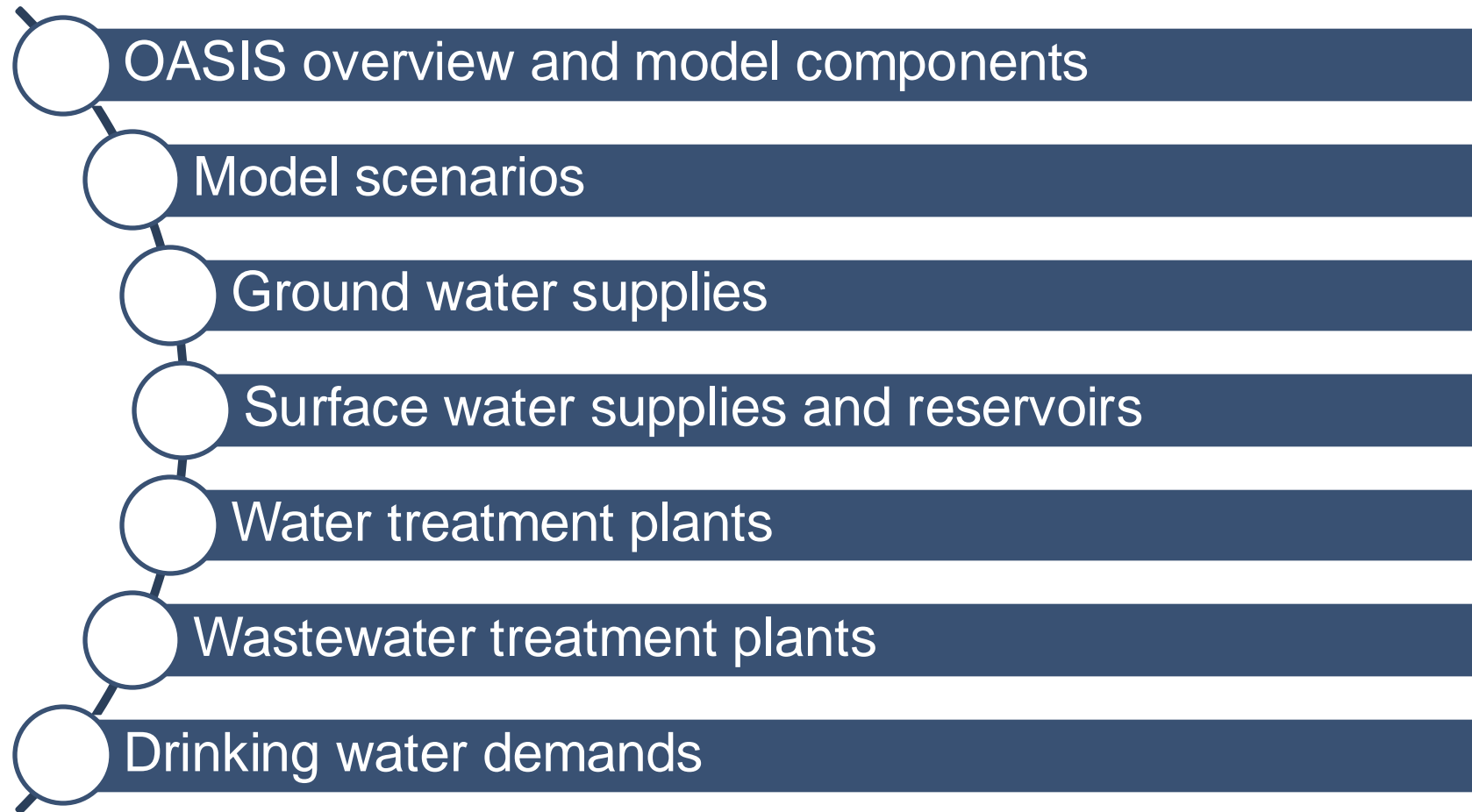




Central Ohio Regional Water Study Integrated Water Resources Model Approach (OASIS)

Table of Contents



- OASIS overview and model components
- Model scenarios
- Ground water supplies
- Surface water supplies and reservoirs
- Water treatment plants
- Wastewater treatment plants
- Drinking water demands

OASIS Overview and Model Components

OASIS Overview



Operational Analysis and Simulation of Integrated Systems

- A mass balance water accounting model
- Captures physical elements and operating rules of the system
- Typical Applications:



River Basin Management



Water Supply



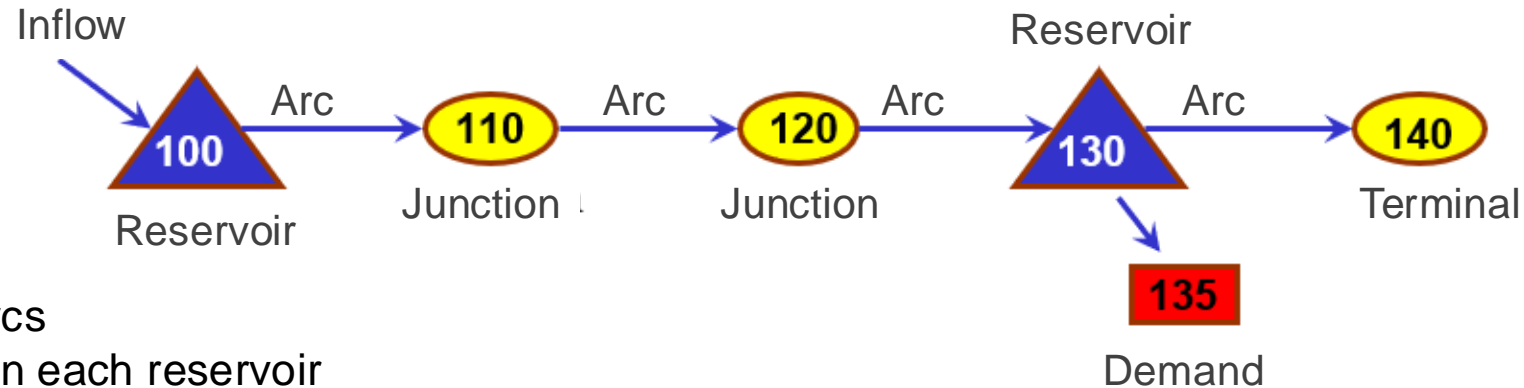
Hydropower



Collaborative Decision Making



What OASIS Does and Role of Constraints and Goals



Flow through arcs

Volume stored in each reservoir

Delivery (volume) allocated to each demand node

... calculated every timestep for the period of record

A **linear programming solver** is called every time step

Constraints: rules that OASIS must obey

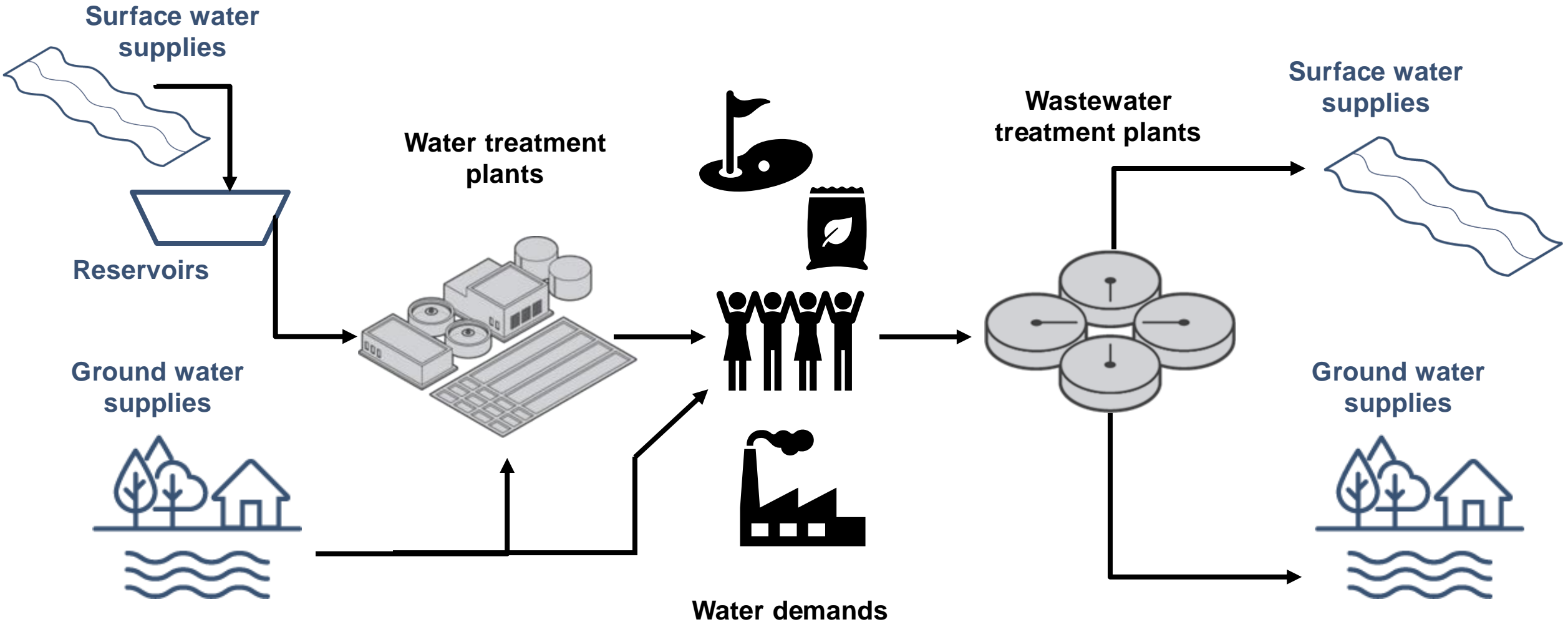
Goal: rule that OASIS tries to meet

You specify **what** to do but not **how** to do it.

The solver is a “smart operator” that obeys the laws of physics (and other specified constraints) while aiming to achieve water supply goals.

