County Capital Improvements Program (CIP)
Cost & Schedule Estimates
Transportation-Road Projects

Department of Transportation

August 5, 2008

CountyStat

CountyStat Principles

- Require Data-Driven Performance
- Promote Strategic Governance
- Increase Government Transparency
- Foster a Culture of Accountability

Agenda

- Welcome and Introductions
- Goals of Initial CountyStat Involvement
- CIP Road Project Process
  - Process Overview
  - Cost Estimating
    - Comparison of Escalation Methodology (OMB, OLO, and FWHA)
    - Inflation Indexes Used by Other AAA-Rated Jurisdictions
  - Schedule Estimating
  - Relationship Between Project Scheduling and Cost Estimating
  - Areas for Improvement
    - Facility Planning
    - Project Monitoring
- Follow-up items
- Wrap-up

Goals of Initial CountyStat Involvement

- **CountyStat approach**
  - Assess current Capital Improvement Program (CIP) estimating process for road projects
  - Analyze cost estimation methodology
  - Analyze schedule estimation
  - Identify the relationship between costs and scheduling
  - Determine areas for improvement

This is the first of to be regularly scheduled CIP meetings. Moving forward, CountyStat will examine cost and time associated with the CIP program in order to determine where efficiencies can be implemented.

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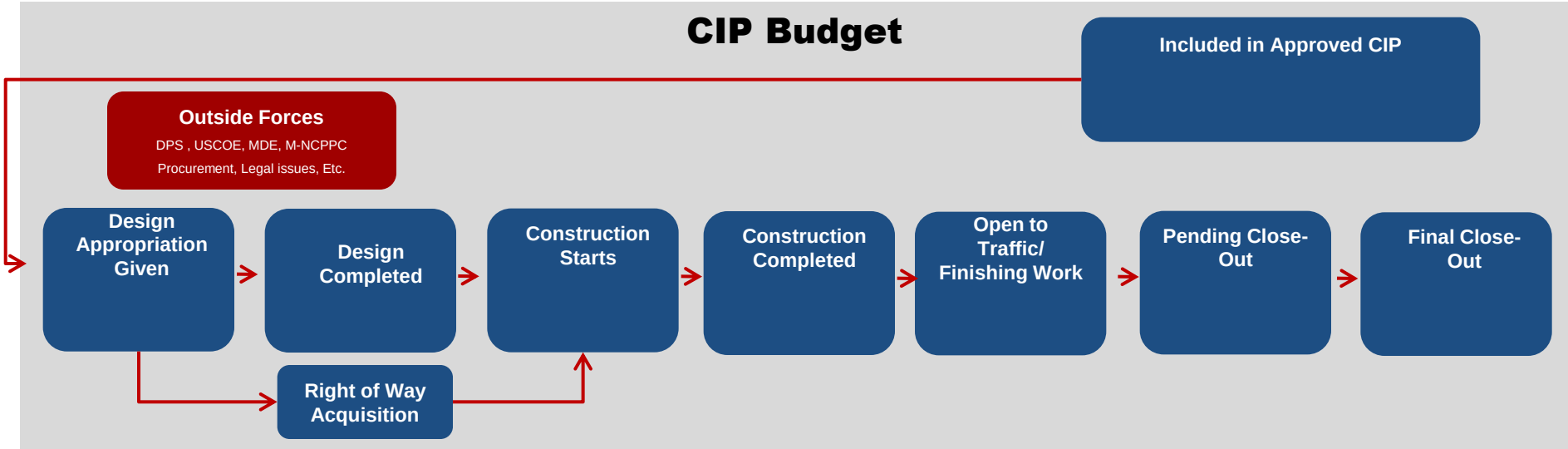
CIP Road Project Process: Overview



Source: County Executive's FY09 Recommended Capital Budget and FY09-14 Capital Improvement Program (CIP) January 2008, p. 4-3 (adapted)

CIP Road Project Process: Facility Planning

Phase 1: Conceptual Planning

- Determine project need and features
- Identify environmental and social impacts
- Identify design options and alternatives
- Produce concept plans
- Investigate preliminary impacts:
  - Traffic, environment, community, noise, historical, etc.
- Recommend preferred alternative

Phase 2: Preliminary Design

- Develop 35% project design
- Develop stormwater management and sediment control management plan
- Determine environmental and noise impacts and mitigation measures
- Estimate land acquisition and utility relocation costs
- Establish preliminary cost estimates and possible schedules

Project Abandoned

Continue to Phase 2

By the end of Phase 2, a project has completed approximately 35% of design and refined the cost and schedule estimates that become part of the CIP.

