HLC FEASIBILITY STUDY
Stormwater Treatment and Runoff Reduction
MANAGEMENT UPDATE MEETING
July 31, 2014

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Innovation • Collaboration • Inspiration

Thinking Together to Inspire

Project Goal and Objectives

- **Evaluate the Feasibility of Using the HLC for Stormwater Treatment and Runoff Reduction:**
  - **Identification and quantification of watersheds which currently do or could flow into the HLC.**
  - **Determination of the HLC's capacity to accommodate runoff for water quality treatment.**
  - **Determination of infrastructure needed to convey, treat, and discharge stormwater flows from the HLC.**
  - **Estimation of annual volume of stormwater available for infiltration in the HLC.**
  - **Identification of measures needed mitigate health and safety concerns associated with stormwater treatment.**

Project Goal and Objectives

- **Evaluate the Feasibility of Using the HLC for Stormwater Treatment and Runoff Reduction:**
  - **Quantification of anticipated benefits of water quality treatment, preservation of trees, and enhancement of the recreational experience.**
  - **Estimation of capital improvement and operation and maintenance costs.**
  - **Evaluation of framework for operating within the Colorado water rights administration system.**
  - **Conceptual design of a pilot project to further confirm the project feasibility.**
  - **Identification of future steps for project implementation.**

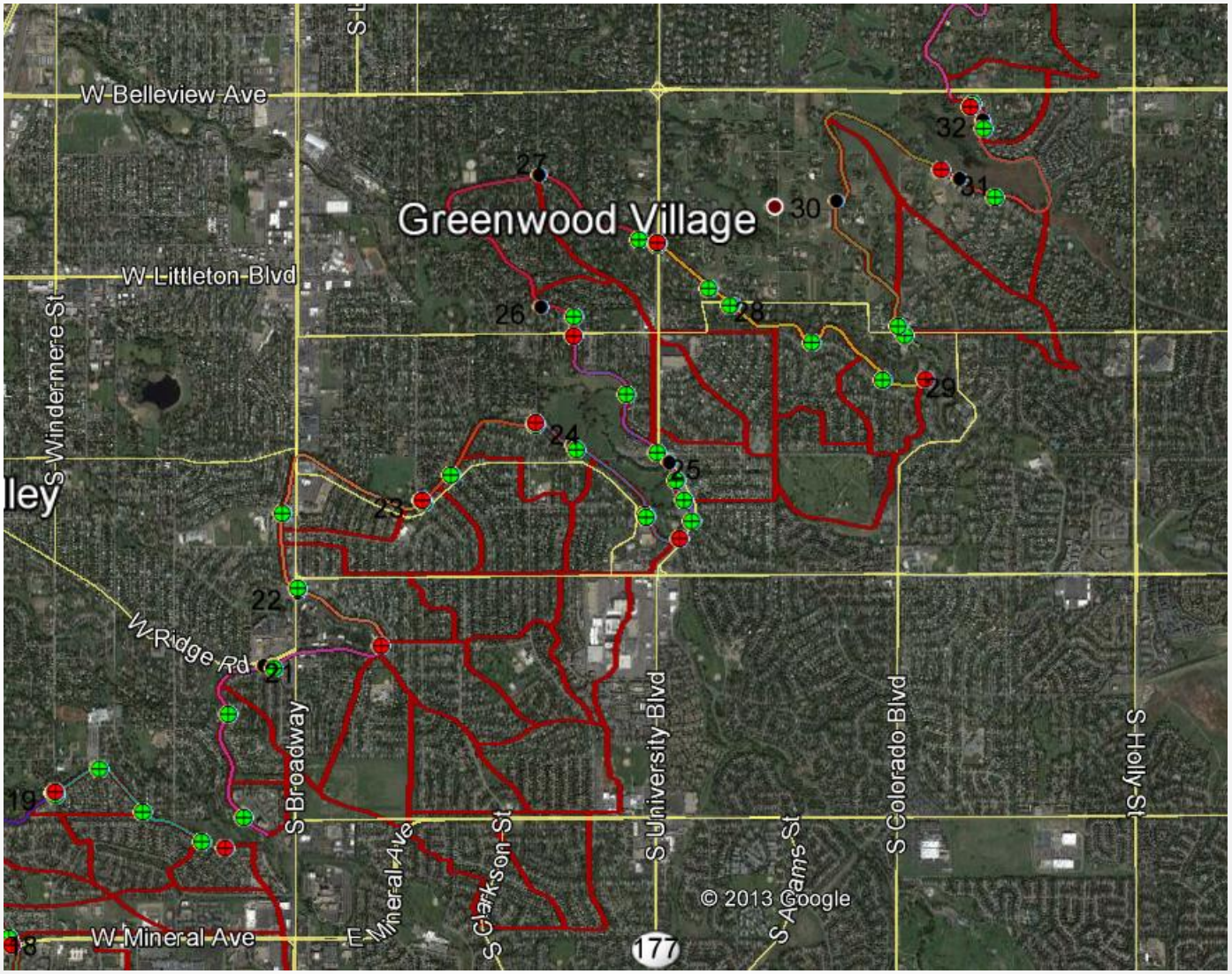
Project Participation

- **Participants**
  - **Engineering and Parks/Recreation/Open Space staff from the following entities:**
    - Arapahoe County
    - Douglas County
    - City and County of Denver
    - City of Aurora
    - City of Greenwood Village
    - City of Littleton
    - City of Cherry Hills Village
    - Southeast Metro Stormwater Authority
    - Denver Water
    - Urban Drainage and Flood Control District

