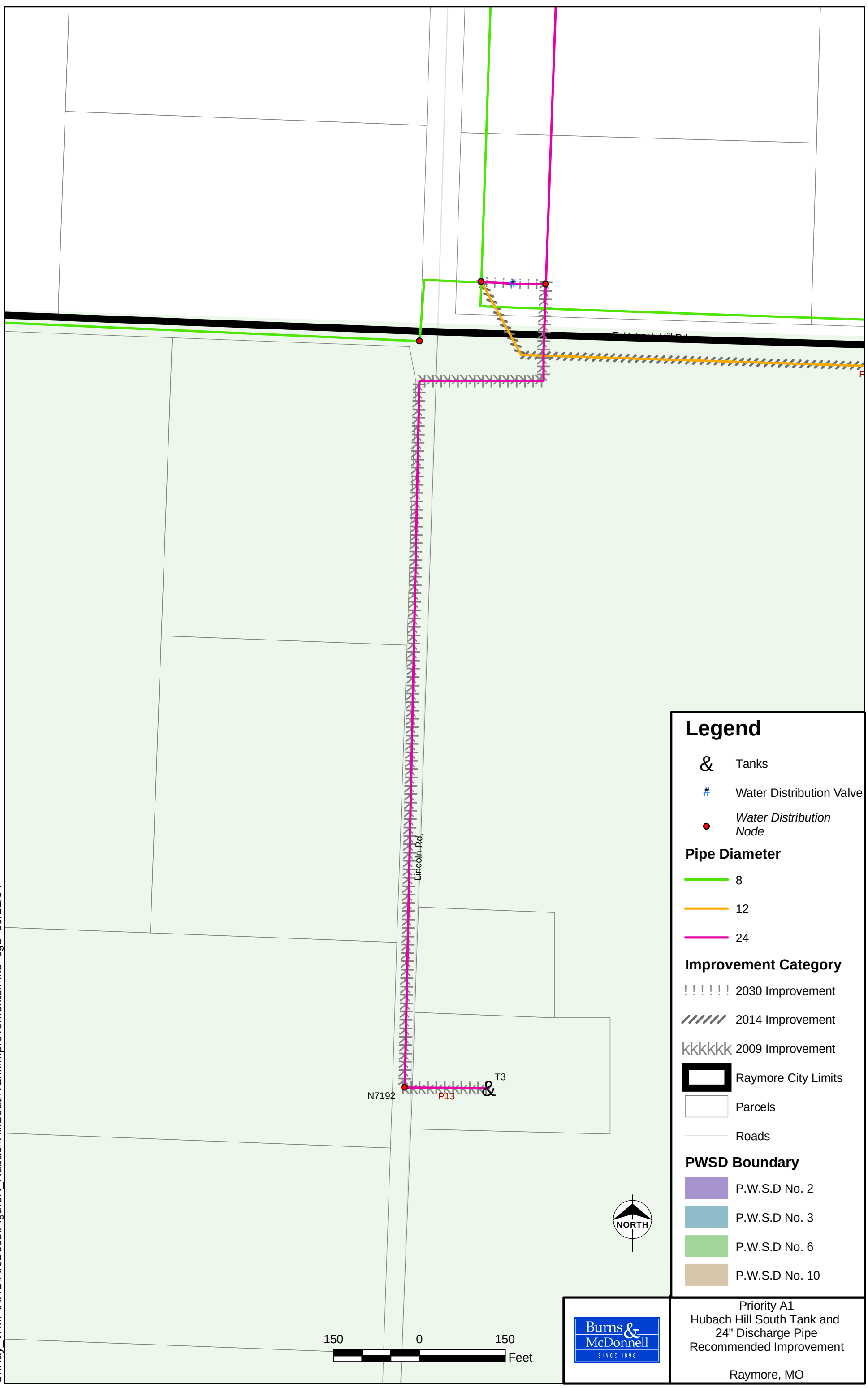
