



NTSB National Transportation Safety Board

Office of Aviation Safety

Helicopter Performance **John O'Callaghan**



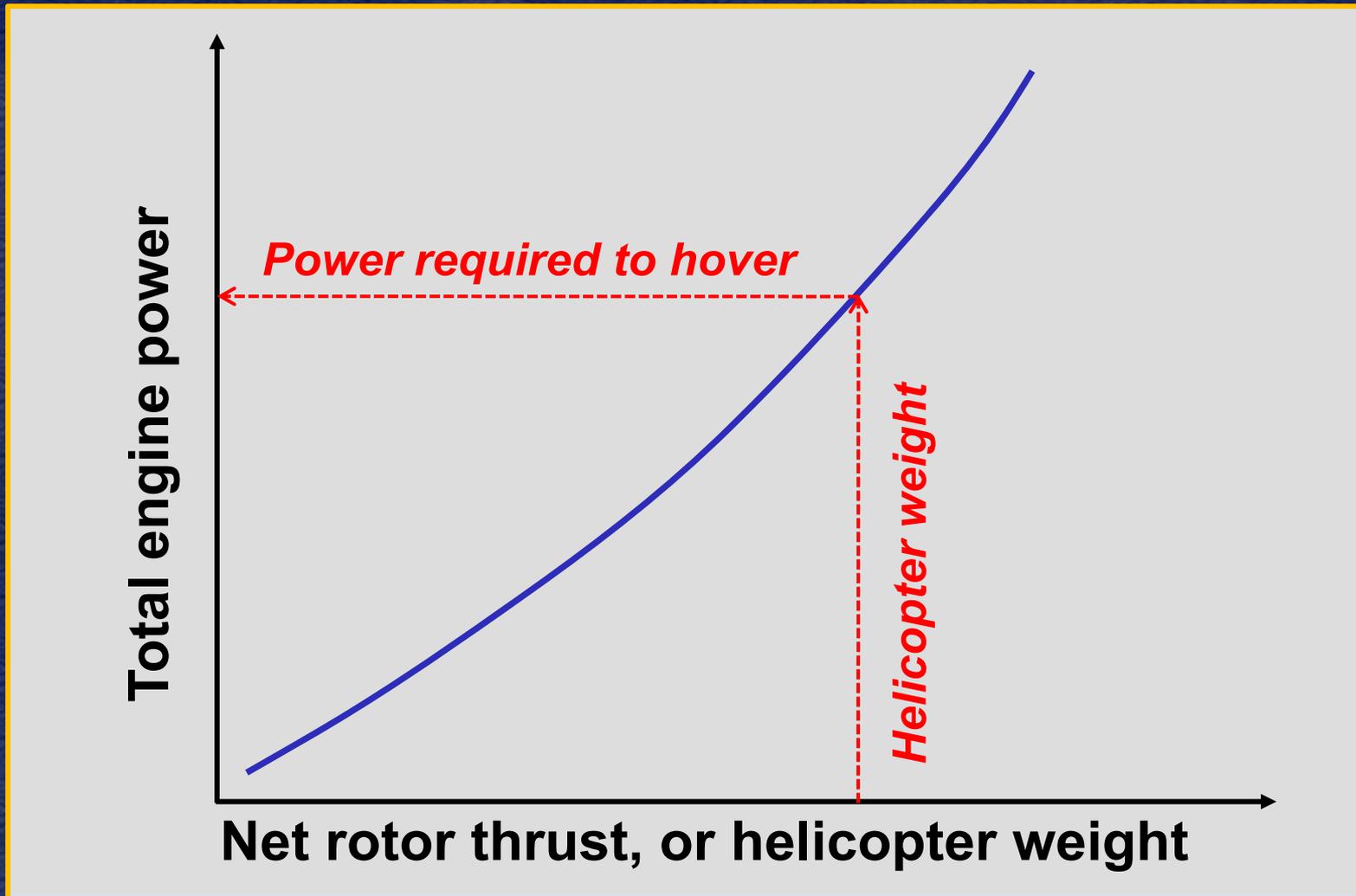
Carson Helicopters S-61N
Operated by U.S. Forest Service
Weaverville, CA
August 5, 2008