Information Management

- A GIS base map was prepared which includes the following information:
  - HLC stationing
  - Storm sewer systems crossing the canal
  - Stormwater inflow points into the canal
  - Potential stormwater outflow points out of the canal
  - Denver Water HLC headgates
  - Tributary Watersheds
  - Jurisdictional Boundaries
  - Canal Segments
  - Data exported into Google Earth for review and comment by project stakeholders

Information Management



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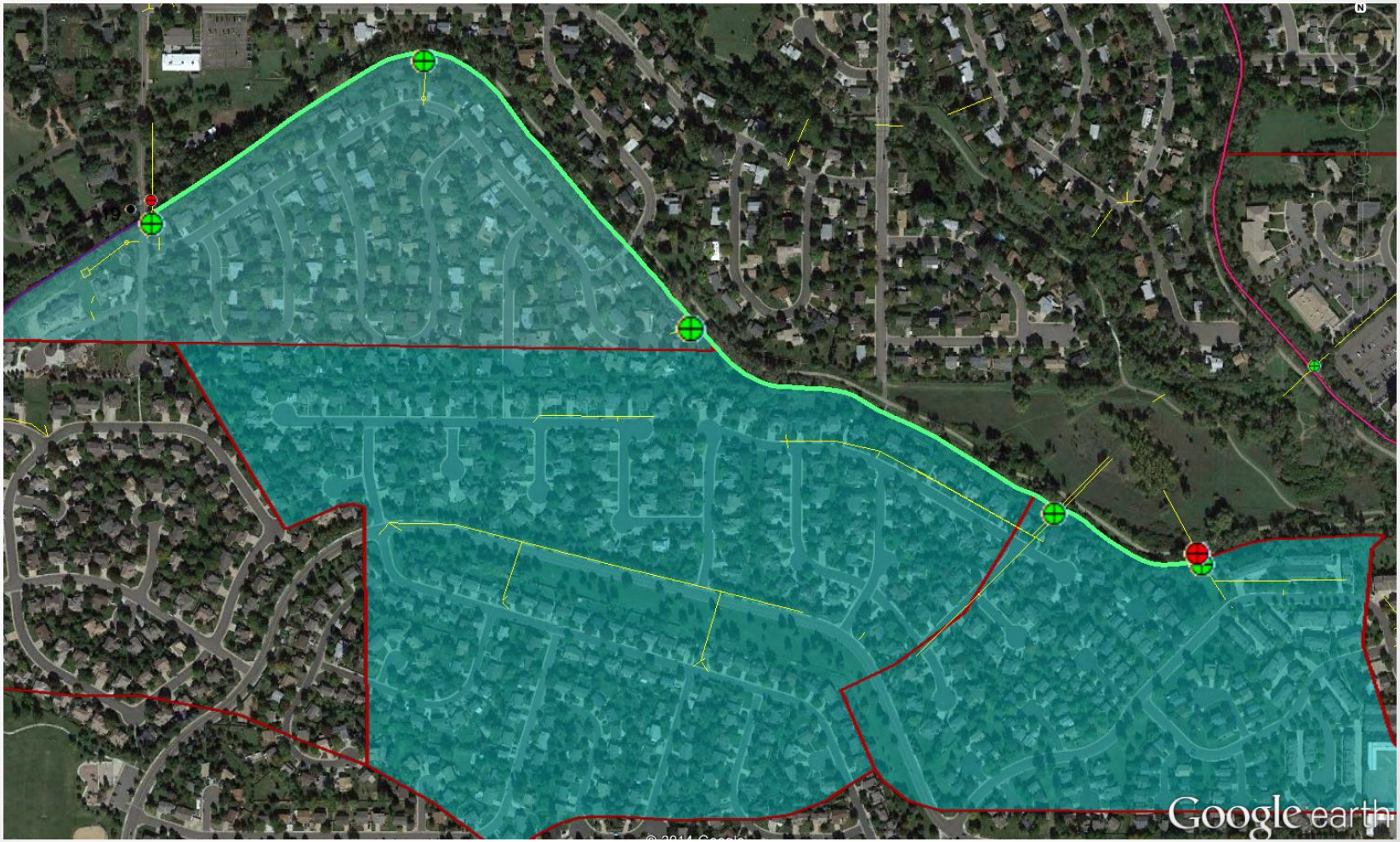
Information Management



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Watersheds Considered in Study

