Ad hoc Water Committee
3 Pilot Project Plans

July 16, 2025

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Leak Record Details
2nd Meter data Building 31 of no consequence

223 224 Buildings

Locations Description
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Savings 10 year "Do Nothing" vs "Conservation
Sprinkler Cost Retail-Wholesale-Rebate Estimates
3 controllers, master valves, flow sensors, 671 popups heads,
23 rotor heads
Zone and head maps

217 218 50% Yale Median

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Introduction and Summary 3 Pilot Water Conservation Plans

There are 3 separate plans for:
South Town Houses Areas 30 and 31 with 2 meters
Buildings 223 224 Area 13
Buildings 217 218 Area 9 and Linvale Yale Median

A 2 page mostly financial summary follows highlighting savings, investment costs, paybacks, and rates of return.

Appendices A and B emphasize and repeat past discussions involving <14,000 gal/person/yr or about 38 gal/person/day AND 9 gal/sqft/yr with KY Blue Grass.

This essentially finalizes most assignments in the Procedural Memorandum given to the Adhoc Water Committee. Some research remains regarding storm water and near surface water table. Tracking system needs some work relative to finding leaks.

If not rejected, then any or all 3 plans need an implementation process. The process involves equipment such as the new controllers and their new software settings as well as some likely resident building participation during installations and for next 2 years to perhaps help get city rebates.

MITCH ALBERT

Mitch has a BSc in Geology-Cleveland State University, a MSc in Mineral Economics-Pennsylvania State University and a PhD in Mineral Economics-Rand Afrikaans University in Johannesburg, South Africa. He is one of 40 certified mineral appraisers (IIMA 1995-4), a Rotary International Fellowship Scholar, and a Paul Harris Fellow.

His career began in Republic of South Africa working on energy and ferroalloy commodities for Mobil Oil Corporation, South African Minerals Bureau, Energy Institute, and African Explosives and Chemicals Industry Company. As Manager of Economic Services for Occidental Petroleum's Island Creek Coal Company, then the 4th largest U.S. coal company, he was responsible for project financial evaluations and strategic plans. Mitch joined Burlington Northern Inc.'s Meridian Minerals Company to develop and manage their marketing, financial evaluation and planning functions for coal, precious metal and industrial mineral projects. BNI's 20 billion ton coal reserves were the 2nd largest in the US. Industrial mineral work involved 30 major commodities with emphasis on talc, diatomite, calcium carbonate and kaolin. As Manager of Business Development, he started Meridian's aggregate business with a large exploration program, quarry acquisitions and obtained a +5 million tpy ballast sales contract eventually resulting in 20+ mines and +15 million tpy sales. Sales involved coordinating 4,600 railroad cars delivering 5-6 million tpy of rock by unit train for BNSF. He was president/partner of Agile Stone Systems, Inc. 1997-2000 and founder-CEO/partner of Rock & Rail, Inc 1987-2000. Rock & Rail, Inc is a 52 mile Surface Transportation Board federally certified common carrier freight shortline railroad. The company operates rock unit trains from a permitted granite/sand & gravel mine (first on CO front range since 1976) built by Agile Stone Systems, Inc. Subsequent aggregate projects involved 4 miles of new track built into a new ballast quarry he located, 2 new quarry permits in NM, quarry permits/rail tracks in MO. He operates from DCR, Inc.

Project work has included the purchase/ownership of railroad track and assets from BNSF and UPRR; construction/ownership/operation of track and mine facilities and several rail delivery off loading terminals; solely permitted 7 quarries/pits of 1-5 million tpy in 5 different states at costs of $10,000-$500,000/site; shortline railroad development; bulk transportation logistics-rates-equipment procurement-crew planning; developed detailed rail freight rate model based on unit train economics dissecting each rate component item including fuel surcharges, escalation alternative rates, railroad revenue adequacy and captive versus competitive station origins destinations; development of an alternative productivity management tool; and applied linear programming techniques to a 2 million tpy aggregate plant reducing operating costs >$0.20/ton (1995); exploring, locating and leasing several new quarry/mine sites; multiple private and federal appraisals primarily for large mining land exchanges involving 22 billion tons of coal, 5 square miles of iron ore reserves; gold properties in several western states, a MT coal project with 5 billion tons of reserves and 7 logical mining units, 2 MT coal mines involving AVF (alluvial valley floor) deposits, a $400 million UT coal mine in a new federal monument area, a successful income appraisal against the US Dept Justice as expert witness District Court 1 Albuquerque, NM for a 200 MWe geothermal power plant; numerous aggregate projects, and an operating diatomite mine for the US Department Justice and FL bankruptcy court.

Mitch is or has been a member of the American Railroad & Engineering Maintenance Association, National Railroad Contractors Assoc, American Institute for Mining & Engineering, National Stone Association, International Institutee of Minerals Appraisers, U.S. Justice Department Expert Witness Group, National Mining (Coal) Association Life Honorary Member, American Society for Testing & Materials, and a Washington State registered professional geologist.

13793 E Marina Dr Unit A Aurora CO 80014 303-741-2556

Mitch Albert

Certified Mineral Appraiser

13793 E Marina Dr Unit A
Aurora, CO 80014
July 16, 2025

Re: Confirmation of Qualifications and "No Conflicts of Interest" for Heather Gardens Water Conservation Work.