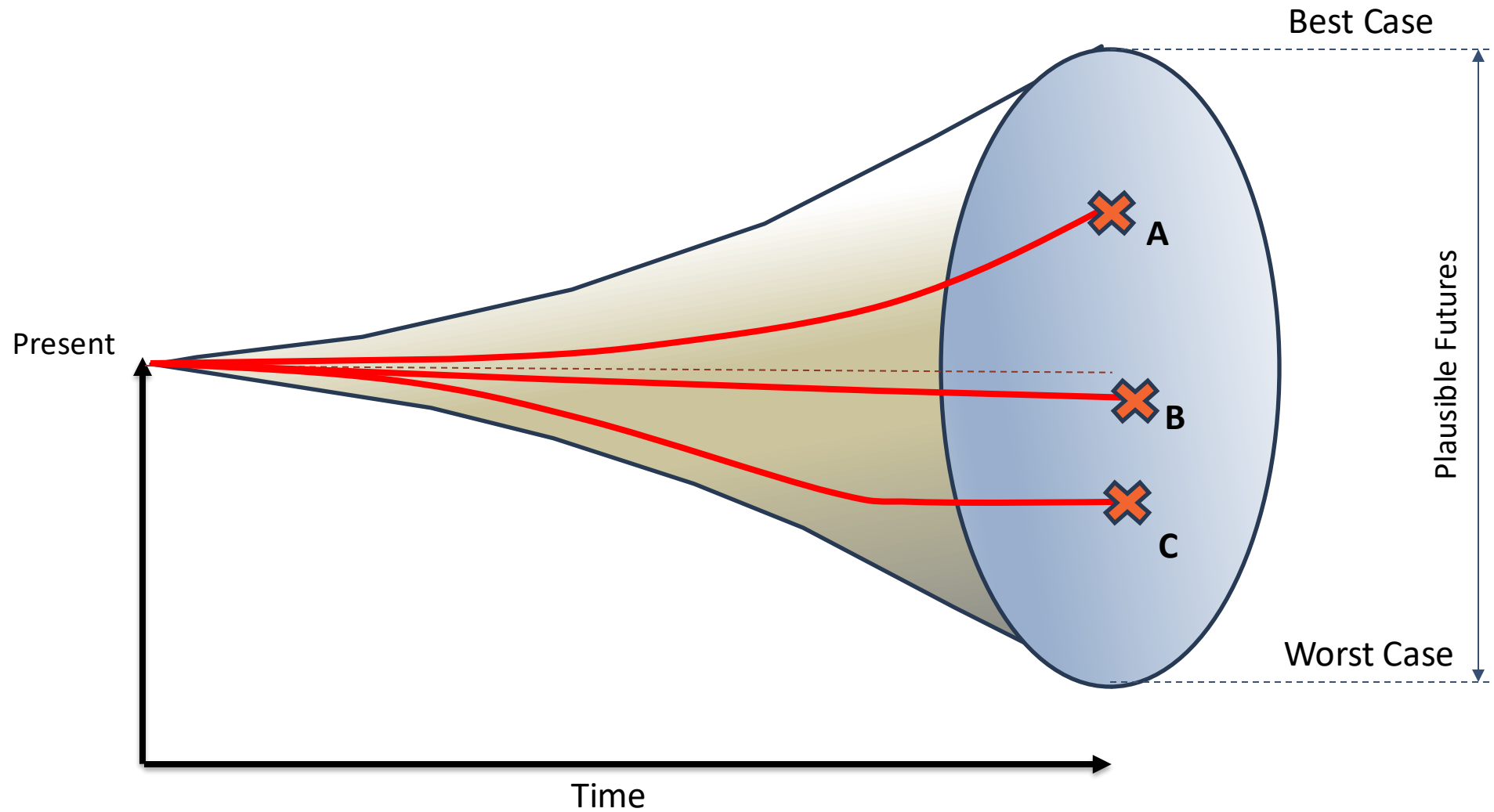
Central Ohio Regional Water Study

Model Components



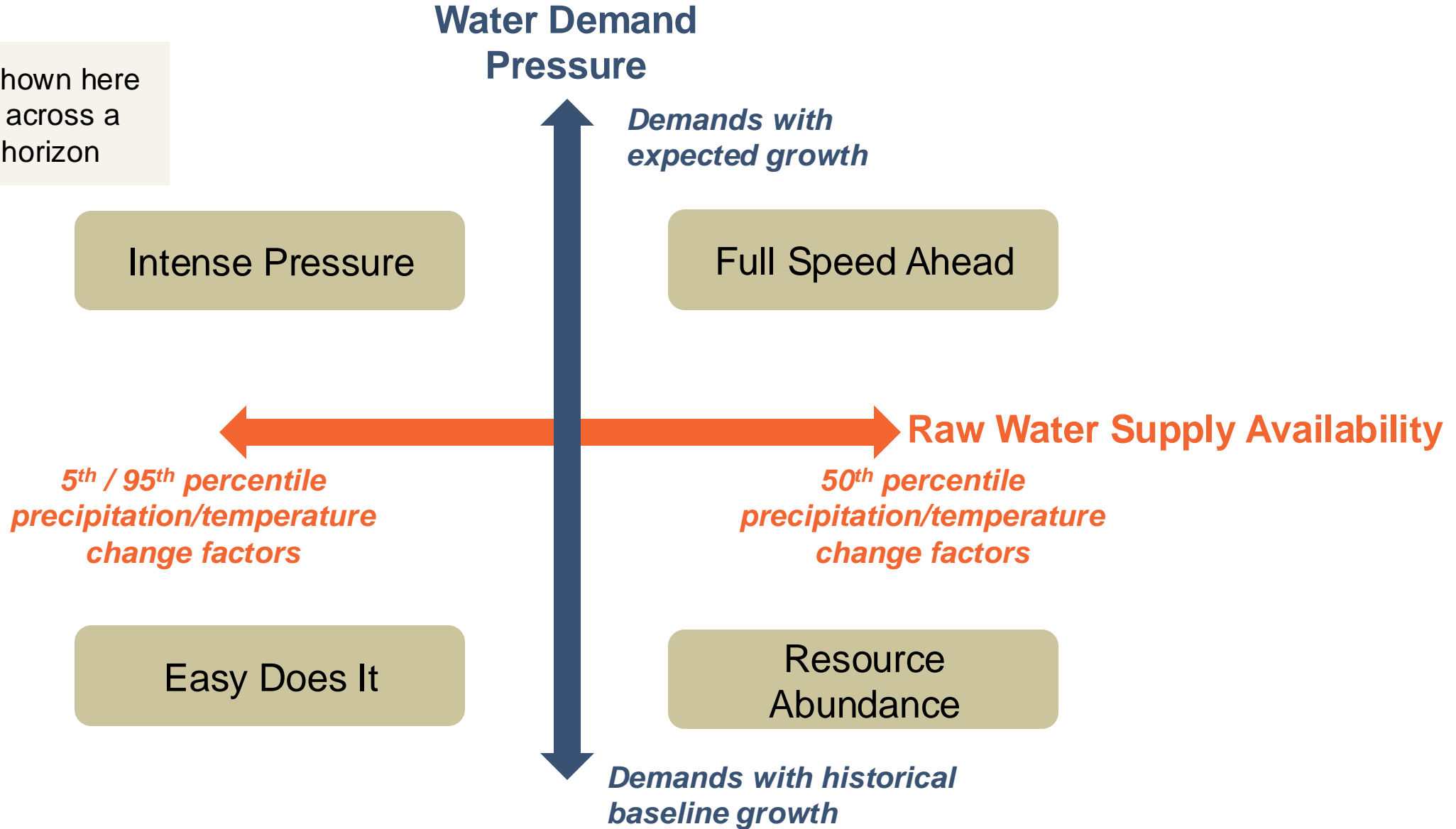
Model Scenarios

Planning for Multiple Future Scenarios Reduces Risk of Failure



Model Scenarios

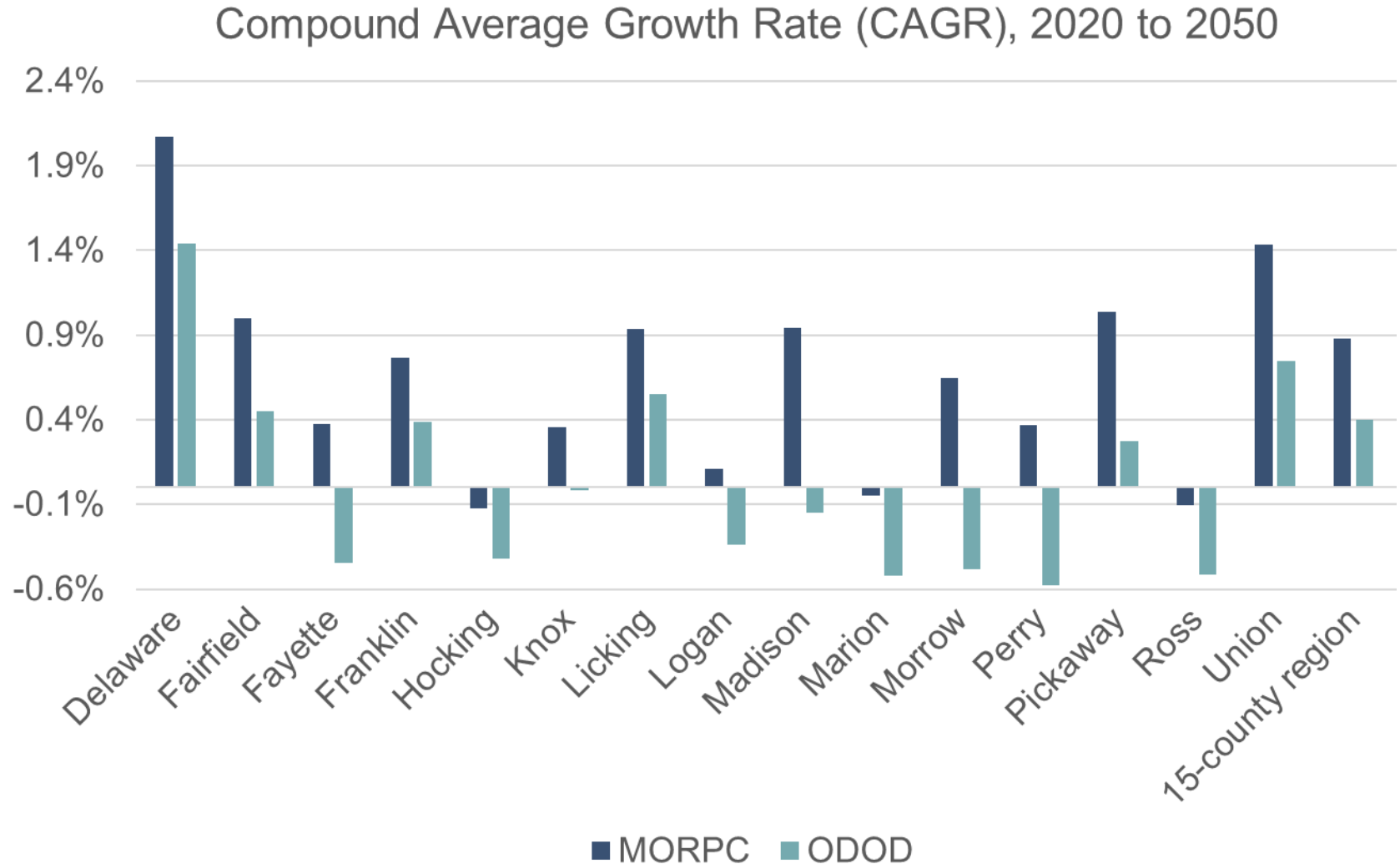
The four scenarios shown here were run in OASIS across a 25-year planning horizon