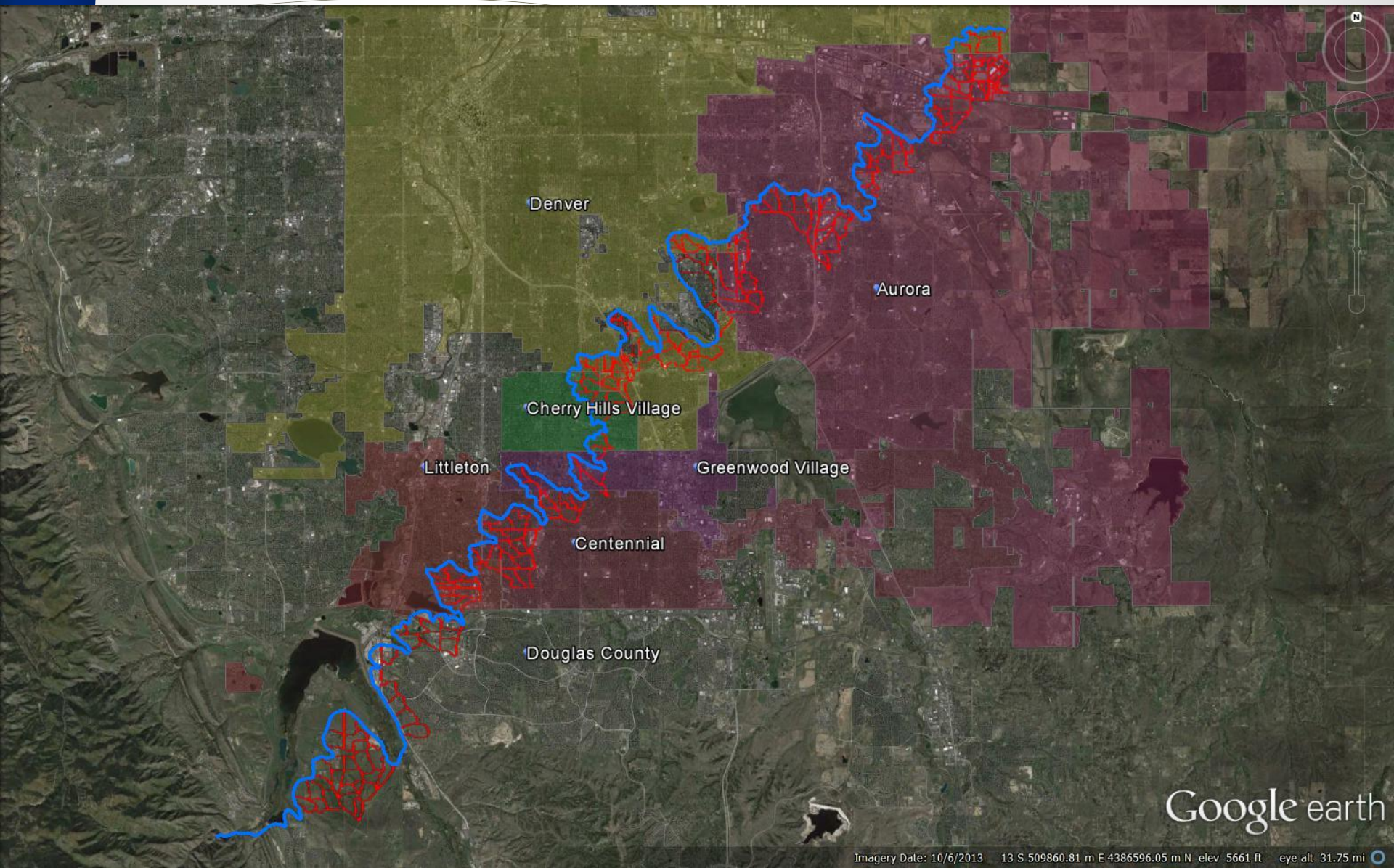
- Watersheds which currently drain into or could drain into the HLC were evaluated based upon the following:
  - Area of watersheds available to drain into the HCL are limited based upon:
    - Capacity of HLC
    - Physical ability to drain into the HLC
    - Flow from storm sewer systems and streets
    - Diversions from natural channels are not feasible without obtaining a diversion water right and augmentation
  - About 240 watersheds were selected for consideration to drain to the HLC for a total of about 26 square miles.

Water Quality BMP Design Criteria

- BMP Design Criteria
  - Maximize available canal volume
  - Maximum ponding depth of 3 feet
  - 72 Hour drain time
    - Maximum allowed by the State Engineer
  - Used UD&FCD Updated Water Quality Capture Volume (WQCV) equation to determine optimum stormwater capture volume
  - Must have defined outflow location

