

University of Virginia

Energy and Utilities Master Plan

February 10, 2016



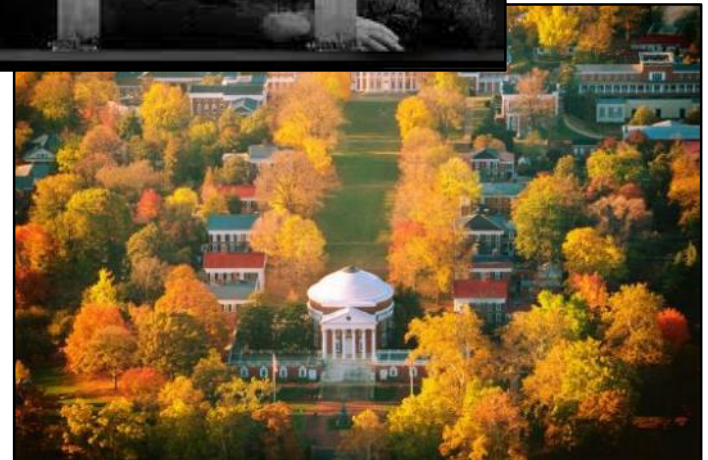
Master Plan Goals

- Assess and document deficiencies in the existing systems
 - Heating
 - Cooling
 - Electrical
 - Sanitary Sewer
 - Water
 - Stormwater
- Identify and evaluate opportunities to:
 - Reduce energy usage
 - Minimize financial and operational risks
 - Enhance reliability and service
 - Evaluate opportunities to enhance UVA's environmental stewardship



Master Plan Goals

- Plan for capital renewal and growth
 - 25 year horizon
 - 16 MM to 22 MM GSF
 - Load projections and analysis
 - Capacity additions
 - Distribution system modeling
- Create a “Roadmap”
 - Comprehensive project list
 - Budgetary costs
 - Integrate with GIS?
 - A “Living” plan



Existing Conditions

- Three district heating plants
 - 500,700 MBH / 275,000 MBH
 - Steam and MTHW
 - Coal and natural gas
- Seven main regional chilled water loops
 - 50,300 Tons / 32,800 Tons
 - Electric centrifugal chillers
- Three substations
 - 128 MVA / 61 MVA
- Good level of redundancy and reliability



Load Projection Summary



Time Frame	Heating (MBH)	Electrical (MVA)	Cooling (Tons)	Potable Water (Peak Hourly Demand - GPM)	Sanitary Sewer (Peak Day Flow - GPM)
Existing	275,013	61.2	32,754	2,712	1,868
0 - 5	304,436	66.4	39,179	3,601	2,290
6 - 10	350,621	70.3	43,561	3,953	2,490
11 - 15	377,226	72.4	48,404	4,207	2,607
16 - 20	394,207	73.6	50,533	4,362	2,717
20 - 25	433,887	77.0	55,385	4,656	2,950
25+	478,524	80.6	59,579	4,901	3,060

Increase

74%

32%

82%

81%

64%

Major Recommendations

- 13.4 MW CHP and 4.7 MW Other Power Generation
- Dedicated natural gas service and phase out of coal
- Continued conversion from steam to hot water distribution
- Install DVP “express” substation feeders to increase reliability
- Implementation of more CHW optimization and conservation strategies
- Optimization of operation and quality testing program for DCW
- Correct sanitary inflow and infiltration (I&I) deficiencies
- Develop strategies for implementation and compliance with new stormwater National Pollutant Discharge Elimination System (NPDES) regulatory requirements

