# *MINUTES OF A SPECIAL MEETING WORKSHOP OF BIG BEAR MUNICIPAL WATER DISTRICT HELD ON TUESDAY, JULY 27, 2010*

The Open Session workshop began at 9:30 am. Those in attendance included President Fashempour, Director Suhay, Director Murphy, Director Smith, Director Eminger, General Manager Scott Heule, Lake Manager Mike Stephenson, and Board Secretary Vicki Sheppard.

**BIG BEAR LAKE ECOSYSTEM RESTROATION STUDY ALTERNATIVES WORKSHOP DISCUSSION**

Mr. Heule made a brief introduction explaining that he hopes we will be able to come up with a direction on how to proceed. He listed the topics to be discussed as follows: (1) Selecting a sponsor preferred alternative from the list of cost effective and best buys described; (2) the affect of the elimination of alum treatment from the alternatives; (3) the FAA issues related to bird strikes and the airport; (4) the ACOE study schedule and costs.

Mr. Heule briefly went over the Advisory Circular from the Department of Transportation regarding land uses having the potential to attract hazardous wildlife to the vicinity of public use airports. Director Suhay asked how much power the FAA has. Mr. Heule explained that if the FAA has any problem with any of the alternatives the ACOE would not do the project. Director Smith explained that the City of Big Bear Lake Planning Commission would not approve anything that could present a safety issue to local or visiting pilots. He added that they would most likely turn it down even if the FAA approves it. Director Murphy suggested we take out any Stanfield Marsh options. Mr. Heule suggested that we could leave Stanfield Marsh options in and let the FAA eliminate them making it easier for us to pursue other plans. Director Suhay suggested that we could continue to retain Walter Yep and go to Washington DC with a proposal in mind and solicit money for a specific project. The consensus is to leave the Stanfield Marsh in for the time being. Mr. Heule went over the preferred alternatives explaining that Kathy Bergmann, ACOE, likes Alternative B. He explained that we could agree on one or make a plan of our own from the plans presented. He stated that the decision to not pursue the alum treatments was tentatively made at the last Board Meeting. He explained that when we pick a preferred alternative that is where F4 will go. President Fashempour stated if we are only going to try to get to F4 does it matter which alternative we pick? Mr. Heule explained that the F4 Document could be used to get our blanket 404 and then we could have a plan and get our design. Mr. Stephenson stated that if it stops at F4 maybe one day we could use a piece of it for our own project. Director Suhay suggested that we not use additional money to go to F5 but stop at F4 and then go for money in Washington DC on our own with the help of Walter Yep. Mr. Heule stated that he believes we could get more accomplished by concluding ACOE and concentrating on TMDL. Director Smith reported that Tim Moore believes that the ACOE can't help us at this time. President Fashempour stated that from this discussion she concludes that we are going to finish F4. Director Suhay stated that at the conclusion of F4 we could then go to Washington DC with a project (even a small project) all ready to go. Director Smith stated that perhaps we could get Jerry Lewis to commit a certain amount of money to the District and not to ACOE. Director Suhay stated that we need to have someone to lobby for us that knows where

money is available and go after it. President Fashempour asked if we want to pick an Alternative today. The consensus is that we pick Alternative 3 (Comprehensive Alternative B) minus the alum and let the FCC pull the Stanfield Marsh.
Mr. Heule stated that he will contact Walter Yep and also stay in contact with the airport. He added that he will be having a meeting with Mike Rogers, MWH. He discussed the walking bridge at the dam explaining that it is still not decided if it will be a change-order with Caltrans.
Director Suhay asked if the fishing dock at Boulder Bay Marina should have a sign saying "no boats on the fishing dock". Mr. Heule stated that the City of Big Bear Lake could decide what they wanted. Mr. Heule stated that he has been contacted by Jim Miller of the City to ask if we would be interested in partnering to finish the pedestrian walk in the Marsh. Director Smith inquired where the pedestrian walk around the marsh is proposed to end. Mr. Heule pointed it out on the map stating that it would end at the DWP well site on North Shore and Division. He added that no decision or commitment has been discussed by the District regarding finishing the walkway. Director Smith inquired about the latest information on the trout pond. Mr. Heule stated that it is up for sale again and the District will be holding a closed session on it the second meeting in August.

**ADJOURNMENT**
There being no further business, the workshop was adjourned at 11:16 AM.

Vicki Sheppard
Secretary to the Board
Big Bear Municipal Water District

(SEAL)

# BIG BEAR
# MUNICIPAL WATER DISTRICT

# Memorandum

**To:** Board of Directors

**CC:** Lake Manager

**From:** Scott Heule

**Date:** 7/20/2010

**Re:** Tuesday July 27, 2010 Board Workshop – Army Corps of Engineers Feasibility Study

---

The attached materials are for your review prior to our next workshop on July 27, 2010 at 9:30 AM. We should attempt to select a sponsor preferred alternative from the short list of cost effective and best buys described. At this time we do not know how the elimination of alum treatment from the alternatives will affect the rating scales. I have also attached an advisory circular from the FAA that addresses issues related bird strikes and the airport. I believe the circular is self explanatory.

Sorry for all the reading. You probably have most of the needed information already based on our earlier discussions and the ACOE presentation.

Finally, I believe it will be useful to have a candid discussion about how much more effort the District should expend on this study. Even with a liberal policy of in-kind contributions the District will need to come up with a cash payment to the ACOE for them to get us to the F5 level.

Thanks

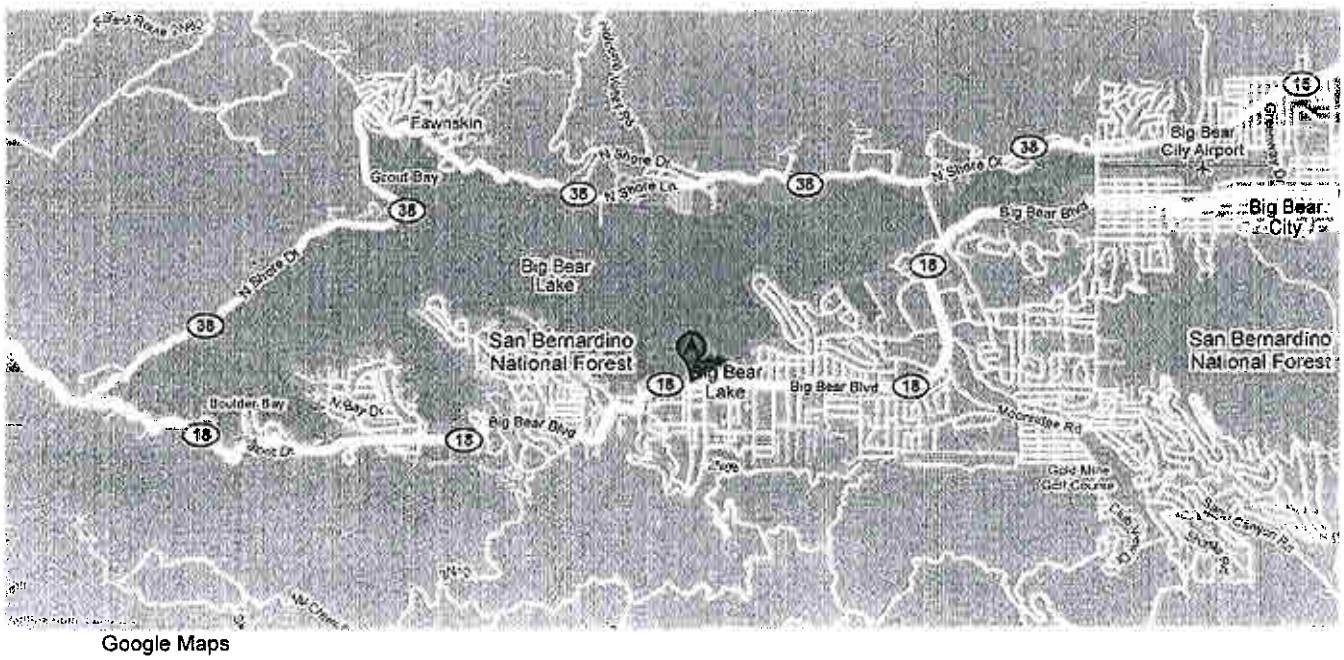
P.O. Box 2863, 40524 Lakeview Drive, Big Bear Lake CA 92315
(909)866-5796 Phone • (909)866-6485 Fax
sheule@bbmwd.org

US Army Corps
of Engineers

# Big Bear Lake Feasibility Study
# Cost Effectiveness and Incremental Cost Analysis of Alternatives

## Economics Section
## Draft
## May 12, 2010

Rev 5-12-2010 edits




Google Maps

# Cost of Alternatives

The cost estimates which follow were developed by the Los Angeles District Cost Engineering Section. There are 12 sets of tables. The first table shows the cost components of the alternative. The cost components are real estate, lake and shoreline measures, tributary measures, planting measures, adaptive management, planning, engineering and design (PED), construction management (S&A), and engineering during construction (EDC). Also included are contingency costs. The second table includes the cost of the O&M expenses, interest during construction and average annual costs, as well as estimates of ecosystem restoration benefits in terms of habitat units generated from the CHAP analysis.

## Alternative 2 – Comprehensive A

This alternative includes most proposed restoration measures to restore the lake and surrounding riparian and marsh/meadows. Riparian and marsh/meadow areas on tributaries that have negatively affected lake health are also restored. Structural management measures such as sediment basins or major geomorphic restructuring of shoreline are not included. Fisheries are expected to benefit from this alternative, but no actions will be taken to improve them.

**Table 1: Big Bear Lake Ecosystem Restoration - Cost Estimates on Comprehensive A**

**PROJECT: Big Bear Lake Ecosystem Restoration - Cost Estimates on Comprehensive A - Alternative 2**

| DESCRIPTION | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | CONTINGENCY PERCENT |
|---|---|---|---|---|
| **Real Estate** | **$28,855,402** | | **$28,855,402** | 0.0% |
| | | | | |
| **Lake & Shoreline Measures** | | | | |
| **Stanfield Marsh Restoration** | $385,000 | $96,250 | $481,250 | 25.0% |
| | | | | |
| **Tributary Measures** | $4,954,375 | $1,238,594 | $6,192,969 | 25.0% |
| | | | | |
| **Planting Measures** | | | | |
| **Invasives** | $2,409,369 | $602,342 | $3,011,711 | 25.0% |
| **Vegetation Type** | $25,019,650 | $6,254,913 | $31,274,563 | 25.0% |
| | | | | |
| **Total Estimated Construction Cost** | **$32,768,394** | **$8,192,099** | **$40,960,493** | 25.0% |
| | | | | |
| Adaptive Management (3% of Construction Cost) | $1,228,815 | | $1,228,815 | 10.0% |
| Planning, Engineering and Design (PED), 10% | $4,096,049 | | $4,096,049 | 10.0% |
| Construction Management (S&A), 6.7% | $2,744,353 | | $2,744,353 | 6.7% |
| Engineering During Construction (EDC), 1.5% | $614,407 | | $614,407 | 6.7% |
| Total Project Cost | **$41,452,019** | **$8,192,099** | **$49,644,118** | |
| | | | | |
| Total Project Cost (Including Real Estate) | **$70,307,421** | **$8,192,099** | **$78,499,520** | |

Table 2: Alternative 2 - Average Annual Cost

| Big Bear Lake Alternative 2 - Comprehensive A | |
|---|---|
| Incremental Gains Beyond NO ACTION (AAHU) | 523.53 |
| Total Project Construction Cost (First Costs) | $78,499,520 |
| Interest During Construction | $5,115,678 |
| Total Gross Investment | $83,615,197 |
| Present Value of O&M over the life of the project | $12,929,062 |
| **Total Costs** | **$96,544,259** |
| Annual Cost of Total Gross Investment | $4,145,404 |
| Annual Cost of O&M | $640,986 |
| Total Annual Costs | $4,786,391 |
| **Average Annual Cost Per AAHUs** | **$9,142.53** |

## Alternative 3 – Comprehensive B

This alternative includes all proposed restoration measures in Comprehensive Alternative A except the water source for restoration in Stanfield Marsh. This alternative is distinguished by the most additional measures.