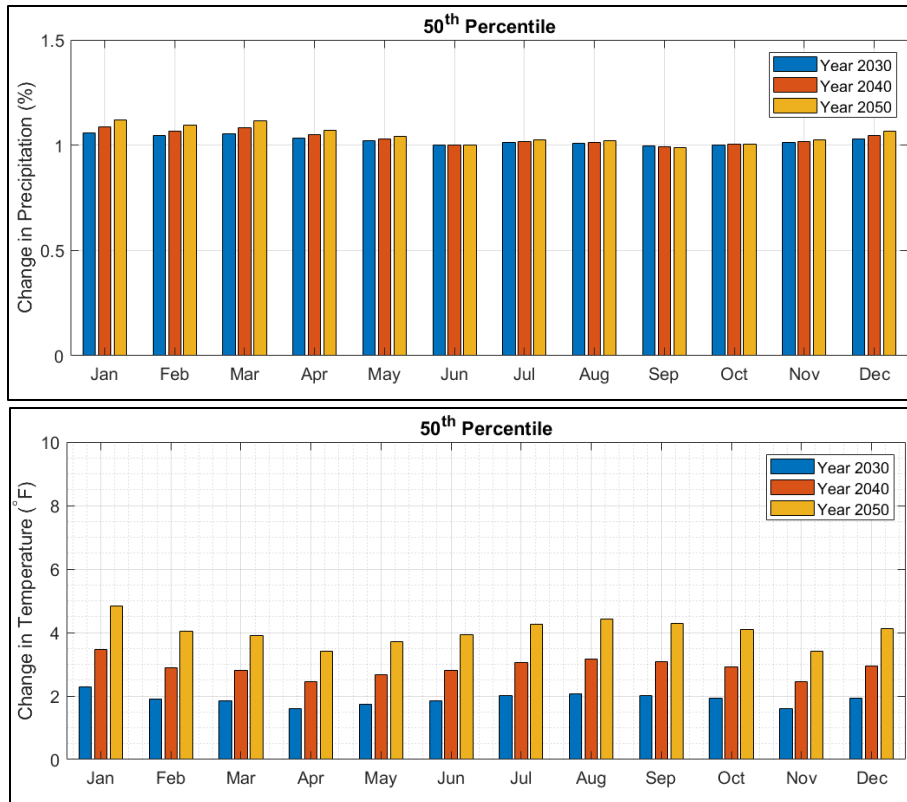
Scenario Planning

Population Growth

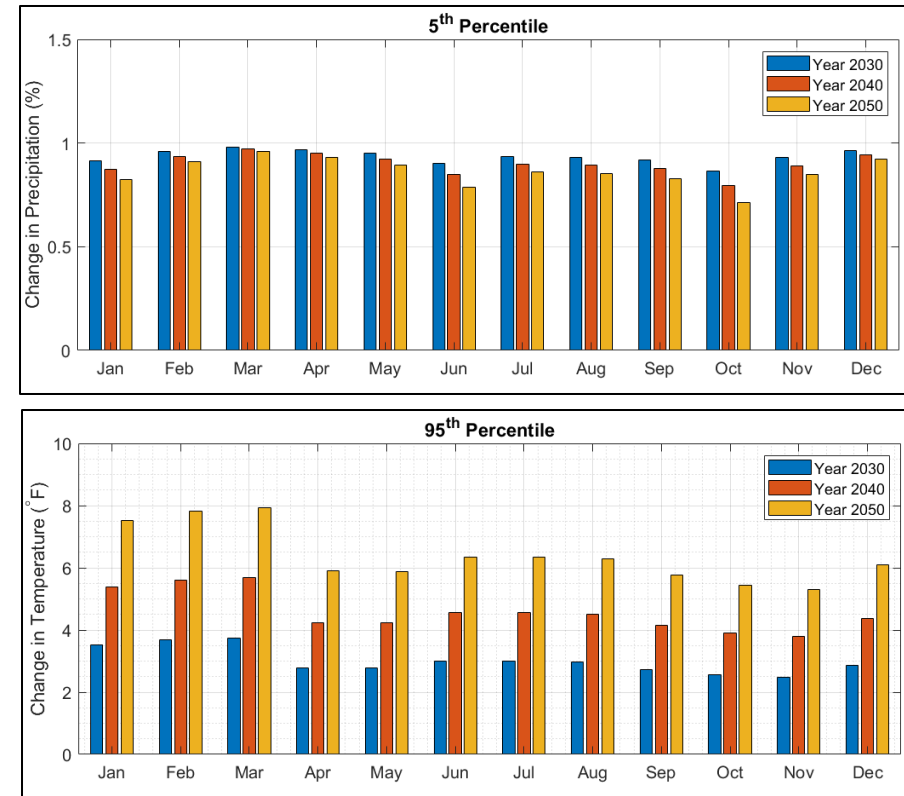
- Two population projections considered
 - Historical baseline growth informed by Ohio Department of Development (ODOD). This projection uses historical growth trends and projects those into the future.
 - Expected growth informed by the Mid-Ohio Regional Planning Commission (MORPC). This projection uses land use and zoning plans to estimate population growth.



Future Scenarios – Temperature and Precipitation Change



Moderate Change (50th Percentile Temperature and Precipitation)



Extreme Change (5th Percentile Precipitation and 95th Percentile Temperature)

List of Model Scenario Runs

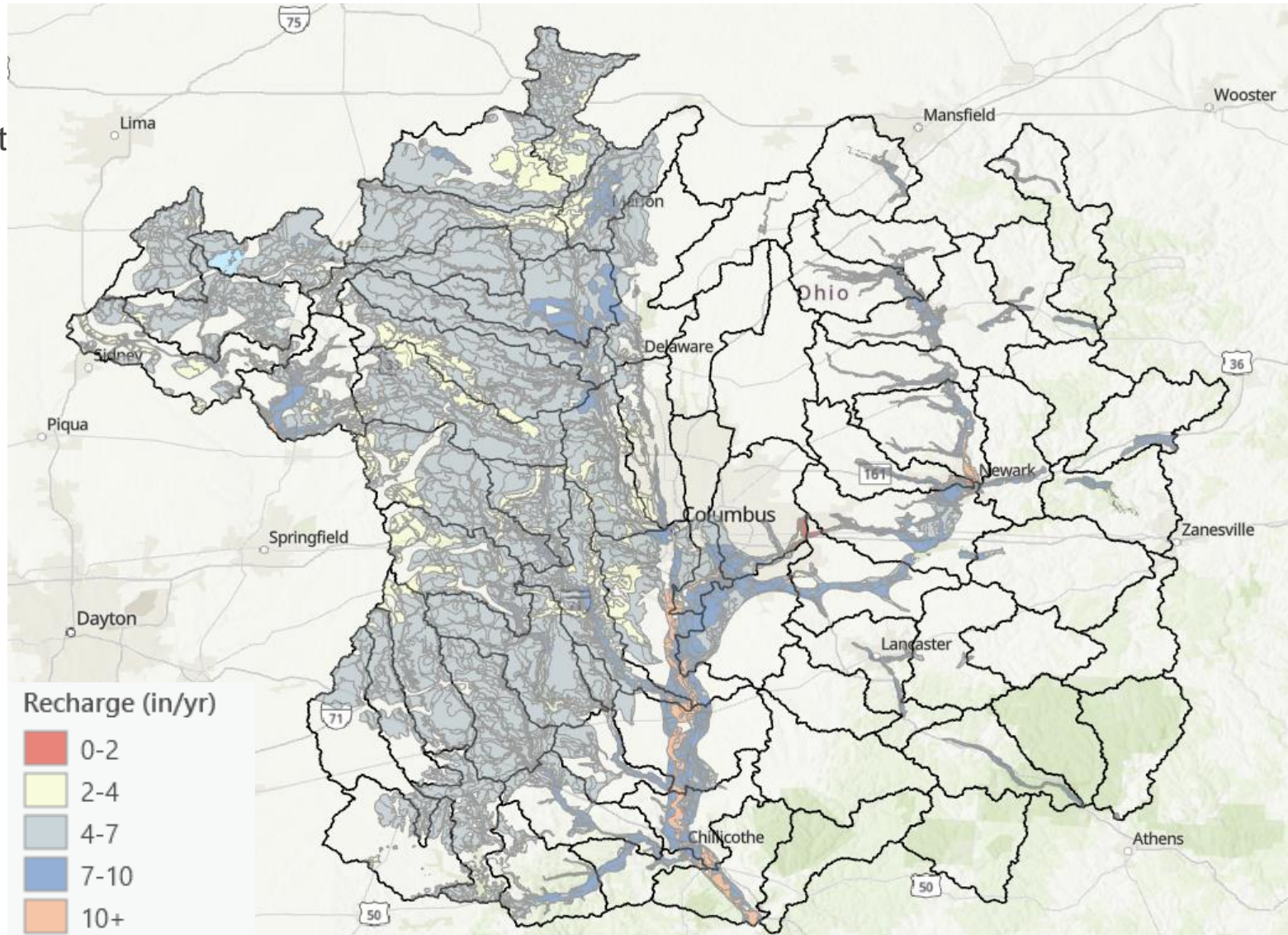
Population Growth Trend	Temperature/Precipitation Trend	Model Year
Historical / Expected (Base)	None	2021
Historical Growth Trend	None	2030
Historical Growth Trend	None	2040
Historical Growth Trend	None	2050
Historical Growth Trend	50 th Percentile	2030
Historical Growth Trend	50 th Percentile	2040
Historical Growth Trend	50 th Percentile	2050
Historical Growth Trend	5 th /95 th Percentile	2030
Historical Growth Trend	5 th /95 th Percentile	2040
Historical Growth Trend	5 th /95 th Percentile	2050

Population Growth Trend	Temperature/Precipitation Trend	Model Year
Expected Growth Trend	None	2030
Expected Growth Trend	None	2040
Expected Growth Trend	None	2050
Expected Growth Trend	50 th Percentile	2030
Expected Growth Trend	50 th Percentile	2040
Expected Growth Trend	50 th Percentile	2050
Expected Growth Trend	5 th /95 th Percentile	2030
Expected Growth Trend	5 th /95 th Percentile	2040
Expected Growth Trend	5 th /95 th Percentile	2050

Ground Water Supplies

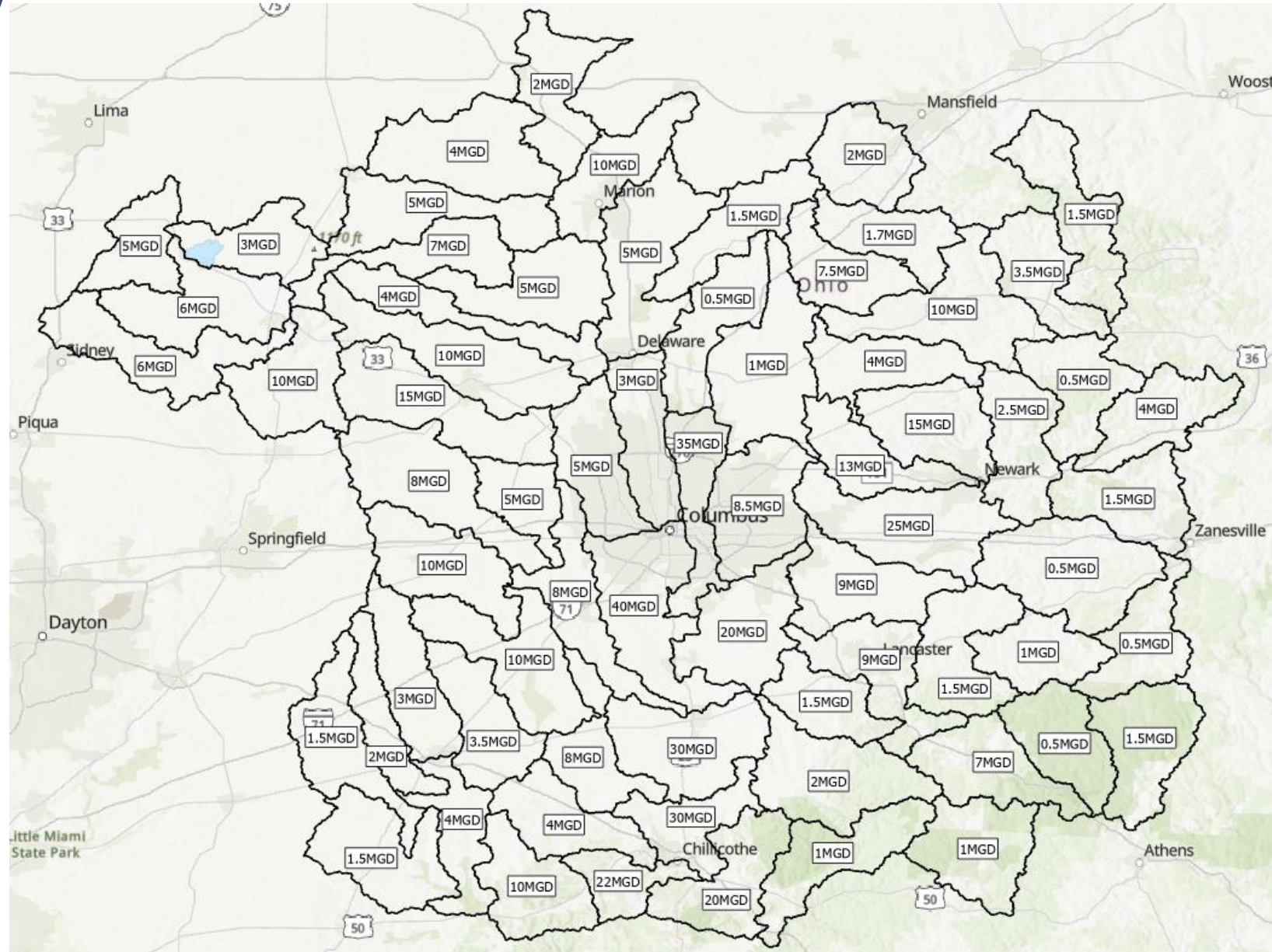
Ground Water Availability Approach

- Ground water availability was estimated at the HUC 10 level
- Eagon & Associates provided a high yield aquifer map
- Ground water vulnerability and recharge maps were provided from ODNR data
- Calculations used the average recharge value within high yield aquifers to derive a ground water availability value in MGD
- After calculations, Eagon & Associates adjusted values as needed and reviewed values with ODNR