Carson Helicopters

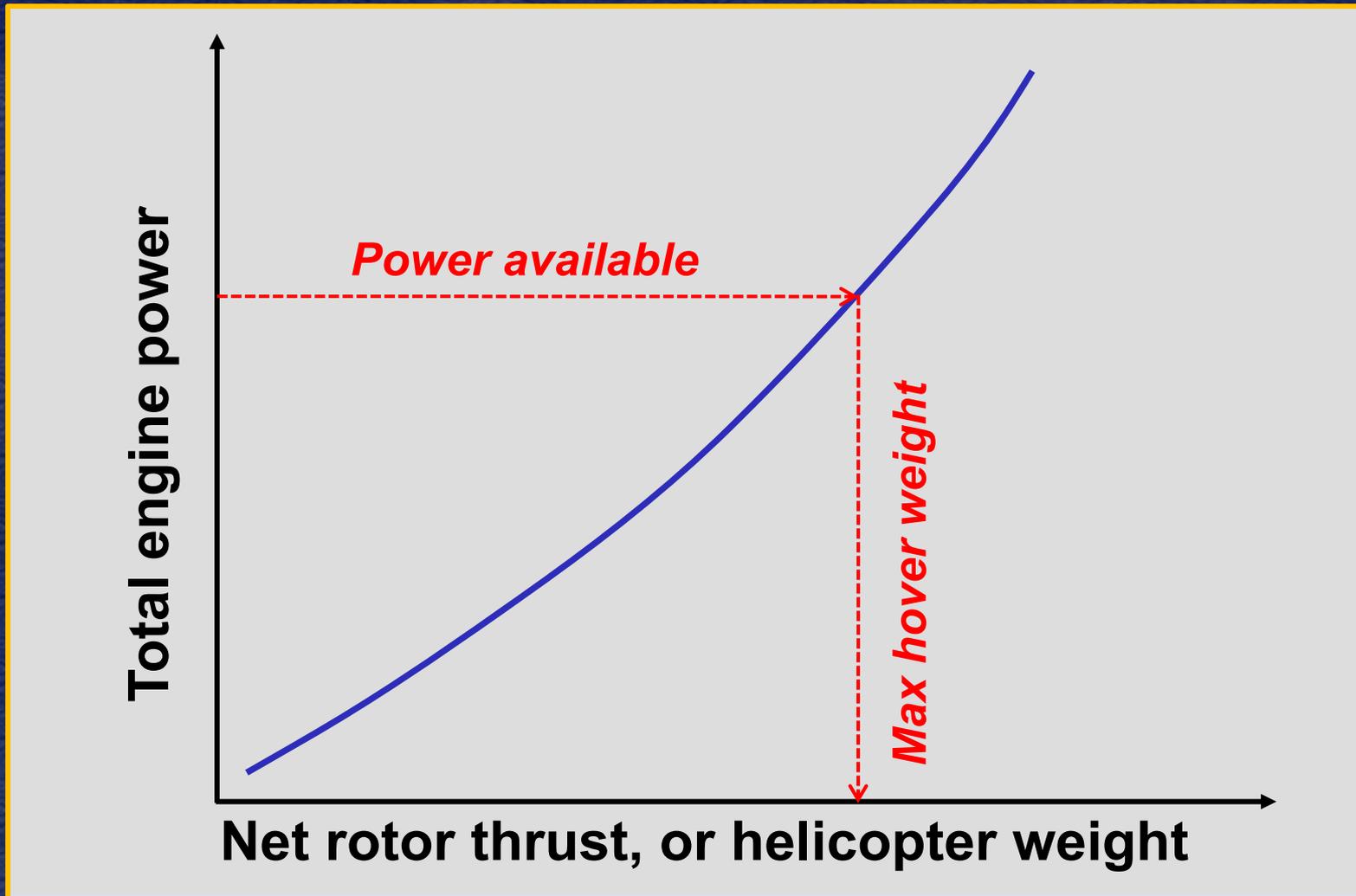
Topics

- Hover performance
- Ground effect
- Translational lift
- Hover performance of S-61N with Carson Composite Main Rotor Blades (CMRBs)
 - Carson RFMS #8
 - Sikorsky 2010 prediction
- Simulations of accident takeoff

