KAYUGA SOLUTION

LIVERMORE CALIFORNIA

CAMP Meeting - Walls

City of Livermore

December 5, 2016 – This presentation was revised after meeting.

Agenda

- The *Not So* Great Walls in Livermore
  - Why do we have walls?
  - Why do walls fail?
  - What type of walls do we have?
  - How much walls do we have?
  - Where are they?
  - What kind of shape are they in?
  - What will it take to repair and replace them?
- Discussions
  - Public vs. private benefits
  - Wall repair vs. replacement
  - Wall criticality methodology
  - Wall policy recommendations

Walls in Livermore

Why Do We Have Walls?

- "Built by developers"
  - Main public purpose → aesthetics
  - Private benefits
    - Security
    - Privacy
    - Sound attenuation
    - Retaining

Causes of Wall Failure

- What causes a wall to fail?
  - Age / condition
  - Physical damage
  - Trees
  - Backfill
  - Drainage
  - Earthquakes

Wall Types / Materials

Brick

Concrete Blocks (Old Style)

Concrete Blocks (New Style)

Stone

Stone Veneer

Concrete Pre-cast Panels

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Wall Types / Materials

Slump Block

Wood

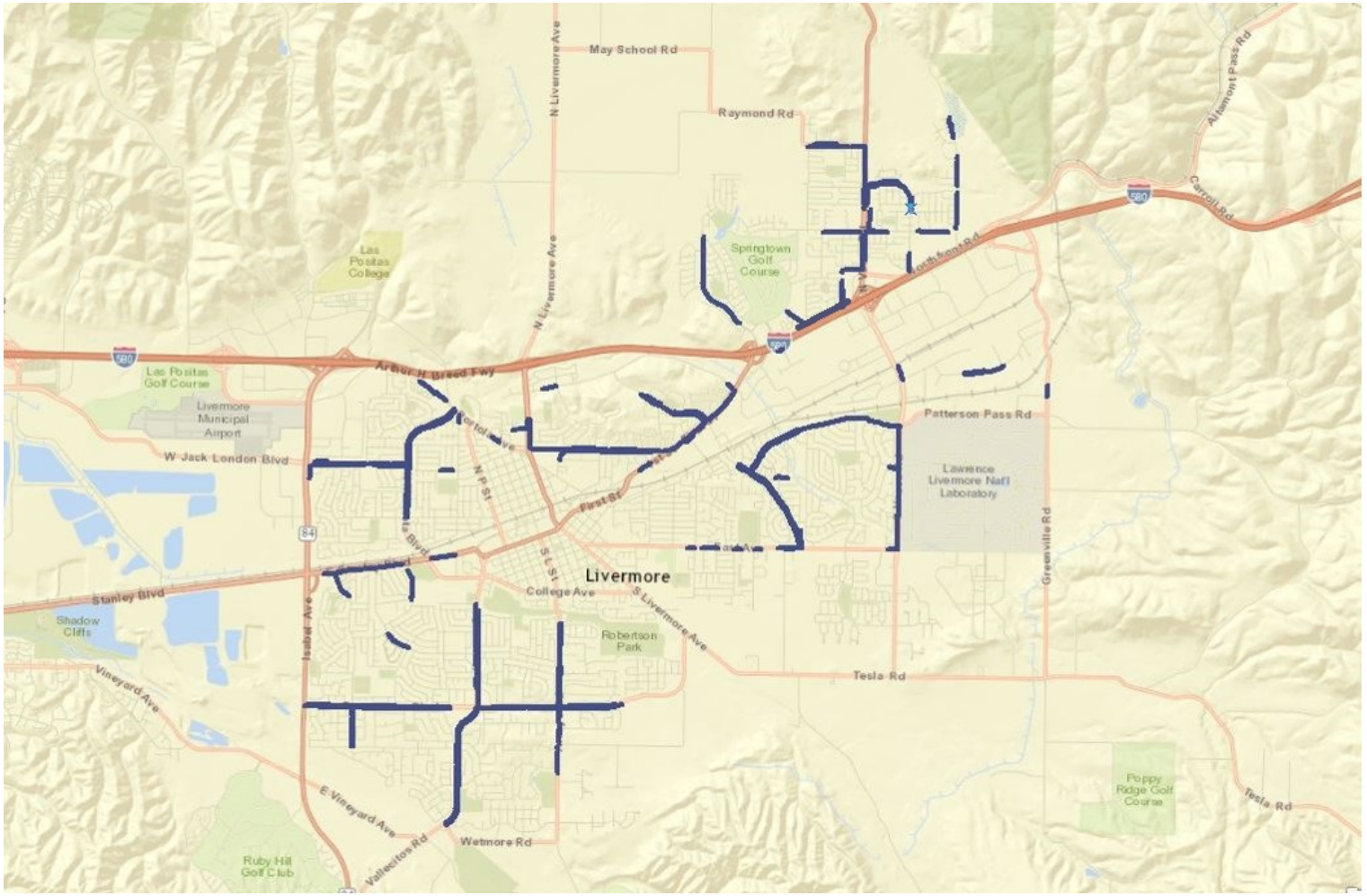
Other Considerations

- Stranded property (i.e., zig-zag walls)
- Compromised drainage
- Non-retaining vs. retaining

