White Sands Missile Range Tree Management & Life Cycle Plan

Priority - WSMR Housing Area, Main Cantonment

Prepared by:

Division of Master Planning

in corporation with

Directorate of Public Works

White Sands Missile Range

December, 2021

Table of Contents

Sample Map indicating tree condition and location of water lines

List of DoD Regulations and Policies

References:

a. AR 200-1, Environmental Protection and Enhancement, 13 December 2007
b. 32 CFR Part 651 , Environmental Analysis of Army Actions (AR 200-2, March 2002)
c. Migratory Bird Treaty Act
d. Memorandum of Understanding between the U.S. Department of Defense and the U.S. Fish and Wildlife Service to Promote the Conservation of Migratory Birds
e. Sikes Act
f. National Environmental Policy Act, 42 U.S.C. 4321 et seq.
g. Environmental Analysis of Army Actions, 32 CFR 651, 29 Mar 02

Acronyms

a. WSMR – White Sands Missile Range
b. BBC – Belfour Beatty Community
c. WSP - Directorate of Public Works (WSP)
d. WSP-M - Master Planning Division

Acknowledgments

Business Operations Integration Division
Environmental Division
Energy Division
GIS H2Direct
Housing Division
Master Planning Division
Operation & Maintenance Division, Road & Grounds

Thank you for your collaboration and support.

Section 1 Introduction

The Directorate of Public Works (WSP) was tasked with establishing a Tree Management Plan for the Main Cantonment of White Sands Missile Range (WSMR). COL M. Ryan Howell, Garrison Commander, wanted a plan in place to track and better care for the trees that enhance the overall quality of life on the Main Cantonment and provide needed shade, especially in the Housing Areas. The Master Planning Division (WSP-M) of WSP was assigned to lead the project, working alongside WSMR WSP Divisions of Housing, Environmental, Energy, and Operations and Maintenance, while also collaborating with WSMR partner Belfour Beatty, Privatized Housing.

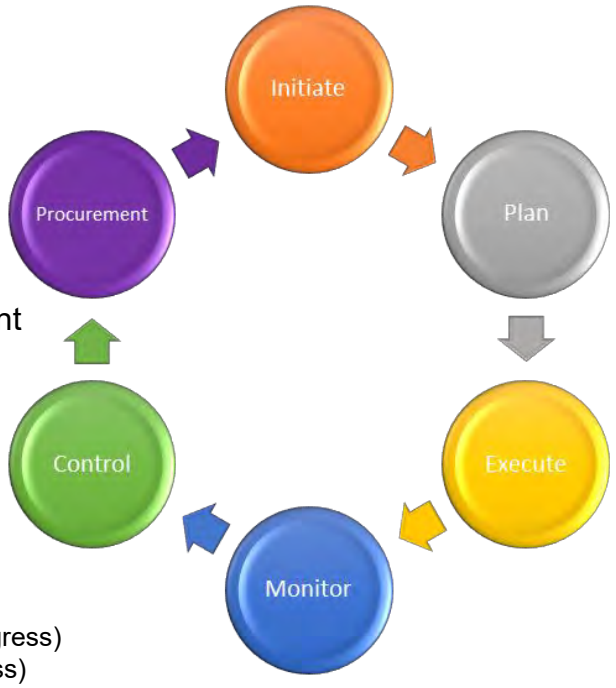
The immediate goals of the Tree Management Plan were to map and estimate the number of trees on the Main Cantonment, identify their species, locate access to existing irrigation or water supply, and develop a plan to replace dead trees in the Housing Areas.

Aspects of the Tree Management Life Cycle Plan will be incorporated in the WSMR Annual Work Plan. The Tree Management Life Cycle Plan will allow WSP-M to obtain data on the conditions of the trees and estimate costs of tree maintenance. WSP-M will work with the Environmental Division to develop a list of acceptable replacement tree species. Trees that can provide privacy and best planting locations will be taken into consideration.

Goals

The Goal is to maintain trees as living assets. Trees must be maintained, so saplings can mature into healthy trees and avoid becoming hazardous unmaintained mature trees.

Maintaining trees supports DoD/Army objectives and policies to provide a habitat for and conserve migratory birds. This plan also supports goals/objectives of the WSMR Installation Natural Resources Management Plan.



A tree management plan includes life cycle replacement recommendations, including optimal timeline and suitable species for the area. Replacement is dependent on available resources. Once the resources are verified, a way forward can be decided. A Tree Management Life Cycle Plan will require maintenance and care that will be improved and controlled by:

- Initiating –Starting the planning process (Currently in progress)
- Planning – Major concerns or issues (Currently in progress)
- Executing – Getting the right resources in place
- Monitoring – Documenting progress and adjustments as required
- Controlling – Tracking expenses and reevaluating the plan
- Procurement – Replacement and purchasing trees

Section 2 Stakeholders Interests

Directorate of Public Works:
Division of Master Planning
Division of Housing
Division of Environmental
Division of Energy
FMWR (Recreation)
DPTMS (Anti-Terrorism)
DES (Physical Security)
Safety (Line of Sight and Concealment)
Residents
Employees
Belfour Beatty/White Sands Housing

Building 100 applying best practices to preserve trees

Directorate of Public Works has been in communication with Belfour Beatty. It is important that DPW addresses issues of key stakeholders and works to develop a functional, realistic, and economic tree management plan. Sustainable management of our natural resources go hand in hand with the wellness and quality of life for those who live and work here in the WSMR Main Cantonment.

Consider the ever-changing climate and the noticeable differences now experienced here at WSMR (see figure 1). Comparing weather changes form the past to the present demonstrates the area has been experiencing a period of drought. Approximately half of the montane springs on the Range have dried out since the early 1990s demonstrating a drying climate (WSMR 2018). Recent rains are helpful, but intense rain events cause problems, especially with soil erosion. Local water wells with elevated nitrates (see fig 1, fig 2) provide an opportunity to repurpose water use for landscaping rather than drinking water. This best management practice will aid in conserving existing drinking water supplies for human use. Sustainment of existing potable water supply will be beneficial as the military mission shifts overtime with the potential for future growth of soldiers and civilians residing on post. In addition, mature conifers are living assets with monetary value. It would cost $35,000 to replace a tree located on the southwest side of building 100 (an estimate according to Dr. Jeff Anderson, Agricultural Extension Agent USDS-NMSU).

Along with other areas of concern, this has been an area of concern here at WSMR as it effects the environment, the use of energy resources, and the quality of life. WSMR is therefore taking the initiative to prepare a report that will bring awareness to these issues to better plan for the future by encouraging a more balanced budget and plans.

Section 2A Housing Division DPW – RCI Homes

Housing Division has communicated the importance with our RCI partner, Belfour Beatty Community BBC, to equally share the concerns of our shared WSMR Tree Management Plan. We are determining cost estimates per tree, including water requirements, to sustain positive tree oversight into the near and far future.

Additionally, in consideration of the contractual agreement, we have discussed the verbiage regarding the cost and budget and will attempt to expedite this as a high importance priority. The housing area will be first priority, followed by parks and other suitable green community spaces. As we move forward, we can improve the Quality of Life and beautification for our residents by offering the best shaded location in this isolated area.

The intent is to have a unified way forward as we provide oversight to WSMR's tree management program.

Section 2B Ground Lease Modifications

Housing Division is communicating with the RCI partner (BBC) in order to address any adjustments or modifications to the ground lease to facilitate the progress of the WSMR Tree Management Plan. Monetary or labor cost, all-inclusive, will be identified and executed as it pertains to the partner in the planning and execution of the plan. WSMR requires expediting irrigation, tree installation management, and supplies, to prioritize RCI Homes, Parks and any other shared common areas.