CIP Road Project Process: Cost Estimating Methodology

Estimate of Unknown Contingency

40%+/-

35%+/-

20%+/-

10%+/-

- **Order of Magnitude Cost Estimates**
  - Quick analysis of alternatives where there is little other information
  - Based on best available information and historical linear foot or square foot costs
- **Conceptual Cost Estimates**
  - Basic alignments and general consensus on type of structures, etc. are known
  - Based on conceptual plans on topographic maps, and historical linear foot or square foot costs
- **Preliminary Cost Estimates**
  - Actual field and aerial surveys, and prepared (35%) preliminary plans and plats
  - Based on actual alignments with most features, and the right-of-way plats have computed preliminary areas to be acquired
  - Based on actual preliminary quantities and the most closely related unit prices
- **Final Cost Estimates**
  - Based on the 100% final plans and plats
  - Refined alignment features; permits acquired; utility impacts, property acquisitions completed or in “quick take”; detour routes established; etc
  - Right-of-way plats been adjusted to take into account these extra items
  - Based on 100% final quantities and the most closely related unit prices

The level of contingency needed decreases as design is finalized and the number of unknowns decreases.

Source: United States Department of Transportation - Federal Highway Administration

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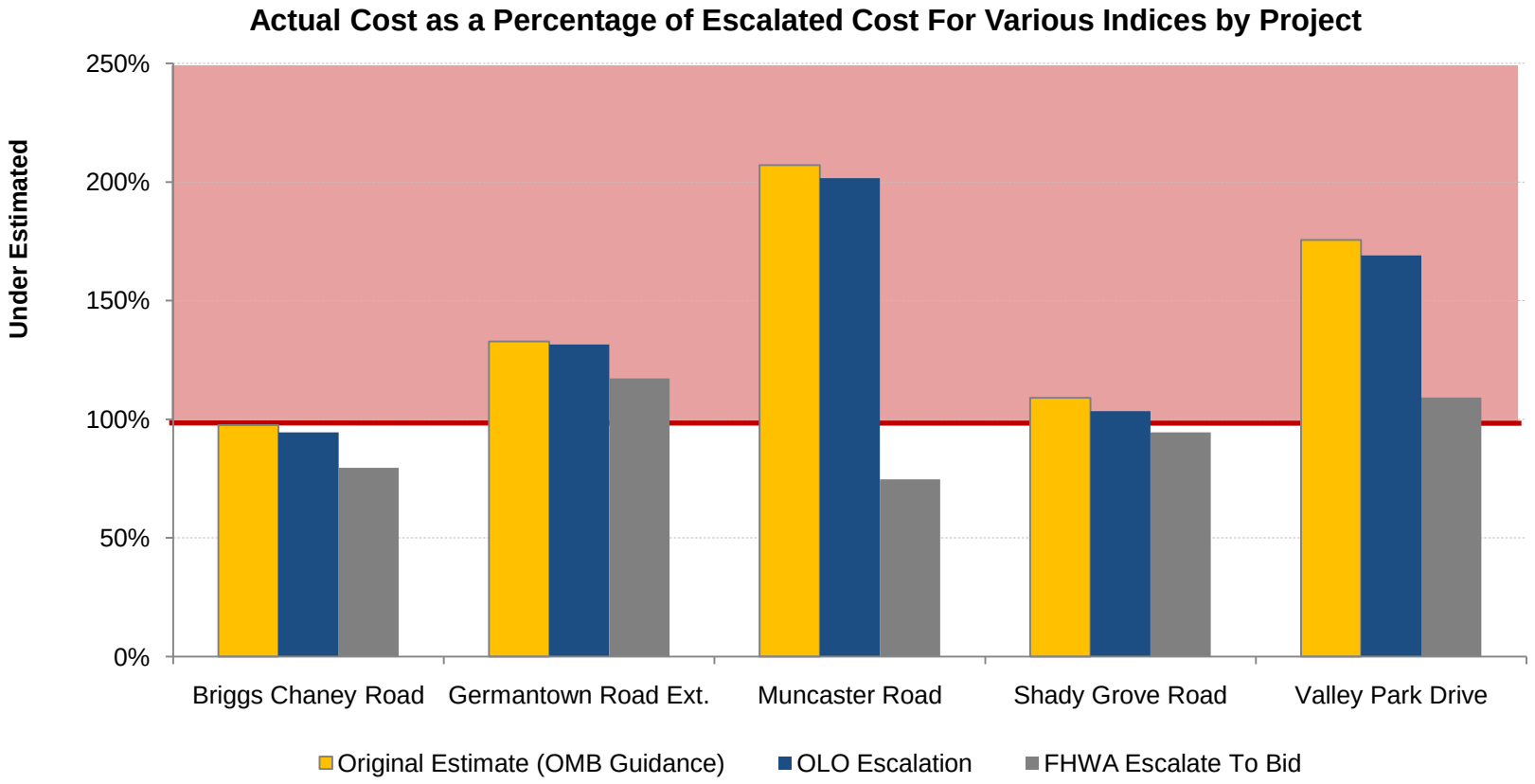
Cost Estimating: Comparison of Escalation Methodology