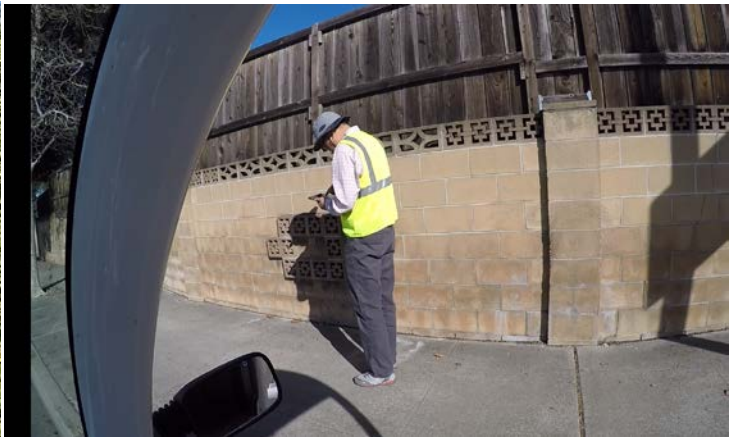
Wall Inventory

Material	Total Length	
	Feet	Miles
Brick	6,135	1.2
Concrete Block	86,983	16.5
Concrete Panel	40,518	7.7
Slump Block	20,921	4.0
Steel	1,500	0.3
Stone	1,830	0.3
Veneer Stone	17,071	3.2
Wood	9,630	1.8
Total	**184,588**	**35.0**

Wall Locations



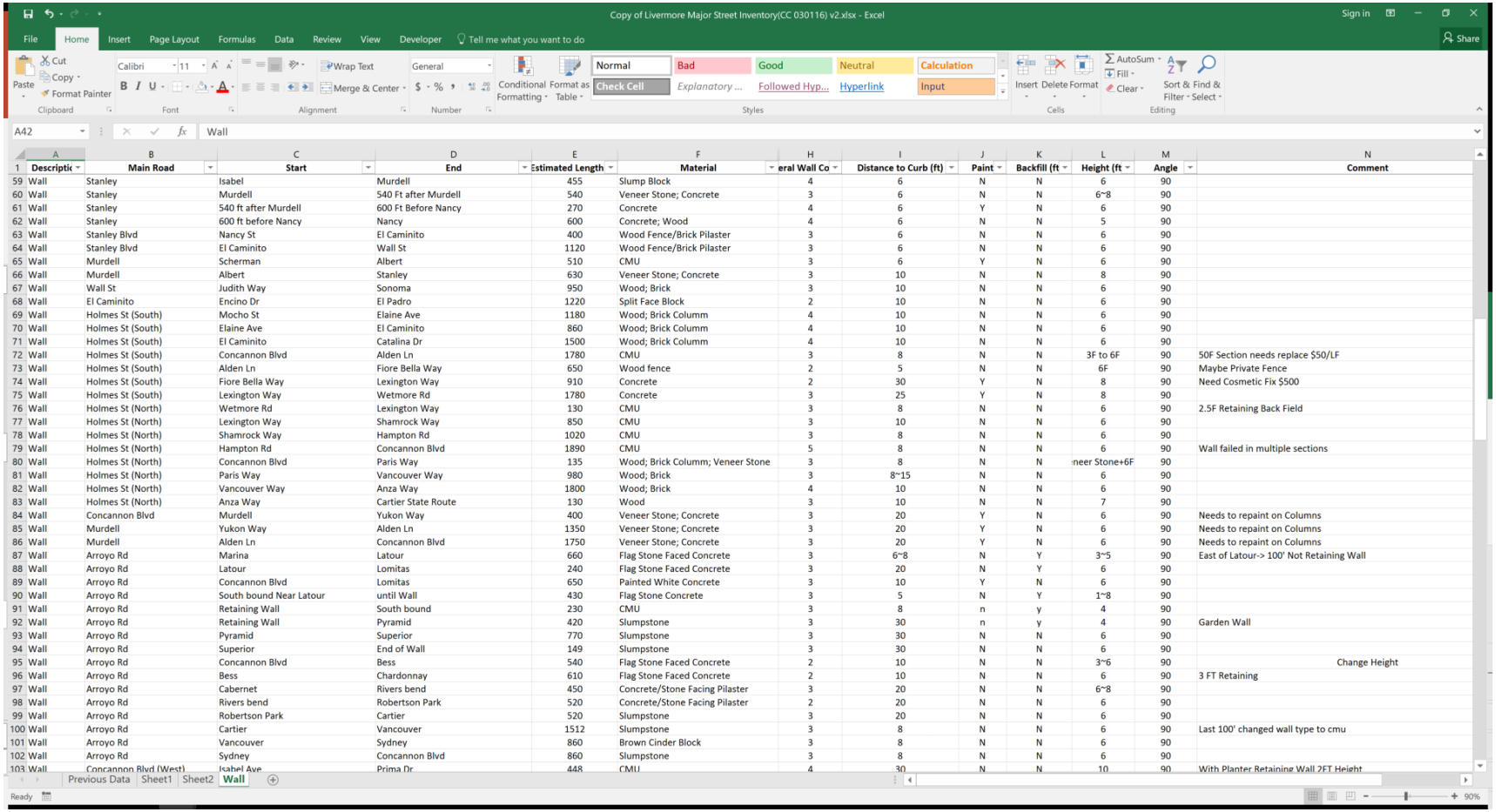
Inventory and Assessment Process



Wall Data Attributes Collected

- Install Year (age)
- Location (street names, GPS)
- Length (estimated)
- Material (e.g., concrete, slumpstone, wood)
- Type (e.g., zig-zag, straight, scalloped)
- Height
- Distance from curb
- Proximity to sidewalk
- Condition
- Paint (yes/no) → If yes, condition
- Picture/video
- Approximate backfill
- Landscape Maintenance District (LMD) → (yes/no)