My biographical sketch is included. Many projects of a similar nature both mining and other industrial projects have been modeled and appraised. Methodologies involving industrial modeling, input-output material balancing and detailed cash flow financial evaluations have been completed for 47 years. The Heather Gardens Water Conservation Work was completed in the same manner.

I certify that I have received nor will receive any payment intended to direct conclusions or from any vendor involved in this project. All work and conclusions comply with both the Uniform Code for Professional Appraisal Practice per the Appraisal Institute and US Justice Department and all standards from the International Institute of Mineral Appraisers of which I have been a member since 1995.

Sincerely,

Mitchell Albert, PhD

Excutive Summary Water Gallons and $ Savings by Project and Total

	% Savings	100%									
						Equipment 99% Sprinkler Documented Plans (excludes landscaping)					
						Retail	Wholesale	Wholesale			
	HG $	HG $	HG Gallons	HG Gallons	Irrigated	Costs	Costs	5 Yr	City Rebates	Net Costs	5 Yr
Meter-Building	5 yr Saved	10 yr Saved	5 yr Saved	10 yr Saved	Sq Ft	Yr 0	Yr 0	Payback	Yr 2 End	After Rebates	Payback
South Townhouses+Garden+ Garden Perimeter+Median+ Parking	$143,935	$327,636	19,035	38,069	131,503	$82,491	$64,818	**2.3**	-$19,891	$44,927	**1.6**
217 218 +50% Yale Median Sprinklers ONLY	$108,254	$246,416	10,200	20,401	167,104	$67,085	$52,953	**2.4**	-$15,139	$37,814	**1.7**
With current $16kplants plan+$40klabor FYI						$123,485	$109,353	**5.1**	-$31,139	$78,214	**3.6**
5,700 sf; $8-$12sqft est all in cost; Any landscape plant-labor costs excluded in 10 yr planning sheets. Current landscape plan not reviewed.											
223 224	$85,558	$194,753	7,888	15,776	105,266	$45,921	$35,101	**2.1**	-$12,622	$22,479	**1.3**
Totals	**$337,746**	**$768,806**	**37,123**	**74,246**	**403,873**	**$195,496**	**$152,873**	**2.3**	**-$47,652**	**$105,221**	**1.6**
			No grass replacement		9.3	Excludes any landscaping			No Landscape	**Without Landscaping Looks Too Good**	
					acres						
								Payback Yrs = Cost / (5 yr ave savings/yr)			

Key Learning Lessons Producing These 3 Plans Applicable to Future +40 HG plans (to limit attainable work with bankable profits)

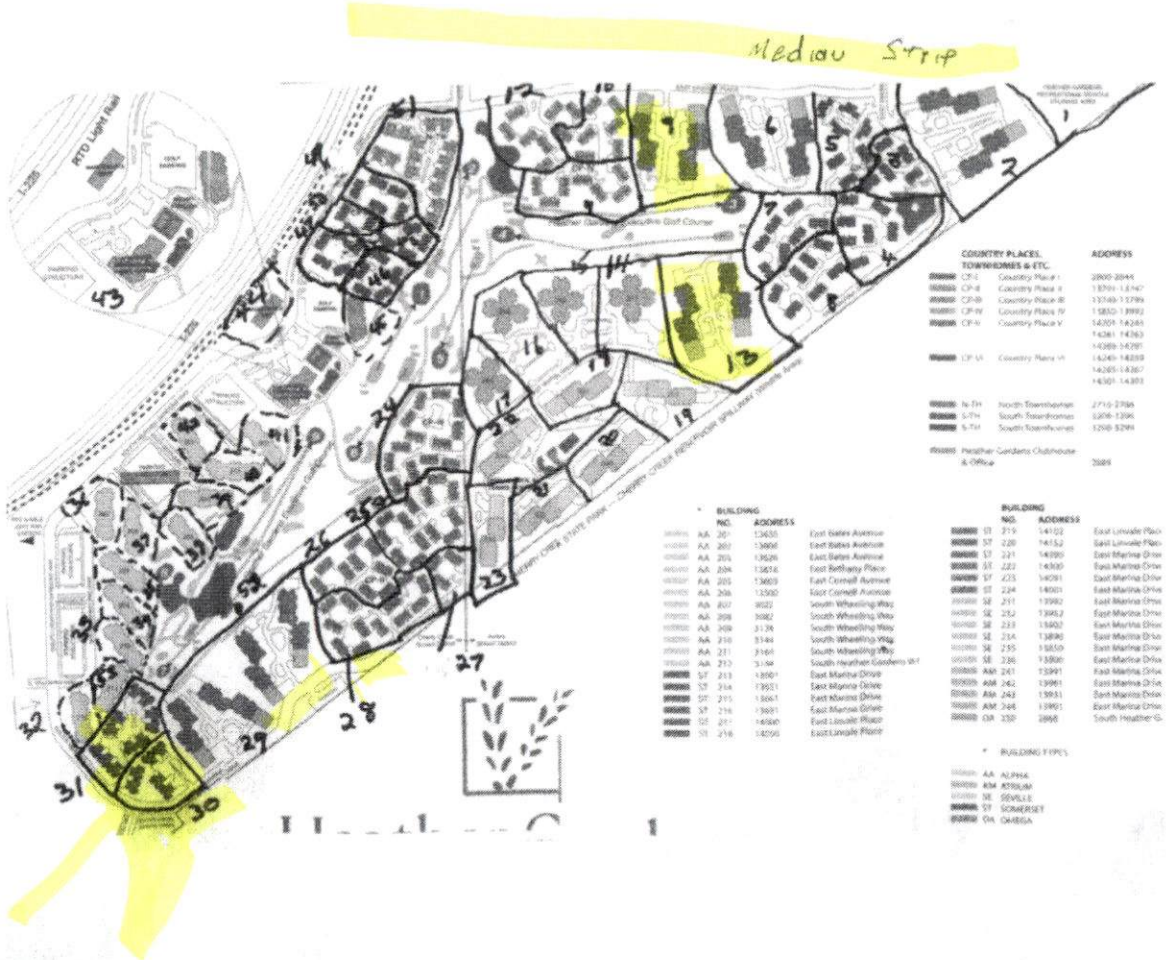
1) First thing irrigation contractors want is to "re-design" your already functioning (coverage) pipe and head system. NO NO NO. Fix the leaks and always look for the next leak and fix it when it happens. Most expensive part of "replacement" is new pipes.
2) No grass replacement. Today's panacea "mantra". Large upfront costs resulting in no "profits" and unlikely additional water savings. SEE APPENDIX B "PRIMER" ON EXPERIENCE AND MANAGING KY BLUE GRASS FOR SUPPORTING EVIDENCE
3) Irrigation OR landscape plans need to be done separately as required by City. Meter residents should do plans as they wish, submit to board for approval from City. Warnings: The above water savings are likely to be 100% of what is available. Don't double count. DO NOT SHOW THESE SAVINGS TO CITY. ASK ME WHY.
4) Do not change landscaping under trees. If you do, then have residents pay for city stipulated tree "appraisal". If appraised trees "die", City will expect HG to pay Aurora City the value of the tree irrespective of ownership. It is recommendation to prohibit landscape changes beneath trees.
5) Integrate some stormwater retention on surface and recharging the 5-20' deep water table into plans as this was 100% ignored. Currently, no time help. It rains-snows every month. Big months are May and July. Hottest months July August. Go figure.
6) Implementation key remaining issue. Management has to not only believe but know we can get 9 gal/sqft/yr IRR and <=14,000 gal/person/yr sewer water Find the leaks both IRR and building and understand smart controllers inside and out.