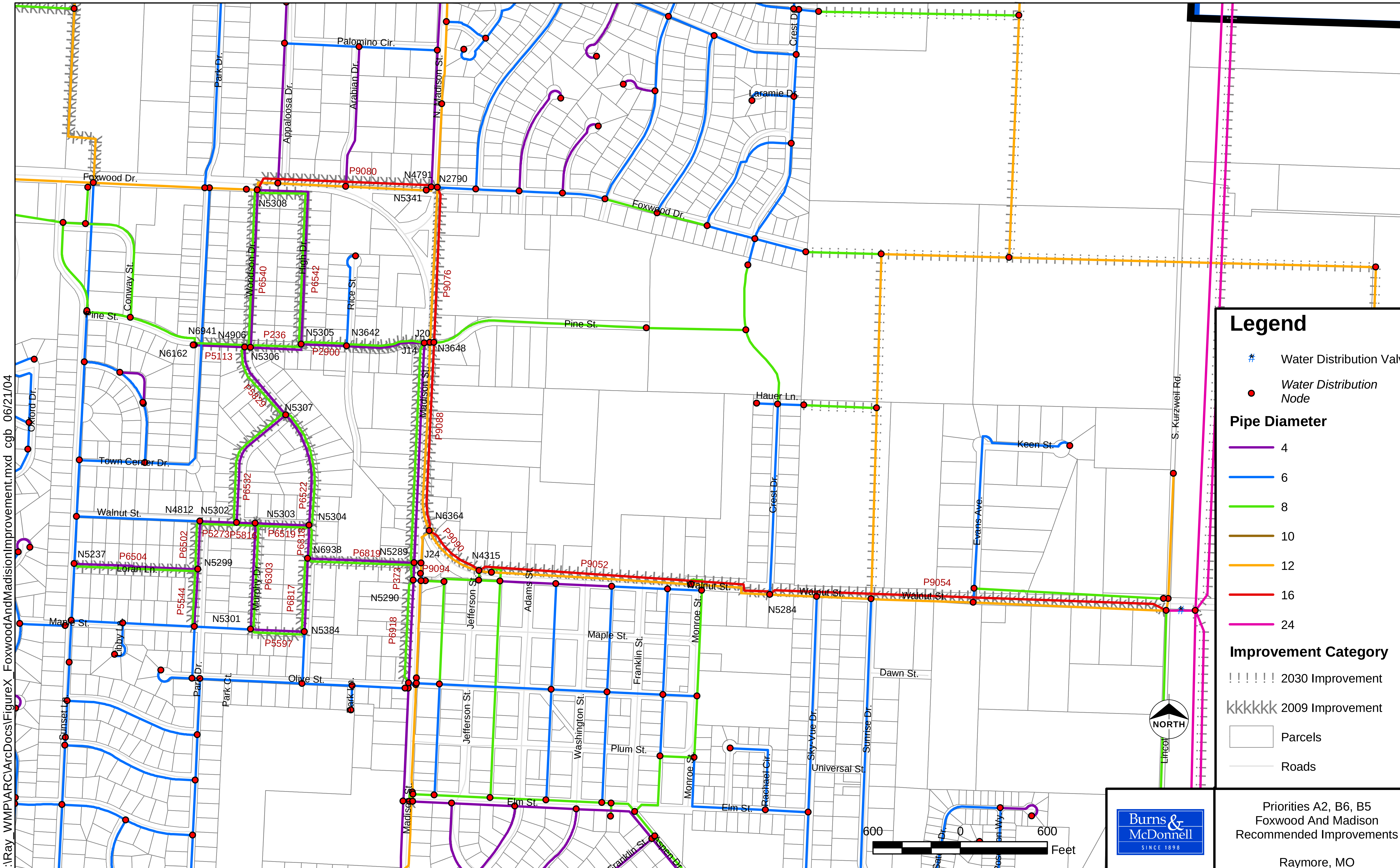