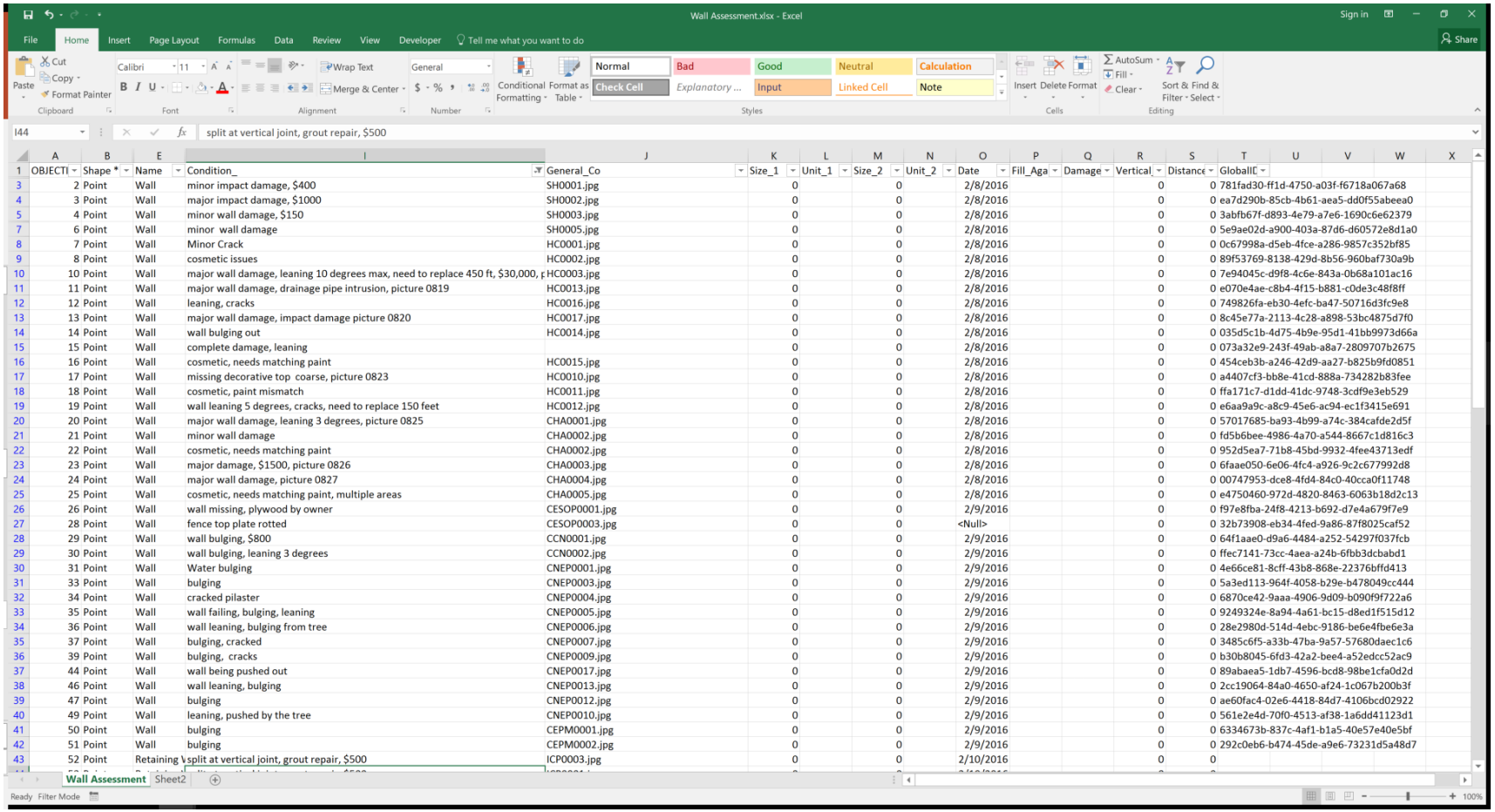
Wall Database



Copy of Livermore Major Street Inventory(CC 030116).v2.xlsx - Excel

	Descriptio	Main Road	Start	End	Estimated Length	Material	eral Wall Co	Distance to Curb (ft)	Paint	Backfill (ft	Height (ft	Angle	Comment
59	Wall	Stanley	Isabel	Murdell	455	Slump Block	4	6	N	N	6	90	
60	Wall	Stanley	Murdell	540 Ft after Murdell	540	Veneer Stone; Concrete	3	6	N	N	6~8	90	
61	Wall	Stanley	540 ft after Murdell	600 Ft Before Nancy	270	Concrete	4	6	Y	N	6	90	
62	Wall	Stanley	600 ft before Nancy	Nancy	600	Concrete; Wood	4	6	N	N	5	90	
63	Wall	Stanley Blvd	Nancy St	El Caminito	400	Wood Fence/Brick Pilaster	3	6	N	N	6	90	
64	Wall	Stanley Blvd	El Caminito	Wall St	1120	Wood Fence/Brick Pilaster	3	6	N	N	6	90	
65	Wall	Murdell	Scherman	Albert	510	CMU	3	6	Y	N	6	90	
66	Wall	Murdell	Albert	Stanley	630	Veneer Stone; Concrete	3	10	N	N	8	90	
67	Wall	Wall St	Judith Way	Sonoma	950	Wood; Brick	3	10	N	N	6	90	
68	Wall	El Caminito	Encino Dr	El Padro	1220	Split Face Block	2	10	N	N	6	90	
69	Wall	Holmes St (South)	Mocho St	Elaine Ave	1180	Wood; Brick Columm	4	10	N	N	6	90	
70	Wall	Holmes St (South)	Elaine Ave	El Caminito	860	Wood; Brick Columm	4	10	N	N	6	90	
71	Wall	Holmes St (South)	El Caminito	Catalina Dr	1500	Wood; Brick Columm	4	10	N	N	6	90	
72	Wall	Holmes St (South)	Concannon Blvd	Alden Ln	1780	CMU	3	8	N	N	3F to 6F	90	50F Section needs replace $50/LF
73	Wall	Holmes St (South)	Alden Ln	Fiore Bella Way	650	Wood fence	2	5	N	N	6F	90	Maybe Private Fence
74	Wall	Holmes St (South)	Fiore Bella Way	Lexington Way	910	Concrete	2	30	Y	N	8	90	Need Cosmetic Fix $500
75	Wall	Holmes St (South)	Lexington Way	Wetmore Rd	1780	Concrete	3	25	Y	N	8	90	
76	Wall	Holmes St (North)	Wetmore Rd	Lexington Way	130	CMU	3	8	N	N	6	90	2.5F Retaining Back Field
77	Wall	Holmes St (North)	Lexington Way	Shamrock Way	850	CMU	3	10	N	N	6	90	
78	Wall	Holmes St (North)	Shamrock Way	Hampton Rd	1020	CMU	3	8	N	N	6	90	
79	Wall	Holmes St (North)	Hampton Rd	Concannon Blvd	1890	CMU	5	8	N	N	6	90	Wall failed in multiple sections
80	Wall	Holmes St (North)	Concannon Blvd	Paris Way	135	Wood; Brick Columm; Veneer Stone	3	8	N	N	neer Stone+6F	90	