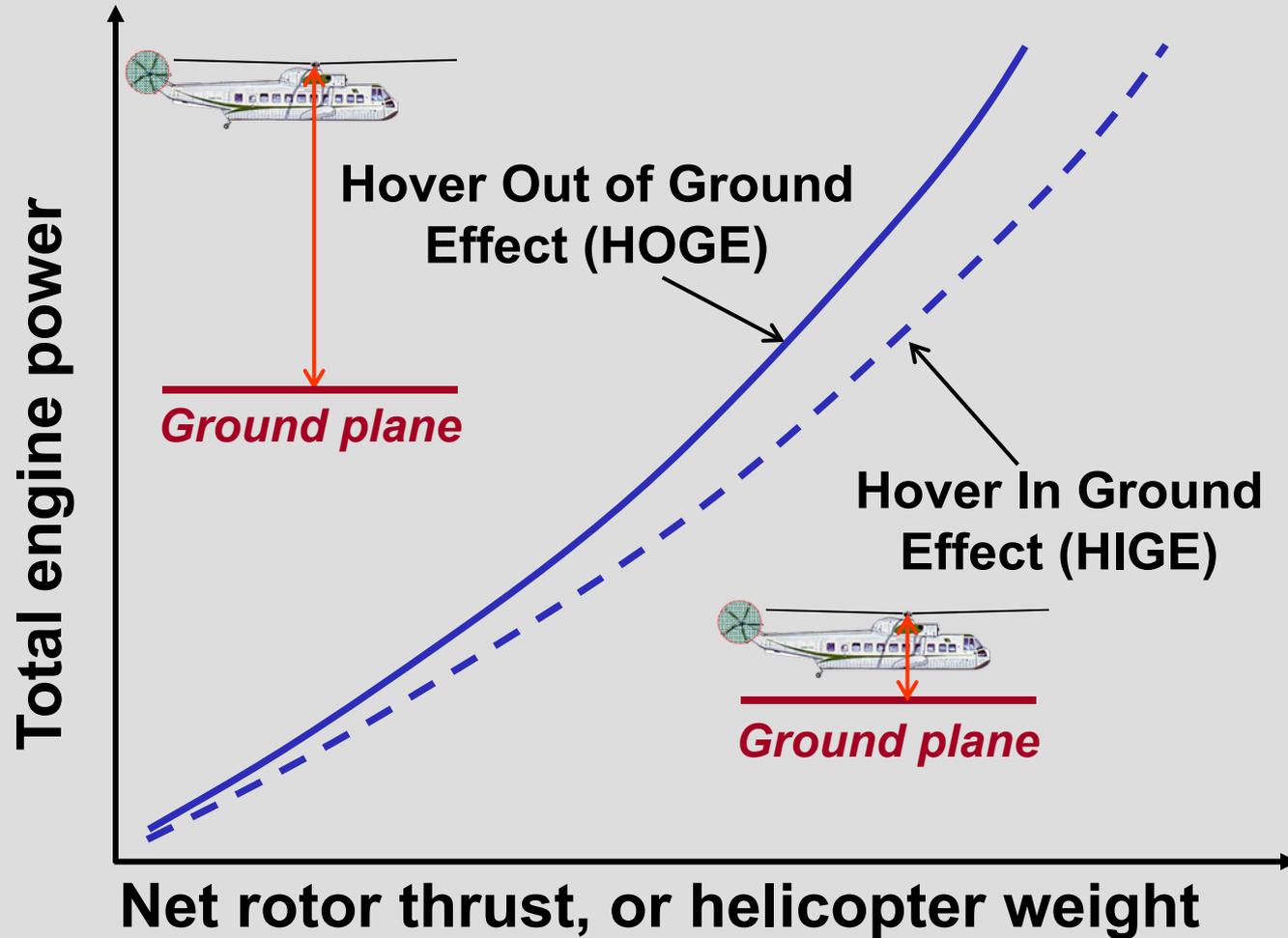
Hover Performance



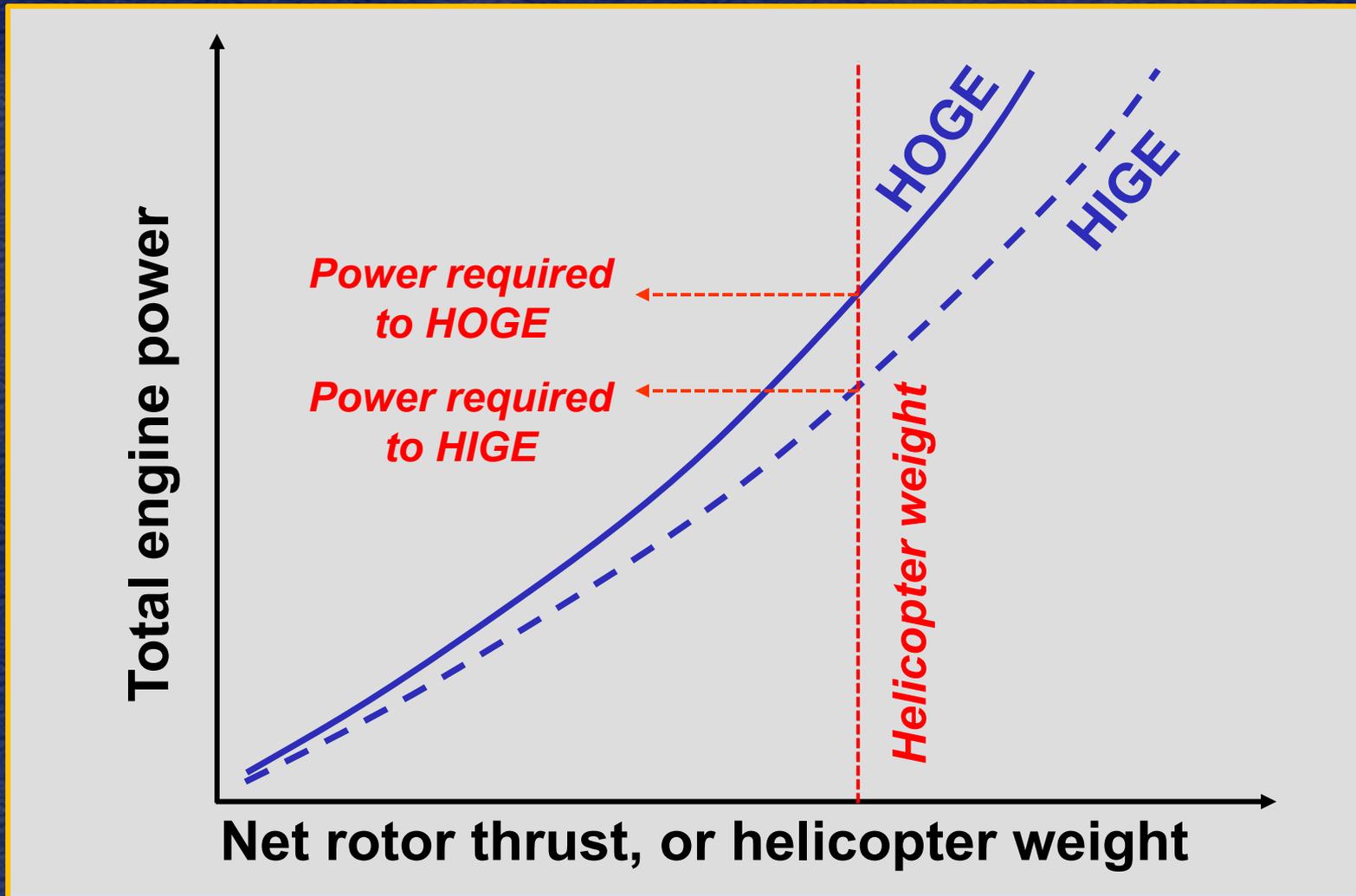
Hover Performance



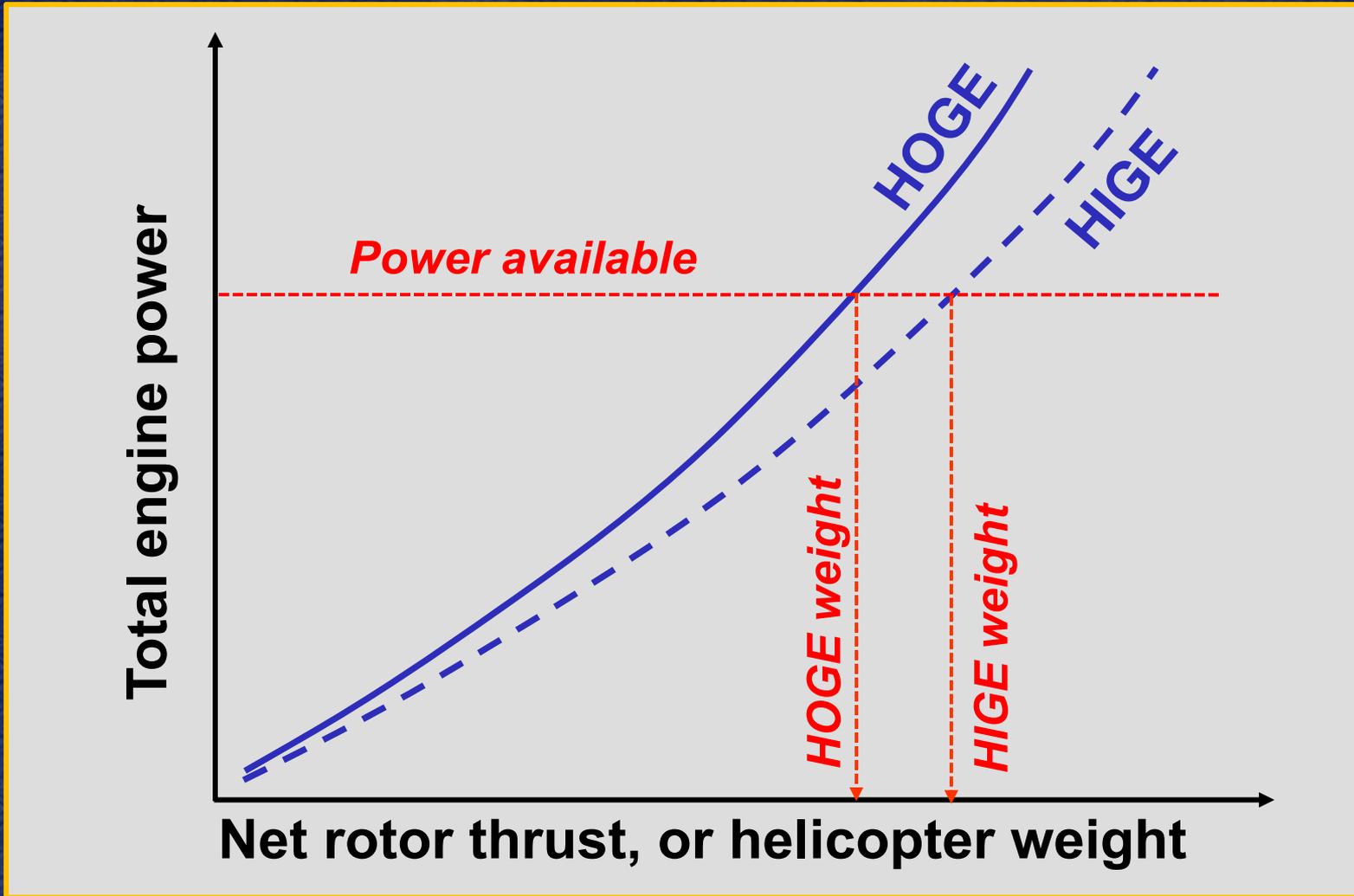
Ground Effect



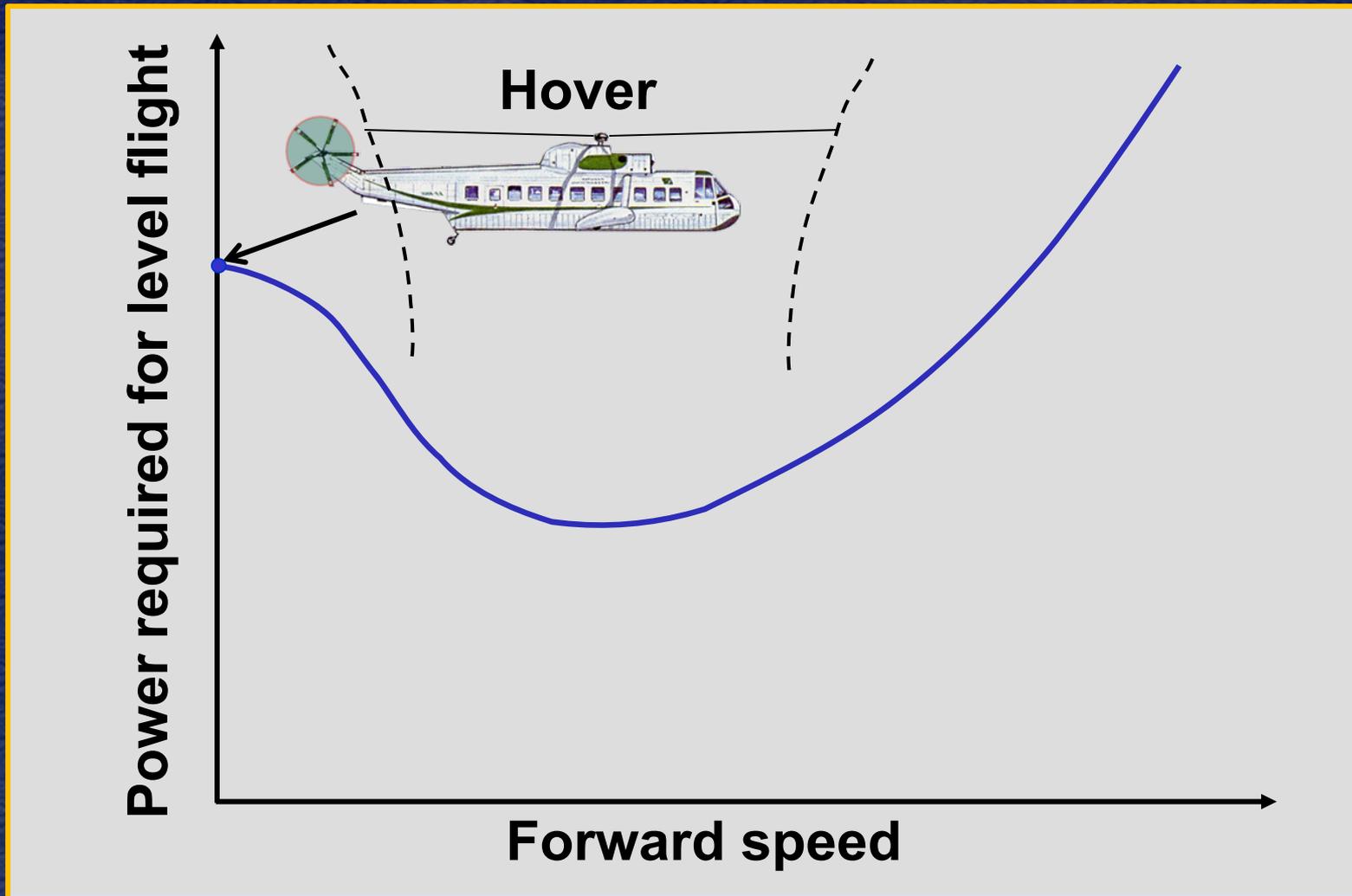
Ground Effect



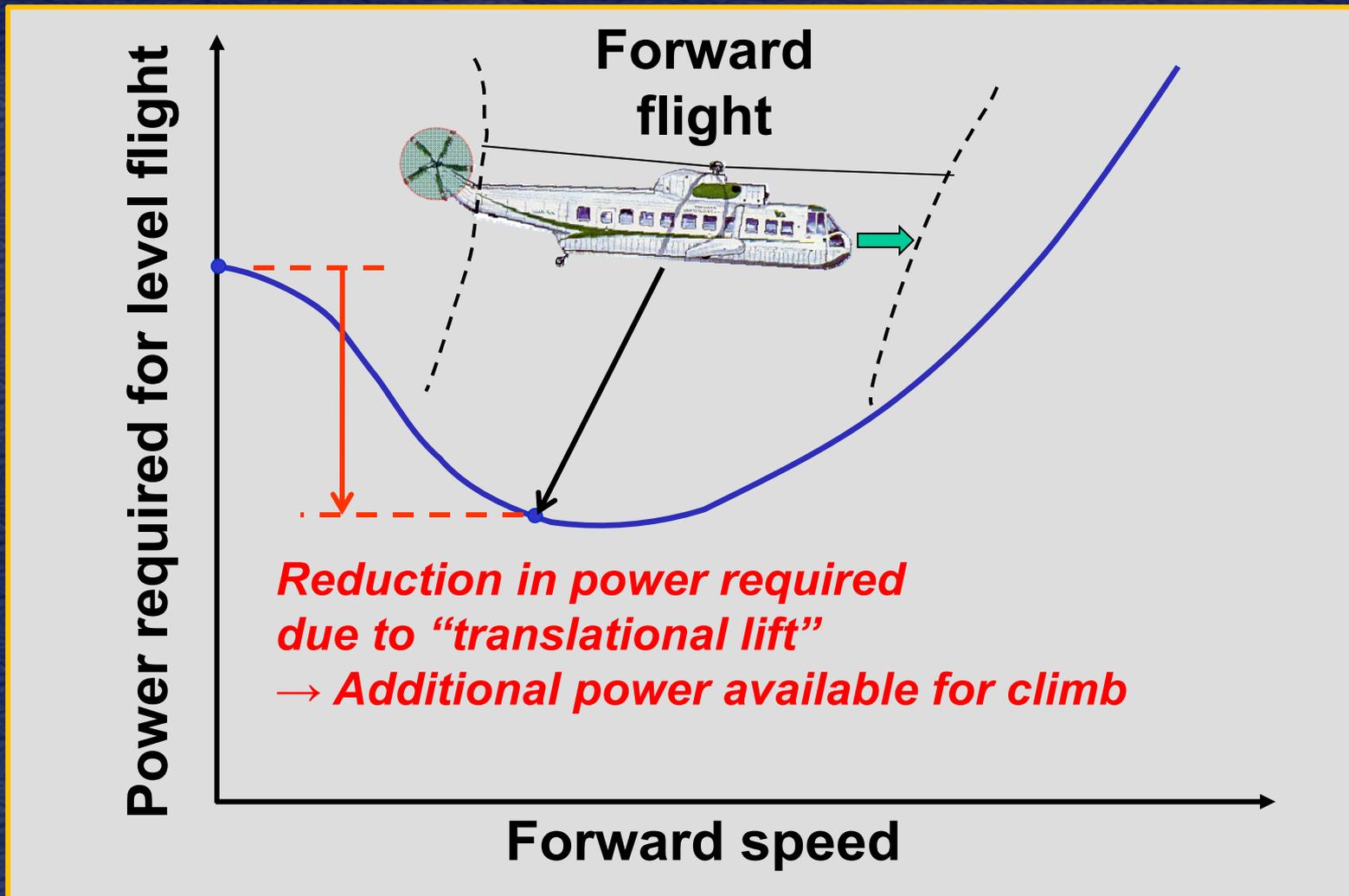
