

Preliminary Hydrologic Comparison of Demonstration CSO Facilities

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Rouge Watershed CSO Workgroup:

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Oakland County

Wayne County

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Bloomfield Township

City of Beverly Hills

City of Birmingham

City of Bloomfield Hills

City of Dearborn Heights

City of Detroit

City of Inkster

Redford Township

Preliminary Hydrologic Comparison of Demonstration CSO Facilities

<u>Data Reporting Period:</u>	Official Start-Up through September 30, 1998
<u>No. Of Facilities:</u>	Six
<u>Data Status:</u>	Preliminary
<u>Special Notes:</u>	Dearborn Heights data are used selectively due to impacts from known North Huron Valley/Rouge Valley interceptor surcharging problem, which is being addressed by a nearly completed interceptor pump station.

- I. Background Information
- II. Annualized Operating Statistics
- III. Actual Basin Detention Times
- IV. Volumetric Performance
- V. Additional Observations
- VI. Next Steps

I. Background Information

Facility Basis of Design

- Five of the six facilities with monitoring data available are demonstration size basins sized to 20 or 30 minutes of detention.
- The remaining facility is sized per one aspect of MDEQ's adequate treatment guidance.*
- In three main areas there was significant variability between basin designers in the design approaches/assumptions used:
 - The selected rainfall distribution within the peak hour of the design storm.
 - The modeling approach used to determine the influent hydrograph for the proposed basin given the selected rainfall distribution.
 - the method used to calculate the required basin volume given the influent hydrograph for the design storm.

Basin	Sizing Criteria	Design Detention Time (minutes)	Design Storm
Inkster	Demonstration	20	1 year, 1 hour (1 in)
Redford	Demonstration	20	1 year, 1 hour (1 in)
Acacia Park	Demonstration	30	1 year, 1 hour (1 in)
Birmingham	Demonstration	30	1 year, 1 hour (1 in)
Bloomfield Village	Demonstration	30	1 year, 1 hour (1 in)
Dearborn Heights	Portion of MDEQ Guidance*	30	10 year, 1 hour (1.75 in)

* MDEQ's Adequate Treatment Guidance is sizing a basin to capture the 1 year, 1 hour storm event *and* provide a minimum of 30 minutes of detention for the 10 year, 1 hour storm event. The Dearborn Heights basin was designed *only* to provide 30 minutes of detention for the 10 year, 1 hour storm.

I. Background Information

Monitoring Duration and Key Basin Information

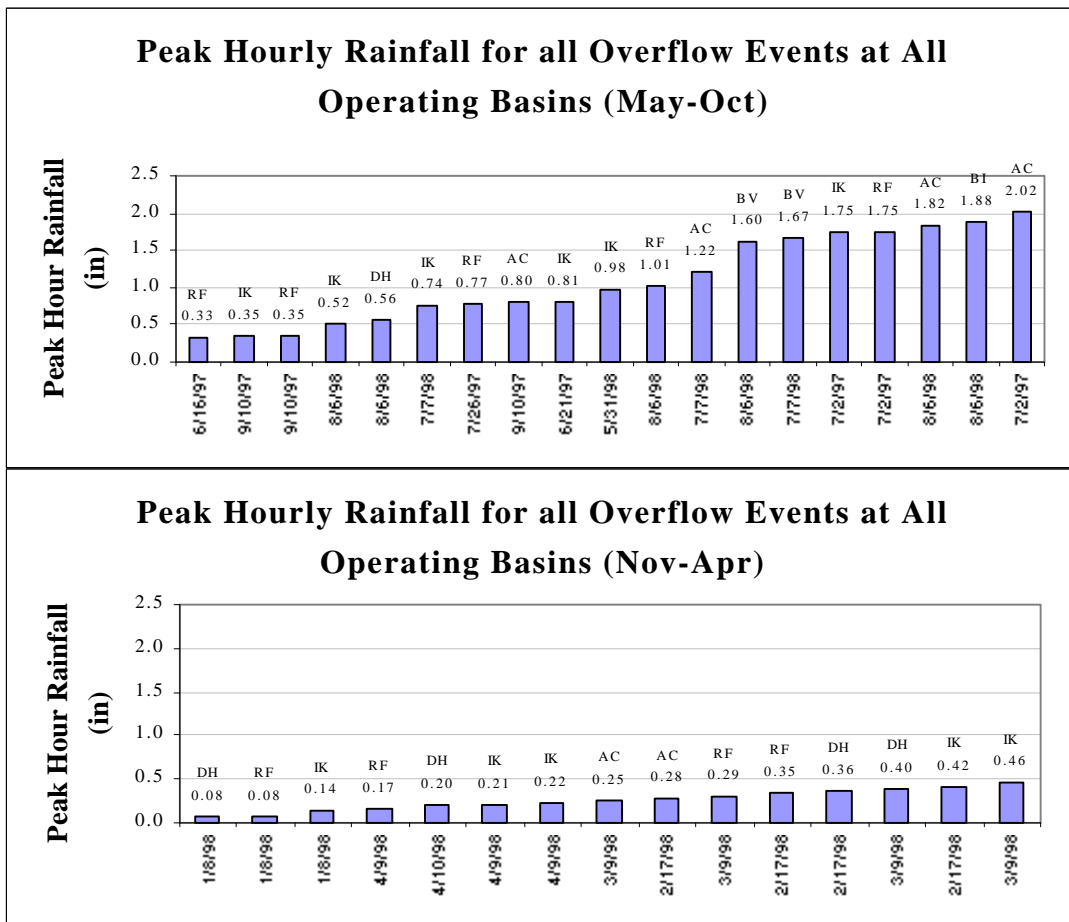
Basin	Combined/ Storm Drainage Area (acres)	Separate Sanitary Drainage Area (acres)	Basin Volume (MG)	Basin Volume (in*)	Months Monitored		
					May- Oct	Nov- Apr	Total
Inkster	838	548	3.1	0.14	10	6	16
Redford	669	1622	1.9	0.10	10	6	16
Acacia Park	816	0	4.0	0.18	8	6	14
Birmingham	1185	0	5.5	0.17	5	1	6
Bloomfield Village	1735	590	10.0	0.21	5	4	9
Dearborn Heights	360	0	2.7	0.28	7	6	13