**Table 3: Big Bear lake Ecosystem Restoration - Cost Estimates on Comprehensive B**

| PROJECT: Big Bear Lake Ecosystem Restoration - Cost Estimates on Comprehensive B - Alternative 3 | | | | |
|---|---|---|---|---|
| DESCRIPTION | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | CONTINGENCY PERCENT |
| **Real Estate** | **$28,895,816** | | **$28,895,816** | 0.0% |
| **Lake & Shoreline Measures** | | | | |
| **Dredging within the Lake** | $4,224,448 | $1,056,112 | $5,280,560 | 25.0% |
| **Alum Treatment of Entire Lake** | $10,000,000 | $2,500,000 | $12,500,000 | 25.0% |
| **Fisheries Restoration** | $2,000,000 | $500,000 | $2,500,000 | 25.0% |
| **Install Solar Powered Water Pumps to Recyle Water** | $5,174,325 | $1,293,582 | $6,467,907 | 25.0% |
| **Stanfield Marsh Restoration** | $7,378,600 | $1,844,650 | $9,223,250 | 25.0% |
| **Geomorphic Restructing** | $380,000 | $95,000 | $475,000 | 25.0% |
| **Island Near Rathbum** | $14,669,736 | $3,667,434 | $18,337,170 | 25.0% |
| **Island Near Metcalf** | $9,495,710 | $2,373,928 | $11,869,638 | 25.0% |
| **Tributary Measures** | $6,309,205 | $1,577,301 | $7,886,506 | 25.0% |
| **Planting Measures** | | | | |
| **Invasives** | $2,409,369 | $602,342 | $3,011,711 | 25.0% |
| **Vegetation Type** | $26,308,750 | $6,577,188 | $32,885,938 | 25.0% |
| **Total Estimated Construction Cost** | **$88,350,143** | **$22,087,536** | **$110,437,679** | 25.0% |
| Adaptive Management (3% of Construction Cost) | $3,313,130 | | $3,313,130 | 3.0% |
| Planning, Engineering and Design (PED), 10% | $11,043,768 | | $11,043,768 | 10.0% |
| Construction Management (S&A), 6.7% | $7,399,325 | | $7,399,325 | 6.7% |
| Engineering During Construction (EDC), 1.5% | $1,656,565 | | $1,656,565 | 1.5% |
| Total Project Cost | **$111,762,931** | **$22,087,536** | **$133,850,467** | |
| Total Project Cost (Including Real Estate and O&M) | **$140,658,747** | **$22,087,536** | **$162,746,283** | |

Table 4: Alternative 3 - Average Annual Cost

| Big Bear Lake Alternative 3 - Comprehensive B | |
|---|---|
| Incremental Gains Beyond NO ACTION (AAHU) | 1775.41 |
| Total Project Construction Cost (First Costs) | $162,746,283 |
| Interest During Construction | $10,605,894 |
| Total Gross Investment | $173,352,177 |
| Present Value of O&M over the life of the project | $32,027,111 |
| **Total Costs** | **$205,379,288** |
| Annual Cost of Total Gross Investment | $8,594,309 |
| Annual Cost of O&M | $1,587,813 |
| Total Annual Costs | $10,182,123 |
| **Average Annual Cost Per AAHUs** | **$5,735.08** |

## Alternative 4 – Lake Restoration

This Alternative focuses on in-lake restoration. The alternative assumes that restoration of marsh and meadow at the fluctuating lake edge will further meet objectives for both lake and riparian restoration.

**Table 5: Big Bear Lake Ecosystem Restoration - Cost Estimates on Lake Restoration**

| PROJECT: Big Bear Lake Ecosystem Restoration - Cost Estimates on Lake Restoration Alternative (4) | | | | |
|---|---|---|---|---|
| DESCRIPTION | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | CONTINGENCY PERCENT |
| **Real Estate** | **$8,523,937** | | **$8,523,937** | 0.0% |
| **Lake & Shoreline Measures** | | | | |
| **Dredging within the Lake** | $4,224,448 | $1,056,112 | $5,280,560 | 25.0% |
| **Alum Treatment of Entire Lake** | $10,000,000 | $2,500,000 | $12,500,000 | 25.0% |
| **Fisheries Restoration** | $2,000,000 | $500,000 | $2,500,000 | 25.0% |
| **Install Solar Powered Water Pumps to Recyle Water** | $5,174,325 | $1,293,581 | $6,467,906 | 25.0% |
| **Stanfield Marsh Restoration** | $385,000 | $96,250 | $481,250 | 25.0% |
| **Geomorphic Restructing** | $202,500 | $50,625 | $253,125 | 25.0% |
| **Tributary Measures** | $0 | $0 | $0 | |
| **Planting Measures** | | | | |
| **Invasives** | $2,409,369 | $602,342 | $3,011,711 | 25.0% |
| **Vegetation Type** | $17,179,070 | $4,294,768 | $21,473,838 | 25.0% |
| **Total Estimated Construction Cost** | **$41,574,712** | **$10,393,678** | **$51,968,390** | 25.0% |
| Adaptive Management (3% of Construction Cost) | $1,559,052 | | $1,559,052 | 3.0% |
| Planning, Engineering and Design (PED), 10% | $5,196,839 | | $5,196,839 | 10.0% |
| Construction Management (S&A), 6.7% | $3,481,882 | | $3,481,882 | 6.7% |
| Engineering During Construction (EDC), 1.5% | $779,526 | | $779,526 | 1.5% |
| Total Project Cost | **$52,592,011** | **$10,393,678** | **$62,985,689** | |
| Total Project Cost (Including Real Estate) | **$61,115,948** | **$10,393,678** | **$71,509,626** | |

Table 6: Alternative 4 – Average Annual Cost

| Big Bear Lake Alternative 4 - Lake | |
|---|---|
| Incremental Gains Beyond NO ACTION (AAHU) | 1732.68 |
| Total Project Construction Cost (First Costs) | $71,509,626 |
| Interest During Construction | $4,660,159 |
| Total Gross Investment | $76,169,784 |
| Present Value of O&M over the life of the project | $21,451,440 |
| **Total Costs** | **$97,621,224** |
| Annual Cost of Total Gross Investment | $3,776,282 |
| Annual Cost of O&M | $1,063,502 |
| Total Annual Costs | $4,839,783 |
| **Average Annual Cost Per AAHUs** | **$2,793.24** |

## Alternative 5 – Lake and Shoreline Restoration

This alternative focuses on restoration of the lake and surrounding shoreline. This alternative includes all the measures in the Lake Restoration Alternative except that restoration of Stanfield Marsh will use reclaimed water piped in from the wastewater treatment plant and pumps and pipelines.

**Table 7: Big Bear Lake Ecosystem Restoration - Cost Estimates on Lake and Shoreline Restoration**

**PROJECT: Big Bear Lake Ecosystem Restoration - Cost Estimates on Lake and Shoreline Restoration Alternative (5)**

| DESCRIPTION | COST WITHOUT CONTINGENCY | CONTINGENCY | COST WITH CONTINGENCY | CONTINGENCY PERCENT |
|---|---|---|---|---|
| **Real Estate** | **$12,219,038** | | **$12,219,038** | 0.0% |
| **Lake & Shoreline Measures** | | | | |
| **Dredging within the Lake** | $4,224,448 | $1,056,112 | $5,280,560 | 25.0% |
| **Alum Treatment of Entire Lake** | $10,000,000 | $2,500,000 | $12,500,000 | 25.0% |
| **Fisheries Restoration** | $2,000,000 | $500,000 | $2,500,000 | 25.0% |
| **Stanfield Marsh Restoration** | $385,000 | $96,250 | $481,250 | 25.0% |
| **Geomorphic Restructing** | $380,000 | $95,000 | $475,000 | 25.0% |
| **Island Near Rathbum** | $14,669,736 | $3,667,434 | $18,337,170 | 25.0% |
| **Island Near Metcalf** | $9,495,710 | $2,373,928 | $11,869,638 | 25.0% |
| **Tributary Measures** | $0 | $0 | $0 | |
| **Planting Measures** | | | | |
| **Invasives** | $2,409,369 | $602,342 | $3,011,711 | 25.0% |
| **Vegetation Type** | $23,720,510 | $5,930,128 | $29,650,638 | 25.0% |
| **Total Estimated Construction Cost** | **$67,284,773** | **$16,821,193** | **$84,105,966** | 25.0% |
| Adaptive Management (3% of Construction Cost) | $2,523,179 | | $2,523,179 | 3.0% |
| Planning, Engineering and Design (PED), 10% | $8,410,597 | | $8,410,597 | 10.0% |
| Construction Management (S&A), 6.7% | $5,635,100 | | $5,635,100 | 6.7% |
| Engineering During Construction (EDC), 1.5% | $1,261,589 | | $1,261,589 | 1.5% |
| Total Project Cost | **$85,115,238** | **$16,821,193** | **$101,936,431** | |
| Total Project Cost (Including Real Estate) | **$97,334,276** | **$16,821,193** | **$114,155,469** | |

Table 8: Alternative 5 - Average Annual Cost

| Big Bear Lake Alternative 5 - Lake and Shoreline | |
|---|---|
| Incremental Gains Beyond NO ACTION (AAHU) | 1758.71 |
| Total Project Construction Cost (First Costs) | $114,155,469 |
| Interest During Construction | $7,439,314 |
| Total Gross Investment | $121,594,783 |
| Present Value of O&M over the life of the project | $26,827,622 |
| **Total Costs** | **$148,422,405** |
| Annual Cost of Total Gross Investment | $6,028,325 |
| Annual Cost of O&M | $1,330,037 |
| Total Annual Costs | $7,358,362 |
| **Average Annual Cost Per AAHUs** | **$4,183.95** |

**Table 25: Big Bear Lake Alternative Summary of Costs and HUs**

| Big Bear Lake Alternative Summary - Costs and HUs | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Description | Total Acres | Initial Uplift (HUs) | Secondary Uplift (HUs) | Total Incremental HUs | Total Costs | Total Annual Costs | Cost per HU based on Total Cost | Cost per HU based on Total Annual Costs |
| Alternative 2 - Comprehensive A | 3083.48 | 413.8 | 109.8 | 523.53 | $96,544,300 | $4,786,400 | $184,400 | $9,140 |
| Alternative 3 - Comprehensive B | 3102.89 | 1570.1 | 205.3 | 1775.41 | $205,379,300 | $10,182,100 | $115,700 | $5,740 |
| Alternative 4 - Lake | 2871.30 | 1518.8 | 213.9 | 1732.68 | $97,621,200 | $4,839,800 | $56,300 | $2,790 |
| Alternative 5 - Lake and Shoreline | 3029.74 | 1554.3 | 204.4 | 1758.71 | $148,422,400 | $7,358,400 | $84,400 | $4,180 |
| Alternative 6 - Lake and Marsh | 1273.96 | 165.5 | 105.1 | 270.57 | $121,836,100 | $6,040,300 | $450,300 | $22,320 |
| Alternative 7 - Lake and Meadow | 1141.80 | 95.1 | 100.1 | 195.20 | $98,604,600 | $4,888,500 | $505,100 | $25,040 |
| Alternative 8 - Lake and Riparian | 2824.25 | 1496.6 | 196.0 | 1692.55 | $158,032,500 | $7,834,800 | $93,400 | $4,630 |
| Alternative 9 - Shoreline | 583.73 | 78.7 | 5.3 | 84.01 | $97,332,900 | $4,825,500 | $1,158,600 | $57,440 |
| Alternative 10 - Meadow and Lake | 1177.83 | 74.3 | 107.7 | 182.03 | $90,087,100 | $4,466,300 | $494,900 | $24,540 |
| Alternative 11 - Meadow and Riparian | 328.36 | 40.2 | 0.0 | 40.20 | $61,410,200 | $3,044,500 | $1,527,600 | $75,730 |
| Alternative 12 - Aquatic Planting | 486.28 | 66.5 | 5.3 | 71.84 | $40,258,600 | $1,995,900 | $560,400 | $27,780 |
| Alternative 13 - Invasives Removal | 678.09 | 89.4 | 0.0 | 89.44 | $69,774,000 | $3,459,200 | $780,100 | $38,680 |

Table 26: Big Bear Lake Alternatives - Cost Effective and Best Buy Analysis

| Big Bear Lake Alternatives - Cost Effective & Best Buy Analysis | | | |
|---|---|---|---|
| Description | Total Annual Cost | Total Incremental HUs | Cost Effective |
| Alternative 1 - No Action | $0 | 0.00 | Best Buy |
| Alternative 11 - Meadow and Riparian | $3,044,500 | 40.20 | No |
| Alternative 12 - Aquatic Planting | $1,995,900 | 71.84 | Yes |
| Alternative 9 - Shoreline | $4,825,500 | 84.01 | No |
| Alternative 13 - Invasives Removal | $3,459,200 | 89.44 | Yes |
| Alternative 10 - Meadow and Lake | $4,466,300 | 182.03 | Yes |
| Alternative 7 - Lake and Meadow | $4,888,500 | 195.20 | No |
| Alternative 6 - Lake and Marsh | $6,040,300 | 270.57 | No |
| Alternative 2 - Comprehensive A | $4,786,400 | 523.53 | Yes |
| Alternative 8 - Lake and Riparian | $7,834,800 | 1692.55 | No |
| Alternative 4 - Lake | $4,839,800 | 1732.68 | Best Buy |
| Alternative 5 - Lake and Shoreline | $7,358,400 | 1758.71 | Best Buy |
| Alternative 3 - Comprehensive B | $10,182,100 | 1775.41 | Best Buy |
| | | | |
| | | | |

The next figure is a graph from the IWR Plan program which depicts the alternatives differentiated by cost effectiveness.