Aurora City Capital Cost Savings			**gal/yr saved**	**ac ft**	**gal/ac ft**
$/acft;Feb 2024 Auction Range	$50,000	$72,000	7,424,581	114	325,850
City Capital Savings	$5,696,318	$8,202,698			

* As 30 yr Certified Appraiser, I must adher to specified ethical standards involving scope of work as explained to 2 board members, several residents 217 218 and 223 224 directly and several times indirectly. I must and have considered all resident-board Ideas, opinions, and "facts" but must independently decide "scope of work" per USPAP. I am required to recluse myself if my SCOPE is rejected. Grass replacement would require me to recuse myself. Research and tracking system not completed. Otherwise, Ad Hoc Water Committee Procedural Memorandum work essentially done. Need a break.

	A	B	C	D	E	F	G	I	J	K	L	M	N
47	**Rates of Return (ROR)**												
48	**Yearly Cash Flow**												
49				Year 1	Year 2	Year 3	Year 4	Year 5					
50	**South Townhouses+Garden+**		**Savings**	$26,049	$27,351	$28,719	$30,154	$33,245	100% available savings				
51	**Garden Perimeter+Median+**		**Rebates**			$19,891							
52	**Parking**		**Costs**	-$64,818					Wholesale Costs				
53			**Cash Flow**	-$38,770	$27,351	$48,610	$30,154	$33,245					
54			**ROR**	83%									
55													
56	**217 218 +50% Yale Median**		**Savings**	$19,591	$20,571	$21,599	$22,679	$25,004	100% available savings				
57			**Rebates**			$15,139			(irrigation + landscape Option 1)				
58			**Costs**	-$52,953					(irrigation + landscape Option 1)				
59			**Cash Flow**	-$33,362	$20,571	$36,738	$22,679	$25,004					
60			**ROR**	72%									
61													
62	With Current $16k proposed Plants		**Savings**	$19,591	$20,571	$21,599	$22,679	$25,004	Plan needs reviewed to satisfy				
63			**Rebates**	$0	$0	$31,639	$0	$0	city rebates, contractor 1st				
64			**Costs**	-$109,353	$0	$0	$0	$0	estimate needed; city says				
65			**Cash Flow**	-$89,762	$20,571	$53,238	$22,679	$25,004	$8-12/sqft all in, 5700 sf plan				
66			**ROR**	19%					$3/sqft material so $7/sf labor				
67													
68	**223 224**		**Savings**	$15,484	$16,258	$17,071	$17,924	$19,762	100% available savings				
69			**Rebates**			$12,622							
70			**Costs**	-$35,101					Wholesale Costs				
71			**Cash Flow**	-$19,617	$16,258	$29,693	$17,924	$19,762					
72			**ROR**	100%									
73													
74	This table not set up to adjust for <100% of available goal benchmarks. Easily done.												
75	Table can also be set up for 60 months for more precision but no change in conclusions.												
76	217 218 ROR for spinklers at 72% drops to the expected 19% as discussed several times.												