Ground Water Availability

- The ground water availability values are meant to represent the availability for long-term, sustained daily use
- Ground water availability values for each HUC 10 are shown in the figure to the right

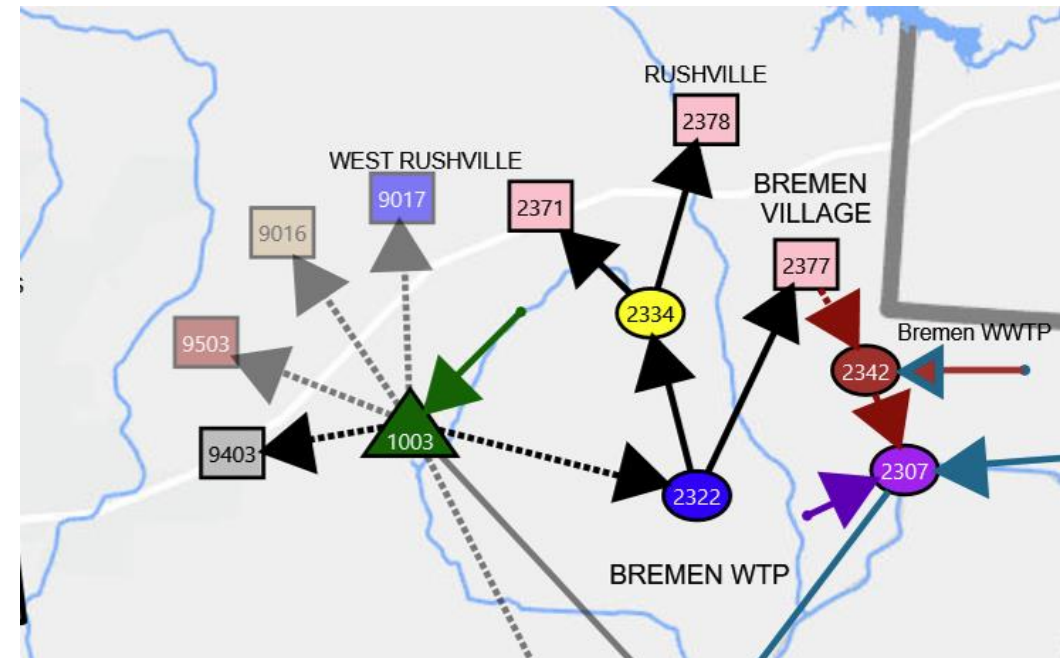


Ground Water Availability

- **SCALE** – This study estimates total ground water availability in each HUC-10 watershed as a single value, which makes its predictive capability only suitable for very large-scale assessments. The results are not suitable for site-specific analysis or any ground water investigations besides those at a regional or sub-regional scales.
- **DELINEATION** - Aquifer boundaries do not always coincide with overlying surface water systems. In this study, ground water boundaries are defined by surface watersheds and, consequently, some aquifers may be split by unsuitable borders. This may lead to unexpected or misleading results, especially near watershed boundaries.
- **UNCERTAINTY** - ground water maps and studies always involve a high degree of uncertainty due to the complex nature of aquifers and the lack of widespread, reliable datasets of aquifer characteristics and water-level information. While this is not unique to this study, its scale and timeframe make its ground water availability estimates especially uncertain. Site-specific ground water investigation could mitigate these uncertainties.

Incorporation of Ground Water Estimates in OASIS

- In OASIS ground water is treated as a daily available water inflow, unused water is sent to a terminal node and storage is not accounted for since available ground water accounts for what is available in storage
- When there is not enough ground water in the system to meet all demands, the water is proportionally delivered to each demand showing a shortage in each demand. I.e. does not prioritize one user over another
- Ground water availability estimates remained constant for every scenario and did not change for future land use or climate scenarios



Example GW node to multiple demands

Surface Water Supplies and Reservoirs

Surface Water Inflows

- Surface water runoff volumes were added at points of interest into the OASIS model as inflows
 - Areas of interest were identified as areas along streams with a surface water intake, instream reservoir or confluences with wastewater returns
- Different inflows were provided as XML files for each watershed for various modeling scenarios
 - OCL code was written to determine which timeseries to use for the simulation depending on user input within the OASIS platform.
- Metrological data from SWMM was utilized to calculate precipitation and evaporation time series for Reservoirs
- See SWMM Modeling Approach for more details on surface water runoff calculations



Modeled Inflows



10 inflow timeseries per surface water nodes representing different climate and year scenarios

Name
2160/INFLOW_2050_5pct95pct
2160/INFLOW_2050_None
2160/INFLOW_Baseline_None
2161/INFLOW_2030_50pct
2161/INFLOW_2030_5pct95pct
2161/INFLOW_2030_None
2161/INFLOW_2040_50pct
2161/INFLOW_2040_5pct95pct
2161/INFLOW_2040_None
2161/INFLOW_2050_50pct
2161/INFLOW_2050_5pct95pct
2161/INFLOW_2050_None
2161/INFLOW_Baseline_None

Reservoirs

Reservoir Table in OASIS

For each reservoir, the information in the reservoir table was found from the following sources:

- Inflows & Evaporation
 - Derived from SWMM model
- Maximum Storage
 - Identified from ODNR GIS Dam layer
 - Model discourages storing water here. Used for flood storage.
- Upper Rule Curve- Normal/Summer Pool
 - Identified for each reservoir as summer and normal pool
 - If not strictly identified used the elevation of the dam crest
- Lower Rule – Trigger for operations
 - Only used for O'Shaughnessy and Griggs reservoirs.
 - From Columbus OASIS model
- Dead & Initial Storage
 - Assumed 0 or the elevation of usable storage
- Storage-Area-Elevation (SAE) Table
 - Derived from ODNR contours in GIS
 - If contours unavailable, assumed constant slope and used DEM data

Reservoir Node

Run: S3_2050

Name	Buckeye Lake	Number	4560				
Inflow	OCL						
Maximum Storage	Constant	891.75	FT	D Weight	-1000	Priority	1
Upper Rule Curve	Time Pattern			C Weight	120	Priority	1
Lower Rule Curve	Constant	0	MG	B Weight	120	Priority	1
Dead Storage	Constant	0	MG	A Weight	120	Priority	1
Initial Storage	Constant	891.75	FT				
Evaporation	OCL						
S-A-E Table	Stor-Area-Elev						

Columbus Reservoir Operations

Operations developed with City for development of Columbus OASIS model of Drought Planning

- Columbus Upground Reservoirs (Doutt, R1 and R3)
 - Doutt Online through all scenarios
 - R1 and R3 online starting in 2040
 - Release water to O'Shaughnessy once usable storage of O'Shaughnessy < 80%
 - Release is limited based on number of reservoirs online:
 - *Just Doutt: Maximum of 37 MGD*
 - *Doutt, R1 and R3: Maximum of 70 MGD*
- O'Shaughnessy Reservoir
 - Supplements Griggs Reservoir to keep Griggs usable storage at 95%
 - Del-Co max allocation of 16.9 MGD to Olentangy Upground Reservoirs
 - Starting in 2030, Home Rd WTP pulls directly from O'Shaughnessy Reservoir
- Griggs Reservoir
 - Releases water to downstream pump station for Dublin Rd WTP
 - Begins drawdown once O'Shaughnessy usable storage is below 80%, Griggs and O'Shaughnessy are drawn down at the same rate

Alum Creek Allocations

- Westerville: 3 MGD
 - Westerville has two other water sources, ground water and Westerville Reservoir
 - Historical data supports that Westerville will meet 90% of demand with surface water. 25% of that surface water demand is met with Westerville Reservoir
 - Previous models and historical data show that Westerville does not always use their full 3 MGD allocation
- Del-Co: 6 MGD
 - Derived from communication with Del-Co
 - Model prioritizes using Alum Creek allocation first to meet demand at RES WTP
 - Del-Co also has access to downstream pumping station to fill TFM reservoir that is not part of their allocation
- Columbus: 31 MGD yearly average (11.3 BG yearly allocation)
 - Rules developed from Columbus OASIS model and collaboration with the City
 - Pumping triggered when Hoover Reservoir reaches 75% capacity
 - *May to September – 35 MGD*
 - *September to April – 70 MGD*
 - Pumping ceases when annual allotment is reached, or Hoover reaches seasonal capacity target:
 - *June to July - 90% capacity*
 - *August to May – 80% capacity*

Reservoir Surface Area Elevation (SAE) Curves and Operations

2160- Delaware Lake

- Maximum storage: constant = 947 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
11/30	915.00
12/01	910.00
01/01	910.00
04/14	910.00
04/15	915.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 9303
- Minimum Release: 5 cfs

Elevation (ft)	Storage (MG)	Area (acres)
885.15	0.00	0.02
887.34	0.08	0.23
889.53	0.49	1.57
891.72	6.03	16.72
893.91	25.01	48.33
896.10	88.57	112.29
898.29	195.66	194.92
900.48	363.72	275.75
902.67	580.41	338.12
904.86	856.99	424.80
907.05	1198.25	546.49
909.24	1642.66	712.37
911.43	2222.37	937.74
913.62	2995.61	1161.37
915.81	3849.87	1242.51
918.00	4781.73	1361.53

2162- Westerville Reservoir

- Maximum storage: constant = 873 ft
- Upper Rule Curve: constant = 870 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 2533

Elevation (ft)	Storage (acre-ft)	Area (acres)
826.00	0.00	0.00
873.00	1258.00	55.83

2163- Alum Creek Lake

- Maximum storage: constant = 901 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
11/30	888.00
12/01	885.00
01/01	885.00
04/14	885.00
04/15	888.00

- Lower Rule Curve: constant = 841.5 ft
- Dead Storage: constant = 841.5 ft
- Nodes with Direct Withdrawals: 2122 & 2164
- Minimum Release: 6.5 cfs

Elevation (ft)	Storage (MG)	Area (acres)
826.62	0.00	0.02
830.92	17.81	28.92
835.21	116.37	135.54
839.50	405.18	303.98
843.79	938.42	486.41
848.08	1735.98	679.86
852.37	2817.73	855.08
856.67	4224.73	1133.10
860.96	6004.63	1395.25
865.25	8155.40	1681.58
869.54	10675.49	1925.75
873.83	13520.42	2166.71
878.12	16708.77	2431.36
882.42	20322.83	2728.81
886.71	24302.94	3278.79
891.00	29161.90	3663.55

2164- Hoover Reservoir

- Maximum storage: constant = 33056.6 MG
- Upper Rule Curve: constant = 21591.9 MG
- Lower Rule Curve: constant = 278.2 MG
- Dead Storage: constant = 278.2 MG
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
831.50	17.90	20.50
835.00	65.70	74.90
844.00	504.60	242.60
854.00	1648.20	489.50
862.00	3209.90	726.80
870.00	5430.80	1000.20
872.00	6124.10	1137.60
874.00	6931.40	1340.50
875.00	7382.90	1428.50
879.00	9467.20	1773.60
880.00	10069.00	1900.20
882.00	11374.00	2088.40
884.00	12795.00	2264.10
889.00	16857.00	2722.20
890.00	17758.00	2802.20
896.00	23654.00	3234.80
902.00	30529.00	3796.10
904.00	33057.00	3942.90

2167- Olentangy Upground Reservoirs

- Maximum storage: constant = 1564 MG
- Upper Rule Curve: constant = 1562 MG
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 2121
- Pump Capacities:
 - From 2108: 39.0 MGD
 - From 2161: 16.2 MGD