Table 27: Big Bear Lake Alternatives - Incremental Cost by HUs

**Big Bear Lake Alternatives - Incremental Cost of Best Buy Plan Combinations Ordered by HUs**

| Description | Order by Incremental Cost of Best Buy Plan | Total Annual Cost | Total Incremental HUs | Average Annual Cost Per HU | Incremental Cost | Incremental HU | Incremental Cost per HU |
|---|---|---|---|---|---|---|---|
| Alternative 1 - No Action | 1 | $0 | 0.00 | | | | |
| Alternative 4 - Lake | 2 | $4,839,800 | 1732.68 | $2,790 | $4,839,800 | 1732.68 | $2,790 |
| Alternative 5 - Lake and Shoreline | 3 | $7,358,400 | 1758.71 | $4,180 | $2,518,600 | 26.03 | $96,760 |
| Alternative 3 - Comprehensive B | 4 | $10,182,100 | 1775.41 | $5,740 | $2,823,800 | 16.70 | $169,090 |

# BIG BEAR LAKE ECOSYSTEM RESTORATION

## Primary Objectives

### To restore Big Bear Lake and Shoreline including degraded Tributaries as needed to restore Lake and Shoreline Habitat.

Big Bear Valley, prior to the raising of the dam, was home to a diverse ecosystem dependent upon a 500 to 1000 acre semi perennial lake surrounded by 6000 acres of marsh and meadows. In 1884 the valley was dammed and today the reservoir serves as the economic base of for the Big Bear resort community. Water demands range from local needs, downstream water supply for residential uses to lakeside and downstream Bear Creek habitat.

Taking a watershed approach, this study seeks to formulate and evaluate alternatives for restoring the Lake and adjacent areas of the Valley, and to improve the health of the lake while supporting both the community and surrounding habitat. While some measures proposed are not within the authority of the sponsor, BBMWD, or the Corps of Engineers to implement, it is hoped that other agencies and governments in the Valley will participate in their implementation to improve the health of the lake, shoreline, and degraded tributaries in the watershed.

Proposed project alternatives are described below, encompassing a variety of measures to improve the lake, shoreline marshes and meadows, and degraded habitat along selected lake tributaries. For each alternative, Best Management Practices" (BMPs) and public education measures have also been identified and evaluated, to include:

- Guidelines for keeping marinas clean and free of invasive macrophytes, to include such measures as boat washing prior to lake entry.
- Shoreline and park signage, newsletters, public education on ecosystems and historic habitats, kiosks in parks, and shoreline landscaping guides,
- Economic incentives for developers:
    - Permit requirements.
    - Tax credits or property tax relief.
    - Funding support (state/Fed grants).
- BMPs for sediment management.
- Mitigation for development, as follows, with built-in tax breaks :
    - Meadow protection and restoration,
    - Creation of marsh habitat along tributaries and shoreline,
    - Recreation trails to direct pedestrian traffic away from restored areas,
    - Restoration of native riparian areas
- Zoning regulations to set aside land for open space, and/or to designate setbacks,
- Economic and other incentives for landowners to support environmental and open space values.
- Further reduction of wave action to prevent shoreline erosion.

Fourteen alternatives were originally developed, with a total of seventy variations. As these alternatives and their variations were screened, measures were eliminated that did not meet project objectives and/or were less effective than others proposed. These alternatives were then screened based on pairwise comparison, weighting of objectives, and the effectiveness of each measure in meeting those objectives. Weighting of objectives was accomplished by Project Delivery Team (PDT) members, including the Corps, Sponsor, USFWS, FS, CF&G, NRCS, and the RCWQB. Alternatives that were not significantly different from similar alternatives were also eliminated by the PDT.

The remaining, still preliminary, array of alternatives addresses objectives to restore the ecosystem in the lake and, to varying degrees, related shoreline and tributary habitats. While similar in many respects, individual alternatives focus on different landscape locales and, or, restoration measures. The names of the alternatives are intended to reflect their relative focus, with the first word representing their primary focus (e.g. lake), and the second their secondary focus (e.g. meadow). Riparian may refer to one or more of several montane riparian habitat communities, to include Montane Riparian, Wet or Dry Montane Meadow, or Montane Marsh. If Marsh or Meadow is named, it is because that specific riparian community is the focus of the alternative as opposed to other riparian communities. All restoration areas are supported with water harvesting, grading and excavation as needed for sustainability. The comprehensive alternatives, in turn, subsume different combinations of multiple measures in multiple habitat types. The alternative names are:

Lake – Alt. 4
Lake and Shoreline – Alt. 5
Lake and Marsh
Lake and Meadow
Lake and Riparian
Shoreline
Meadow and Lake
Meadow and Riparian
Aquatic Plant Restoration
Invasive Removal and Restoration
Comprehensive Alternative A – Alt. 2
Comprehensive Alternative B – Alt. 3

Alt. #2 **COMPREHENSIVE ALTERNATIVE A**

This alternative includes most proposed restoration measures to restore the lake and surrounding riparian and marsh/meadows. Riparian and marsh/meadow areas on tributaries that have negatively affected lake health are also restored. Structural management measures such as sediment basins are not included.

The following measures form this alternative:

**Lake Restoration**

- Eradicate invasive aquatic vegetation, and following eradication treatment, plant native aquatic and depth-tolerant vegetation in deeper locations (in the littoral zone).
- Improve aquatic plant habitat in littoral zone
- Fisheries Restoration:
    - Remove non-native, nuisance species of fish by netting, electro-fishing and carp round-up.
- Marsh/Meadow Restoration
    - Install pump in the East End Deepening Project area of the lake with pipeline conveying water to recirculate water through Stanfield Marsh. This water resource will keep marsh wet all year. Water will flow through a braided system developed by micro-grading back through the porous Stanfield Crossing toward the west into the lake. This will allow wet meadow and marsh habitat to develop along wetted areas as lake levels rise and fall with varying weather conditions.
    - Construct low lying islands from dredge material, planted with riparian, marsh and meadow vegetation to restore habitat for migratory birds and waterfowl in Metcalf Bay and near the mouth of Rathbun Creek. Island design would include a moat to lengthen the time the island base is protected from predators and surrounded by deep water as lake levels fluctuate. Dredge material from terracing would be used for island construction.
    - Terracing or geomorphic restructuring of the shoreline within the fluctuating area primarily along the northern edges of the lake –so that as the water level changes, the plant community would change from aquatic to marsh to meadow on terraces. To establish this community, we would include bed treatments and planting to establish seed beds, and a diverse native aquatic plant community appropriate for migratory birds, fish, native amphibians, and migratory waterfowl habitat.
    - Restore marsh/meadow at mouth of Metcalf Creek and along Metcalf Bay
    - Restore and reintroduce native plants and remove invasives in existing riparian scrub, marsh, and meadow in Grout Bay.

**Shoreline Restoration**

- Meadows:
    - Remove invasives and replant native vegetation.

    - Restore and reintroduce native plants in areas along the shoreline where meadows once existed.
    - Improve areas with existing meadows and at mouths of creeks.
- Marsh:
    - Increase meadow/marsh areas along shoreline – grade from emergent to meadow grasses.
    - Dredge shallow shoreline areas creating a terrace to restore shoreline marsh at public access points.
- Montane Riparian:
    - Improve shoreline riparian areas and restore with native riparian scrub plantings along public shoreline and as riparian buffer zones of 15 to 100 meters along restored marsh/meadow areas.

**Marsh/Meadow and Riparian Restoration on Tributaries**

- Add riparian buffer zones from 15 meters to 100 meters widths along restored marsh meadow areas of tributaries where possible.
- Restore and reintroduce native plants and remove invasives in existing riparian scrub, marsh, and meadow.
- Restore marsh/meadow areas at existing stream meanders on the inside of bends along the lower creek.
- Stabilize steam banks with riparian vegetation.
- Restore wet meadows in ski area.
- On Knickerbocker Creek restore riparian strand in areas upstream.

Cost Effective
Alt. #2

## Big Bear Lake Ecosystem Restoration - Engineer's Estimate on Alternative A - 2010 PRICE LEVEL

| Code of Acc. | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | COST WITHOUT CONTING | CONTING | COST WITH CONTING | CONTG % |
|---|---|---|---|---|---|---|---|---|
| 01 | **REAL ESTATE** | | | | | | | |
| | 01 Government Lands | 1 | LS | $2,801,419 | $2,801,419 | | $2,801,419 | 0% |
| | 02 Private Lands | 1 | LS | $26,053,983 | $26,053,983 | | $26,053,983 | 0% |
| | **Total Real Estate Cost** | | | $28,855,402 | $28,855,402 | | $28,855,402 | |
| 06. | **LAKE & SHORELINE MEASURES** | | | | | | | |
| | 1 Stanfield Marsh Restoration | | | | | | | |
| | Grading in Stanfield Marsh to use reclaimed water effectively (Water supplied by Water Treatment Plant) | 154 | ACR | $2,500 | $385,000 | $96,250 | $481,250 | 25% |
| | **Total Lake and Shoreline Measures** | | | | $385,000 | $96,250 | $481,250 | |
| 09. | **TRIBUTARY MEASURES** | | | | | | | |
| | 1 Grading at Knickerbocker, Rathbun, Metcalf, and Summit for Vegetation Planting | | | | | | | |
| | Terracing to encourage marsh development | 162 | ACR | $24,300 | $3,936,600 | $984,150 | $4,920,750 | 25% |
| | Grading planting areas | 407 | ACR | $2,500 | $1,017,775 | $254,444 | $1,272,219 | 25% |
| | **Total Tributary Measures** | | | | $4,954,375 | $1,238,594 | $6,192,969 | |
| 09. | **PLANTING MEASURES** | | | | | | | |
| | 1 Invasives | | | | | | | |
| | Eradicate aquatic invasives | 1 | LS | $1,153,369 | $1,153,369 | $288,342 | $1,441,711 | 25% |
| | Remove shoreline & tributary invasive plants (391 acres, assume 40% invaded) | 157 | ACR | $8,000 | $1,256,000 | $314,000 | $1,570,000 | 25% |
| | 2 Vegetation Types | | | | | | | |
| | Aquatic Communities | 717 | ACR | $15,000 | $10,760,250 | $2,690,063 | $13,450,313 | 25% |
| | Marsh Communities | 226 | ACR | $15,000 | $3,387,600 | $846,900 | $4,234,500 | 25% |
| | Riparian Communities | 62 | ACR | $36,000 | $2,228,400 | $557,100 | $2,785,500 | 25% |
| | Meadow Communities | 112 | ACR | $40,000 | $4,462,400 | $1,115,600 | $5,578,000 | 25% |
| | Marsh/Meadow Communities | 81 | ACR | $35,000 | $2,826,600 | $706,650 | $3,533,250 | 25% |
| | Meadow/Riparian Communities | 34 | ACR | $40,000 | $1,354,400 | $338,600 | $1,693,000 | 25% |
| | **Total Planting Measures** | | | | $27,429,019 | $6,857,255 | $34,286,273 | |
| | **Construction Cost** | | | | $32,768,394 | $8,192,098 | $40,960,492 | |
| | **Adaptive Management (3% of Construction Cost)** | | | | $1,228,815 | | $1,228,815 | |
| 30. | **Planning, Engineering and Design (PED), 10%** | | | | $4,096,049 | | $4,096,049 | |
| 31. | **Construction Management (S&A), 6.7%** | | | | $2,744,353 | | $2,744,353 | |
| | **Engineering During Construction (EDC), 1.5%** | | | | $814,407 | | $814,407 | |
| | **Total Project Cost** | | | | $41,452,018 | $8,192,098 | $49,644,117 | |
| | **O & M costs** | | | | | | | |
| | **O & M Costs (annual costs over life of project).** | | | | $408,838 | | | |
| | **TOTAL PROJECT COST FOR ALTERNATIVE A (Including Real Estate)** | | | | $70,307,420 | $8,192,098 | $78,499,519 | |
| | **USFS LAND RESTORATION** | | | | | | | |
| | Real estate impact | | | | | | | |
| | Planting | | | | | | | |
| | Geomorphic Restructuring | | | | | | | |
| | Subtotal Federal Non-Corps (USFS) Costs | | | | | | | |

