Using Relative Difference Modeling to predict the benefits of LID in “Flood Events” on a Watershed Master Plan

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Topics

- Model Building Techniques
- Examples of a Relative Difference Model
- Relative Differences which can be quantified
- Results of Modeling for Regional Projects
- Results of Modeling at a Watershed Level
- Models are not applicable to all situations.

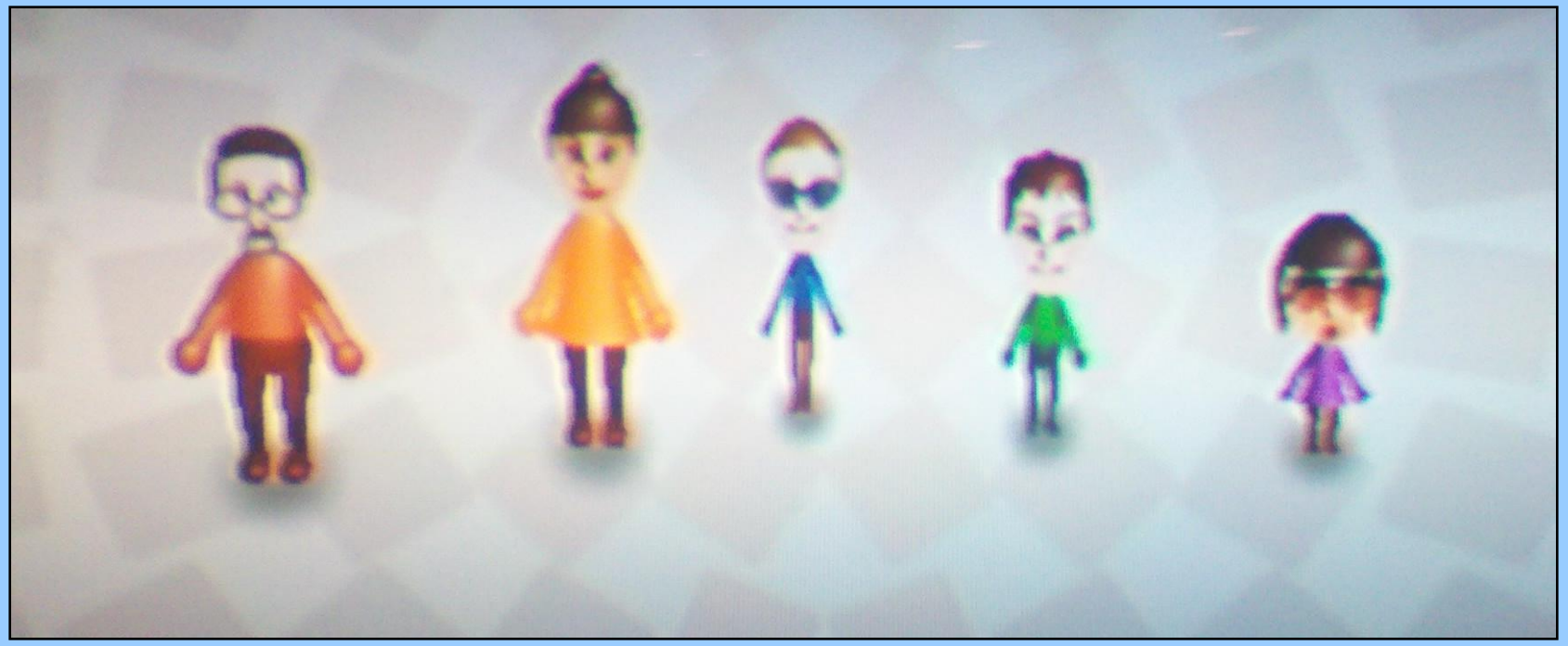
Model Building Technique

- Models are built with limited information
- Local Standards are used
- Base model is created for data set of “Current” conditions
- A limited set of variables are changed to represent the “Post-Project” conditions.
- Differences in models are documented
- Sensitivity analysis is performed

Examples of Models

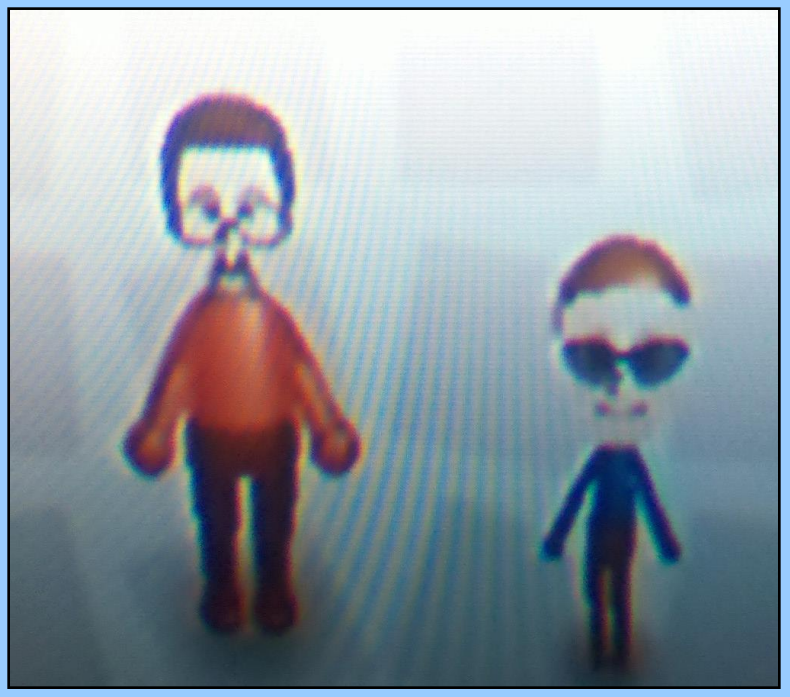
Examples of a Model

Examples of a Model



- Mii's from the Wii gaming system represent a limited information model used for a specific purpose
- Generated from the answers to approx. 20 questions

