Flexibility in Real Estate Project Development

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Cover Story

- Case investigates two general questions in real estate development strategy:
  - Is it worth investing upfront to acquire particular infrastructures (e.g. a park, utilities, etc.)?
  - Is flexibility in expansion timing worthwhile?
- Particular instance studied:
  - Development of apartment units around a park

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Apartment Development Project

- Development of apartment units around a park
  - Five phases, 24 months each, start in 2007
  - All units 1000 SF each
 - Market value represents NPV (at 9% discount rate) of all revenues once phase is completed

Phase	Type	SF	Units	Net Acreage	Start	Completion
I	APT	50,000	50	1.15	1/07	1/09
II	APT	80,000	80	1.84	1/08	1/10
III	APT	90,000	90	2.07	1/09	1/11
IV	APT	110,000	110	2.53	1/10	1/12
V	APT	100,000	100	2.30	1/11	1/13
Total		430,000	430	9.87		

Static Case

- Key Assumptions
  - <u>Deterministic forecast</u> for market value of built property currently evaluated at $350/SF -- increases at 2.5% per year
  - <u>Deterministic forecast</u> for development costs currently evaluated at $220/SF -- increase with inflation at 2.5% per year
  - Development of all phases in a row benefits from cost reductions of 2.5% due to <u>economies of scale</u>
  - <u>Discount rate</u> for market value of built apartment property (r_V) is 9%, and for construction costs (r_C) is 6%, close to currently prevailing risk-free rate

Static Case

- Market value of built property and development cost models
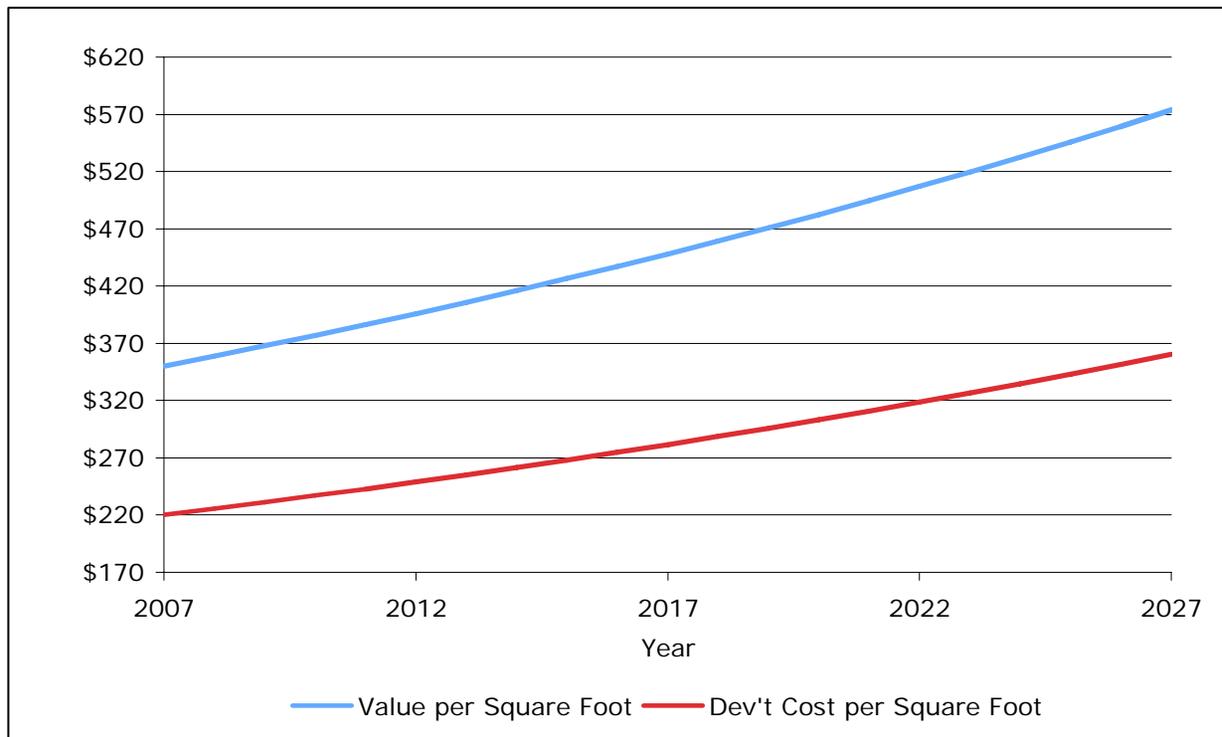
Static Case

- Assumptions:
  - Park area is about 50,000 SF (1 acre) and costs $1M to develop along with the five development phases.
  - Cost is distributed to each phase as $200,000 each.
  - Land acquisition costs $15M, paid when phase I begins
 - Infrastructure development, which includes site grading, paving, utilities, and landscaping is estimated at $29/SF

Static Case

- ## Pro Forma Discounted Cash Flow (DCF) model

| Year	2007	2008	2009	2010	2011	2012	2013
Period	0	1	2	3	4	5	6
Built property value per SF ($)	$350	$359	$368	$377	$386	$396	$406
Dev't cost per SF ($)	$220	$226	$231	$237	$243	$249	$255
Phase I value	$0	$0	$18,385,938	$0	$0	$0	$0
Phase I dev't cost	$10,725,000	$0	$0	$0	$0	$0	$0
Phase II value	$0	$0	$0	$30,152,938	$0	$0	$0
Phase II dev't cost	$0	$17,589,000	$0	$0	$0	$0	$0
Phase III value	$0	$0	$0	$0	$34,770,106	$0	$0
Phase III dev't cost	$0	$0	$20,282,316	$0	$0	$0	$0
Phase IV value	$0	$0	$0	$0	$0	$43,559,216	$0
Phase IV dev't cost	$0	$0	$0	$25,409,234	$0	$0	$0
Phase V value	$0	$0	$0	$0	$0	$0	$40,589,270
Phase V dev't cost	$0	$0	$0	$0	$23,676,787	$0	$0
Acquisition cost	$15,000,000	$0	$0	$0	$0	$0	$0
Infrastructure cost	$1,426,911	$2,340,134	$2,698,467	$3,380,580	$3,150,086	$0	$0
Park development cost	$195,000	$199,875	$204,872	$209,994	$215,244	$0	$0
Value of built property	$0	$0	$18,385,938	$30,152,938	$34,770,106	$43,559,216	$40,589,270
Total cost	$27,346,911	$20,129,009	$23,185,655	$28,999,808	$27,042,116	$0	$0
Net value	-$27,346,911	-$20,129,009	-$4,799,717	$1,153,130	$7,727,990	$43,559,216	$40,589,270
PV of built property	$115,903,253						
PV total cost	$112,740,379						
NPV	$3,162,873						
Return over initial cost (incl. discount rate)	12%						