Elevation (ft)	Storage (MG)	Area (acres)
876.00	0.00	0.00
960.00	1564.00	171.60

2168- TFM Reservoirs

- Maximum storage: constant = 991 MG
- Upper Rule Curve: constant = 989 MG
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 2122 & 2125
- Pump capacity: 8.6 MGD

Elevation (ft)	Storage (MG)	Area (acres)
939.00	0.00	0.00
975.00	989.00	113.62

2166- Doutt Reservoir

- Maximum storage: constant = 10530 MG
- Upper Rule Curve: constant = 9300 MG
- Lower Rule Curve: constant = 1300 MG
- Dead Storage: constant = 1300 MG
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
920.00	0.00	0.00
925.00	1300.00	120.00
939.00	4830.00	445.00
955.00	9300.00	857.00
960.00	10530.00	970.00

2560- Griggs Reservoir

- Maximum storage: constant = 1643 MG
- Upper Rule Curve: constant = 1419.8 MG
- Lower Rule Curve: constant = 1348.81 MG
- Dead Storage: constant = 1 MG
- Nodes with Direct Withdrawals: none
- Minimum Release: 41.3 cfs

Elevation (ft)	Storage (MG)	Area (acres)
734.00	0.00	0.40
738.00	22.10	52.30
739.00	42.90	75.40
741.00	105.70	116.90
744.00	245.50	170.80
746.00	375.20	228.20
747.00	453.40	252.30
750.00	727.70	310.30
752.00	937.30	338.60
757.00	1517.90	373.90
758.00	1643.00	389.30

2161- O'Shaughnessy Reservoir

- Maximum storage: constant = 4907.3 MG
- Upper Rule Curve: constant = 4429.9 MG
- Lower Rule Curve: constant = 3100.93 MG
- Dead Storage: constant = 92.7 MG
- Nodes with Direct Withdrawals: 2167
- Minimum Release: 95.2 cfs

Elevation (ft)	Storage (MG)	Area (acres)
799	0.00	0.00
805	13.30	18.60
808	39.10	36.40
812	102.50	63.70
815	176.10	87.40
825	606.60	191.30
830	984.00	276.00
836	1636.80	397.50
838	1915.20	461.30
840	2246.90	559.20
842	2652.50	690.70
843	2887.60	754.50
844	3142.40	803.10
846	3687.20	869.90
847	3975.10	896.80
848	4275.20	941.90
848.5	4429.9	954.9
849	4586.5	967.6
850	4907.3	1004.3

3760- Hocking Hills Reservoir

- Maximum storage: constant = 906.83 ft
- Upper Rule Curve: constant = 895 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
870.63	0.00	0.02
873.83	0.12	0.21
877.03	0.58	0.67
880.23	1.73	1.55
883.43	3.88	2.83
886.63	7.71	4.43
889.83	13.12	5.92
893.03	20.24	7.68
896.23	29.04	9.21
899.42	39.32	10.58
902.62	51.20	12.19
905.82	64.86	13.95
909.02	80.45	16.07
912.22	97.93	17.42
915.42	116.64	18.51
918.62	137.41	21.26

2460- Washington Court House New Reservoir

- Maximum storage: constant = 984 ft
- Upper Rule Curve: constant = 981.13 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 2422

Elevation (ft)	Storage (MG)	Area (acres)
962.90	0.00	0.00
984.00	803.00	37.85

2461- Washington Court House Old Reservoir

- Maximum storage: constant = 1000 ft
- Upper Rule Curve: constant = 998 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 2422
- Pump Capacity: 6.0 MGD

Elevation (ft)	Storage (MG)	Area (acres)
981.00	0.00	0.00
1000.00	626.30	35.60

3761- Lake Logan

- Maximum storage: constant = 782 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
01/01	759.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
739.04	0.00	0.02
740.51	1.38	6.30
741.97	6.99	16.49
743.43	16.90	25.26
744.90	36.50	59.62
746.36	71.21	83.75
747.82	116.21	104.88
749.29	169.99	120.60
750.75	232.22	143.85
752.22	308.05	175.26
753.68	399.42	204.74
755.14	500.65	219.37
756.61	609.00	231.43
758.07	738.36	317.20
759.54	895.29	341.08
761.00	1064.20	366.38

4260- Apple Valley Lake

- Maximum storage: constant = 1028 ft
- Upper Rule Curve: constant = 1026 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
937.31	0.00	0.02
941.51	4.40	10.72
945.70	27.61	23.04
949.90	67.01	35.27
954.09	130.74	57.73
958.29	225.70	80.94
962.49	361.00	114.91
966.68	535.51	141.08
970.88	755.58	185.21
975.07	1042.95	232.71
979.27	1388.45	271.77
983.47	1784.02	304.52
987.66	2219.17	331.72
991.86	2691.41	359.63
996.05	3209.89	402.89
1000.25	3810.62	471.37

4560- Buckeye Lake

- Maximum storage: constant = 891.75 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
01/01	889.00
03/01	890.00
03/15	890.50
04/01	891.00
05/01	891.75
11/01	891.78
11/15	891.00
12/01	890.00
12/15	889.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
876.79	0.00	0.02
877.86	0.61	4.24
878.92	3.10	10.35
879.99	8.63	26.27
881.05	24.05	61.44
882.11	52.21	108.42
883.18	110.33	244.44
884.24	240.35	531.57
885.30	477.35	854.96
886.37	849.78	1299.29
887.43	1395.43	1866.83
888.50	2129.23	2287.48
889.56	3001.26	2843.93
890.62	4049.75	3107.77
891.69	5144.30	3207.25
892.75	6276.98	3336.77

4561- Dillion Lake

- Maximum storage: constant = 790 ft
- Upper Rule Curve: time pattern

Date	Storage (ft)
11/30	737.00
12/01	734.00
01/01	734.00
04/14	734.00
04/15	737.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none
- Minimum Release: 50 cfs

Elevation (ft)	Storage (MG)	Area (acres)
711.59	0.00	0.02
713.49	0.38	2.04
715.38	3.34	8.88
717.27	16.95	37.33
719.17	57.27	131.57
721.06	170.30	221.38
722.96	330.19	306.70
724.85	547.06	393.14
726.74	835.89	515.94
728.64	1183.47	624.51
730.53	1599.53	714.57
732.42	2075.61	811.64
734.32	2599.85	910.27
736.21	3228.88	1136.83
738.11	3989.62	1341.77
740.00	4874.27	1499.75

4660- Indian Lake

- Maximum storage: constant = 998.3 ft
- Upper Rule Curve: constant = 996.3
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (MG)	Area (acres)
979.26	0.00	0.02
980.20	0.99	7.76
981.14	5.12	19.77
982.09	13.32	32.63
983.03	25.01	43.10
983.97	40.07	57.85
984.91	64.05	99.00
985.86	105.69	193.24
986.80	288.73	1190.41
987.74	771.90	2014.79
988.69	1608.34	3493.22
989.63	2758.15	3944.89
990.57	4040.51	4460.15
991.52	5462.48	4747.49
992.46	7018.32	5323.71
993.40	8671.11	5418.18

4960- Choctaw Lake

- Maximum storage: constant = 7783 acre-ft
- Upper Rule Curve: constant = 1016.4 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none

Elevation (ft)	Storage (acre-ft)	Area (acres)
998.00	0.00	0.00
1040.00	7783.00	563.26

6460- Somerset Reservoir

- Maximum storage: constant = 945 ft
- Upper Rule Curve: constant = 941.2 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 6421

Elevation (ft)	Storage (acre-ft)	Area (acres)
909.90	0.00	0.00
945.00	130.40	9.52

6461- New Lexington Reservoir

- Maximum storage: constant = 909 ft
- Upper Rule Curve: constant = 907.75 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 6420

Elevation (ft)	Storage (acre-ft)	Area (acres)
864.00	0.00	0.00
909.00	707.00	36.00

6462- New Lexington Water Supply Reservoir

- Maximum storage: constant = 940 ft
- Upper Rule Curve: constant = 938 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 6420

Elevation (ft)	Storage (acre-ft)	Area (acres)
895.50	0.00	0.00
940.00	1144.00	44.00

6560- Deer Creek Lake

- Maximum storage: constant = 844 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
11/30	810.00
12/01	796.00
01/01	796.00
04/14	796.00
04/15	810.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none
- Minimum Release: 10 cfs

Elevation (ft)	Storage (MG)	Area (acres)
773.37	0.00	0.02
776.04	0.36	0.88
778.72	1.63	2.12
781.39	9.87	31.04
784.07	65.72	106.03
786.74	217.39	231.01
789.42	452.06	308.17
792.10	807.66	503.49
794.77	1282.99	580.69
797.45	1864.81	752.47
800.12	2592.32	910.06
802.80	3447.96	1031.54
805.47	4386.01	1127.98
808.15	5448.38	1310.08
810.82	6613.59	1365.12
813.50	7850.88	1475.94

7160- Paint Creek Lake

- Maximum storage: constant = 845 ft
- Upper Rule Curve: time pattern

Date	Elevation (ft)
11/30	798.00
12/01	787.50
01/01	787.50
04/14	787.50
04/15	798.00

- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: none
- Minimum Release: 10 cfs

Elevation (ft)	Storage (MG)	Area (acres)
757.98	0.00	0.04
760.78	0.49	1.64
763.58	5.99	13.41
766.38	24.96	30.64
769.18	80.90	100.70
771.98	202.72	159.21
774.79	381.96	232.50
777.59	617.88	288.36
780.39	926.33	383.17
783.19	1308.06	459.11
785.99	1783.05	655.50
788.79	2467.31	878.00
791.60	3351.45	1051.41
794.40	4400.45	1203.90
797.20	5516.28	1239.89
800.00	6670.49	1302.04

8060- Marysville Reservoir

- Maximum storage: constant = 1021 ft
- Upper Rule Curve: constant = 1021 ft
- Lower Rule Curve: constant = 0
- Dead Storage: constant = 0
- Nodes with Direct Withdrawals: 8020
- Pumping Capacity: 2.00 MGD

Elevation (ft)	Storage (MG)	Area (acres)
973.00	0.00	0.00
1021.00	1510.00	171.00

Water Treatment Plants

Data Used

- OASIS model includes all water treatment plants (WTPs) with associated permitted treatment capacities and connections to demands
- The following data were used for water treatment plant characterization
 - Historical Water Treatment Plant Production Data – Used to calculate average daily demand, monthly peaking factors, and to validate OASIS flows
 - Master Plans – Used for utility specific information, as available
 - Municipality Consumer Confidence Reports - Used to confirm operations and water supply sources
 - [Home - Drinking Water Viewer](#) – Used to identify emergency connections or water purchases between plants
 - ODNR Surface Water / ground water Withdraw Capacities – used to identify water supply withdraw limits

WTP Capacities in Model

WTP Capacities (Base Year)

OASIS NUMBER	PLANT NAME	Capacity (MGD)
2120	DELAWARE WTP	8.04
2121	DEL-CO OLENTANGY WTP	28.8
2122	RE SCOTT WTP (ALUM CK)	6.55
2123	THOMAS E. STEWARD WTF	6
2125	TFM WTP	4
2320	AMANDA VILLAGE WTP	0.288
2321	BALTIMORE WTP	0.72
2322	BREMEN VILLAGE OF	0.432
2323	FAIRFIELD COUNTY WTP	3
2324	GREENFIELD TWP WATER DISTRICT	0.576
2325	LANCASTER CITY - NORTH PLANT	9.3
2326	LANCASTER CITY - SOUTH PLANT	8.4
2328	LITTLE WALNUT WTP	0.5
2329	MILLERSPORT VILLAGE	1
2330	PICKERINGTON WTP	3.5
2331	PLEASANTVILLE PWS	0.1224
2332	SUGAR GROVE VILLAGE WTP	0.1224
2333	THURSTON WTP 2	0.144
2352	LITHOPOLIS PWS	0.5