81	Wall	Holmes St (North)	Paris Way	Vancouver Way	980	Wood; Brick	3	8~15	N	N	6	90	
82	Wall	Holmes St (North)	Vancouver Way	Anza Way	1800	Wood; Brick	4	10	N	N	6	90	
83	Wall	Holmes St (North)	Anza Way	Cartier State Route	130	Wood	3	10	N	N	7	90	
84	Wall	Concannon Blvd	Murdell	Yukon Way	400	Veneer Stone; Concrete	3	20	Y	N	6	90	Needs to repaint on Columns
85	Wall	Murdell	Yukon Way	Alden Ln	1350	Veneer Stone; Concrete	3	20	Y	N	6	90	Needs to repaint on Columns
86	Wall	Murdell	Alden Ln	Concannon Blvd	1750	Veneer Stone; Concrete	3	20	Y	N	6	90	Needs to repaint on Columns
87	Wall	Arroyo Rd	Marina	Latour	660	Flag Stone Faced Concrete	3	6~8	N	Y	3~5	90	East of Latour-> 100' Not Retaining Wall
88	Wall	Arroyo Rd	Latour	Lomitas	240	Flag Stone Faced Concrete	3	20	N	Y	6	90	
89	Wall	Arroyo Rd	Concannon Blvd	Lomitas	650	Painted White Concrete	3	10	Y	N	6	90	
90	Wall	Arroyo Rd	South bound Near Latour	until Wall	430	Flag Stone Concrete	3	5	N	Y	1~8	90	
91	Wall	Arroyo Rd	Retaining Wall	South bound	230	CMU	3	8	n	y	4	90	
92	Wall	Arroyo Rd	Retaining Wall	Pyramid	420	Slumpstone	3	30	n	y	4	90	Garden Wall
93	Wall	Arroyo Rd	Pyramid	Superior	770	Slumpstone	3	30	N	N	6	90	
94	Wall	Arroyo Rd	Superior	End of Wall	149	Slumpstone	3	30	N	N	6	90	
95	Wall	Arroyo Rd	Concannon Blvd	Bess	540	Flag Stone Faced Concrete	2	10	N	N	3~6	90	Change Height
96	Wall	Arroyo Rd	Bess	Chardonnay	610	Flag Stone Faced Concrete	2	10	N	N	6	90	3 FT Retaining
97	Wall	Arroyo Rd	Cabernet	Rivers bend	450	Concrete/Stone Facing Pilaster	3	20	N	N	6~8	90	
98	Wall	Arroyo Rd	Rivers bend	Robertson Park	520	Concrete/Stone Facing Pilaster	2	20	N	N	6	90	
99	Wall	Arroyo Rd	Robertson Park	Cartier	520	Slumpstone	3	20	N	N	6	90	
100	Wall	Arroyo Rd	Cartier	Vancouver	1512	Slumpstone	3	8	N	N	6	90	Last 100' changed wall type to cmu
101	Wall	Arroyo Rd	Vancouver	Sydney	860	Brown Cinder Block	3	8	N	N	6	90	
102	Wall	Arroyo Rd	Sydney	Concannon Blvd	860	Slumpstone	3	8	N	N	6	90	
103	Wall	Concannon Blvd (West)	Isabel Ave	Prima Dr	448	CMU	4	30	N	N	10	90	With Planter Retaining Wall 2FT Height