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No Pre-Investment in Park

- Value At Risk and Gain curve (VARG curve)
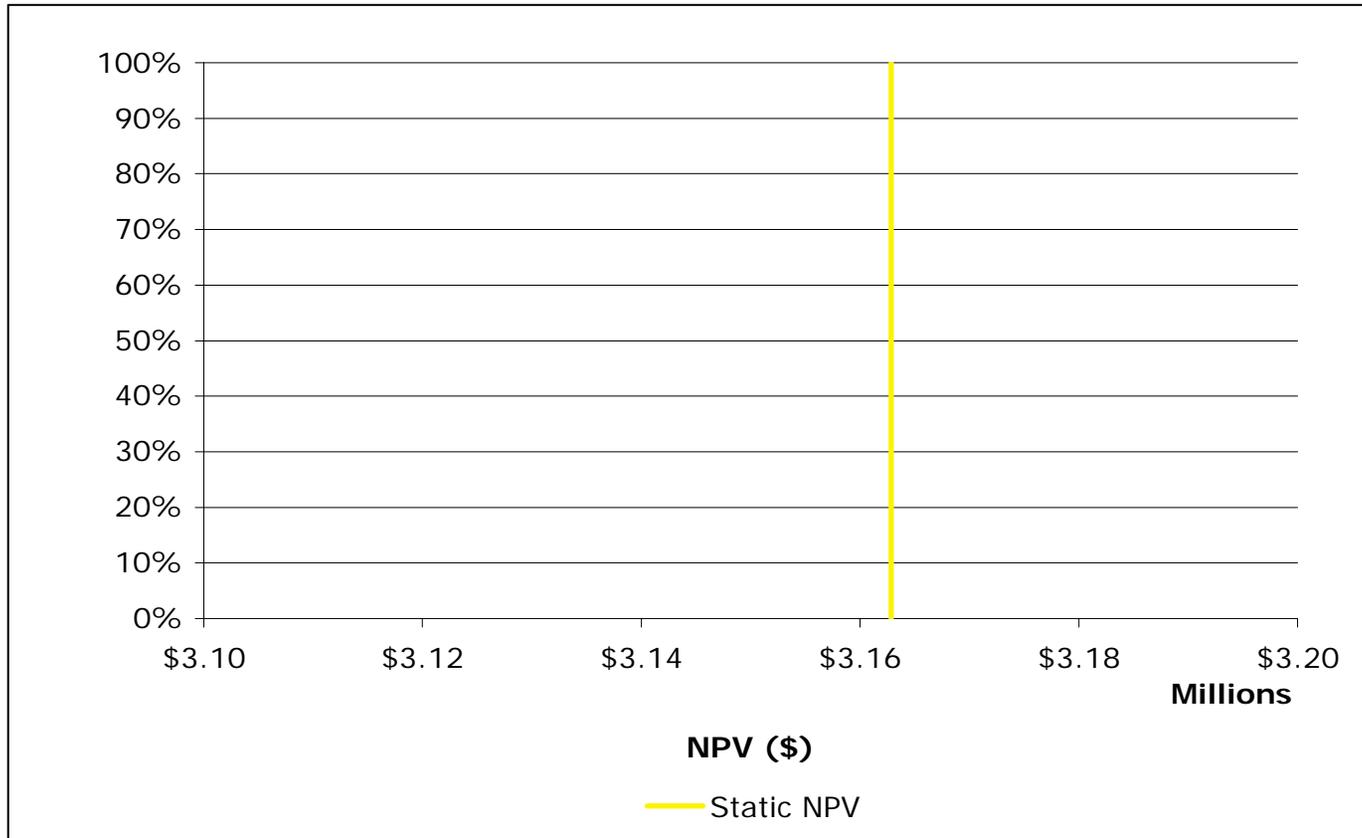
With Pre-Investment in Park

- Value At Risk and Gain curve (VARG curve)
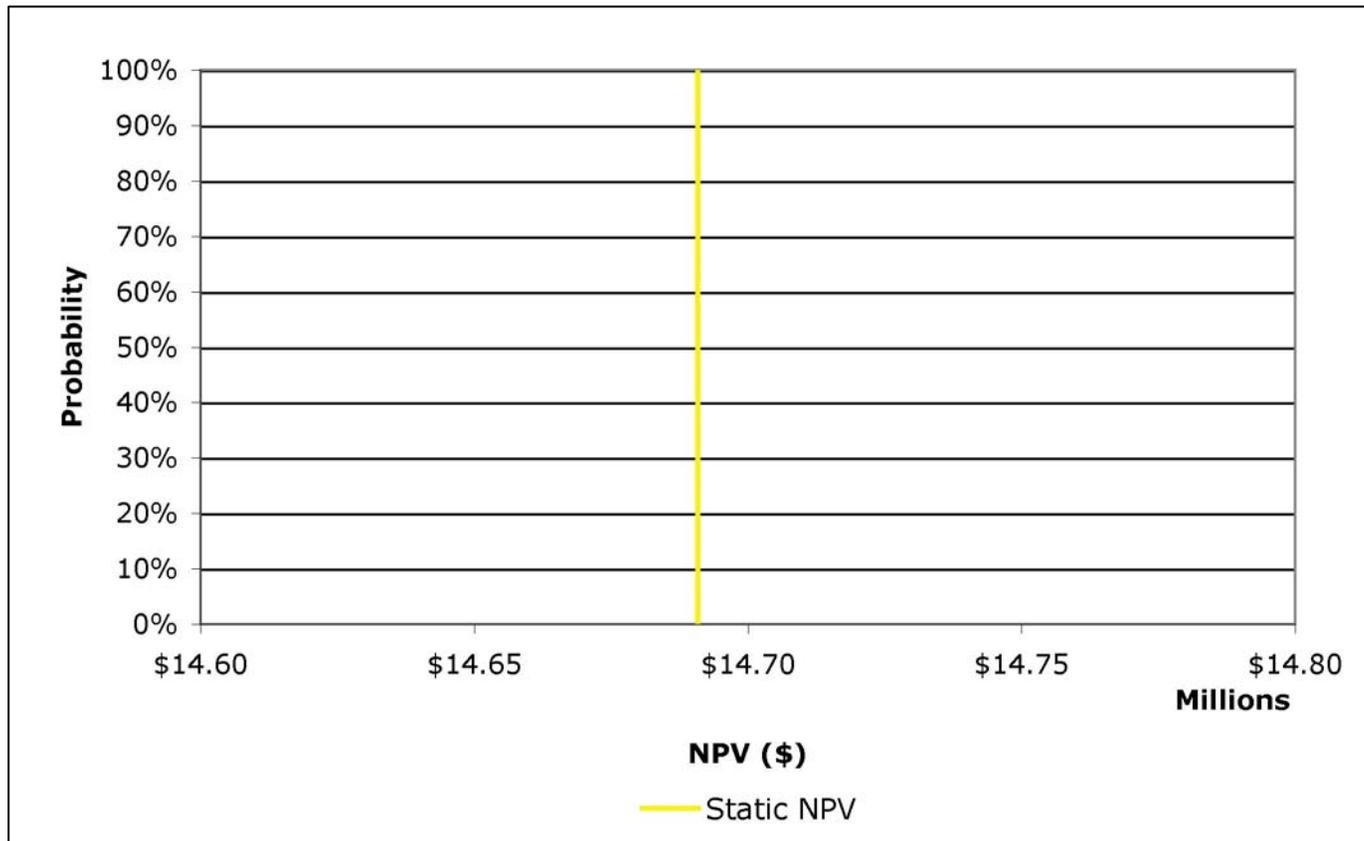
Case Recognizing Uncertainty