Lincoln Rd.
N7192
P13
T3
NORTH
150
0
150
Feet
U:\Ray_WMP\ARC\ArcDocs\FigureX_HubachHillSouthTankImprovements.mxd cgb 06/21/04
Legend
Tanks
Water Distribution Valve
Water Distribution Node
Pipe Diameter
8
12
24
Improvement Category
2030 Improvement
2014 Improvement
2009 Improvement
Raymore City Limits
Parcels
Roads
PWSD Boundary
P.W.S.D No. 2
P.W.S.D No. 3
P.W.S.D No. 6
P.W.S.D No. 10
Burns & McDonnell
SINCE 1898
Priority A1
Hubach Hill South Tank and
24" Discharge Pipe
Recommended Improvement
Raymore, MO



U:\Ray_WMP\ARC\ArcDocs\FigureX_FoxwoodAndMadisionImprovement.mxd cgb 06/21/04

U:\Ray_WMP\ARC\ArcDocs\FigureX_B7HeronBetweenFalconandLincolnImprovements.mxd cgb 06/21/04

N5265

Heron St.

P6994

N6993

Lincoln Rd.

Falcon St.

NORTH

100 0 100 Feet

Legend

Water Distribution Node

Pipe Diameter

6

8

24

kkkkkk 2009 Improvement

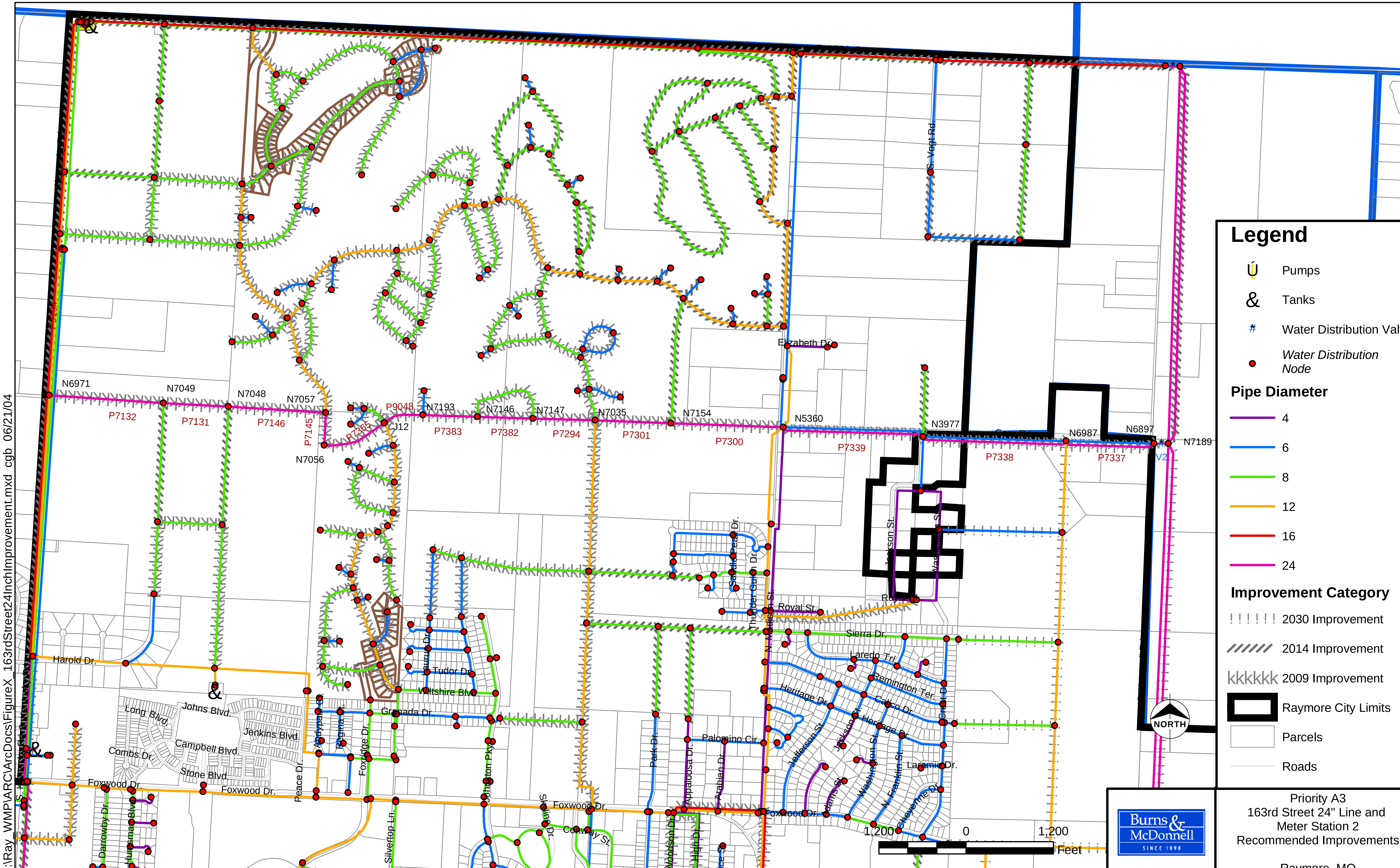
Parcels

Roads

Burns & McDonnell SINCE 1898

Priority B7
6" Proposed Line at Heron Between Falconand Lincoln
Recommended Improvement

Raymore, MO



Burns & McDonnell
SINCE 1898

Priority A3
163rd Street 24" Line and Meter Station 2
Recommended Improvements

Raymore, MO

U:\Ray_WMP\ARC\ArcDocs\FigureX_163rdStreet24InchImprovement.mxd cgb 06/21/04

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N5289

P9094

J24

Walnut St.