OASIS NUMBER	PLANT NAME	Capacity (MGD)
2420	BLOOMINGBURG PWS	0.25
2421	JEFFERSONVILLE PWS	0.3744
2422	WASHINGTON COURT HOUSE PWS	3
2423	I-71 & ST RTE 35 PWS	0.2016
2520	AQUA OHIO - BLACKLICK	1.44
2521	AQUA OHIO - HUBER RIDGE	1.15
2522	AQUA OHIO - LAKE DARBY	0.72
2523	AQUA OHIO - WORTHINGTON HILLS	0.72
2524	CANAL WINCHESTER WTP	2
2525	CITY OF GROVEPORT WTP 2	0.576
2526	COLUMBUS DUBLIN ROAD WTP	80
2527	COLUMBUS HAP CREMEAN WTP	125
2528	COLUMBUS PARSONS AVE WTP	50
2529	JWSD WTP	1.73
2530	AQUA OHIO - TIMBERBROOK	0.18
2531	TIMBERLAKE WATER SYSTEM	0.3
2532	OBETZ PWS	0.432
2533	WESTERVILLE WTP	7.5

OASIS NUMBER	PLANT NAME	Capacity (MGD)
3720	LAURELVILLE VILLAGE	0.4248
3721	LOGAN WTP	2.5
4220	DANVILLE STU 2	0.3
4221	FREDERICKTOWN WTP	0.67
4222	KNOX CO W & WW	1.152
4223	MARTINSBURG VILLAGE	0.0432
4224	MOUNT VERNON WTP	6.2
4520	GRANVILLE WTP	2
4521	HEATH CITY	4
4522	HEBRON VILLAGE	2.16
4523	JOHNSTOWN WTP	1
4524	NEWARK WTP	15
4525	LICKING CO PRESCOTT ESTATES	0.17
4526	PATASKALA WTF STU 1	1.3
4527	PATASKALA WTF STU 2	0.864
4528	ST. LOUISVILLE WTP	0.108
4529	SWLCW STU 2	3
4530	UTICA WATER DEPT	0.72

WTP Capacities (Base Year) Continued

OASIS NUMBER	PLANT NAME	Capacity (MGD)
4620	BELLE CENTER VILLAGE	0.489
4621	BELLEFONTAINE CITY STU 2 WEST	4.61
4622	DEGRAFF VILLAGE	0.24
4623	LAKEVIEW WATER DEPARTMENT	0.374
4624	RUSSELLS POINT WTP	0.43
4625	QUINCY VILLAGE	0.576
4626	RUSHSYLVANIA PWS	0.24
4627	WEST LIBERTY WTP	0.43
4628	WEST MANSFIELD PWS	0.14
4920	CHOCTAW UTILITIES STU2	0.55
4921	LONDON WTP	1.5
4922	WATER DISTRICT 1 TREATMENT PLANT	1.5
4923	MOUNT STERLING TREATMENT PLANT 2	0.864
4924	PLAIN CITY PWS	1.152
4925	WEST JEFFERSON PWS	0.936

OASIS NUMBER	PLANT NAME	Capacity (MGD)
4926	SOUTH SOLON WTP	0.1224
5120	AQUA OHIO - MARION	9.1
5121	LA RUE VILLAGE	0.18
5122	OAKRIDGE ESTATES LLC	0.0936
5920	CARDINGTON WTP	0.75
5921	MT GILEAD WTP	1
6420	NEW LEXINGTON WTP	1
6421	WTP-SOMERSET	0.425
6422	WTP-THORNVILLE	0.504
6423	BURR OAK REGIONAL WTP	4
6424	ROSEVILLE WTP	0.5
6520	ASHVILLE VILLAGE	0.65
6521	CIRCLEVILLE CITY	4
6522	COMMERCIAL POINT - TP2	1
6523	DARBYVILLE WTP	0.085

OASIS NUMBER	PLANT NAME	Capacity (MGD)
6524	EARNHART HILL REGIONAL W & SD	2.16
6525	NEW HOLLAND VILLAGE	0.216
6526	SOUTH BLOOMFIELD VILLAGE	0.25
6527	WILLIAMSPORT WTP	0.216
6528	PICKAWAY CORRECTIONAL INSTITUTION	2.3
7120	BAINBRIDGE VILLAGE	0.432
7121	CHILlicothe WTP	7
7122	ROSS CO WATER SOUTH PLANT	4.57
7123	ROSS CO WATER NORTH PLANT	4
7124	CLARKSBURG VILLAGE	0.072
7125	FRANKFORT VILLAGE	0.3168
7126	KINGSTON VILLAGE	0.23
8020	MARYSVILLE WTP 2	4
8021	MILFORD CENTER WTP	0.166
8022	RICHWOOD WTP	0.374

Assumed WTP Capacity Changes

Future plants and increased capacities were incorporated into the model for future model years. These assumed changes are as follows:

COUNTY	OASIS NUMBER	PLANT NAME (NODE)	BASECASE CAPACITY (MGD)	FUTURE CAPACITY (MGD)	YEAR FUTURE CAPACITY INCORPORATED
Licking	4523	Johnstown WTP	1	3	2030
Licking	4555	Licking Regional WTP	3	5	2030
Franklin	2535	Home Road WTP	N/A	48	2030

WTP Operations and Withdrawals

Municipalities with Multiple WTP

For municipalities with multiple water treatment plants, hydraulic distribution areas were not accounted for in the model. Instead, the demand on each WTP was proportional to the individual treatment capacity over the entire system capacity. If one plant could not meet the demand based on supply availability, a connected plant was allowed to make up the deficit and deliver more water.

Systems with Multiple Plants			
Municipality	Number of WTP's	Total System Capacity (MGD)	Plants
Ross County Water	2	8.57	Ross County Water North Plant, Ross County Water South Plant
City of Lancaster	2	17.7	Lancaster City- North Plant, Lancaster City - South Plant
Fairfield County Utilities	3	4.076	Fairfield County Tussing Rd WTP, Greenfield TWP, Little Walnut WTP
City of Pataskala	2	2.164	Pataskala WTF STU 1, Pataskala WTP STU 2
Del-Co	4	45.35	Olentangy WTP, Thomas E. Steward WTP, RE Scott WTP, Timothy McNamara WTP (Summer Only)
City of Columbus	3 (Current), 4 (Future Years)	255 (Current), 303 (Future)	Dublin Road WTP, Hap Cremean WTP, Parsons Ave WTP, Home Road WTP (Future)
Mid-Ohio	3	4.152	Water District 1 Treatment Plant, Plain City WTP, London WTP

WTP Rules for Plants with Multiple Sources

For water treatment plants with multiple water sources, municipal master plans, city websites and ODNR withdrawal data were utilized to determine the use between sources. If one source is in a deficit, the model still allowed access to the other source (if available) to meet demands even if did not match historical operations.

Municipality	Water Sources	Model Assumption
Washington Court House	Washington Court House Upground Reservoirs, ground water	CCR indicates meeting 40% of demand in summer with ground water
Westerville	Alum Creek Allocation, Westerville Reservoir, ground water	Production data indicates city meeting 10% of demands with ground water. Surface water demand is met using Alum Creek allocation first
Aqua Ohio Marion	Little Scioto River, ground water	Production data indicates demands being met with 40% ground water
Marysville	Marysville Reservoir, ground water	City indicated only using ground water during shortfalls in surface water availability.

WTP Surface Water Withdraw Capacities

- Data from ODNR Withdrawal Capacities
- Surface water capacities were modeled as constraints to follow permits from ODNR
 - Pumping capacities are representative of the pumping capacity from the source tributary to either the WTP or a systems upground reservoir
- Ground water withdrawals were NOT constrained as historical data indicated users withdrew more than ODNR permits regularly based on pumping capacity

COUNTY	OASIS NUMBER	PLANT NAME	Surface Water Withdrawal Capacity (MGD)
Delaware	2120	DELAWARE WTP	8.04
Delaware	2121	DEL-CO OLENTANGY WTP	5.76
Delaware	2122	RE SCOTT WTP (ALUM CK)	6
Delaware	2125	TFM WTP	4
Fayette	2422	WASHINGTON COURT HOUSE PWS	6
Franklin	2526	COLUMBUS DUBLIN ROAD WTP	130
Franklin	2527	COLUMBUS HAP CREMEAN WTP	200
Franklin	2533	WESTERVILLE WTP	3
Franklin	2535	COLUMBUS HOME RD WTP	48
Licking	4524	NEWARK WTP	15
Marion	5120	AQUA OHIO - MARION	24.06
Perry	6420	NEW LEXINGTON WTP	1
Perry	6421	WTP-SOMERSET	0.62
Union	8020	MARYSVILLE WTP 2	2

Wastewater Treatment Plants

Data Used

- OASIS model includes all wastewater treatment plants (WWTPs) with associated permitted treatment capacities and connections to demands
- The following data were used for wastewater treatment plant characterization
 - Historical WWTP Discharge Data – Used to validate WWTP flows in OASIS model
 - Master Plans – Used for utility specific information, as available
 - NPDES Information – Used to determine WWTP discharge location, WWTP plant capacity

WWTP Capacities, Returns and Assumptions

WWTP Flow Assumptions

- Initially assumed that 90% of WTP production was returned to WWTP
- Reviewed Base Flow, I&I Flow, and Total Flow and compared to Historical data to determine any correction factors that needed to be added for the estimation of WWTP flows (see I&I section)
- Model only accounted for wastewater returns that discharge to surface water
 - Septic returns are considered to be captured in the available ground water availability calculations
- Created an approach for Inflow and Infiltration, which will be discussed further in subsequent slides
- Model allows all projected wastewater flows to pass through a WWTP node regardless of WWTP capacity. Capacity is used as a flag in dashboard to identify gaps.
- For systems with multiple WWTPs, wastewater flow to each plant was split proportionally based on WWTP capacity. Systems with multiple WWTP's:
 - City of Columbus
 - Delaware Regional Sewer District
 - Mid- Ohio (Starting in 2030)
 - Lancaster
 - Fairfield County Utilities
 - Licking County Regional Water District
 - Aqua Ohio Marion

WWTP Capacities (Base Year)

OASIS NUMBER	PLANT NAME	Capacity (MGD)
2140	Alum Creek WWTP	10
2141	Ashley WWTP	0.19
2142	Galena WWTP No 2	0.5
2143	Lower Scioto WRF	1.4
2144	Olentangy Environmental Control Center	6
2145	Ostrander WWTP	0.09
2146	Sunbury WWTP	1.125
2147	Upper Olentangy WRF	10
2340	Amanda WWTP	0.1269
2341	Baltimore WWTP	1.01
2342	Bremen WWTP	0.336
2343	Lancaster WPCF	10
2344	Little Walnut Sycamore WRF	0.75
2345	Millersport STP	1
2346	Pickerington WWTP	3.2
2348	Stoutsville WWTP	1.3
2349	Sugar Grove WWTP	0.07
2350	Upper Hocking WPCF	2
2351	Walnut Creek SD	0.4
2353	Tussing RD WRF	3

OASIS NUMBER	PLANT NAME	Capacity (MGD)
2440	Bloomingsburg WWTP	0.25
2441	Jeffersonville WWTP No 2	0.1
2442	Rattlesnake SD #1 WWTP	1
2443	Washington Court House WWTP	6
2540	Aqua Ohio - Blacklick WWTP	1.2
2541	Aqua Ohio - Huber Ridge WWTP	1.03
2542	Aqua Ohio - Lake Darby WWTP	0.5
2544	Canal Winchester WWTP	2.48
2545	Columbus Southerly WWTP	114
2546	Darbydale WWTP	0.45
2547	Jackson Pike WWTP	68
3740	Laurelville WWTP	0.2
3741	Logan WWTP	1.6
3742	Rockbridge WWTP	0.028
4240	Centerburg WRF	0.2
4241	Danville WWTP	0.2
4242	Fredericktown WWTP	0.3
4243	Gambier WWTP	0.45
4244	Little Jelloway Creek WWTP	0.9
4245	Mount Vernon WWTP	3.5

