Tioga

2019-2050 Bay Area Seaport Forecast

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Outline

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   - Port and Terminal Overview
   - Forecast and Capacity Approach
2. Forecasts and Capacity Analysis
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   - Ro-Ro
   - Dry Bulk
3. Bay Area Summary
4. Potential Role of Oakland’s Howard Terminal

Current 2019 Bay Area Cargo Flows

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- Containerized cargo
- Roll-on/Roll-off (Ro-Ro) cargo (formerly classified as "neo-bulk")
- Dry bulk cargo
- Non-petroleum liquid bulk cargo
- Break-bulk cargo (not currently handled)

Commodity	Seaport Plan Public Ports					Private Terminals	
	Oakland	Richmond	Benicia	Redwood City	San Francisco	Levin Richmond	Others
Containerized Imports	X						
Containerized Exports	X						
Containerized Domestic IB	X						
Containerized Domestic OB	X						
Import Autos		X	X		X		
Export Autos		X	X		X		
Export Scrap Metal	X(1)			X		X(2)	
Import Veg Oils		X					
Import Chemicals							X
Import Gypsum				X			X
Import Cement				X	X		
Export Pet Coke			X			X	
Export Coal						X	
Import Sand & Gravel				X	X		X
Harvested Bay Sand				X	X		
Import Slag				X			
Import Bauxite				X			

(1) Schnitzer Steel (2) From SIMS Richmond

Exhibit 14, p. 14

Overview: Forecast and Capacity Approach

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- Forecast through 2050
- Separate forecasts and capacity estimates for each cargo type
  - Containerized: Domestic, Imports, Exports, Empties
  - Ro-Ro: Imports, Exports
  - Dry Bulk: Each commodity group forecast separately
- Projected volumes compared to existing and potential capacity
- Implications for Bay Area terminal land requirements

Economic & Trade Trends

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Bay Area seaport activity will be determined by economic activity in:

- Bay Area itself
- Broader Central and Northern California market
- Neighboring states including OR and NV

Reviewed forecasts suggest:

- Slower growth in CA in next 3-5 years
- Neat-term West Coast growth will moderate relative to the rest of the nation
- Steady growth over the long term, but slower than previously
- Bay Area employment increasing 1.0% - 1.1% annually through 2040

Forecast Methodology: Containerized Cargo

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Imports and Exports

- Loaded volume forecasts each driven by separate econometric models incorporating Moody's Analytics forecasts
  - GDP sub-components, industrial production, SF metro output
  - Both modeled quarterly to incorporate seasonal variation
- Additional TEU over three-year periods due to introduction of "first-call" vessels
- Empty volume growth tied to loaded volume growth rates

Domestic

- Declining volumes required different approach: assigned growth rate and market shares for loaded volume
- Empty volumes based on historical rates

Container Forecast Scenarios

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Moderate Growth

- International: first-call vessels added 2022-2024
- Domestic: 0.9% CAGR Matson cargo growth, non-Matson cargo remains level

Slow Growth

- International: reduced growth rate by ≈0.5% from 2022 onwards, no first call vessel service
- Domestic: 0.5% CAGR Matson cargo growth, non-Matson cargo to zero in 5 years

Strong Growth

- International: increased growth rate by ≈0.5% per year from 2022 onwards, first-call vessels added 2020-2022 and 2030-2032
- Domestic: 2.3% CAGR Matson cargo growth, non-Matson cargo 15% share

International TEU Forecast

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Moderate Growth Scenario

- Loaded import TEU grow at 3.1% CAGR
- Loaded export TEU grow at 1.3% CAGR
- Total TEU grow at 2.3% CAGR