White Sands Missile Range Housing Area

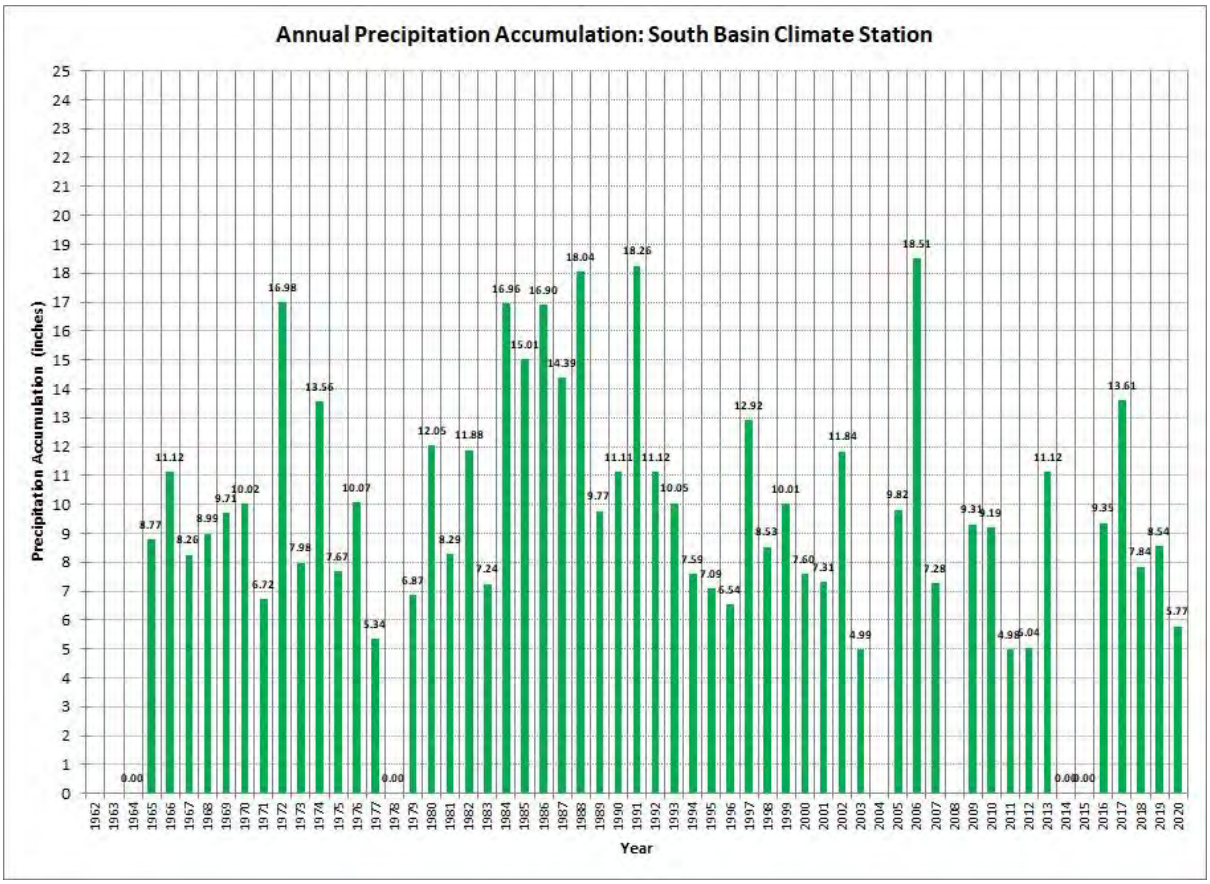


Figure 1 Annual Precipitation Accumulation

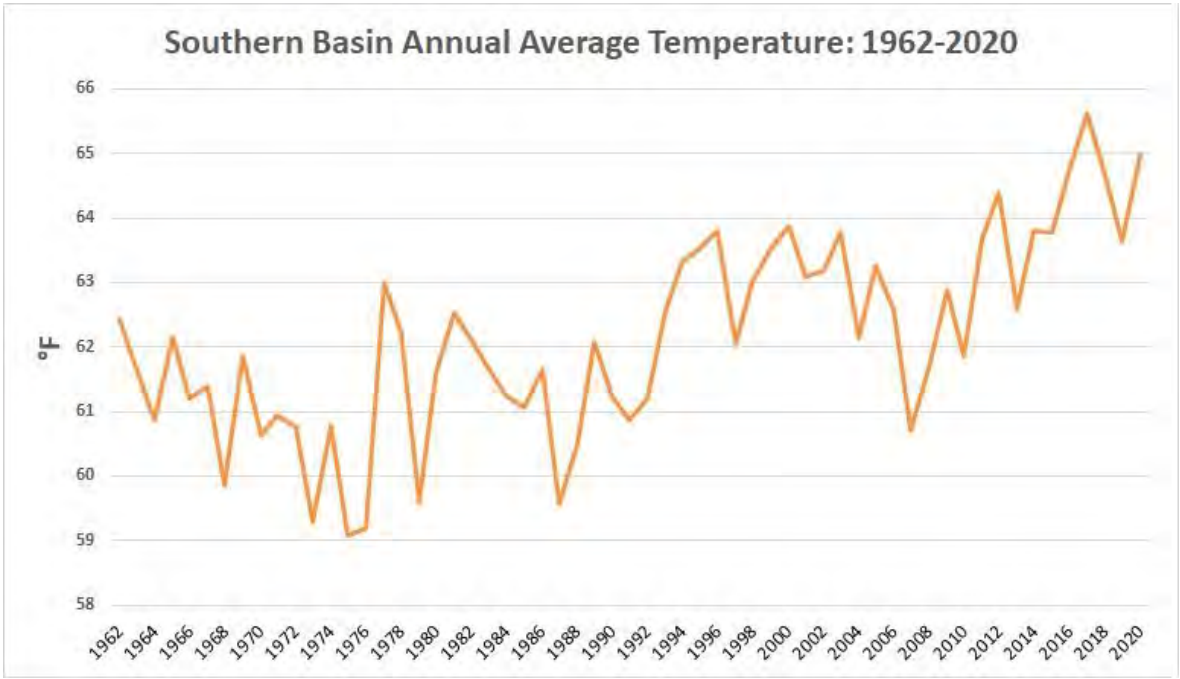


Figure 2 Southern Basin increase in temperature
Charts provided by Eric Webb Meteorology, WSMR.

Section 3. Inventory

In order to develop a tree management plan, a complete inventory is needed to provide a scope of the work to support and fund the maintenance of trees. An inventory of trees located within the community of WSMR Main Cantonment should be completed, along with the generating of a conditions assessment. Where applicable, an inventory for other districts within the installation should be developed following the methods as prescribed in this report, (see figure 3 – 10).

Section 3A. Methods

The GIS team divided the Main Post Cantonment area into 225 map sections to track the tree inventory. Sampling sections were prioritized starting with the White Sands housing community, followed by the Desert Emerald Park, Volunteer Park, and around facilities traveling east from housing then towards Headquarters Avenue and the Main Post Museum. Sections were walked to identify the species for all trees, note their physical condition, identify stressors, and attribute an age category (Appendix A, Tree Conditions Definitions). In the housing community, some trees were not visible from the street if they were in backyards and were not included in the inventory. Photographs were taken to provide examples of various tree conditions (Appendix B, Tree Condition Photographs). The GIS team developed a feature class within the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) database as an Army non-CIP (Common Installation Picture) layer. The feature class clearly identifies the tree condition stating whether trees are Dead, Critical, Fair, or in Excellent condition. Later in this report, Section 4 Budget, current suggested estimates for tree replacement will be discussed. Further effects to tree condition will result as the region dries. (see Appendix A).

Lance Harkey, (retired) professional Horticulturist and Landscape Designer, served as a volunteer through the Army Community Service Volunteer Program. Mr. Harkey donated 100+ hours over 90 days. He assisted with 90% of the data collection, assisted with data compilation, and provided best management practices for tree survival (see Appendix A).

Section 3B Species – Accumulating Data

There are an estimated 3515 trees located on Main Post, of which 1089 have been inventoried and assessed. Of the 1089 inventoried, 58% are greater than 16 years old, 37% are 6 to 10 years old, and 5% are 1 to 5 years old. This is illustrated in the graph below (see figure 3).

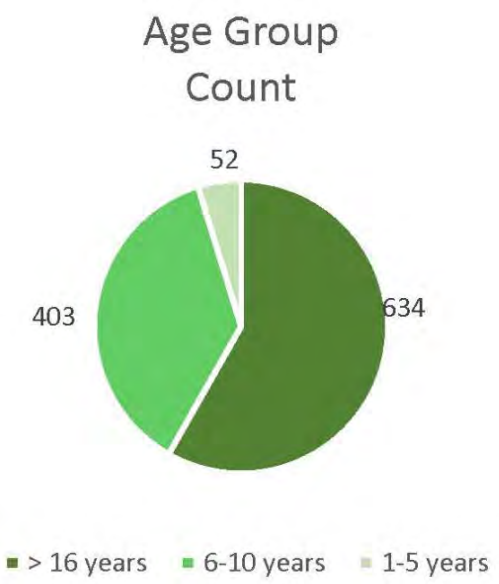


Figure 3.Age Class – Count Illustrating the number of trees in the tree age groups

Section 3Bi. Existing Species

42 species of trees have been identified to date. Predominant species are Green Ash (Fraxinus pennsylvanica) at 21%), Afghan Pine (Pinus eldarica) 20%, Mulberry (Morus alba) at 15%, Chinese Pistache (Pistacia chinensis) at 9%, Honey Locust (Gleditsia triacanthos) 4%, and Desert Willow (Chilopsis linearis) at 4%. Other species range from 3% to under 1%, with some species having just 1 or 2 examples in the housing area. In total, other species make up 27% of the total inventoried trees.