OASIS NUMBER	PLANT NAME	Capacity (MGD)
4540	Alexandria WWTP	0.08
4541	Buckeye Lake WWTP	2
4542	Granville WWTP	2
4543	Hanover WWTP	0.16
4544	Hartford WWTP	0.06
4545	Heath WWTP	1.75
4546	Hebron Village WRF	2.16
4547	Johnstown WWTP	1.2
4548	Kirkersville WWTP	0.1
4549	Newark WWTP	8
4550	Pataskala WWTP	3
4551	SWLCWSD Gale Rd Envir Control Facility	4.3
4552	Utica WWTP	0.42
4640	Bellefontaine WWTP	4.5
4641	Indian Lake WPCF	4.6
4643	Quincy-DeGraff STP	0.495
4644	Rushsylvania WWTP	0.1
4645	West Liberty STP	0.5

WWTP Capacities (Base Year) Continued

OASIS NUMBER	PLANT NAME	Capacity (MGD)
4940	London WWTP	5.8
4941	Madison County SD #2 WWTP	0.3
4942	Mount Sterling WWTP	1
4943	Plain City WWTP	0.495
4944	South Solon WWTP	0.1
4945	West Jefferson WWTP	0.5
4946	Madison County SD #1	0.15
5140	Caledonia WWTP	0.0759
5141	Grandview Estates SD 2A	0.2
5142	LaRue WWTP	0.6
5143	Marion WPC	10.5
5144	New Bloomington WWTP	0.125
5145	Prospect WWTP	0.24
5146	SD No 7 Water Reclamation Plant	1.75
5147	Waldo WWTP	1.4
5148	Fountain Place WWTP SD 5A	0.1

OASIS NUMBER	PLANT NAME	Capacity (MGD)
5940	Cardington WWTP	0.5
5941	Chesterville WWTP	0.095
5943	Marengo Village	0.038
5944	Mt Gilead WWTP	1
5945	SoMoCo WWTP	0.175
5946	Sparta WWTP	0.042
6440	Corning WWTP	0.06
6441	Glenford WWTP	0.036
6442	Junction City WWTP	0.1
6443	New Lexington WWTP	0.87
6444	New Straitsville WWTP	0.095
6445	Shawnee WWTP	0.093
6446	Somerset WWTP	0.25
6447	Thornville WWTP	0.4
6448	Roseville WWTP	0.671
6540	Ashville Village WRRF	0.8

OASIS NUMBER	PLANT NAME	Capacity (MGD)
6541	Circleville WWTP	4
6542	Commercial Point WWTP	0.43
6543	New Holland WWTP	0.15
6544	Pickaway Correctional Institution	2.3
6545	South Bloomfield WWTP No 2	0.5
6546	Williamsport WWTP	0.15
6547	Earnhart Hill Regional W & SD WWTP #2	0.3
7140	Chillicothe WWTP - Easterly	3.8
7141	Clarksburg WWTP	0.06
7142	Frankfort WWTP	0.19
7143	Kingston WWTP	0.052
7144	South Salem WWTP	0.03
7145	Village of Bainbridge WWTP	0.15
8040	Liberty Twp Regional Treatment Facility	0.1
8041	Marysville WRF	10
8042	Richwood WWTP	0.38

Assumed WWTP Capacity Changes

Future plants, decommissioned plants, and increased capacities were incorporated into the model for future model years. These assumed changes are as follows:

COUNTY	OASIS NUMBER	PLANT NAME (NODE)	BASECASE CAPACITY (MGD)	FUTURE CAPACITY (MGD)	YEAR FUTURE CAPACITY INCORPORATED
Licking	4523	Johnstown	1.2	2.4	2030
Madison	4948	Mid-Ohio	0	5	2030
Pickaway	6542	Commercial Point	0.43	1.4	2030
Licking	4553	Wagram	0	2.5	2030
Licking	4550	Pataskala	1.1	3	2030
Logan	4642	Logan County ERSD WWTP	0	0.1	2030

COUNTY	OASIS NUMBER	PLANT NAME (NODE)	BASECASE CAPACITY (MGD)	FUTURE CAPACITY (MGD)	YEAR OF DECOMMISSIONING
Madison	4946	Madison County SSD 1	0.15	0	2030
Madison	4941	Madison County SSD 2	0.3	0	2030

Inflow & Infiltration (I&I) Application

I&I Methodology

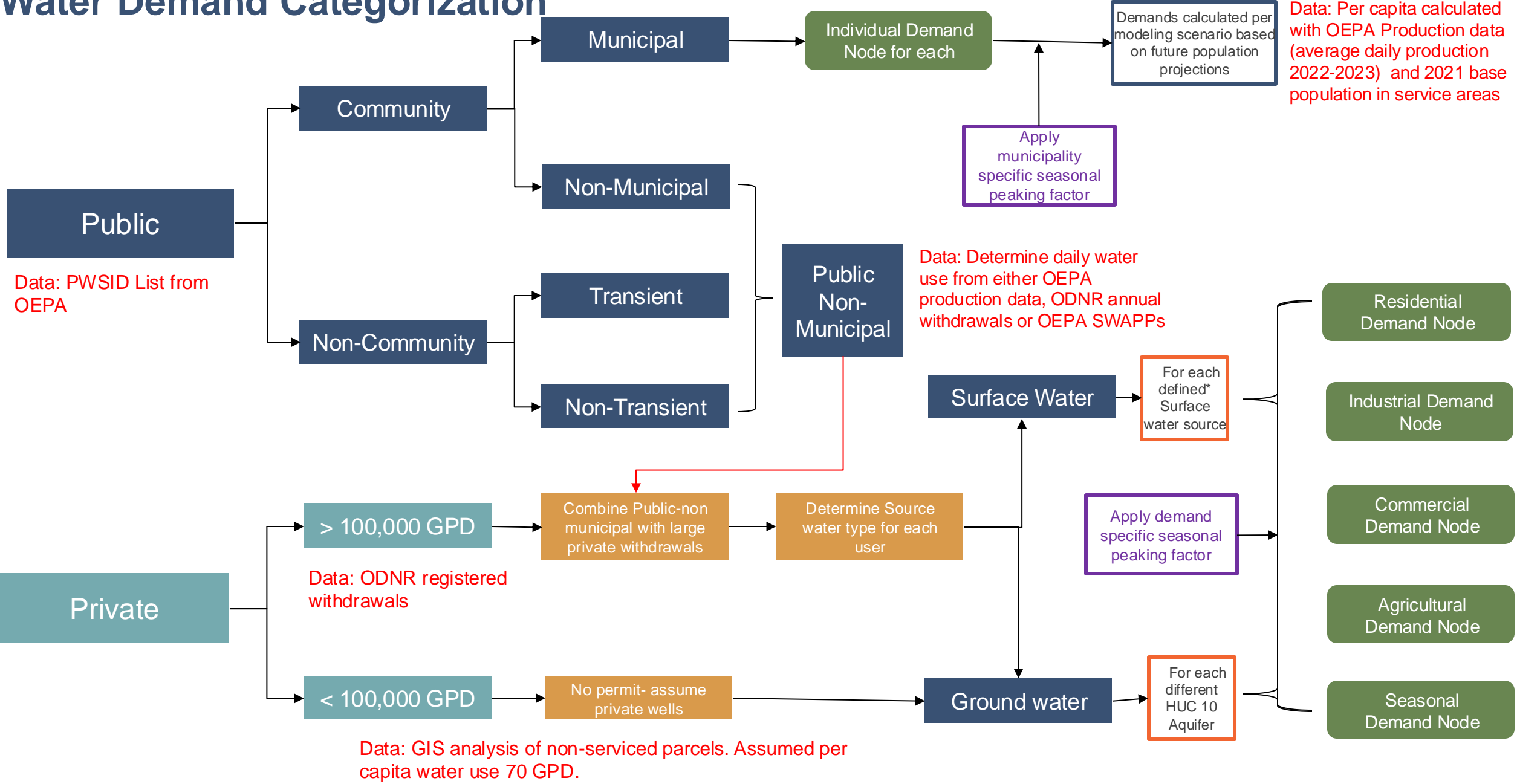
- Used City of Columbus collection system model to approximate the amount of rainfall that becomes I&I for combined and sanitary service areas
- I&I flows to individual WWTPs are based on service area size, service area characteristics (combined vs. separate), and historical rainfall
 - Used 2A forms from NPDES permits to determine the percent of every WWTP service area in the 15-county model that is combined versus separate
- To maintain mass-balance, I&I inflows were removed from closest downstream surface water inflow to account for water from watershed captured through wastewater treatment plant
- Reviewed model outputs, compared to historical data, and adjusted assumptions as needed

I&I Rainfall Assumptions

WWTP w/ Service Areas < 15,000 acres				WWTP w/ Service Areas > 15,000 acres			
Daily rain depth, inches	Combined Systems		Separate Systems	Summed rain depth (past 3 days and current day), inches	Combined Systems		Separate Systems
	% of daily rain volume over combined system area that contributes to I&I	% of daily rain volume over separate area that contributes to I&I	% of rain over total area that contributes to I&I		% of 4-day summed rain volume over combined system area that contributes to I&I	% of 4-day summed rain volume over separate system area that contributes to I&I	% of 4-day summed rain volume over total area that contributes to I&I
0-0.15	50%	4%	4%	0-0.15	50%	4%	4%
0.15-0.5	40%	2%	4%	0.15-0.5	40%	2%	2%
0.5-1.0	40%	2%	2%	0.5-1.0	40%	2%	2%
>1.0	1.5%	0.5%	0.5%	>1.0	1.5%	0.5%	0.5%