Combine Assessor Parcel & City Meter Locations



South Townhouse 8 Buildings (#'s 30-31---2 Meters) Business Plan

Item 1 Land Area, Buildings, Meters-----COMPLICATED

There are 2 meters with 100% of the irrigation coming from 1 of the meters that also serves 3 of the 8 buildings with 12 units 22 people. The 2nd meter services the 5 remaining buildings with 22 units 36 people. The first meter had 170 gph leak mid Dec-April doubling sewer costs for next 12 months. Other leaks remain. Second meter shows no townhouse building leaks AND has <14,000 gal/person/yr.

There are 5 independent areas irrigated from the first meter.

1) The townhouse 8 building irrigated area is all north of Marina Dr
2) Across Marina Dr to the garden fence perimeter
3) Across Marina Dr to the city land median strip
4) Across Marina Dr to the HG garden area 85 uncontrolled spigots
5) Across and east up Marina Dr to the parking area opposite 216

Item 2 shows how the irrigated acres (and sq ft) were derived

Items 3 and 4

Historically, Item 3 showing 2019-2024 graphical and tabular data, shows the water use has gone from "high" to atrocious.

Same data in Item 4, rows 3 and 4. Row 3 shows total water paid to City. Row 4 shows this meter using much above City allocations for which HG's water costs are essentially doubled. Use is >= 4.2 million gal/yr. The City's allocated water is 3.2 million gal/yr. It "could should" be <1.5 million gal/yr if properly managed is the conclusion built into Item 4.

The second meter's data, Building 31, is the last item. One can see the drop from 18,000 gal/person/yr 2019 to 12,600 gal/person/yr 2024. The opposite of the increasing trend with the first meter going from 24,500 gal/person/yr 2019 to 36,400 gal/person/yr 2024. This meter does not support any irrigation. The

cost savings spreadsheet is printed for building 31 as the last item enclosed but is pointless as no changes made or needed.

Item 5

Detailed sprinkler equipment type, models, retail costs and likely pass thru wholesale costs along with maps and/or photos showing zone and head locations.

Item 6

Substantial records are provided documenting the excessive water use causing Tier 2 pricing.
Substantial records are provided documenting the 170 gph 140 day leak Dec 2024 through April 2025 now doubling the sewer costs for the next 12 months and giving zero water.
Building 31 second meter included but of no consequence.

South Town House Proposed Plan

The goal is to get all sq ft irrigated at 9 gal/sqft/yr and all personal sewer water use <14,000 gal/person/yr. (5 buildings and residents on second meter ALREADY below 14,000 gal/person/yr and do-have zero irrigation.)
Financial plans show 1.6 year payback for initial $65,000 investment. (wholesale costs) 5 year cash flow rate of return indicates 83%. Costs have been inflated to current levels, extra contractor hrs and 15% contingency but recommend increasing these cost items.

1) $143,935 5-year total savings
2) $327,636 10-year total savings (10-year savings never discussed-shown)
3) $33,000 wholesale pricing smart controllers (3), master valves, flow sensors and 694 heads mostly popups (retail pricing $48,000) + $24,000 contractor + 15% contingency for $65,000 total.
4) Replace all heads in all 20 zones: 44 popups and 201 rotor heads.
5) Eliminate the 2 zones around the garden's white fence with 37 popup heads. Take out turf and install 58 tons -1" rock from local quarry (not landscaper) over 4,750 sq ft 3" deep.
6) No current landscape changes proposed.
7) Make deal with City to keep watering their land and "our" 1 zone 25 popup heads. They need to reduce the now doubled 12 month fixed sewer charge based on Dec-April 170 gph leak for which we get 0 extra water. Next, we need something else for HG doing this courtesy going forward.
8) Install <$800 battery operated lockable meter and timer feeding the gardens 85 independent spigots. Set days per City requirements to 2 days/week May June, Sept and 3 days/week July August with no watering between 10 am and 6 pm and also probably no watering something like 10 pm to 6 am.
9) Consider popup sprinkler overlaps front of parking area opposite 216.
10) Fix known leaks in 3 Xanadu buildings to get to <14,000 gal/person/yr JUST LIKE THE OTHER 5 BUILDINGS ON SEPARATE METER. Richard maintenance and Lary have been most receptive to identifying methodologies to address leaks. This is key issue for personal-building consumption > 14,000 gal/person/yr for these 3 buildings as well as much

of remaining HG buildings. Suggest we meet as discussed to finish leak identification protocols or policies or whatever and implement. I recommend that minor appliance "leaks" like flappers be paid for by HG as is already being implemented----thank you Richard-Lary. HG gets the water cost reduction for doing this.

11) Finish quotes for equipment and get insured contractor quote.

12) Figure out how to supervise appropriate installation and settings and then EFFECTIVELY manage for mandatory 2 yr City Rebate requirement to quickly get 9 gal/sqft/yr. Options from smart controllers are new.

13) Consider Marina Dr curb cuts to drain into garden perimeter to collect FREE stormwater when doing sod removal-stone emplacement. Is there terracing in the garden to preclude storm water runoff?

223 224 Buildings (# 13---1 Meter)
Business Plan

Item 1 Land Area, Buildings, Meter-----SIMPLEST PROJECT
2 six story condominium buildings with 2 controllers. Project area is essentially the parcel recorded by county assessor but INCREASED to recognize mapped sprinkler head coverage both east and west towards other areas.

Item 2 shows how the irrigated acres (and sq ft) were derived

Items 3 and 4
A very typical HG type water conservation project. Nothing too "high" but consistently around 17,000 gal/person/yr instead of 14,000 gal/person/yr. Irrigation around 17 gal/sqft/yr. Item 3 focuses graphically and with table for last 5 yrs records.
Item 4 is the 10 yr savings forecast predicated on quickly attaining 14,000 gal/person/yr and 9 gal/sqft/yr irrigation.