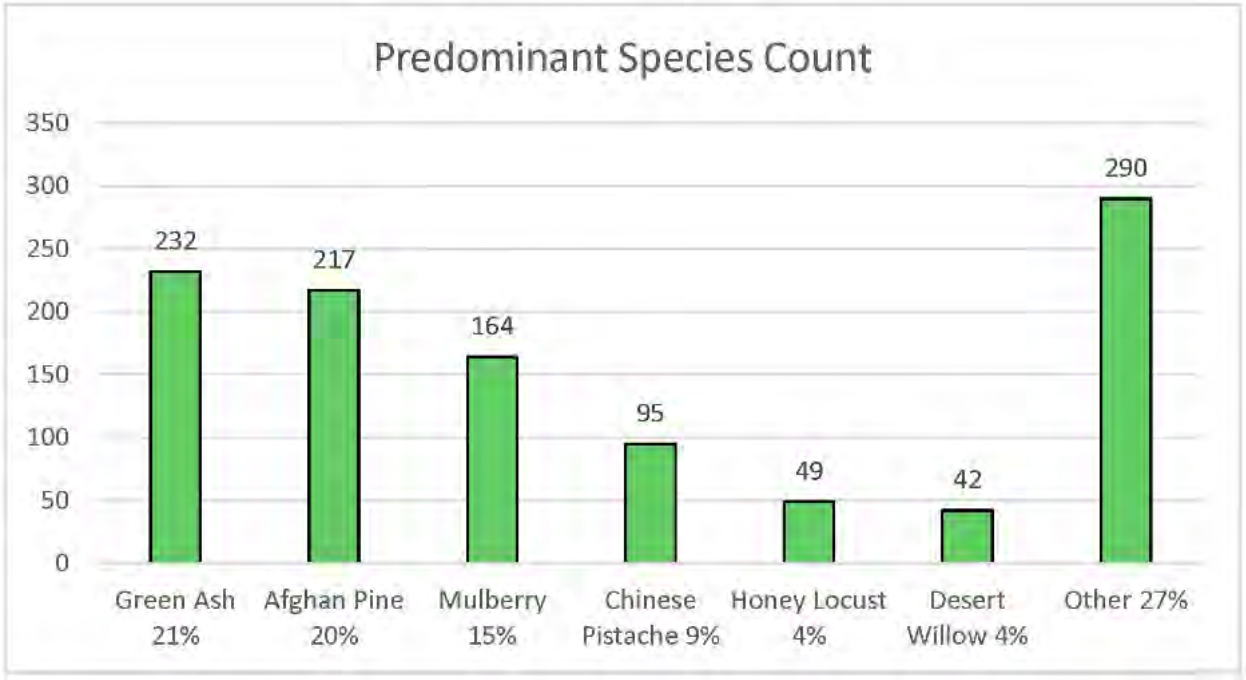


Figure 4 – Illustrating the predominant species here at WSMR

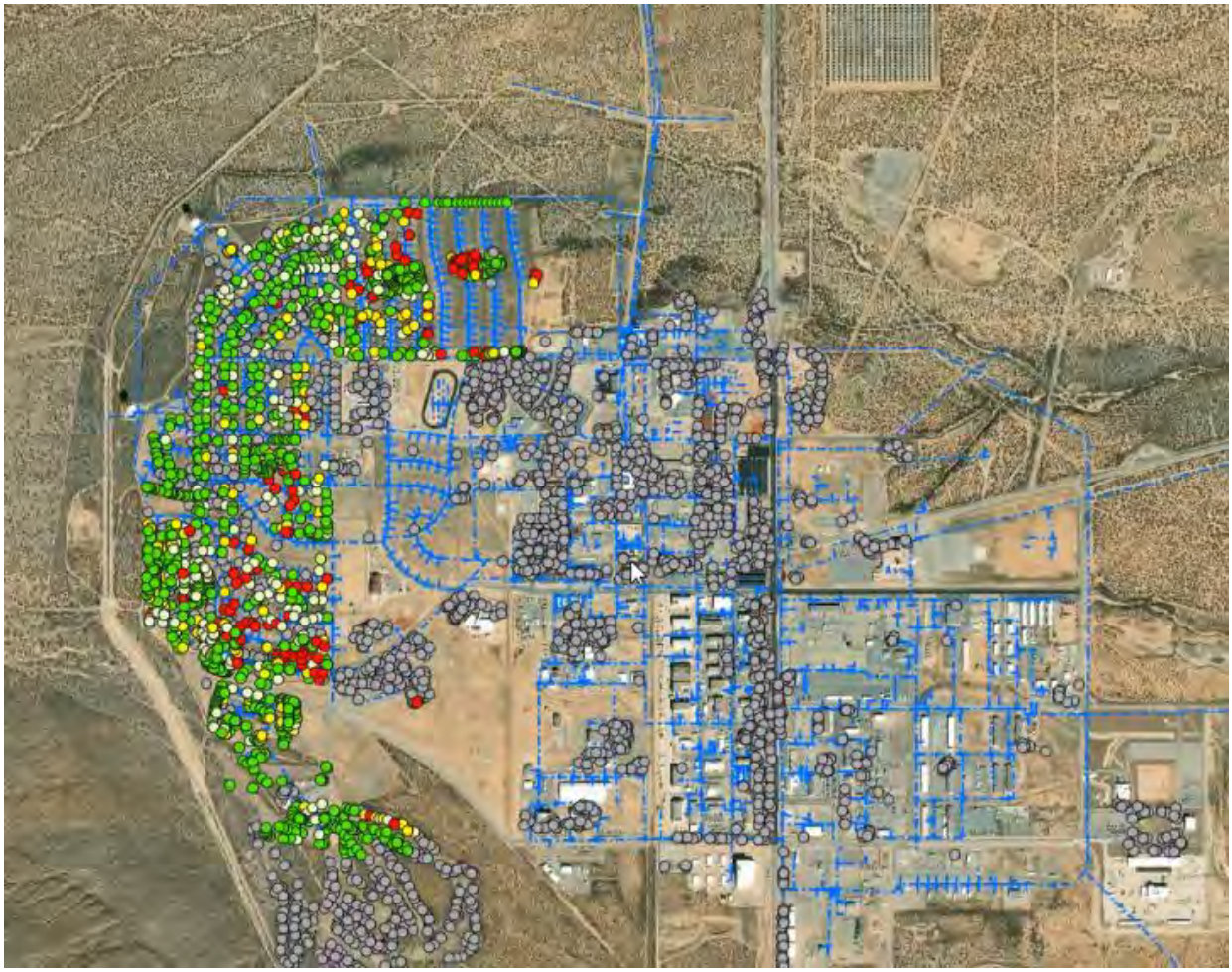


Figure 5 Example ARC GIS Portal database prepared by the local GIS Team - image indicates trees in locations specific to the housing area and their general adjacencies to the potable water lines.

Section 3Bii. Suitable Species

Short list of recommended species. More information about potential species is available in Appendix K

Common Name/ Botanical Name	Description	Attribute
Whitethorn acacia	Small tree to large shrub. Most have small ball-shaped flowers in spring or summer. Select species that are cold hardy.	Cold hardiness: varies Soil Type: Adaptable Light: full sun Water: Moderate to low
Netleaf hackberry Celtis reticulata	Small- to medium-sized deciduous tree, to 30' tall and Similar width.	Cold hardiness: to –10F Soil type: well drained Light: partial shade to full sun Water: moderate to low
Desert willow Chilopsis linearis	Deciduous shrub to 25' tall and 15' wide, can be trimmed up to tree shape. Lavender, pink or white flowers, April through September.	Cold hardiness: to 10F Soil type: well drained, adaptable Light: full sun Water: moderate to low
Chitalpa Chitalpa tashkentensis (Chilopsis X catalpa)	Small- to medium-sized deciduous tree, to 25' tall and 25'wide. White, pink or lavender flowers May to November.	Cold hardiness: to 10F Soil type: well drained Light: full sun Water: low to moderate
Arizona cypress Cupressus arizonica Large	Large evergreen tree, to 50' with 45' spread. Nice shape with good shade. NOTE: This plant can produce large quantities of pollen during several months, which should be considered prior to selecting for planting.	Cold hardiness: to 0F Soil type: well drained, alkaline adaptable Light: full sun Water: moderate to low
Texas Ash, Arizona Ash Fraxinus texensis, Fraxinus arizonicus	Deciduous tree, 25' to 40' in height, and 25' to 35' crown.	Cold hardiness: to -20F Soil type: well drained Light: full sun Water: low to moderate
Golden ball lead tree Leucaena retusa	Small- to medium-size tree, 15' to 25' tall and about as wide. Flowers in spring, with yellow golden puffball-like flowers. Often has multiple trunks, but can be trimmed to a single main trunk.	Cold hardiness: to 5F Soil type: adaptable Light: full sun Water: low to none
Chinese pistache P. chinense	Small, semi-evergreen tree, 25' in height, and 25' in width. Green leaves often will have bronze tips.	Cold hardiness: to –10F Soil type: well drained, adaptable, salt and alkaline tolerant Light: full sun to partial sun Water: low
Honey mesquite Prosopis glandulosa var. glandulosa	Deciduous tree or large shrub. Can achieve 25' high and 30' wide, though commonly smaller. Yellow flower spikes April and May, fruit pods summer through fall. May need to trim lower branches to achieve tree form.	Cold hardiness: to 0F Soil type: well drained Light: full sun Water: low

Section 3C. Analyze the data

Section 3Ci. Condition Assessments

Specifically for the WSMR housing area, most trees are in excellent (21%) to fair (8%) condition. However, 9% of trees inventoried are dead, and 9% more are in critical condition. Lance Harkey estimates that trees in critical condition have less than 2 years before death (see Appendix A).

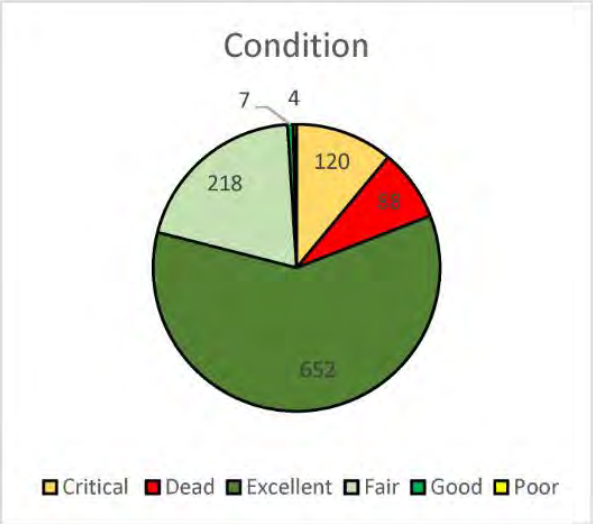
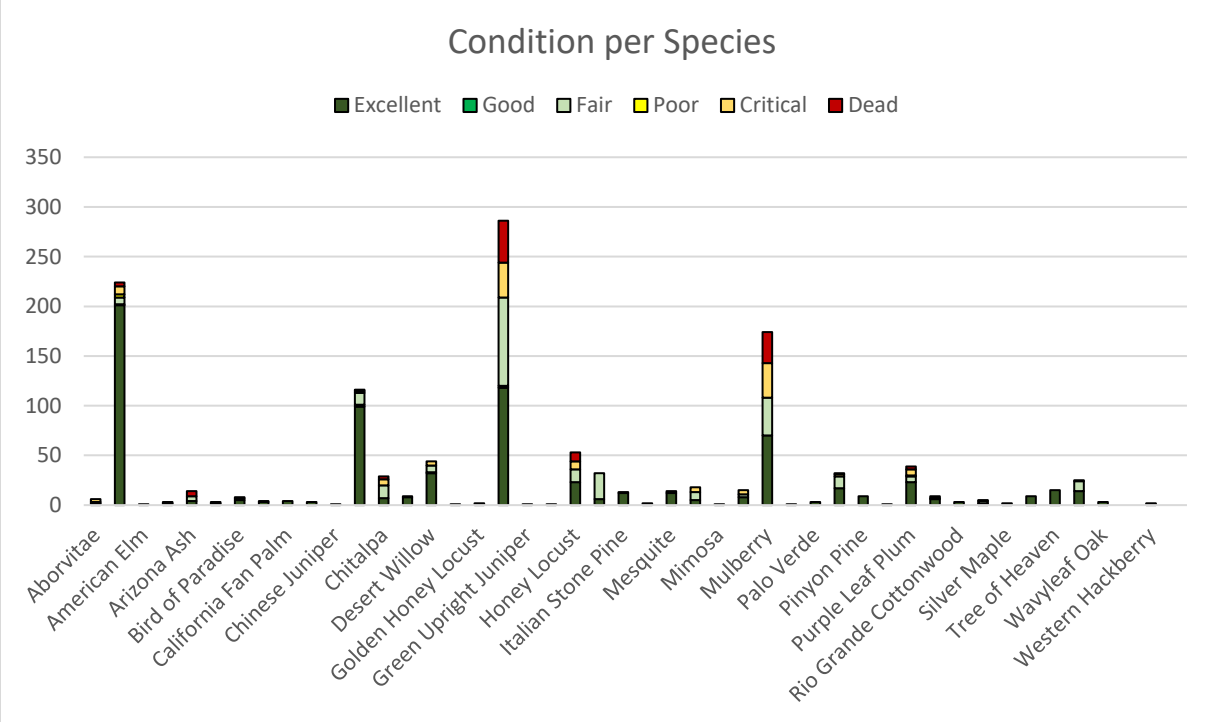


Figure 6 Housing Area Total Tree Inventory Condition

Figure 7 The graph below illustrates the count of species and condition.