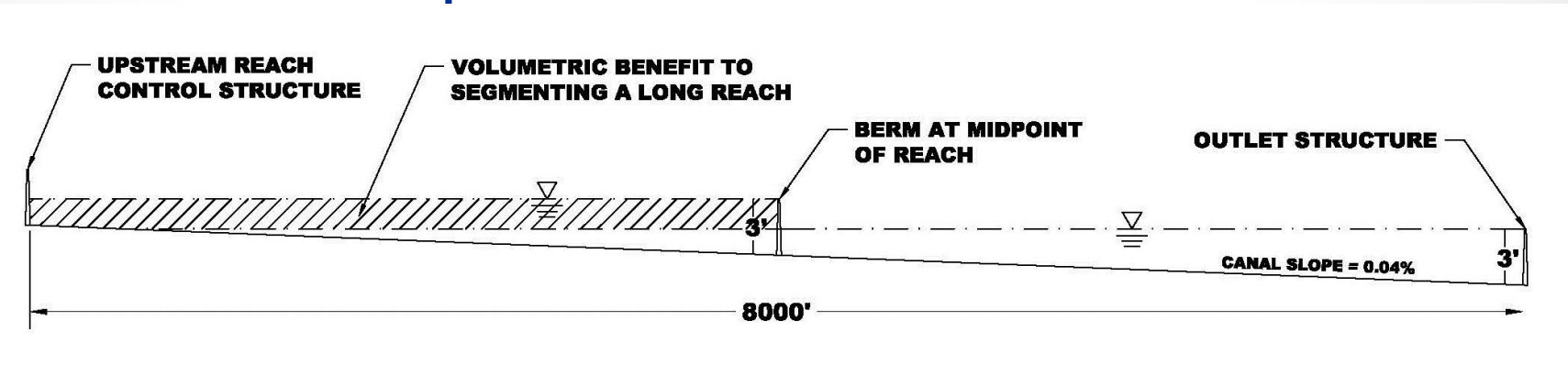
- Based upon these criteria the canal was divided into 52 reaches.

Watersheds Considered in Study



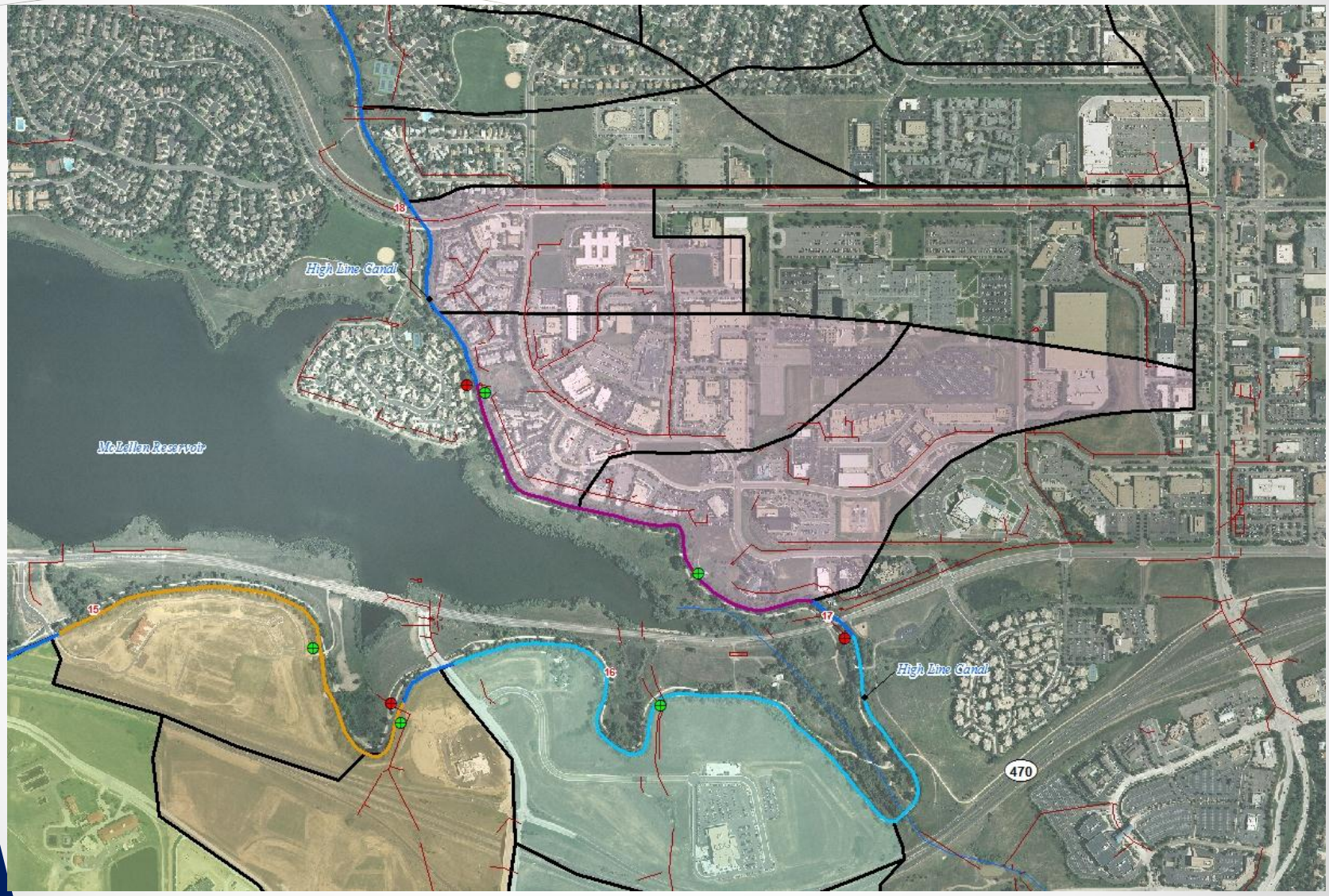
Canal Segmenting Efficiencies

- Segmented Design Concept
  - More volume and infiltration than one control structure per reach



- Limitations
  - Inflow points required in upper segment
  - Added cost for additional structure
  - Additional maintenance access require