Slow Growth Scenario

- TEU grow at 1.4% CAGR

Strong Growth

- TEU grow at 3.3% CAGR

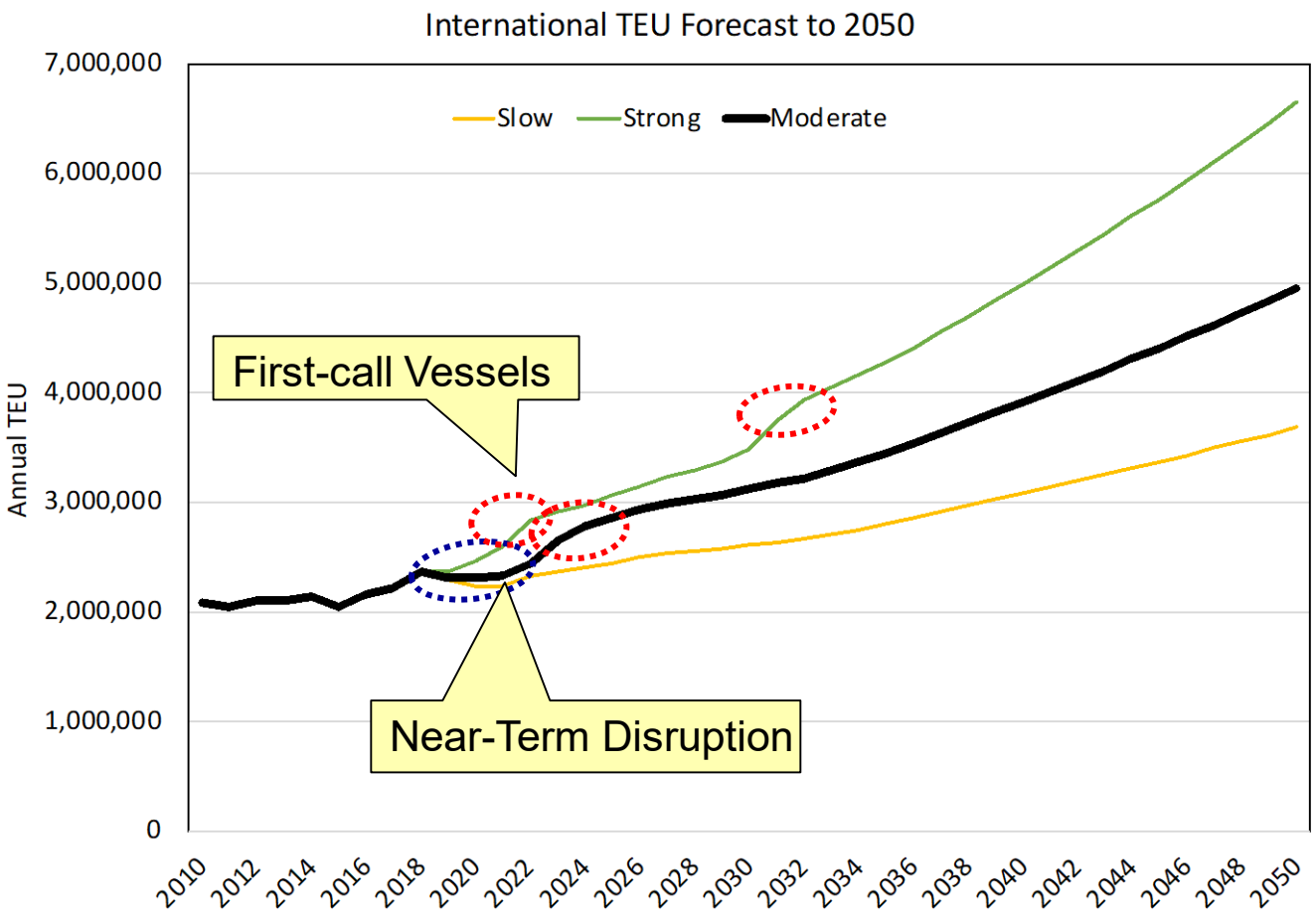

Exhibit 77, p. 68

Domestic TEU Forecast to 2050

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Moderate Growth Scenario

- Loaded inbound 0.6% CAGR
- Loaded outbound 0.8% CAGR
- Total TEU 0.7% CAGR

Slow Growth Scenario

- Total TEU -0.01% CAGR

Strong Growth Scenario

- Total TEU 2.3% CAGR

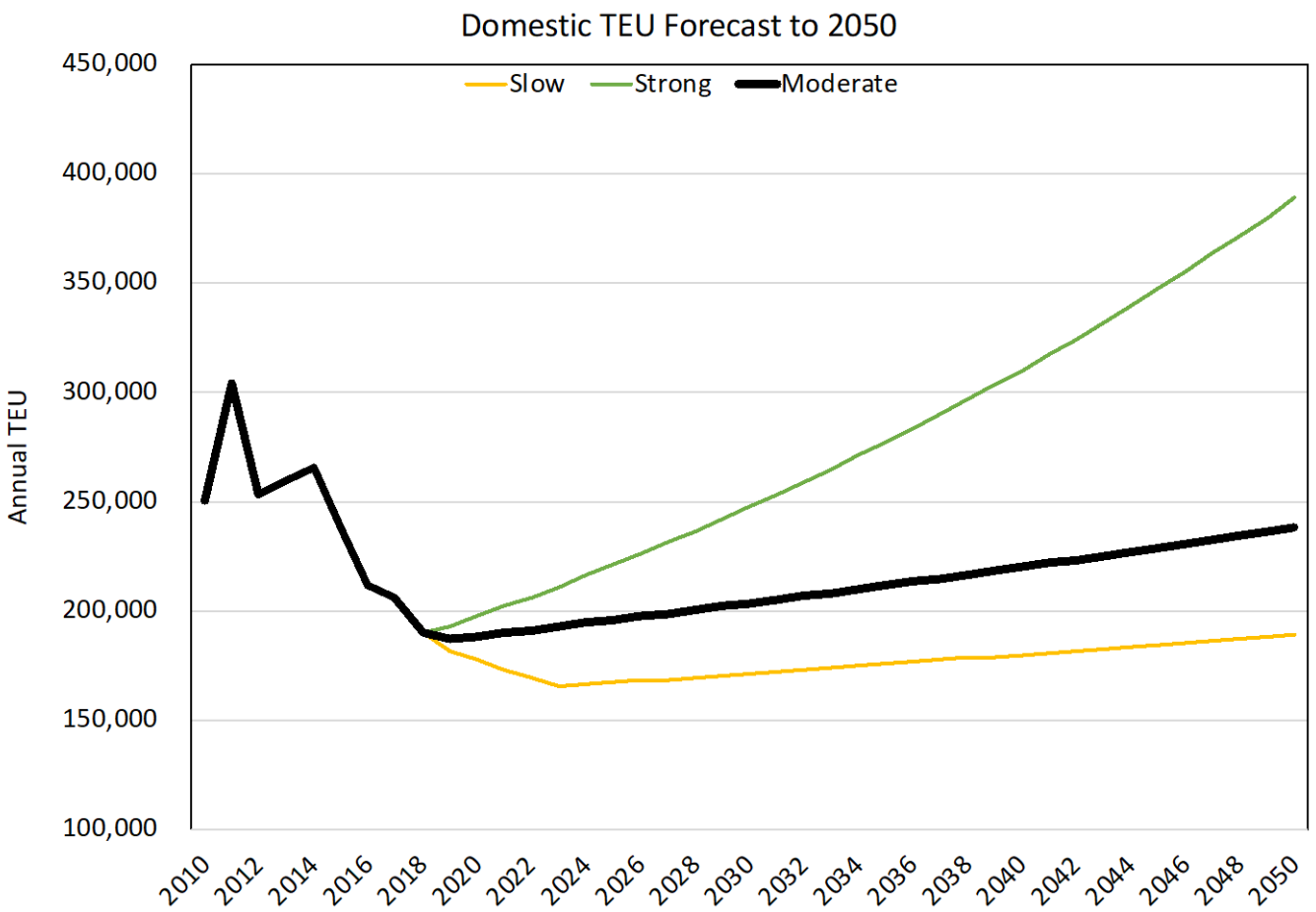

Exhibit 79 p. 70

Total TEU Forecast

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Moderate Growth Scenario

- Total TEU 2.2% CAGR
- 5.2 million TEU by 2050

Slow Growth Scenario

- Total TEU 1.3% CAGR
- 3.9 million TEU by 2040

Strong Growth Scenario

- Total TEU 3.2% CAGR
- 7.0 million TEU by 2050

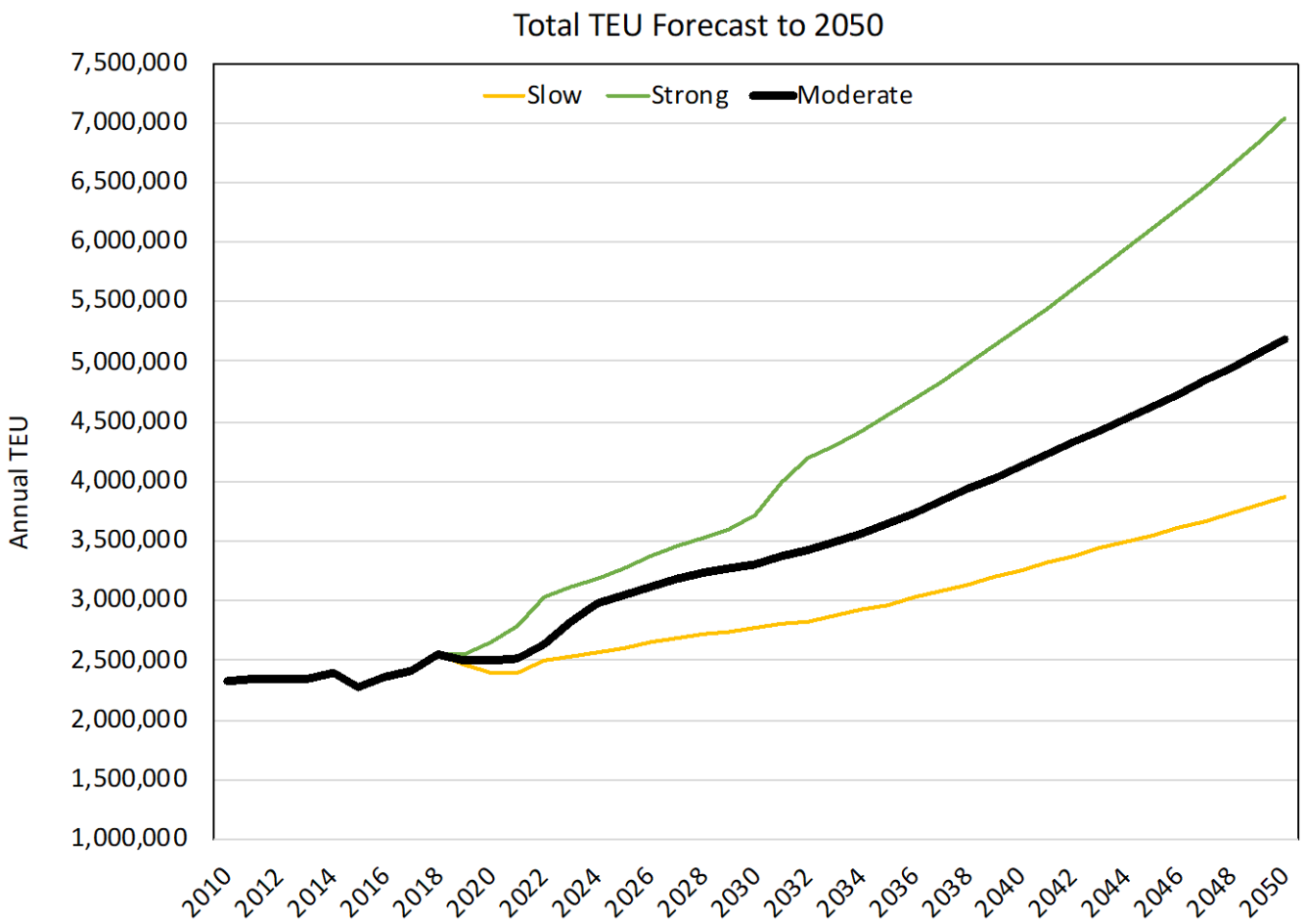

Exhibit 81 p. 72

Moderate Growth Forecast: Containerized Cargo

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By 2050

- Imports 2.7 million TEU
- +149% vs 2018

- Exports 2.3 million TEU
- +77% vs 2018

- Domestic 0.2 million TEU
- +25% vs 2018

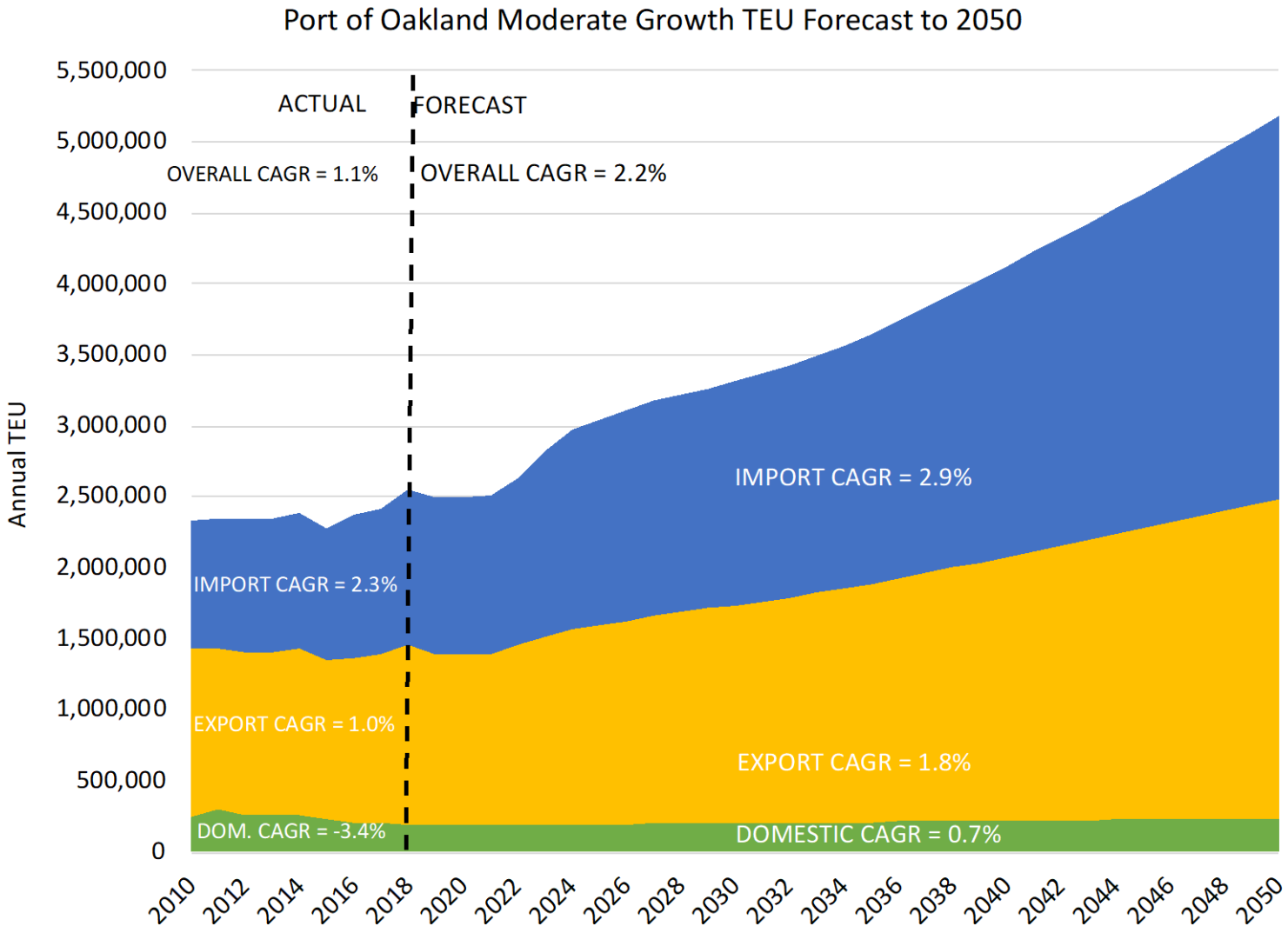

Exhibit 82, p. 72

Port of Oakland Terminals

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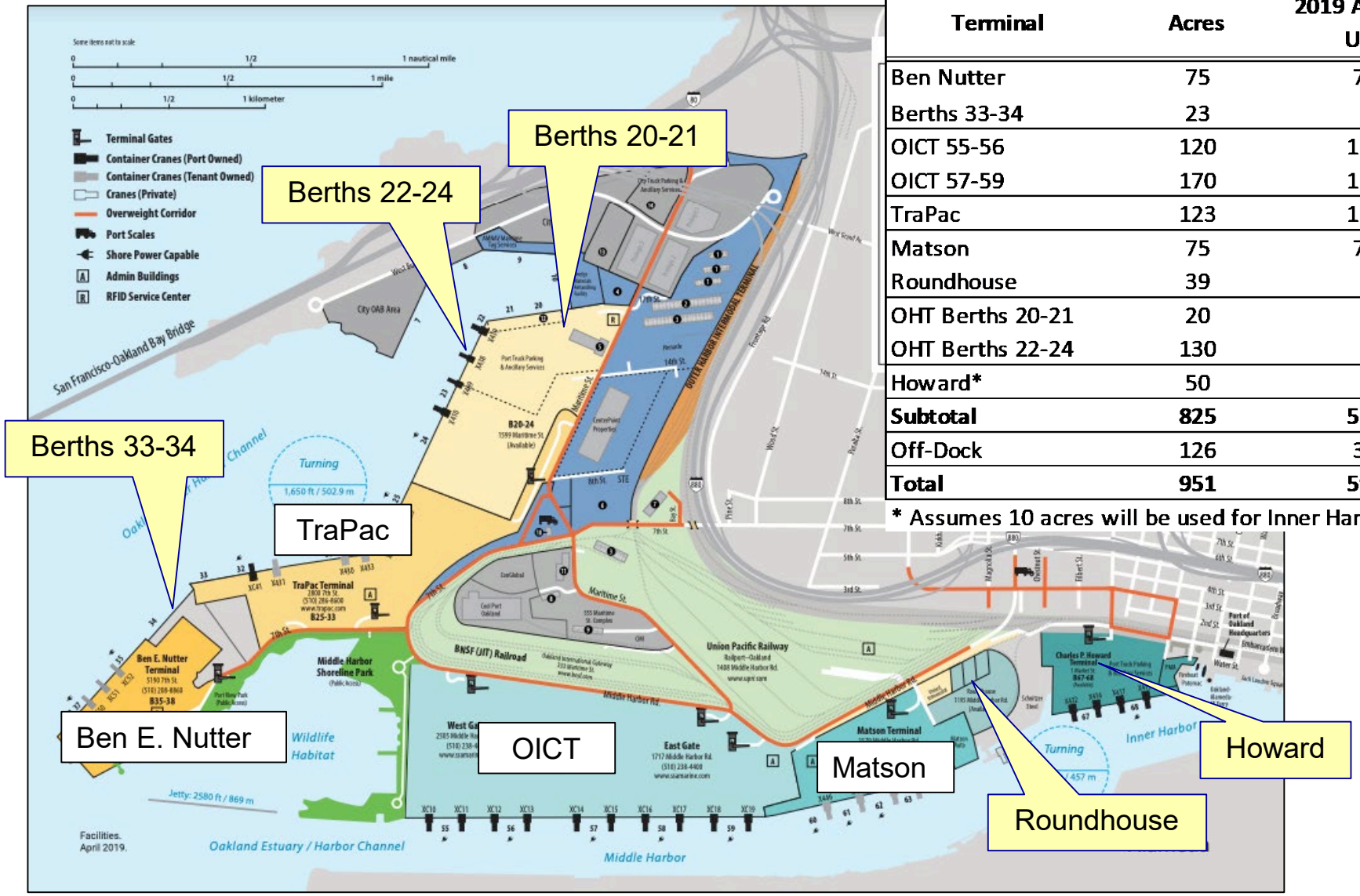

Terminal	Acres	2019 Acres in Use	Available Acres	Build-out Acres	Post-Electrification Acres
Ben Nutter	75	75	0	98	96
Berths 33-34	23		23		
OICT 55-56	120	120	0	290	288
OICT 57-59	170	170	0		
TraPac	123	123	0	123	121
Matson	75	75	0	114	112
Roundhouse	39		39		
OHT Berths 20-21	20		150	150	148
OHT Berths 22-24	130				
Howard*	50		50	40	38
Subtotal	**825**	**563**	**262**	**815**	**803**
Off-Dock	126	30	96	0	0
Total	**951**	**593**	**358**	**815**	**803**

* Assumes 10 acres will be used for Inner Harbor Turning Basin

Exhibit 87-88 p. 77

Container Terminal Productivity – TEU/Acre

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- Conventional Productivity
  - OICT is Oakland's most productive terminal, nearly at capacity
  - 2018 throughput averaged 4,265 annual TEU/acre
  - At 95% utilization, OICT sustainable capacity would be **5,264 TEU per acre**
- "High Productivity" terminals sustainable average capacity estimated at 7,112 TEU/acre
- "Completely Automated" terminals have not proved productivity claims

Terminal	Acres	Published Capacity Annual TEU*	Max TEU/Acre	Sustainable @ 80%	Average
Conventional Terminals					
Oakland OICT (Est.)	290	2,105,789	6,581	5,264	6,061
Off-dock	30				
GCT Deltaport	210	1,800,000	8,571	6,857	
High Productivity					
VIG Portsmouth	291	2,000,000	6,873	5,498	7,112
TraPac Los Angeles	220	1,600,000	7,273	5,818	
Sydney Auto-strad	156	1,600,000	10,282	8,226	
Brisbane Auto-strad	99	1,100,000	11,134	8,907	
Complete Automation					
LBCT Long Beach	170	3,100,000	18,235	14,588	17,008
GCT Bayonne	70	1,700,000	24,286	19,429	

* OICT is actual TEU

Exhibit 85 p. 75

Container Terminal Capacity Growth

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Tioga defined 6 phased expansion phases:

- Assumes terminals will expand as needed to stay slightly ahead of demand
- Other terminals will come up to OICT's benchmark
- Initial horizontal expansion on available land with conventional productivity
- Progressive transitions to high-productivity norms at busiest terminals
- Allowance for acreage lost to electrification requirements

Estimated Sustainable Capacity at 815/803 Acres	Port Capacity Estimates						
	2018 Capacity Estimate	Phase 1: Horizontal Expansion on Available Terminal Acres	Phase II: 150 Acres High Productivty at OICT or OHT	Phase III: High Productivity at OICT & OHT	Phase IV: High Productivity at OICT, OHT, Ben Nutter	Phase V: High Productivity at OICT, OHT, Ben Nutter, TraPac	Phase VI: High Productivity at all Terminals
Total Terminal Acres	**825**	**815**	**813**	**811**	**809**	**807**	**803**
Terminal Acres in Conventional Use	593	815	663	371	271	146	0
Terminal Acres in High Productivity Use	0	0	148	436	532	653	791
Terminal Acres in Electrification Support	0	0	2	4	6	8	12