- **OMB Methodology for Cost Escalation**
  - Past CIP guidance
    - Consumer Price Index (CPI) rates estimated by Finance are used as a guideline
    - Escalated to year 2 of the 6-year program
    - Inflationary factors should be applied as appropriate to project expenditures (*for contracts that have not yet been awarded*)
  - FY09 CIP guidance
    - CPI rates estimated by Finance are used as a guideline
      - Standard inflation rates for the FY09-14 CIP were 2.8% for FY09 and 2.7% for FY10
      - In development of the FY09-14 CIP, road projects were inflated 5-7% annually to the first year of construction
    - Escalated to year 2 of the 6-year program
    - Inflationary factors should be applied as appropriate to project expenditures (*for contracts that have not yet been awarded*)
    - Departments can use "extraordinary" inflation rates (i.e. adjustments needed due to current market environment)
- **OLO Methodology for Cost Escalation**
  - Utilized a composite of the following indexes to determine escalation of different cost elements
    - Engineering News-Record (ENR) Construction Cost Index for the Baltimore Region: Construction element
    - U.S. Bureau of Labor Statistics, Consumer Price Index (CPI-U) for Washington-Baltimore Region:
    - Land Price Escalation (10% year):
- **Federal Highway Administration (FHWA) Methodology for Cost Escalation**
  - Utilized a composite bid price index to determine escalation of construction cost element

Cost Estimating: Comparison of Escalation Methodology

Recently Completed Road Projects



An accurate cost estimate is one which mirrors the actual costs of the project i.e. 100%, If the actual cost is greater than the escalated cost than the project cost was under estimated.

Cost Estimating: Comparison of Escalation Methodology

Pros

- **OMB**
  - FY09 CIP
    - CPI rates estimated by Finance are a guideline
    - Departments can use discretion based on "extraordinary" inflation rates and current market conditions
- **OLO**
  - Uses actual inflation costs that occurred to determine accuracy of original estimate, if given complete information
  - Uses separate indexes for each cost element
- **FHWA**
  - Index concentrates on the construction cost element specifically for roads which represent 60-70% of the costs associated with a road project

Cons

- **OMB**
  - OMB offers guidance but implementation varies by project
  - Ability to perform comparative analysis of projects is limited
- **OLO**
  - Asphalt is the major material used in construction of roads and is not fully represented by the ENR index used to escalate the construction cost element
  - Assumes 10% land cost escalation per year
- **FHWA**
  - Significant data quality issues
  - FHWA officials are concerned about reliability of bid price data due to underreporting and self-reporting
  - Data collection for the index may be discontinued in the near future
  - Does not take into account escalation of planning, design, site improvement, utilities, and land

Cost Estimating: Inflation Indexes Used by Other AAA-rated Jurisdictions

Jurisdiction	Inflation factor used in budgeting road projects	FY09 Transportation
Montgomery County, MD*	FY09-14 CIP, projects were generally inflated 5% annually to the mid-point of construction (with some variation)	$174,465,000
Prince Georges County, MD	Does not use an escalation rate, recalculates yearly based on current costs	$65,350,000
Fairfax County, VA	Between 3.5-4% to the mid-point of construction	$247,341,000
Howard County, MD	Uses State Highway Authority as a base 5-6%	$47,097,000

*Two year CIP budget cycle

DOT needs to coordinate with OMB and other parties to determine the optimal method for determining cost estimates.