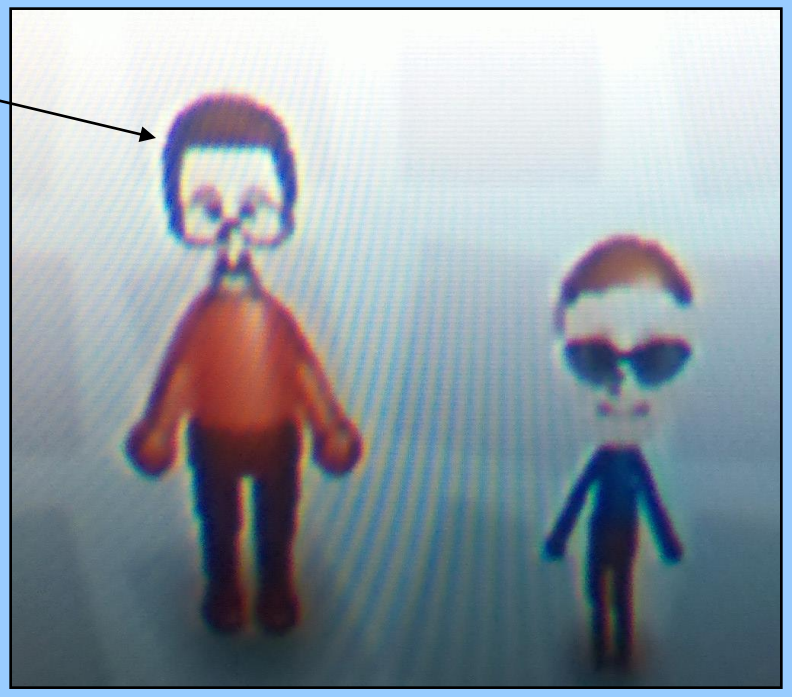
Examples of a Model



•While we share billions of pieces of genetic code, there are differences in these models, which represent real differences.

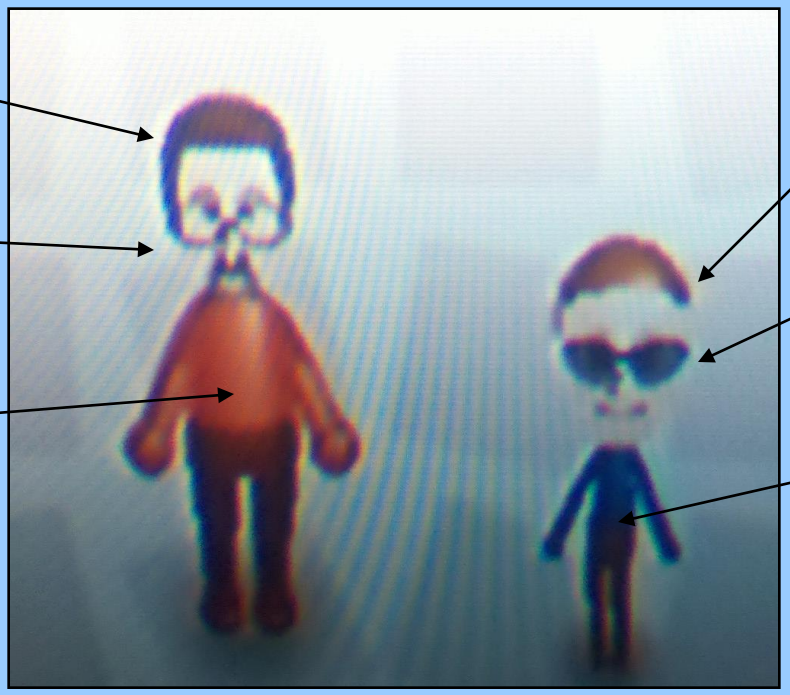
Relative Differences

Taller by
18 inches



- We can estimate differences between the two models

Relative Differences



- Lots of Differences in this case

Hydrologic Models

- Built with estimated Factors:
  - Rainfall (usually from a standard or statistical data)
  - Terrain (slope, roughness, shape of channels)
  - Soils (infiltration rates and saturated response)
  - Landuse (timing and amount of flow delivery)
  - Imperviousness (directly connected)
  - Vegetation (losses and roughness)
  - …

Hydrologic Models

- For LID Evaluation in “Flood Events”:
  - Estimate which installed LID’s will have an impact on Flood Event runoff and quantify their use ONLY.
  - Adjust Directly Connected Imperviousness based on estimate of benefits of LID to account for increased infiltration and other losses
  - Adjust for timing changes (not usually applicable to Flood Events)
  - Model for “Relative Differences” by only changing the estimated benefit related factors

Watershed Benefits from Project Planning

- Looking for (Flood Events):
  - Reductions in Peak Flood Flows
  - Minimization of Change (with reduction) to Flow-Volume-Duration relationship
- Show Results of Analysis for:
  - Two Large Planning Projects in Western Placer County/Roseville
  - Analysis for the Dry Creek Watershed for all remaining development, in a build-out scenario.