Conventional Annual TEU/Acre (OICT 2018)	**5,264**	**5,264**	**5,264**	**5,264**	**5,264**	**5,264**	**5,264**
Conventional Capacity	3,279,767	4,290,546	3,490,346	1,953,120	1,426,672	768,613	-
High Productivity Annual TEU/Acre	**7,112**	**7,112**	**7,112**	**7,112**	**7,112**	**7,112**	**7,112**
High Productivity Capacity	-	-	1,052,614	3,100,945	3,783,722	4,644,306	5,625,797
Total Sustainable Capacity	**3,279,767**	**4,290,546**	**4,542,960**	**5,054,065**	**5,210,395**	**5,412,919**	**5,625,797**

Exhibit 89 p. 81

Container Terminal Capacity with Howard Terminal

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Capacity tight in Moderate Growth Scenario, inadequate for Strong Growth

Millions of TEU	Comparison at 815/803 Acres						Comparison at 795/783 Acres w/o Berths 20-21					
	Moderate Growth	Available Capacity	Slow Growth	Available Capacity	Strong growth	Available Capacity	Moderate Growth	Available Capacity	Slow Growth	Available Capacity	Strong growth	Available Capacity
2018	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3
2020	2.5	3.3	2.4	3.3	2.6	3.3	2.5	3.3	2.4	3.3	2.6	3.3
2025	3.0	3.3	2.6	3.3	3.3	3.3	3.0	3.3	2.6	3.3	3.3	3.3
2030	3.3	4.3	2.8	3.3	3.7	4.3	3.3	4.2	2.8	3.3	3.7	4.2
2035	3.6	4.3	3.0	3.3	4.5	5.1	3.6	4.2	3.0	3.3	4.5	4.9
2040	4.1	4.3	3.3	3.3	5.3	5.4	4.1	4.2	3.3	3.3	5.3	5.5
2041	4.2	4.3	3.3	4.3	5.4	5.6	4.2	4.4	3.3	4.2	5.4	5.5
2042	4.3	4.5	3.4	4.3	5.6	5.6	4.3	4.4	3.4	4.2	5.6	5.5
2043	4.4	4.5	3.4	4.3	5.8	5.6	4.4	4.9	3.4	4.2	5.8	5.5
2044	4.5	4.5	3.5	4.3	5.9	5.6	4.5	4.9	3.5	4.2	5.9	5.5
2045	4.6	5.1	3.6	4.3	6.1	5.6	4.6	4.9	3.6	4.2	6.1	5.5
2046	4.7	5.1	3.6	4.3	6.3	5.6	4.7	4.9	3.6	4.2	6.3	5.5
2047	4.8	5.1	3.7	4.3	6.5	5.6	4.8	4.9	3.7	4.2	6.5	5.5
2048	5.0	5.1	3.7	4.3	6.6	5.6	5.0	5.1	3.7	4.2	6.6	5.5
2049	5.1	5.2	3.8	4.3	6.8	5.6	5.1	5.3	3.8	4.2	6.8	5.5
2050	5.2	5.2	3.9	4.3	7.0	5.6	5.2	5.3	3.9	4.2	7.0	5.5
CAGR	**2.2%**	**1.5%**	**1.3%**	**0.9%**	**3.2%**	**1.8%**	**2.2%**	**1.5%**	**1.3%**	**0.8%**	**3.2%**	**1.7%**

Exhibit 91 p. 87

Container Terminal Capacity without Howard Terminal

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Capacity tighter in Moderate Growth Scenario, inadequate for Strong Growth

Millions of TEU	Comparison at 775/763 Acres w/o Howard						Comparison at 755/743 Acres w/o Howard or Berths 20-21					
	Moderate Growth	Available Capacity	Slow Growth	Available Capacity	Strong growth	Available Capacity	Moderate Growth	Available Capacity	Slow Growth	Available Capacity	Strong growth	Available Capacity
2018	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3	2.5	3.3
2020	2.5	3.3	2.4	3.3	2.6	3.3	2.5	3.3	2.4	3.3	2.6	3.3
2025	3.0	3.3	2.6	3.3	3.3	3.3	3.0	3.3	2.6	3.3	3.3	3.3
2030	3.3	4.1	2.8	3.3	3.7	4.1	3.3	4.0	2.8	3.3	3.7	4.0
2035	3.6	4.1	3.0	3.3	4.5	4.8	3.6	4.0	3.0	3.3	4.5	4.7
2040	4.1	4.3	3.3	3.3	5.3	5.3	4.1	4.2	3.3	3.3	5.3	5.2
2041	4.2	4.3	3.3	4.1	5.4	5.3	4.2	4.2	3.3	4.0	5.4	5.2
2042	4.3	4.3	3.4	4.1	5.6	5.3	4.3	4.7	3.4	4.0	5.6	5.2
2043	4.4	4.8	3.4	4.1	5.8	5.3	4.4	4.7	3.4	4.0	5.8	5.2
2044	4.5	4.8	3.5	4.1	5.9	5.3	4.5	4.7	3.5	4.0	5.9	5.2
2045	4.6	4.8	3.6	4.1	6.1	5.3	4.6	4.7	3.6	4.0	6.1	5.2
2046	4.7	4.8	3.6	4.1	6.3	5.3	4.7	4.9	3.6	4.0	6.3	5.2
2047	4.8	5.0	3.7	4.1	6.5	5.3	4.8	5.1	3.7	4.0	6.5	5.2
2048	5.0	5.0	3.7	4.1	6.6	5.3	5.0	5.1	3.7	4.0	6.6	5.2
2049	5.1	5.2	3.8	4.1	6.8	5.3	5.1	5.2	3.8	4.0	6.8	5.2
2050	5.2	5.2	3.9	4.1	7.0	5.3	5.2	5.2	3.9	4.0	7.0	5.2
CAGR	**2.2%**	**1.5%**	**1.3%**	**0.7%**	**3.2%**	**1.6%**	**2.2%**	**1.5%**	**1.3%**	**0.6%**	**3.2%**	**1.5%**

Exhibit 91 p. 87

Container Cargo Growth vs. Terminal Capacity

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- Oakland at or near capacity by 2050 with moderate growth and with estimated maximum terminal capacity under high productivity assumptions.
- If both Howard and Berths 20-21 were withdrawn from container cargo use, the port would be at full capacity by 2050.
- The slow growth forecast would leave Oakland at 69%-74% of capacity by 2050.
- The strong growth forecast would exceed the port's estimated maximum capacity by 25% to 35%, topping out in 2042 (2040 w/o Howard).