- Recognize reality of uncertainty
  - Only around market value of built property
  - Initial value within $\pm$ 50% of projection
  - Annual growth factor also $\pm$ 50% of projection
  - 15% volatility around each annual growth value
  - Otherwise same DCF model

- Use Monte Carlo: 2000 simulations each
  - Easy, routine - no special program

Case Recognizing Uncertainty

- Example of Uncertain Market Value Pattern
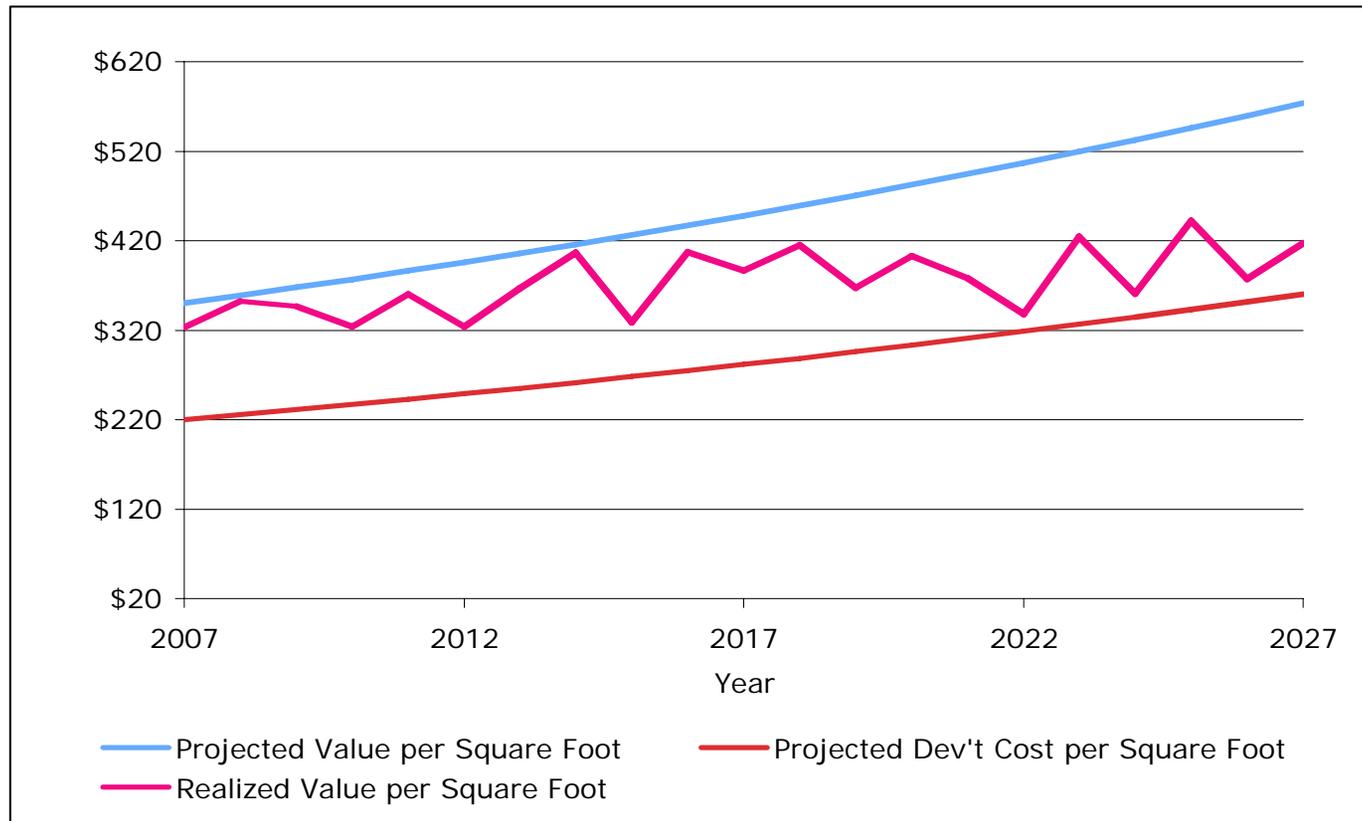
Case Recognizing Uncertainty