Madison St.

Madison St.

NORTH

50 0 50 Feet

Legend

Water Distribution Node

Pipe Diameter

4

6

8

12

16

kkkkkk 2009 Improvement

Parcels

Roads

Burns & McDonnell SINCE 1898

Priorities B5
12" Proposed Line Near
Foxwood And Madison
Recommended Improvements

Raymore, MO

U:\Ray_WMP\ARC\ArcDocs\FigureX_12InchFireFlowNorthSierraNortMadisonImprovement.mxd sar 09/17/04

Saddle Peak Dr.
Madison Creek Dr.
Saddle Ridge Ct.
Thunder Gulch Dr.
Spring Branch Dr.
N Madison St.
Royal St.
P9114
Jackson St.
Washington St.
Royal St.
Sierra Ct.
Sierra Dr.
Laredo Ct.
N. Washington St.
Laredo Trl.
Calico Dr.
Jackson St.
Heritage Dr.

Legend

- Water Distribution Valve
- *Water Distribution Node*

Pipe Diameter

- 4
- 6
- 8
- 12

Improvement Category

- 2030 Improvement
- 2014 Improvement
- 2009 Improvement
- Raymore City Limits
- Parcels
- Roads

NORTH

200 0 200 Feet

Burns & McDonnell SINCE 1898

Priority B4
12" Fire Flow North of Sierra Dr.
Recommended Improvement

Raymore, MO

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Jefferson St.

Elm St.

P9228

kkkkk

Madison St.

NORTH

50 0 50 Feet

Legend

Water Distribution Node

Pipe Diameter

4

8

12

Improvement Category

kkkkkk 2009 Improvement

Parcels

Roads

Burns & McDonnell SINCE 1898

Priority B11
8" Proposed Line
South of Original Raymore
Recommended Improvement

Raymore, MO

U:\Ray_WMP\ARC\ArcDocs\FigureX_8InchProposedLineSouthOriginalRaymoreImprovementB12.mxd cgb 06/21/04

Plum St.
Adams St.
Franklin St.
Monroe St.
Rachael Cir.
Universal St.
Elm St.
Elm St.
Franklin St.
Monroe St.
Aspen Dr.
Vue Dr.