* inches over combined/storm drainage area

I. Background Information

Seasonal Rainfall Variations

- There are strong seasonal differences in the peak hour intensity of the rainfall events that have caused basin overflows to occur. Therefore various results in this document are shown by season.
- Peak hour rainfall totals in November through April ranged from 0.1 to 0.5 inches.
- Peak hour rainfall totals in May through October ranged from 0.3 to 2.0 inches.
- The peak hour rainfall of the two design storms used in sizing the six basins discussed herein (1 inch for the 1 year, 1 hour storm and 1.75 inches for the 10 year, 1 hour storm) have only occurred between the months of May through October.

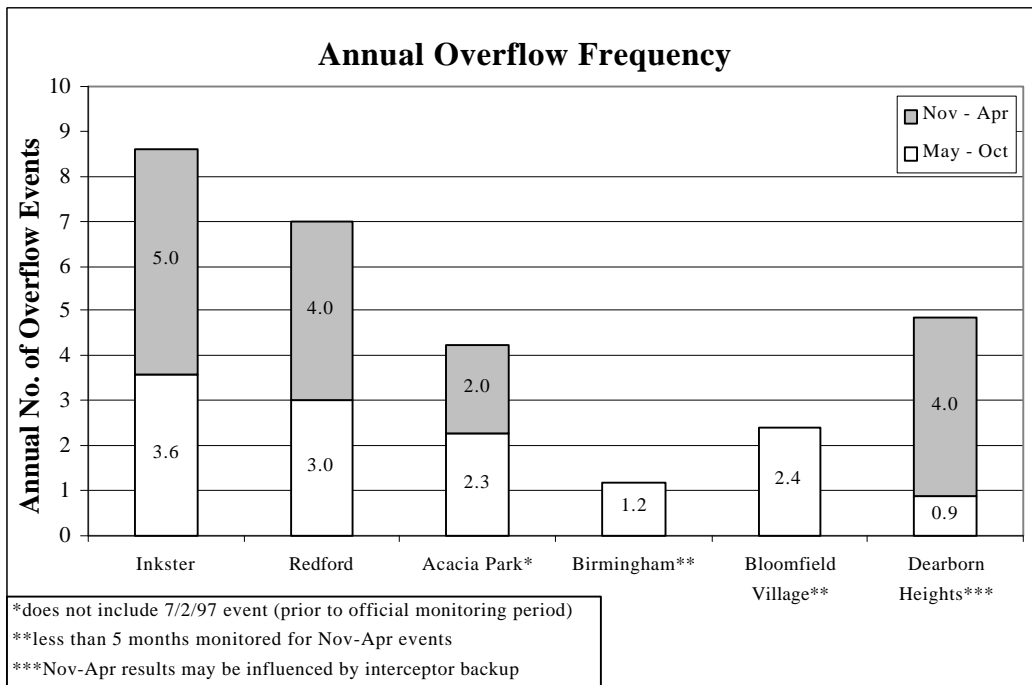


II. Annualized Operating Statistics

Treated Overflow Frequency

Note: All results in Section II are only shown for basins where there has been close to a full season monitored.

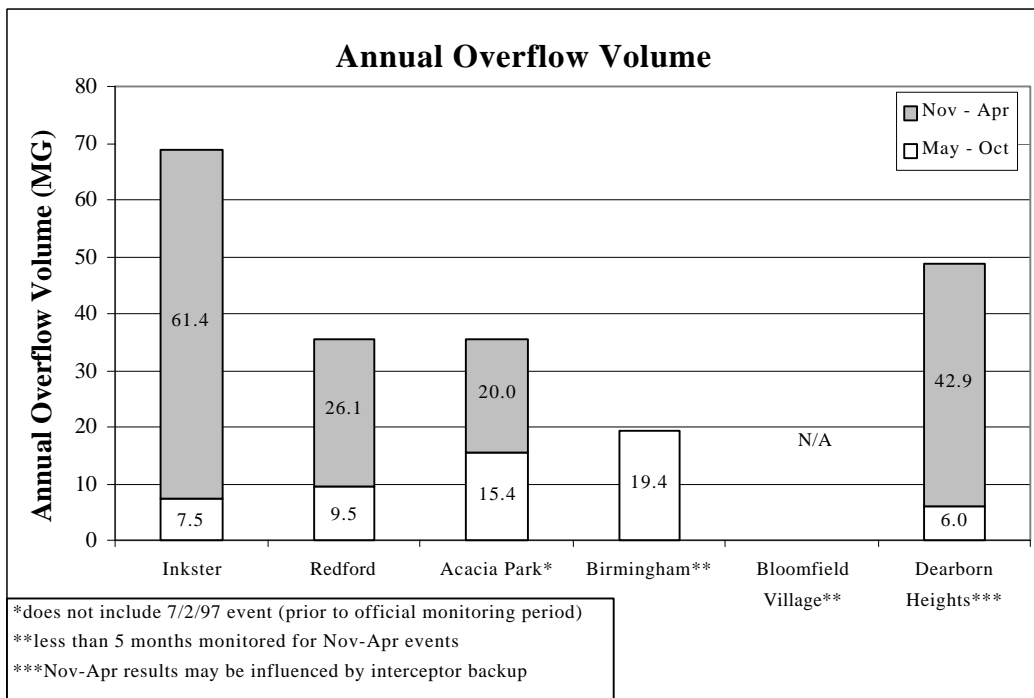
- Treated overflow frequency ranged from 4 to 9 events/year.
- Treated overflow frequency ranged from 1 to 4 events for the period of May through October.