Ground Effect



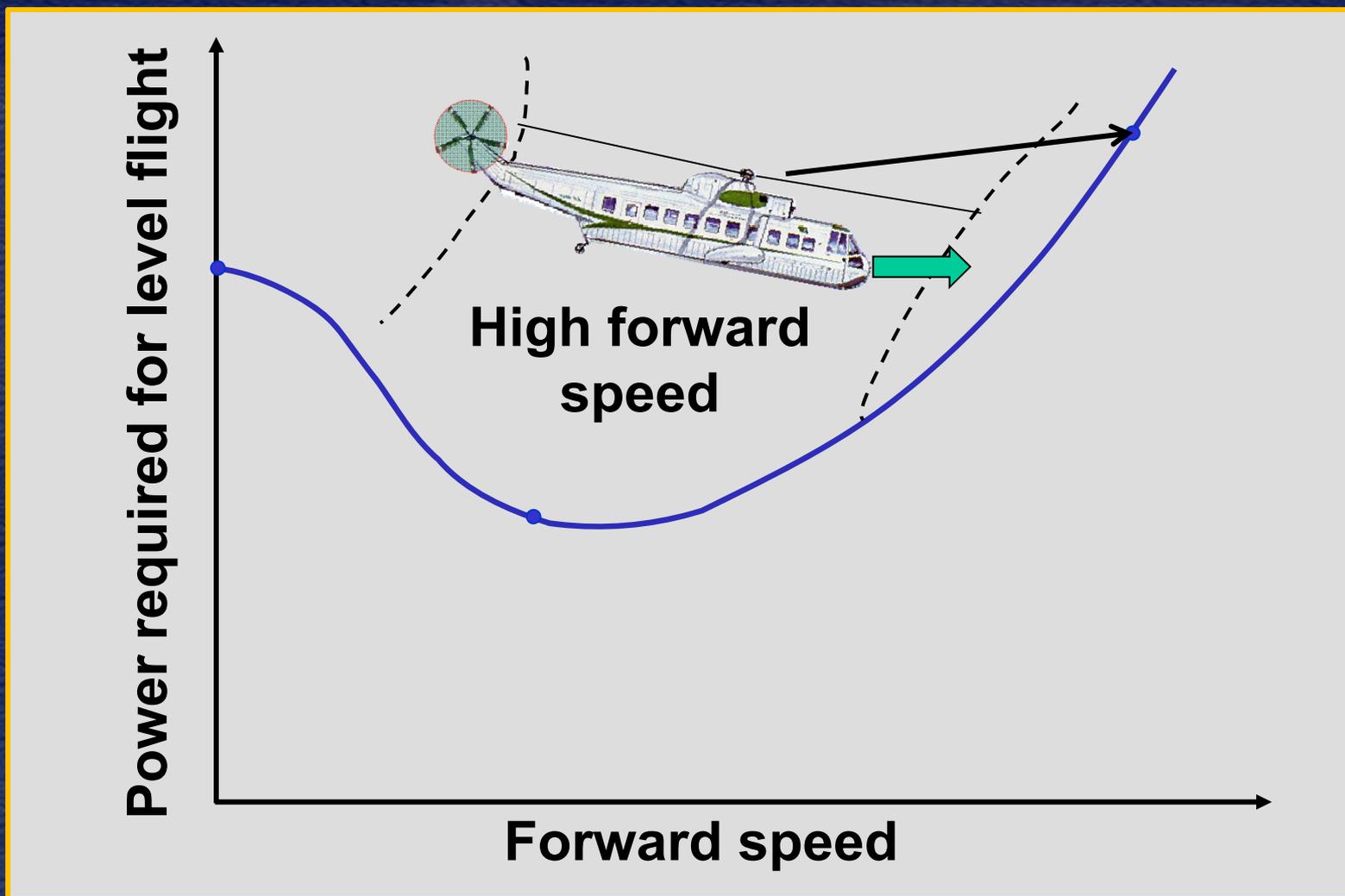
Translational Lift



Translational Lift



Translational Lift



Takeoff Profiles

Weight < HOGE weight:
vertical takeoff possible



Ground plane

Weight = HOGE weight:
Short takeoff run required



Ground plane

