Typical Historical Data Center Design Philosophy:
Typical data center designs of the past 10 to 15 years have mostly fallen into three Mechanical approaches to cooling: Air Cooled Chillers (ACC's) with Computer Room Air Handlers (Type I), Direct Expansion Rooftop Condensers with Computer Room Air Conditioners (Type II), and finally Water Cooled Chillers with Cooling Towers and Computer Room Air Handlers (Type III). For your knowledge, please utilize the below table in understanding the energy efficiency and water usage of each of these past approaches to data center design.

Mechanical Approach	Primary Cooling Equip	Energy Efficiency	Water Usage
TYPE I	Air Cooled Chillers & CRAH's	Moderate Efficiency	Minimal Water Usage (Closed Loop)
TYPE II	DX Condensers & CRAC's	Moderate Efficiency	Zero Water Usage
TYPE III	Water Cooled Chillers, Cooling Towers, & CRAH's	High Efficiency	Extremely High Water Consumption

As detailed in the table above, a water cooled chiller approach that is paired with evaporative cooling towers may have a high electrical efficiency, but has a very high impact on local water consumption. With our design at Maysville, CM|MC set out to wholistically re-think how data centers are cooled.

CM|MC's Approach @ Maysville-Northern Data Facility:
Northern Data is purchasing the latest NVIDIA AI technology, and as such, these servers offer innovative features like liquid cooled servers that operate at elevated fluid temperatures. Since the fluid temperatures can be elevated (113°F Entering Water Temp), a significant portion of the data center load can be cooled via equipment known as Dry Coolers, reducing the need for compressorized equipment like Air Cooled Chillers and greatly increasing energy efficiency without the negative impact of excessive water usage seen in evaporative cooling tower approaches.

As the name suggests, Dry Coolers alone do NOT consume water on a daily basis. They are a cooling coil with fans, and utilize a closed piping loop that circulates fluid between them and the servers. In an ideal scenario, the only time municipal water is consumed for this loop is upon install and start-up for the processes of cleaning out construction debris from the piping.

Municipal water connections to this spray nozzle array are planned, and would serve to only be an emergency back-up, should a maintenance event or never before seen weather event could occur that would potentially exhaust our on-site storage.

Within the Dry Cooler loop itself, the fluid that is delivered to the servers to exchange heat from them to the outdoors, our operating fluid will be Dowfrost LC25 or equivalent. This fluid will be shipped to the site in tanker trucks and pumped into the loop. Then for any future servicing of this loop, only off-site delivered fluids would ever be utilized for servicing leaks or piping section failures and re-fills.

There is a second loop within this system approach, known as the facility water loop, where we provide a more typical 66°F chilled water supply temperature to various cooling equipment in ancillary spaces like critical electrical equipment rooms, and for the rear door heat exchangers in the data halls. Air Cooled Chillers on the roof of the building provide the cooling for this closed circuit loop. This loop will never consume municipal water supply for any reason other than to initially flush and fill the loop and trickle in refill water for any leaks that occur over time.

Research Performed:

1. Data Collection:
   CM|MC obtained existing weather hourly bin data for the past 20 years from five sources. All five sources were inserted into excel to compare standard deviations from one another, we then throw the least reliable data out(in this case one had many months/years of incomplete data). From the sources (Open Meteo, Open Weather, Visual Crossing, and NOAA) that had the most informed data, we documented hourly ambient dry bulb temperatures, as well as recorded precipitation. We also obtained wind direction coincidence and wind speeds from this data.

2. Model Inputs/Software:
   Software: Siemens FloEFD, Microsoft Excel
   Site Location - 121 Industrial Drive, Maysville, GA 30558.
   Site Elevation – Approximately 858 Ft.
   Building – Model 1:1 our building design and equipment layout
   Input Weather Data: From various sources mentioned above.
   Input Wind Data: From National Oceanic and Atmospheric Administration (NOAA)

Results Continued:

Table below shows precipitation over the past 20 years. 2007 also had the least amount of precipitation. We'll use this year as our worst case evaluation in the final table below.