Canal Segmenting Example



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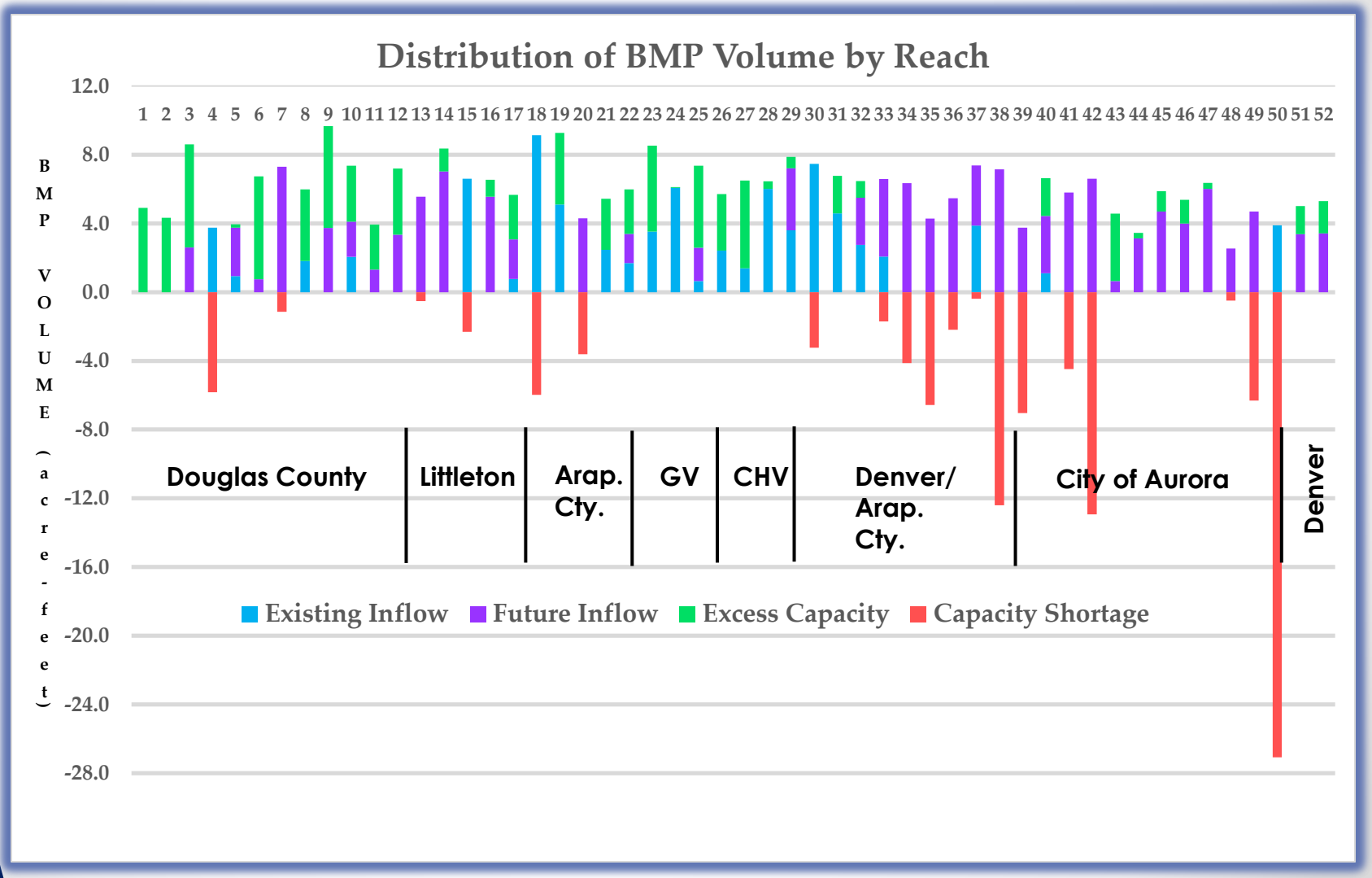
Water Quality BMP Results

- Precipitation
  - Average annual precipitation about 15 to 16 inches – Ranges from 10 to 20 inches
  - Precipitation occurs in an average of 40 to 50 storm events per year.
  - BMP design proposed to capture about 85% of these storm events
  - Runoff from these events generates an average of about 5 to 6 inches of potentially captureable runoff per year.
  - This represents about 4000 acre-feet of runoff per year from the 26 square mile tributary watersheds

Water Quality BMP Results

- Canal Capacity
  - Available BMP storage capacity in the HLC is about 313 acre-feet.
  - Needed water quality storage capacity is about 287 acre-feet.
  - However, effective BMP storage available is about 202 acre-feet (70% of available). This is due to:
    - Available capacity where capacity is not needed.
    - Excess runoff where capacity is not available.
  - This results in an average of about 2900 acre-feet per year of water temporarily stored by the BMP.