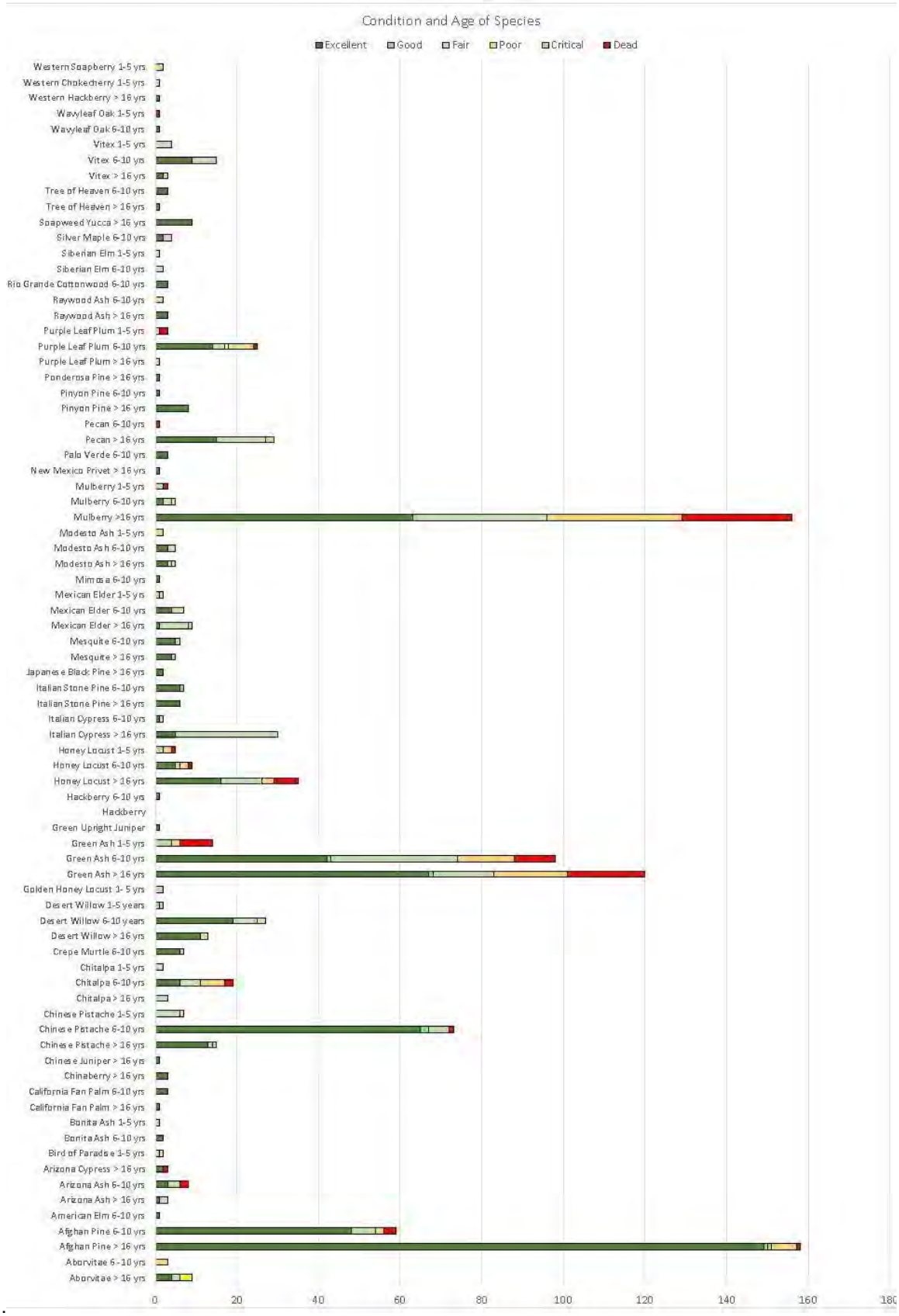


Figure 8 The graph illustrates the expanded count by species condition and the age

Section 3Cii. Develop statistical projections

Problem: Trees are dying on Main Post.

Why do we care:

- Weak and dead trees create a hazard for people and property.

- Weak and dead trees are costly to remove.

- Trees provide critical habitat to wildlife.

- Trees cool the cantonment area (in a warming climate) and reduce energy needs of facilities.

- Trees add to Quality of Life for residents and work staff.

What to do:

Step 1- Inventory trees

- Scope and scale of problem: Only the housing area has been assessed

- Identify critical areas of concern: Specifically identify the oldest trees in the inventory to protect against safety hazards and financially assess the value of mature trees and the cost to replace them.

- Determine what is causing the die off.

Step 2 – Results of the inventory

- In Housing Area 9% are dead, 9% are in critical condition.
- 89% of dead or critical trees are caused by water stress.
- Freeze damage is a water issue for cold tolerant plants; if they don't have enough moisture, they don't survive the freeze.

Step 3 - Compare cost of doing nothing to cost of mitigations

- Do nothing - Cost of tree removal (critical trees will be lost within 2 years), safety issues, loss of habitat.

- Short term mitigation – Repair/replace irrigation lines and emitters, add irrigation lines and backflow preventers to specific areas of concern, pruning smartly, haul water from high nitrate wells, and replant variety of trees that are drought, heat and freeze tolerant.

- Long term mitigation - Add irrigation line from elevated nitrate well to golf course and other areas of concern and replant variety of trees that are ‘drought, heat and freeze tolerant’.

Tree Removal				
Condition	Age > 16 years	Age 6-10 years	Age 1-5 years	Total per condition
Dead	54	21	13	88
Critical	68	41	11	120
Poor	3	1	0	4
	125	63	24	212
Unit Cost	x $ 1,500.00	X $ 1,200.00	x 450.00	
Estimated Cost	$ 187,500.00	$ 75,600.00	$ 10,800.00	$ 273,900.00

Please note: Subject to change according to the current market

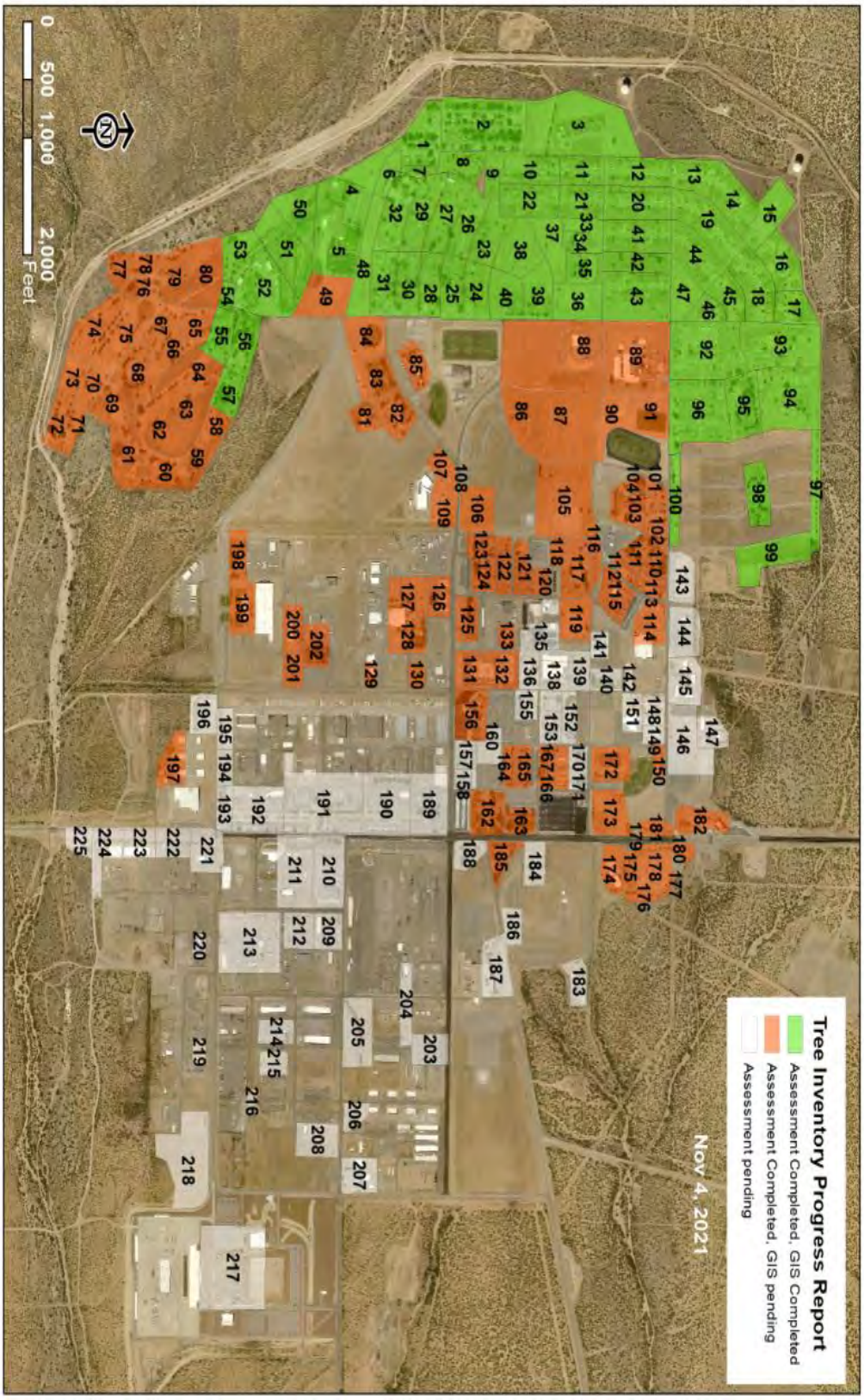


Figure 9 Inventory Progress Report as of 4 Nov 2021

Section 4 Economics

Section 4Ai. Maintenance

Maintenance activities included in landscape design and planning:

- Damage care
- Pruning
- Pest Management
- Mulching
- Soil Nutrient and Soil Protection
- Watering
- Removal
- Wildlife Services

Damage Care

Urban forests require care. The Main Post of White Sands Missile Range sits at the foothills of the Organ Mountains, which can present harsh conditions for growing many tree species. Facility managers should include tree care into their facility maintenance budgets to sustain existing trees rather than planting new trees.

Trees are susceptible to various stresses such as overwatering, drought, heat, sun scorching, poor soil quality, and wind damage. A stressed tree will be more susceptible to insect infestation or disease. Proper maintenance practices will increase tree longevity.

Guy Wires – Guy wires may be considered for protecting trees from wind damage but need to be designed to prevent harm to wildlife.

Wraps – Wraps or paints can prevent sun damage and should prevent harm to wildlife. Paints should be stored safety, and unwanted paints should be disposed properly following environmental compliance requirements.

Pruning

Pruning activities and tree removal will comply with the Memorandum of Understanding between the DoD and the USFWS to Promote the Conservation of Migratory Birds (2006). A nesting bird survey will be required for any pruning or tree removal during the nesting season (between 1 March and 31 August). The Environmental Division, Conservation Branch will provide best management practices to avoid adversely affecting migratory bird populations including breeding, migration, winter habitats and minimizing take of migratory birds. It is also possible for some species (like doves) to nest early/late in trees. This must be taken into consideration.

Pest Management

DoD maintains an Integrated Pest Management (IPM) program designed to reduce the use of pesticides to the necessary minimum. Pesticide or biological controls, uses for landscaping, and nuisance wildlife issues will be coordinated with the Integrated Pest Management Coordinator, Conservation branch, Environmental Division. Only chemicals approved by the Department of Army may be used. There are requirements to track amounts used. Certification is required for application of pesticides. Use of pesticides in sensitive areas, such as children’s playgrounds, youth centers, or inhabited workspace, may have additional requirements.

Find a good balance between removing and keeping some dead leaves. Too many leaves can result in extensive down woody material and damaged roots. Monitor leaf removal to minimize pest infestations. Leaving some leaves is good for insects and birds. WSMR can examine what areas on Main Post would be suitable.

Mulching

Mulching can include ground wood chips, rocks, geo-textiles, etc. Mulch should be comprised of natural materials and not plastics. Mulch should not harbor insects that might damage a tree or harm wildlife.

Soil Nutrients and Soil Protection

Trees absorb their food from the soil, water and sunlight. Soil nutrients play an import role in tree health. When a tree has too little or too much of a nutrient, it becomes vulnerable to disease and pests. Macronutrients include nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. Micronutrients include boron, copper, chloride, iron, manganese, molybdenum, and zinc. On occasion having soils test for chemical properties can help determine what nutrients would be beneficial.

Soil protection involves keeping soil around trees. Wind and water cause soil erosion. Trees protect soils from erosion, with roots that can bind soil in place. Over time, soil can erode away from the base of a tree because of overwatering or other practice.

These factors support why the landscaping contract must have provisions requiring a subject matter expert responsible for assessing the needs of the trees and making recommendations accordingly. For instance, a single dose of Magnesium can stop a tree from dying over its lifetime.