244
J52
N5272
J54
N5274
N5245
N5273
N5276
J56
N5277
P5240

150 0 150 Feet

NORTH

Legend

Water Distribution Node

Pipe Diameter

4
6
8
12

kkkkkk 2009 Improvement

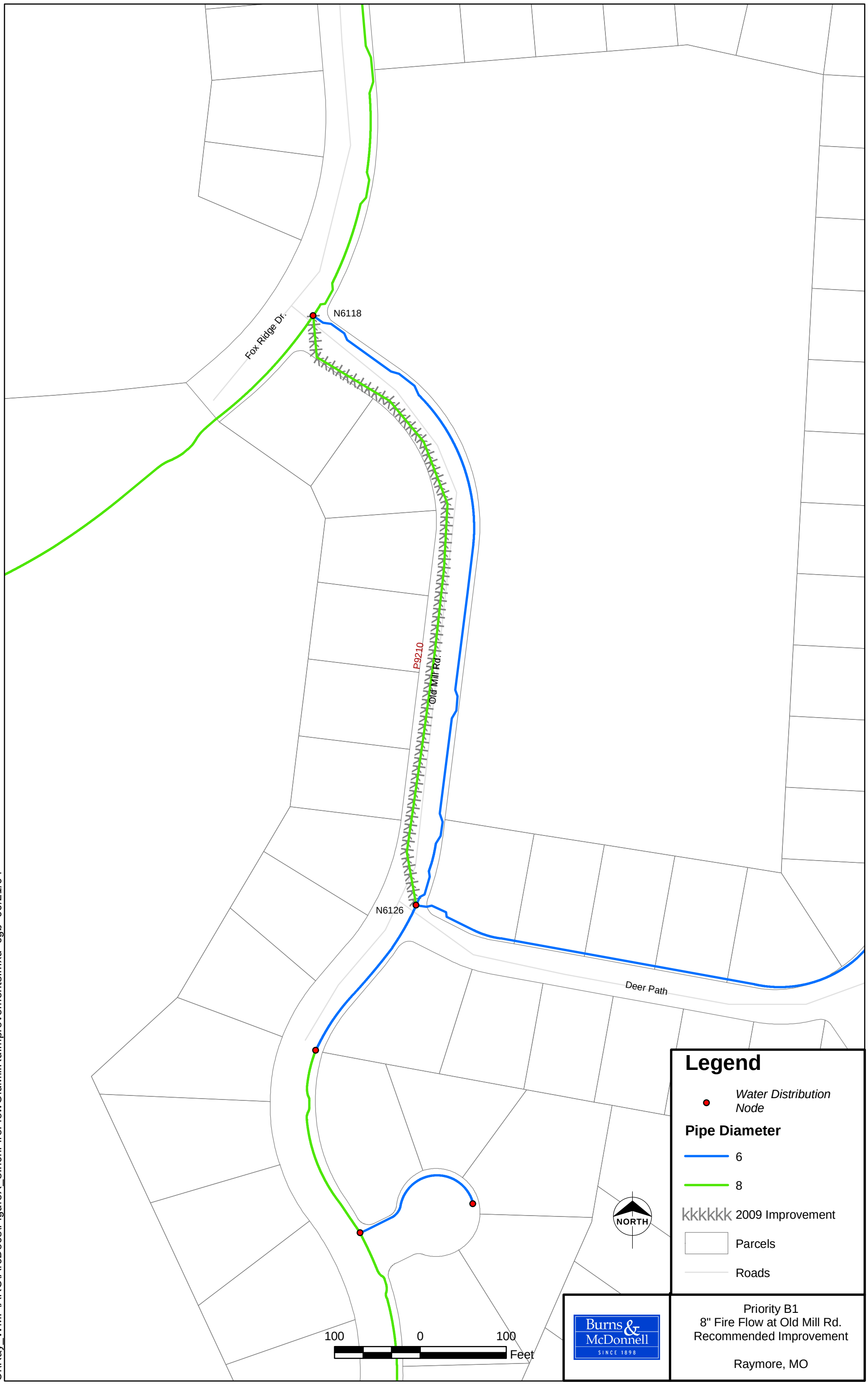
Parcels

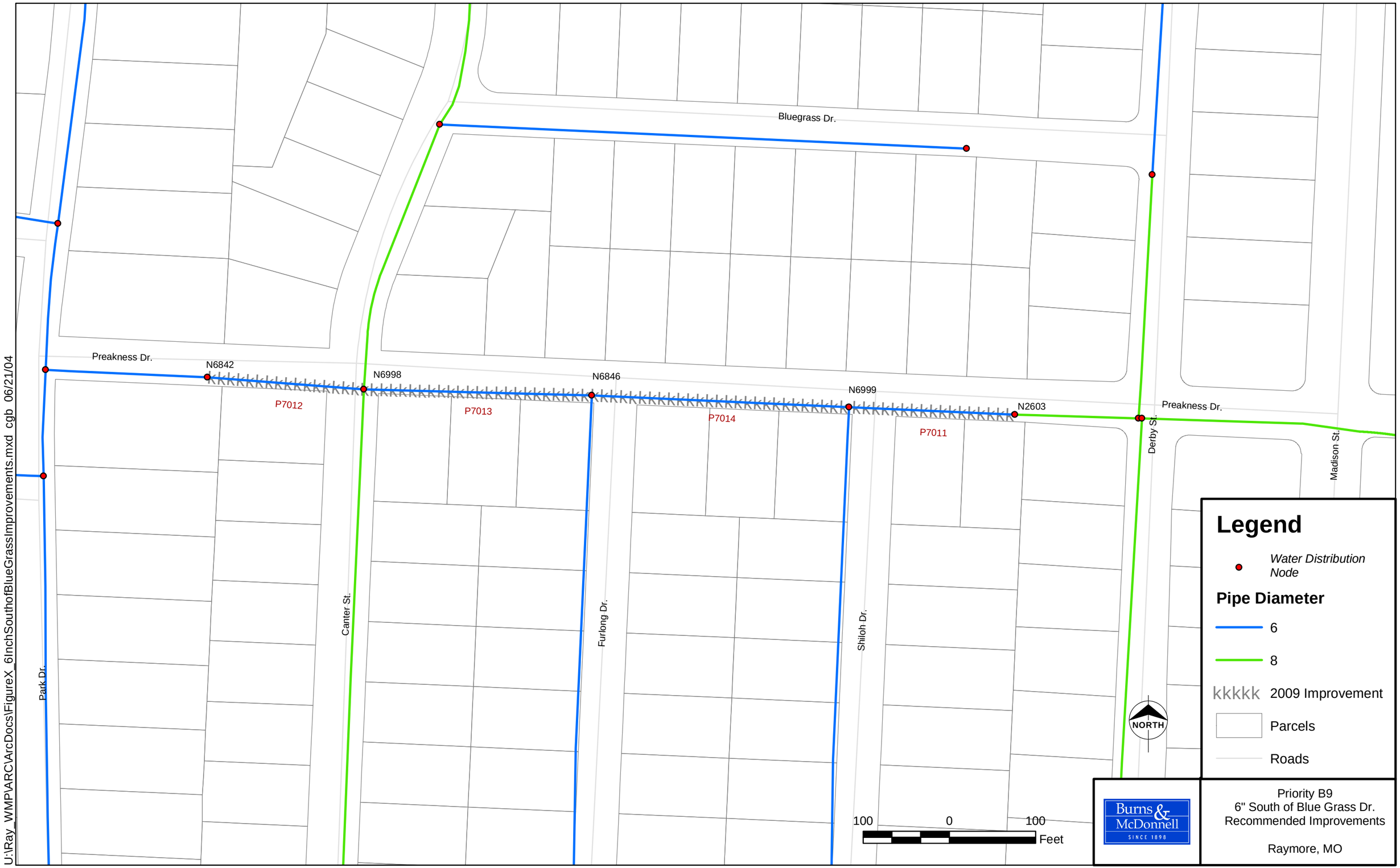
Roads

Burns & McDonnell SINCE 1898

Priority B12
8" Proposed Line
South of Original Raymore
Recommended Improvements

Raymore, MO


N6118
Fox Ridge Dr.
P9210
Old Mill Rd.
N6126
Deer Path
NORTH
100
0
100
Feet
Legend
Water Distribution Node
Pipe Diameter
6
8
2009 Improvement
Parcels
Roads
Burns & McDonnell
SINCE 1898
Priority B1
8" Fire Flow at Old Mill Rd.
Recommended Improvement
Raymore, MO
U:\Ray_WMP\ARC\ArcDocs\FigureX_8InchFireFlowOldMillRdImprovements.mxd cgb 06/21/04


Bluegrass Dr.
Preakness Dr.
N6842
N6998
N6846
N6999
N2603
P7012
P7013
P7014
P7011
Preakness Dr.
Derby St.
Madison St.
Park Dr.
Canter St.
Furlong Dr.
Shiloh Dr.
NORTH
100
0
100
Feet
Legend
Water Distribution Node
Pipe Diameter
6
8
kkkkk 2009 Improvement
Parcels
Roads
Burns & McDonnell
SINCE 1898
Priority B9