Water Quality BMP Results



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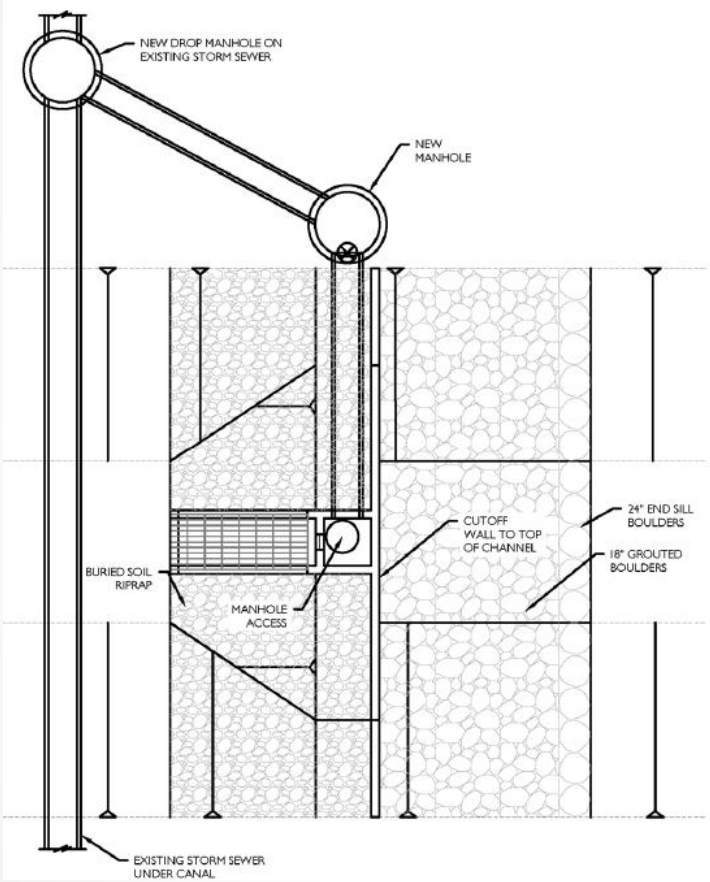
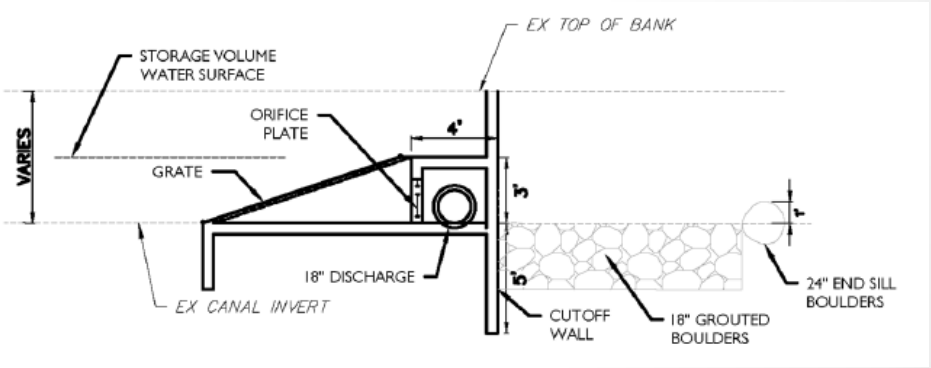
Water Quality BMP Results

- Effectiveness for providing additional soil moisture/water for trees and vegetation:
  - 72 hour drain time provides about 100 additional days that the canal bottom will be wet after storm events.
  - Canal infiltration estimated to average about 20 acre-feet per event or about 1000 acre-feet per year.
  - Infiltration is variable throughout the canal length.
  - Remaining stored volume of about 1900 acre-feet per year is returned to the stream system.