Watering

Watering regimen can influence the presence of many insects. Irrigation control systems design can minimize overwatering, preventing pest infestations and runoff. Landscape designs that minimize low or high spots will improve even watering and reduce puddling of water that could attract nuisance wildlife such as pocket gophers, squirrels, bobcats, coyotes, etc.

Landscape materials used to prevent erosion, increase soil moisture, etc., must function in a manner that does not harm wildlife. Consult with the Environmental Division to identify current best practices when designing.

Incorporation of native plants into landscape designs will increase pest resistance and are better suited for the local climate.

Water is an important natural resource. WSMR relies on ground water for our potable water supply. For many trees in the Main Cantonment area, rainwater is the main source of water. The Housing Area and recreational fields have irrigation. However, these systems may not be well maintained, and they might not be the most efficient design. Improvements to irrigation systems might reduce water requirements while providing trees with necessary supplemental water to keep them healthy.

Main Cantonment is in an arid climate. Evidence shows that climates may continue to dry with longer periods between wet periods, more intense rainfalls and warmer temperatures. Repurposed well water can be beneficial for landscape vegetation, because the wells that would be used have elevated levels of nitrates.

Main Post Well 16 has been offline for over a decade due to elevated levels of nitrates. Not using the well allows the nitrates in the aquifers to migrate to the wells that are pumping over time. Using Well 16 to water trees and other vegetation provides three benefits: (1) Provides nitrogen and minerals for vegetation, (2) provides water for vegetation, and (3) eliminates the migration of elevated levels of nitrates to other wells used for potable water.

Using Well 16 supplemental waters would provide the needed minerals and nitrogen (from the nitrates) for trees and vegetation. The water not used by the trees and vegetation and lost to evaporation would percolate through the soil to replenish the aquifer with most of the nitrates converted to nitrogen to help with tree and vegetation growth, completing a sustainable cycle.

We could also redirect some of Well 16 water to sports fields and parks, eliminating using potable water.

The horticulturist, Mr. Lance Harkey who completed the inventory site visits and report stated, *"Plants that have the right amount of water provided to them can tolerate much colder condition than plants in a drought condition. The stressor could be freezing or low water. The lack of water for the trees could be listed as the stressor when considering freeze damage.*

Getting water to trees at WSMR is the biggest problem, but this problem can be greatly helped by proper water management.

The easiest way to reduce cost and improve tree health is changing the amount of water depending on the time of year. Trees use 20% less water between November 1st to February 1st than what they use in June or July. Reducing water starting in August will condition the trees to slow down growth in the fall and harden off so that the trees are not affected as much in colder weather.

"Keeping the irrigation systems working and (in some cases) redesigned is one of the easiest ways to save water. The old golf course at the base is being watered by sprinklers used to keep fairways in great shape. But as the use of the ex-golf course expands or contracts, it could save thousands of gallons to adapt the irrigation of the needs to fit how it is being used at present (see Appendix A Conditions Assessment Report – Lance Harkey).

In areas with functional irrigation systems or willing stewards, trees can be trained to use water more efficiently. The following watering practices are recommended:

- The effective watering area of a tree should include the distance of the canopy, because the roots that take up water extend out to the canopy. If a well of dirt is constructed around a tree, that well should be out towards the edge of the canopy to ensure the roots receive most of the water. Watering at the trunk of a tree is not effective nor efficient, (see figure 11)
- Starting in February, trees should be watered about two times a week for about 15 minutes.
- When springs are colder, then increase the watering schedule before the freeze to protect the tree. If springs are warmer, then stay constant with watering twice a week until the tree is no longer dormant.
- During the warmer drier months, May through July, trees should be watered twice a week, but increase the watering time to 35-40 minutes.
- By August, watering can decrease to about twice a week for 15 minutes through the winter.

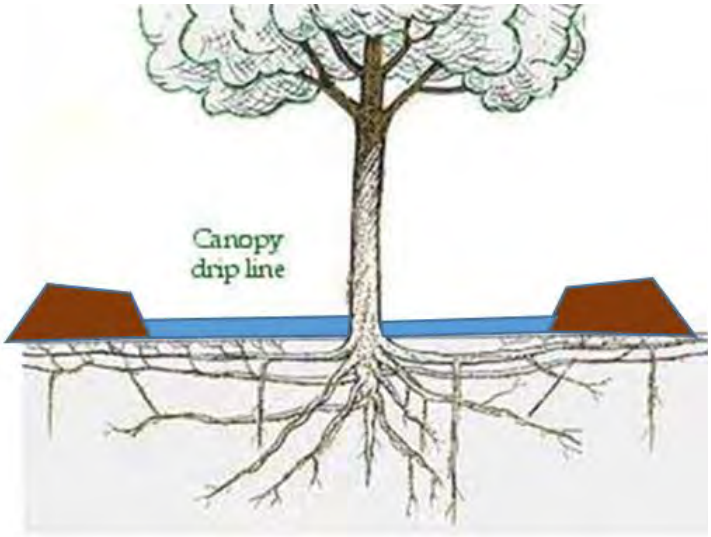


Figure 10 Roots of tree in relation to Canopy

Removal

Trees or limbs may need removal. It is best to remove a dead tree outside of the nesting season. Storm events may blow a tree over and require removal during nesting season. To minimize the risk of damaging migratory bird habitats, limbs or trees will be removed outside of the nesting season. Otherwise, a nesting bird survey should be completed by a biologist certified by the Conservation Branch, Environmental Division, (see figure 11)

Figure 11 Example of a dead tree here at WSMR

Wildlife Services

Trees provide habitat for birds. The Migratory Bird Treaty Act protects migratory birds and their habitats. Trees serve as roosts, nesting sites, food, and shelter. Even a dead tree can provide habitat for both birds and mammals. Before removal, if a dead tree is sound and not a hazard, it should be considered to remain in place for wildlife services. The Conservation Branch, Environmental Division should be consulted to determine how a tree might be providing habitat for wildlife. How a tree is providing a service for wildlife will dictate how to manage the asset.

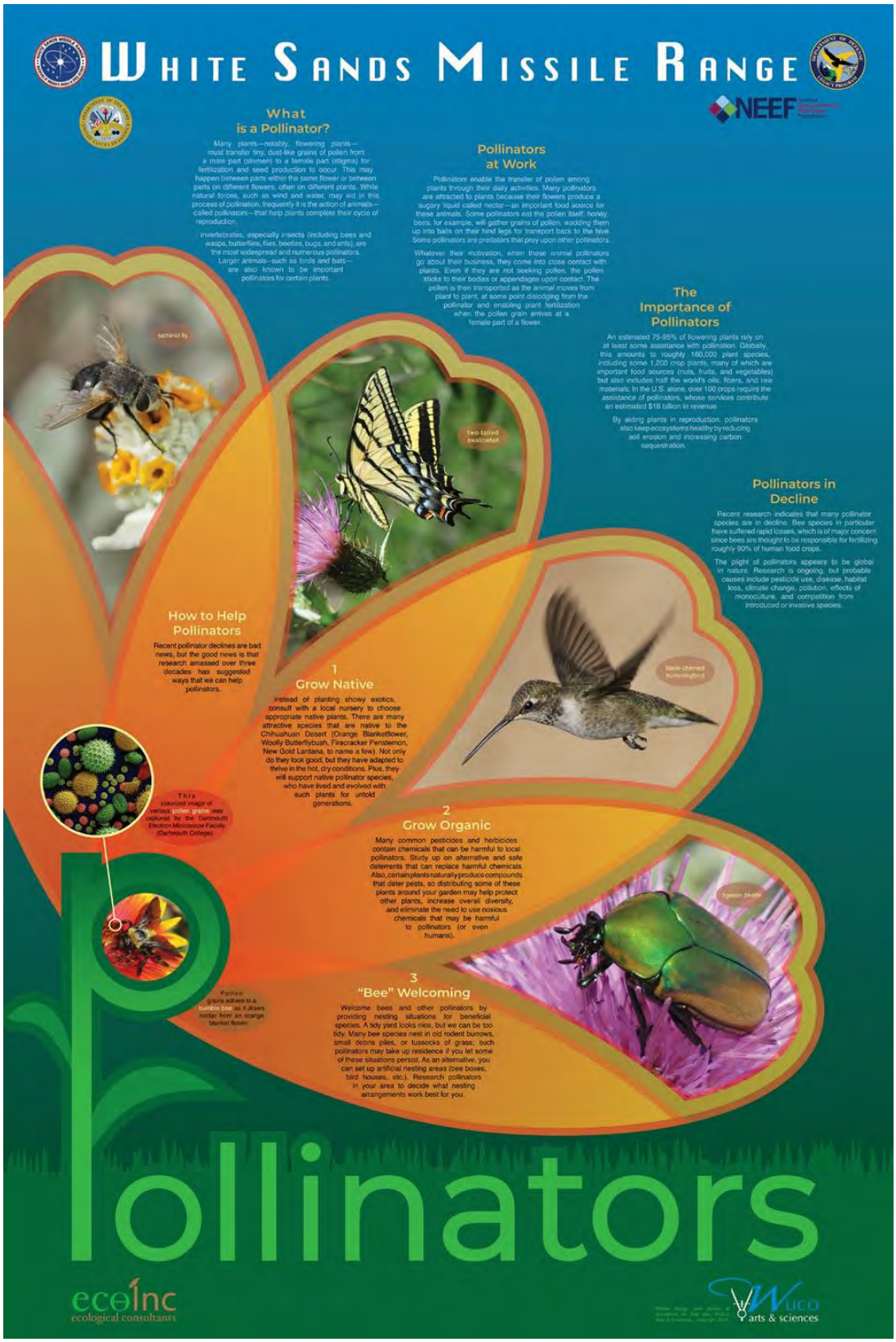


Figure 12 White Sands Missile Range Pollinators are highlighted in the INCRMP which illustrates the importance of the diversity of species on the range.

Section 4B. Roads and Grounds, Operation and Maintenance DPW

Hauling in Water

In order to solve the drought problem, we can consider hauling water into the Housing Area especially where irrigation is not possible because of the cost and lack of funding associated with upgrading irrigation supply or there lack of access to water supply.

Hauling in water would be labor and time intensive – but it is the best chance we have to save the tree inventory. The trucked water would need to be slowly added so the water would permeate the soil and not runoff. This option could be used on a short term basis to save trees and other vegetation assuming we have the resources.

Reimbursable Services

WSMR Roads and Grounds, Directorate of Public Works, sees the benefit in the investment of the upfront costs to save the trees by funding the repurpose water from WSMR Well 16. WSMR would need to install the pump and water tank to pump and store the repurposed water. This will aid in the filling up of the trucks that will be utilized to haul water to the areas in housing that require water that cannot be irrigated. In the future, a long term solution would be the installation of an irrigation system, along with the flow back preventers to water the trees in the housing area.

Upfront Cost to DPW would involve acquiring the vehicles and equipment to adequately water the trees. The upfront cost far outweighs the cost to replace the dead trees and the adverse safety issues (trees falling on homes etc.) that could arise from the mature tree roots not being able to spread their roots and improve the structural integrity of the tree root system. The tree root system would help with stabilizing the soil, aerating the soil and allowing for the filtration process of the water.