- NPV distribution for 2000 simulations
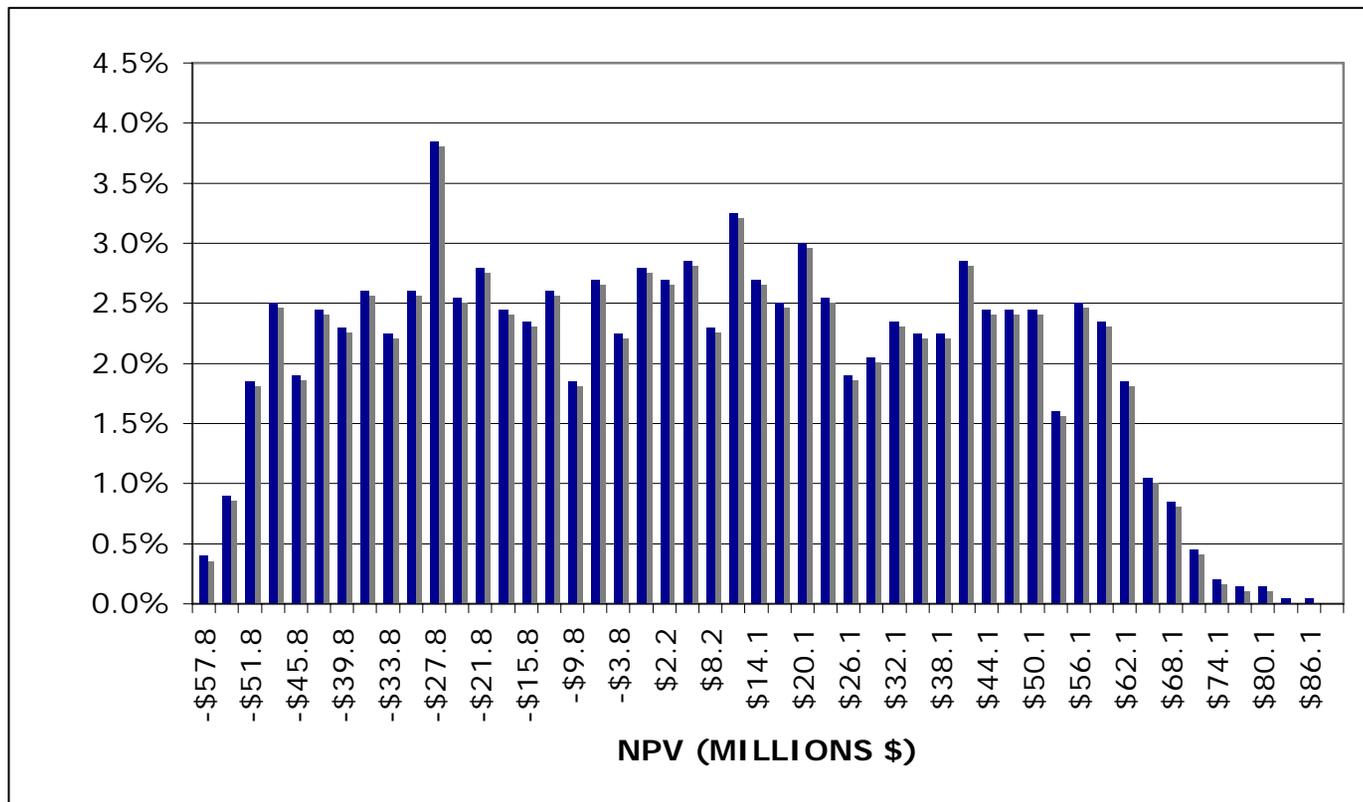
Case Recognizing Uncertainty

- Observations
  - Expected NPV is $3.17M, compared to $3.16M for static case
    - Relatively similar due to unconstrained nature of problem
    - Situation different from parking garage
  - Now deal with a <u>distribution</u> of outcomes rather than single value
    - <u>Expected</u> NPV (ENPV) rather than NPV

Case Recognizing Uncertainty

- ## Value At Risk and Gain curve (VARG curve)
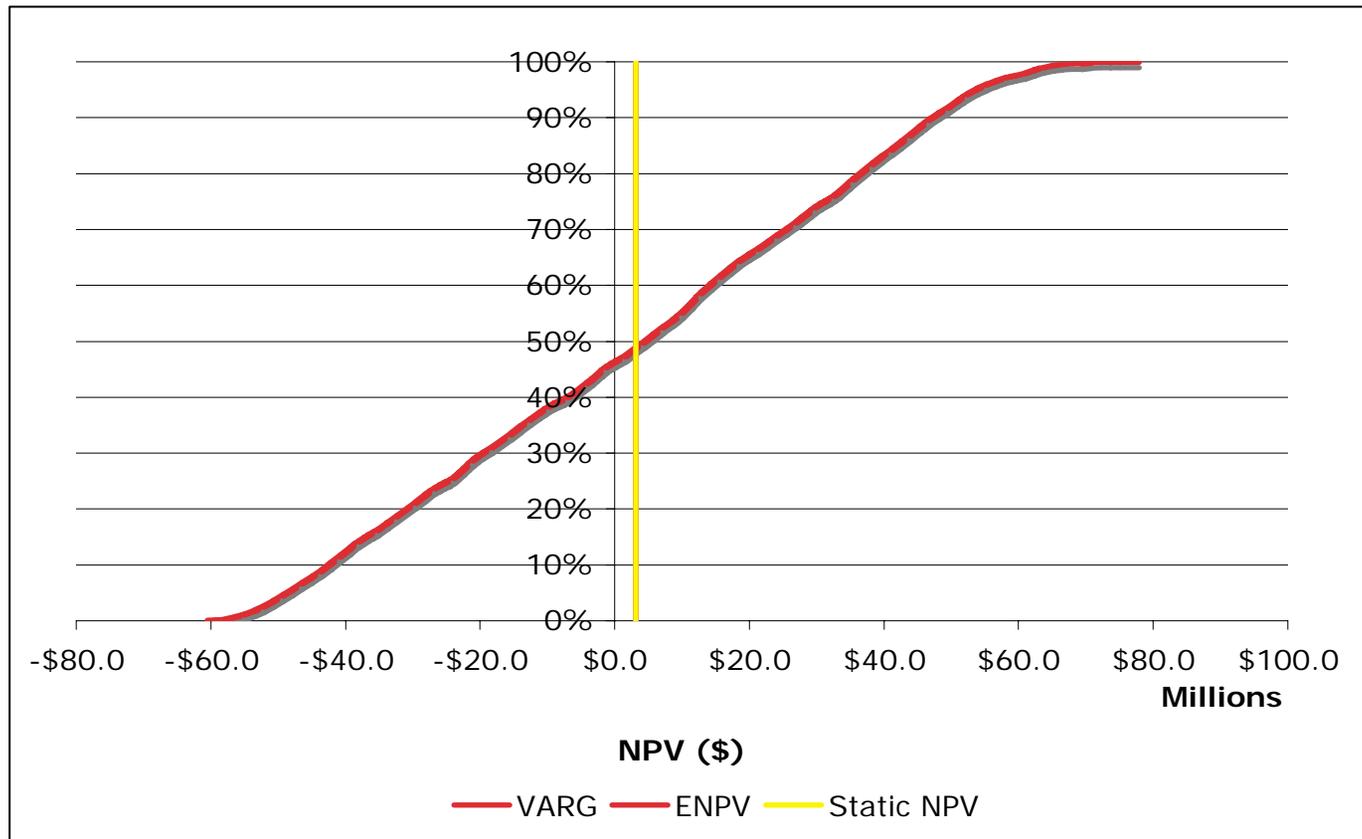
Flexible Case