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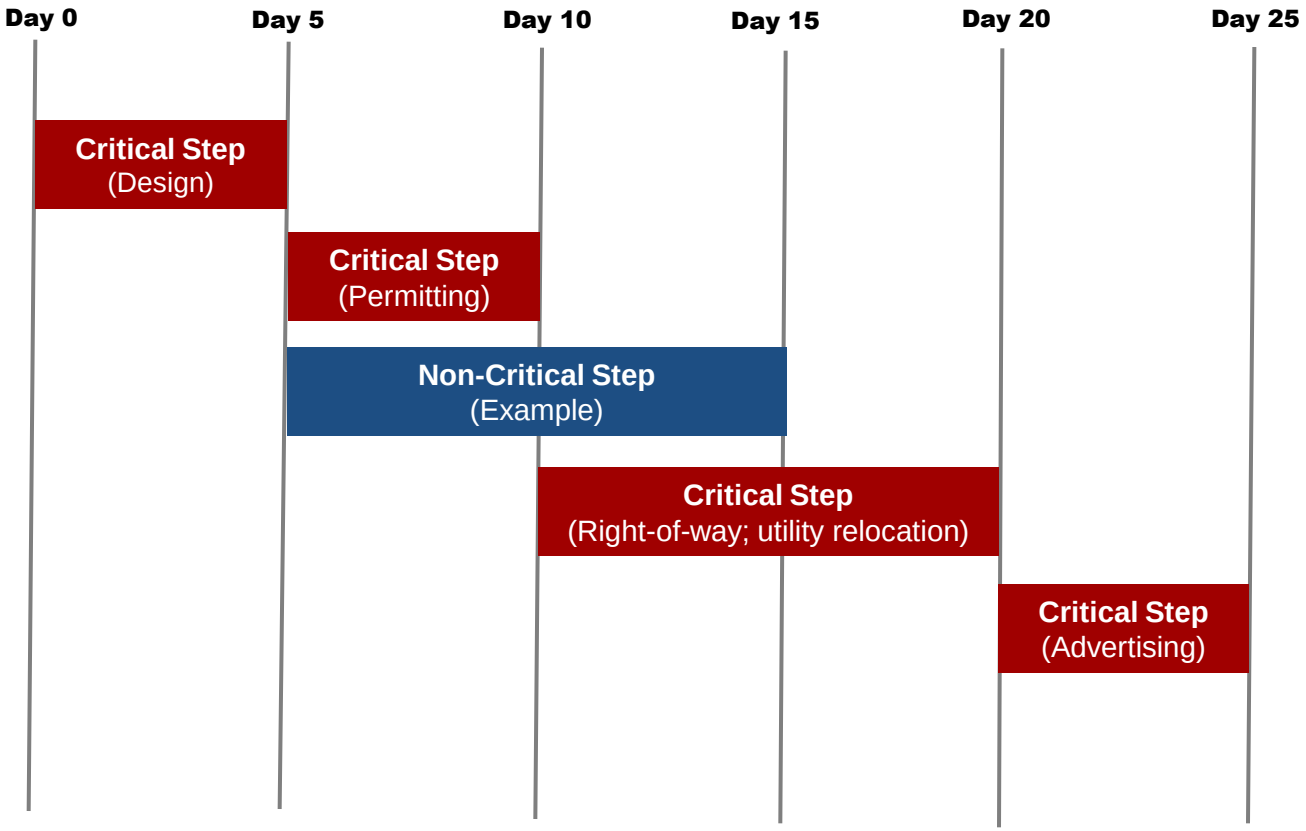
Project Scheduling: Definitions

- **Project Description Form (PDF) - a document in the CIP which provides information on:**
  - Project number, title, estimated expenditures, funding schedules, annual operating budget impact, description, justification, etc.

- **Year first appropriated – the year money was earmarked for a project to begin in the original PDF**

For the purpose of CountyStat meetings and measuring DOT time estimates, project scheduling estimates begin at the date of first appropriation in the original Project Description Form (PDF)

Project Scheduling: Critical Path Model



The critical path is the longest sequence of activities in a project plan. An activity on the critical path cannot be started until its predecessor activity is complete; any delay will create subsequent delays.

Project Scheduling: Analysis of Overall Delays

Current Projects	Estimate based on Year Money is Appropriated in Original PDF	FY08 Estimate	Original PDF and FY08 Estimate Difference	Cause for Delay
Burtonsville	4 Years	6 Years	2 Years	Coordination with DHCA
Citadel	3 Years	6 Years	3 Years	Retaining wall on WMATA property, relocate 66" water main
Fairland	6 Years	6 Years	0 Years	Coordinated utility relocation with construction resulted in zero delay
Greencastle	4 Years	6 Years	2 Years	Change scope to add bike path length, underground SWM, coordinate with developers
Montrose	7 Years	7 Years	0 Years	6 month delay for permit acquisition
Nebel	3 Years	7 Years	4 Years	Property acquisitions involving existing buildings
Redland	3 Years	11 Years	8 Years	Scope change re: reversible lanes, dam retrofit
Stringtown	5 Years	5 Years	0 Years	Coordination with developers, relocation of historical marker, intersection construction
Woodfield	5 Years	11 Years	6 Years	Change consultant, scope change, environmental permitting, historical conflicts

Delays can occur outside of the critical path and impact the project schedule. Moving forward, monitoring these delays and those that occurred in critical path steps will be the subject of regular CountyStat meetings