II. Annualized Operating Statistics

Treated Overflow Volumes (Million Gallons)

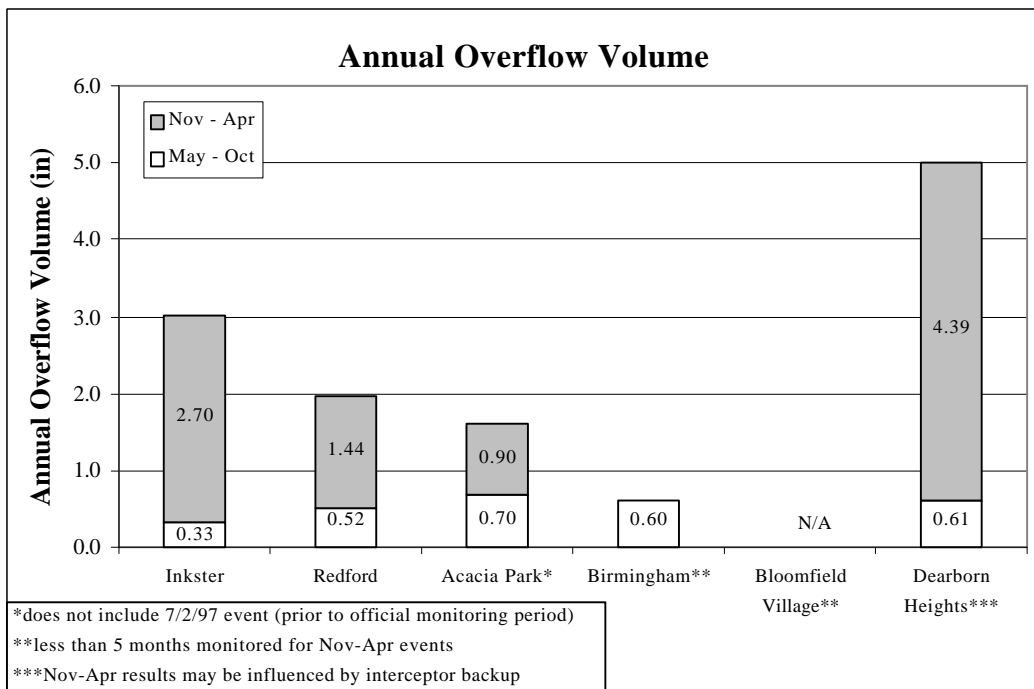
- Treated overflow volumes ranged from 36 to 69 million gallons/year.
- For all basins with both seasons of data shown, 20 percent of the annual treated overflow volume occurred during the period of May through October.



II. Annualized Operating Statistics

Treated Overflow Volumes (Inches over Combined/Storm Drainage Area)

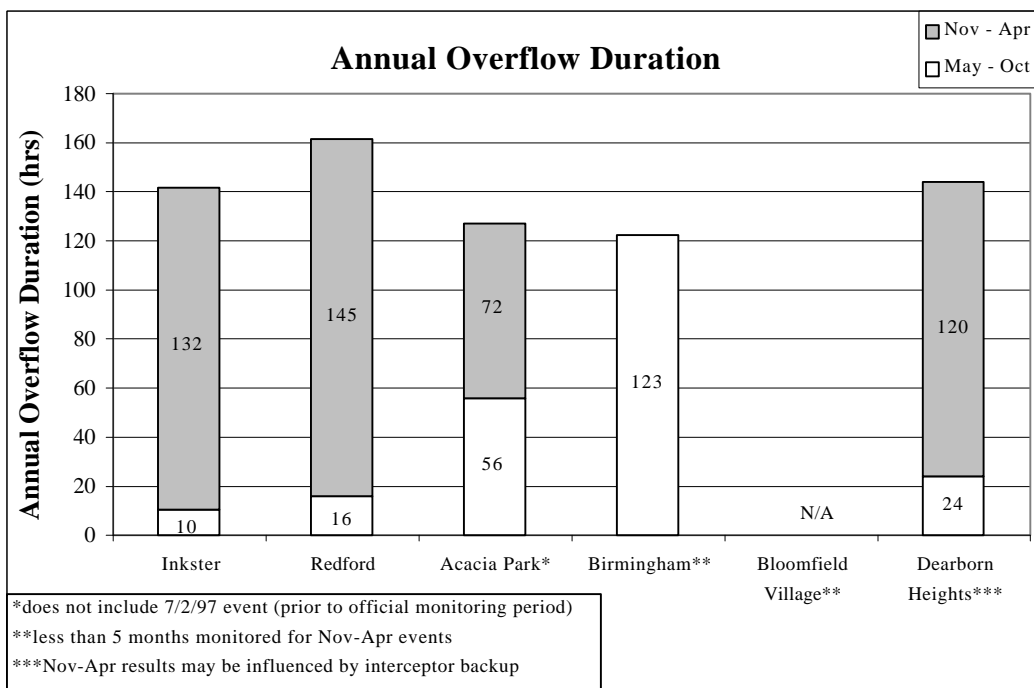
- Treated overflow volumes ranged from 1.6 to 5.0 inches/year.
- Treated overflow volumes ranged from 0.3 to 0.7 inches for the period of May through October.