Master Project List Cost Summary

Time Frame	Heating	Electrical	Cooling	Potable Water	Sanitary Sewer	Storm Water	Sub-Totals
TBD	\$ -	\$ -	\$ -	\$ -	\$ 797,000	\$ -	\$ 797,000
0 - 5	\$ 46,665,000	\$ 7,102,500	\$ 44,360,000	\$ 11,217,600	\$ 3,445,800	\$ 4,605,600	\$ 117,396,500
6 - 10	\$ 71,880,000	\$ 9,155,000	\$ 77,790,000	\$ 2,794,900	\$ 1,919,900	\$ 13,447,000	\$ 176,986,800
11 - 15	\$ 18,144,000	\$ 2,015,000	\$ 47,420,000	\$ 809,800	\$ 617,000	\$ 2,093,400	\$ 71,099,200
16 - 20	\$ 3,525,000	\$ 2,160,000	\$ 30,450,000	\$ 169,100	\$ 1,558,400	\$ 1,944,600	\$ 39,807,100
20 -25	\$ 11,052,000	\$ 4,210,000	\$ 56,370,000	\$ 2,989,300	\$ 1,862,500	\$ 62,700	\$ 76,546,500
25+	\$ 14,465,000	\$ 3,260,000	\$ 44,660,000	\$ 1,939,300	\$ 5,820,000	\$ -	\$ 70,144,300
Sub-Totals	\$ 165,731,000	\$ 27,902,500	\$ 301,050,000	\$ 19,920,000	\$ 16,020,600	\$ 22,153,300	\$ 552,777,400



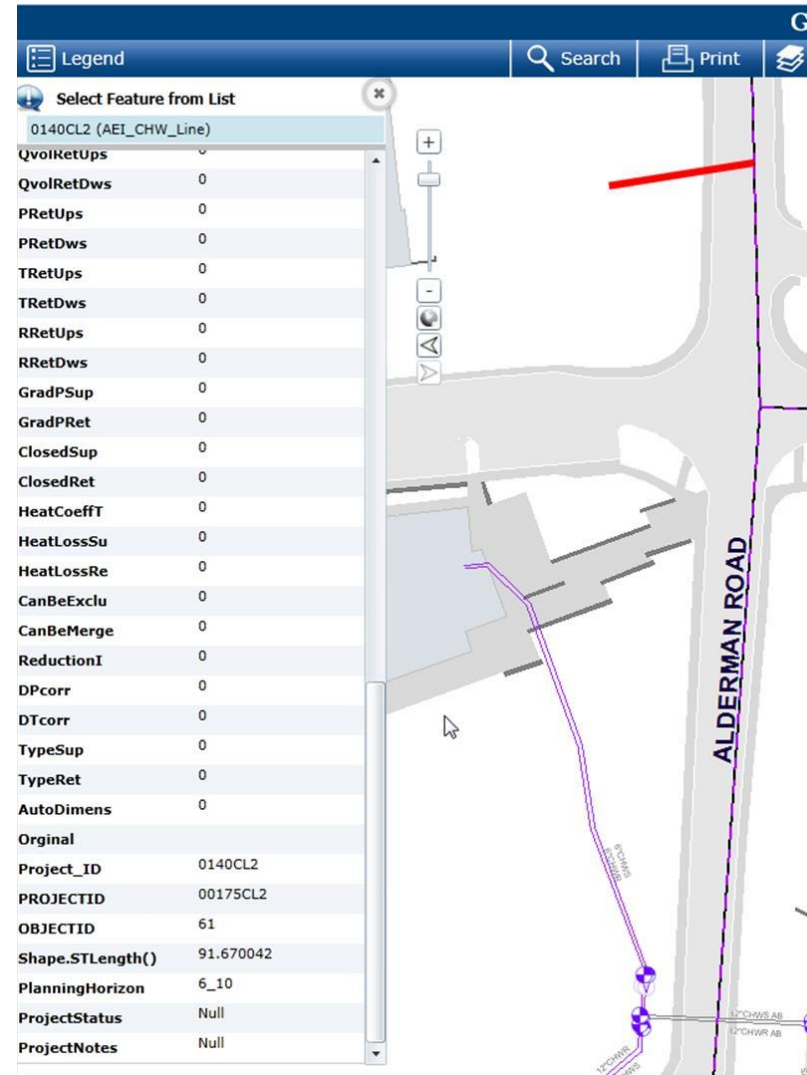
“Living” Distribution Modeling

- Systems and Software
 - Heating – KY Pipe
 - Cooling – Termis*
 - Sanitary Sewer – Innovyze InfoSewer*
 - Water – Innovyze InfoWater*
 - Stormwater – Innovyze InfoSWMM*
- GIS Integration
 - Compatibility with UVA’s GIS Programs
 - Direct import of mapping and attributes
 - “Automatic” updates to GIS
- UVA Owns and Maintains Models