Project Scheduling: Analysis of Critical Path Delays

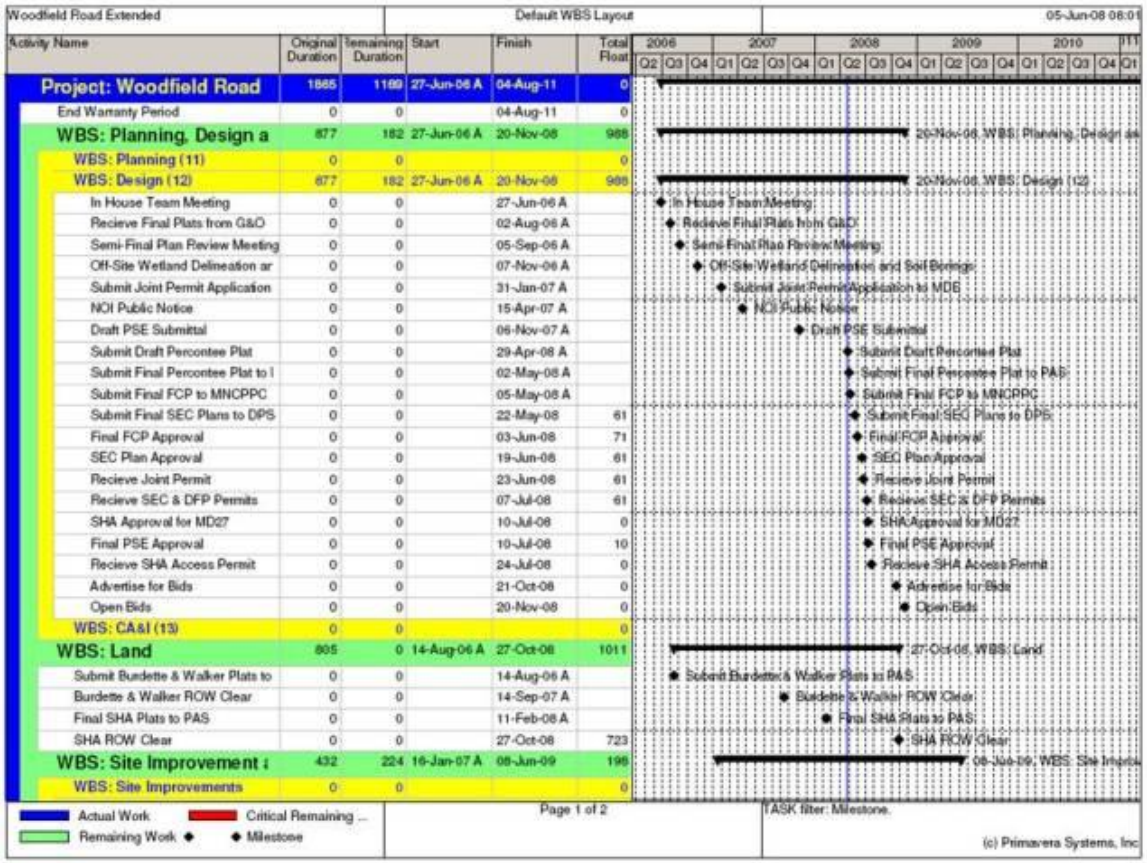
Current Projects: Number of Days Off Schedule from Projected Date

	Projects in Design		Property Acquisition	To Be Advertised	Under Construction				
	Burtonsville Access Road	Woodfield Road	Nebel Street	Redland Road	Fairland Road	Greencastle Road	Montrose Parkway	Stringtown Road	Citadel Avenue
Present Cost Estimate	$ 6,252,000	$ 11,443,000	$ 12,011,000	$ 4,965,000	$ 10,945,000	$ 3,507,000	$ 68,135,000	$ 8,810,000	$ 5,407,000
Final Plans/Specs & Estimate (100%)	204	0	0	0	0	25	0	0	-420
Advertise for Bids	0	111	0	58	0	-18	0	0	-88
Right-of-Way Clear	0	125	0	0	0	8	168	27	180
Utility Relocation	0	165	0	201	0	0	0	0	0
Permitting Total	0	881	0	0	0	0	137	137	0
Start Construction	0	95	0	78	162	0	0	0	5

The critical path does not account for all schedule delays. DOT should determine how to document total delay and disaggregate based on cause i.e. community input, weather, court challenges, unforeseen permitting issues, etc.

Source: Report, Capital Improvement Program FY08 Progress Ending 04/08
Note: Five of the projects analyzed by OLO do not have data in the current project management tracking system and are not represented here

Project Scheduling: DOT Project Management



DOT's new project management software (Primavera) tracks and analyzes project schedules and will facilitate improvements to DOT's schedule estimating.