Condition Assessment Database



Wall Assessment.xlsx - Excel

OBJECTI	Shape *	Name	Condition_	General_Co	Size_1	Unit_1	Size_2	Unit_2	Date	Fill_Aga	Damage	Vertical	Distance	GlobalID
2	Point	Wall	minor impact damage, $400	SH0001.jpg	0		0		2/8/2016			0	0	781fad30-ff1d-4750-a03f-f6718a067a68
3	Point	Wall	major impact damage, $1000	SH0002.jpg	0		0		2/8/2016			0	0	ea7d290b-85cb-4b61-aea5-dd0f55abeea0
4	Point	Wall	minor wall damage, $150	SH0003.jpg	0		0		2/8/2016			0	0	3abfb67f-d893-4e79-a7e6-1690c6e62379
6	Point	Wall	minor wall damage	SH0005.jpg	0		0		2/8/2016			0	0	5e9ae02d-a900-403a-87d6-d60572e8d1a0
7	Point	Wall	Minor Crack	HC0001.jpg	0		0		2/8/2016			0	0	0c67998a-d5eb-4fce-a286-9857c352bf85
8	Point	Wall	cosmetic issues	HC0002.jpg	0		0		2/8/2016			0	0	89f53769-8138-429d-8b56-960baf730a9b
10	Point	Wall	major wall damage, leaning 10 degrees max, need to replace 450 ft, $30,000, p	HC0003.jpg	0		0		2/8/2016			0	0	7e94045c-d9f8-4c6e-843a-0b68a101ac16
11	Point	Wall	major wall damage, drainage pipe intrusion, picture 0819	HC0013.jpg	0		0		2/8/2016			0	0	e07e4ae-c8b4-4f15-b881-c0de3c48f8ff
12	Point	Wall	leaning, cracks	HC0016.jpg	0		0		2/8/2016			0	0	749826fa-eb30-4efc-ba47-50716d3fc9e8
13	Point	Wall	major wall damage, impact damage picture 0820	HC0017.jpg	0		0		2/8/2016			0	0	8c45e77a-2113-4c28-a898-53bc4875d7f0
14	Point	Wall	wall bulging out	HC0014.jpg	0		0		2/8/2016			0	0	035d5c1b-4d75-4b9e-95d1-41bb9973d66a
15	Point	Wall	complete damage, leaning		0		0		2/8/2016			0	0	073a32e9-243f-49ab-a8a7-2809707b2675
16	Point	Wall	cosmetic, needs matching paint	HC0015.jpg	0		0		2/8/2016			0	0	454ceb3b-a246-42d9-aa27-b825b9fd0851
17	Point	Wall	missing decorative top coarse, picture 0823	HC0010.jpg	0		0		2/8/2016			0	0	a4407cf3-bb8e-41cd-888a-734282b83fee
18	Point	Wall	cosmetic, paint mismatch	HC0011.jpg	0		0		2/8/2016			0	0	ffa171c7-d1dd-41dc-9748-3cdf9e3eb529
19	Point	Wall	wall leaning 5 degrees, cracks, need to replace 150 feet	HC0012.jpg	0		0		2/8/2016			0	0	e6aa9a9c-a8c9-45e6-ac94-ec1f3415e691
20	Point	Wall	major wall damage, leaning 3 degrees, picture 0825	CHA0001.jpg	0		0		2/8/2016			0	0	57017685-ba93-4b99-a74c-384cafde2d5f
21	Point	Wall	minor wall damage	CHA0002.jpg	0		0		2/8/2016			0	0	fd5b6bee-4986-4a70-a544-8667c1d816c3
22	Point	Wall	cosmetic, needs matching paint	CHA0002.jpg	0		0		2/8/2016			0	0	952d5ea7-71b8-45bd-9932-4fee43713edf
23	Point	Wall	major damage, $1500, picture 0826	CHA0003.jpg	0		0		2/8/2016			0	0	6faae050-6e06-4fc4-a926-9c2c677992d8
24	Point	Wall	major wall damage, picture 0827	CHA0004.jpg	0		0		2/8/2016			0	0	00747953-dce8-4fd4-84c0-40cca0f11748
25	Point	Wall	cosmetic, needs matching paint, multiple areas	CHA0005.jpg	0		0		2/8/2016			0	0	e4750460-972d-4820-8463-6063b18d2c13
26	Point	Wall	wall missing, plywood by owner	CESOP0001.jpg	0		0		2/9/2016			0	0	f97e8fba-24f8-4213-b692-d7e4a679f7e9
28	Point	Wall	fence top plate rotted	CESOP0003.jpg	0		0		<Null>			0	0	32b73908-eb34-4fed-9a86-87f8025caf52
29	Point	Wall	wall bulging, $800	CCN0001.jpg	0		0		2/9/2016			0	0	64f1aae0-d9a6-4484-a252-54297f037fcb
30	Point	Wall	wall bulging, leaning 3 degrees	CCN0002.jpg	0		0		2/9/2016			0	0	ffec7141-73cc-4aea-a24b-6fbb3dcbabd1
31	Point	Wall	Water bulging	CNEP0001.jpg	0		0		2/9/2016			0	0	4e66ce81-8cff-43b8-868e-22376bffd413
33	Point	Wall	bulging	CNEP0003.jpg	0		0		2/9/2016			0	0	5a3ed113-964f-4058-b29e-b478049cc444
34	Point	Wall	cracked pilaster	CNEP0004.jpg	0		0		2/9/2016			0	0	6870ce42-9aaa-4906-9d09-b090f9f722a6
35	Point	Wall	wall failing, bulging, leaning	CNEP0005.jpg	0		0		2/9/2016			0	0	9249324e-8a94-4a61-bc15-d8ed1f515d12
36	Point	Wall	wall leaning, bulging from tree	CNEP0006.jpg	0		0		2/9/2016			0	0	28e2980d-514d-4ebc-9186-be6e4fbe6e3a
37	Point	Wall	bulging, cracked	CNEP0007.jpg	0		0		2/9/2016			0	0	3485c6f5-a33b-47ba-9a57-57680daec1c6
39	Point	Wall	bulging, cracks	CNEP0009.jpg	0		0		2/9/2016			0	0	b30b8045-6fd3-42a2-bee4-a52edcc52ac9
44	Point	Wall	wall being pushed out	CNEP0017.jpg	0		0		2/9/2016			0	0	89abaea5-1db7-4596-bcd8-98be1cfa0d2d
46	Point	Wall	wall leaning, bulging	CNEP0013.jpg	0		0		2/9/2016			0	0	2cc19064-84a0-4650-af24-1c067b200b3f
47	Point	Wall	bulging	CNEP0012.jpg	0		0		2/9/2016			0	0	ae60fac4-02e6-4418-84d7-4106bcd02922
49	Point	Wall	leaning, pushed by the tree	CNEP0010.jpg	0		0		2/9/2016			0	0	561e2e4d-70f0-4513-af38-1a6dd41123d1
50	Point	Wall	bulging	CEPM0001.jpg	0		0		2/9/2016			0	0	6334673b-837c-4af1-b1a5-40e57e40e5bf
51	Point	Wall	bulging	CEPM0002.jpg	0		0		2/9/2016			0	0	292c0eb6-b474-45de-a9e6-73231d5a48d7
52	Point	Retaining V	split at vertical joint, grout repair, $500	ICP0003.jpg	0		0		2/10/2016			0	0	