II. Annualized Operating Statistics

Treated Overflow Duration

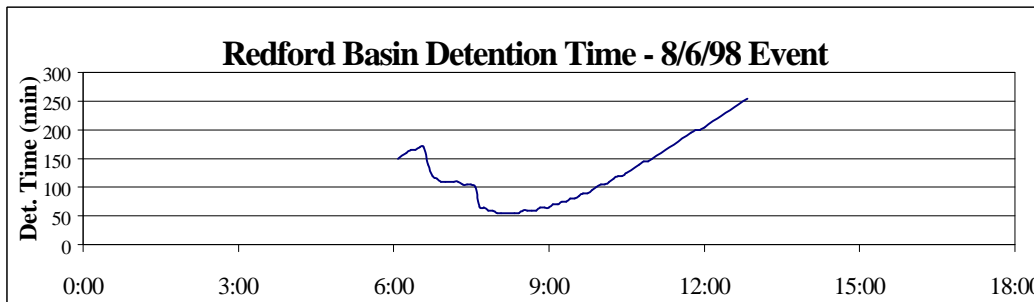
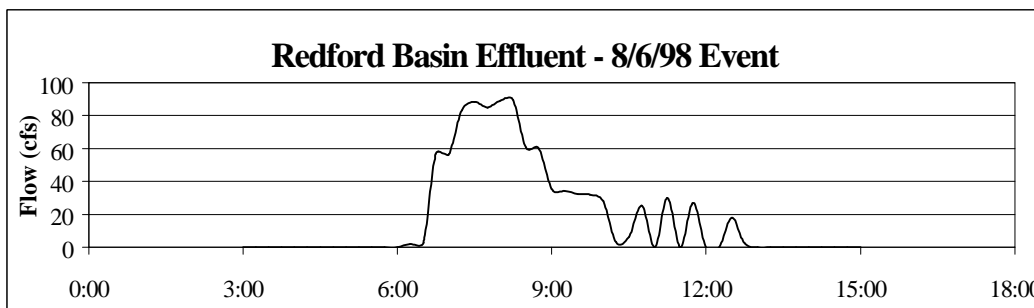
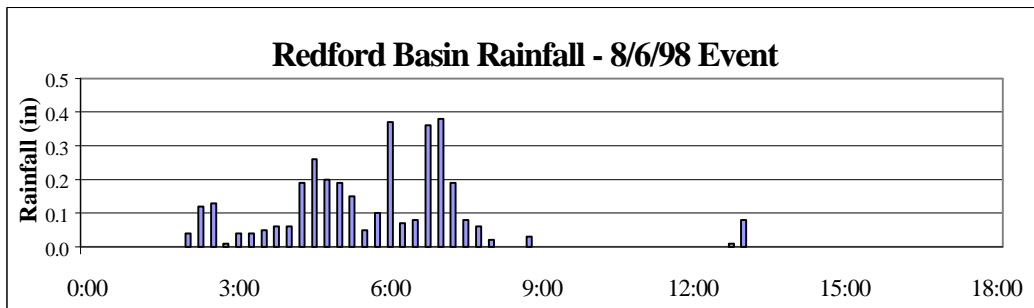
- Treated overflow duration is defined as the length of time between the moment a basin first overflows to the final moment of overflow within a storm event. This includes any time between these times when the basin is not overflowing.
- Treated overflow duration ranged from 128 to 161 hours/year.
- For all basins with both seasons of data shown, 18 percent of the annual treated overflow duration occurred during the period of May through October.