Estimated Sustainable Capacity at:	Phase VI: High Productivity at all Terminals	2050 Moderate Growth TEU and Maximum Capacity Utilization		2050 Slow Growth TEU and Maximum Capacity Utilization		2050 Strong Growth TEU and Maximum Capacity Utilization	
815/803 Acres	5,625,797	5,187,588	**92%**	3,862,435	69%	7,038,560	125%
775/763 Acres w/o Howard	5,341,307	5,187,588	**97%**	3,862,435	72%	7,038,560	132%
795/783 Acres w/o Berths 20-21	5,483,552	5,187,588	**95%**	3,862,435	70%	7,038,560	128%
755/743 Acres w/o Howard or Berths 20-21	5,199,062	5,187,588	**100%**	3,862,435	74%	7,038,560	135%

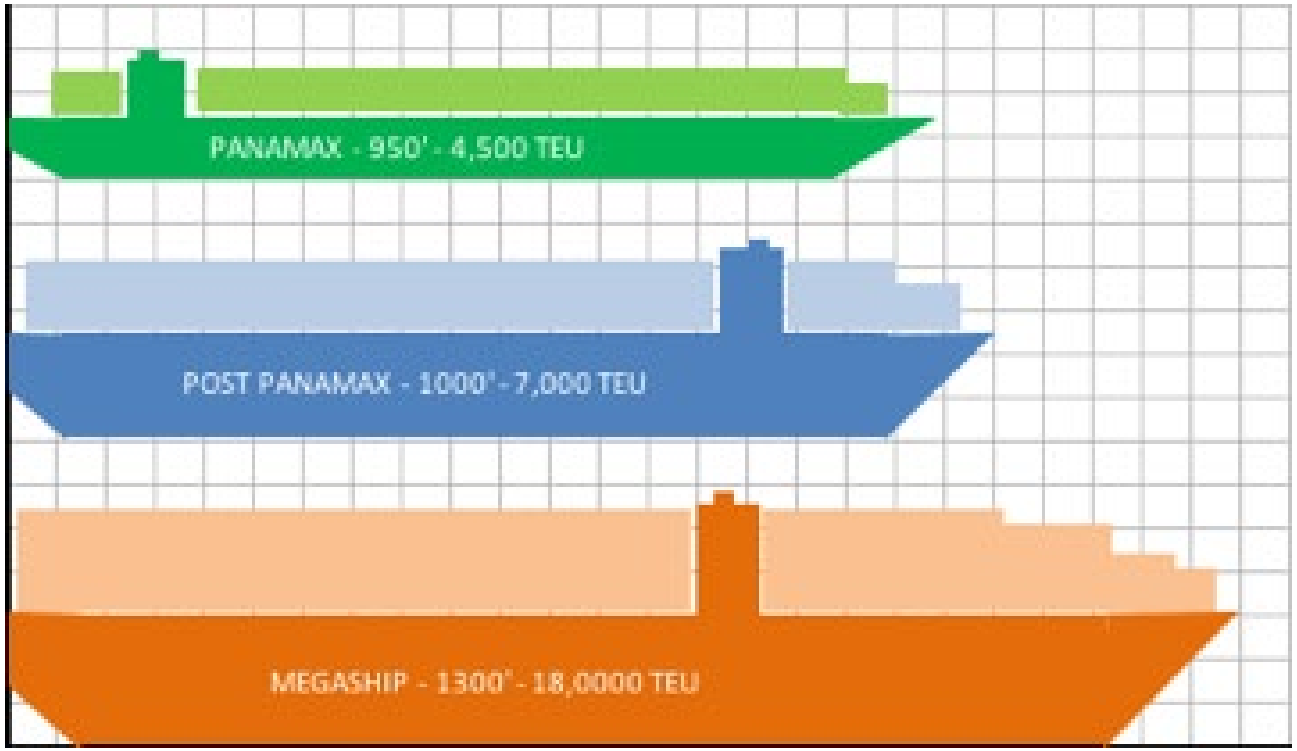
Exhibit 92 p. 88

Container Vessel Size

Average and maximum container ship sizes increasing due to "megaships" of up to 22,000 TEU.

- Container volume surges
- Need for 50' channel depth
- Need for greater berth capacity

Vessel	TEU Capacity	Containers Across	Containers Above/Below Deck	Draft Feet	Beam Feet	Air Draft Feet	LOA Feet	Berth Feet
Panamax	4,000	15	5/6	40	105	117	950	1,055
Post-Panamax	7,000	17	6/9	49	141	138	1,000	1,141
Post-Panamax	9,000	19	6/9	50	158	159	1,200	1,358
NeoPanamax	13,000	20	6/10	50	161	164	1,200	1,361
Megaship	**18,000**	**23**	**9/10**	**52**	**193**	**187**	**1,300**	**1,493**



Exhibits 59 & 60, p. 53

Vessel Size Forecast

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Forecast extended a 2018 Mercator vessel forecast to 2050

- With unlimited vessel sizes
- With a 25,000 TEU cap and split/additional services

Terminal	Service	Schedule Call Day	2019 Vessel Size TEU	Unlimited Vessel Size				25,000 TEU Vessel Cap		
				Mercator/ Tioga 2035	2050 Estimated Dwell Time	2050 Vessel Class	2050 Berth Length Req.	2050 Estimated Dwell Time	2050 Vessel Class	2050 Berth Length Req.
Matson	Hawaii 2	Mon	3,600	4,003	24	5,000	1,114	24	5,000	1,114
Matson	Hawaii 1	Wed	3,600	4,003	24	5,000	1,114	24	5,000	1,114
Nutter	CPS/CC5/AAC2/HBB	Sat	8,530	12,000	36	16,000	1,449	36	16,000	1,449
Nutter	HTW/AAS3/GEX	Sun	7,024	14,000	36	19,000	1,461	36	19,000	1,461
Nutter	TPS/Jade Express/AAS4/S	Wed	13,800	18,000	36	24,000	1,462	36	24,000	1,462
OICT	TP8/Orient/PS4/UPAS1	Fri	9,580	22,000	40	29,000	1,626	40	25,000	1,462
OICT	TP2/Jaguar/PS3/UPAS 2	Tue	13,100	16,000	36	22,000	1,462	40	25,000	1,462
OICT	PSW1/PANZ-PSW/WAS/A	Sat	4,563	6,769	24	9,000	1,242	24	9,000	1,242
OICT	EX1	Fri	5,780	10,000	36	14,000	1,350	36	14,000	1,350
OICT	WAMS/WCCA2/AZTEC1/W	Fri	1,841	2,731	24	4,000	1,004	24	4,000	1,004
OICT	SSEA/Polynesia	Thu	1,304	1,934	24	3,000	898	24	3,000	898
OICT	MPS/MCPS/MPS	Sun/Wed	4,612	6,841	24	9,000	1,242	24	9,000	1,242
OICT	PS2/TP7/Lotus	Fri	6,350	11,000	36	15,000	1,454	36	15,000	1,454
OICT	California Express	Wed	9,400	13,944	36	19,000	1,461	36	19,000	1,461
OICT	Pearl River Express/SC1/P	Fri	14,414	20,900	40	28,000	1,626	40	28,000	1,626

Exhibit 104 p. 97

Berth Capacity Analysis

- Analysis developed multiple berth occupancy scenarios
- Vessels need length + beam (width) for mooring lines
- Mooring lines can overlap
- Dwell time based on vessel size and Oakland experience

Howard berth reduced to 981 feet for IHTB)