Alt. #3 **COMPREHENSIVE ALTERNATIVE B**

This alternative includes all proposed restoration measures in Comprehensive Alternative A. In contrast to Comprehensive Alternative A, the alternative includes alum treatment of the lakebed, pumping upstream from the lake on tributaries for spawning of fish, dredge capping of high nutrient areas in the lake, dredging of shoreline within the lake, and dredging of Knickerbocker Creek at the tributary mouth. It also includes sediment basins and improvement of sediment traps at the ski overflow parking area on Rathbun Creek.

This alternative includes the following additional measures:

**Lake Restoration**

- Restore aquatic vegetation:
  - Plant appropriate native aquatics remaining littoral zone.
  - Plant emergent marsh/meadow along shoreline edge
- Improved shallow areas will be configured and seeded to encourage development of aquatic and marsh habitats. Deep water habitat is expected to develop where dredging deepens shallow areas.
- Alum treatment to establish a physical barrier between nutrient rich sediments and the water column (entire Lake).
- Placement of a soil cap in the lakebed over areas of high nutrient concentration along with suction dredging of top layer of high nutrient concentration.
- Install water pump to recycle lake water to provide fish spawning habitat at Grout and Metcalf Creeks a short distance upstream. Pump only during spawning season for trout and bass.
- Create rocky, gravely creek bottoms for spawning beds in Grout & Metcalf.

**Shoreline Restoration**

- Dredge lake shoreline & creek mouths to provide wetted area for emergent shoreline marsh areas

**Marsh/Meadow and Riparian Restoration on Tributaries**

- Rathbun Creek:
  - Improve sediment traps on Rathbun Creek at ski parking lot. Traps need to be improved to allow some pass through of fines, yet control excessive sedimentation that would damage riparian and marsh/meadow areas downstream.
  - New sediment catchment basins located upstream on Rathbun in Sand Canyon and at Bear Mountain.
- Knickerbocker Creek
  - New sediment catchment basin above urbanized area with meandering stream lined with riparian vegetation.

Best Buy
Alt. #3

## Big Bear Lake Ecosystem Restoration - Engineer's Estimate on Alternative B - 2010 PRICE LEVEL

| Code of Acc. | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | COST WITHOUT CONTING | CONTING | COST WITH CONTING | CONTG % |
|---|---|---|---|---|---|---|---|---|
| **01** | **REAL ESTATE** | | | | | | | |
| 01 | Government Lands | 1 | LS | $26,087,397 | $26,087,397 | | $26,087,397 | 0% |
| 02 | Private Lands | 1 | LS | $2,808,419 | $2,808,419 | | $2,808,419 | |
| | **Total Real Estate Cost** | | | $2,808,419 | $28,895,816 | | $28,895,816 | |
| **06.** | **LAKE & SHORELINE MEASURES** | | | | | | | |
| 1 | **Dredging within the Lake** | | | | | | | |
| | Mob and Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Dredge material and pump to cap over high-nutrient areas (within 188 acre center) | 323,665 | CY | $11.50 | $3,724,448 | $931,112 | $4,655,559 | 25% |
| 2 | **Alum treatment of entire lake (3000 acres)** | 1 | LS | $10,000,000 | $10,000,000 | $2,500,000 | $12,500,000 | 25% |
| 3 | **Fisheries Restoration** | | | | | | | |
| | Remove non-native, nuisance species of fish | 1 | LS | $2,000,000 | $2,000,000 | $500,000 | $2,500,000 | 25% |
| 4 | **Install solar powered water pumps to recycle lake water for spawning** | | | | | | | |
| | Install pump station and pipelines at Grout Creek | 1 | LS | $3,132,950 | $3,132,950 | $783,238 | $3,916,188 | 25% |
| | Install pump station and pipelines at Metcalf Creek | 1 | LS | $1,989,775 | $1,989,775 | $497,444 | $2,487,219 | 25% |
| | Gravely stream bottom in both creeks | 1 | LS | $51,600 | $51,600 | $12,900 | $64,500 | 25% |
| 5 | **Stanfield Marsh Restoration** | | | | | | | |
| | Grading in Stanfield Marsh to use pumped water effectively | 154 | ACR | $2,500 | $385,000 | $96,250 | $481,250 | 25% |
| | Install pump station and pipelines - Multiple Outlets Option | 1 | LS | $6,993,600 | $6,993,600 | $1,748,400 | $8,742,000 | 25% |
| 6 | **Geomorphic Restructuring** | | | | | | | |
| | Grading in Meadow | 81 | ACR | $2,500 | $202,500 | $50,625 | $253,125 | 25% |
| | Terrace or geomorphic restructuring of shoreline | 71 | ACR | $2,500 | $177,500 | $44,375 | $221,875 | 25% |
| 7 | **Island near Rathbun** | | | | | | | |
| | Sheetpile ( 16' to 19' deep @ PZ40 lb/sf) | 1,910 | ton | $4,500 | $8,595,000 | $2,148,750 | $10,743,750 | 25% |
| | Mob/Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Remove existing weaker base soil to affirm structure | 41,000 | CY | $8.00 | $328,000 | $82,000 | $410,000 | 25% |
| | Dredge Material | 284,592 | CY | $8.00 | $2,276,736 | $569,184 | $2,845,920 | 25% |
| | Rock Habitat - Placement | 99,000 | ton | $30.00 | $2,970,000 | $742,500 | $3,712,500 | 25% |
| 8 | **Island near Metcalf** | | | | | | | |
| | Sheetpile ( 16' to 19' deep @ PZ40 lb/sf) | 1,191 | ton | $4,500 | $5,359,500 | $1,339,875 | $6,699,375 | 25% |
| | Mob/Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Remove weaker soil to affirm structure | 27,100 | CY | $7.50 | $203,250 | $50,813 | $254,063 | 25% |
| | Dredge Material | 189,726 | CY | $7.50 | $1,422,960 | $355,740 | $1,778,700 | 25% |
| | Rock Habitat - Placement | 67,000 | ton | $30.00 | $2,010,000 | $502,500 | $2,512,500 | 25% |
| | **Total Lake and Shoreline Measures** | | | | $53,322,819 | $13,330,705 | $66,653,523 | |
| **09.** | **TRIBUTARY MEASURES** | | | | | | | |
| 1 | **Knickerbocker Creek: Water Infiltration / Sediment Basin** | | | | | | | |
| | Excavation | 5,600 | CY | $14 | $78,400 | $19,600 | $98,000 | 25% |
| | 24" RCP (Exc, lay pipe, bedding, backfill) | 770 | LF | $170 | $130,900 | $32,725 | $163,625 | 25% |
| | 12' High Gravity Wall (Conrt, forms, reinfr and finish) | 240 | CY | $260 | $62,400 | $15,600 | $78,000 | 25% |
| 2 | **Rathbun Creek:** | | | | | | | |
| | 1' High Stone Berms (2 ea) and 24" riprap slope | 1,616 | TON | $50 | $80,800 | $20,200 | $101,000 | 25% |
| | Excavation | 50,855 | CY | $14 | $711,970 | $177,993 | $889,963 | 25% |
| | 24" RCP (Exc, lay pipe, bedding, backfill) | 790 | LF | $170 | $134,300 | $33,575 | $167,875 | 25% |
| | 10' High Outlet Wall (Conrt, forms, reinfr and finish) | 459 | CY | $340 | $156,060 | $39,015 | $195,075 | 25% |
| 3 | **Grading at Knickerbocker, Rathbun, Metcalf, and Summit for Vegetation Planting** | | | | | | | |
| | Terracing to encourage marsh development | 162 | ACR | $24,300 | $3,936,600 | $984,150 | $4,920,750 | 25% |
| | Grading planting areas | 407 | ACR | $2,500 | $1,017,775 | $254,444 | $1,272,219 | 25% |
| | **Total Tributary Measures** | | | | $6,309,205 | $1,577,301 | $7,886,506 | |
| **09.** | **PLANTING MEASURES** | | | | | | | |
| 1 | **Invasives** | | | | | | | |
| | Eradicate aquatic invasives | 1 | LS | $1,153,369 | $1,153,369 | $288,342 | $1,441,711 | 25% |
| | Remove shoreline & tributary invasive plants (391 acres, assume 40% invaded) | 157 | ACR | $8,000 | $1,256,000 | $314,000 | $1,570,000 | 25% |
| 2 | **Vegetation Types** | | | | | | | |
| | Aquatic Communities | 705 | ACR | $15,000 | $10,580,550 | $2,645,138 | $13,225,688 | 25% |
| | Marsh Communities | 235 | ACR | $15,000 | $3,523,050 | $880,763 | $4,403,813 | 25% |
| | Riparian Communities | 84 | ACR | $36,000 | $3,009,600 | $752,400 | $3,762,000 | 25% |
| | Meadow Communities | 113 | ACR | $40,000 | $4,502,800 | $1,125,700 | $5,628,500 | 25% |
| | Marsh/Meadow Communities | 95 | ACR | $35,000 | $3,340,750 | $835,188 | $4,175,938 | 25% |
| | Meadow/Riparian Communities | 34 | ACR | $40,000 | $1,352,000 | $338,000 | $1,690,000 | 25% |
| | **Total Planting Measures** | | | | $28,718,119 | $7,179,530 | $35,897,648 | |
| | **Construction Cost** | | | | $88,350,142 | $22,087,536 | $110,437,678 | |
| | **Adaptive Management (3% of Construction Cost)** | | | | $3,313,130 | | $3,313,130 | |
| 30. | **Planning, Engineering and Design (PED), 10%** | | | | $11,043,768 | | $11,043,768 | |
| 31. | **Construction Management (S&A), 6.7%** | | | | $7,399,324 | | $7,399,324 | |
| | **Engineering During Construction (EDC), 1.5%** | | | | $1,656,565 | | $1,656,565 | |
| | **Total Project Cost** | | | | $111,762,930 | $22,087,536 | $133,850,466 | |
| | **O & M costs** | | | | | | | |
| | Alum Treatment repeated every 10 years | | | | | | | |
| | **O & M Costs (annual costs over life of project).** | | | | $1,325,251 | | | |
| | **TOTAL PROJECT COST FOR ALTERNATIVE A (including Real Estate)** | | | | $140,658,746 | $22,087,536 | $162,746,282 | |
| | **USFS LAND RESTORATION** | | | | | | | |
| | Real estate impact | | | | | | | |
| | Planting | | | | | | | |
| | Geomorphic Restructuring | | | | | | | |
| | Subtotal Federal Non-Corps (USFS) Costs | | | | | | | |

# PRELIMINARY ALTERNATIVES DESCRIPTION

Alt. #4 LAKE RESTORATION ALTERNATIVE

This Alternative focuses on in-lake restoration including dredging to enhance habitat, eradication of non-native aquatics, re-establishment of native aquatic vegetation, and includes a pump and pipeline to keep the Stanfield Marsh wetted year round to meet objectives for riparian and marsh/meadow restoration. Alum treatment to establish a physical barrier between nutrient rich sediments and the water column over the entire lakebed will improve water quality for aquatic plants and fish. The alternative assumes that restoration of marsh and meadow at the fluctuating lake edge will further meet objectives for riparian restoration. The alternative includes balancing of fisheries for a diverse and healthy aquatic plant community, along with support of spawning areas which will be kept wet during spawning season on Grout and Metcalf Creeks using a pump system.