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    - DOT Follow-Up
    - Inflation Indexes Used by Other AAA-Rated Jurisdictions
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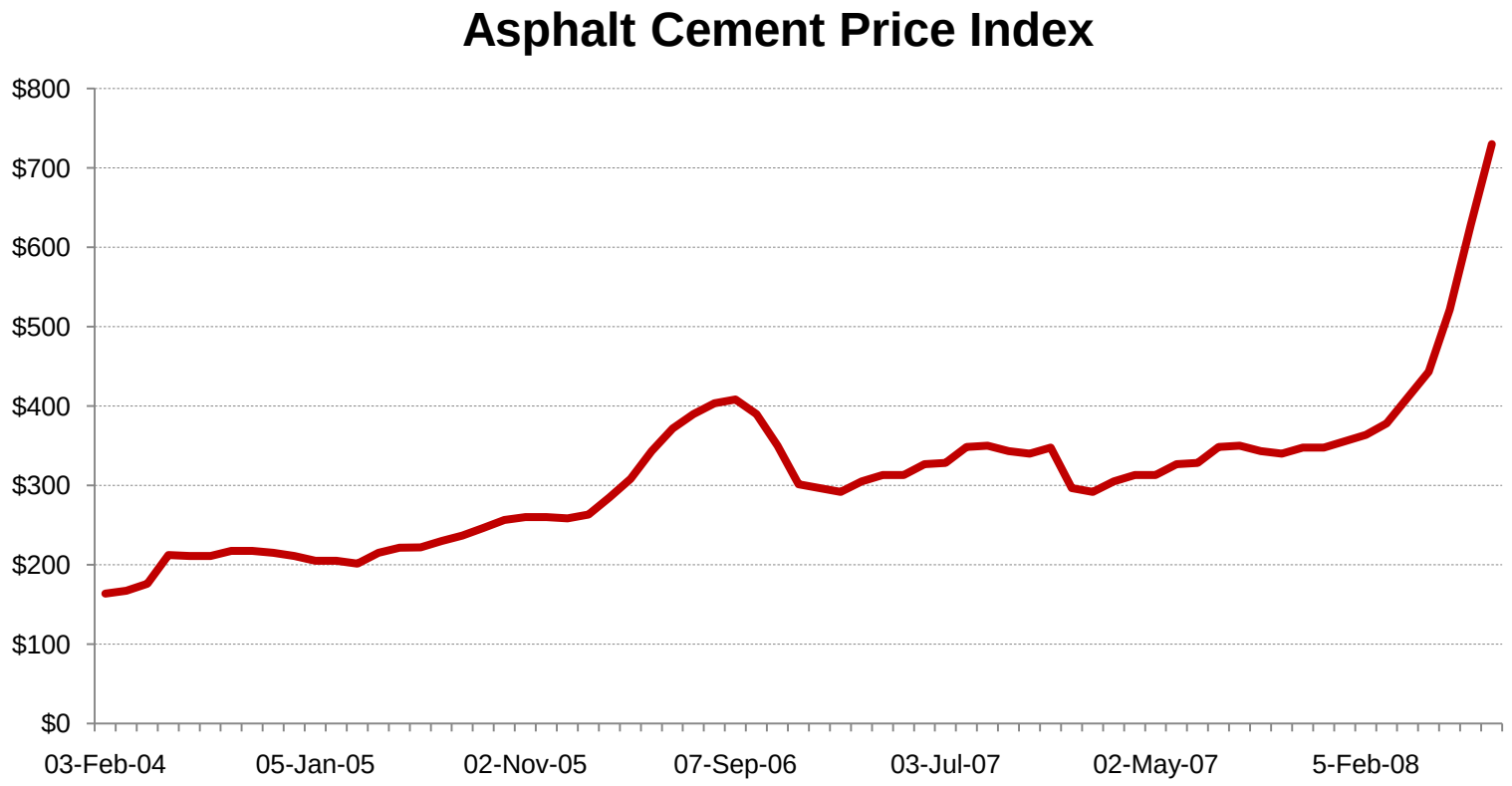
Relationship Between Project Scheduling and Cost Estimating: Cost of Delay

- **Cost of delay**
  - Prior to construction, the cost of delay is escalation
    - For each $1,000,000 at 5%
      - One year delay = $50,000
      - One month delay = $4,167
      - One week delay = $1,000 (approximately)
  - During construction
    - Owner-caused delay adds direct costs to contractor price
      - Field office overhead
      - Extended home office overhead
      - Escalated material and fuel costs
      - Idle crews and equipment
      - Remobilization
    - Contractor-caused delay results in contractor paying owner liquidated damages

The County can best achieve cost savings by limiting project duration through identification of process efficiencies.

Relationship Between Project Scheduling and Cost Estimating: Construction Cost Escalation



Even minor scheduling delays have a significant impact on construction costs.