- Sources of flexibility
  - Develop park upfront all at once for $1M
    - Increases market value of built property by 10% ONLY when market value was increasing in previous year
  - Expand at strategic times
    - When market value of built property is 50% higher than development cost
  - Abandon
    - At year 20, when phase is undeveloped

Flexible Case

- If recognize uncertainty, what are possible outcomes from managerial perspective?

VS.

Value > Cost all time

Value < Cost most times

Flexible Case

- ## Positive NPV Scenario

Year	2007	2008	2009	2010	2011	2012	2013	2014
Develop? Abandon? Wait?	Develop							
Dev't value criteria	$7,200,000	$0	$0	$0	$0	$0	$0	$0
Phase I value	$0	$0	$23,276,250	$0	$0	$0	$0	$0
Phase I abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase I dev't cost	$11,000,000	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Develop					
Dev't value criteria		$8,602,270	$18,751,000	$0	$0	$0	$0	$0
Phase II value	$0	$0	$0	$0	$38,233,990	$0	$0	$0
Phase II abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase II dev't cost	$0	$0	$18,491,000	$0	$0	$0	$0	$0
Develop? Abandon? Wait?			Wait	Develop				
Dev't value criteria			$21,094,875	$17,481,349	$0	$0	$0	$0
Phase III value	$0	$0	$0	$0	$0	$44,531,643	$0	$0
Phase III abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III dev't cost	$0	$0	$0	$21,322,434	$0	$0	$0	$0
Develop? Abandon? Wait?				Wait	Develop			
Dev't value criteria				$21,366,093	$25,859,464	$0	$0	$0
Phase IV value	$0	$0	$0	$0	$0	$0	$59,004,637	$0
Phase IV abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase IV dev't cost	$0	$0	$0	$0	$26,712,272	$0	$0	$0
Develop? Abandon? Wait?					Wait	Develop		
Dev't value criteria					$23,508,604	$24,588,622	$0	$0
Phase V value	$0	$0	$0	$0	$0	$0	$0	$52,649,235
Phase V abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase V dev't cost	$0	$0	$0	$0	$0	$24,890,981	$0	$0
Phase(s) completed			Phase I	Phase I	Phase II	Phase III	Phase IV	Phase V
Project abandoned?								
Acquisition cost	$15,000,000	$0	$0	$0	$0	$0	$0	$0
Infrastructure cost	$1,463,499	$0	$2,460,141	$2,836,850	$3,553,943	$3,311,629	$0	$0
Park development cost	$1,000,000	$0	$0	$0	$0	$0	$0	$0
Value of built property	$0	$0	$23,276,250	$0	$38,233,990	$44,531,643	$59,004,637	$52,649,235
Total cost	$28,463,499	$0	$20,951,141	$24,159,285	$30,266,215	$28,202,609	$0	$0
Net value	-$28,463,499	$0	$2,325,109	-$24,159,285	$7,967,775	$16,329,033	$59,004,637	$52,649,235
PV of built property	$139,603,060							
PV total cost	$112,442,848							
NPV	$27,160,211							
Return over initial cost (incl. discount rate)	95%							

Flexible Case

- Positive NPV Scenario

Year	2007	2008	2009	2010	2011	2012	2013	2014
Develop? Abandon? Wait?	Develop							
Dev't value criteria	$7,200,000	$0	$0	$0	$0	$0	$0	$0
Phase I value	$0	$0	$23,276,250	$0	$0	$0	$0	$0
Phase I abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase I dev't cost	$11,000,000	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Develop					
Dev't value criteria		$8,602,270	$18,751,000	$0	$0	$0	$0	$0
Phase II value	$0	$0	$0	$0	$38,233,990	$0	$0	$0
Phase II abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase II dev't cost	$0	$0	$18,491,000	$0	$0	$0	$0	$0
Develop? Abandon? Wait?			Wait	Develop				
Dev't value criteria			$21,094,875	$17,481,349	$0	$0	$0	$0
Phase III value	$0	$0	$0	$0	$0	$44,531,643	$0	$0
Phase III abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III dev't cost	$0	$0	$0	$21,322,434	$0	$0	$0	$0
Develop? Abandon? Wait?				Wait	Develop			
Dev't value criteria				$21,366,093	$25,859,464	$0	$0	$0
Phase IV value	$0	$0	$0	$0	$0	$0	$59,004,637	$0
Phase IV abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$26,712,272	$0	$0	$0	$0
Develop? Abandon? Wait?					Wait	Develop		
Dev't value criteria					$23,508,604	$24,588,622	$0	$0
	$0	$0	$0	$0	$0	$0	$0	$52,649,235
	$0	$0	$0	$0	$0	$0	$0	$0
	$0	$0	$0	$0	$0	$24,890,981	$0	$0

	Phase I	Phase I	Phase II	Phase III	Phase IV	Phase V
	$0	$0	$0	$0	$0	$0
	$0	$2,460,141	$2,836,850	$3,553,943	$3,311,629	$0	$0
	$0	$0	$0	$0	$0	$0	$0
	$0	$23,276,250	$0	$38,233,990	$44,531,643	$59,004,637	$52,649,235
	$0	$20,951,141	$24,159,285	$30,266,215	$28,202,609	$0	$0
	$0	$2,325,109	-$24,159,285	$7,967,775	$16,329,033	$59,004,637	$52,649,235

Legend:
- Projected Value per Square Foot
- Projected Dev't Cost per Square Foot
- Realized Value per Square Foot