The following measures form this alternative:

**Lake Restoration**

- Eradicate invasive aquatic vegetation, and following eradication treatment, plant aquatic and depth-tolerant vegetation in deeper locations (in the littoral zone).
- Dredging will be used for restoration as follows:
    - Terracing or regrading to create a geomorphic surface at levels within the fluctuating area–so that as the water level changes, the plant community would change from aquatic to marsh to meadow in terraced or graded areas. To establish this community, we would include bed treatments and planting to establish seed beds, and a diverse native aquatic plant community appropriate for birds, fish, and wildlife. As areas are dredged there will be an increase deeper water habitat and marsh around the lake edge.
    - Place a soil cap from low-nutrient lake dredge material in the lakebed over areas of high nutrient concentration.
    - Construct low lying islands from dredge material, planted with riparian, marsh and meadow vegetation to restore habitat for migratory birds and waterfowl in Metcalf Bay and near the mouth of Rathbun Creek. Island design would include a moat to lengthen the time the island base is wetted, protected and surrounded by water as lake levels fluctuate.
- Fisheries Restoration:
    - Improve aquatic plant habitat in shallow areas.
    - Remove non-native, nuisance species of fish by netting, electro-fishing and carp round-up.
- Alum treatment to establish a physical barrier between nutrient rich sediments and the water column (entire Lake).
- Install solar powered water pump to recycle lake water to provide fish spawning habitat at Grout and Metcalf Creeks a short distance upstream. Pump only during spawning season for trout and bass. Create rocky, gravely creek bottoms for spawning beds.

- Lake Marsh/Meadow Restoration
    - Install pump in the East End Deepening Project area of the lake with pipeline conveying water to recirculate water through Stanfield Marsh. This water resource will keep marsh wetter during dry periods. Water will flow through a braided system developed by micro-grading back through the porous Stanfield Crossing toward the west into the lake. This will allow wet meadow and marsh habitat to develop along wetted areas as lake levels rise and fall with varying weather conditions.

Best Buy
Alt. #4

## Big Bear Lake Ecosystem Restoration - Engineer's Estimate on Lake Restoration Alternative

| Code of Acc. | | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | COST WITHOUT CONTING | CONTING | COST WITH CONTING | CONTG % |
|---|---|---|---|---|---|---|---|---|---|
| 01 | | **REAL ESTATE** | | | | | | | |
| | 01 | Government Lands | 1 | LS | $1,638,747 | $1,638,747 | | $1,638,747 | 0% |
| | 02 | Private Lands | 1 | LS | $6,885,190 | $6,885,190 | | $6,885,190 | 0% |
| | | Total Real Estate Cost | | | $8,523,937 | $8,523,937 | | $8,523,937 | |
| 06. | | **LAKE & SHORELINE MEASURES** | | | | | | | |
| | 1 | **Dredging within the Lake** | | | | | | | |
| | | Mob and Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | | Dredge material and pump to cap over high-nutrient areas (within 188 acre center) | 323,885 | CY | $11.50 | $3,724,448 | $931,112 | $4,655,559 | 25% |
| | 2 | **Alum treatment of entire lake (3000 acres)** | 1 | LS | $10,000,000 | $10,000,000 | $2,500,000 | $12,500,000 | 25% |
| | 3 | **Fisheries Restoration** | | | | | | | |
| | | Remove non-native, nuisance species of fish | 1 | LS | $2,000,000 | $2,000,000 | $500,000 | $2,500,000 | 25% |
| | 4 | **Install solar powered water pumps to recycle lake water for spawning** | | | | | | | |
| | | Install pump station and pipelines at Grout Creek | 1 | LS | $3,132,950 | $3,132,950 | $783,238 | $3,916,188 | 25% |
| | | Install pump station and pipelines at Metcalf Creek | 1 | LS | $1,989,775 | $1,989,775 | $497,444 | $2,487,219 | 25% |
| | | Gravely stream bottom in both creeks | 1 | LS | $51,600 | $51,600 | $12,900 | $64,500 | 25% |
| | 5 | **Stanfield Marsh Restoration** | | | | | | | |
| | | Grading in Stanfield Marsh to use pumped water effectively (Water supplied by Water Treatment Plant) | 154 | ACR | $2,500 | $385,000 | $96,250 | $481,250 | 25% |
| | 6 | **Geomorphic Restructuring** | | | | | | | |
| | | Grading in Meadow | 81 | ACR | $2,500 | $202,500 | $50,625 | $253,125 | 25% |
| | | Total Lake and Shoreline Measures | | | | $21,986,273 | $5,496,568 | $27,482,841 | |
| 09. | | **PLANTING MEASURES** | | | | | | | |
| | 1 | **Invasives** | | | | | | | |
| | | Eradicate aquatic invasives | 1 | LS | $1,153,369 | $1,153,369 | $288,342 | $1,441,711 | 25% |
| | | Remove shoreline & tributary invasive plants (391 acres, assume 40% invaded) | 157 | ACR | $8,000 | $1,256,000 | $314,000 | $1,570,000 | 25% |
| | 2 | **Vegetation Types** | | | | | | | |
| | | Aquatic Communities | 720 | ACR | $15,000 | $10,803,000 | $2,700,750 | $13,503,750 | 25% |
| | | Marsh Communities | 230 | ACR | $15,000 | $3,445,350 | $861,338 | $4,306,688 | 25% |
| | | Riparian Communities | 3 | ACR | $36,000 | $106,920 | $26,730 | $133,650 | 25% |
| | | Marsh/Meadow Communities | 81 | ACR | $35,000 | $2,823,800 | $705,950 | $3,529,750 | 25% |
| | | Total Planting Measures | | | | $19,588,439 | $4,897,110 | $24,485,548 | |
| | | **Construction Cost** | | | | $50,098,648 | $10,393,678 | $60,492,326 | |
| | | **Adaptive Management (3% of Construction Cost)** | | | | $1,814,770 | | $1,814,770 | |
| 30. | | **Planning, Engineering and Design (PED), 10%** | | | | $6,049,233 | | $6,049,233 | |
| 31. | | **Construction Management (S&A), 6.7%** | | | | $4,052,986 | | $4,052,986 | |
| | | **Engineering During Construction (EDC), 1.5%** | | | | $907,385 | | $907,385 | |
| | | **Total Project Cost** | | | | $62,923,021 | $10,393,678 | $73,316,699 | |
| | | **O & M Costs (annual costs over life of project).** | | | | $988,160 | | | |
| | | **TOTAL PROJECT COST FOR ALTERNATIVE A (including Real Estate)** | | | | $71,446,958 | $10,393,678 | $81,840,635 | |
| | | **USFS LAND RESTORATION** | | | | | | | |
| | | Real estate impact | | | | | | | |
| | | Planting | | | | | | | |
| | | Geomorphic Restructuring | | | | | | | |
| | | Subtotal Federal Non-Corps (USFS) Costs | | | | | | | |

## LAKE AND SHORELINE RESTORATION ALTERNATIVE

This alternative focuses on restoration of the lake and surrounding shoreline. It includes eradication of invasives and restoration of native aquatic and riparian plants as well as improvement of the Stanfield Marsh habitat. It reconfigures the lake edge to encourage establishment of marsh/meadow/riparian vegetation as the lake levels fluctuate. Fisheries are balanced between warm and cold-water habitat and restored aquatic vegetation. High nutrient areas of the lake are capped and spawning areas for trout and bass are supported by pumping water upstream during spawning season.

This alternative includes all the measures in the Lake Restoration Alternative and adds the following:

**Shoreline Restoration**

- Meadows:
  - Remove invasives and replant native vegetation.
  - Restore and reintroduce native plants in areas along the shoreline where meadows once existed.
  - Improve areas with existing meadows and at mouths of creeks.
- Marsh:
  - Increase meadow/marsh areas along shoreline
  - Dredge shallow shoreline areas creating a terrace to restore shoreline marsh at public access points.
- Montane Riparian:
  - Shoreline revegetation - native plantings along public shoreline –from emergent to grasses to riparian scrub.