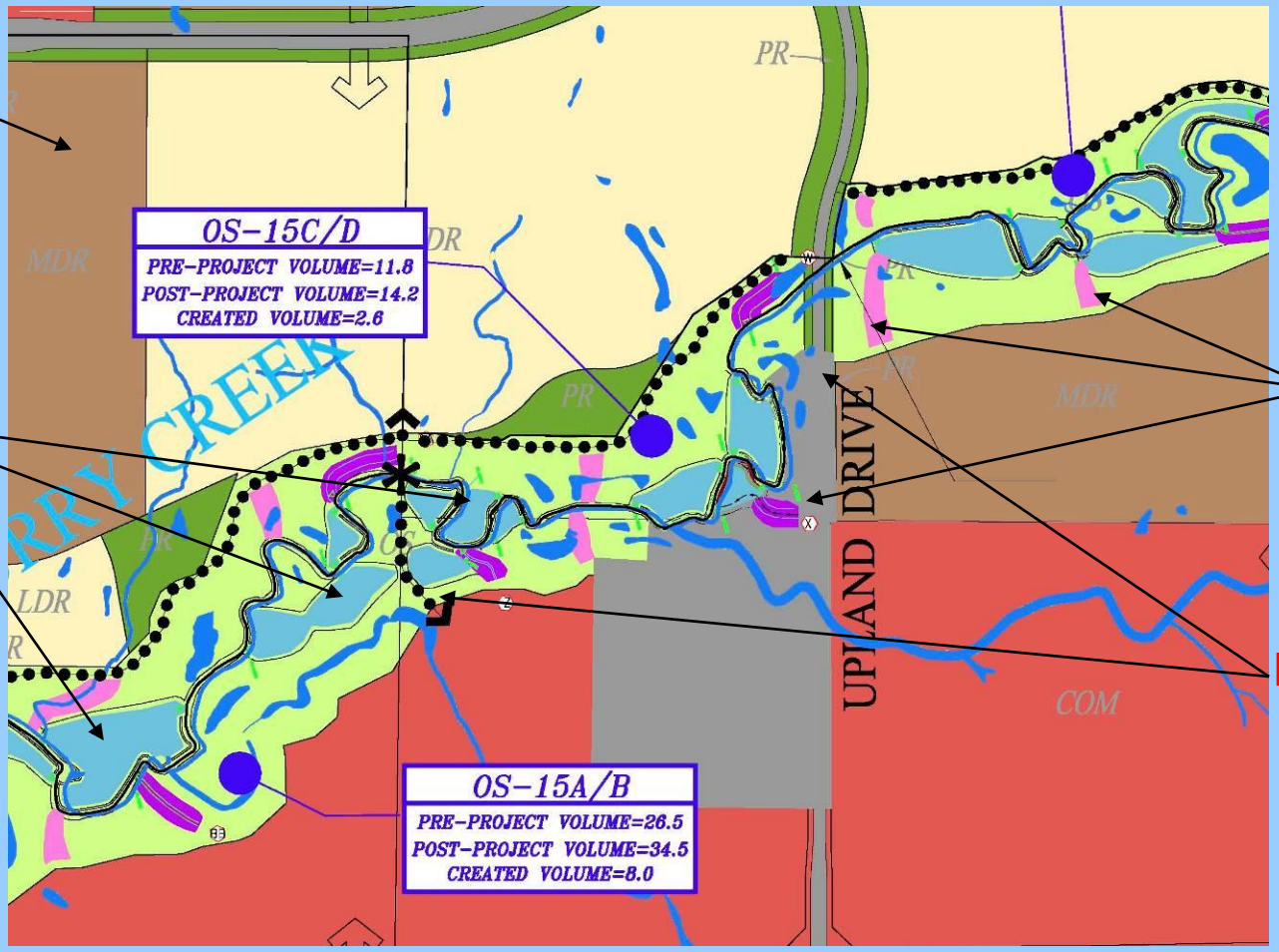
Specific Plan Hyd. Factors

LAND USE

WETLAND CREATION AREAS

WATER QUALITY SWALES

BRIDGES



Specific Plan LID Factors

- Quantified all Planned LID to Develop RVR's:

TABLE IV.B.1 – LID Required Volume Reductions (RVR)

Land Use Type:	LID 85th Percentile Event Volume Reduction from all measures except Vegetated Swales
Low Density Residential (LDR)	80.5%
Medium Density Residential (MDR)	78.6%
High Density Residential (HDR)	70.8%
Commercial	74.2%
Park	100%
Public/Quasi Public	81.6%
Roadway	71.4%

Specific Plan LID Factors

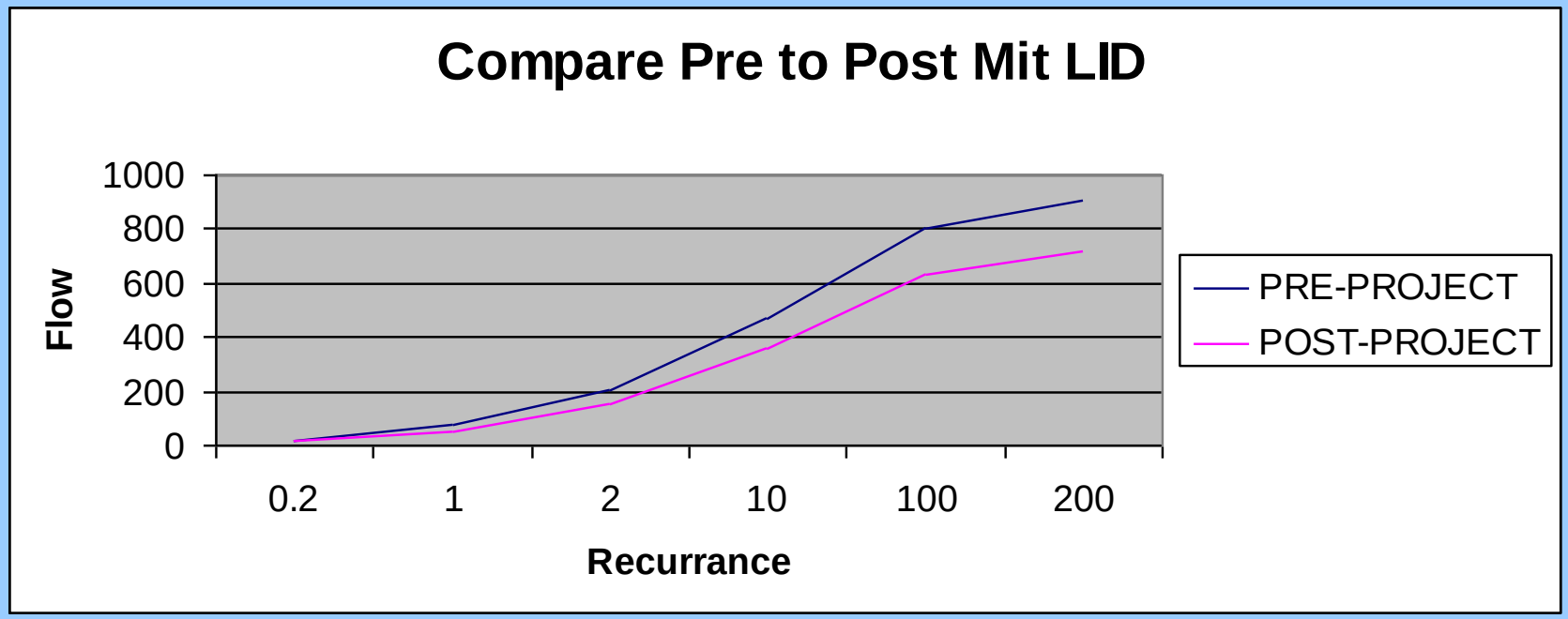
- Quantified all Planned LID to Develop RVR's:

TABLE IV.B.3 – Alternative LID Use to Achieve Minimum RVR

Land Use Type	Disconnected roof drains	Pervious or partially paved driveways & Porous pavement areas, and soil confinement	Separated sidewalks, Pavement Disconnection, and eliminated impervious paving areas (including sidewalks)	Tree Planting and Canopy Preservation ***	Soil amendments in landscaped areas & Planters (est. acreage of amendments per 100 acres of dev.)	Stream Buffer	Vegetated Swales	Required Volume Reduction (RVR) ****
LDR	* 95%	-	8%	3 per lot	1.5 ac.	-	**	80.5%
MDR	* 80%	-	8%	1 per lot	1.5 ac.	-	**	78.6%
HDR	* 50%	-	15%	1 per unit	1.5 ac.	-	**	70.8%
COM	* 50%	-	15%	20 per acre	2.0 ac.	-	**	74.2%
PARK	* 50%	-	20%	5 per acre	0.5 ac.	10%	**	100%
PQP	* 50%	-	20%	10 per acre	1.5 ac.	-	**	81.6%
ROAD	-	-	50%	10 per acre	1.0 ac.	-	**	71.4%

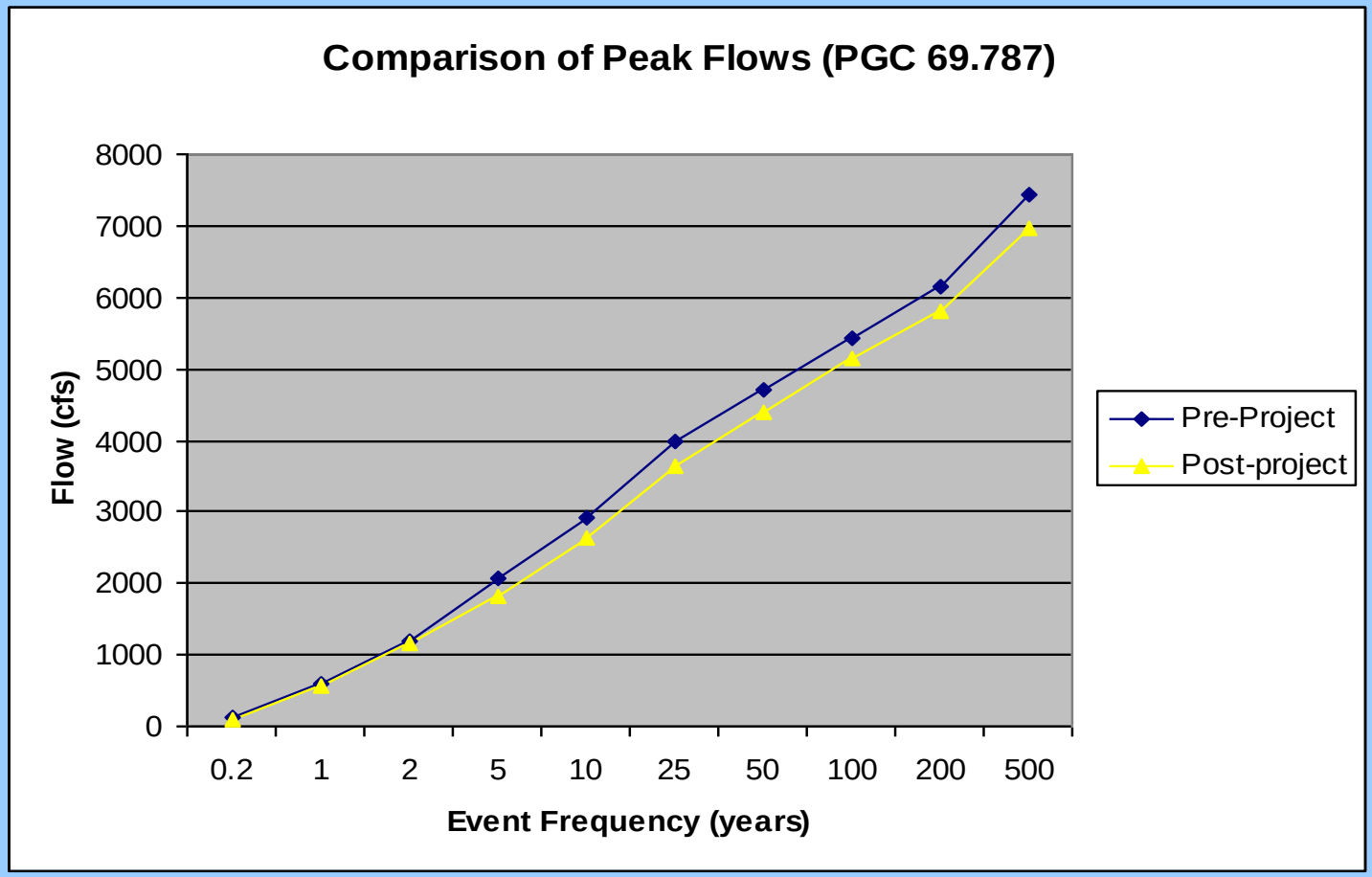
Specific Plan LID & Open Space Design Benefits