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Identified Areas for Impacting Time

- **Determine the optimal level of facility planning**
- **Project monitoring**

Areas for Improvement: Facility Planning Categorization

- OLO recommended that projects go through facility planning in order to minimize delays in scheduling and cost estimation
- DOT believes that Facility Planning Phase 1: Concept Design can be eliminated for some simple projects
- CountyStat has worked with DOT to categorize their road projects into groups based on complexity
- This grouping can help determine what extent of facility planning is necessary
  - Simple projects – No Facility Planning Phase 1
  - Intermediate projects – Some Facility Planning Phase 1
  - Complex projects – Extensive Facility Planning Phase 1

Area for Improvement: Facility Planning

Correlation between Facility Planning and accuracy of cost and schedule estimates

Cost Estimates

	All Projects	Completed Facility Planning	Not Completed Facility Planning
Average Cost Increase (Constant dollars)	**54%**	**28%**	**80%**
Average Cost Increase (Adjusted for Inflation)	**42%**	**12%**	**72%**

Schedule Estimates

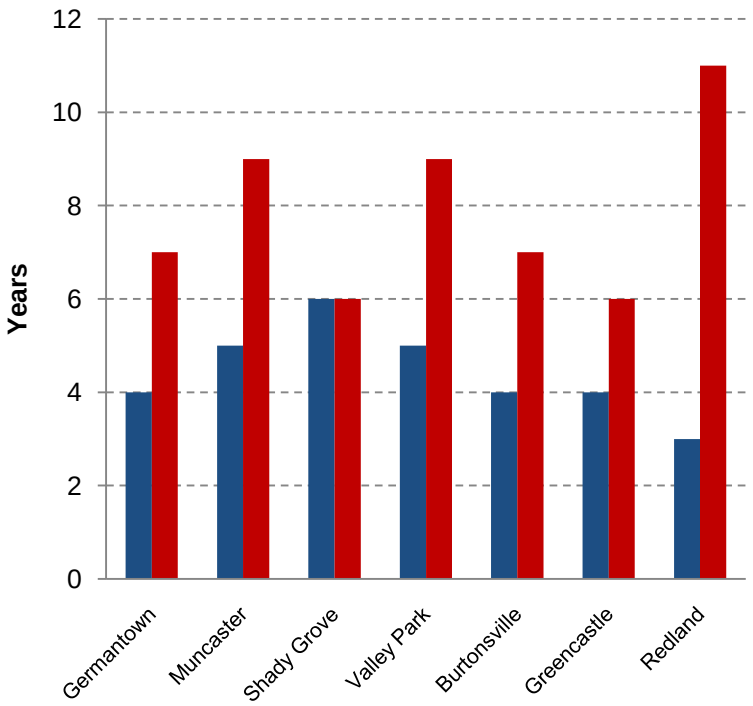
	All Projects	Completed Facility Planning	Not Completed Facility Planning
Average Delay Beyond Initial Schedule	**2.8 years**	**2.1 years**	**3.4 years**

Road projects that complete facility planning have more accurate initial cost schedule estimates, and shorter delay periods than projects that do not complete facility planning.

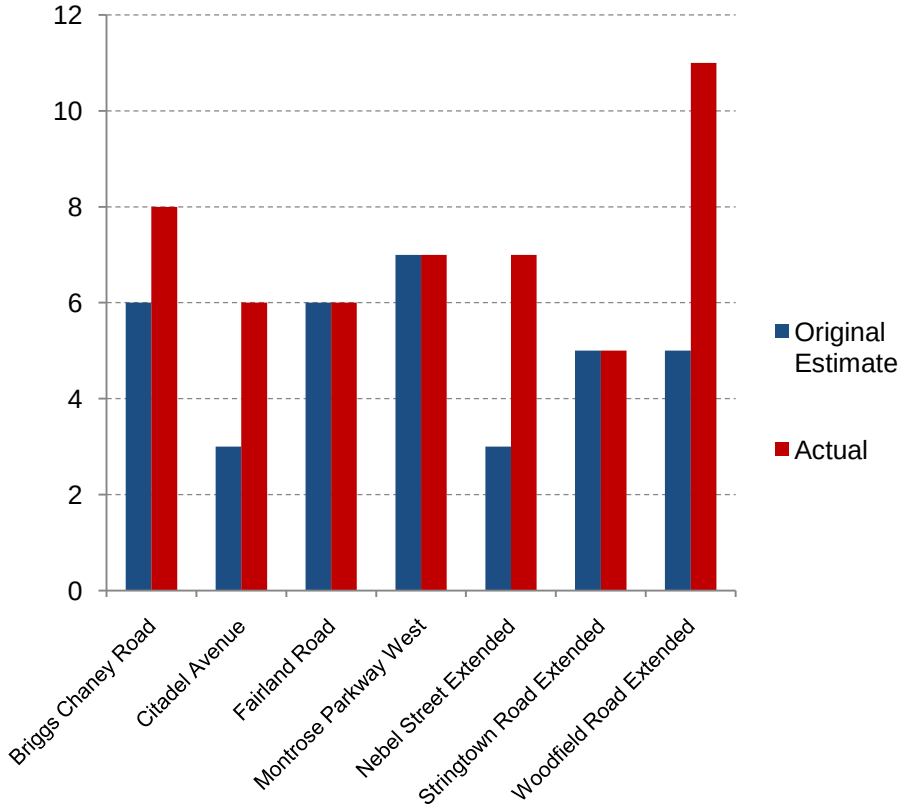
Source: OLO Report 2008-4 "A Study of County Road Project Cost and Schedule Estimates