Wall Assessment | Sheet2

Ready Filter Mode

Concept of Failure

- What constitutes a failure?
  - Modes of failure
    - Mortality
      - Condition
    - Functionality
      - Aesthetics
      - Sound

Condition

- Condition Scale

Scale	Description
1	New or nearly new
2	Very good
3	Good
4	Poor or recommended replacement within near-term
5	Failed or nearing failure, needs immediate attention

Condition 5

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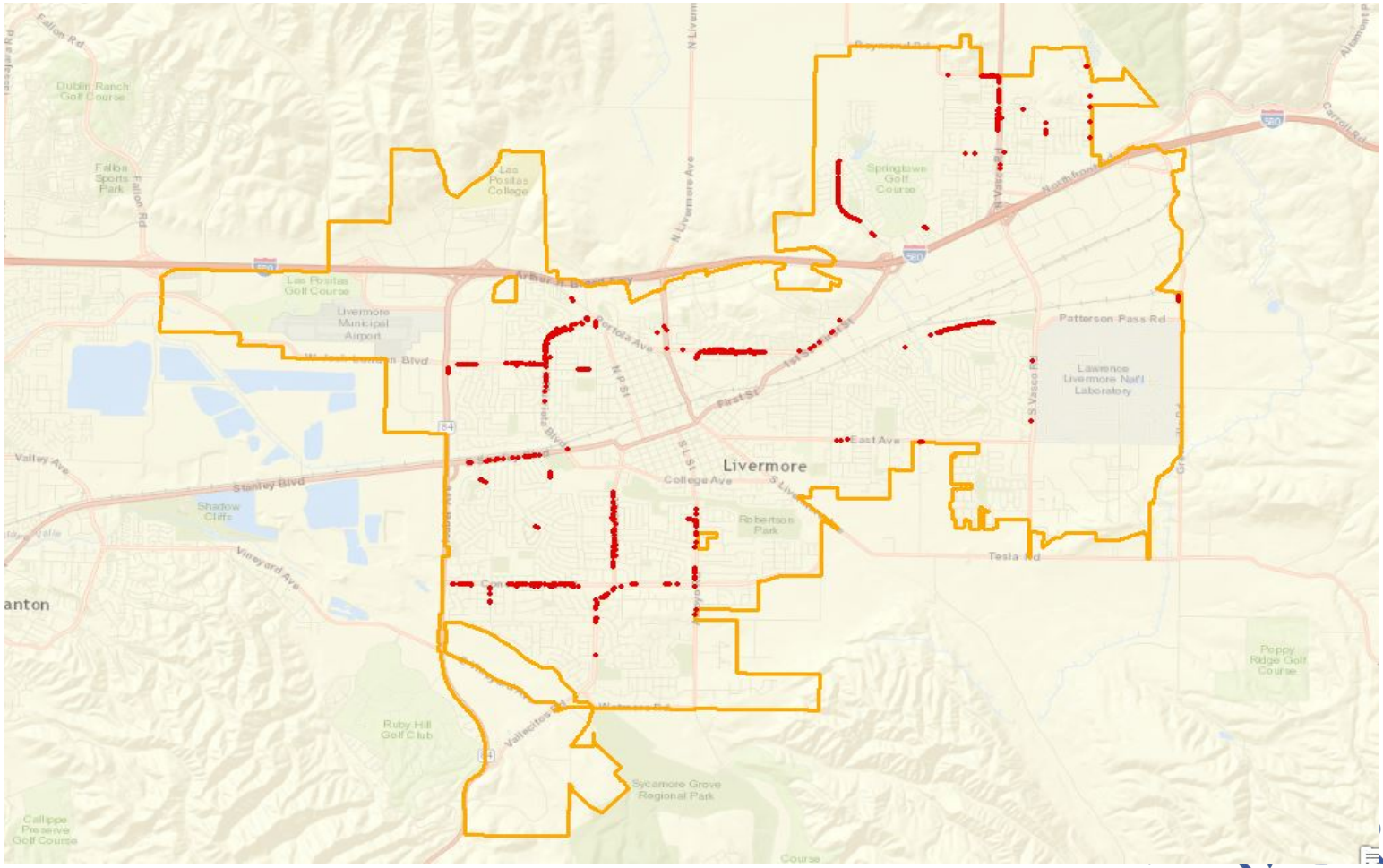
Condition 4