- Project 1 (small creek) - Peak Flow:



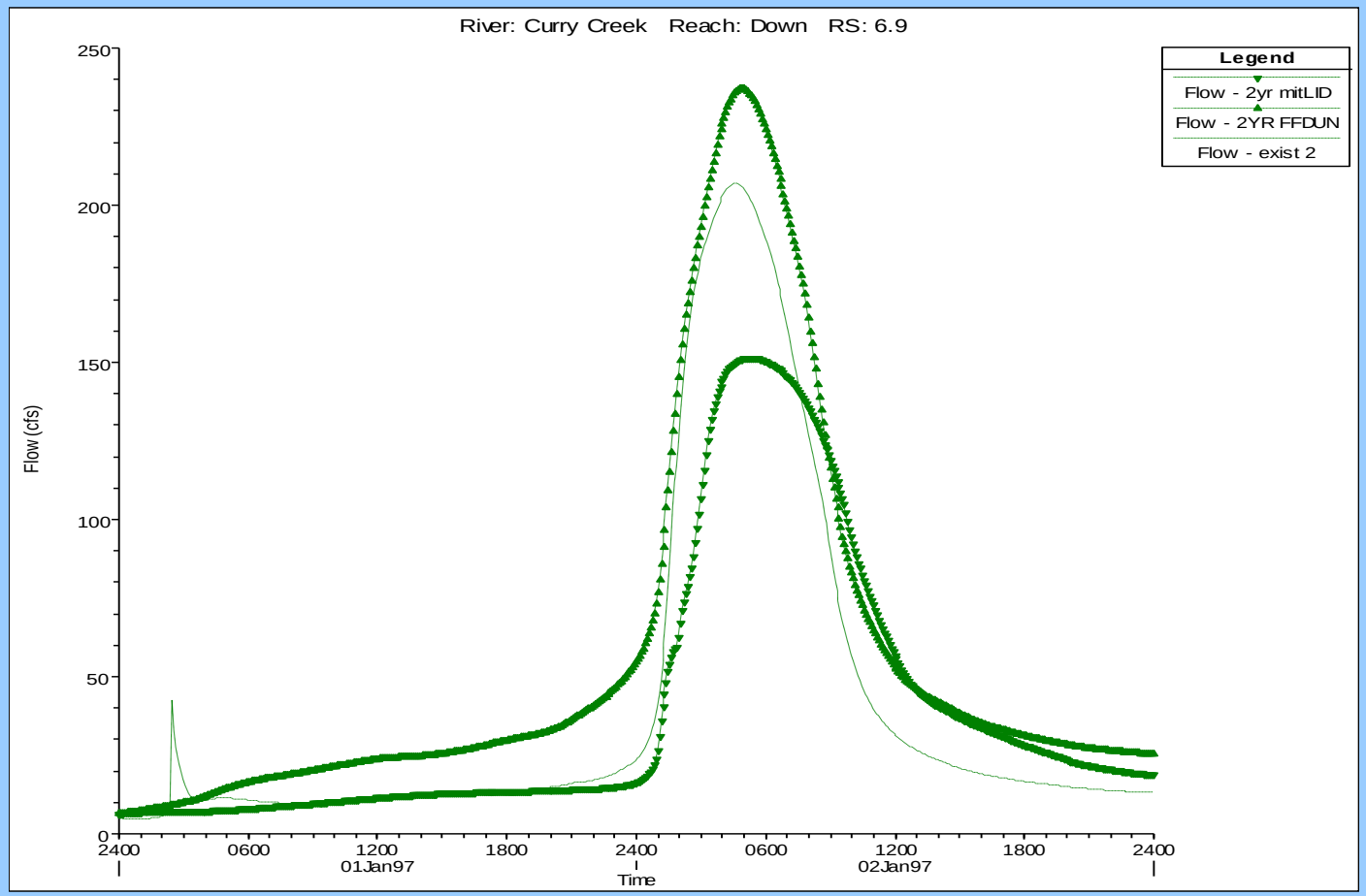
Specific Plan LID & Open Space Design Benefits

- Project 2 (large creek) - Peak Flow:



Specific Plan LID & Open Space Design Benefits

- Project 1 (small creek) – Volume-Duration Flow:



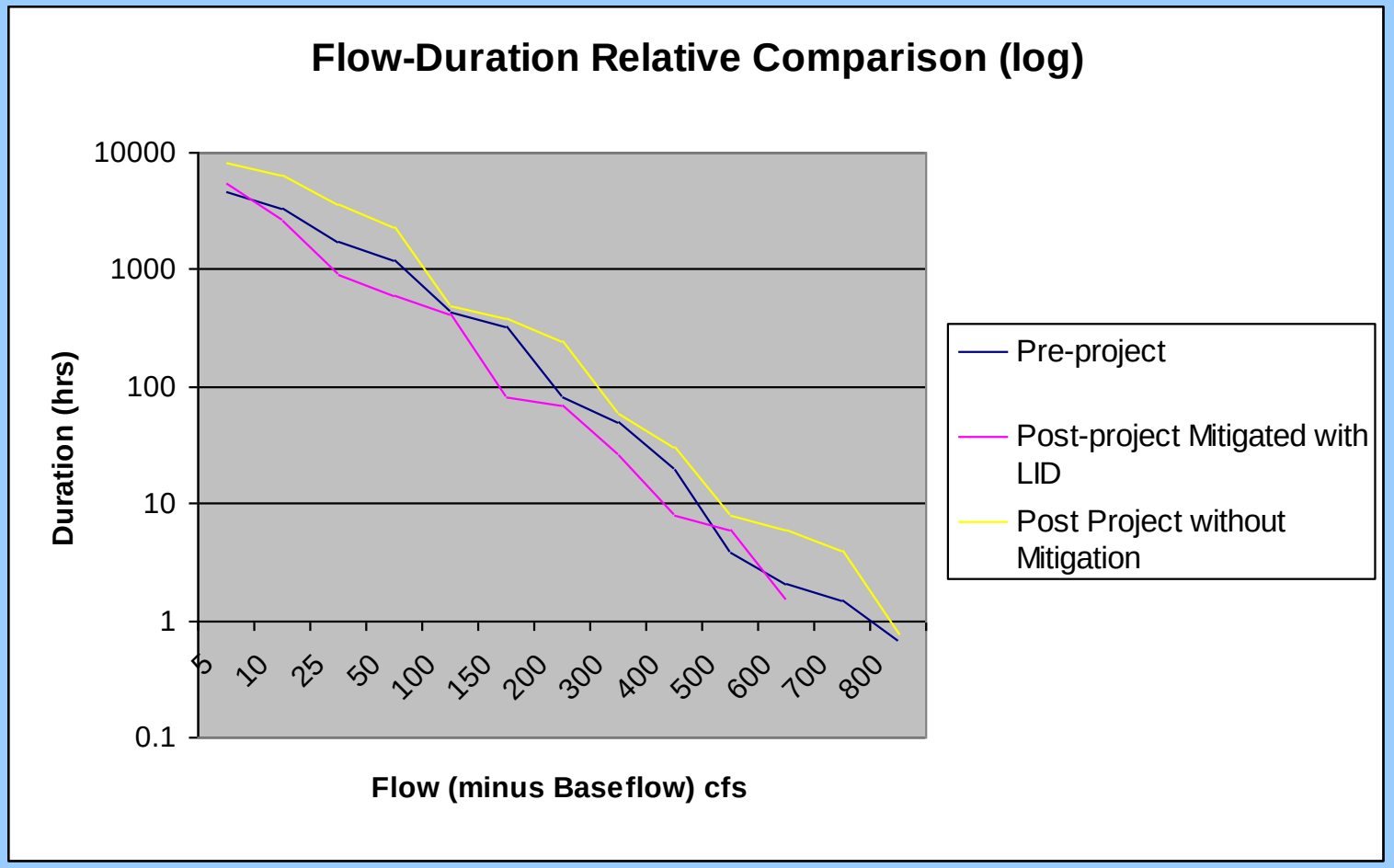
Specific Plan LID & Open Space Design Benefits

- Project 1 (small creek) – Volume-Duration Flow:

Event	48-hour Runoff Volume (AF)			Peak Flow (CFS)		
	PRE-	POST MIT LID	UN-MIT	PRE-	POST MIT LID	UN-MIT
200-YEAR	648	597	712	907	720	882
100-YEAR	600	544	663	804	632	811
10-YEAR	411	374	437	466	357	472
2-YEAR	162	156	227	207	152	237
50% of 2-YEAR	82	86	118	77	54	91
10% of 2-YEAR	28	38	40	19	13	23

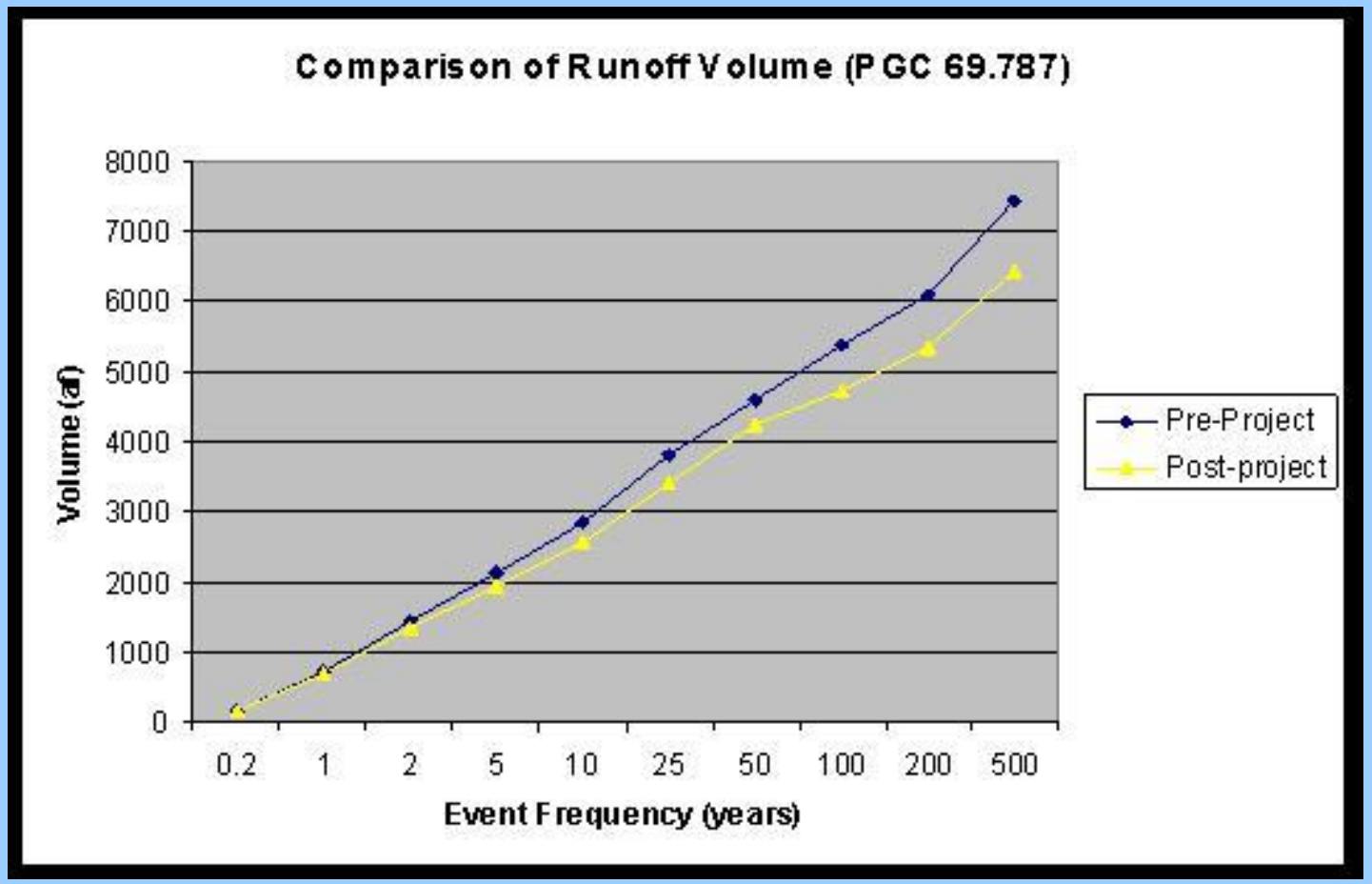
Specific Plan LID & Open Space Design Benefits