Flexible Case

- ## Negative NPV Scenario

Year	2007	2021	2022	2023	2024	2025	2026	2027
Develop? Abandon? Wait?	Wait	Develop						
Dev't value criteria	$2,500,000	$7,817,520	$0	$0	$0	$0	$0	$0
Phase I value	$0	$0	$0	$23,695,280	$0	$0	$0	$0
Phase I abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase I dev't cost	$0	$15,542,712	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$12,508,032	$11,698,569	$11,785,149	$6,601,009	$5,958,301	$12,838,556	$5,854,494
Phase II value	$0	$0	$0	$0	$0	$0	$0	$0
Phase II abandonment value	$0	$0	$0	$0	$0	$0	$0	$2,498,636
Phase II dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$14,071,536	$13,160,890	$13,258,292	$7,426,135	$6,703,088	$14,443,376	$6,586,305
Phase III value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$17,198,544	$16,085,532	$16,204,579	$9,076,387	$8,192,663	$17,653,015	$8,049,929
Phase IV value	$0	$0	$0	$0	$0	$0	$0	$0
Phase IV abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase IV dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$15,635,040	$14,623,211	$14,731,436	$8,251,261	$7,447,876	$16,048,195	$7,318,117
Phase V value	$0	$0	$0	$0	$0	$0	$0	$0
Phase V abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase V dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Phase(s) completed				Phase I	Phase I	Phase I	Phase I	Phase I
Project abandoned?								Abandoned
Acquisition cost	$0	$21,194,607	$0	$0	$0	$0	$0	$0
Infrastructure cost	$0	$2,067,885	$0	$0	$0	$0	$0	$0
Park development cost	$0	$1,412,974	$0	$0	$0	$0	$0	$0
Value of built property	$0	$0	$0	$23,695,280	$0	$0	$0	$2,498,636
Total cost	$0	$40,218,178	$0	$0	$0	$0	$0	$0
Net value	$0	-$40,218,178	$0	$23,695,280	$0	$0	$0	$2,498,636
PV of built property	$6,413,958							
PV total cost	$17,788,539							
NPV	-$11,374,581							

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Flexible Case

- ## Negative NPV Scenario

Year	2007	2021	2022	2023	2024	2025	2026	2027
Develop? Abandon? Wait?	Wait	Develop						
Dev't value criteria	$2,500,000	$7,817,520	$0	$0	$0	$0	$0	$0
Phase I value	$0	$0	$0	$23,695,280	$0	$0	$0	$0
Phase I abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase I dev't cost	$0	$15,542,712	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$12,508,032	$11,698,569	$11,785,149	$6,601,009	$5,958,301	$12,838,556	$5,854,494
Phase II value	$0	$0	$0	$0	$0	$0	$0	$0
Phase II abandonment value	$0	$0	$0	$0	$0	$0	$0	$2,498,636
Phase II dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
Dev't value criteria		$14,071,536	$13,1..	$13,258,292	$7,426,135	$6,703,088	$14,443,376	$6,586,305
Phase III value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III abandonment value	$0	$0	$0	$0	$0	$0	$0	$0
Phase III dev't cost	$0	$0	$0	$0	$0	$0	$0	$0
Develop? Abandon? Wait?		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
			$16,085,532	$16,204,579	$9,076,387	$8,192,663	$17,653,015	$8,049,929
			$0	$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0	$0
		Wait	Wait	Wait	Wait	Wait	Wait	Abandon
			$14,623,211	$14,731,436	$8,251,261	$7,447,876	$16,048,195	$7,318,117
			$0	$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0	$0
			$0	$0	$0	$0	$0	$0
			Phase I	Phase I	Phase I	Phase I	Phase I Abandoned
		$0	$0	$0	$0	$0	$0
		$0	$0	$0	$0	$0	$0
		$0	$0	$0	$0	$0	$0
		$0	$23,695,280	$0	$0	$0	$2,498,636
		$0	$0	$0	$0	$0	$0
		$0	$23,695,280	$0	$0	$0	$2,498,636

Chart axes: $620, $520, $420, $320, $220, $120, $20 (vertical); Year 2007, 2012, 2017, 2022, 2027 (horizontal)

— Projected Value per Square Foot
— Projected Dev't Cost per Square Foot
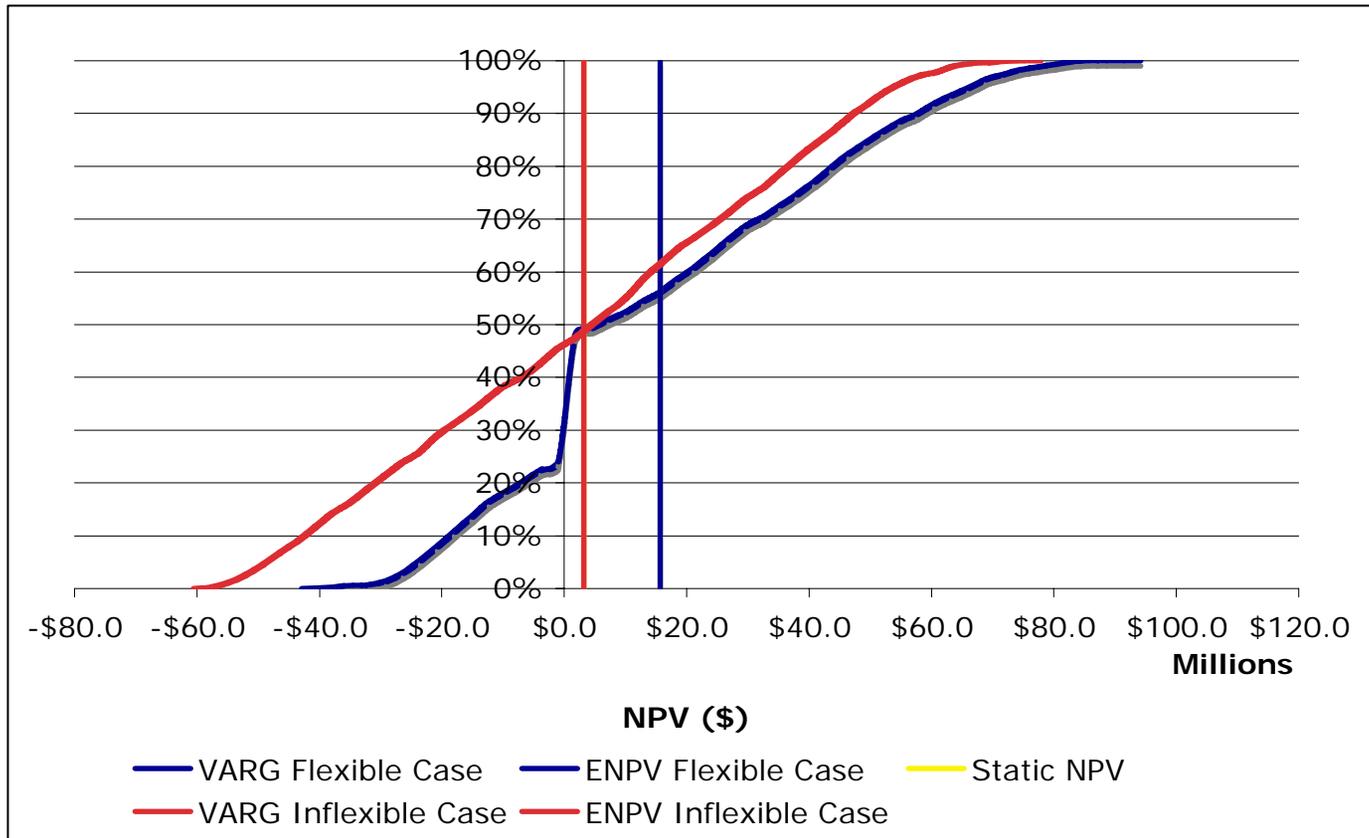— Realized Value per Square Foot