* GIS compatible software

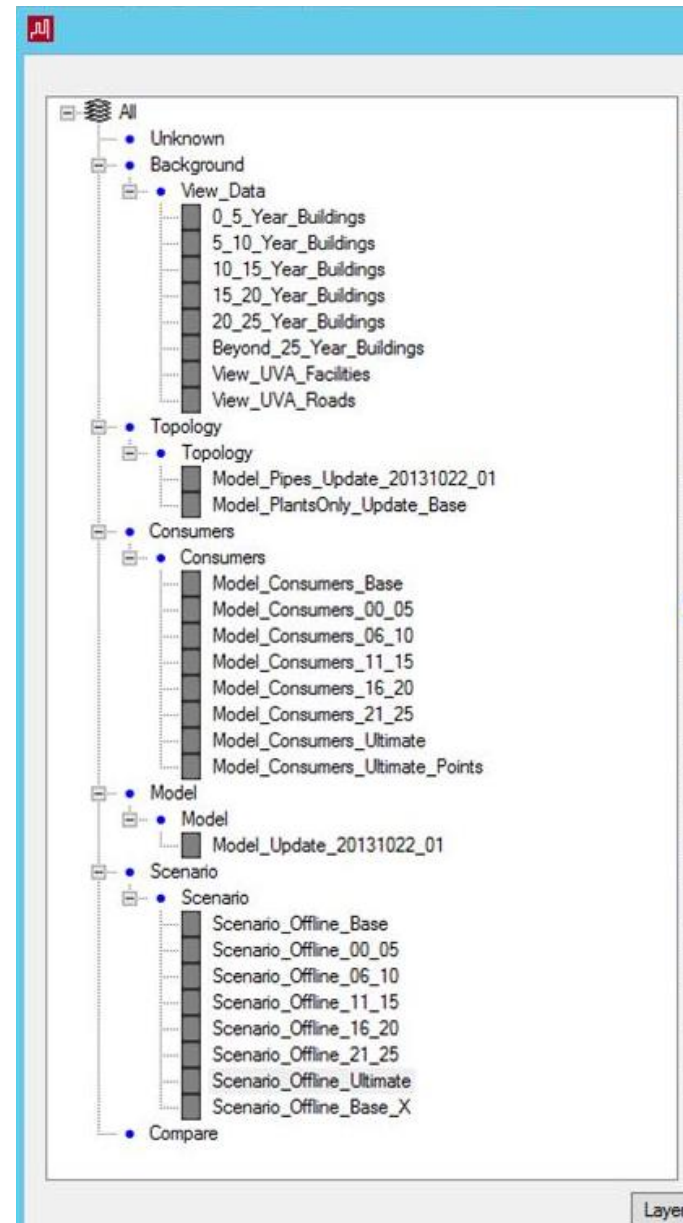
“Living” Distribution Modeling – CHW Example

- UVA “cleaned-up” the existing CHW GIS for use with hydraulic modeling
 - GIS pipe routing/size reviewed
 - Attributes to GIS model for pipe properties (material and analysis outputs)
 - Modeling effort validated GIS accuracy
- Performed “test runs” of existing CHW model and compared to metered data
 - Small adjustments and corrections made to align with measurements