Area of Improvement: Facility Planning

Comparison of Original Estimate and Actual Years to Completion for Projects that Did Not Complete Facility Planning



Comparison of Original Estimate and Actual Years to Completion for Projects that Completed Facility Planning



Projects completing Facility Planning are more likely to be completed on schedule.

Source: OLO Report 2008-4 "A Study of County Road Project Cost and Schedule Estimates

Areas for Improvement: Facility Planning Categorization

- **Time**
  - Facility Planning takes 8 months to 2 years to complete
- **Cost versus Benefit**
  - Cost of Facility Planning stage 1: Concept Design yields minimal additional benefit for simple projects, the benefit increases with project complexity
- **Purpose and Need**
  - There is no need for an extensive Purpose and Need Document for very obvious projects

The costs and benefits of Facility Planning vary by project type.

Areas for Improvement: Facility Planning Categorization

FY 09 Project

Project Criteria

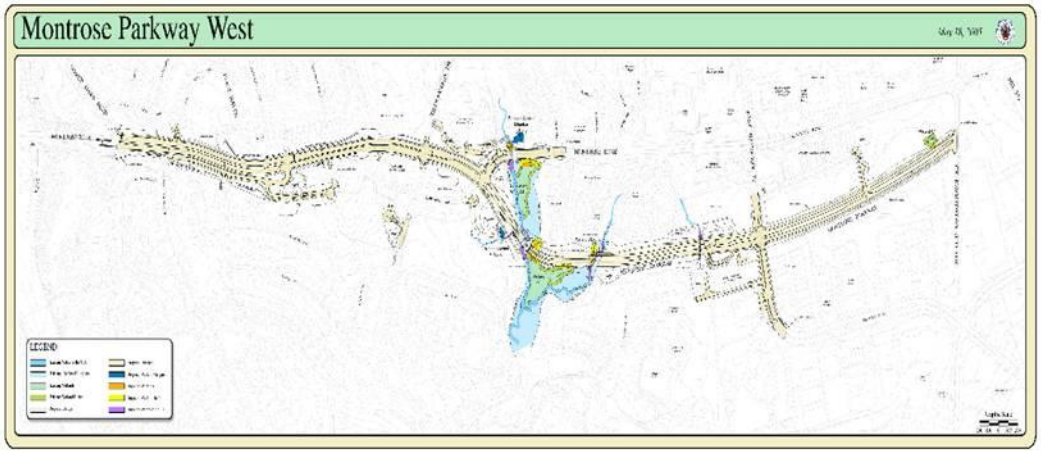
	Project Length	Complexity of Topography	Environmental & Historic Permits	ROW Requirements	Utility Relocation	Location	**Facility Planning Category**
Locbury Drive			X				Simple
Central Avenue Sidewalk						X	Simple
MD 355 Sidewalk		X	X	X	X		Intermediate
Oak Drive/MD 27 Sidewalk		X	X	X	X		Intermediate
East Gude Dr Widening	X	X	X		X	X	Complex
Bradley Boulevard Bikeway	X	X	X	X	X		Complex

DOT is in the process of formalizing Facility Planning categorization into the standard operating procedures.

Simple Project
Locbury Drive

Intermediate Projects
Seminary Road

Complex Projects
Montrose Parkway West



Area for Improvement: Project Monitoring (*Under Development*)

- Participate in quarterly briefing meetings with the CAO to provide status reports on cost and scheduling issues
- Allow for executive level monitoring and problem solving

Preliminary Criteria

	Cost/Scheduling				
Road project	**Original Cost**	**Original Time Estimate**	**Current Cost Estimate**	**Current Schedule Estimate**	**Reasons for Variation**
Hypothetical Project 1					
Hypothetical Project 2					
Hypothetical Project 3					

SAMPLE

Proposed DOT framework would monitor and report project cost and schedule information to CAO.

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Follow-up Items

- **Cost estimating**
  - DOT will coordinate with OMB and other parties to determine the optimal method for determining cost estimates.
- **Project scheduling**
  - Identify efficiencies in:
    - Land acquisition in right-of-ways
    - Permitting
    - Procurement
    - Utility relocation (Memoranda of Understanding (MOU) with Utilities)

Wrap-Up

- Confirmation of follow-up items
- Time frame for next meeting