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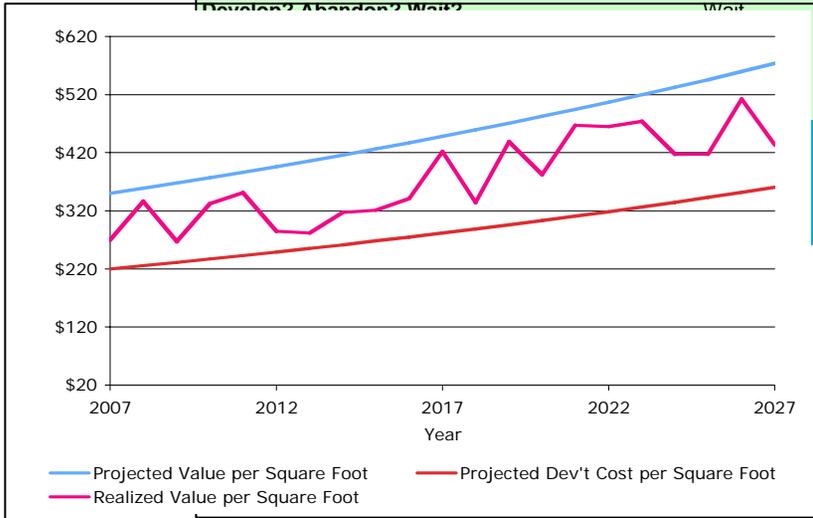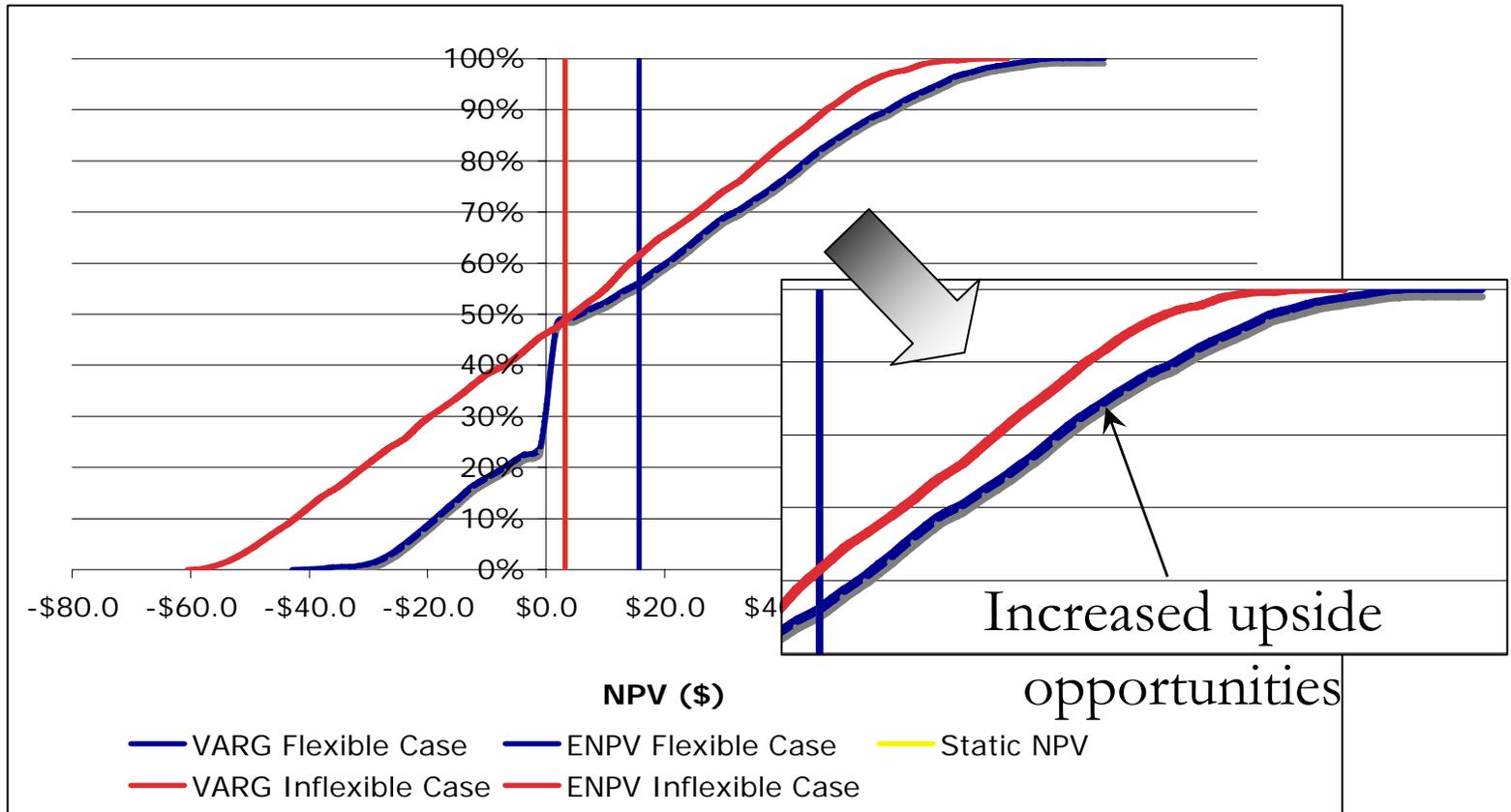
Flexible Case