Weight > HOGE weight:
Longer takeoff run required

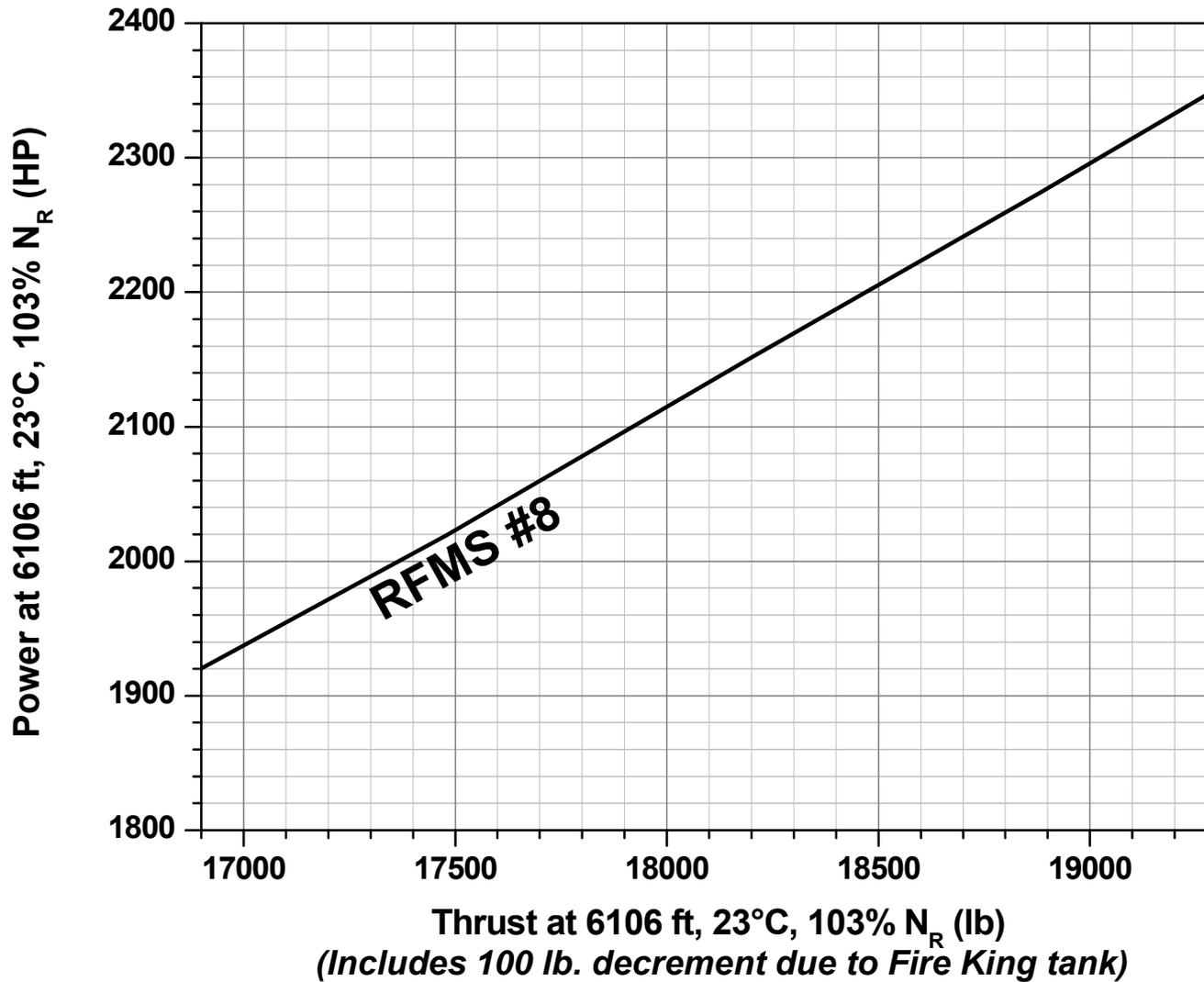


Ground plane

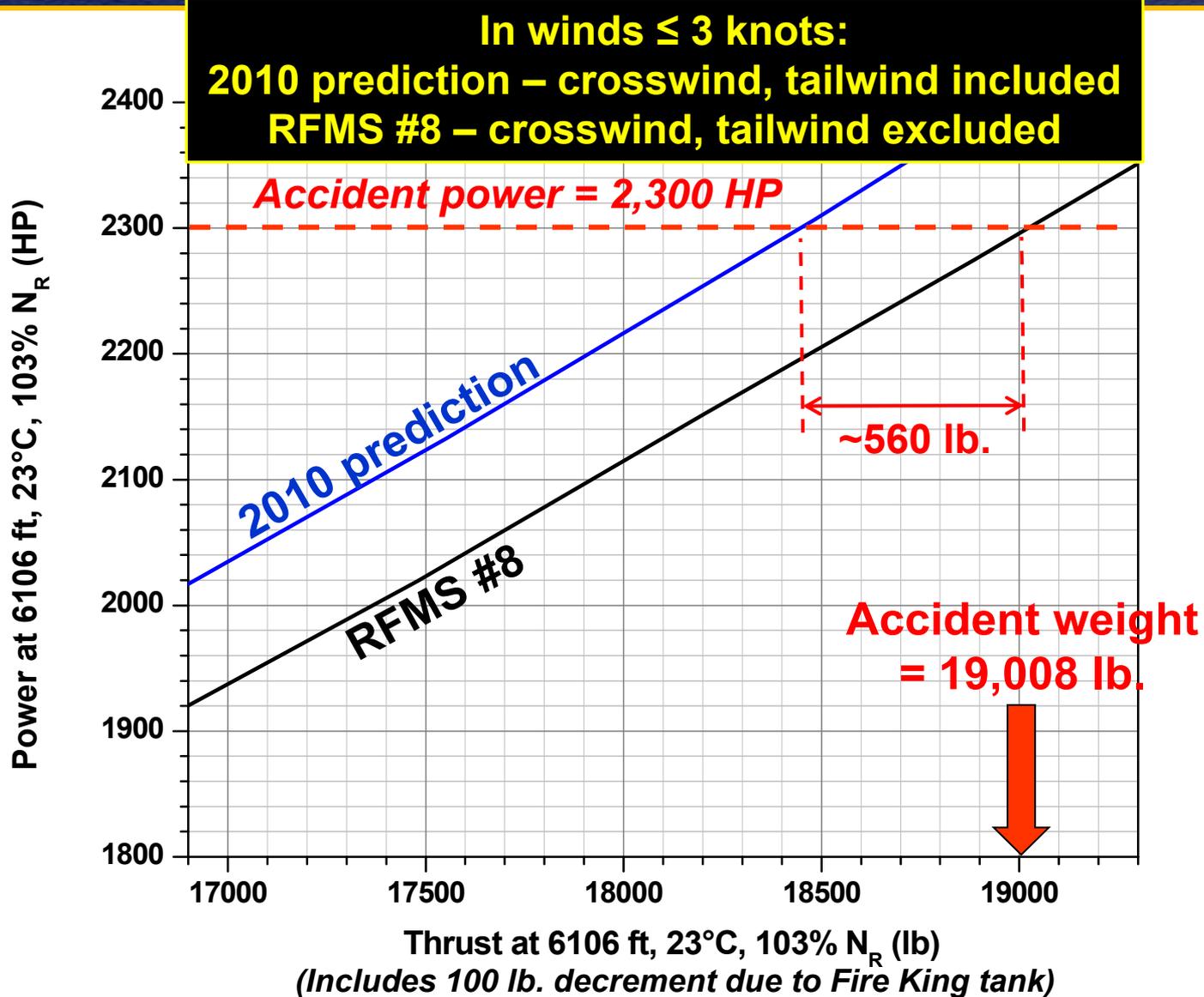
Helicopter HOGGE Capability

- Carson RFMS #8
 - S-61N; no Fire King tank
 - Based on flight tests in 2006
- Sikorsky 2010 prediction based on NVH-3A tests
 - Configuration differences accounted for by calculation
 - Prediction “spot checked” by joint Sikorsky / Carson flight tests of an S-61A helicopter
 - Scatter in S-61A test data attributed to wind effects
- Fire King tank effects accounted for by calculation