Item 5
Detailed sprinkler equipment type, models, retail costs and likely pass thru wholesale costs along with maps and/or photos showing zone and head locations.

Item 6
Past 5 yr sample monthly bill showing allocated millions gal/yr and sewer charges. Typical use is 5.3 million gal/yr. Allocated water is at 4.97 million gal/yr so there is some Tier 2 pricing caused by the difference. This Tier 2 pricing is quickly eliminated with minimal effort.

223 224 Proposed Plan

Goals are to get all sq ft irrigated at 9 gal/sqft/yr and all personal sewer water use <14,000 gal/person/yr. 141 condominium living units with 200 people. No landscaping changes have been proposed by residents or committee.

Financial plans show 1.3 year payback for initial +$35,000 investment (wholesale cost). 5 year cash flow rate of return indicates 100%. Costs have been inflated to current levels, extra contractor hrs and 15% contingency but recommend increasing these cost items.

1) $85,558 5 year total savings
2) $194,753 10 year total savings (10 year savings never discussed-shown)
3) $19,000 wholesale pricing smart controllers (2), master valves, flow sensors and 694 heads mostly popups (retail pricing $28,000) + $12,000 contractor labor + contingency 15% for total +$35,000.
4) Fix leaks. No notable outdoor leaks but some minor leaks exist per ATM meter alerts.
5) Aggressive attention to indoor bldg. leaks to achieve 14,000 gal/person/yr. I recommend that minor appliance "leaks" like flappers be paid for by HG as is already being implemented----thank you Richard-Lary. HG will save $ from reduced water use.
6) Finish quotes for equipment and get insured contractor sprinkler quote.
7) Figure out how to supervise appropriate installation and settings and then EFFECTIVELY manage for mandatory 2 yr City Rebate requirement to quickly get 9 gal/sqft/yr. Setting options from smart controllers are new—more sophisticated.
8) **Find ways to collect stormwater from elevation change of 14' down from front of buildings on Marina Dr to golf course in back.**

217 218 Buildings (# 9---1 Meter)
Business Plan

Item 1 Land Area, Buildings, Meter-----NOT COMPLICATED NOT SIMPLE
2 six story condominium buildings with 3 (really 2.5??) controllers. Project area is essentially the parcel recorded by county assessor but INCREASED to recognize mapped sprinkler head coverage both east and west into other parcels. In addition, the area includes the entire median strip between Linvale and Yale. This area is owned by HGMD. Irrigation is shared with the next meter area to the east, Buildings 219 220 #6. There is a controller on the north side of Linvale whose water is supplied 50/50? from both 217 218 and 219 220. This open loop was tested extensively with a HG grounds employee to verify this situation of openly sharing water from 2 meters into 1 controller. To reconcile this situation for number crunching, 50% of the median strip land and 50% of the heads are attributed to 217 218. Since there is no way to split a controller, 100% of a new controller is included with 217 218 costs.

Item 2 shows how the irrigated acres (and sq ft) were derived

Items 3 and 4
Somewhat typical HG type water conservation project. Historical 5 yr data shows high but not too "high" irrigation rates >17 gal/sqft/yr along with >20,000 gal/person/yr. Item 3 focuses graphically and with the table for last 5 years of verifiable city records.
Item 4 is the 10-yr savings forecast predicated on quickly attaining 14,000 gal/person/yr and 9 gal/sqft/yr irrigation.

Item 5
Current expected sprinkler equipment and labor cost projection are shown. Several "maps" show the distribution of zones and heads as identified by building residents (in the snow April).

Item 6
Past 5 yr sample monthly bills showing allocated millions gal/yr & sewer charges.

217 218 Proposed Plan

Goals are to get all sq ft irrigated at 9 gal/sqft/yr and all personal sewer water use <14,000 gal/person/yr. 141 condominium living units with 200 people. No landscaping changes have been proposed by residents or committee.

Financial plans show 1.7-year payback for initial +$53,000 investment (wholesale cost). 5-year cash flow rate of return indicates 72%. Costs have been inflated to current levels, extra contractor hrs and 15% contingency but recommend increasing these cost items.

This is the only plan including possible but not finished landscape plans covering about 5,100 sq ft. Implications of likely impact on finance parameters is to increase payback to 3.8 years, and a rate of return reduced to 19%.

1) +$108,000 5-year total savings
2) +$246,000 10-year total savings (10-year savings never discussed-shown)
3) $53,000 wholesale pricing smart controllers (3), master valves, flow sensors and 409 heads mostly popups (retail pricing +$39,000) + $20,000 contractor labor + contingency 15% or $67,000).
4) Fix large >140 gph leaks when irrigation is turned on per ATM meter alerts.
5) Aggressive attention to indoor building leaks to achieve 14,000 gal/person/yr. Fix minor appliance "leaks" like flappers at HG expense as is already being implemented----thank you Richard-Lary. HG will get reduced water bills.
6) Finish quotes for equipment and get insured contractor sprinkler quote.
7) Figure out how to supervise appropriate installation and then EFFECTIVELY manage for mandatory 2 yr City Rebate requirement to quickly get 9 gal/sqft/yr. Options from smart controllers are new.
8) **Find ways to collect stormwater from elevation change of +10' down from front of buildings on Linvale to golf course in back to the south. Stop throwing water down the drains-culvert to the pond off Marina Dr and giving it for free to Army Corp lands wetlands woods wildlife. We can share.**

Appendix A

Personal Water Consumption Benchmark <14,000 gal/person/yr

HG is at 47.9 gallons/person/day. We should be at 38.4 gallons/person/day. See below identified to Board and Residents for 6 months. The goal is readily done at 38.4 gal/day/person or 14,000 gal/person/year compared to other similar metro areas.