Best Buy
Alt. #5

## Big Bear Lake Ecosystem Restoration - Engineer's Estimate on Lake & Shoreline Restoration Alternative

| Code of Acc. | DESCRIPTION | QUANTITY | UNIT | UNIT PRICE | COST WITHOUT CONTING | CONTING | COST WITH CONTING | CONTG % |
|---|---|---|---|---|---|---|---|---|
| **01** | **REAL ESTATE** | | | | | | | |
| 01 | Government Lands | 1 | LS | $1,814,975 | $1,814,975 | | $1,814,975 | 0% |
| 02 | Private Lands | 1 | LS | $10,404,063 | $10,404,063 | | $10,404,063 | 0% |
| | **Total Real Estate Cost** | | | $12,219,038 | $12,219,038 | | $12,219,038 | |
| **06.** | **LAKE & SHORELINE MEASURES** | | | | | | | |
| 1 | **Dredging within the Lake** | | | | | | | |
| | Mob and Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Dredge material and pump to cap over high-nutrient areas (within 188 acre center) | 323,865 | CY | $11.50 | $3,724,448 | $931,112 | $4,655,559 | 25% |
| 2 | **Alum treatment of entire lake (3000 acres)** | 1 | LS | $10,000,000 | $10,000,000 | $2,500,000 | $12,500,000 | 25% |
| 3 | **Fisheries Restoration** | | | | | | | |
| | Remove non-native, nuisance species of fish | 1 | LS | $2,000,000 | $2,000,000 | $500,000 | $2,500,000 | 25% |
| 4 | **Stanfield Marsh Restoration** | | | | | | | |
| | Grading in Stanfield Marsh to use pumped water effectively (Water supplied by Water Treatment Plant) | 154 | ACR | $2,500 | $385,000 | $96,250 | $481,250 | 25% |
| 5 | **Geomorphic Restructuring** | | | | | | | |
| | Grading in Meadow | 81 | ACR | $2,500 | $202,500 | $50,625 | $253,125 | 25% |
| | Terrace or geomorphic restructuring of shoreline | 71 | ACR | $2,500 | $177,500 | $44,375 | $221,875 | 25% |
| 6 | **Island near Rathbun** | | | | | | | |
| | Sheetpile ( 16' to 19' deep @ PZ40 lb/sf) | 1,910 | ton | $4,500 | $8,595,000 | $2,148,750 | $10,743,750 | 25% |
| | Mob/Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Remove existing weaker base soil to affirm structure | 41,000 | CY | $8.00 | $328,000 | $82,000 | $410,000 | 25% |
| | Dredge Material | 284,592 | CY | $8.00 | $2,276,736 | $569,184 | $2,845,920 | 25% |
| | Rock Habitat - Placement | 99,000 | ton | $30.00 | $2,970,000 | $742,500 | $3,712,500 | 25% |
| 7 | **Island near Metcalf** | | | | | | | |
| | Sheetpile ( 16' to 19' deep @ PZ40 lb/sf) | 1,191 | ton | $4,500 | $5,359,500 | $1,339,875 | $6,699,375 | 25% |
| | Mob/Demob | 1 | LS | $500,000 | $500,000 | $125,000 | $625,000 | 25% |
| | Remove weaker soil to affirm structure | 27,100 | CY | $7.50 | $203,250 | $50,813 | $254,063 | 25% |
| | Dredge Material | 189,728 | CY | $7.50 | $1,422,960 | $355,740 | $1,778,700 | 25% |
| | Rock Habitat - Placement | 67,000 | ton | $30.00 | $2,010,000 | $502,500 | $2,512,500 | 25% |
| | **Total Lake and Shoreline Measures** | | | | $41,154,894 | $10,288,723 | $51,443,617 | |
| **09.** | **PLANTING MEASURES** | | | | | | | |
| 1 | **Invasives** | | | | | | | |
| | Eradicate aquatic invasives | 1 | LS | $1,153,369 | $1,153,369 | $288,342 | $1,441,711 | 25% |
| | Remove shoreline & tributary invasive plants (391 acres, assume 40% invaded) | 157 | ACR | $8,000 | $1,256,000 | $314,000 | $1,570,000 | 25% |
| 2 | **Vegetation Types** | | | | | | | |
| | Aquatic Communities | 705 | ACR | $15,000 | $10,580,250 | $2,645,063 | $13,225,313 | 25% |
| | Marsh Communities | 231 | ACR | $15,000 | $3,462,450 | $865,613 | $4,328,063 | 25% |
| | Riparian Communities | 23 | ACR | $36,000 | $821,160 | $205,290 | $1,026,450 | 25% |
| | Meadow Communities | 101 | ACR | $40,000 | $4,054,800 | $1,013,700 | $5,068,500 | 25% |
| | Marsh/Meadow Communities | 95 | ACR | $35,000 | $3,324,650 | $831,163 | $4,155,813 | 25% |
| | Meadow/Riparian Communities | 37 | ACR | $40,000 | $1,477,200 | $369,300 | $1,846,500 | 25% |
| | **Total Planting Measures** | | | | $26,129,879 | $6,532,470 | $32,662,348 | |
| | **Construction Cost** | | | | $67,284,772 | $16,821,193 | $84,105,965 | |
| | **Adaptive Management (3% of Construction Cost)** | | | | $2,523,179 | | $2,523,179 | |
| 30. | **Planning, Engineering and Design (PED), 10%** | | | | $8,410,597 | | $8,410,597 | |
| 31. | **Construction Management (S&A), 6.7%** | | | | $5,635,100 | | $5,635,100 | |
| | **Engineering During Construction (EDC), 1.5%** | | | | $1,261,589 | | $1,261,589 | |
| | **Total Project Cost** | | | | $85,115,237 | $16,821,193 | $101,936,430 | |
| | **O & M Costs (annual costs over life of project).** | | | | $1,144,682 | | | |
| | **TOTAL PROJECT COST FOR ALTERNATIVE A (Including Real Estate)** | | | | $97,334,275 | $16,821,193 | $114,155,468 | |
| | **USFS LAND RESTORATION** | | | | | | | |
| | Real estate impact | | | | | | | |
| | Planting | | | | | | | |
| | Geomorphic Restructuring | | | | | | | |
| | Subtotal Federal Non-Corps (USFS) Costs | | | | | | | |

U.S. Department
of Transportation

**Federal Aviation
Administration**

# Advisory Circular

**Subject:** HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS

**Date:** 5/1/97
**Initiated by:**
AAS-310 and APP-600

**AC No:** 150/5200-33
**Change:**

**1. PURPOSE.** This advisory circular (AC) provides guidance on locating certain land uses having the potential to attract hazardous wildlife to or in the vicinity of public-use airports. It also provides guidance concerning the placement of new airport development projects (including airport construction, expansion, and renovation) pertaining to aircraft movement in the vicinity of hazardous wildlife attractants. Appendix 1 provides definitions of terms used in this AC.

**2. APPLICATION.** The standards, practices, and suggestions contained in this AC are recommended by the Federal Aviation Administration (FAA) for use by the operators and sponsors of all public-use airports. In addition, the standards, practices, and suggestions contained in this AC are recommended by the FAA as guidance for land use planners, operators, and developers of projects, facilities, and activities on or near airports.

**3. BACKGROUND.** Populations of many species of wildlife have increased markedly in the last few years. Some of these species are able to adapt to human-made environments, such as exist on and around airports. The increase in wildlife populations, the use of larger turbine engines, the increased use of twin-engine aircraft, and the increase in air-traffic, all combine to increase the risk, frequency, and potential severity of wildlife-aircraft collisions.

Most public-use airports have large tracts of open, unimproved land that are desirable for added margins of safety and noise mitigation. These areas can present potential hazards to aviation because they often attract hazardous wildlife. During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives world-wide, as well as billions of dollars worth of aircraft damage. Hazardous wildlife attractants near airports could jeopardize future airport expansion because of safety considerations.

DAVID L. BENNETT
Director, Office of Airport Safety and Standards

# SECTION 1. HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.

**1-1. TYPES OF HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AIRPORTS.** Human-made or natural areas, such as poorly-drained areas, retention ponds, roosting habitats on buildings, landscaping, putrescible-waste disposal operations, wastewater treatment plants, agricultural or aquacultural activities, surface mining, or wetlands, may be used by wildlife for escape, feeding, loafing, or reproduction. Wildlife use of areas within an airport's approach or departure airspace, aircraft movement areas, loading ramps, or aircraft parking areas may cause conditions hazardous to aircraft safety.

All species of wildlife can pose a threat to aircraft safety. However, some species are more commonly involved in aircraft strikes than others. Table 1 lists the wildlife groups commonly reported as being involved in damaging strikes to U.S. aircraft from 1993 to 1995.

**Table 1. Wildlife Groups Involved in Damaging Strikes to Civilian Aircraft, USA, 1993-1995.**

| Wildlife Groups | Percent involvement in reported damaging strikes |
|---|---|
| Gulls | 28 |
| Waterfowl | 28 |
| Raptors | 11 |
| Doves | 6 |
| Vultures | 5 |
| Blackbirds-Starlings | 5 |
| Corvids | 3 |
| Wading birds | 3 |
| Deer | 11 |
| Canids | 1 |

**1-2. LAND USE PRACTICES.** Land use practices that attract or sustain hazardous wildlife populations on or near airports can significantly increase the potential for wildlife-aircraft collisions. FAA recommends against land use practices, within the siting criteria stated in 1-3, that attract or sustain populations of hazardous wildlife within the vicinity of airports or cause movement of hazardous wildlife onto, into, or across the approach or departure airspace, aircraft movement area, loading ramps, or aircraft parking area of airports.

Airport operators, sponsors, planners, and land use developers should consider whether proposed land uses, including new airport development projects, would increase the wildlife hazard. Caution should be exercised to ensure that land use practices on or near airports do not enhance the attractiveness of the area to hazardous wildlife.

**1-3. SITING CRITERIA.** FAA recommends separations when siting any of the wildlife attractants mentioned in Section 2 or when planning new airport development projects to accommodate aircraft movement. The distance between an airport's aircraft movement areas, loading ramps, or aircraft parking areas and the wildlife attractant should be as follows:

**a. Airports serving piston-powered aircraft.** A distance of 5,000 feet is recommended.

**b. Airports serving turbine-powered aircraft.** A distance of 10,000 feet is recommended.

**c. Approach or Departure airspace.** A distance of 5 statute miles is recommended, if the wildlife attractant may cause hazardous wildlife movement into or across the approach or departure airspace.

## SECTION 2. LAND USES THAT ARE INCOMPATIBLE WITH SAFE AIRPORT OPERATIONS.

**2-1. GENERAL.** The wildlife species and the size of the populations attracted to the airport environment are highly variable and may depend on several factors, including land-use practices on or near the airport. It is important to identify those land use practices in the airport area that attract hazardous wildlife. This section discusses land use practices known to threaten aviation safety.

**2-2. PUTRESCIBLE-WASTE DISPOSAL OPERATIONS.** Putrescible-waste disposal operations are known to attract large numbers of wildlife that are hazardous to aircraft. Because of this, these operations, when located within the separations identified in the sitting criteria in 1-3 are considered incompatible with safe airport operations.

FAA recommends against locating putrescible-waste disposal operations inside the separations identified in the siting criteria mentioned above. FAA also recommends against new airport development projects that would increase the number of aircraft operations or that would accommodate larger or faster aircraft, near putrescible-waste disposal operations located within the separations identified in the siting criteria in 1-3.

**2-3. WASTEWATER TREATMENT FACILITIES.** Wastewater treatment facilities and associated settling ponds often attract large numbers of wildlife that can pose a threat to aircraft safety when they are located on or near an airport.

**a. New wastewater treatment facilities.** FAA recommends against the construction of new wastewater treatment facilities or associated settling ponds within the separations identified in the siting criteria in 1-3. During the siting analysis for wastewater treatment facilities, the potential to attract hazardous wildlife should be considered if an airport is in the vicinity of a proposed site. Airport operators should voice their opposition to such sitings. In addition, they should consider the existence of wastewater treatment facilities when evaluating proposed sites for new airport development projects and avoid such sites when practicable.

**b. Existing wastewater treatment facilities.** FAA recommends correcting any wildlife hazards arising from existing wastewater treatment facilities located on or near airports without delay, using appropriate wildlife hazard mitigation techniques. Accordingly, measures to minimize hazardous wildlife attraction should be developed in consultation with a wildlife damage management biologist. FAA recommends that wastewater treatment facility operators incorporate appropriate wildlife hazard mitigation techniques into their operating practices. Airport operators also should encourage those operators to incorporate these mitigation techniques in their operating practices.

**c. Artificial marshes.** Waste-water treatment facilities may create artificial marshes and use submergent and emergent aquatic vegetation as natural filters. These artificial marshes may be used by some species of flocking birds, such as blackbirds and waterfowl, for breeding or roosting activities. FAA recommends against establishing artificial marshes within the separations identified in the siting criteria stated in 1-3.

**d. Wastewater discharge and sludge disposal.** FAA recommends against the discharge of wastewater or sludge on airport property. Regular spraying of wastewater or sludge disposal on unpaved areas may improve soil moisture and quality. The resultant turf growth requires more frequent mowing, which in turn may mutilate or flush insects or small animals and produce straw. The maimed or flushed organisms and the straw can attract hazardous wildlife and jeopardize aviation safety. In addition, the improved turf may attract grazing wildlife such as deer and geese.

Problems may also occur when discharges saturate unpaved airport areas. The resultant soft, muddy conditions can severely restrict or prevent emergency vehicles from reaching accident sites in a timely manner.

**e. Underwater waste discharges.** The underwater discharge of any food waste, e.g., fish processing offal, that could attract scavenging wildlife is not recommended within the separations identified in the siting criteria in 1-3.

**2-4. WETLANDS.**

**a. Wetlands on or near Airports.**

**(1) Existing Airports.** Normally, wetlands are attractive to many wildlife species. Airport operators with wetlands located on or nearby airport property should be alert to any wildlife use or habitat changes in these areas that could affect safe aircraft operations.

**(2) Airport Development.** When practicable, the FAA recommends siting new airports using the separations identified in the siting criteria in 1-3. Where alternative sites are not practicable or when expanding existing airports in or near wetlands, the wildlife hazards should be evaluated and minimized through a wildlife management plan prepared by a wildlife damage management biologist, in consultation with the U.S. Fish and Wildlife Service (USFWS) and the U.S. Army Corps of Engineers (COE).

**NOTE:** If questions exist as to whether or not an area would qualify as a wetland, contact the U.S. Army COE, the Natural Resource Conservation Service, or a wetland consultant certified to delineate wetlands.

**b. Wetland mitigation.** Mitigation may be necessary when unavoidable wetland disturbances result from new airport development projects. Wetland mitigation should be designed so it does not create a wildlife hazard.

**(1)** FAA recommends that wetland mitigation projects that may attract hazardous wildlife be sited outside of the separations identified in the siting criteria in 1-3. Wetland mitigation banks meeting these siting criteria offer an ecologically sound approach to mitigation in these situations.