Helicopter HOGGE Capability



Helicopter HOGGE Capability



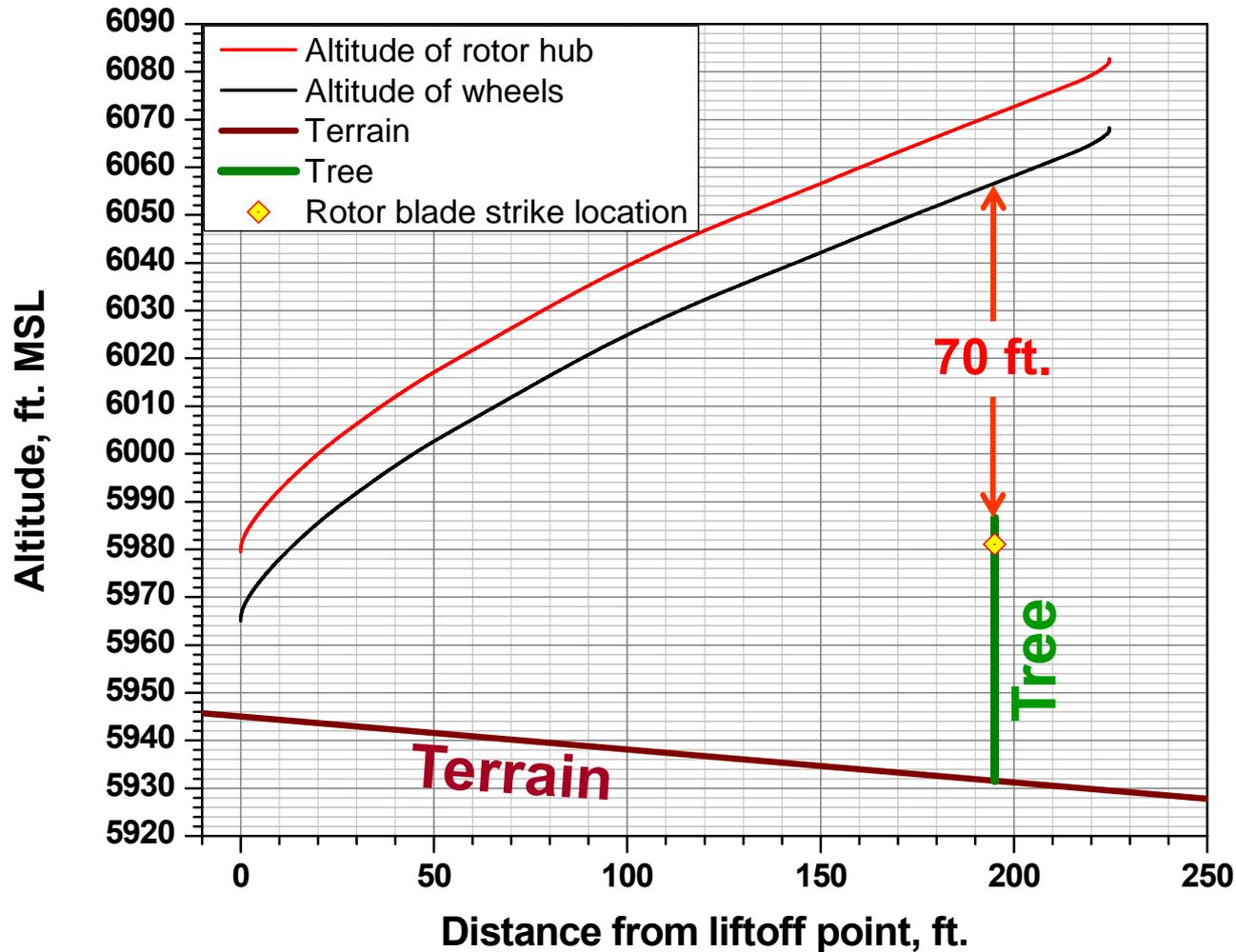
Simulations of Accident Takeoff

- Sikorsky “GenHel” helicopter simulation
- Helicopter weight = 19,008 lb.
- Engine power and torque based on N_G & N_R speeds from CVR & General Electric engine models
- Collective control driven to match available torque
- Cyclic control driven to match time to tree impact
- HOGE performance per RFMS #8 and 2010 prediction for S-61N with CMRBs
- Fire King tank effects included
- Air temperatures of 20° C and 23° C
- 4 scenarios (2 temps x 2 performance bases)