“Living” Distribution Modeling – CHW Example

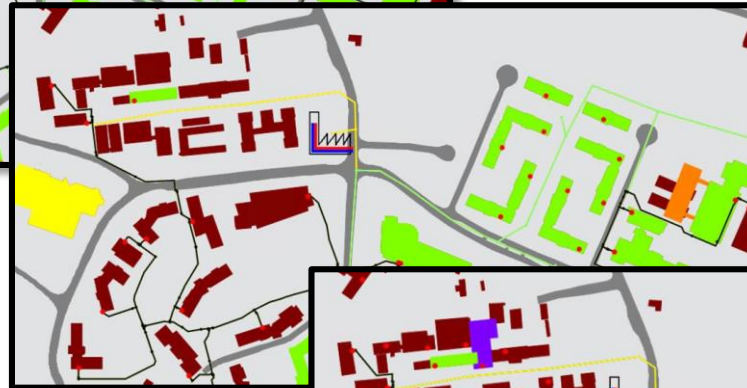
- Utilizing the layer function in Hydraulic Model program to separate piping into different time horizons
 - First built “Beyond 25 Year” model
 - Removed pipes and loads to step backwards through time
 - Program has functionality to automatically size pipes based on velocity/differential pressure parameters



“Living” Distribution Modeling – CHW Example

Current Scenario

- Model results for pipeline upgrades/ additions for each timeframe imported into GIS model



25+ Year Scenario

“Living” Master Project List

- Complete Master Plan Project List compiled
- Nearly 500 individual projects identified
- Project information and cost
- Synergy reviews / groupings
- Linked to GIS



Project Number	Main Project ID	Sub Project ID	Project Timeframe	System	Capacity / Distribution	Project Description	Project Cost (in 2014 Dollars)
1001CL1	1001	CL1	0-5 Years	Cooling	Distribution	Extend McCormick Loops System Piping to McCormick Dorms	\$ 2,120,000
1001HT1	1001	HT1	0-5 Years	Heating	Distribution	12" MTHW Main Piping Tunnel from Chemistry to Leake (Main Campus)	\$ 7,443,800
1002CL1	1002	CL1	0-5 Years	Cooling	Distribution	Interconnect New Newcomb Road Chiller Plant to McCormick Loop with System Piping	\$ 2,020,000
1003CL1	1003	CL1	0-5 Years	Cooling	Capacity	Remove five existing 1,200 ton Chillers in the North Chiller Plant, as they have reached their useful life.	\$ 420,000
1004CL1	1004	CL1	0-5 Years	Cooling	Capacity	Remove Existing R22 Chillers from Gooch/Dillard and Hereford Plants.	\$ 140,000
1004CL2	1004	CL2	0-5 Years	Cooling	Distribution	Extend McCormick Road System Piping to Gooch/Dillard and Hereford.	\$ 2,630,000
1005CL1	1005	CL1	0-5 Years	Cooling	Capacity	Add one 1,200 ton chiller to Massie Road Plant.	\$ 3,360,000
1006CL1	1006	CL1	0-5 Years	Cooling	Capacity	Add one 1,200 ton chiller to North Grounds Plant	\$ 3,360,000
1006CL2	1006	CL2	0-5 Years	Cooling	Distribution	Extend System Piping to Monsanto Development Area and Falkner House.	\$ 2,830,000
1007CL1	1007	CL1	0-5 Years	Cooling	Capacity	Add two 2,000 ton chillers to East Chiller Plant. This represents the full build out of current plant shell.	\$ 9,520,000
1008HT1	1008	HT1	0-5 Years	Heating	Capacity	New Fontaine Redevelopment Zone Heating Plant - (2) 10,000 MBH Boilers	\$ 2,912,000
1008HT2	1008	HT2	0-5 Years	Heating	Distribution	6" to 10" HW Direct Buried Distribution Mains (Fontaine Redevelopment Zone)	\$ 1,393,000
1008CL1	1008	CL1	0-5 Years	Cooling	Capacity	New Future B Chiller Plant. 5,400 Tons Ultimate Capacity. Two 1,200 ton and one 400 ton chillers initial.	\$ 24,480,000
1008CL2	1008	CL2	0-5 Years	Cooling	Distribution	Extend System Piping to Master Plan Building 48, 49 and 50, and to Ray C. Hunt Drive 560	\$ 1,520,000
1008EL1	1008	EL1	0-5 Years	Electric	Capacity	Install new Fontaine Substation.	\$ 1,500,000
1008EL2	1008	EL2	0-5 Years	Electric	Distribution	Electrical Service to Future Chiller Plant B	\$ 225,000