Drinking Water Demands

Water Demand Categorization



Municipal Demands

Municipal Demands

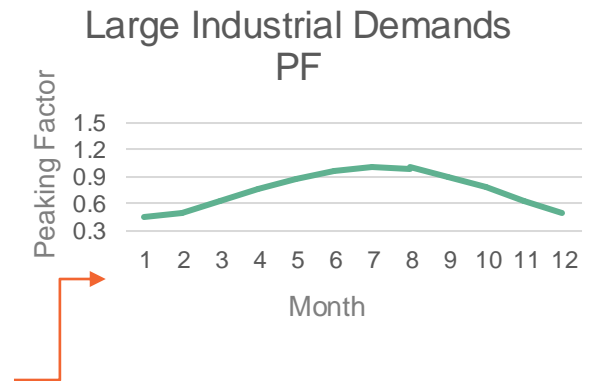
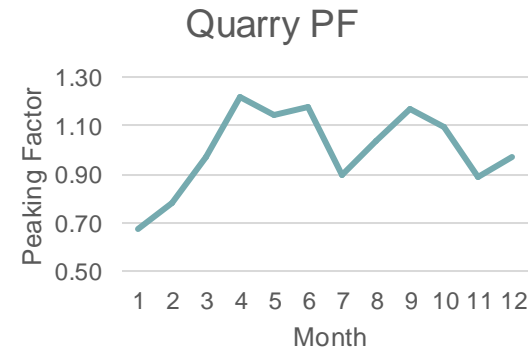
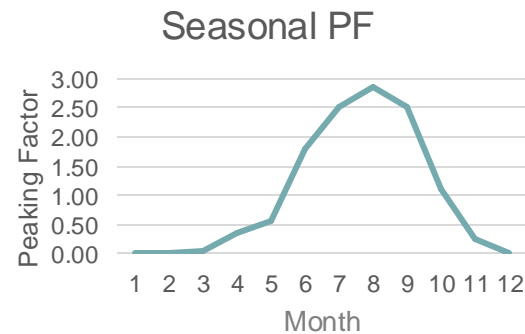
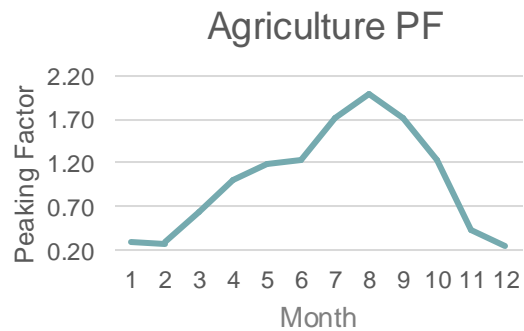
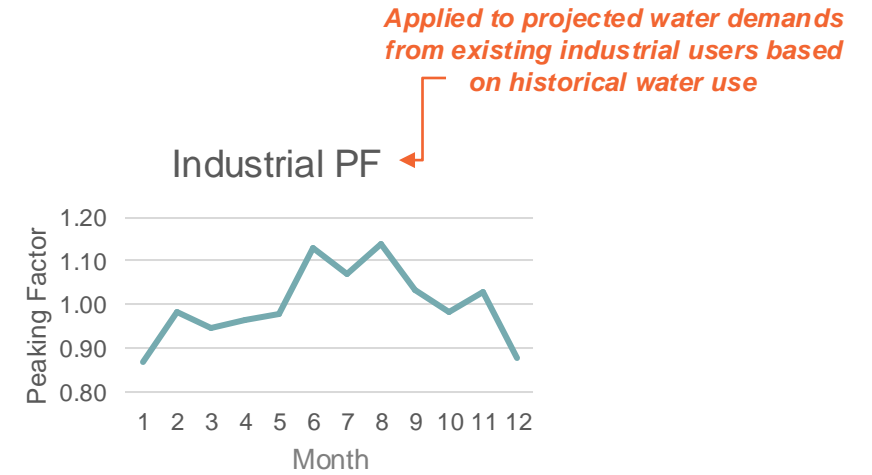
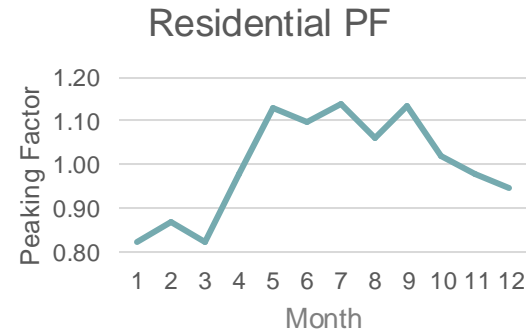
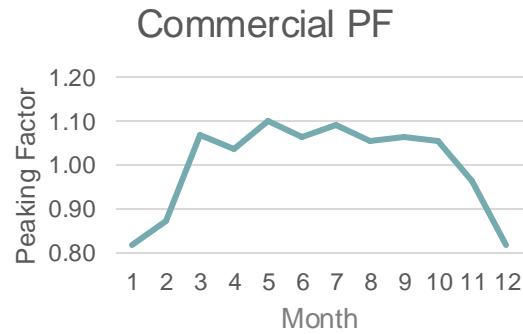
- Data Used
 - MORPC/ODOD Population Projections
 - Service Areas (Derived from Available Maps/Shapefiles, Municipal Boundaries, or USEPA Water Service Area Layer)
 - [Community Water System Service Area Boundaries | US EPA](#)
 - 2022-2023 Production Data (derived current annual average demand to calculate peaking factors and per-capita water use)
- Future demands were calculated with the following method:
 - Average Historical per Capita Water Use = Average 2022-2023 Water Production / Base Year Population in Service Area
 - *Municipal Demands (MGD) = Average Historical Per Capita Water Use * Projected Population in Service Area (ODOD or MORPC) * Calculated Seasonal Peaking Factor*

Non-Municipal Demands

Non-Municipal Demands

- Data Used:
 - OEPA Source Water Protection Plans
 - ODNR Withdraw Data
 - Data was aggregated into singular nodes by source as reflected in the demand flow chart
 - *Seasonal demands include Golf Courses and Campgrounds or other users with only summer use*
 - *Residential demands include mobile home parks and apartment complexes on their own wells*
 - *Agriculture demands includes farms and orchards with heavier water use in the dry season*
 - *Commercial demands include all users who have daily water use for potable water*
 - *Industrial demands includes those users classified as industry by ODNR or Mineral Extraction. Different peaking factors were applied for regular industrial users, future large industrial users and quarry industrial users.*
- Peaking factors were developed for each demand type by analyzing a representative sample of demand data for each category
- Assumed no growth for current non-municipal demands

Non-Municipal Demand Peaking Factors



Quarry Demands

Industrial – Quarry Demands

Quarry demands are met only after all other system demands have been met. They have unique peaking factors compared to all other demands in the OASIS model. Quarry demands are for dewatering the quarry after encountering the water table. Quarry demands were calculated using reported withdrawals for the past 5 years.

COUNTY	OASIS NUMBER	DEMAND NAME	DEMAND (MGD)
Licking	9113	Van Wey Sand & Gravel	0.09
Logan	9143	Shelly Materials – Belle Center	0.63
Pickaway	9206	Melvin Stone Company- Williamsport Quarry	0.67
Ross	9219	S&S Aggregate - Chillicothe	0.15
Ross	9223	Melvin Stone – Plano	5.76
Franklin	9246	The Olen Corporation	22.72
Franklin	9247	Columbus Limestone	11.08
Union	9248	Shelly Materials - Ostrander	4.74
Franklin	9249	Dewatering - AGG ROK Materials	2.14
Marion	9250	National Lime & Stone - Marion	2.10
Delaware	9251	National Lime & Stone - Delaware	3.551
Franklin	9252	Shelly Materials - Marble Cliff	2.08

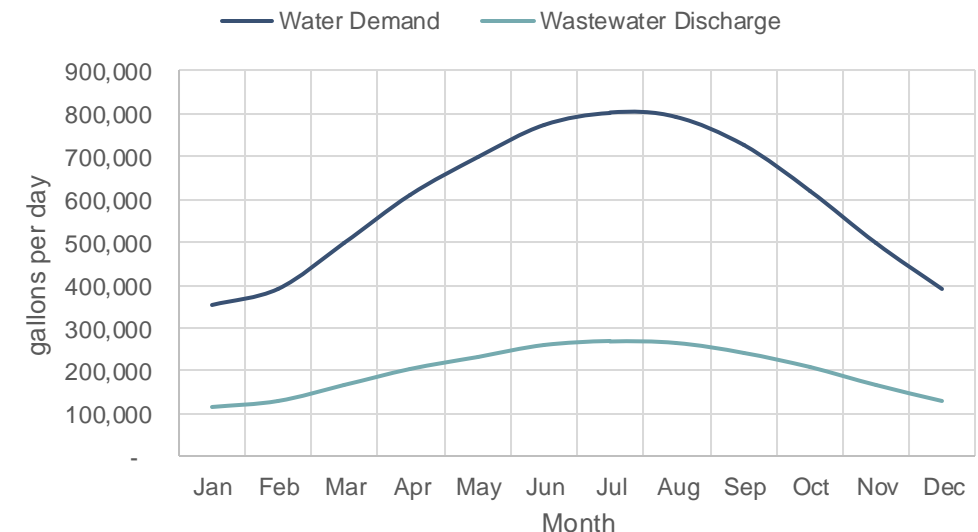
Future Industrial Cooling Demands

Industrial Cooling Water

- Demand for data storage and processing and artificial intelligence is driving the need for additional cooling water
- Cooling methods include use of water, air, and refrigerants
- Mechanical draft cooling towers using water are the most common method due to cost effectiveness
- Example water use from single site with cooling towers is shown in graph and table
- Factors affecting water usage:
 - **Size**
 - **Daily temperatures**
 - **Water quality**
 - **Operations**

Max Monthly Demands (MGD) per Site			
	2030 (50 Acre Site)	2040 (80 Acre Site)	2050 (100 Acre Site)
Water Demand	0.80	1.29	1.61
Wastewater Demand	0.27	0.43	0.54

Typical Max Day Water Usage at Single Site



Future Industrial Demands

COUNTY	OASIS NUMBER	2050 FUTURE DEMAND (MGD)
Licking	9117	37.74
Fairfield	9253	3.59
Franklin	9255	11.96
Madison	9256	1.19
Madison	9257	1.19
Fayette	9258	1.6
Delaware	9259	4.78
Delaware	9260	3.59
Pickaway	9261	4.79
Union	9265	1.19
Union	9266	3.58
Licking	9267	21.54
Licking	9268	1.19
Licking	9269	8.37
Licking	9270	1.19
Pickaway	9272	2.39

Future Agricultural Irrigation Demands

Agricultural Irrigation Demands

- OSU professor estimates that by 2040 irrigation will be more widespread, driven by increasing temperatures
- Estimated + 5-inches per year, supplemented in critical growing season (July / August / September)
- Increases annual ground water demand by 9.15 BG across the entire 15-county area (0.02 MG to 1.16 BG per year at HUC-10 level)

Ohio's Country Journal

Irrigation in Ohio?



The 23-tower pivot on Imboden's farm is the largest in the Midwest. Like his other irrigation pivots, it is accompanied by big benefits and big challenges.

Future Agricultural Demands

Daily use during growing season only (92 days)

OASIS NODE NUMBER	HUC 10 NUMBER	COUNTY	2050 Additional Irrigation Demand (MGD)
9014	506000116	DELAWARE	0.04
9027	506000117	FAIRFIELD	0.118
9056	506000118	FRANKLIN	1.873
9061	506000122	FRANKLIN	2.742
9088	504000301	KNOX	0.719
9090	504000302	KNOX	3.609
9094	504000303	KNOX	2.838
9107	504000601	LICKING	1.947
9109	504000602	LICKING	2.138
9116	504000603	LICKING	0.472
9119	504000604	LICKING	0.533
9173	506000102	MARION	1.014
9202	506000123	PICKAWAY	3.97
9213	506000204	PICKAWAY	9.166
9233	506000106	UNION	0.124
9235	506000107	UNION	0.538
9503	503020402	HOCKING, FAIRFIELD	0.05
9515	504000304	KNOX	1.93
9524	504000605	LICKING	0.34
9525	504000606	LICKING	0.0003
9549	506000201	MADISON	1.42
9528	506000103	MARION	0.81
9529	506000104	LOGAN	1.46

Future Agricultural Demands

Daily use during growing season only (92 days)

OASIS NODE NUMBER	HUC 10 NUMBER	COUNTY	2050 Additional Irrigation Demand (MGD)
9530	506000105	MARION, DELAWARE, UNION	3.97
9569	506000309	ROSS	2.41
9566	506000306	FAYETTE, ROSS	0.92
9500	506000308	FAYETTE, MADISON	1.19
9570	506000310	ROSS	1.87
9550	506000202	FAYETTE, PICKAWAY, MADISON	0.93
9534	506000109	MORROW	0.03
9535	506000110	MARION, DELAWARE	0.26
9544	506000119	LOGAN, UNION	1.4
9545	506000120	MADISON, UNION	0.5
9546	506000121	MADISON, FRANKLIN	0.27
9551	506000203	ROSS, PICKAWAY	1.64
9553	506000205	ROSS, PICKAWAY	5.03
9557	506000209	ROSS, HOCKING	0.002
9558	506000210	ROSS	2.46
9561	506000301	FAYETTE, MADISON	1.29
9562	506000302	FAYETTE, MADISON	0.28
9572	508000102	LOGAN	0.02
9574	508000104	LOGAN	4.56
9505	503020404	HOCKING, FAIRFIELD	0.21
9507	503020406	HOCKING	0.43
9573	508000103	LOGAN	12.61
9563	506000303	FAYETTE	0.09
9571	508000101	LOGAN	4.12
9575	508000115	LOGAN	9.14
9567	506000307	ROSS	5.93