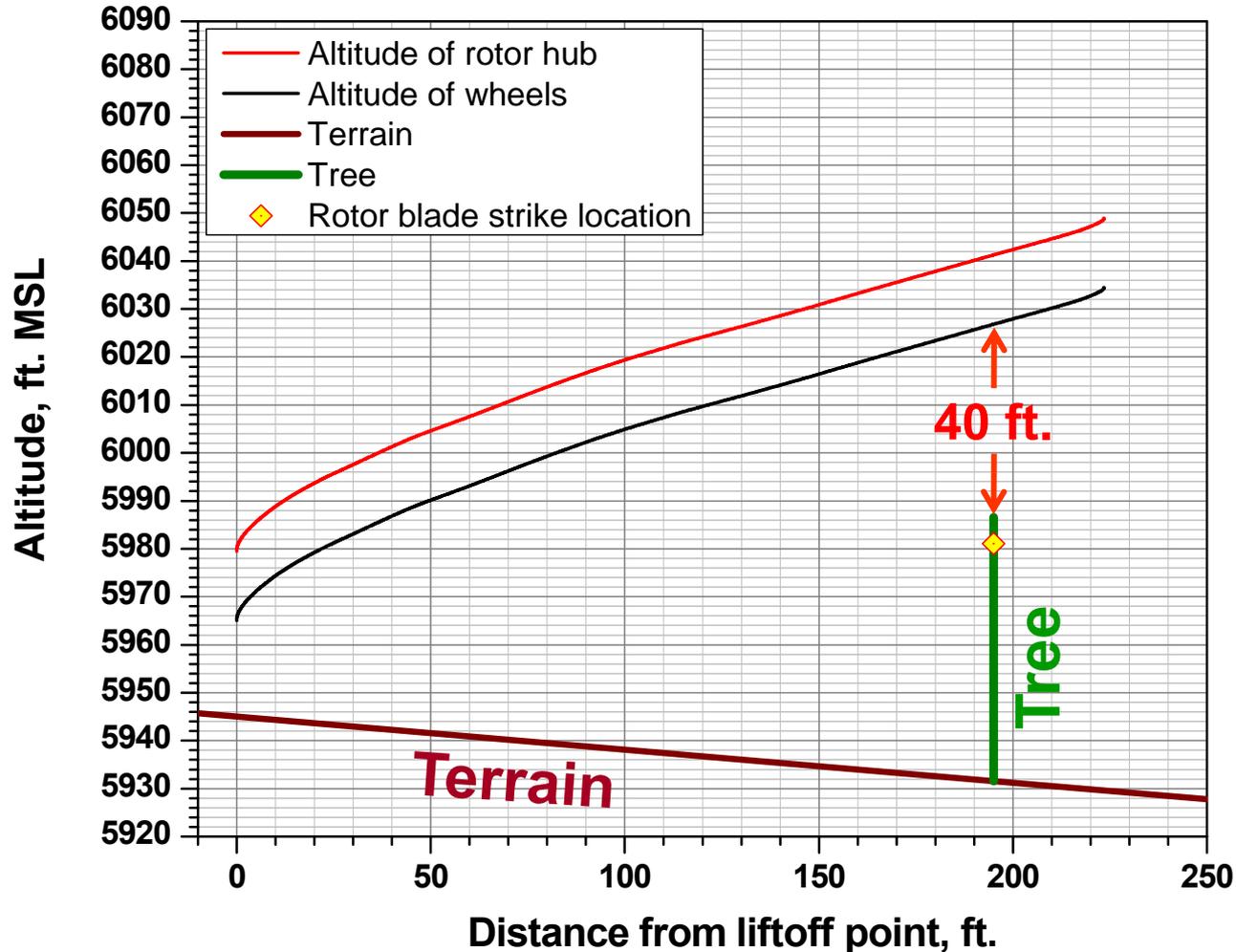
Simulations of Accident Takeoff

GenHel simulation results: RFMS #8 performance, 20° C



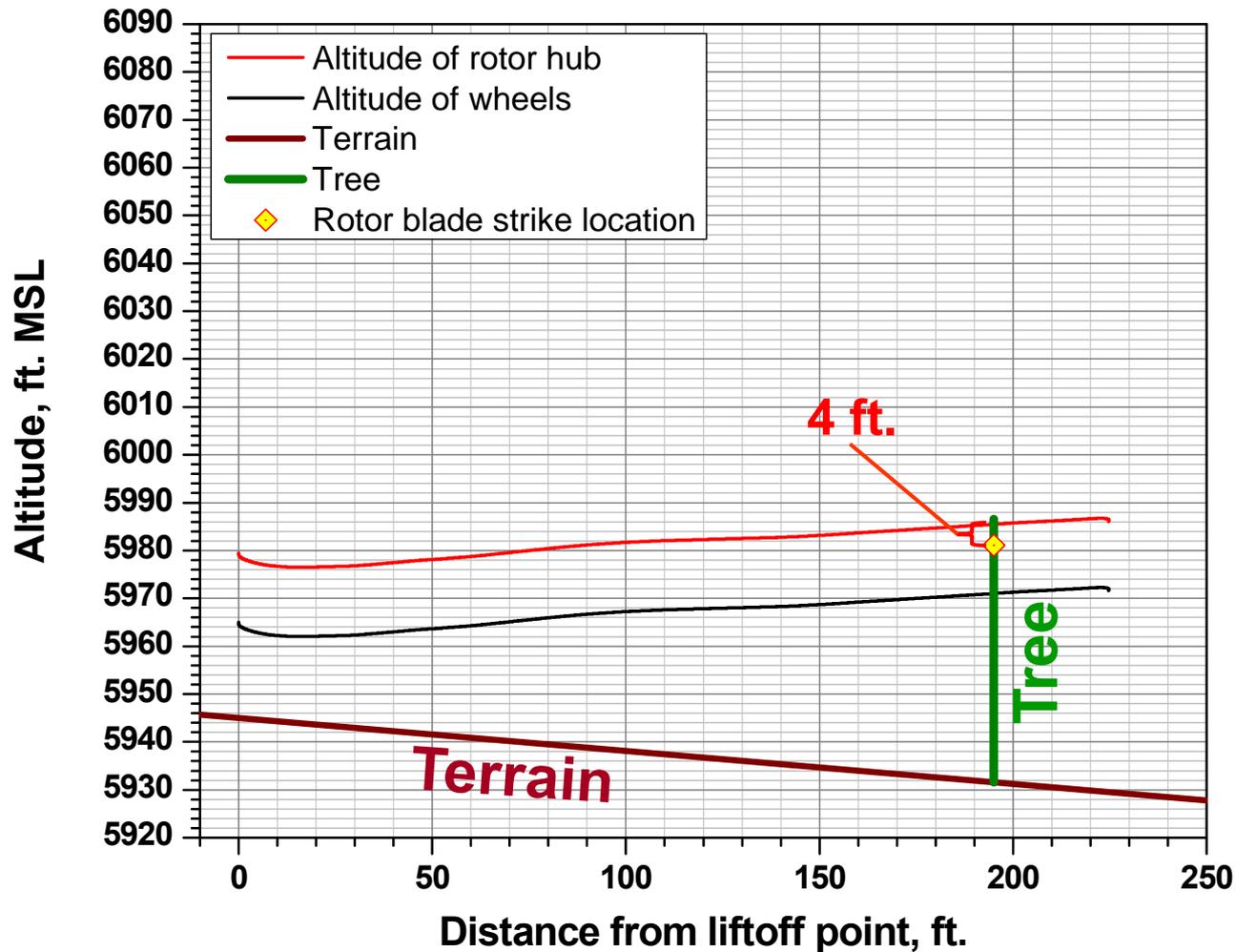
Simulations of Accident Takeoff

GenHel simulation results: RFMS #8 performance, 23° C



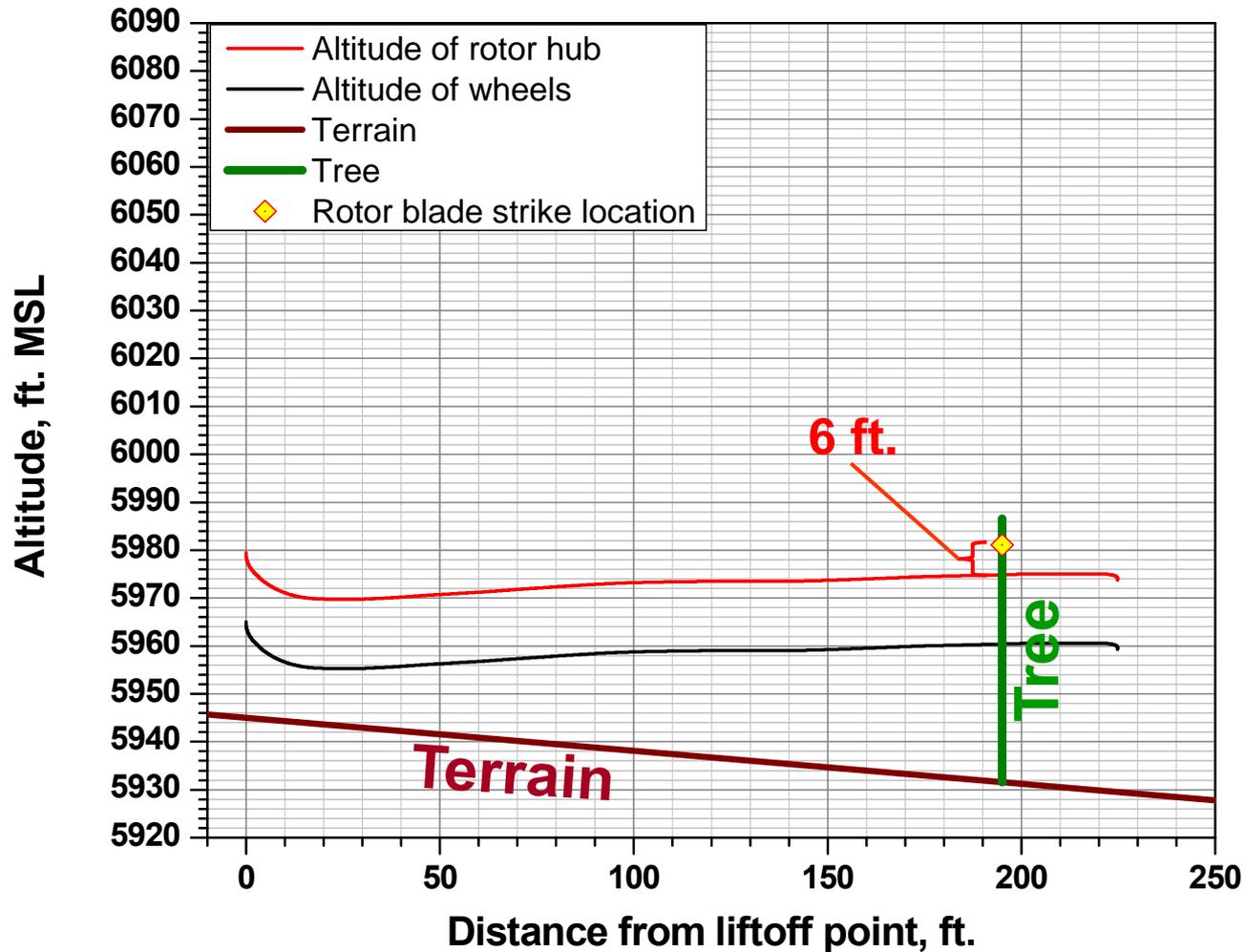
Simulations of Accident Takeoff

GenHel simulation results: 2010 prediction performance, 20° C



Simulations of Accident Takeoff

GenHel simulation results: 2010 prediction performance, 23° C



Summary

- Assuming RFMS #8 performance, HOGE capability about equal to helicopter weight
- Assuming 2010 predicted performance, HOGE capability ~560 lb. less than helicopter weight
- Assuming RFMS #8 performance, helicopter clears tree by 40 - 70 ft.
- Assuming 2010 predicted performance, rotor strikes tree within 6 ft. of measured strike mark
- Performance differences due to different ways of accounting for wind during flight testing



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