**(2)** Exceptions to locating mitigation activities outside the separations identified in the siting criteria in 1-3 may be considered if the affected wetlands provide unique ecological functions, such as critical habitat for threatened or endangered species or ground water recharge. Such mitigation must be compatible with safe airport operations. Enhancing such mitigation areas to attract hazardous wildlife should be avoided. On-site mitigation plans may be reviewed by the FAA to determine compatibility with safe airport operations.

**(3)** Wetland mitigation projects that are needed to protect unique wetland functions (see 2-4.b.(2)), and that must be located in the siting criteria in 1-3 should be identified and evaluated by a wildlife damage management biologist before implementing the mitigation. A wildlife damage management plan should be developed to reduce the wildlife hazards.

**NOTE:** AC 150/5000-3, *Address List for Regional Airports Division and Airports District/Field Offices*, provides information on the location of these offices.

**2-5. DREDGE SPOIL CONTAINMENT AREAS.** FAA recommends against locating dredge spoil containment areas within the separations identified in the siting criteria in 1-3, if the spoil contains material that would attract hazardous wildlife.

## SECTION 3. LAND USES THAT MAY BE COMPATIBLE WITH SAFE AIRPORT OPERATIONS.

**3-1. GENERAL.** Even though they may, under certain circumstances, attract hazardous wildlife, the land use practices discussed in this section have flexibility regarding their location or operation and may even be under the airport operator's or sponsor's control. In general, the FAA does not consider the activities discussed below as hazardous to aviation if there is no apparent attraction to hazardous wildlife, or wildlife hazard mitigation techniques are implemented to deal effectively with any wildlife hazard that may arise.

**3-2. ENCLOSED WASTE FACILITIES.** Enclosed trash transfer stations or enclosed waste handling facilities that receive garbage indoors; process it via compaction, incineration, or similar manner; and remove all residue by enclosed vehicles, generally would be compatible, from a wildlife perspective, with safe airport operations, provided they are not located on airport property or within the runway protection zone (RPZ). No putrescible-waste should be handled or stored outside at any time, for any reason, or in a partially enclosed structure accessible to hazardous wildlife.

Partially enclosed operations that accept putrescible-waste are considered to be incompatible with safe airport operations. FAA recommends these operations occur outside the separations identified in the siting criteria in 1-3.

**3-3. RECYCLING CENTERS.** Recycling centers that accept previously sorted, non-food items such as glass, newspaper, cardboard, or aluminum are, in most cases, not attractive to hazardous wildlife.

**3-4. COMPOSTING OPERATIONS ON AIRPORTS.** FAA recommends against locating composting operations on airports. However, when they are located on an airport, composting operations should not be located closer than the greater of the following distances: 1,200 feet from any aircraft movement area, loading ramp, or aircraft parking space; or the distance called for by airport design requirements. This spacing is intended to prevent material, personnel, or equipment from penetrating any Obstacle Free Area (OFA), Obstacle Free Zone (OFZ), Threshold Siting Surface (TSS), or Clearway (see AC 150/5300-13, *Airport Design*). On-airport disposal of compost by-products is not recommended for the reasons stated in 2-3.d.

**a. Composition of material handled.** Components of the compost should never include any municipal solid waste. Non-food waste such as leaves, lawn clippings, branches, and twigs generally are not considered a wildlife attractant. Sewage sludge, wood-chips, and similar material are not municipal solid wastes and may be used as compost bulking agents.

**b. Monitoring on-airport composting operations.** If composting operations are to be located on airport property, FAA recommends that the airport operator monitor composting operations to ensure that steam or thermal rise does not affect air traffic in any way. Discarded leaf disposal bags or other debris must not be allowed to blow onto any active airport area. Also, the airport operator should reserve the right to stop any operation that creates unsafe, undesirable, or incompatible conditions at the airport.

**3-5. ASH DISPOSAL.** Fly ash from resource recovery facilities that are fired by municipal solid waste, coal, or wood, is generally considered not to be a wildlife attractant because it contains no putrescible matter. FAA generally does not consider landfills accepting only fly ash to be wildlife attractants, if those landfills: are maintained in an orderly manner; admit no putrescible-waste of any kind; and are not co-located with other disposal operations.

Since varying degrees of waste consumption are associated with general incineration, FAA classifies the ash from general incinerators as a regular waste disposal by-product and, therefore, a hazardous wildlife attractant.

**3-6. CONSTRUCTION AND DEMOLITION (C&D) DEBRIS LANDFILLS.** C&D debris (Class IV) landfills have visual and operational characteristics similar to putrescible-waste disposal sites. When co-located with putrescible-waste disposal operations, the probability of hazardous wildlife attraction to C&D landfills increases because of the similarities between these disposal activities.

FAA generally does not consider C&D landfills to be hazardous wildlife attractants, if those landfills: are maintained in an orderly manner; admit no putrescible-waste of any kind; and are not co-located with other disposal operations.

**3-7. WATER DETENTION OR RETENTION PONDS.** The movement of storm water away from runways, taxiways, and aprons is a normal function on most airports and is necessary for safe aircraft operations. Detention ponds hold storm water for short periods, while retention ponds hold water indefinitely. Both types of ponds control runoff, protect water quality, and can attract hazardous wildlife. Retention ponds are more attractive to hazardous wildlife than detention ponds because they provide a more reliable water source.

To facilitate hazardous wildlife control, FAA recommends using steep-sided, narrow, linearly-shaped, rip-rap lined, water detention basins rather than retention basins. When possible, these ponds should be placed away from aircraft movement areas to minimize aircraft-wildlife interactions. All vegetation in or around detention or retention basins that provide food or cover for hazardous wildlife should be eliminated.

If soil conditions and other requirements allow, FAA encourages the use of underground storm water infiltration systems, such as French drains or buried rock fields, because they are less attractive to wildlife.

**3-8. LANDSCAPING.** Wildlife attraction to landscaping may vary by geographic location. FAA recommends that airport operators approach landscaping with caution and confine it to airport areas not associated with aircraft movements. All landscaping plans should be reviewed by a wildlife damage management biologist. Landscaped areas should be monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be implemented immediately.

**3-9. GOLF COURSES.** Golf courses may be beneficial to airports because they provide open space that can be used for noise mitigation or by aircraft during an emergency. On-airport golf courses may also be a concurrent use that provides income to the airport.

Because of operational and monetary benefits, golf courses are often deemed compatible land uses on or near airports. However, waterfowl (especially Canada geese) and some species of gulls are attracted to the large, grassy areas and open water found on most golf courses. Because waterfowl and gulls occur throughout the U.S., FAA recommends that airport operators exercise caution and consult with a wildlife damage management biologist when considering proposals for golf course construction or expansion on or near airports. Golf courses should be monitored on a continuing basis for the presence of hazardous wildlife. If hazardous wildlife is detected, corrective actions should be implemented immediately.

**3-10. AGRICULTURAL CROPS.** As noted above, airport operators often promote revenue-generating activities to supplement an airport's financial viability. A common concurrent use is agricultural crop production. Such use may create potential hazards to aircraft by attracting wildlife. Any proposed on-airport agricultural operations should be reviewed by a wildlife damage management biologist. FAA generally does not object to agricultural crop production on airports when: wildlife hazards are not predicted; the guidelines for the airport areas specified in 3-10.a-f. are observed; and the agricultural operation is closely monitored by the airport operator or sponsor to ensure that hazardous wildlife are not attracted.

**NOTE:** If wildlife becomes a problem due to on-airport agricultural operations, FAA recommends undertaking the remedial actions described in 3-10.f.

**a. Agricultural activities adjacent to runways.** To ensure safe, efficient aircraft operations, FAA recommends that no agricultural activities be conducted in the Runway Safety Area (RSA), OFA, and the OFZ (see AC 150/5300-13).

**b. Agricultural activities in areas requiring minimum object clearances.** Restricting agricultural operations to areas outside the RSA, OFA, OFZ, and Runway Visibility Zone (RVZ) (see AC 150/5300-13) will normally provide the minimum object clearances required by FAA's airport design standards. FAA recommends that farming operations not be permitted within areas critical to the proper operation of localizers, glide slope indicators, or other visual or electronic navigational aids. Determinations of minimal areas that must be kept free of farming operations should be made on a case-by-case basis. If navigational aids are present, farm leases for on-airport agricultural activities should be coordinated with FAA's Airway Facilities Division, in accordance with FAA Order 6750.16, *Siting Criteria for Instrument Landing Systems.*

**NOTE:** Crop restriction lines conforming to the dimensions set forth in Table 2 will normally provide the minimum object clearance required by

FAA airport design standards. The presence of navigational aids may require expansion of the restricted area.

**c. Agricultural activities within an airport's approach areas.** The RSA, OFA, and OFZ all extend beyond the runway shoulder and into the approach area by varying distances. The OFA normally extends the farthest and is usually the controlling surface. However, for some runways, the TSS (see AC 150/5300-13, Appendix 2) may be more controlling than the OFA. The TSS may not be penetrated by any object. The minimum distances shown in Table 2 are intended to prevent penetration of the OFA, OFZ, or TSS by crops or farm machinery.

**NOTE**: Threshold Siting standards should not be confused with the approach areas described in Title 14, Code of Federal Regulations, Part 77, (14 CFR 77), *Objects Affecting Navigable Airspace.*

**d. Agricultural activities between intersecting runways.** FAA recommends that no agricultural activities be permitted within the RVZ. If the terrain is sufficiently below the runway elevation, some types of crops and equipment may be acceptable. Specific determinations of what is permissible in this area requires topographical data. For example, if the terrain within the RVZ is level with the runway ends, farm machinery or crops may interfere with a pilot's line-of-sight in the RVZ.

**e. Agricultural activities in areas adjacent to taxiways and aprons.** Farming activities should not be permitted within a taxiway's OFA. The outer portions of aprons are frequently used as a taxilane and farming operations should not be permitted within the OFA. Farming operations should not be permitted between runways and parallel taxiways.

**f. Remedial actions for problematic agricultural activities.** If a problem with hazardous wildlife develops, FAA recommends that a professional wildlife damage management biologist be contacted and an on-site inspection be conducted. The biologist should be requested to determine the source of the hazardous wildlife attraction and suggest remedial action. Regardless of the source of the attraction, prompt remedial actions to protect aviation safety are recommended. The remedial actions may range from choosing another crop or farming technique to complete termination of the agricultural operation.

Whenever on-airport agricultural operations are stopped due to wildlife hazards or annual harvest, FAA recommends plowing under all crop residue and harrowing the surface area smooth. This will reduce or eliminate the area's attractiveness to foraging wildlife. FAA recommends that this requirement be written into all on-airport farm use contracts and clearly understood by the lessee.

**Table 2. Minimum Distances Between Certain Airport Features And Any On-Airport Agriculture Crops.**

| Aircraft Approach Category And Design Group [1] | Distance In Feet From Runway Centerline To Crop | | Distance In Feet From Runway End To Crop | | Distance In Feet From Centerline Of Taxiway To Crop | Distance In Feet From Edge Of Apron To Crop |
|---|---|---|---|---|---|---|
| | Visual & ≥ ¾ mile | < ¾ mile | Visual & ≥ ¾ mile | < ¾ mile | | |
| Category A & B Aircraft | | | | | | |
| Group I | 200 [2] | 400 | 300[3] | 600 | 45 | 40 |
| Group II | 250 | 400 | 400[3] | 600 | 66 | 58 |
| Group III | 400 | 400 | 600 | 800 | 93 | 81 |
| Group IV | 400 | 400 | 1,000 | 1,000 | 130 | 113 |
| Category C, D & E Aircraft | | | | | | |
| Group I | 530[3] | 575[3] | 1,000 | 1,000 | 45 | 40 |
| Group II | 530[3] | 575[3] | 1,000 | 1,000 | 66 | 58 |
| Group III | 530[3] | 575[3] | 1,000 | 1,000 | 93 | 81 |
| Group IV | 530[3] | 575[3] | 1,000 | 1,000 | 130 | 113 |
| Group V | 530[3] | 575[3] | 1,000 | 1,000 | 160 | 138 |
| Group VI | 530[3] | 575[3] | 1,000 | 1,000 | 193 | 167 |

1. Design Groups are based on wing span, and Category depends on approach speed of the aircraft.

| | |
|---|---|
| Group I: Wing span up to 49 ft. | Category A: Speed less than 91 knots |
| Group II: Wing span 49ft. up to 78 ft. | Category B: Speed 91 knots up to 120 knots |
| Group III: Wing span 79 ft. up to 117 ft. | Category C: Speed 121 knots up to 140 knots |
| Group IV: Wing span 118 ft. up to 170 ft. | Category D: Speed 141 knots up to 165 knots |
| Group V: Wing span 171 ft. up to 213 ft. | Category E: Speed 166 knots or more |
| Group VI: Wing span 214 ft. up to 261 ft. | |

2. If the runway will only serve small airplanes (12,500 lb. And under) in Design Group I, this dimension may be reduced to 125 feet; however, this dimension should be increased where necessary to accommodate visual navigational aids that may be installed. For example farming operations should not be allowed within 25 feet of a Precision Approach Path Indicator (PAPI) light box.