Heather Gardens			Current	Goal	Low	High	
		gal/person/yr ave	17,500	14,000	13,500	44,170	
		gal/day/person	47.9	38.4	37	121	
Documented National Ave		2015	↓	↓			
					HG		
	gal/person/day	60	47.9	38.4	Change		
Toilet	24%	14.4	11.5	9.2	-2.3	(Ave 5 flushes/day/person	
Shower	20%	12.0	9.6	7.7	-1.9		
Faucet	19%	11.4	9.1	7.3	-1.8		
Washing Machine	17%	10.2	8.2	6.5	-1.6		
Leaks	12%	7.2	5.8	4.6	-1.2	(toilets or old pipes)	
Other	6%	3.6	2.9	2.3	-0.6		
Dishwasher	2%	1.2	1.0	0.8	-0.2		
1,000 gal/person/yr	100%				-9.6		
	gal/person/year	21,900	17,500	14,000			

	Denver Metro 2024 gal/person/day	Other Metro's 2024 gal/person/day
Toilet	12.9	11.5
Shower	10.4	8.1
Faucet	4.3	4.9
Washing Machine	2.9	1.9
Other	2.1	1.7
Leaks	1.4	0.9
Dishwasher	0.4	0.1
	34.6	29.1
1,000 gal/person/yr	12,612	10,616

Colorado (Indoor)	CastleRock	Den Current	Den Goal	Aurora Hi	Aurora Low
gal/person/indoor/month	1,429	1,521	1,217	1,500	1,250
gal/person/indoor/day	47.6	50.0	40.0	50.0	41.7
gal/person indoor/yr	17,381	18,250	14,600	18,000	15,000

HG has several residents-meters-buildings meeting this benchmark expectation. WHY CAN'T ALL RESIDENTS-METERS-BUILDINGS DO THE SAME? I suspect mostly leaks and perhaps old high gpf toilets. Ideas?

Appendix B

9 gal/sq ft/yr Goal-Benchmark Justification-Background Primer

1) **Most important, I have personal past experience getting City Denver conservation $60,000 rebate for another HOA along with copies of signed contract, payment and water bill documentation based on 8-10 gal/sqft/yr for KY Blue Grass.**
   As the hoa's past treasurer in charge of green belt maintenance (with President), we maintained this KY Blue Grass consumption rate for 5 years while on board and another 4-5 years afterwards when I followed water bills. City now has conservation committee of contractors and turf vendors who "voted" to increase to 12 gal/sqft/yr. (No published reasoning nor explanation available from their management.)
   The 2 most important items was new controllers (including many head replacements) and persistent attention to fixing pipe or valve leaks.
2) Typically, the phrase **"Evapotranspiration formula" (ET)** is used to justify different "numbers" especially involving medium to high heat grass replacement from vendors. Rarely, City included, does anyone explain ET and especially not the formula. A summary of various documented data follows to help understand how modern controller software reduces water consumption. **If "we" don't know how Aurora calculates expected ET water use for their opinions or conclusions, then it's probably difficult to make decisions. (See item later discussing how City records HG water irrigation.)**
3) All plants anywhere anytime need some water. The starting point is either the ET for plant PLUS some soil factor that evaporates considering rain water OR the "theoretical" plant water requirements. You must know a person's starting point. The likely

ET by region and rainfall is published and readily available. It includes local rainfall historical data and covers both water needed by the plant and excess water in the soil that does not go to the plant but evaporates. A recent task force of 26 government agencies and universities "demystified" these ET's by city.

4) Many of the next comments are ACCURATE but subjective to help address realistic and practical watering practices. (These issues when taken separately and added up create incorrect water saving values. They'll add up to more than 100% water savings. BUT THIS POINTS OUT THAT THERE ARE MULTIPLE WAYS TO ACHIEVE A PRACTICAL GOAL.
5) General Conclusions: Yes, KY Blue Grass is a cool turfgrass typically needing more water than the new hybrid "warm" turfgrasses. The conclusion, though, is that nearly identical water use results can be achieved and have been achieved with KY Blue Grass. Items addressed include landscape features (plants, plant density, wind, weather ("K" factors) and above all---sprinkler efficiency based on age, smart controllers-heads and leakage. K factors with effective management reduce water AVERAGE (not plant) needs by 30%. Old sprinkler equipment with limited management for "K" factors and leak repairs is easily 50% efficient meaning 200% expected water is used to achieve what "might" be expected in properly managed and maintained grasses (perhaps like HG's old systems).
6) HG Landscape Background. (Comments exclude any rain or storm runoff management.)
    a. HG's Denver, Colorado location is a "semi-arid" geography. This means that we have a higher ET which for "cool" "high" water plants is 6-25 average 14 gal/sqft/yr. (Such average values are lower with warm or low water use plants.)
        i. HG and most of Denver is stuck with KY Blue Grass "cool" grass turf.