These reimbursable cost will have to be paid by the RCI Partner Balfour Beatty through the submission of services orders. The contract between the WSMR and the RCI Partner states that they will adhere to the Installation Natural Resources Management Plan and supports management of vegetation on cantonment.

The Roads and Grounds staff have had experience in working at Wright Paterson Air Force Base (AFB) Ohio, An installation where similar measures were put in place to save the trees. The gains in the tree inventory where far more advantageous that the losses. With the installation saving more that 75% at Wright Paterson AFB of their tree inventory.

Section 4C Budget

All Ground Maintenance falls under the Garrison's Operations and Maintenance funding. This funding source is very limited and has experienced decrements annually from FY19-FY21. The Garrison expects another decrement, but the actual amount is unknown at this point.

The Garrison maintains a Grounds maintenance contractor for the majority of the Main Cantonment outside of the RCI Housing footprint and west of Headquarters Avenue. This contractor is responsible for maintenance of all landscaping, including tree condition and trimming. This is a fixed price contract with specific parameters of contractor performance. Anything above the existing Statement of Work is an extra expense.

The Main Cantonment area east of Headquarters Avenue. is maintained by DPW in-house personnel. Due to the above mentioned funding cuts, maintenance has been reduced to a minimum. Tree removal, replanting, and other tree maintenance activities can be performed, but reductions in other maintenance would need to be planned.

Any infrastructure development, such as a new water line from pump sites or connections to existing water lines to specific trees, will be funded from the Garrison's Sustainment Conversion funds. This is a small portion, 5-7.5%, of the overall Sustainment budget that is typically reserved for Life Health Safety (LHS) issues, such as installation of emergency lighting and fire detection/suppression system in older facilities.

Section 4Bi Annual Work Plan

Any infrastructure project for new water lines and connections must be submitted via Work Order to the DPW Business Operations Integration Division. This will be included with all other Conversion projects and ranked according to a scoring matrix that favors LHS over other requests. Any projects that fall below the 7.5% funding limit will be held for the following year's scoring.

Section 4Bii Funding

Funding limitations for both tree maintenance and new construction of water lines will limit the Garrison's ability to support.

Tree Removal

Estimated cost (Size Dependent) - $200 - $2000

Small (under 30 feet): $200-$450
Medium (30-60 feet): $420-1,200
Large (60-80 feet): $800-$1,500
Extreme (80 feet and over): $1,000 - $2,000
Please note: Subject to change according to the current market

Tree Removal				
Condition	**Age > 16 years**	**Age 6-10 years**	**Age 1-5 years**	**Total No. Trees per Condition**
Dead	54	21	13	88
Critical	68	41	11	120
Poor	3	1	0	4
	125	63	24	212
Unit Cost	x $ 1,500.00	x $ 1,200.00	x 450.00	
Estimated Cost	$ 187,500.00	$ 75,600.00	$ 10,800.00	$ 273,900.00

Hauling Water

Acquire Water truck 4000 - 6000 gal - $50,000.00 -$60,000.00
Equipment hourly cost – to be determined
E.g. Crane $150.00 per hr.
Labor cost @ $ 50.00 per hr. - removal & hauling water
Please note: Review with BOID

https://www.homeadvisor.com/cost/lawn-and-garden/tree-removal/

https://www.homeadvisor.com/cost/lawn-and-garden/tree-removal/

Section 5. Recommendations – Future Actions

Section 5Ai Division of Energy DPW

Irrigation

The Energy Office recommends repurposing water from Well 16 to irrigate the Desert Emerald Green Space (previously known as the Main Post golf course). This will irrigate the trees located there and save the potable water that is currently being used for irrigating. Also, it can be used to water other areas of Main Post where trees are located such as Volunteer Park. The Energy Division has put together a DD1391 form and submitted it for funding through the Energy & Resiliency Conservation Investment Program (ERCIP).
(see appendix H and I)

Section 5B Environmental Division

Section 5Bi Natural Resource Management Planning

The Environmental Division, Conservation Branch, has an Integrated Natural and Cultural Resources Management Plan (INCRMP) and Environmental Assessment, 2015-2019 (2015) that considers the importance of trees in residential sections for breeding birds and roosting bats. A revision to the five-year adoptive management plan is anticipated in fiscal year 2022. The INCRMP highlights the diversity of species on the range and importance of managing habitats that conserve this diversity, including those of birds and other pollinators (see figure 13). The Environmental Compliance Branch has oversight of water quality, to include keeping drinking water safe and management of storm water. Overall, the Environmental Division contributes to the decisions made about landscaping to ensure environmental laws, regulation and policy are followed in the process of managing.

In 2004, there was a decision for the residential areas of White Sands Missile Range to be managed by a private contract. This manager started as the Government, Military Housing, Limited Liability Company , but has since changed names. The Environmental Assessment for Residential Communities (2004) committed the manager to revegetating the residential area using native vegetation and maintaining trees whenever possible. Belfour Beatty/White Sands Housing, the current manager, is required to manage natural resources on White Sands Missile Range. This organization is operating under an integrated natural resources management plan developed by Government Military Housing, LLC (2006). This plan governs the environmental program for the privatized housing area but does not provide guidance on landscaping requirements or procedures. The plan does direct the contractor to coordinate with the Environmental Division at White Sands Missile Range. Guidance on landscape management between the contractor and White Sands Missile Range is captured in other documents such as, Installation Natural Resources Management Plan and Installation Residential community Initiative.

The Memorandum for Water Use for Landscaping (2017) promotes conservation of water as part of the facility design and operations. Every reasonable effort must be

made to reduce demand on potable water while seeking opportunities to increase alternative water sources. Reduction or elimination of potable water use for landscaping would be a prudent conservation measure.

The Final Environmental Assessment for Water Reclamation and Bio Solids Composting (2020) and Findings of No Significant Impact determined raw well water would be repurposed for landscape irrigation. Implementing this decision would be a sustainable best management practice for water conservation and would reduce the demand on potable water supplies.

The following are considerations to incorporate into landscape designed to conserve natural resources:

- Incorporate native plants
- Incorporate irrigation practices that minimize over watering
- Promote conservation of migratory birds
- Prevent infestation of pests
- Decrease the presence of nuisance wildlife (such as raccoons)
- Minimize interference with pedestrians and vehicle safety
- Maximize summer cooling and winter heating
- Matching the slope to surrounding topographic features and work positively with natural drainages
- Prune trees outside of the nesting season
- Conduct nesting bird surveys prior to tree or limb removal
- Proper maintenance of mature existing trees before removal and replacement
- Prevent damage or removal to healthy existing trees during maintenance, construction or demolition activities
- Trees provide food, shelter, roosting, and nesting habitat to native wildlife, and may be used by some species to mark territory serve as roosts, provide food and shelter, or mark territory
- Consult with the Environmental Division on preferred native or non-invasive non-native plants to consider in landscape designs
- Discourage use of non-native, invasive, or noxious plants
- Water conservation measures
- Ground water protection measures

Mr. Lance Harkey stated, “*The maintenance should consider all stressors when planning ways to reduce tree stress including water, pruning, planning, treating insects and disease and weeds management which are all responsible for the condition to the trees on base. Done properly, the quality of the trees would increase, and the cost of the management could be reduced”.*

Section 6. Conclusion

Master Planning

As of 14 Nov 2021, the estimated number of trees accounted for on Main Post and mapped are 1089 of 3515. The trees assessment has been categorized by condition and age. If WMSR does not take action a large number of trees and benefits of having these trees will be lost in the next two years, not only in housing area but on WSMR Main Cantonment as a whole. These concerns are mentioned by stakeholders who contributed to the preparation of this report. Housing working with Balfour Beatty to create conditions that are suitable for the livability and wellness of the WSMR Housing area is a must. Watering the trees will cost, but not as much as it will cost to remove dead trees. These issues must be rectified working hand-in-hand with managing our environmental and energy resources.

Housing

End state is to populate trees that have died or areas that are identified as missing, allowing the most shade and greenery for WSMR. Specifically beginning with parks and homes in our community. This can only be successful if the BBC Partner, in alliance with the Army Housing Office, not only commit to but gainfully track progress as we openly identify and support the tree management. Ideally, we should implement both budget and labor required, and as a way forward, replace missing trees over the next ten years with two where the one has died, or at least until we have identified that the tree replacement is satisfactory by all parties.

Energy

Watering all trees on Main Post or the Housing area is expensive and complicated, but many trees can be watered using repurposed water from Well 16. Some piping distribution lines and water tanks would need to be constructed (new construction).

Building 143 Example of effective tree management strategies

Environmental

We must consider the issue of the adverse weather events. Do we take the risk of letting the tree condition deteriorate to the point that the trees die and become a hazard to the structures and the people who live nearby? Or do we make an effort to specifically save the mature trees and avoid the high removal cost? Watering by hauling water from the elevated nitrate wells not only provides the trees with nutrients to thrive, but also removes the brackish water that is not potable from the water supply and protects the potable water supply we do have. In this case, it may be better to water the trees, than not to water the trees to improve the future of the environment and the habitats that WSMR provides to wildlife.

Effects of changing climate are and will be a national security issue. Installations have been directed by the Army to plan for energy and climate resilience efforts (10 USC § 2864 (Master plans for major military installations, April 2020)). The 2019 NDAA Section 2805 defines climate resilience as the “anticipation, preparation for, and adaptation to utility disruptions and changing environmental conditions …”

Maintenance of adequate water resources is critical for facility design and operations. Application of drought resistant, smart water designs will contribute to a more sustainable future for the numerous living assets within the Main Containment.

The Main Cantonment Area has a living legacy – Hundreds of mature shade trees. Practical efforts should be taken to maintain the health of these living organisms. A mature tree can cost up to $35,000 to replace and 10 years to regrow. Shade trees in landscaping designs reduce heating costs by 10-30% (McPhearson et al, 2005; Green Blue Urban 2017; EPA) and evaporative cooling costs by 75-90% (Huang 1990; Green Blue Urban 2017; EPA). Trees benefit native wildlife by providing habitat, places to nest and roost as well as food. Trees improve air quality by filtering harmful dust and pollutants such as ozone, carbon monoxide and sulfur dioxide. Trees give off oxygen and store carbon. Trees reduce the amount of storm water runoff, reduces soil erosion and improves the overall health of a watershed, contributing to range sustainment critical for WSMR missions. Trees improve the quality of life for residents and employees.

Courses of Action

Providing the Tree Management and Life Cycle Plan to all stakeholders to follow, these are the suggested ways forward for Housing and WSMR main cantonment. Please Note: For all COAs monitor progress and improvements over 6 months to a year and record results to the Tree Management & Life Cycle Plan.