III. Actual Basin Detention Times

Definition of Detention Time

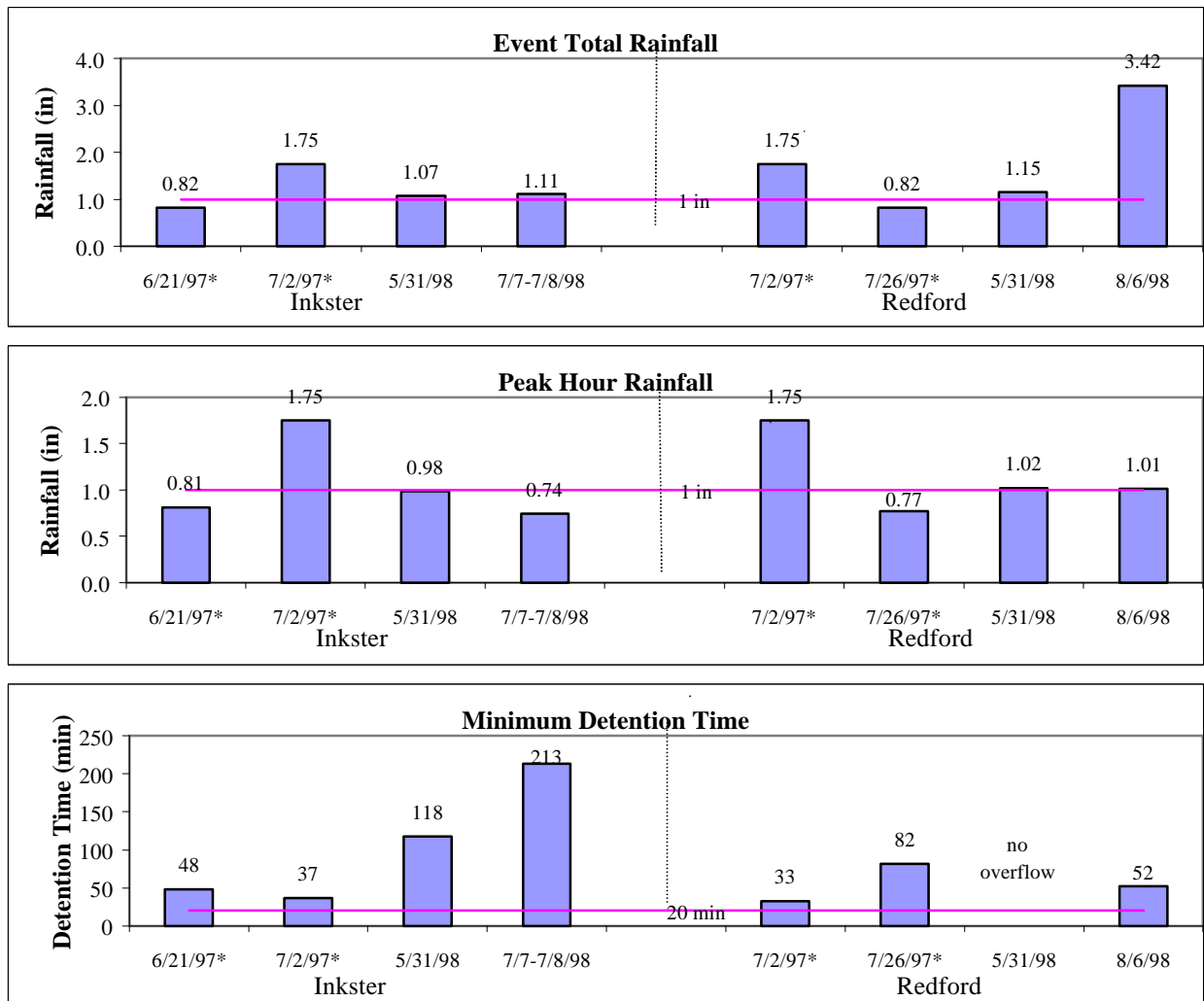
- Detention time is the time which passes from when a drop of water first enters one of the CSO basin's flow through compartments to when that same drop overflows from the CSO basin to the river.
- Actual detention time is calculated assuming plug flow occurs through the total volume of all flow-through compartments in operation for an event.
- Actual detention time varies significantly throughout an event as shown in the example below. The shortest detention time that occurs within an event is referred to as the *Minimum Detention Time* for the event.



III. Actual Basin Detention Times

Demonstration Size Basins Designed for 20 Minutes Detention

- At facilities designed for 20 minutes detention for the 1 year, 1 hour storm, 8 rainfall events have occurred which had a peak hour rainfall intensity of close to or greater than that of the design storm: 1 inch in 1 hour.
- One of these 8 events was captured. Minimum Detention Times for the 7 events that did overflow ranged from 33 to 213 minutes.
- Three events met one of the two MDEQ sizing criteria:
 - A 1 year, 1 hour storm was captured at the Redford basin on 5/31/98.
 - More than 30 minutes of detention was provided for the 10 year, 1 hour storm at the Inkster and Redford basins on 7/2/97.

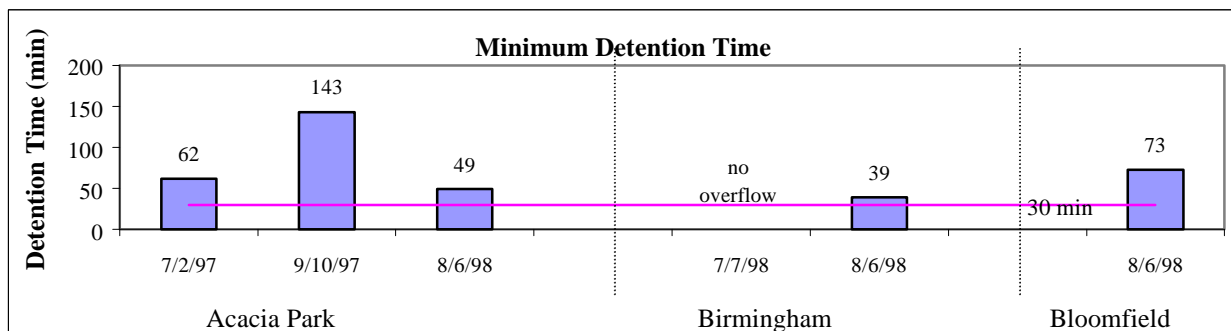
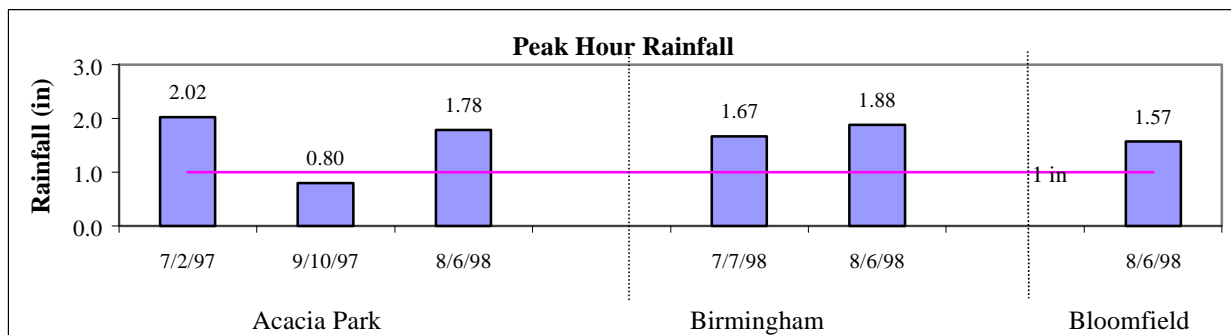
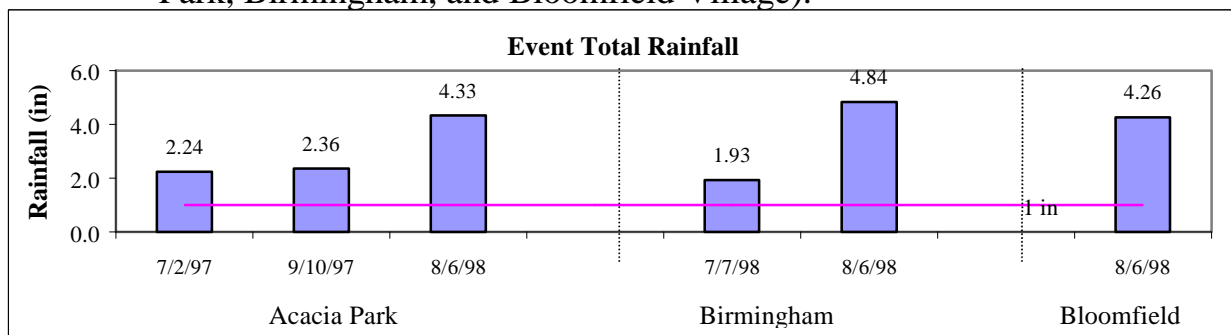