Exhibit 94 p. 89

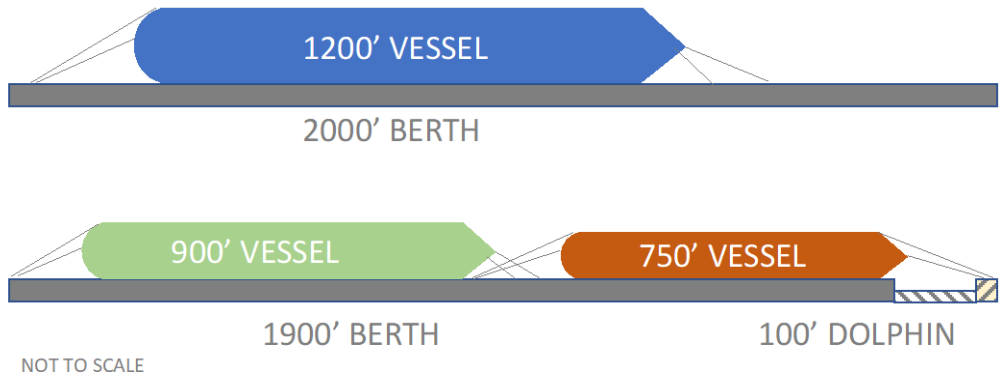
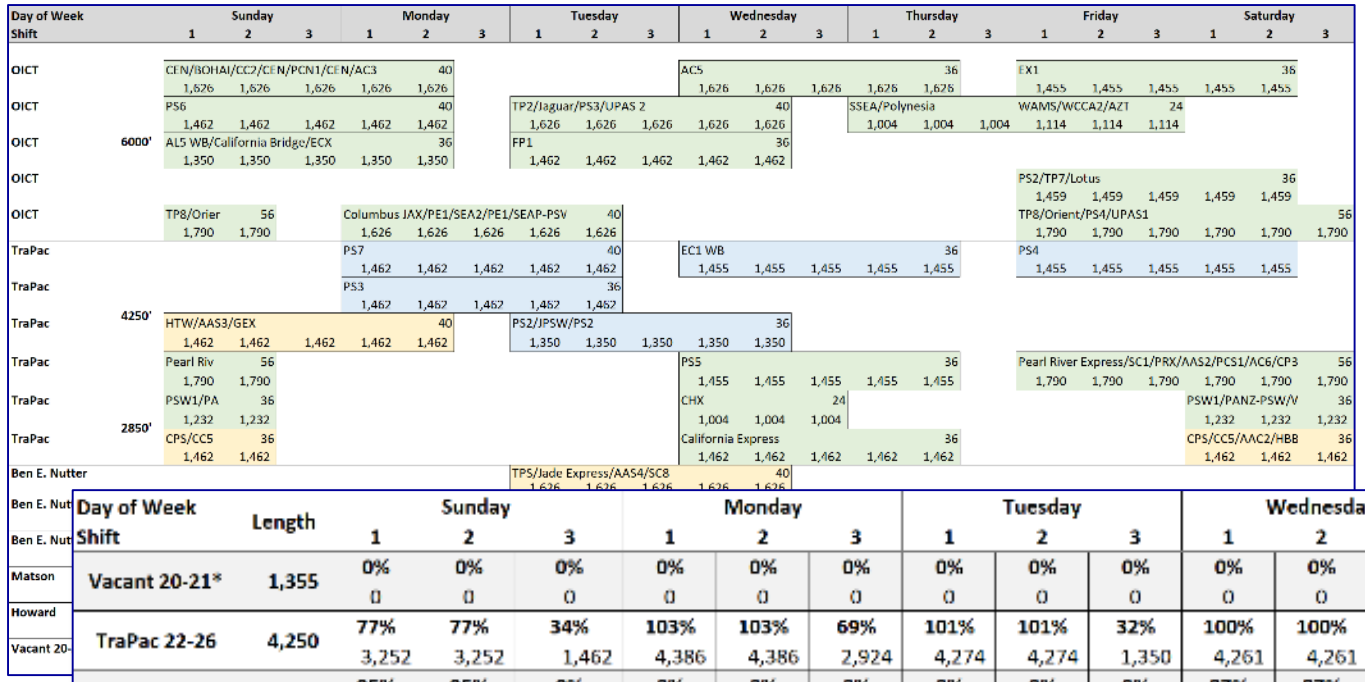


Exhibit 96 p. 90

Moderate Growth Berth Occupancy



Day of Week	Length	Sunday			Monday			Tuesday			Wednesday			Thursday			Friday			Saturday		
Shift		1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Vacant 20-21*	1,355	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0
TraPac 22-26	4,250	77% 3,252	77% 3,252	34% 1,462	103% 4,386	103% 4,386	69% 2,924	101% 4,274	101% 4,274	32% 1,350	100% 4,261	100% 4,261	68% 2,910	68% 2,910	68% 2,910	0% -	76% 3,245	76% 3,245	76% 3,245	76% 3,245	76% 3,245	42% 1,790
TraPac 30-33	2,850	95% 2,694	95% 2,694	0% -	0% -	0% -	0% -	0% -	0% -	0% -	87% 2,466	87% 2,466	87% 2,466	51% 1,462	51% 1,462	0% -	0% -	0% -	0% -	95% 2,694	95% 2,694	95% 2,694
BEN 35-37	2,257	60% 1,350	60% 1,350	60% 1,350	60% 1,350	60% 1,350	0% -	72% 1,626	72% 1,626	72% 1,626	72% 1,626	72% 1,626	0% -	60% 1,350	60% 1,350	60% 1,350	60% 1,350	60% 1,350	0% -	0% -	0% -	0% -
BEN 38	850	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -
OICT 55-59	6,000	104% 6,228	104% 6,228	74% 4,438	101% 6,064	101% 6,064	27% 1,626	79% 4,714	79% 4,714	51% 3,088	79% 4,714	79% 4,714	27% 1,626	44% 2,630	44% 2,630	17% 1,004	97% 5,819	97% 5,819	97% 5,819	78% 4,704	78% 4,704	30% 1,790
Matson 60-63	2,743	0% -	0% -	0% -	41% 1,111	41% 1,111	41% 1,111	0% -	0% -	0% -	41% 1,111	41% 1,111	41% 1,111	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -
Howard 67-68**	981	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -	0% -

*Proposed for dry bulk

** Reduced by 965' for turning basin expansion and a further 70' for loss of dolphin

"Manual" allocation of berth space

- Ignored company affiliation
- Capped daily utilization at ≈105%

Exhibits 110 & 111, p. 101

Berth Capacity Implications

Tioga

- Analyzed both unconstrained vessel size and capped at 25,000 TEU capacity
- Average weekly utilization rises to 70+% at TraPac and OICT
- Howard and Berths 20-21 may not be required in Slow and Moderate Growth scenarios
- Berths 20-21 required in Strong Growth scenario
- At 981 feet post-IHTB, Howard may be too small for 2050 container vessels

	Unconstrained			25,000 TEU Vessel Cap	
	Moderate	Slow	Strong	Moderate	Strong
Vacant 20-21*	0%	0%	**47%**	0%	**69%**
TraPac 22-26	73%	64%	71%	70%	65%
TraPac 30-33	40%	35%	40%	50%	52%
BEN 35-37	46%	32%	34%	42%	44%
BEN 38	0%	0%	0%	0%	0%
OICT 55-59	71%	61%	63%	55%	63%
Matson 60-63	12%	12%	12%	12%	12%
Howard 67-68**	0%	0%	0%	0%	0%

*Proposed for dry bulk

** Reduced by 965' for turning basin expansion and a further 70' for loss of dolphin

New Exhibit

Ancillary Service Space

For the Seaport Plan, relevant ancillary functions are those with strong reasons to be located in the immediate port facility:

- Overnight parking for drayage tractors, containers on chassis, and bare chassis
- Short-term truck parking
- Truck services
- Heavy cargo facilities
- Reefer container depots

The Port is committed to 15 acres for overnight truck parking

Year	Drayage Tractor Parking	Container/ Chassis Parking	Short-Term Parking	Truck Services	Heavy Cargo Facilities	Working Reefer Depots	Total Core Service Acres	Port Land	Est. Usable Port Land (90%)	Gap
2000	5	7	1	4	36	18	71	125	113	-
2005	7	8	2	4	44	24	88	180	162	-
2010	9	10	2	7	56	30	114	155	140	-
2015	12	12	5	7	70	38	143	130	117	26
2020	16	14	8	8	85	47	178	105	95	84

Exhibit 122, p. 110

Exhibit 121, p. 109

Ancillary Service Needs

Tioga

Adequate space within Port complex for ancillary services to support projected cargo growth in all three scenarios

- Early 2019: 314 acres in use, under development, or available
- 2050 requirements range from 167 in Slow Growth to 269 in Strong Growth

Acres Required	Truck Services	Overnight Truck Parking	Short-Term Truck Parking	Heavy Cargo Transloading	Reefer Depots	Total
Moderate Growth	8	30	3	109	59	**209**
Slow Growth	8	28	3	82	45	**167**
Strong Growth	8	30	4	147	80	**269**
Acres in Ancillary Use and Available	**Seaport Logistics Complex**	**555 Maritime St Complex**	**Outer Harbor**	**City of Oakland**	**Union Pacific**	**Total**
As of Early 2019	149	78	13	63	11	**314**

Exhibit 134, p. 119

Ro-Ro Import Forecast

Tioga

Moderate Growth:

- 2019-2021: Vehicle sales decrease: slowing economy + trade disputes
- 2022-2025: Vehicle sales increase: economy rebounds
- 2026-2035: Vehicle sales increase: slightly faster than population
- 2036-2050: Vehicle sales increase: slower, in line with population and transition to shared vehicles

Slow Growth:

- Vehicle sales under-perform 2022-2025 forecast and increase with population 2026-2048

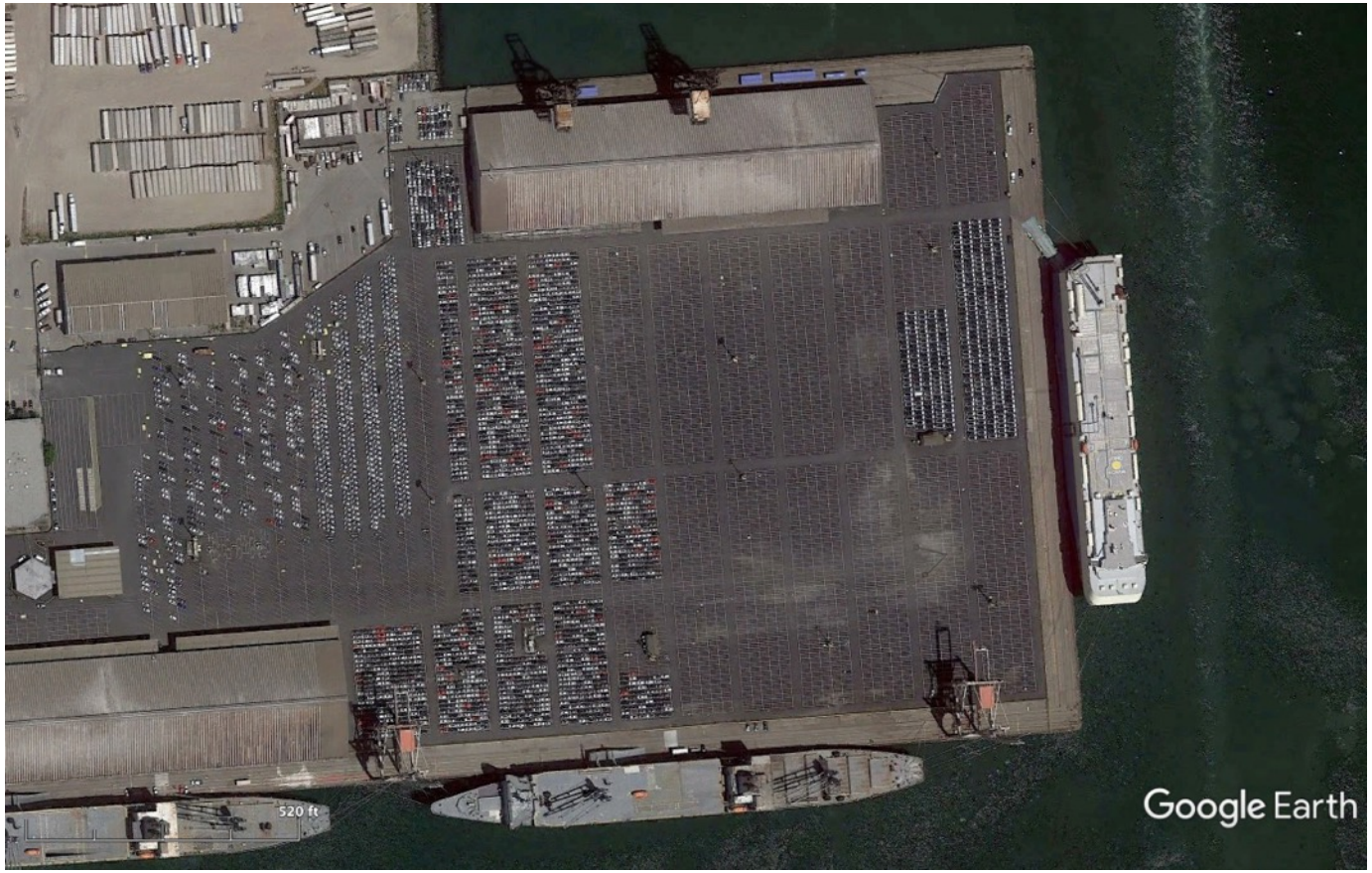
Strong Growth:

- Vehicle sales outperform the 2019-2021 CAR forecast and increase faster than population 2026-2048

Ro-Ro Export Forecast

Exports – driven by electric vehicle exports

- Moderate Growth: weekly vessel call
- Slow Growth: bi-weekly vessel call through 2028, then tri-weekly
- Strong Growth: twice-weekly vessel call from 2022 onward



2050 Bay Area Ro-Ro Vehicle Count Forecast

Tioga

Moderate Growth Scenario

- Vehicle count increases at 1.0% CAGR
- 489k vehicles by 2050

Slow Growth Scenario

- Vehicle count increases at 0.5% CAGR
- 425k vehicles by 2050

Strong Growth

- Vehicle count increases at 1.7% CAGR
- 618k vehicles by 2050

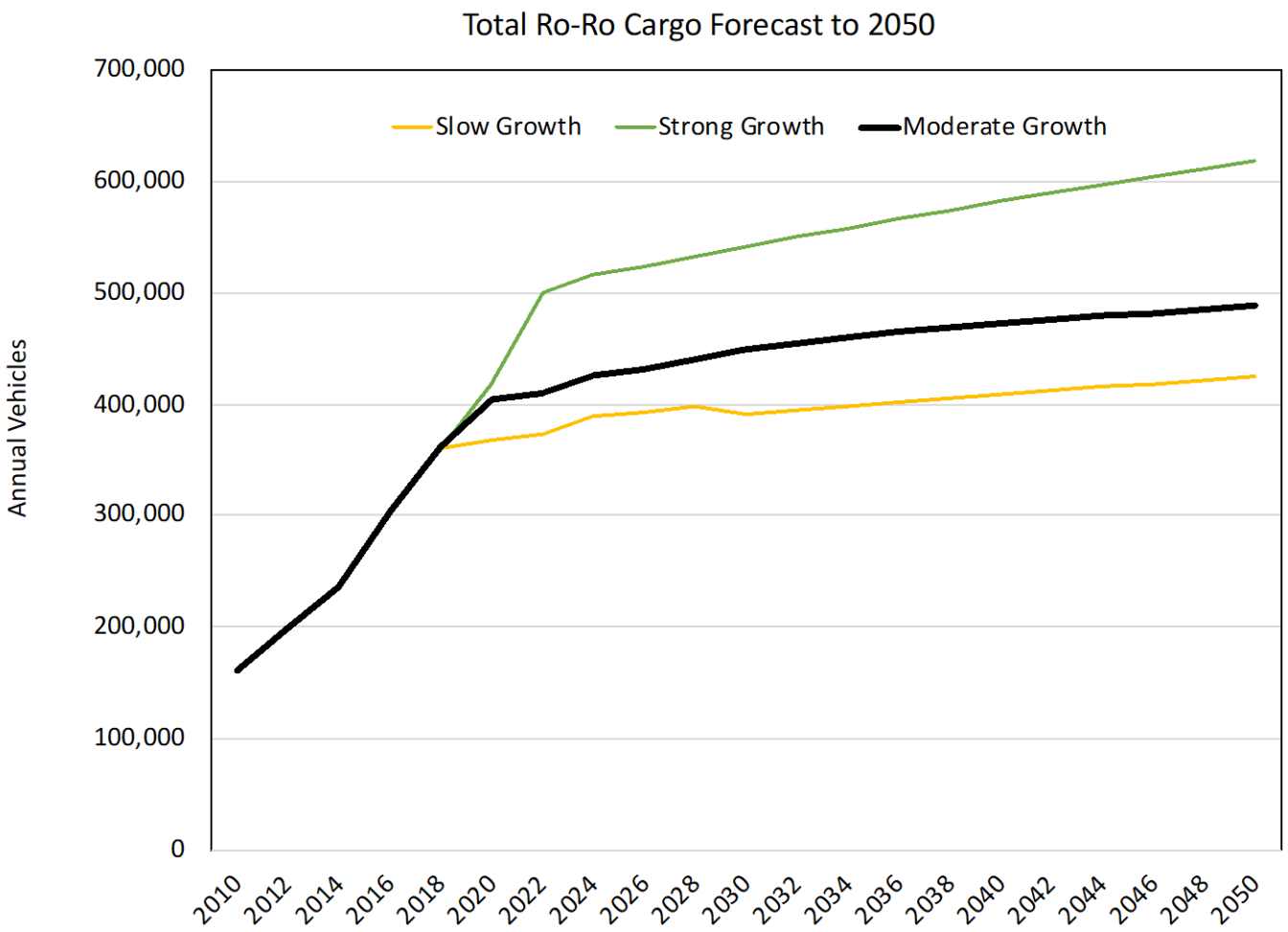
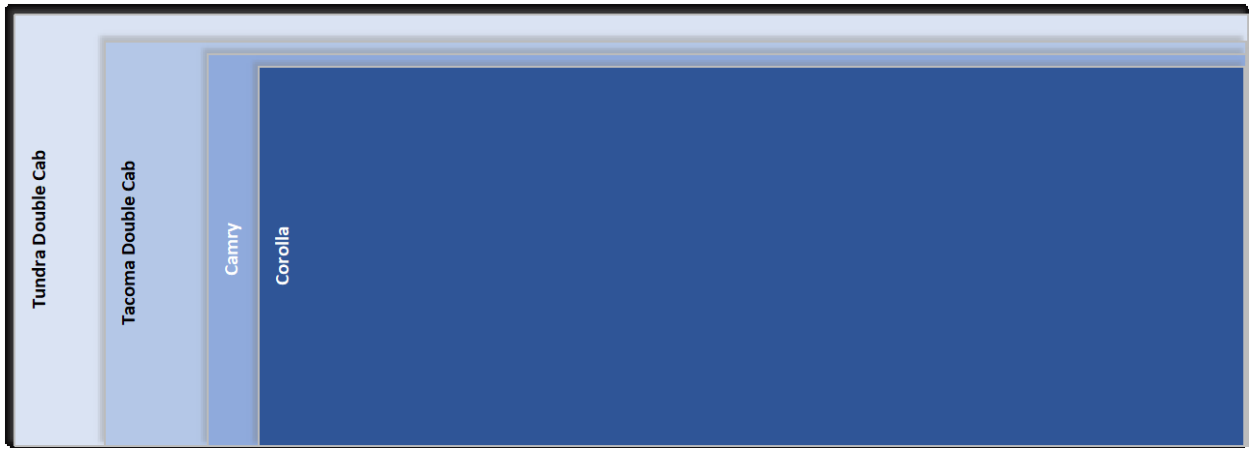


Exhibit 147, p. 133

Ro-Ro Terminal Productivity

Tioga

- Productivity scenarios affected by vehicle mix and average dwell days.
- Larger vehicles, especially dual-cab trucks, take up more terminal space
- Local deliveries dwell longer than rail shipments
- Base scenario assumes units/acre remains stable at 2018 levels.
  - Low: 19% less efficient
  - High: 28% more efficient



Case	Average Dwell Days	Unit Size Distribution - Square feet				Occupancy Index	% Change	Annual Units per Acre
		Compact 88.8	Mid-Size 96.6	Truck 109.7	Average			
Low Productivity	18	25%	50%	25%	97.9	1,763	24%	**1,371**
Base Case	15	40%	50%	10%	94.8	1,422	na	**1,700**
High Productivity	12	50%	50%	0%	92.7	1,113	-22%	**2,173**

Exhibit 151, p. 136

Scenario	2018	2020	2022	2024	2026	2028	2030
Low Productivty Units/Acre	1,700	1,640	1,583	1,527	1,473	1,421	1,371
Base Productivty Units/Acre	1,700	1,700	1,700	1,700	1,700	1,700	1,700
High Productivty Units/Acre	1,700	1,771	1,845	1,922	2,002	2,086	2,173

Exhibit 152, p. 136

Ro-Ro Terminal Capacities

Tioga

- Benicia and Richmond are near capacity
- SF Pier 80 is handling Tesla export growth
- SF Pier 96 and Howard Terminal are logical expansion candidates

Terminal	Acres	Low Capacity	Base Case Capacity	High Capacity
Annual Units per Acre		**1,371**	**1,700**	**2,173**
Existing	**215**	**294,859**	**365,500**	**467,146**
Benicia	75	102,858	127,500	162,958
Richmond Pt. Potrero	80	109,715	136,000	173,822
SF Pier 80	60	82,286	102,000	130,366
Potential	**103**	**141,258**	**175,100**	**223,795**
SF Pier 96	53	72,686	90,100	115,157
Oakland Howard Terminal	50	68,572	85,000	108,639
Total	**318**	**436,117**	**540,600**	**690,941**

Removal of 10 acres of terminal space at Howard reduces capacity by between 14,000 and 22,000 units

Exhibit 155, p. 139

Bay Area: Ro-Ro Capacity Requirements

Tioga

- Moderate growth/ Base Case productivity needs 73 additional acres
- Slow/Base Case needs 35 acres
- Strong/High Case needs 69 acres

Scenario	2018	2020	2030	2040	2050	Existing Acres	New Acres	CAGR
Slow Growth	**360,671**	**368,207**	**390,388**	**409,298**	**424,892**			**0.5%**
Low Prod. Acres	212	224	285	298	310	215	95	1.2%
Base Prod. Acres	212	217	230	241	250	215	35	0.5%
High Prod. Acres	212	208	180	188	196	215	(19)	-0.3%
Moderate Growth	**360,671**	**404,607**	**448,696**	**472,768**	**488,768**			**1.0%**
Low Prod. Acres	212	247	327	345	356	215	141	1.7%
Base Prod. Acres	**212**	**238**	**264**	**278**	**288**	**215**	**73**	**1.0%**
High Prod. Acres	212	228	207	218	225	215	10	0.2%
Strong Growth	**360,671**	**418,831**	**541,505**	**582,249**	**617,923**			**1.8%**
Low Prod. Acres	212	255	395	425	451	215	236	2.5%
Base Prod. Acres	212	246	319	342	363	215	148	1.8%
High Prod. Acres	212	236	249	268	284	215	69	0.9%