ii. Ground areas are a mix of plants and if managed accordingly, has a weighted average ET 30%-50% less.
iii. From many references: *"It is estimated that as much as 50% of the residential outdoor water we use is wasted through evaporation, wind, or runoff, due in part to improper irrigation system design, installation, and maintenance." 2017 EPA WaterSense* This 50% covers the above item comments on plant management and sprinkler equipment both.

b. HG has "microclimates" and "high density" plants. (These 2 items along with plant diversity are called "K" coefficient values by the academics. K factors when managed properly can reduce water consumed-needed for plants by 20-50%.) Microclimates range from areas of no shade, direct sun vs all shade and no direct sun. These areas cannot be well addressed with current old HG sprinkler systems but can be addressed precisely with new smart systems. HG plant "density" is typically "high" meaning full ground coverage needing more water as opposed to average or low density plant coverage.
c. MOST IMPORTANT is the sprinkler efficiency. Systems with poor maintenance and lack of proper scheduling (assumed for HG from records) have a 50% rating. (Ranges from 65-85% for medium to high efficiency). HG is rated at 50% efficiency due to limited controller features and known leaks.
d. TO ACHIEVE 9 gal/sqft/yr.
    i. Obey Aurora City Rules about watering time periods 2 days/week May, June, September and 3 days/week for July August. Do not irrigate before May 1 or after Oct 1. (Some limited latitude for Oct but HG irrigates some areas into November and even December.)
    Separate "Large Property Variance Certified Properties", such as HG, suggest inaccurate records kept by City. I have all

records. The city only records what they interpret as outside water use between 4/1 and 9/30 showing 20 gal/sqft/yr BUT with pre 4/1 and post 9/30 watering, City supplied documents, HG shows 23 gal/sqft/yr sometimes/often triggering tier2 pricing into HG 54 monthly water bills.

ii. Repair existing known pipe leaks per AMI alerts.

iii. Yes, selective plant replacement can achieve water reductions but at high capital cost practically offering ZERO financial incentives.

iv. Get Smart Controllers-Heads perhaps master valves and flow sensors to customize time and water flow to each individual zone (station)

1. Recognize our sandy-loam (clay) soils indicating the use of "cycle+soak" short duration repetitive timing. Excess water runs off loam-clay soils quickly. Soils with some clay retain higher amounts of water if properly watered. 50% of retained soil based water can and does get absorbed by plant roots. Exploit this feature by balancing soaking without run off. This is a part of the ET formula not usually identified.
2. Use >=3 wireless weather stations, historical data and rain sensors to stop irrigating under poor weather conditions or to raise lower water flow per zone.
3. Turn off leaking zones automatically if equipment is available or installed. Finding and fixing pipe leaks quickly is critical.
4. Get email alerts to HG employee and maybe even building AR to turn off irrigation system if excess water indicated from AMI alerts--records.

5. Control current excessive runoff going into stormwater drains and causing oxygen deprivation for the plants and grasses.
6. Modify station flow for any low water use plants.
7. Consider controlling head psi, if feasible-available, at around 30 psi. (Can result in 20% water savings from misting, fogging, overlapping coverage.)
8. Make excessive zone-station control adjustments to NOT water sidewalks, parking or driveways

7) The above factors can readily drop 14 gal/sq ft/yr to <10. Success does not have to occur in each controller management area. The goal, however, reached by multiple methods is the key management approach.

A final management tool is to recognize that most plants have a wide "stress" capability and still be healthy. KY Blue Grass tolerates a 40% water reduction and will still be green and healthy. (TX A&M, Fipps Professor Ag Eng and McAfee Professor Turgrass, 2005, page 2). No one recommends going to the 40% limit but this is another management tool to at least consider—explore. An example:

a. 217 218 has 108 zones and the new controllers let us make each zone unique based on plant types, varying levels of shade-sun and wind between 6 story buildings (referred to as micro climate), plant density, and perhaps soil variation. These items can be quickly "guessed" to intuitively program and adjust new controllers. They can later be increased or decreased OR the new controllers simply allow us to increase or decrease all factors as a group for each individual zone.
b. Plant type <u>weighted average</u> typically reduces the theoretical ET by 30%.

c. Most old systems like HG's have fogging, misting and extensive overwatering and runoff areas. Each of these issues can now be eliminated for each zone. Wind increases evaporation AND causes non-uniform water distribution causing browning-wilting areas. The new controllers fixed to 3+ wireless remote weather stations can then delay or reschedule zone watering. (Perhaps zones between 2 large bldgs like 218-219 with tree cover may not be affected as much by wind as the zones between Linvale and Yale.) Each zone can be programmed accordingly. Head replacement within each zone alone can reduce water consumption by +20%.

Achieving The Water Conservation Goal for HG Irrigated Residential Green Spaces

This document outlines strategies and justifications for reducing water consumption in our HOA's green areas, aiming for a goal of 9 gallons per square foot per year. The approach is based on successful past experience and modern irrigation principles, while recognizing the unique characteristics of our landscape.

Goal: 9 gallons/sq ft/year with Kentucky Blue Grass

Our goal of 9 gallons per square foot per year (gal/sq ft/yr) is based on proven past experience. One HOA successfully achieved a $60,000 conservation rebate from the City of Denver by maintaining a rate of 8-10 gal/sq ft/yr for Kentucky Bluegrass. As past treasurer in charge of green belt maintenance, this consumption rate was maintained for 5 years and observed for another 4-5 years afterwards through water bills.