* Rain gage was located several miles from the basin drainage area.

III. Actual Basin Detention Times

Demonstration Size Basins Designed for 30 Minutes Detention

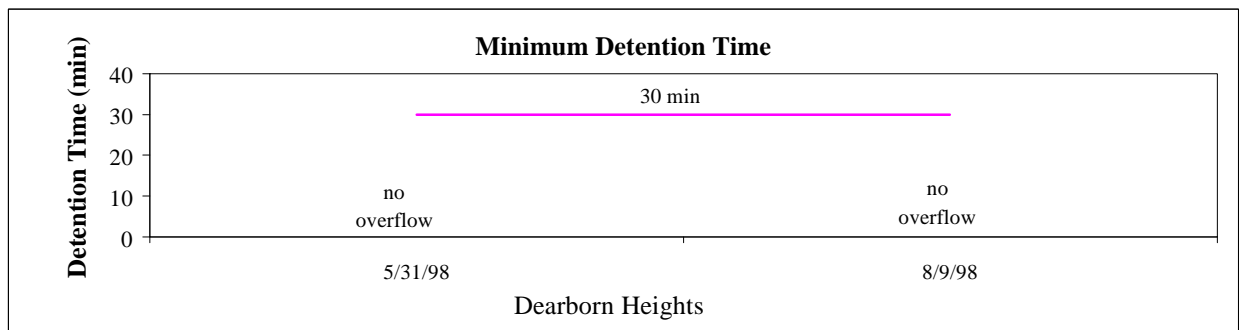
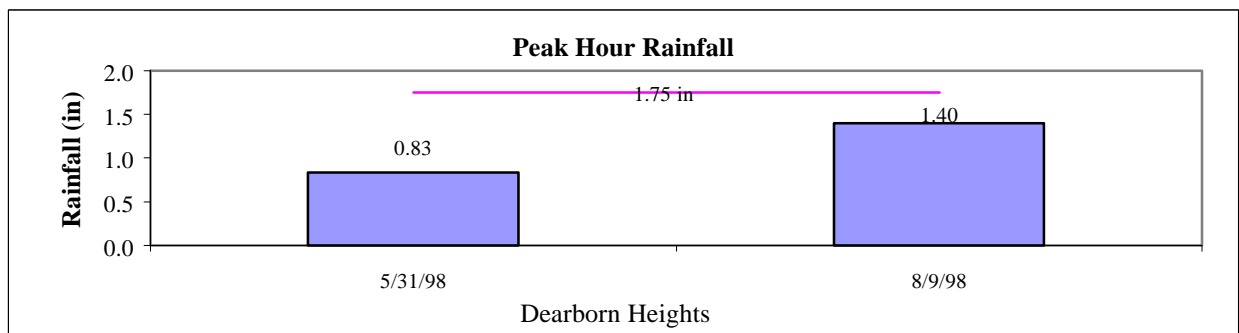
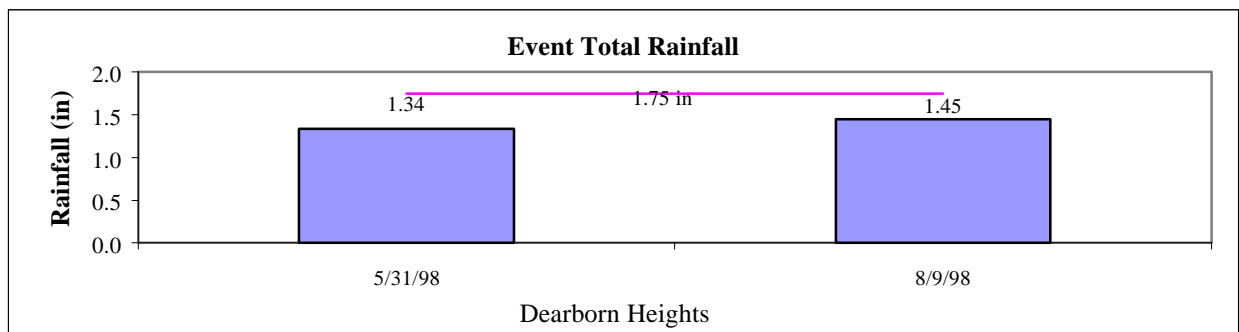
- At facilities designed for 30 minutes detention for the 1 year, 1 hour storm, 6 rainfall events have occurred which had a peak hour rainfall intensity of close to or greater than that of the design storm: 1 inch in 1 hour.
- One of these 6 events (7/7/98) was captured. Minimum Detention Times for the 5 events that did overflow ranged from 39 to 143 minutes.
- Of the 5 events most comparable to the two design criteria used in MDEQ's Adequate Treatment Guidance, all 5 events meet at least one of the two MDEQ criteria:
 - A 1 year, 1 hour storm was captured at the Birmingham basin on 7/7/98.
 - More than 30 minutes of detention was provided for the 10 year, 1 hour storm during 4 other events (7/2/97 at Acacia Park and 8/6/98 at Acacia Park, Birmingham, and Bloomfield Village).