Problematic Areas

- 841 wall fault locations



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Poor Condition Summary

- Condition 4

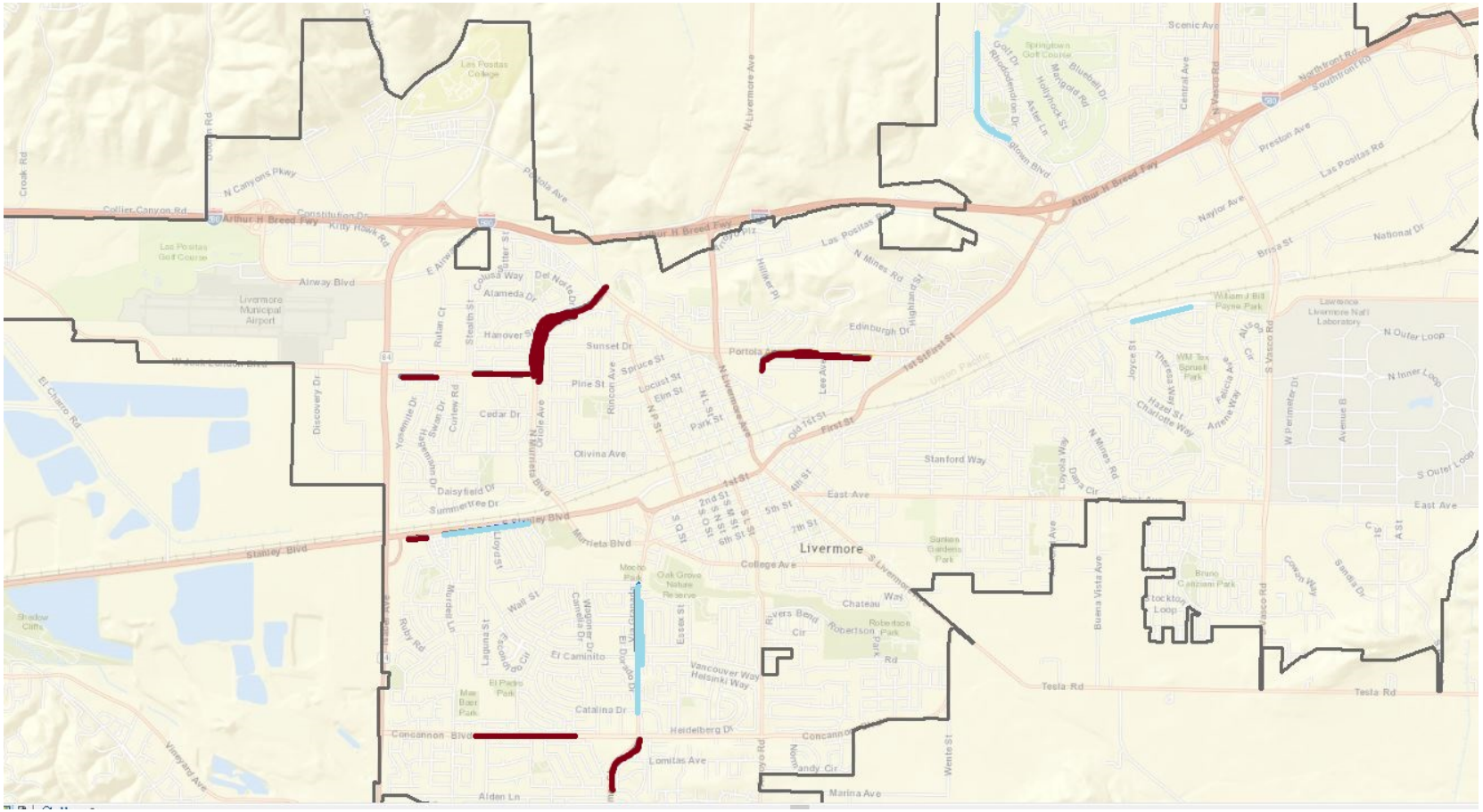
Total Est. Length (ft)	Total Est. Length (mi)	Percent of Total Wall Length
20,060	3.8	11%

- Condition 5

Total Est. Length (ft)	Total Est. Length (mi)	Percent of Total Wall Length
3,490	0.7	2%

Initial Poor Condition Summary

- Condition 4 & 5



Average Wall Replacement Cost Estimates

Wall Type	Average Replacement Cost* ($/LF)
Brick	$ 700
Concrete Block	$ 750
Concrete Panel	$ 500
Slump Block	$ 700
Steel	$ 250
Stone-Short	$ 400
Veneer Stone	$ 700
Wood	$ 100

* Replacement cost includes materials, removal, and installation. Does not include permits and/or increased cost for retaining walls.

Other Indirect Costs

- Other costs for consideration
  - Engineering / Design/ Project Management
  - Demolition and removal
  - Permit
  - Contractor overhead/profit
  - Contingency
  - Traffic control
  - General conditions

Estimated Cost to Replace

- Estimated cost to replace all walls: $112 million
- Current poor condition walls:

Condition	Estimated Cost
Condition 4	$10.2 million
Condition 5	$2.4 million
Total	**$12.6 million**

- Ave. budget needed for replacement: $1.6 million/yr
- Ave. maintenance needs: $0.4 million/yr

Discussions

Public vs. Private Benefits

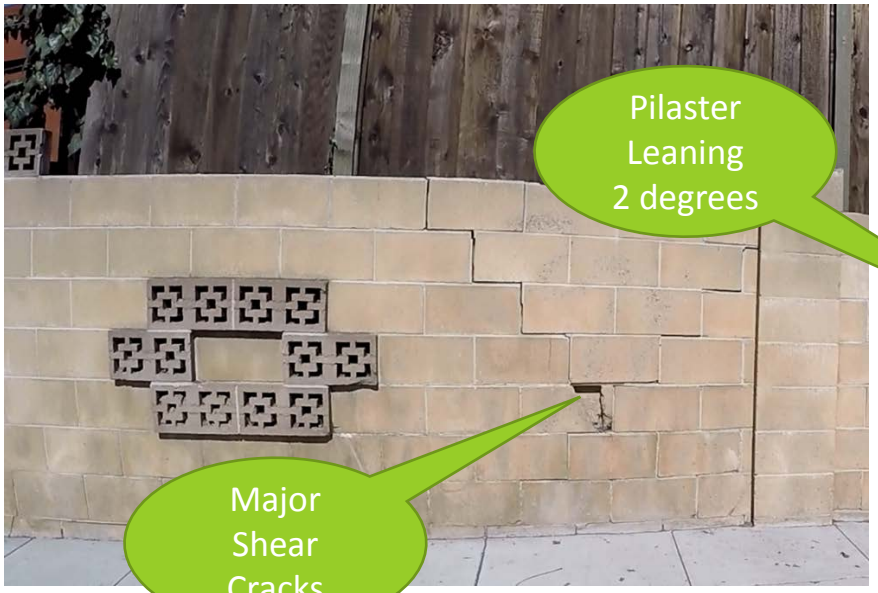
- Public vs. private benefits
- Aesthetic concerns
- Community character