Exhibit 154, p. 138

Forecast and Capacity Analysis: Dry Bulk

Tioga

- Bay Area ports handle a variety of dry bulk cargo:
  - Import sand and gravel at Redwood City and San Francisco
  - Harvested bay sand at Redwood City and San Francisco
  - Import bauxite and slag at Redwood City
  - Import gypsum at Richmond and Redwood City
  - Export scrap metal at Redwood City, Richmond, and Schnitzer Steel in Oakland Harbor
  - Export petroleum coke at Benicia and Levin Richmond Terminal
  - Export coal at Levin Richmond Terminal

- Dominated by construction industry needs

Dry Bulk Forecast Methodology

Tioga

- Forecast prepared for each cargo type

- Reported shortfall in permitted reserves of sand & gravel implies import substitution, although long-term supply fluctuates
  - 2018 - estimated that imported sand & gravel met 8.1% of demand
  - 2050 - share of imported sand & gravel projected to increase to:
    - Moderate Growth: 30%
    - Slow Growth: 15%
    - Strong Growth: 50%

2050 Dry Bulk Forecast

Tioga

Major sources of growth are:

- Imported aggregates (sand & gravel) due to import substitution
- Exported scrap metal

Other commodities show little or no growth

2050 Tonnage	Gypsum	Aggregates	Bauxite & Slag	Export Scrap	Export Pet Coke	Export Coal	Total Dry Bulk
Moderate Growth	515,913	14,348,832	274,082	4,357,345	562,112	596,259	20,654,542
2018-2050 CAGR	1.0%	4.8%	2.0%	1.7%	0.0%	-1.6%	3.1%
Slow Growth	454,003	7,174,416	241,698	3,268,008	346,563	540,755	12,025,443
2018-2050 CAGR	0.6%	2.5%	1.6%	0.8%	-1.5%	-1.9%	1.4%
Strong Growth	644,891	23,914,720	301,089	6,455,325	618,661	1,248,921	33,183,607
2018-2050 CAGR	1.7%	6.5%	2.3%	3.0%	0.3%	0.7%	4.6%

New Exhibit

2050 Bay Area Dry Bulk Forecast

Tioga

Sand & gravel imports are the major dry bulk demand driver

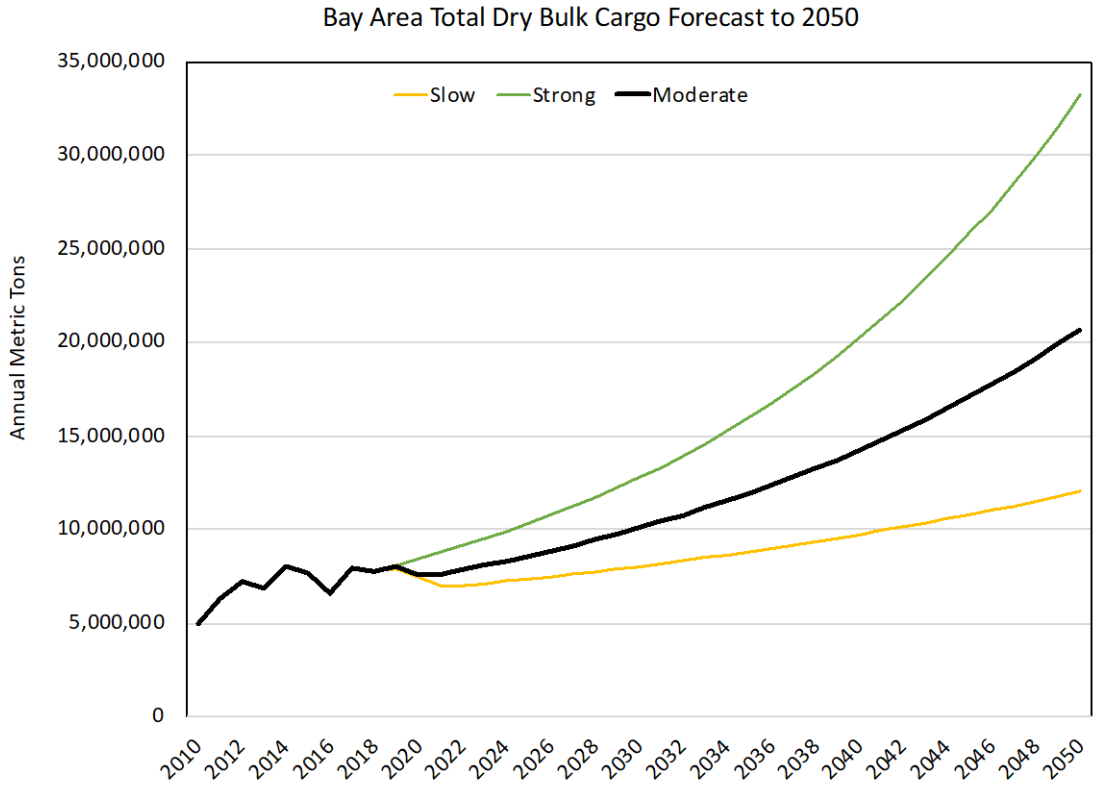
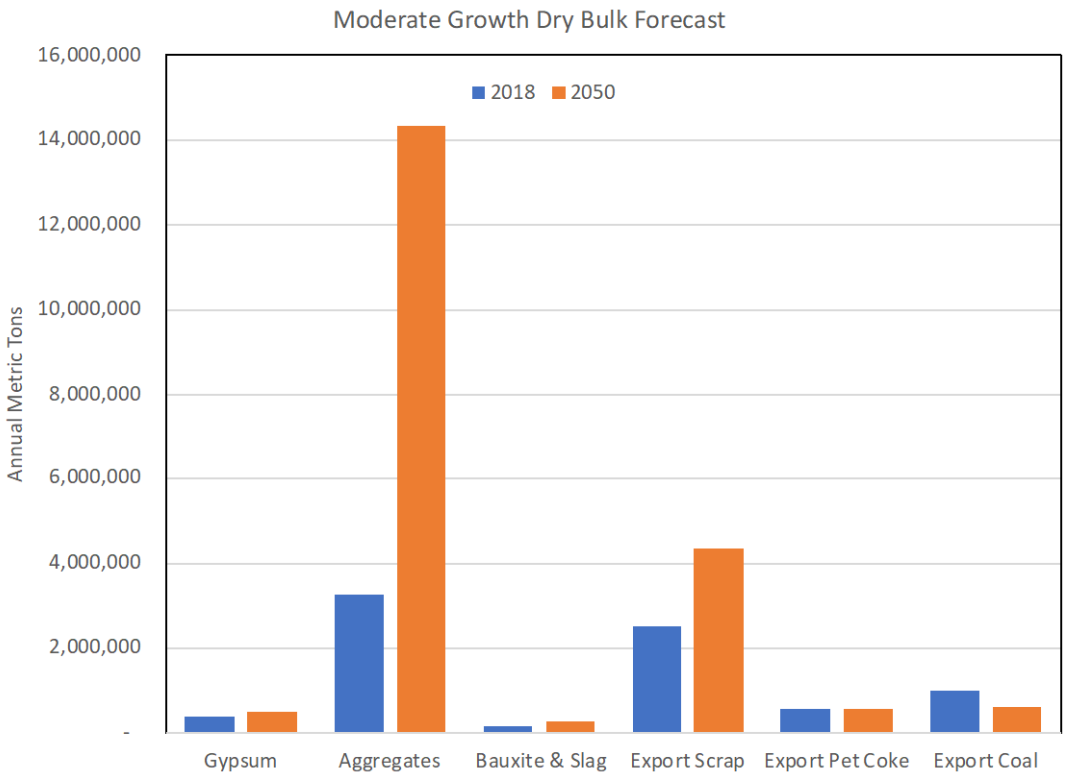


Exhibit 177, p. 159



New Exhibit

Dry Bulk Capacity Needs

Tioga

Depending on throughout per acre, the Bay Area may need 24-73 additional acres of dry bulk terminal space by 2050

- Throughput depends on storage capacity and dwell time
- Proposed Berth 20-21 terminal at Oakland would move 100,000 annual tons per acre.
- Proposed OBOT (not on Seaport Plan land) would move 325,000 annual tons per acre

Factor	Existing	Moderate Growth	Slow Growth	Strong Growth
Annual Metric Tons	7,801,857	20,654,542	12,025,443	33,183,607
Tonnage increase	na	145%	48%	284%
Acres	**166**	**200**	**190**	**239**
MT/Acre	47,141	103,500	63,455	317,073
Acres per Terminal	13.8	13.8	13.4	14.9
Teminals	**12**	**15**	**14**	**16**
MT/Berth	650,155	1,423,120	843,577	2,402,750
Berths	**12**	**15**	**14**	**16**
New Acres		**34**	**24**	**73**
New Berths		**3**	**2**	**4**

Exhibit 195, p. 168

Dry Bulk Capacity Options

Tioga

- **Oakland's Pier 20-21:** active proposal to use portion for dry bulk aggregates
- **SF Pier 96:** adjacent to the active Pier 94 Hanson Aggregate terminal, part of Pier 94–96 complex that formerly handled containers and other cargoes
- **Howard Terminal:** capable of handling dry bulks
- **Richmond's Terminal 3:** could handle dry bulk cargo under some circumstances.
- **Levin Richmond Terminal:** potential transition from coal/coke to other dry bulk
- **Oakland Bulk and Oversized Terminal (OBOT):** Oakland Army Base "Gateway Development Area", not on Seaport Plan land, proposed dry bulk handling, specifically export coal but faces strong local opposition

Forecast and Capacity Analysis: Other Cargo

Break Bulk

- Bay Area ports do not currently handle any break-bulk cargo, but have done so in the past and may be needed to do so in the future

Liquid Bulk

- Single-purpose terminals: most are under private ownership.

Estimated Seaport Acreage Requirements

Tioga

- With moderate cargo growth the Bay Area will need more active terminal space, estimated at about **271 acres** by 2050.
- With slow cargo growth the Bay Area need about **36 acres** more active terminal space by 2050.
- With strong cargo growth, the Bay Area will need about **646 more acres** than is now active (and additional berth space for larger container vessels).