- Project 1 (small creek) – Volume-Duration Flow:



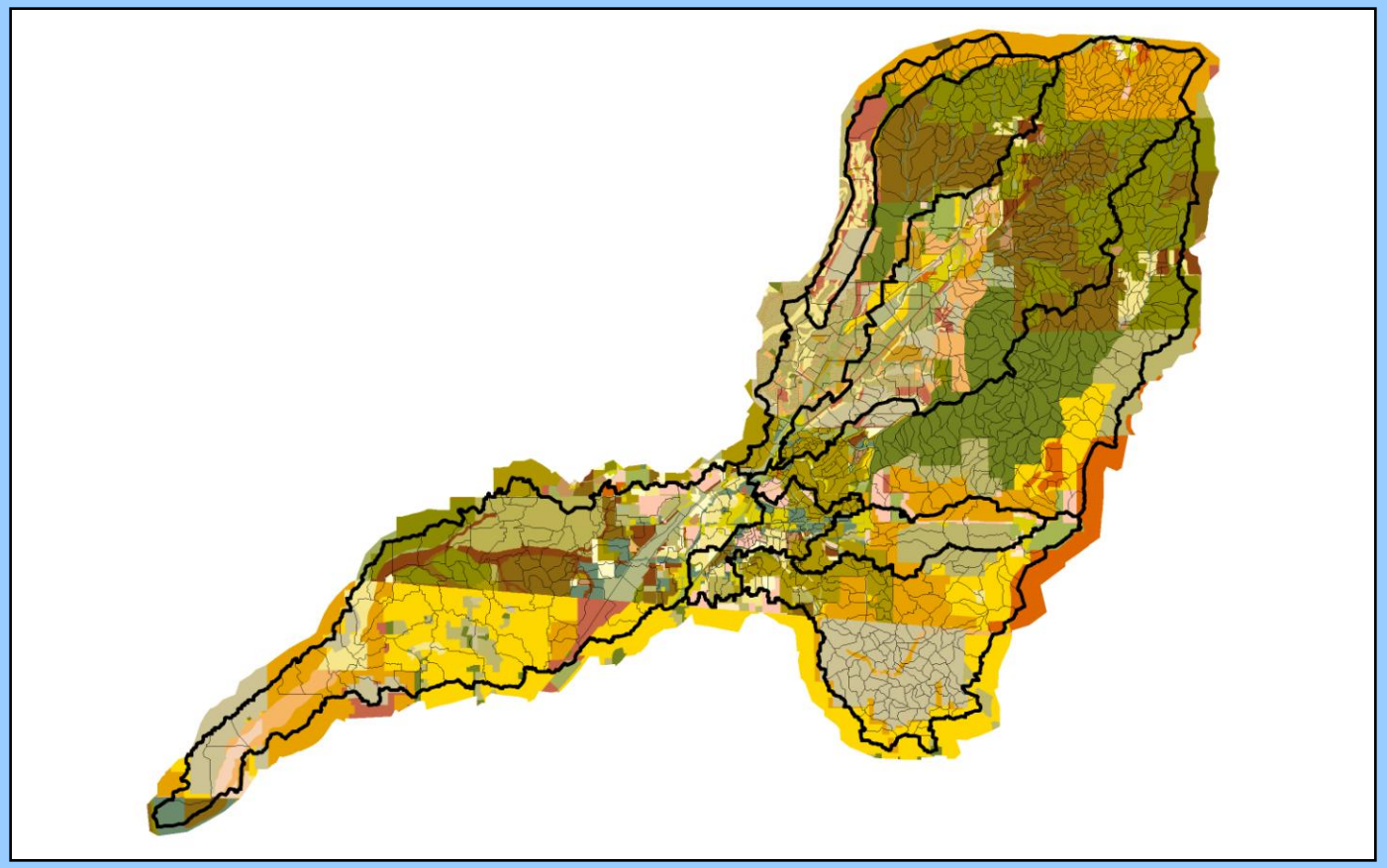
Specific Plan LID & Open Space Design Benefits

- Project 2 (large creek) – Volume-Duration Flow:



Watershed Level Analysis

- Dry Creek Watershed:



Watershed Level Analysis

- Dry Creek Watershed:
  - Comprehensive Watershed Analysis began in 1992 (so it is used as our baseline)
  - From 1992 to current conditions:
    - Approximately 50% built out relative to General Plans, and hydrologic impacts
    - LID has not been widely used within the watershed to date
    - LID is expected to be used throughout the watershed moving forward
    - PCFCWCD is currently re-studying the hydrology of the watershed, and wants to know what the impacts/benefits of the widespread use of LID may be to peak flows, hydrograph timing, and volume-duration issues.