“Living” Master Project List

FILEHOMEINSERTPAGE LAYOUTFORMULASDATAREVIEWVIEWDEVELOPERADD-INSACROBATPOWERPIVOTDESIGN

CutCopyFormat Painter

Clipboard

Arial11

“Living Master Plan” in GIS

- Project Elements Illustrated – GIS “Objects”
- Project Information – GIS “Attributes”
- Project “Attributes” created from project list
- Other “Elements” and “Attributes” linked to modeling software
- Existing and future facilities incorporated
- All broken down into 5 year planning time frames can be viewed individually or collectively
- Live Demonstration

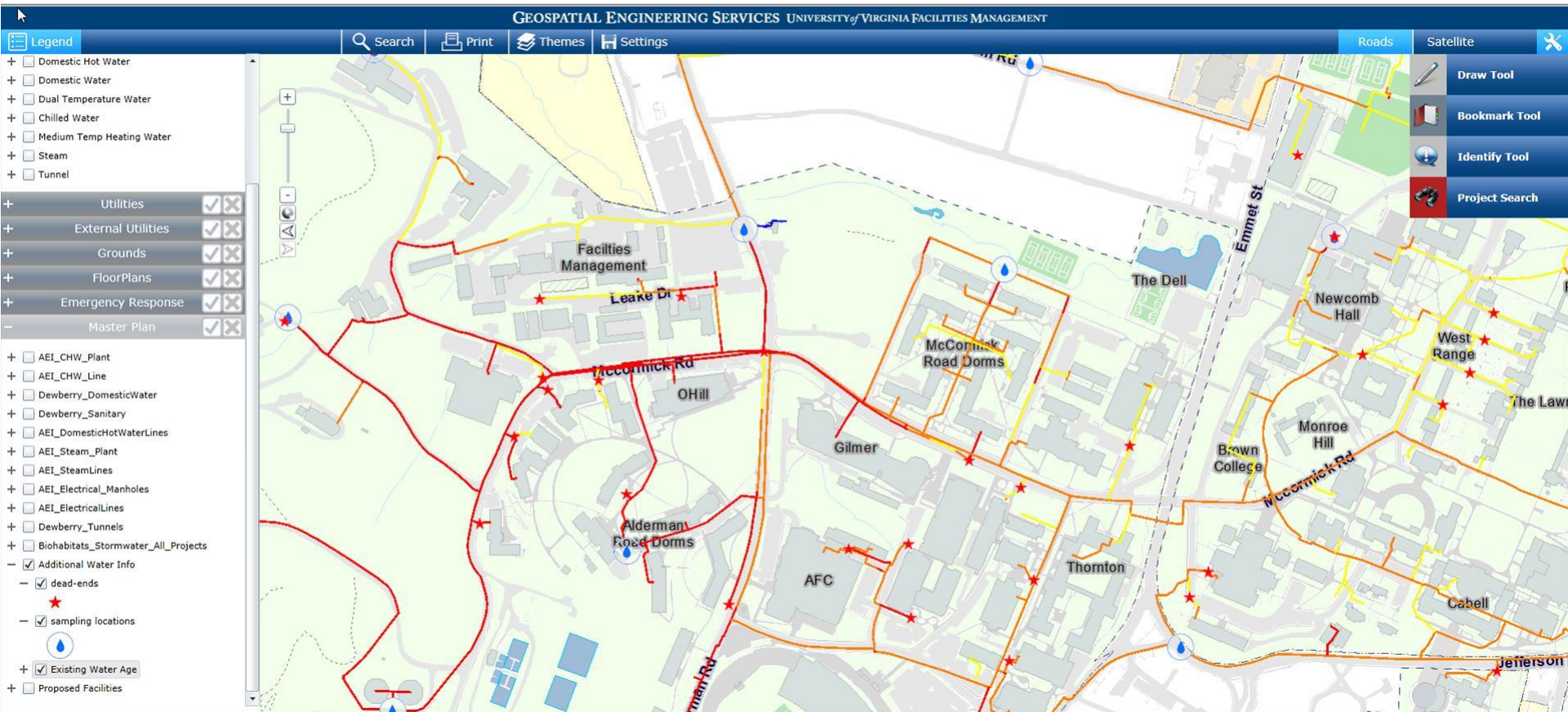


“Living Master Plan” in GIS – Live Demonstration



In lieu of Live Demonstration, see slides 16 though 20

“Living Master Plan” in GIS -



“Living Master Plan” in GIS

GEOSPATIAL ENGINEERING SERVICES UNIVERSITY of VIRGINIA FACILITIES MANAGEMENT

Legend Search Print Themes Settings Roads Satellite

Select Feature from List

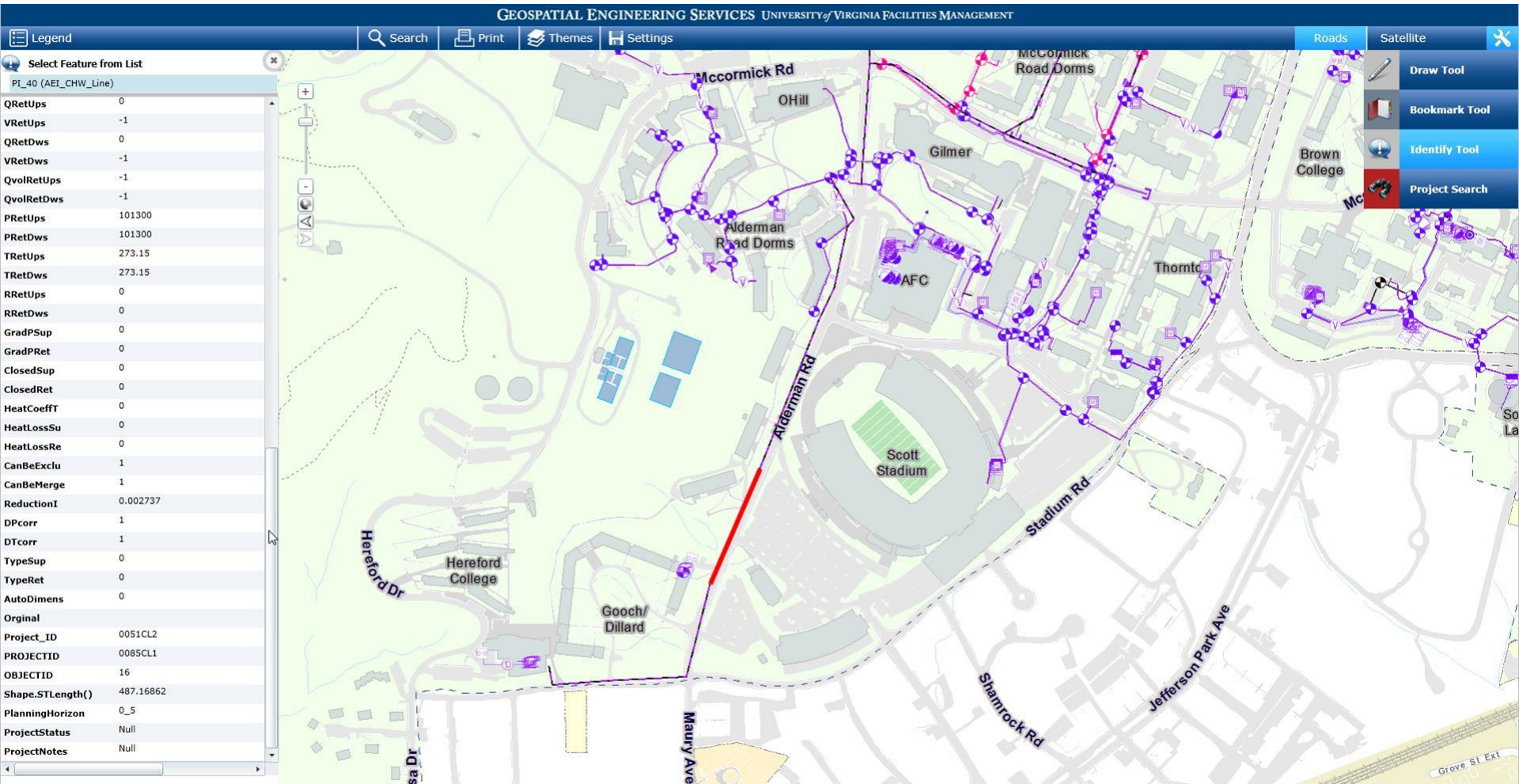
HDPE (Chilled Water Lines)
HDPE 2634 (Chilled Water Lines)