COA	Recommendations
COA 1	Work with partner Belfour Beatty to provide reimbursable services dedicating 1 LRC Water Buffalo to be utilized by the Roads and Grounds DPW or adjust their landscaping contract to provide water to trees in “Critical Condition” within the WSMR Housing Area; watering once a month in winter and twice a month in summer. Removal and replacement of dead trees 1:1 will be required.
COA 2	Dedicate funding and 1 LRC Water Buffalo to be utilized by the Roads and Grounds / Water, Utilities Section DPW to provide water to trees in “Critical Condition” on WSMR Main Cantonment; watering once a month in winter and twice a month in summer. Removal and replacement of dead trees 1:1 will be required.
COA 3	Dedicate funds to remove but not replace dead trees from Main Cantonment that are posing a life health safety risk to people and adjacent buildings.
Please Note: For all COAs monitor progress and improvements over 6 months to a year and record results to the Tree Management & Life Cycle Plan.	

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Appendix A – Conditions Assessment Report – Lance Harkey

Tree Inventory and stress factors

The purpose of this report is to explain methods used to inventory trees and to identify stress factors that affect the trees at WSMR.

Satellite pictures of the WSMR Headquarters were used to identify each tree after verifying the tree in person.

Each tree was placed on a list that identified the tree by location and assigned number. The common name, the botanical name, the condition of the tree, a stressor (if present) and an estimate of the tree age were provided.

Condition

The conditions were marked with one of the following Codes:

E= Excellent

F= Fair minor signs of limited stressors including damage

C- Critical – Appears unhealthy

D= Dead- greater that 90% of crown dieback or poor vigor

H= Hazard- poses an immediate threat to public safety.

Stressors

Stressor codes were added if the tree condition was graded a F or a C.

The stressors were basic reasons for tree conditions. This does not consider other factors that led to the stressors which were identified. These other factors could have a direct correlation to the conditions listed as the Stressor.

Freeze damage is one example of a stressor. Freezing in plants cause damage by the water changing from liquid to solid or crystal (like a snowflake). When that happens the veins' (Xylem) suction in the plants is lost and the veins stop providing water and nutrients to the upper parts of the tree. Any areas not provided with water and nutrients die.

It is easy to identify freeze damage and cold freezing weather as the cause of freeze damage to the trees. But if there is not enough water available to the plant, the water that is there will turn to crystal easier and will cause the plant to have freeze injury.

Plants that have the right amount of water provided to them can tolerate much colder condition than plants in a drought condition. The stressor could be freezing or low water. The lack of water for the trees could be listed as the stressor when considering freeze damage.

Most of the damage done to the trees at WSMR is lack of proper water.

Age Class

The age of the trees is coded as follows:

Code 1 Approximately 1-5 years

Code 3 Approximately 6-15 years

Code 16 16 years or older

"The Principle of Limiting Factors"

Biology uses "the Principle of Limiting Factors" to explain the effect of stressors that limit or control plant or animal growth. This principle says that there is always something that limits the plant's growth and when that factor is changed some other factor will become the limiting factor. Changing other factors can also affect which factor becomes the limiting factor.

The example of freeze damage being affected by water is just one factor that will control the condition of the trees. The limiting factor could be temperature, or light or nutrients, wind, darkness and basically anything that affects the trees.

Bright light from the southwest sun can cause severe damage to some trees by burning the southwest side of the trunks of trees. Just like the freezing example, increasing water reduces freezing damage in trees. When considering intense light, planting a tree affected by the intense southwest light in areas that are shaded will stop Southwest injury to trunks of trees.

There are many other items to consider when looking at the stress factor of trees.

What happens if proper care is not taken…

When a tree is stressed for years by many factors, the tree's growth can change to the point where the problems cannot be fixed. The art of Bonsai uses stress factors to dwarf the cells and to permanently change the entire structure of the plants. The roots stop growing, the leaves become dwarfed, the trunks remain small to adapt to a size that the reduced roots can support.

This is what happens when old trees are stressed by losing their water supply (or any stress factor) over time. The tree's structures change and loses ability to "fix" the problems, even if the water (or reason for stress) is restored.

Many of the trees that are on the base cannot be easily "fixed". In these cases it would be better to remove the trees and replace them with a tree that adapts easier to the climate at WSMR.

How "Managing" might save the trees and money.

Getting water to trees at WSMR is the biggest problem, but this problem can be greatly helped by proper water management.

The easiest way to reduce cost and improve tree health is changing the amount of water depending on the time of year. Trees use 20% less water between November 1st to February 1st than what they use in June or July. Reducing water starting in August will condition the trees to slow down growth in the fall and harden off so that the trees are not affected as much in colder weather.

Roots of trees start growing about the 1st of February, water managers should increase a small amount of water available in February. This conditions the trees to grow roots when weather gets warmer.

Keeping the irrigation systems working and (in some cases) redesigned is one of the easiest ways to save water. The old golf course at the base is being watered by sprinklers used to keep fairways in great shape. But as the use of the ex-golf course expands or contracts, it could save thousands of gallons to adapt the irrigation of the needs to fit how it is being use at present.

Providing proper care for trees' stressors can do a great deal to reduce damage and ensure tree quality. The maintenance should consider all stressors when planning ways to reduce tree stress including water, pruning, planning, treating insects and disease and weeds management which are all responsible for the condition to the trees on base. Done properly, the quality of the trees would increase, and the cost of the management could be reduced.

Evaluation of the tree inventory will not answer all questions but if done properly could provide a great tool for managing the trees on base.

What the tree inventory might tell us

The inventory will identify some of the trees that do well under really bad conditions. If a diverse list of these trees could be adopted by WSMR, the base could still have the trees people want and need with much reduces the cost of maintenance and watering. However, it is important to have a large diverse population so natural predators or diseases will not attach and wipe out overplanted populations.

Conversely the tree inventory will show what trees to not plant on base. Predictably there will be many trees that keep coming up dead, dying or in need of help. These trees might be added to the "Do not plant list!"

The most important thing is to learn how to manage the resources so WSMR will get the most out of trees with the least cost. But it is also important to realize how trees can save water. Trees shade buildings and houses reducing the cost of cooling. Planting a tree to shade a house in late afternoon will save a lot more in electric bills than the cost of the water.

Appendix B – Tree Condition Definitions

Tree Condition

- E = Excellent
- F = Fair. Minor signs of limited stressors. Structural faults and minor deadwood in the crown, limbs, or trunk.
- C = Critical. Appears 25 percent of the crown is dead and In general state of decline. Exhibiting stress and/or damages. Structural defects. Significant mechanical damage. Advanced decay. Severe crown dieback or poor vigor/failure to thrive. Will not respond to maintenance procedures.
- D = Dead. Main leader is dead and more than 90% of the crown contains dead wood. Not a hazard. Potential wildlife service (nest cavity, roost site, food, etc.)
- H = Hazard. Poses an immediate threat to public safety.

Stressors

- B = Wildlife Damage
- I = Insect Damage
- F = Freeze Damage
- H = Human Damage
- IP = Improper Pruning
- N = Nutrient Deficiency
- R = Root Damage
- So = Soil Deficiency
- Su = Sun scalding
- U = Fungal / Rust
- Wa = Water / Drought
- Wi = Wind Damage
- Other, define

Local Significance

- H = Historic value
- C = Cultural value
- M = monetary value

Age Class

- 1 - Approximately 1-5 years
- 6 – Approximately 6 to 15 years
- 16 – 16 years old

Appendix C. Tree Condition Photographs

Improper Pruning

Drought Stress

Freeze Damage and Improper Pruning

Freeze Damage

Appendix D. Tree Condition Data Collection Form

White Sands Missile Range Tree inventory

Date: _____ Map Title: _____ Surveyor: _____ Recorder: _____

No.	Common Name (abbreviation/code)	Scientific Name	Condition	Stressors	Significance	Age Class	Note(s)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

Appendix E Excerpt – Tree Condition Assessment Map book

Appendix F

ArcGIS Portal

Information to access Portal for ArcGIS:

Please use Chrome or Edge browsers:
https://wsmrw04waac2gi2.nasw.ds.army.mil/portal/home/

When accessing the site you will be prompted for your CAC pin. Please use ONLY your authentication certificate.

Excerpt G- Fort Knox Installation Natural Resources Management Plan

5.1.11 Cantonment Area Management

The goal of cantonment area management is to maintain an aesthetically pleasing cantonment

Area landscape that preserves natural ecosystem functions as much as possible.

The Natural Resources Branch has prepared an Urban Forestry Management Plan which outlines ways to enhance greenspace within the cantonment area in need of improvement. This plan includes specific locations and plans for developing increased tree planting for carbon. This sequestration and improvement of wildlife habitat.

Some examples include:

• Reducing the width of range road shoulder mowing in general

• Returning many disused building sites, especially isolated buildings, to natural habitat

• Planting trees on a one-for-one basis as trees are removed in the cantonment area

• Planting trees in areas that have been returned for natural habitat to increase Fort Knox's carbon sink

Appendix H

Info Paper for Elevated-Nitrate Well 16 for Irrigation of Desert Emerald

White Sands Missile Range (WSMR) operates and owns the DPW water pumping and processing system. WSMR would construct a new additional system that would repurpose water from Well 16's to provide irrigation water for 70 acres of turf at the Desert Emerald Green Space located on the south west side of Main Post. A single transfer pump would move Well 16's water through an 8-inch pipe to a million gallon storage tank near Desert Emerald. Then a pair of 20hp pumps would then pump the water fromthe storage tank to Desert Emerald for irrigation purposes through another 8-inch waterline. Over the last 4 years, Desert Emerald was irrigated with an average of 52 million gallons of potable water per year. In order to repurpose use Well 16's water, WSMR would need to construct an 11,000-foot long pipeline between Well 16 and a storage tank located slightly higher than Desert Emerald. The design intent of the system is to repurpose water according to current Well 16 pumping production and Desert Emerald irrigation data. Firm line distribution power would be used to pump the water through the 11,000 foot long pipeline. During the summer months, the Desert Emerald irrigation could continue to use some potable water if demand exceedsWell 16's pumped water. Or other wells also elevated in nitrates could be repurposed. This project would reduce WSMR's potable irrigation water needs by at least 10%.

Construction: Install an 11,000 feet long pipeline that runs from Well 16 to the Desert Emerald Green Space. Also install associated storage tank and pumping equipment powered by firm power. Project cost is approximately $2.4 million with annual water costsavings of approximately $230,000/year. Based on the current estimated project costs, the construction of a repurposed water system based on this solution is cost effective given the current and projected future water costs of watering Desert Emerald. The project would pay for itself over approximately 10 years through savings.