Watershed Level Analysis

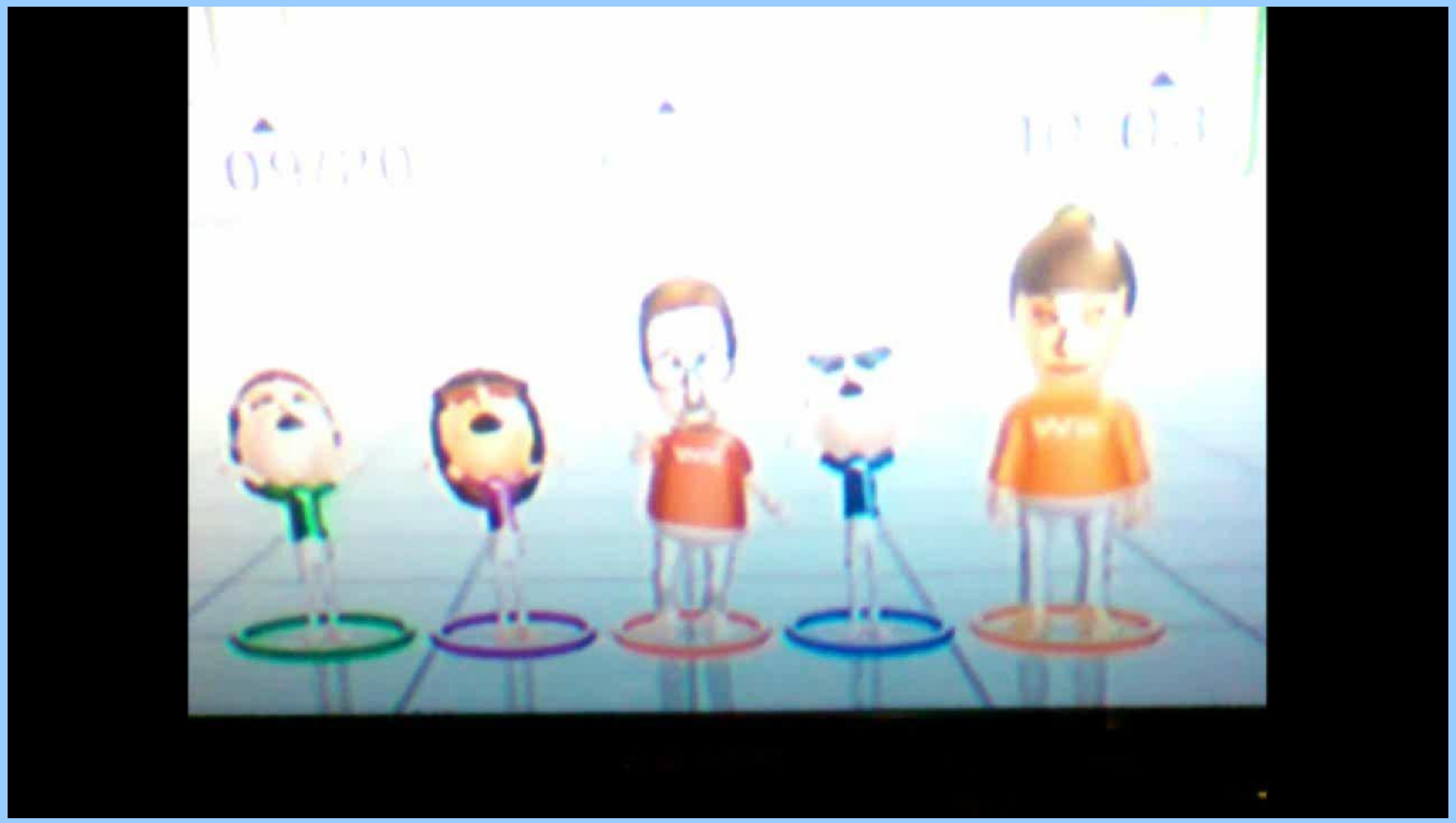
- Dry Creek Watershed Results:
  - Watershed Analysis Update nearing completion 2010 (CESI/RBF):
    - Assumed:
      - a 50% RVR would be applied on average
      - Development runoff timing would not be affected
    - Results:
      - Benefits to offsetting Peak Flow Increases of between 13% and 50% of the impact of the development will be obtained through widespread use of LID.
      - No adverse timing impacts were noted as benefits were widespread and dependant on how much development was occurring in each sub-shed.

Limitations

- Soils Conditions are very important:
  - Results are only applicable where:
    - Saturated soils maintain hydraulic conductivity:
    - No underlying soils cause a “back pressure” and reduce/eliminate infiltration
    - Groundwater is not high enough to affect infiltration
  - Example where it would not be applicable:
    - Natomas Basin: High groundwater and soils conditions are known to reverse the infiltration conditions in some storm events and actually produce more runoff than actually rains within the basin.

End of Presentation

- Final Relative Difference Analysis:



End of Presentation

- Questions?