3. These dimensions reflect the TSS as defined in AC 150/5300-13, Appendix 2. The TSS cannot be penetrated by any object. Under these conditions, the TSS is more restrictive than the OFA, and the dimensions shown here are to prevent penetration of the TSS by crops and farm machinery.

## SECTION 4. NOTIFICATION OF FAA ABOUT HAZARDOUS WILDLIFE ATTRACTANTS ON OR NEAR AN AIRPORT.

**4-1. GENERAL.** Airport operators, land developers, and owners should notify the FAA in writing of known or reasonably foreseeable land use practices on or near airports that either attract or may attract hazardous wildlife. This section discusses those notification procedures.

**4-2. NOTIFICATION REQUIREMENTS FOR WASTE DISPOSAL SITE OPERATIONS.** The Environmental Protection Agency (EPA) requires any operator proposing a new or expanded waste disposal operation within 5 statute miles of a runway end to notify the appropriate FAA Regional Airports Division Office and the airport operator of the proposal (40 CFR 258, *Criteria for Municipal Solid Waste Landfills*, section 258.10, *Airport Safety*). The EPA also requires owners or operators of new municipal solid waste landfill (MSWLF) units, or lateral expansions of existing MSWLF units that are located within 10,000 feet of any airport runway end used by turbojet aircraft or within 5,000 feet of any airport runway end used only by piston-type aircraft, to demonstrate successfully that such units are not hazards to aircraft.

**a. Timing of Notification.** When new or expanded MSWLFs are being proposed near airports, MSWLF operators should notify the airport operator and the FAA of this as early as possible pursuant to 40 CFR Part 258. Airport operators should encourage the MSWLF operators to provide notification as early as possible.

**NOTE:** AC 150/5000-3 provides information on these FAA offices.

**b. Putrescible-Waste Facilities.** In their effort to satisfy the EPA requirement, some putrescible-waste facility proponents may offer to undertake experimental measures to demonstrate that their proposed facility will not be a hazard to aircraft. To date, the ability to sustain a reduction in the numbers of hazardous wildlife to levels that existed before a putrescible-waste landfill began operating has not been successfully demonstrated. For this reason, demonstrations of experimental wildlife control measures should not be conducted in active aircraft operations areas.

**c. Other Waste Facilities.** To claim successfully that a waste handling facility sited within the separations identified in the siting criteria in 1-3 does not attract hazardous wildlife and does not threaten aviation, the developer must establish convincingly that the facility will not handle putrescible material other than that as outlined in 3-2. FAA requests that waste site developers provide a copy of an official permit request verifying that the facility will not handle putrescible material other than that as outlined in 3-2. FAA will use this information to determine if the facility will be a hazard to aviation.

**4-3. NOTIFYING FAA ABOUT OTHER WILDLIFE ATTRACTANTS.** While U. S. EPA regulations require landfill owners to provide notification, no similar regulations require notifying FAA about changes in other land use practices that can create hazardous wildlife attractants. Although it is not required by regulation, FAA requests those proposing land use changes such as those discussed in 2-3, 2-4, and 2-5 to provide similar notice to the FAA as early in the development process as possible. Airport operators that become aware of such proposed development in the vicinity of their airports should also notify the FAA. The notification process gives the FAA an opportunity to evaluate the effect of a particular land use change on aviation safety.

The land use operator or project proponent may use FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, or other suitable documents to notify the appropriate FAA Regional Airports Division Office.

It is helpful if the notification includes a 15-minute quadrangle map of the area identifying the location of the proposed activity. The land use operator or project proponent should also forward specific details of the proposed land use change or operational change or expansion. In the case of solid waste landfills, the information should include the type of waste to be handled, how the waste will be processed, and final disposal methods.

**4-5. FAA REVIEW OF PROPOSED LAND USE CHANGES.**

**a.** The FAA discourages the development of facilities discussed in section 2 that will be located within the 5,000/10,000-foot criteria in 1-3.

**b.** For projects which are located outside the 5,000/10,000-foot criteria, but within 5 statute miles of the airport's aircraft movement areas, loading ramps, or aircraft parking areas, FAA may review development plans, proposed land use changes, operational changes, or wetland mitigation plans to determine if such changes present potential wildlife hazards to aircraft operations. Sensitive airport areas will be identified as those that lie under or next to approach or departure airspace. This brief examination should be sufficient to determine if further investigation is warranted.

**c.** Where further study has been conducted by a wildlife damage management biologist to evaluate a site's compatibility with airport operations, the FAA will use the study results to make its determination.

**d.** FAA will discourage the development of any excepted sites (see Section 3) within the criteria specified in 1-3 if a study shows that the area supports hazardous wildlife species.

**4-6. AIRPORT OPERATORS.** Airport operators should be aware of proposed land use changes, or modification of existing land uses, that could create hazardous wildlife attractants within the separations identified in the siting criteria in 1-3. Particular attention should be given to proposed land uses involving creation or expansion of waste water treatment facilities, development of wetland mitigation sites, or development or expansion of dredge spoil containment areas.

**a. AIP-funded airports.** FAA recommends that operators of AIP-funded airports, to the extent practicable, oppose off-airport land use changes or practices (within the separations identified in the siting criteria in 1-3) that may attract hazardous wildlife. Failure to do so could place the airport operator or sponsor in noncompliance with applicable grant assurances. FAA recommends against the placement of airport development projects pertaining to aircraft movement in the vicinity of hazardous wildlife attractants. Airport operators, sponsors, and planners should identify wildlife attractants and any associated wildlife hazards during any planning process for new airport development projects.

**b. Additional coordination.** If, after the initial review by FAA, questions remain about the existence of a wildlife hazard near an airport, the airport operator or sponsor should consult a wildlife damage management biologist. Such questions may be triggered by a history of wildlife strikes at the airport or the proximity of the airport to a wildlife refuge, body of water, or similar feature known to attract wildlife.

**c. Specialized assistance.** If the services of a wildlife damage management biologist are required, FAA recommends that land use developers or the airport operator contact the appropriate state director of the United States Department of Agriculture/Animal Damage Control (USDA/ADC), or a consultant specializing in wildlife damage management. Telephone numbers for the respective USDA/ADC state offices may be obtained by contacting USDA/ADC's Operational Support Staff, 4700 River Road, Unit 87, Riverdale, MD, 20737-1234, Telephone (301) 734-7921, Fax (301) 734-5157. The ADC biologist or consultant should be requested to identify and quantify wildlife common to the area and evaluate the potential wildlife hazards.

**d. Notifying airmen.** If an existing land use practice creates a wildlife hazard, and the land use practice or wildlife hazard cannot be immediately eliminated, the airport operator should issue a Notice to Airmen (NOTAM) and encourage the land owner or manager to take steps to control the wildlife hazard and minimize further attraction.

**q. Wildlife.** Any wild animal, including without limitation any wild mammal, bird, reptile, fish, amphibian, mollusk, crustacean, arthropod, coelenterate, or other invertebrate, including any part, product, egg, or offspring there of (50 CFR 10.12, *Taking, Possession, Transportation, Sale, Purchase, Barter, Exportation, and Importation of Wildlife and Plants*). As used in this AC, WILDLIFE includes feral animals and domestic animals while out of the control of their owners (14 CFR 139.3, *Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft (Other Than Helicopters)*).

**r. Wildlife attractants.** Any human-made structure, land use practice, or human-made or natural geographic feature, that can attract or sustain hazardous wildlife within the landing or departure airspace, aircraft movement area, loading ramps, or aircraft parking areas of an airport. These attractants can include but are not limited to architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquacultural activities, surface mining, or wetlands.

**s. Wildlife hazard.** A potential for a damaging aircraft collision with wildlife on or near an airport (14 CFR 139.3).

**2. RESERVED.**

# APPENDIX 1. DEFINITIONS OF TERMS USED IN THIS ADVISORY CIRCULAR.

1. **GENERAL.** This appendix provides definitions of terms used throughout this AC.

**a. Aircraft movement area.** The runways, taxiways, and other areas of an airport which are used for taxiing or hover taxiing, air taxiing, takeoff, and landing of aircraft exclusive of loading ramps and aircraft parking areas.

**b. Airport operator.** The operator (private or public) or sponsor of a public use airport.

**c. Approach or departure airspace.** The airspace, within 5 statute miles of an airport, through which aircraft move during landing or takeoff.

**d. Concurrent use.** Aeronautical property used for compatible non-aviation purposes while at the same time serving the primary purpose for which it was acquired; and the use is clearly beneficial to the airport. The concurrent use should generate revenue to be used for airport purposes (see Order 5190.6A, *Airport Compliance Requirements*, sect. 5h).

**e. Fly ash.** The fine, sand-like residue resulting from the complete incineration of an organic fuel source. Fly ash typically results from the combustion of coal or waste used to operate a power generating plant.

**f. Hazardous wildlife.** Wildlife species that are commonly associated with wildlife-aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a wildlife-aircraft strike hazard.

**g. Piston-use airport.** Any airport that would primarily serve FIXED-WING, piston-powered aircraft. Incidental use of the airport by turbine-powered, FIXED-WING aircraft would not affect this designation. However, such aircraft should not be based at the airport.

**h. Public-use airport.** Any publicly owned airport or a privately-owned airport used or intended to be used for public purposes.

**i. Putrescible material.** Rotting organic material.

**j. Putrescible-waste disposal operation.** Landfills, garbage dumps, underwater waste discharges, or similar facilities where activities include processing, burying, storing, or otherwise disposing of putrescible material, trash, and refuse.

**k. Runway protection zone (RPZ).** An area off the runway end to enhance the protection of people and property on the ground (see AC 150/5300-13). The dimensions of this zone vary with the design aircraft, type of operation, and visibility minimum.

**l. Sewage sludge.** The de-watered effluent resulting from secondary or tertiary treatment of municipal sewage and/or industrial wastes, including sewage sludge as referenced in U.S. EPA's *Effluent Guidelines and Standards*, 40 C.F.R. Part 401.

**m. Shoulder.** An area adjacent to the edge of paved runways, taxiways, or aprons providing a transition between the pavement and the adjacent surface, support for aircraft running off the pavement, enhanced drainage, and blast protection (see AC 150/5300-13).

**n. Turbine-powered aircraft.** Aircraft powered by turbine engines including turbojets and turboprops but excluding turbo-shaft rotary-wing aircraft.

**o. Turbine-use airport.** Any airport that ROUTINELY serves FIXED-WING turbine-powered aircraft.

**p. Wastewater treatment facility.** Any devices and/or systems used to store, treat, recycle, or reclaim municipal sewage or liquid industrial wastes, including Publicly Owned Treatment Works (POTW), as defined by Section 212 of the Federal Water Pollution Control Act (P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-576) and the Water Quality Act of 1987 (P.L. 100-4). This definition includes any pretreatment involving the reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a POTW. (See 40 C.F. R. Section 403.3 (o), (p), & (q)).