			Inches of Rainfall											
	Annual Total		January	February	March	April	May	June	July	August	Septemeber	October	November	December
2004	47.798		2.376	4.541	1.159	2.269	2.103	7.38	3.301	2.36	12.432	1.862	4.486	3.529
2005	49.196		2.941	5.483	8.241	3.882	1.993	5.296	6.936	5.04	0.573	2.772	2.38	3.659
2006	38.107		5.23	4.205	2.08	1.649	2.152	2.513	2	4.571	3.028	3.362	3.617	3.7
2007	33.716		3.932	2.18	2.578	3.149	0.794	2.648	5.132	2.108	2.454	2.869	1.656	4.216
2008	41.17		3.15	4.422	4.249	4.703	3.233	1.473	2.57	4.099	1.023	4.258	3.32	4.67
2009	64.559		3.351	3.48	6.924	4.612	5.689	2.217	4.854	3.698	6.599	8.059	5.305	9.771
2010	44.028		6.664	4.278	3.887	2.489	4.875	2.048	3.042	6.022	3.787	1.437	3.987	1.512
2011	37.611		2.576	4.306	7.684	1.811	1.052	2.464	3.448	1.681	3.52	2.015	3.717	3.337
2012	41.491		4.049	4.131	2.985	1.717	2.944	3.598	5.15	5.113	2.6	1.869	1.508	5.827
2013	57.191		5.305	7.508	4.185	4.427	4.965	4.984	8.119	5.824	2.046	1.007	3.016	5.805
2014	40.827		3.189	5.275	4.058	5.203	2.52	3.445	3.158	1.277	1.611	2.304	3.39	5.397
2015	60.092		2.713	4.52	2.673	6.012	2.045	3.292	2.058	4.398	4.429	8.69	9.295	9.967
2016	33.72		3.912	4.52	2.644	3.256	3.221	2.805	1.819	3.517	1.314	0.406	1.578	4.728
2017	58.9		7.957	2.083	3.387	6.052	6.255	6.037	4.358	6.279	6.222	6.249	1.184	2.837
2018	68.412		3.912	6.46	5.055	4.762	8.937	2.423	6.091	6.425	4.118	4.188	6.519	9.522
2019	57.391		5.646	6.131	2.457	5.984	3.954	6.677	3.945	5.947	0.707	4.574	4.175	7.194
2020	74.434		8.328	11.75	7.842	6.272	3.413	3.314	5.664	6.221	8.328	5.595	3.639	4.068
2021	66.29		5.001	5.604	5.148	3.004	3.992	5.512	7.404	7.702	7.669	6.779	1.539	6.936
2022	50.672		5.065	5.736	4.948	2.764	3.761	3.303	5.014	5.348	4.284	1.07	3.939	5.44
2023	49.114		4.868	4.588	6.258	4.488	3.311	4.439	2.481	6.576	3.134	1.596	2.336	5.039
2024	51.389		7.377	4.122	6.382	4.031	4.848	2.046	8.969	0.937	10.536	0.036	2.105	
		Monthly Average	4.644857143	5.015381	4.515429	3.930286	3.621762	3.71019	4.548238	4.530619	4.305428571	3.38081	3.461476	5.3577

Finally, the table below is showing a running tank volume calc, accounting for draw down and refill for the worst case year of the worst case weather data we found in past 20 years, 2007. The column on the right shows, in gallons, the water needed from another source to satisfy building demand.

Running Tank Volume Estimation (Gallons)							
Year	Month	Water Collected	Vortex Filter Water Consumption (%)	Actual Water Collection	Water Consumed	Tank Volume	City Water
2007	January	178742.01	30.00%	125119.41	0.00	0.00	0.00
2007	February	109510.95	30.00%	76657.67	0.00	76657.67	0.00
2007	March	152598.82	30.00%	106819.17	0.00	183476.84	0.00
2007	April	81189.15	30.00%	56832.41	0.00	240309.25	0.00
2007	May	66858.81	30.00%	46801.17	0.00	287110.41	0.00
2007	June	111108.59	30.00%	77776.01	26449.20	338437.23	0.00
2007	July	184019.07	30.00%	128813.35	0.00	467250.57	0.00
2007	August	122146.83	30.00%	85502.78	846374.40	0.00	-293621.04
2007	September	55336.44	30.00%	38735.51	0.00	38735.51	0.00
2007	October	95132.19	30.00%	66592.54	0.00	105328.04	0.00
2007	November	91646.43	30.00%	64152.50	0.00	169480.54	0.00
2007	December	227978.37	30.00%	159584.86	0.00	329065.40	0.00
2008	January	118080.11	30.00%	82656.08	0.00	411721.48	0.00
2008	February	249425.48	30.00%	174597.83	0.00	586319.32	0.00
2008	March	217569.51	30.00%	152298.65	0.00	700000.00	0.00

5. Dry Cooler Ambient Spray System - 0 gallons. This would be fed from the Rain Water Storage System. We are planning to pre-fill this tank in part with water brought in via trucks and will use rain water to fill the tanks the rest of the way. Additionally, we will install a float system in the tank so if the water falls below a certain level we could refill with city water or order additional water to be shipped to the site to refill, depending on the conditions imposed by the City of Maysville. If so determined that Ardent shall not have the option to use city water to supplement the water demand for the spray system, the emergency water line to the spray system can be removed from the design.

If desired, more detailed breakdowns of our precipitation review, ambient dry bulb review, dry cooler performance, and external CFD calculations can be provided. This report simply served as a somewhat brief summary of our studies being performed over the last several months.

We greatly appreciate you taking the time to review, and as noted above, please feel free to reach out with any questions.

Warm regards,

Matthew Mumpower, PE
Co-Founder, Principal
CM Mission Critical Engineering, LLC