While the Denver's conservation committee has recently increased their benchmark to 12 gal/sq ft/yr, the change as based on a vote by grass vendors. (?)

Key Factors for Achieving Water Savings

The important elements in achieving irrigation water conservation are:

* Understand some of the details when anyone talks about ET or Evapotranspiration Formula. The formula's base varies with non-plant water in the soil or not AND has several variables changing the results.
* New Controllers and Head Replacements: Upgrading irrigation controllers and sprinkler heads probably along with Master Valves and Flow Sensors is crucial.
* Persistent Attention to Leaks: Promptly fixing pipe or valve leaks is essential.

Understanding Evapotranspiration (ET)

"Evapotranspiration" (ET) refers to the water needed by plants and the water that evaporates from the soil. Modern controller software helps reduce water consumption by accounting for these factors. ET data, including local rainfall history, is published and readily available by region recently agreed upon and published by a 26 member group of agencies and universities.

Our location in Denver, Colorado, is considered "semi-arid," which means we have a higher ET rate. For "cool," "high-water" plants like Kentucky Bluegrass, the average ET

is 14 gal/sq ft/yr, with a range of 6-25 gal/sq ft/yr. This average is lower for warm or low-water use plants.

Why We Can Achieve Our Goal with Kentucky Bluegrass

While Kentucky Bluegrass is a cool turfgrass and typically needs more water than new hybrid warm turfgrasses, similar water use results can be achieved and have been achieved with Kentucky Bluegrass.

Key factors contributing to this include:

* Landscape Features (K-factors): These include plant types, plant density, wind, and weather. Proper management of these "K" factors can reduce average water needs by 30%-50%. (See more below.)

* Sprinkler Efficiency: Old sprinkler equipment with limited controller software management, old heads and unrepaired leaks can be as low as 50% efficient, meaning double the expected water is used. It is often estimated that as much as 50% of residential outdoor water is wasted due to old controllers, poor software availability or setup, and maintenance. Our current system is rated at 50% efficiency due to limited controller features, old heads, and known leaks. Medium to high efficiency systems range from 65-85%

* Microclimates and High-Density Plants: Our property has "microclimates" (areas with varying sun and shade) and "high density" plants (full ground coverage). These factors, when managed properly with new smart systems, can reduce water consumption by 20-50%.

Practical Steps to Achieve 9 gal/sq ft/yr

* Adhere to City Watering Rules: Follow Aurora City rules for watering times: 2 days/week in May, June, and September, and 3 days/week in July and August.

* Limit Irrigation Season: Limit irrigation before May 1st or after October 1st. Our current practice of irrigating into November and December contributes to higher water usage. The City's records Large Property Variance Designation do not fully capture our water use. These latter city records show 20 gal/sq ft/yr between April 1st and September 30th, but actual usage is more like 23 gal/sq ft/yr when considering pre-April 1st and post-September 30th watering, often leading to higher water Tier 2 prices.

* Repair Leaks: Promptly repair existing pipe leaks identified by AMI alerts.

* Install Smart Controllers and Heads: Implement smart controllers, potentially with master valves and flow sensors, to customize watering times and flow for each individual zone.

* Optimize for Soil Type: Our sandy-loam (clay) soils indicate the use of "cycle+soak" irrigation, which involves short, repetitive watering durations. This prevents excess runoff allowing the soil to absorb water more effectively.

* Utilize Weather Stations: Use at least three wireless weather stations, historical data, and rain sensors to stop or adjust irrigation based on weather conditions.
* Automate Leak Detection: If possible, install equipment to automatically turn off leaking zones.
* Implement Alert Systems: Set up email alerts for excessive water use based on AMI records, notifying relevant personnel to turn off the irrigation system.
* Control Runoff: Modify irrigation to prevent excessive runoff into stormwater drains, which can harm plants.
* Adjust for Low Water Use Plants: Modify station flow for any low-water use plants.
* Manage Water Pressure: If feasible, control head pressure around 30 psi, which can result in 20% water savings by reducing misting, fogging, and improving coverage.
* Eliminate Wasteful Watering: Make adjustments to avoid watering sidewalks, parking areas, or driveways.

By addressing these factors, we can readily reduce our water consumption from 14 gal/sq ft/yr to less than 10 gal/sq ft/yr. Success doesn't require perfection in every area, but achieving the overall goal through multiple methods is the key management approach.

Additional Management Tools and Emphasis

* Plant Stress Tolerance: Most plants, including Kentucky Bluegrass, have a wide "stress" capability and can remain healthy even with reduced water. Kentucky Bluegrass can tolerate a 40% water reduction and still be green and healthy. While not recommended to reach this limit, it is a tool to consider.
* Zone Customization: New controllers allow for unique programming of each of our 108 zones (e.g., in building 217-218) based on plant types, shade/sun levels (microclimates), wind, plant density, and soil variations. These settings can be adjusted individually or as a group.
* Reducing Theoretical ET: Adjusting for plant type weighted average can typically reduce the theoretical ET by 30%.
* Eliminating Waste: Old systems often have fogging, misting, overwatering, and runoff, which new controllers can eliminate for each zone.
* Wind Management: Wind increases evaporation and causes uneven water distribution. New controllers with wireless weather stations can delay or reschedule zone watering accordingly.
* Head Replacement Impact: Simply replacing sprinkler heads within each zone can reduce water consumption by over 20%.