- NPV distribution for 2000 simulations
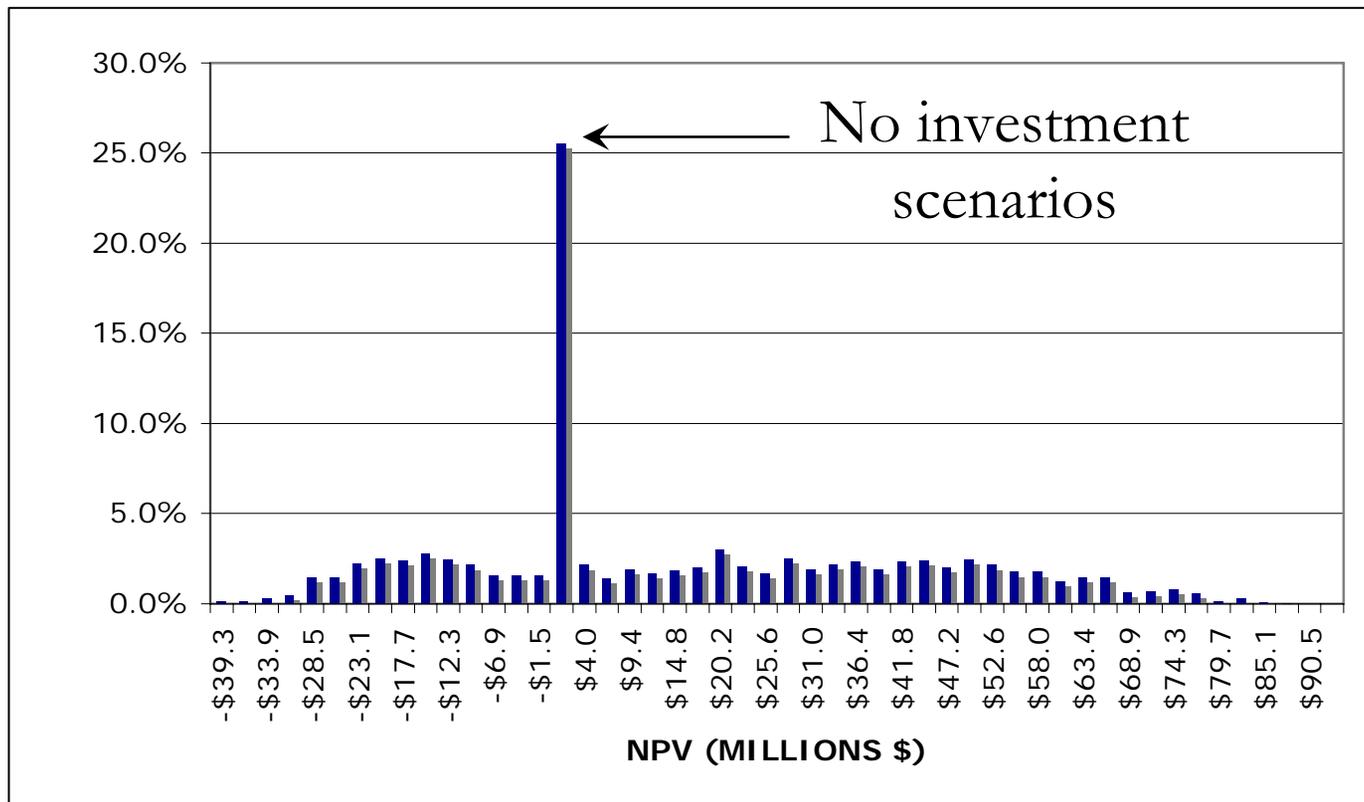
Flexible Case

- Value At Risk and Gain curve (VARG curve)

Flexible Case

- ## Value At Risk and Gain curve (VARG curve)

Increased upside opportunities

Legend:
- VARG Flexible Case
- ENPV Flexible Case
- Static NPV
- VARG Inflexible Case
- ENPV Inflexible Case

NPV ($)

Results

- About distribution
  - Downside reduced, upside increased
- Increased Expected NPV = ENPV
- Consequences of recognizing uncertainty
  - sometimes wait
  - sometimes do not invest
  - sometimes abandon after starting the project
- Sudden jump near zero NPV
  - Scenarios where do not invest compared to scenarios where profit is barely made over initial costs

Results

- Static, "certain" case: <u>no pre-investment</u> in park

  NPV = $3.16M

- Inflexible case: <u>no pre-investment</u> in park

  ENPV = $3.17M

- Flexible case: pre-investment and timing flexibilities

  ENPV = $15.67M

- Value of flexibility due to combination of strategic timing and pre-investment in park:

  $$E[V_{Flexibility}] = MAX(0, E[NPV_{Flex.}] - E[NPV_{Inflex.}])$$
  $$= \$12.5M$$

Results

- Other valuation attributes, in Millions $:

	Inflexible	Flexible	Better?
Expected initial investment	$27.35	$21.35	Flex. Better
Expected NPV	$3.17	$15.67	Flex. Better
Minimum NPV	-$60.56	-$42.94	Flex. Better
Maximum NPV	$77.91	$94.19	Flex. Better
DR)	12%	73%	Flex. Better

Results

- Static, "certain" case: <u>with pre-investment</u> in park

  NPV = $14.69M

- Inflexible case: <u>with pre-investment</u> in park

  ENPV = $10.21M

- Flexible case: pre-investment and timing flexibilities

  ENPV = $15.67M

- Value of flexibility due to strategic timing:

  $E[V_{Flexibility}] = \$(15.67 - 10.21)M = \$5.46M$

  – Deduced value of pre-investment in park:

  $12.5M - $5.5M = $7.0M

Results

- ## Other valuation attributes, in Millions $:

	Inflexible	Flexible	Better?
Expected initial investment	$28.13	$21.35	Flex. Better
Expected NPV	$10.21	$15.67	Flex. Better
Minimum NPV	-$57.79	-$42.94	Flex. Better
Maximum NPV	$95.46	$94.19	Inflex. Better
Return over initial cost (incl. DR)	36%	73%	Flex. Better

Take-Aways

- Easy method to deal with uncertainty
  - No special software required
- Important to recognize uncertainty
  - It's reality!
- Recognizing uncertainty leads to flexible design and management
- Improve expected NPV and other desirable attributes

Questions/Comments?