Typical Control/Outlet Structure





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Critical Issues

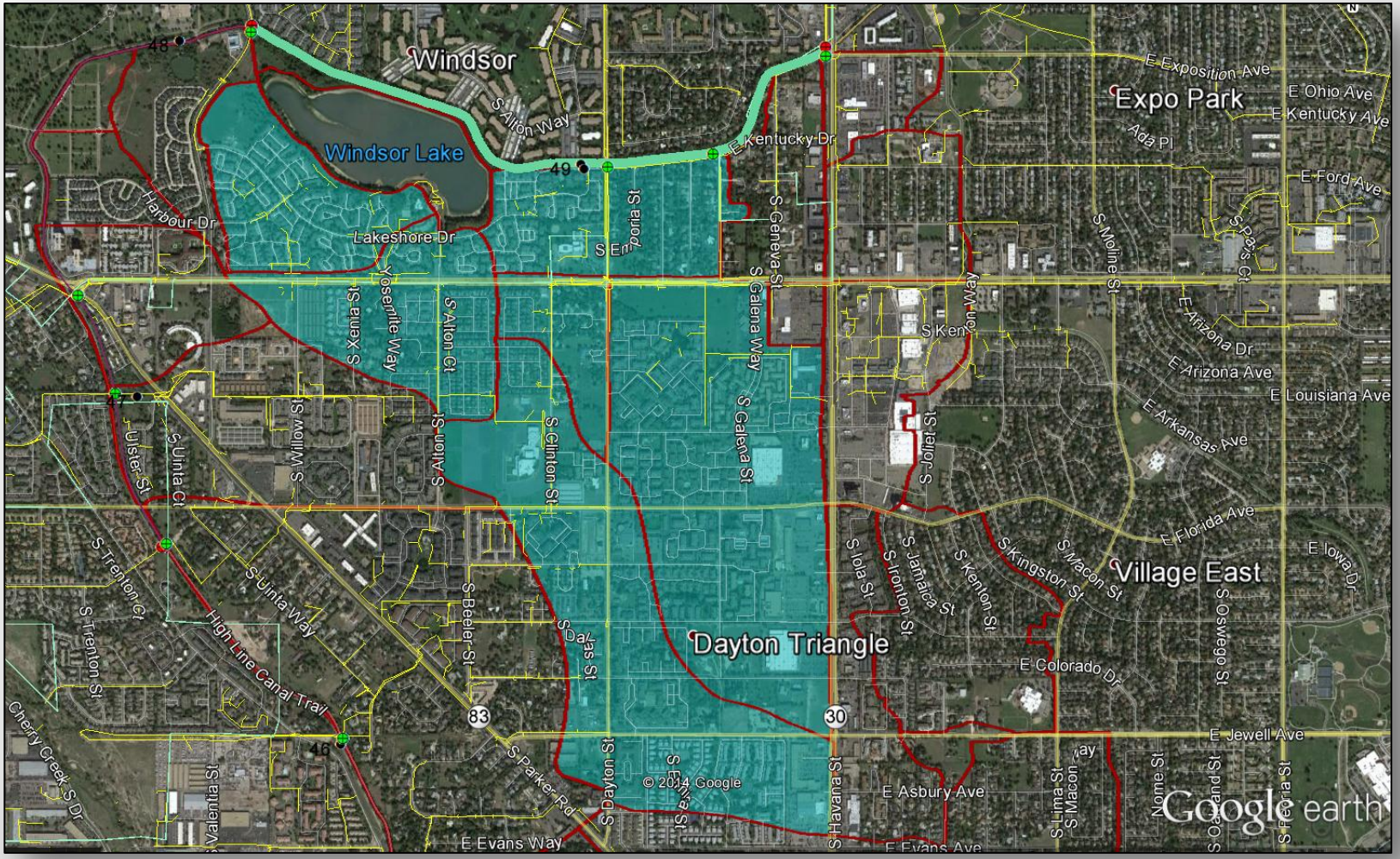
- Provide trash and debris control at inflow points into the canal.
- Provide access to control structures for maintenance and repair.
- Address aesthetic and health and safety issues.
- Maintain stormwater conveyance capacity for larger storm events that enter uncontrolled into the canal.
- Address potential water right impacts, if any.
- Others as may come to light from the pilot conceptual design.

Pilot Study

- The purpose of the Pilot Study is to obtain a proof of concept and obtain a better estimate of project costs and constraints to implementation.
- Reaches were selected downstream of Fairmont Cemetery since canal irrigation water no longer flows downstream of this point.
- Two canal reaches were selected; one in the City and County of Denver and one in the City of Aurora.

Pilot Study Reaches

Pilot Reach 38 in City and County of Denver



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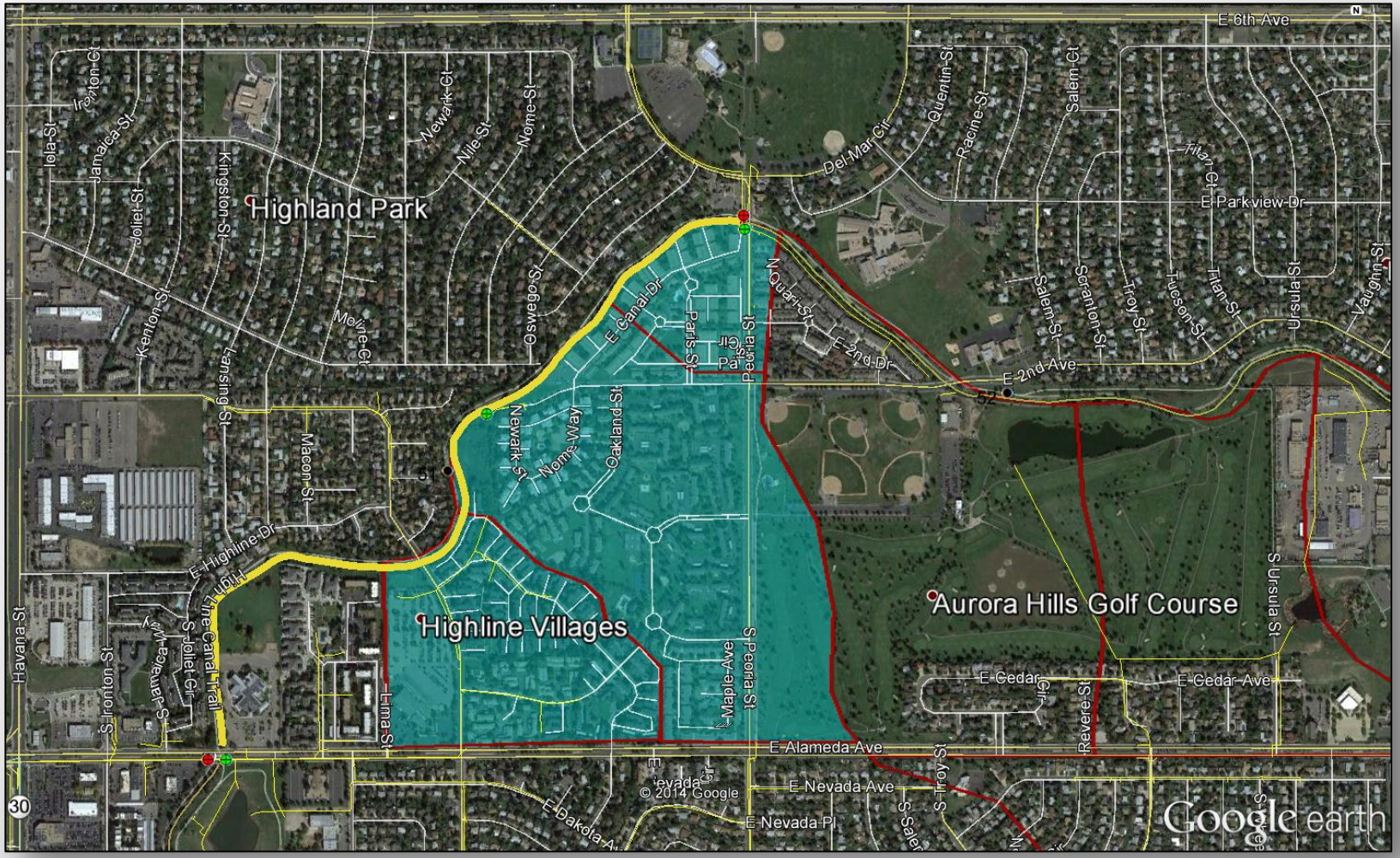
Pilot Study Reaches