III. Actual Basin Detention Times

Basin Sized to Portion of MDEQ Guidance with 30 Minutes Detention

- At the one facility designed to a portion of the MDEQ Adequate Treatment Guidance, no rainfall event has yet occurred with a peak rainfall intensity equal to the design storm for detention: 1.75 inches in 1 hour.
- While the basin was not designed to capture the 1 year, 1 hour storm (1 in), it indeed has captured two events that were near or greater than a peak rainfall intensity of 1 inch in 1 hour.



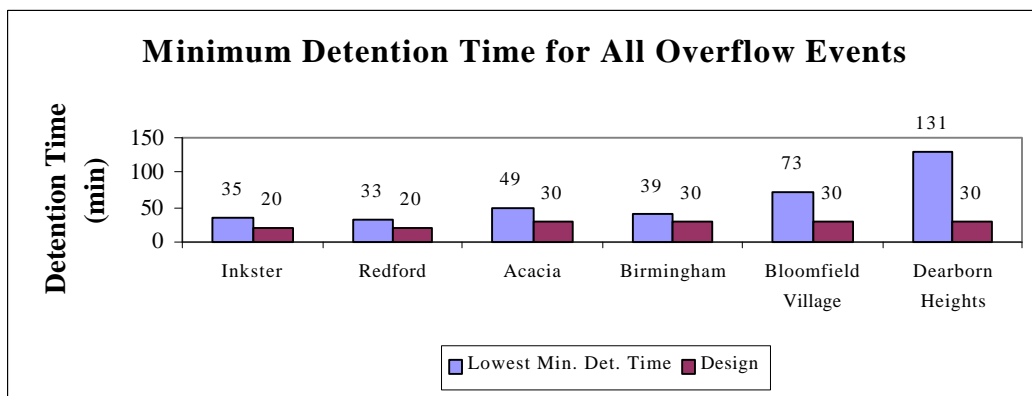
III. Actual Basin Detention Times

Lowest Minimum Detention Time of All Events

- The lowest Minimum Detention Time experienced at each basin was sometimes caused by a winter storm with a peak hour rainfall intensity of less than that of the design storm.

Basin	Low Min Det Time (min)	Event Date	Pk Hr Rain (in)	Total Rain (in)
Inkster	35	2/17-2/20/98	0.42	2.56
Redford	33	7/2/97	1.75	1.75
Acacia Park	49	8/6/98	1.78	4.33
Birmingham	39	8/6/98	1.88	4.84
Bloomfield Village	73	8/6/98	1.57	4.26
Dearborn Heights	131	2/17-2/20/98	0.36	2.66

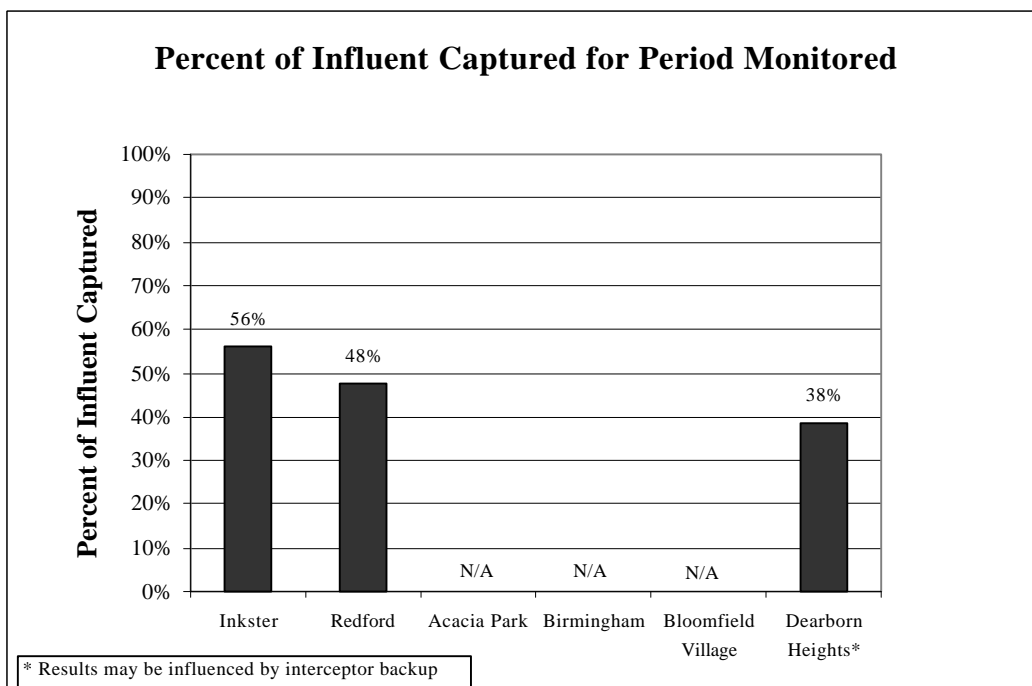
- The lowest Minimum Detention Time of all events experienced at each basin, even the most extreme events, exceeded the respective basin's design detention time.