Forecast Scenario	Container Cargo Terminal Acres			Ro-Ro Cargo Terminal Acres			Dry Bulk Cargo Terminal Acres			Combined Cargo Terminal Acres		
	Existing*	2050**	Additonal	Existing	2050***	Additonal	Existing	2050***	Additonal	Existing	2050	Additonal
Moderate Growth	565	729	164	215	288	73	166	200	34	**946**	**1,216**	**271**
Slow Growth	565	543	(22)	215	250	35	166	189	23	**946**	**982**	**36**
Strong Growth	565	990	425	215	363	148	166	239	73	**946**	**1,592**	**646**

* In-use Acreage at Port of Oakland

** At maximum mainstream productivity

** *Under base productivity assumptions

Exhibit 199, p. 174

Bay Area Seaport Expansion Sites

Tioga

About 320 acres of land available:

- SF 96 partly in non-cargo use
- Oakland berths 20-21, proposed for dry bulk
- Oakland Berths 22-24 & 33-34, expected container use
- Oakland Roundhouse potential expansion of Matson terminal
- Oakland Howard at 38 acres and 981 feet post-IHTB
- Richmond T-3, now in transloading use

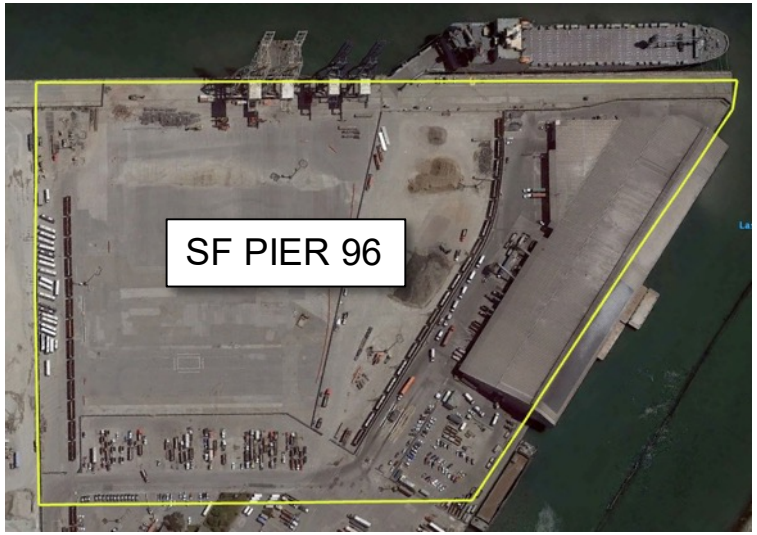
Site	Acres	Potential Use		
		Container	Ro-Ro	Dry Bulk
SF Pier 96	50		X	X
Oakland Berths 20-21	23	X		X
Oakland Berths 22-24	130	X		
Oakland Berths 33-34	20	X		
Oakland Roundhouse	39	X		
Oakland Howard*	38	X	X	X
Richmond Terminal 3	20		X	X
Available Acres	**320**	**189-250**	**0-108**	**0-131**
Moderate Growth Needs	271	164	73	34
Slow Growth Needs	36	-22	35	23
Strong Growth Needs	646	425	148	73

* Post turning basin expansion

Exhibit 200, p. 175

Available Port Sites

Tioga



2050 Forecast & Capacity Findings

Tioga

Overall, Bay Area 2050 seaport capacity will be:

- Tight with moderate growth
- Ample with slow growth
- Inadequate with strong growth

Oakland could probably handle moderate container cargo growth without Howard Terminal or Berths 20-21, but with little or no room for future growth

- Strong growth would exhaust Oakland's total capacity unless terminals can boost productivity higher than anticipated.

Bay Area could probably meet moderate Ro-Ro cargo growth needs at SF Pier 96 and Richmond's Terminal 3

- Strong growth would introduce a conflicting demand for Howard Terminal's acreage

Dry cargo capacity needs may conflict with the availability of SF Pier 96, Oakland's Berth 20-21, or Howard Terminal for Ro-Ro or container cargo.

Oakland’s Howard Terminal

Tioga

On Oakland's Inner Harbor

- 50 acres
- 2,016’ berth including a 70’ dolphin
- 42’ depth

Used for Matson container operations until 2014

Used since for ancillary services, training, and layberthing

Exhibit 203, p. 179

Inner Harbor Turning Basin

Tioga

Preliminary turning basin expansion study:

- Loss of a minimum of 965’ of berth + dolphin, leaving 981’ of berth
- Loss of 10 acres of land

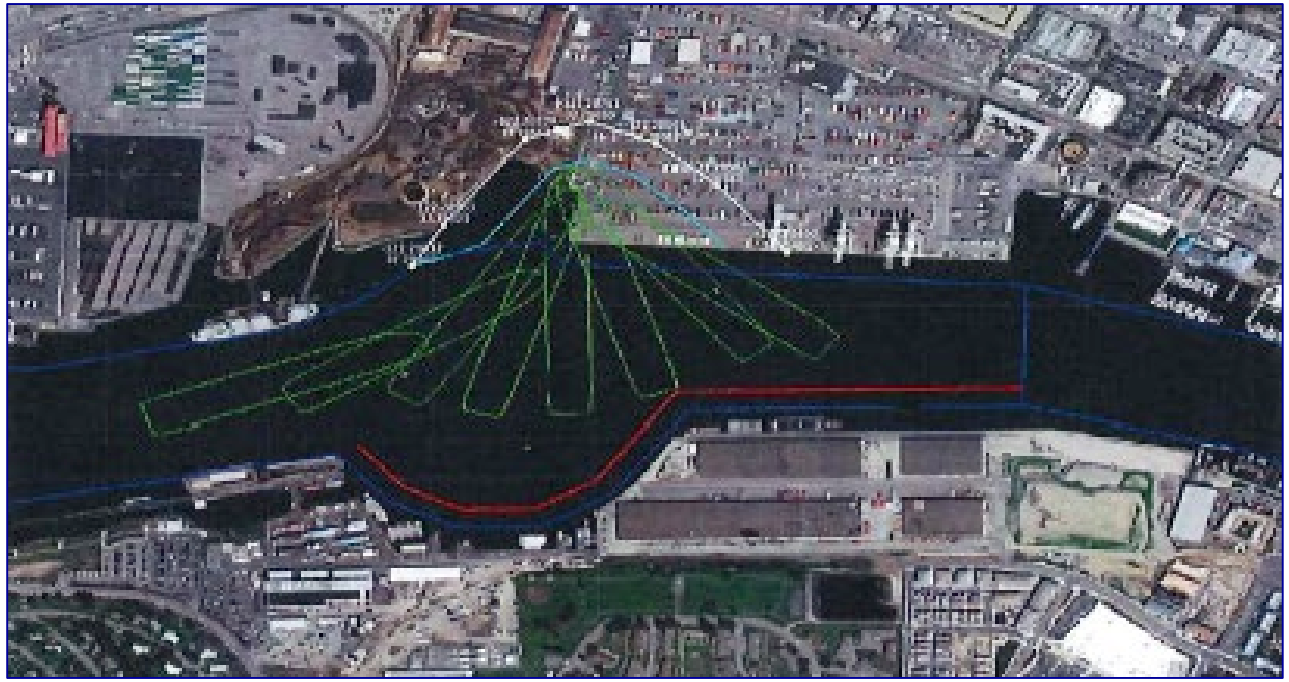


Exhibit 205, p. 181

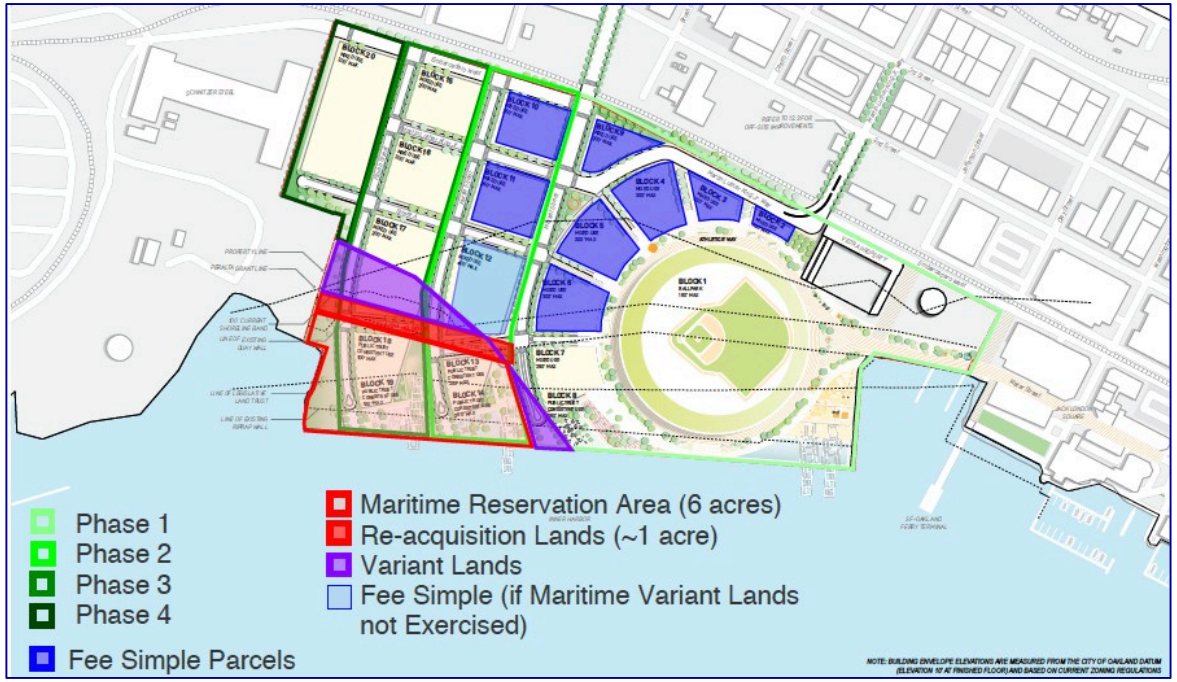


Exhibit 206, p. 181

Howard Terminal Cargo Uses

Tioga

Container Cargo

- Slow and Moderate Growth scenarios may not require Howard's acreage
- Strong growth scenario would definitely require Howard's acreage
- Use of Berths 20–21 for dry bulk cargo would increase the need for Howard
- Truncated berth after turning basin expansion might limit Howard's utility as a stand-alone container terminal

Ro-Ro Cargo

- Could fill some of the need for additional Bay Area capacity under a moderate growth scenario, especially for exports
- Could require rail connectivity and processing facilities

Dry Bulk Cargo

- Could handle dry bulk
- Use of Berths 20–21 or the development of OBOT for dry bulk would reduce the need.

Potential Role of Oakland's Howard Terminal

Tioga

Bay Area seaports are expected to be at or near capacity by 2050 with moderate cargo growth and productivity assumptions

- Howard Terminal would be one option to supply part of that acreage, but cannot serve all three cargo types
- If Howard Terminal is used for container cargo, other sites must accommodate the need for Ro-Ro and dry bulk capacity
- If Howard Terminal's long-term ability to handle containers is compromised by a truncated berth, Ro-Ro or dry bulk cargo may be a more suitable use