Pilot Reach 40 in City of Aurora



Pilot Study Results

- For Reach 38, significant storm sewer system extensions are needed to divert required stormwater into the canal.
- Total capital costs for Reach 38 are estimated to be about $2,300,000.
- One of the most expensive reaches in the entire study due to the large upstream watershed area resulting in large and deep existing storm sewers.
- For Reach 40, significantly less cost (about $1,200,000) needed to implement plan.
- Costs for remaining reaches were prorated based upon Reach 38 costs, watershed slope, and design inflow rates.

Overall Project Costs

- Minimal Costs to Provide Segmentation Berms and Release Structures (About $190,000/Reach).
- Significant Capital Improvement Costs to Divert Additional Runoff Into the Canal (Average of $700,000/Reach).
- Total Estimated Cost for Capital Improvements for all 52 Reaches is about $44,000,000.
- Total Estimated Cost for Operation and Maintenance of all 52 Reaches is about $1,200,000.
- Estimated Cost of Water Rights and Augmentation Plan, if needed, is about $2,500,000.

Overall Project Costs

Costs Summary by Jurisdiction

Jurisdiction	Total Capital Cost - Control and Outfall Structures	Total Capital Cost - WQ Outfall Systems	Grand Total Capital Cost	Total Annual O&M Cost
Douglas County	$2,104,500	$6,352,305	$8,456,805	$259,036
Littleton	$850,500	$4,025,085	$4,875,585	$125,385
SEMSWA	$1,323,000	$3,784,162	$5,107,162	$169,466
Greenwood Village	$661,500	$602,242	$1,263,742	$68,690
Cherry Hills Village	$472,500	$676,026	$1,148,526	$51,502
Denver	$1,701,000	$8,095,166	$9,796,166	$226,257
Aurora	$2,268,000	$10,610,781	$12,878,781	$262,177
Totals	**$9,381,000**	**$34,145,768**	**$43,526,768**	**$1,162,513**

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Overall Project Benefits

- If water quality treatment needed for this same tributary watershed without this project, the estimated costs for comparable facilities is $75,000,000. Not required at this time but would be if end of pipe water quality standards are promulgated in the future.
- Provides for trash and debris control.
- Helps maintain the natural environment associated with the canal recreational experience by providing water for growth of vegetation.
- Actual value to the recreational experience is unknown.
- Provides possible location for water quality treatment for linear roadway projects.

Study Results

- **Technically Feasible to Use Canal for Water Quality Treatment / Runoff Reduction.**
- **Provides Significant Reduction of Stormwater Pollutants which Currently Reach Receiving Stream Systems.**
- **Reduces Stormwater Runoff Rates by an Aggregate Rate of up to 3300 cfs.**
- **May Provide up to 1000 A.F. per year of Additional Water to Canal Vegetation resulting in one-for-one Stormwater Runoff Volume Reduction.**

Next Steps

- Input needed from Stakeholder Agencies as to Desire to Take Next Steps
- Investigate Governance Options / Issues
- Address Outstanding Legal Issues
  - Issues/Risks in Transfer of Ownership of Easements Underlying the Canal
  - Issues/Risks for Water Rights Requirements
  - Issues /Risks of Canal Ownership
- Evaluate a Cost Allocation between Stormwater and Recreation
- Evaluate Additional Pilot Reaches to Further Refine Costs
- Prepare Implementation and Phasing Plan
- Integrate with Other Canal Studies

Project Progress to Date

QUESTIONS?