IV. Volumetric Performance

Percent of Basin Influent Captured

- The percent of basin influent captured over the entire monitoring period ranged from 38 to 56 percent. (These values were calculated directly from the sum of all measured influent and effluent data.)
- The percent of pre-CSO control overflow volume which is captured by each facility may be larger than the capture values shown below due to:
 - the impact of in-system storage;
 - revised regulator settings;
 - and dewatering of flows which are captured upstream of the basin influent flow meter.

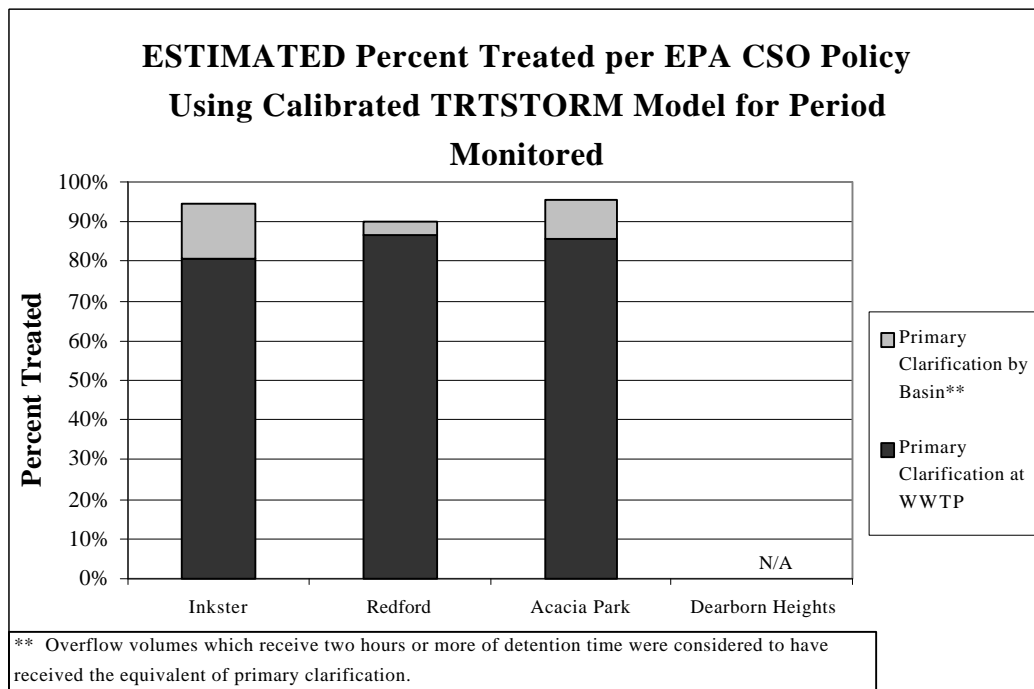


IV. Volumetric Performance

Percent Treated per USEPA's CSO Policy

- The “Percent Treated” value included as one of the presumptive criteria in the USEPA CSO Policy was determined to be between 90 to 95 percent* for three of the demonstration size basins -- exceeding the 85% criteria in the CSO policy. (This calculation includes sanitary base flow during events as part of the combined sewage which is treated.)
- MDEQ will base sizing on meeting the Criteria for Success (4/11/98), and not merely the presumptive approach in the USEPA policy.

* These values could not be determined directly from measured data. They were calculated using the TRTSTORM model after calibration to actual overflow volumes. They were based on analyzing individual drainage areas for each facility - not on a system-wide basis per the policy.



V. Additional Observations

- While there are sufficient data to see how each basin's performance has compared to the design storm, there are not a sufficient number of storms to identify the relative size of each facility to some standard (e.g. if an MDEQ sized basin is size "X", there are not sufficient data to determine if the actual Redford basin is size 0.4X or 0.8X.)
- To better define the relative size of each facility would require either data from more actual events close in size to the design storm, or conducting calibrated/verified model simulations of the design storm at each facility.
- The hydrologic comparisons need to account in some way for what is happening in the interceptor system and the impacts of system storage.
- We can not make final conclusions regarding disinfection effectiveness at the design detention time since those detention times have not been experienced to date at any facility.

VI. Next Steps

- To reach a better understanding of why the actual detention times are higher than expected, the following will be examined for storms close to the design storm:
 - Compare design vs. actual runoff volumes.
 - Compare design vs. actual peak influent flow rates.
 - Examine whether influent pumping and associated wet well storage cause any reduction in peak influent flow rates.
 - Examine whether transport system restrictions cause reductions in actual peak influent flow rates (as compared to predicted).

- The hydrologic comparison between facilities should focus on three key criteria as listed below. The first item is already known. The second and third items will still need to be evaluated.
 - Annualized number of events from May through October.
 - Annualized volume removal considering all changes from before control to the present.
 - Use a model or other means of analysis to look at a common 1 year, 1 hour summer storm at each facility using a consistent set of design assumptions.

- To increase the likelihood of obtaining disinfection effectiveness data for flows experiencing 20 to 30 minute Minimum Detention Times in future events, the following two steps have been initiated:
 - One of the two flow-through compartments at the Inkster basin will be taken out of service for purposes of this evaluation.
 - Sampling for Fecal Coliform and TRC will be conducted at intermediate weirs in the Bloomfield Village CSO basin, potentially even for events which do not overflow to the river.