Area history: WSMR is a Test and Evaluation Command Installation operated primarilyfor the support of research, development, testing, and evaluation of weapon and spacesystems, subsystems, and components. WSMR is almost 3,200 square miles (8,300 km2) in area and is the largest Army installation in the United States. WSMR includes the Oscura Range and WSMR Otero Mesa bombing range. WSMR and the 600,000 acre Fort Bliss Range Complex to the south form a contiguous swath of territory for military testing. The missile range is located in New Mexico. The stated mission of WSMR is to: "provide Army, Navy, Air Force, DoD, and other customers with high quality services for experimentation, test, research, assessment, development, and training in support of the Nation at war." Established

in 1945, WSMR is the largest all- overland test range in the Western Hemisphere and is the Department of the Army's (DA) largest installation, covering approximately 2.2 million acres. With the addition of several extension areas, the range can be expanded to nearly four million acres for certain types of testing. WSMR is bordered by Fort Bliss to the South and by Holloman AFB to the West. Between 1945 and 1989, a total of 38,029 missile firings were completed at WSMR, including the world's first atomic explosion at the Trinity site on July 16, 1945. Facilities located entirely within WSMR boundaries include: San Andres National Wildlife Refuge (U.S. Fish and Wildlife Service; USFWS), White SandsNational Park (National Park Service), and National Aeronautics and Space Administration (NASA) White Sands Test Facility. The Joranda Experimental Range (USDA Forest Service; USFS) also overlaps a portion of WSMR. The cantonment area (or main post) is located in the south end of the installation and is approximately 20 miles east of Las Cruces, New Mexico. The installation has 1,011 permanent buildings and 42 re-locatable buildings comprising 4.45 million square feet of floor space (administrative, barracks, maintenance shops, research facilities, and missile test facilities). In addition, there are 300 Family housing units owned by Balfour Beatty Communities (formerly Military Housing) in four neighborhoods. The housing has been privatized. Currently, the daytime population is approximately 5,000. Executive Order 13834, EPAct 2005, and EISA 2007 require Federal agencies to reduce water intensity each year. WSMR will be able to maintain and further reduce its water intensity goal with this project. Desert Emerald is the largest consumer of potable water on WSMR.

Impact if not provided: Currently, the Desert Emerald Green Space is being watered using potable water at a cost of $4.34/KGAL. Potable water is provided by a series of wells located on the western edge of the site, in the foothills of the Organ and San Augustin Mountains. The depth to groundwater is about 300 to 950 feet. There are 15 wells at Main Post, however only 7 of them are operational at this time. Pumped water is chemically treated and stored in above-ground water towers. Water is primarily usedfor domestic purposes. Other major uses include residential and landscape irrigation. Commercial use includes a car wash and refueling station. Conservation measures arebeing implemented, such as xeriscaping in front yards of residences, to reduce water demands and this proposed solution to utilize high-nitrate water to water Desert Emerald.

Executive Order (EO) 13834, Energy Policy Act of 2005 (EPAct), and Energy Independence and Security Act of 2007 (EISA) requires Federal agencies to reducewater intensity. WSMR must implement a wide range of effective water reduction strategies to meet this goal. Additional reduction measures, such as water efficient plumbing fixtures, will also be required for WSMR to meet water reduction goals.

Appendix I

DD 1391 Water Resiliency: Repurposing Non-potable Water for irrigation

2025 80572 W REVISION DATE: 16 NOV 2021
Army ERCIP (AS OF 11/22/2021 AT 10:30:57) 12 OCT 2011
ACF=1.02 UM=E

White Sands Missile Range
New Mexico

ERCIP
Water Resiliency: Re-purposing Non-Potable Well Water for Irrigation

	844 72	80572		3,900	
PRIMARY FACILITY					3,124
Sustainability/Energy Measures		LS	—	—	(3,124)
SUPPORTING FACILITIES					261
New Mexico Gross Receipts Tax		LS	—	—	(261)

ESTIMATED CONTRACT COST	3,385
CONTINGENCY (5.00%)	169
SUBTOTAL	3,554
SUPERVISION, INSPECTION & OVERHEAD (5.70%)	203
DESIGN/BUILD - DESIGN COST (4.0000%)	142
TOTAL REQUEST	3,899
TOTAL REQUEST (ROUNDED)	3,900
INSTALLED EQT-OTHER APPROPRIATIONS	(0)

White Sands Missile Range (WSMR) operates and owns the DPW water pumping and processing system. WSMR would construct a new additional system that would utilize Well 16's high nitrate water to provide irrigation water for 70 acres of turf at the Desert Emerald Green Space located on the south west side of Main Post. A single transfer pump would move Well 16's water through an 8-inch pipe to a million gallon storage tank near Desert Emerald. Then a pair of 20hp pumps would then pump the water from the storage tank to Desert Emerald for irrigation purposes through another 8-inch water line. Over the last 4 years, Desert Emerald was irrigated with an average of 52 million gallons of potable water per year. In order to use Well 16's high-nitrate water, WSMR would need to construct an 15,000-foot long pipeline between Well 16 and a storage tank located slightly higher than Desert Emerald. The design intent of the system is to use the high-nitrate water according to current Well 16 pumping production and Desert Emerald irrigation data. Firm line distribution power would be used to pump the high-nitrate water through the 15,000 foot long pipeline. During the summer months, the Desert Emerald irrigation could continue to use some potable water if demand exceeds Well 16's pumped water. This project would reduce WSMR's potable irrigation water needs by at least 20%.

11. REQ:	NONE	ADQT:	NONE	SUBSTD:	NONE

2025 80572 W REVISION DATE: 16 NOV 2021
Army ERCIP (AS OF 11/22/2021 AT 10:30:57) 12 OCT 2011
ACF=1.02 UM=E

White Sands Missile Range
New Mexico

ERCIP 80572
Water Resiliency: Re-purposing Non-Potable Well Water for Irrigation

PROJECT:
Install an 15,000 foot long pipeline that runs from Well 16 to the Desert Emerald Green Space. Also install associated storage tank and pumping equipment powered by firm power. Project cost is approximately $3.9 million with annual water cost savings of approximately $426,000/year. Based on the current estimated project costs, the construction of a high-nitrate water system based on this solution is cost effective given the current and projected future water costs of watering Desert Emerald. The project would pay for itself over approximately 9 years through savings. In addition, a 250,000 gallon tank would be constructed at Well 16 with a stand pipe so that water trucks can be filled with the non-potable water and trucked to various watering sites located on WSMR. This tank would be direct-filled by Well 16.

REQUIREMENT:
WSMR is a Test and Evaluation Command Installation operated primarily for the support of research, development, testing, and evaluation of weapon and space systems, subsystems, and components. WSMR is almost 3,200 square miles (8,300 km2) in area and is the largest Army installation in the United States. WSMR includes the Oscura Range and WSMR Otero Mesa bombing range. WSMR and the 600,000 acre Fort Bliss Range Complex to the south form a contiguous swath of territory for military testing. The missile range is located in New Mexico. The stated mission of WSMR is to: "provide Army, Navy, Air Force, DoD, and other customers with high quality services for experimentation, test, research, assessment, development, and training in support of the Nation at war." Established in 1945, WSMR is the largest all-overland test range in the Western Hemisphere and is the Department of the Army's (DA) largest installation, covering approximately 2.2 million acres. With the addition of several extension areas, the range can be expanded to nearly four million acres for certain types of testing. WSMR is bordered by Fort Bliss to the South and by Holloman Air Force Base to the West. Between 1945 and 1989, a total of 38,029 missile firings were completed at WSMR, including the world's first atomic explosion at the Trinity site on July 16, 1945. Facilities located entirely within WSMR boundaries include: San Andres National Wildlife Refuge (U.S. Fish and Wildlife Service; USFWS), White Sands National Park (National Park Service), and National Aeronautics and Space Administration (NASA) White Sands Test Facility. The Joranda Experimental Range (USDA Forest Service; USFS) also overlaps a portion of WSMR. The cantonment area (or main post) is located in the south end of the installation and is approximately 20 miles east of Las Cruces, New Mexico. The installation has 1,011 permanent buildings and 42 re-locatable buildings comprising 4.45 million square feet of floor space (administrative, barracks, maintenance shops, research facilities, and missile test facilities). In addition, there are 300 Family housing units owned by Balfour Beatty Communities (formerly Military Housing) in four neighborhoods. The housing has been privatized. Currently, the daytime population is approximately 5,000. Executive Order 13834, EPAct 2005, and EISA 2007 require Federal agencies to reduce water intensity each year. WSMR will be able to maintain and further reduce its water intensity goal with this project. Desert Emerald is the largest consumer of potable water on WSMR.

2025 80572 W REVISION DATE: 16 NOV 2021
Army ERCIP (AS OF 11/22/2021 AT 10:30:57) 12 OCT 2011
ACF=1.02 UM=E

White Sands Missile Range
New Mexico

ERCIP 80572
Water Resiliency: Re-purposing Non-Potable Well Water for Irrigation

CURRENT SITUATION:
Currently, the Desert Emerald Green Space is being watered using potable water at a cost of $7.75/KGAL. Potable water is provided by a series of wells located on the western edge of the site, in the foothills of the Organ and San Augustin Mountains. The depth to groundwater is about 300 to 950 feet. There are 15 wells at Main Post, however only 7 of them are operational at this time. Pumped water is chemically treated and stored in above-ground water towers. Water is primarily used for domestic purposes. Other major uses include residential and landscape irrigation. Commercial use includes a car wash and refueling station. Conservation measures are being implemented, such as xeriscaping in front yards of residences, to reduce water demands and this proposed solution to utilize high-nitrate water to water Desert Emerald.

IMPACT IF NOT PROVIDED:
Energy Policy Act of 2005 (EPAct) and Energy Independence and Security Act of 2007 (EISA) requires Federal agencies to reduce water intensity. WSMR must implement a wide range of effective water reduction strategies to meet this goal. Additional reduction measures, such as water efficient plumbing fixtures, will also be required for WSMR to meet water reduction goals.

ADDITIONAL:
The AEWRS data input for WSMR is up-to-date and has been certified by Mr. Craig Collins, Energy Manager. POC for this project is Mr. Craig Collins, Energy Manager craig.p.collins.civ@mail.mil (575) 678-4457.

/S/ LEO G. PULLAR
COL, PO
Commanding

ESTIMATED CONSTRUCTION START:	MAR 2025	INDEX: 3311
ESTIMATED MIDPOINT OF CONSTRUCTION:	SEP 2025	INDEX: 3344
ESTIMATED CONSTRUCTION COMPLETION:	MAR 2026	INDEX: 3377

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White Sands Missile Range
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Water Resiliency: Re-purposing Non-Potable Well Water for Irrigation

Item		U/M	Qty	Unit Cost	Cost ($000)
PRIMARY FACILITY.					
GENERAL.					
1.0) 00005	Sustainability/Energy Measures	LS	--	--	(3,124)
1) 75041	Water Reclamation to Irrigate Desert Emer.	EA	1	32,655	33
2) 84710	Water Storage Tank, Non potable Million Ga	EA	1	1306218	1,306
3) 84472	Pump Station, Nonpotable, Pair 20hp	EA	1	40,493	40
4) 84472	Water Pump Station 500 GPM	EA	1	104,019	104
5) 84510	Water Distribution Lines, Nonpotable 8 in.	LF	15,000	62.69	940
6) 84710	Water Storage Tank, Nonpotable 250,000 Gal	EA	1	500,000	500
7) 84510	Water Stand Pipe and Associated Piping	EA	1	200,000	200
INFO SYS & ANTITERRORISM MEASURES.					
The following Building Information Systems cost can be found only in Tab F: $0					
SUPPORTING FACILITIES.					
New Mexico Gross Receipts Tax		LS	--	--	(261)
1)	New Mexico Gross Receipts Tax	LS	--	--	261