6" South of Blue Grass Dr.
Recommended Improvements
Raymore, MO
U:\Ray_WMP\ARC\ArcDocs\FigureX_6InchSouthofBlueGrassImprovements.mxd cgb 06/21/04

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E. Lucy Webb Rd.

P9224

Madison St.

Belmont Dr.

Derby St.

NORTH

50 0 50 Feet

Legend

Water Distribution Node

Pipe Diameter

4

6

12

Improvement Category

kkkkkk 2009 Improvement

Parcels

Roads

Burns & McDonnell SINCE 1898

Priority B10
4" Proposed Line
South of Original Raymore
Recommended Improvement

Raymore, MO

U:\Ray_WMPVARC\ArcDocs\FigureX_SunAndPoseidonImprovements.mxd cgb 06/21/04

Saturn Dr.
Poseidon Wy.
Sunrise Dr.
N6997
Sun Dr.
Sun Dr.
Sun Ct.
Saturn Dr.
Mars Ct.
Poseidon Dr.
P7007
Saturn Dr.
P9218
N6858
Twilight Dr.
Twilight Dr.
Twilight Ct.
N6495
Horizon Pky.
E. Lucy Webb Rd.

100 0 100 Feet

NORTH

Legend

Water Distribution Node

Pipe Diameter

6

8

12

Improvement Category

kkkkkk 2009 Improvement

Parcels

Roads

Burns & McDonnell SINCE 1898

Priorities B2, B8
Sun and Poseidon
Recommended Improvements

Raymore, MO