OBJECTID	2633
Material	HDPE
Notes	Tracer wire
Diameter	12
Status	Active
IsInsulated	Null
Source	Null
SupplyReturn	Return
Type	Chilled
System	Null
UtilityInfrastructureID	7264
LabelConc	Null
Test	0
SystemType	Main
Project	Alderman 6
Installed	4/1/2015
RuleID	Chilled, Active
T_InModel	No
T_Rough	Null
T_HeatXFer	Null
InnerDiameter	12.4
Placement	Underground
Volume_Gal	Null
Shape.STLength()	111.559642

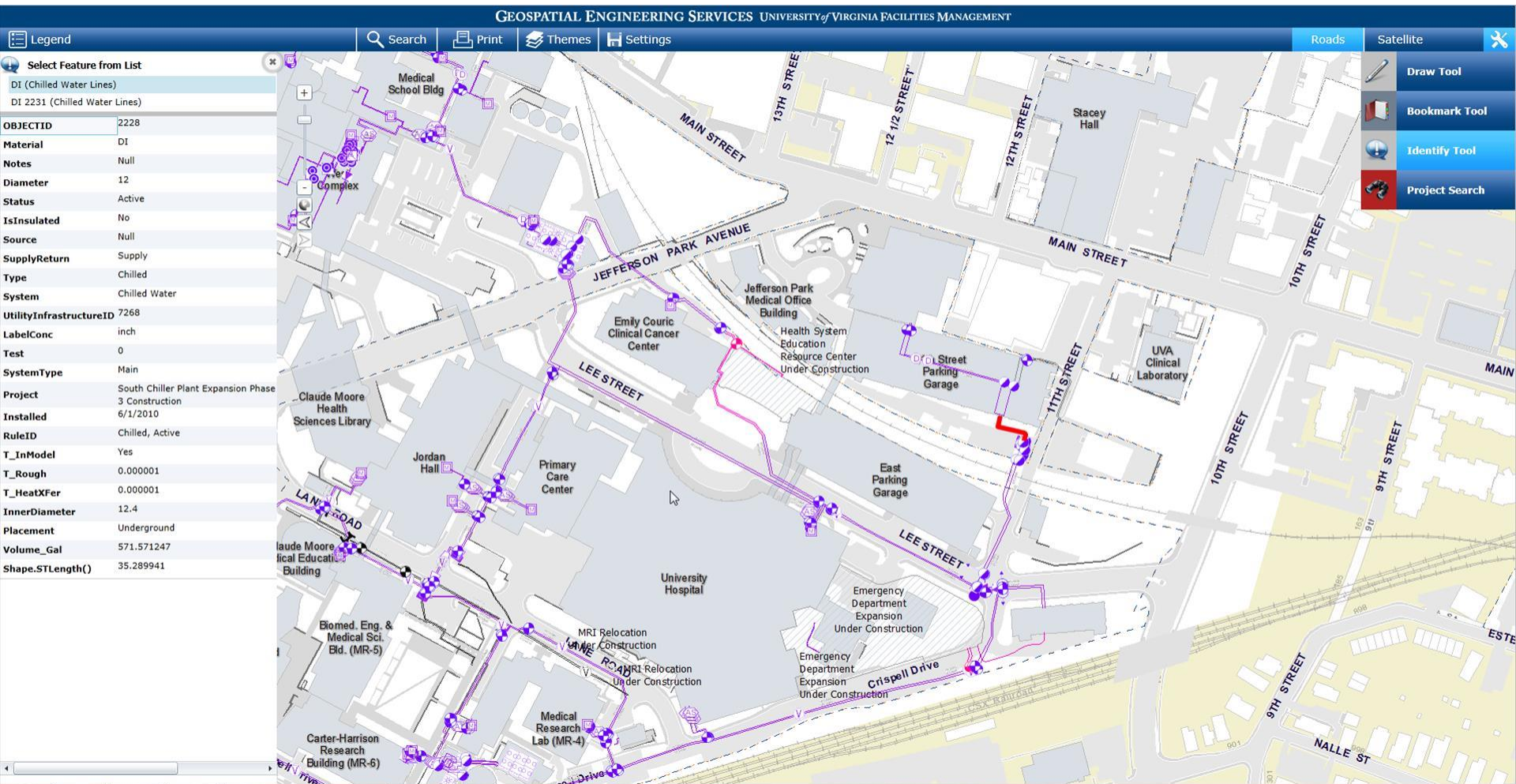
Map features include:

- McCormick Rd
- OHill
- Gilmer
- Alderman Road Doms
- AFC
- Thomson
- Scott Stadium
- Stadium Rd
- Jefferson Park Ave
- Shamrock Rd
- Manly Ave
- Gooch/Dillard
- Hereford College
- Hereford Dr
- sa Dr
- McCormick Road Doms
- Brown College
- Grove St Ext

“Living Master Plan” in GIS



“Living Master Plan” in GIS



“Living Master Plan” in GIS

The screenshot shows the Geospatial Engineering Services software interface. The top bar includes a legend, search bar, and navigation tools. The left panel lists project features and their values. The main map area displays a detailed view of the University of Virginia campus, with buildings, streets, and a network of purple lines representing a project area. A red line highlights a specific path. The right panel shows a list of project features and their values.

Feature	Value
QRetUps	0
VRetUps	0
QRetDws	0
VRetDws	0
QvolRetUps	0
QvolRetDws	0
PRetUps	0
PRetDws	0
TRetUps	0
TRetDws	0
RRetUps	0
RRetDws	0
GradPSup	0
GradPret	0
ClosedSup	0
ClosedRet	0
HeatCoeffT	0
HeatLossSu	0
HeatLossRe	0
CanBeExclu	0
CanBeMerge	0
ReductionI	0
DPcorr	0
DTcorr	0
TypeSup	0
TypeRet	0
AutoDimens	0
Original	0240CL2
Project_ID	0240CL2
PROJECTID	00195CL2
OBJECTID	40
Shape.STLength()	524.749714
PlanningHorizon	11_15
ProjectStatus	Null
ProjectNotes	Null

“Living Master Plan” in GIS

- Readily accessible for UVA staff
- One place to see it all – future big picture view with key details
- Easy to update
- Simplified coordination
- Powerful planning tool



Questions?

- Justin Callihan – UVA – jhc4h@eservices.virginia.edu
- Brad Petterson – AEI - bpetterson@aeieng.com
- George Howe – AEI – ghowe@aeieng.com