Replacement vs. Repair

- Walls recommended for replacement
  - Condition 4 and 5 walls
  - Areas of major damage in multiple places along the wall (e.g., bulging, leaning more than 2 degrees, major cracking)
- Walls recommended for rehabilitation/repair
  - Localized areas of damage
  - Can be fixed with repair or panel replacement

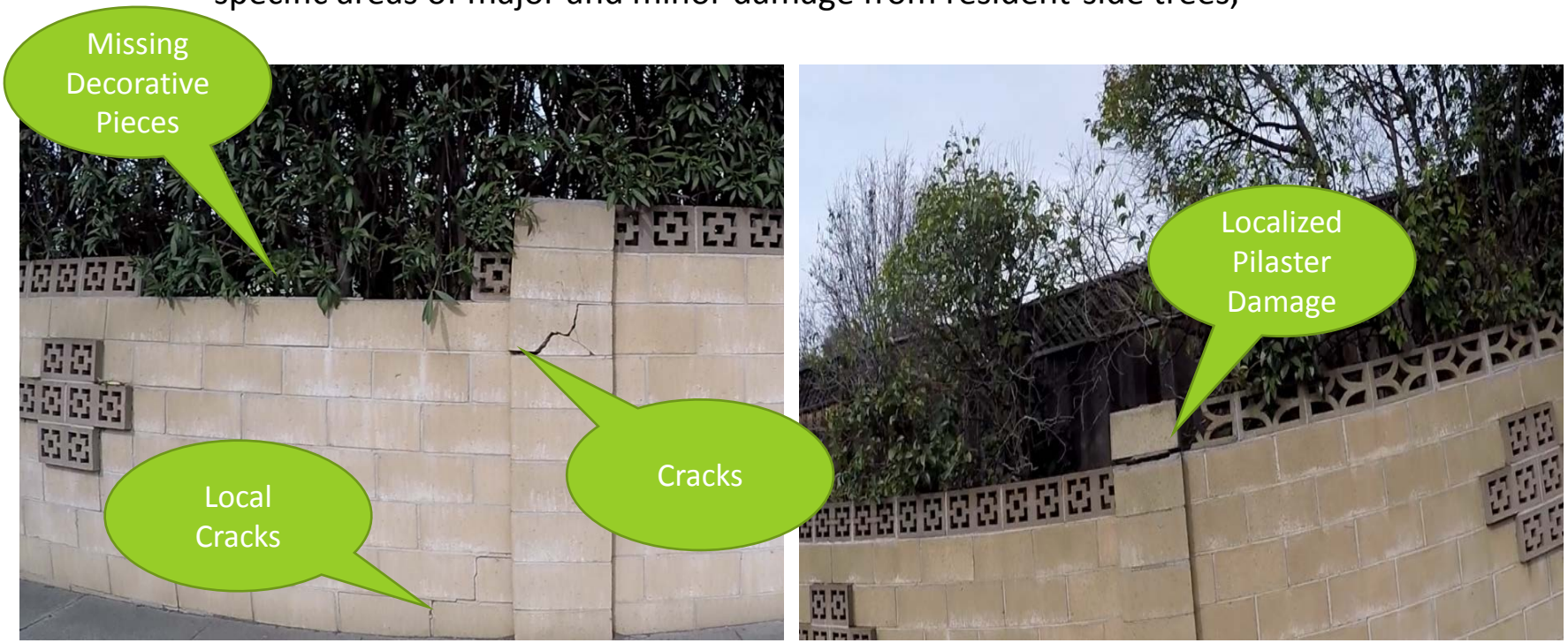
Initial Poor Condition Summary – Replacement Example

- Example: E Jack London Blvd (North) from Murrieta Blvd to Troy St
  - Summary: Bulging, leaning 2 degrees in several areas, multiple panels in need of full replacement, damage to pilasters and bottom course



Initial Poor Condition Summary – Repair Example

- Example: Portola Ave (North) from Yorkshire Dr to Royal Rd
  - Summary: Areas of bottom course damage - can be repaired by mortar/grouting, specific areas of major and minor damage from resident-side trees,



Factors for Assessment of Criticality

- Risk
  - Probability of failure
    - Condition
  - Consequence of failure
    - Safety
      - High pedestrian areas (e.g., near schools, parks)
    - High visibility
      - City entry points (i.e., first quarter mile)
      - Road type (arterials → collectors → residential)

Criticality

Street Class	Weight	Special Considerations	Consequence of Failure
Arterial	High	City Entry Points	5
Arterial	High	High Pedestrian Area	5
Arterial	High	Retaining Wall	5
Arterial	High	General	4
Collector	Med	High Pedestrian Area	5
Collector	Med	Retaining Wall	5
Collector	Med	General	3
Local	Low	High Pedestrian Area	5
Local	Low	Retaining Wall	5
Local	Low	General	2
Other	Low	General	1

Life Cycle Management Strategies

Wall Type	Useful Life (Years)	Rehab Frequency (Years)	Rehab Cost
Brick	70	15	Allocate 5% to address localized damages (e.g., paint, grouting, graffiti removal)
Concrete Blocks	70		
Concrete Panels	80		
Slump Block	70		
Steel	50		
Stone-Short	80		
Veneer Stone	80		
Wood	20	10	Allocate 10% for paint

Policy Considerations

- Finding additional budget
  - Citywide infrastructure district
  - Parcel tax
- Non-asset solution
  - Get rid of it, knock it down
  - Replace it → give it to property owners
  - Share the cost (City and property owners)
  - Share the cost → give it to property owners
  - Wall reimbursement (owner pays) → give it to property owners
  - Replace wall with landscaping
- Design standards
  - City mandated design?
- No new City walls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